

Catchment Management Plan (CMP)

Eastern Catchments - Te Puke and Small Settlements Catchments
(Paengaroa, Maketu/Little Waihi and Pukehina)



Catchment Management Plan (CMP)

Eastern Catchments - Te Puke and Small Settlements Catchments (Paengaroa, Maketu/Little Waihi and Pukehina)

Client: Western Bay of Plenty District Council (WBOPDC)

Co No.: N/A

Prepared by

AECOM New Zealand Limited

115 Cameron Road, Tauranga Central, Tauranga 3110, PO Box 13161, Tauranga Central, Tauranga 3141, New Zealand
T +64 7 927 3080 F +64 7 927 3082 www.aecom.com

14-Dec-2018

Job No.: 60548000

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

© AECOM New Zealand Limited (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

Quality Information

Document Catchment Management Plan (CMP)

Ref 60548000

Date 14-Dec-2018

Prepared by Caroline Secretin, Ange Chaffe, Chen Zhuo, Laura Christian and Ariell King

Reviewed by John Male and Richard Harkness

Revision History

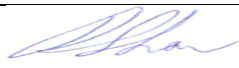
Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
a	13-June-2018	Final Draft for Client Review	Bob Shaw Associate Director - Water	
b	31-Jul-2018	Draft for consultation	Bob Shaw Associate Director - Water	
c	14-Dec-2018	Final for lodgement	Bob Shaw Associate Director - Water	

Table of Contents

1.0	Executive Summary	1
2.0	Introduction	3
2.1	Background	3
2.2	CSC Application	4
2.3	Scope	4
2.4	Consultation on the draft Catchment Management Plan	6
3.0	Cultural values and objectives	7
4.0	Stormwater management objectives	9
4.1	Long Term Objectives	9
4.1.1	Water Quantity Objectives	9
4.1.2	Water Quality Objectives	10
4.1.3	Ecological Objectives	10
4.1.4	Visual Quality and Recreational Objectives	10
4.2	Short Term Objectives	10
5.0	Legislative Framework and Context	12
5.1	National and Regional Regulatory framework	12
5.1.1	Integrated Management	12
5.1.2	SmartGrowth Strategy	13
5.1.3	Western Bay of Plenty District Plan (WBOPDP)	13
5.1.4	WBOPDC Development Code (2009)	14
5.2	Existing Catchment Plans and Discharge Consents	14
6.0	Existing Environment	15
6.1	Study Area	15
6.2	Overview of Eastern Catchments	16
6.3	Eastern Catchments Receiving Environment	17
6.4	Geology and Soil	21
6.5	Landuse and Future Development	23
6.5.1	Existing Landuse	23
6.5.2	Future Development	27
6.6	Receiving Environment Monitoring Results	27
6.6.1	Groundwater Monitoring	28
6.6.2	Freshwater Monitoring	29
6.6.3	Marine Environment Monitoring	36
6.6.4	Ecological Monitoring	38
6.6.5	Stormwater Monitoring, Eastern Catchments, Various dates (WBOPDC 2009-2017)	41
6.6.6	Summary of Receiving Environment Quality at Eastern Catchments	41
7.0	Stormwater Network	44
7.1	Existing Stormwater Network	44
7.1.1	Te Puke	44
7.1.2	Paengaroa	45
7.1.3	Maketu (including Little Waihi)	46
7.1.4	Pukehina	47
7.2	Hydrological Modelling	47
7.2.1	Te Puke Hydrological Modelling	47
7.2.2	Small Urban Settlements Hydrological Modelling	48
7.3	Existing Stormwater Management	49
7.4	Determination of 2% AEP Flood Levels	49
8.0	Catchment Values	50
9.0	Identification of Stormwater Management Issues	65
9.1	Stormwater Quantity	65
9.1.1	Flooding	65
9.1.2	Erosion	71
9.1.3	Stormwater Quantity Improvement Methods	72
9.2	Stormwater Quality	74

	9.2.1	Current Stormwater Quality Management	74
	9.2.2	Potential Sources of Contamination	74
	9.2.3	Stormwater Treatment Requirements	77
	9.2.4	Stormwater Quality Improvement Methods	77
	9.3	Summary of Stormwater Management Issues	79
10.0		Assessment of Environmental Effects	81
	10.1	Te Puke Assessment of Environmental Effects	81
	10.2	Paengaroa Assessment of Environmental Effects	83
	10.3	Maketu / Little Waihi Assessment of Environmental Effects	86
	10.4	Pukehina Assessment of Environmental Effects	88
11.0		Option Evaluation and Recommendations	91
	11.1	Option Evaluation	91
	11.1.1	Engineering Solutions	91
	11.1.2	Non Engineering Solutions	91
	11.2	Recommendations	97
12.0		Monitoring Procedures and Review	103
	12.1	Background of discussions with BOPRC	103
	12.2	Stormwater Monitoring	103
	12.3	Other Recommended Monitoring	105
13.0		CMP Review	106
14.0		Standard Limitation	107
15.0		References	108
Appendix A			
		WBOPDC Planning Maps	A
Appendix B			
		Consultation	B
Appendix C			
		Statutory Assessment	C
Appendix D			
		Other relevant maps (various sources)	D
Appendix E			
		Existing Consents	E
Appendix F			
		Eastern Catchments AECOM Figures	F
Appendix G			
		Eastern Catchments –Receiving Environment Monitoring 2018 Reports	G
Appendix H			
		Cultural Impact Assessments, Eastern Catchments, 2013	H
Appendix I			
		Eastern Catchments Flooding maps	I

1.0 Executive Summary

An integrated and comprehensive approach to managing stormwater provides an opportunity to mitigate the adverse effects on water quality and water levels of the receiving environment. For the eastern catchment of the Western Bay of Plenty District Council this includes the Kaituna River, the Maketu Estuary and the Pacific Ocean.

A Comprehensive Stormwater Consent (CSC) was submitted to the Bay of Plenty Regional Council (BOPRC) in 2013. Since then there has been further investigations and comprehensive consultation undertaken. Accordingly this Catchment Management Plan (CMP) replaces the CMP provided with the 2013 CSC application. Council also holds a number of consents which provided for the installation of physical structures and the discharge of stormwater. These consents will be surrendered in accordance with the Resource Management Act on the granting of the CSC.

The Western Bay of Plenty District Council (WBOPDC) will use the CSC and CMP to guide decision making and capital investment to better control the discharge of stormwater from all the land within the CMP area. The CMP covers the four urban settlements within the eastern part of the Western Bay of Plenty District. These settlements are Te Puke, Paengaroa, Maketu/Little Waihi and Pukehina. The specific boundaries of these areas are included in Appendix A.

For ease of reference Figure 1 shows the extent of the respective catchments for the four settlements.

The CMP has a focus on both stormwater quality and quantity. This includes flooding, overland flow paths, steep slopes, and contaminated discharge. The CMP identifies a number of ways to mitigate the effects arising from these issues and a number of actions are proposed.

The cultural values and objectives which align with this CMP have been identified. During the consultation on the draft CMP it was evident that a number of the values and outcomes sought by the Iwi and hapū in the eastern catchments would be supported by the implementation of the CMP. This included Kaitiakitanga, Mātauranga Māori, and matters of cultural significance.

Section eight also provides an overview of the environmental, social, cultural, economic and public health values for the eastern catchments. These values have helped to develop a range of objectives for both stormwater quantity and quality. An assessment of the actual and potential effects on the catchments from development has also been undertaken. The effects considered include flooding and stormwater quantity, water and sediment quality, ecology and habitat, and social and cultural values, as well as public health.

Monitoring of a number of waterways within the urban settlements has been undertaken to establish an environmental baseline. This monitoring has included water quality, instream macroinvertebrate community assemblages and bank erosion. Overall the results indicated that sampled waterways were generally considered to be in 'Moderate' to 'Poor' condition; suggesting that most, if not all, urban waterways within eastern catchments have been negatively influenced in some way by agricultural runoff and land use intensification in the district.

WBOPDC has already begun to implement solutions to better control and manage stormwater discharges. These are encapsulated in community plans and the Te Puke Built Environment Strategy. The proposed capital works programme from the WBOPDC Long-term Plan 2018 – 28 is also included in the CMP. However it should be noted that further physical works are likely when additional monitoring has been undertaken and further actions identified.

Future physical works and improvements will be based on the design philosophy of minimising runoff and maximising quality through low impact design solutions. Methods that could be utilised include bio retention devices, a reduction of impervious areas, green roofs, wetlands, rainwater tanks, land soakage and ecological river engineering.

Other approaches that may be considered include updating the Council's current District Plan to encourage the implementation of stormwater management devices to manage the effects of future development including industrial areas; increasing public awareness and education in terms of the discharge of contaminants and the effects on community values and the environment; and working with the community on riparian planting programmes.

The CMP also sets out a number of proposed recommendations to manage and /or improve stormwater discharges from specific locations in the eastern catchments. As part of the CSC it is anticipated that a programme of environmental and hydrological monitoring will be required. This monitoring programme will assist in determining if the objectives are being achieved. A review and update of the CMP is proposed every five years to capture changes and ensure the short term and long term objectives still apply. This may also be undertaken in conjunction with any review of the CSC conditions, if deemed necessary. It is also proposed that the CMP will provide for greater reflection of cultural values, statutory acknowledgement areas and Iwi/Hapu Environmental Management Plans. Compliance with the performance measures in the Long-term Plan 2018-28 will also be assessed. These reviews will ensure that the most appropriate measures are being utilised to manage the stormwater quantity and quality within the eastern catchments.

2.0 Introduction

There are thirteen identified urban areas within the Western Bay of Plenty District, comprising four large communities and nine small settlements. Western Bay of Plenty District Council (WBOPDC) currently holds a Comprehensive Stormwater Consent (CSC) for Omokoroa catchment, has applied for CSC for the central catchments (Te Puna and Minden urban settlements), western catchments (Waihi Beach and Katikati urban settlements) and seeks to obtain a CSC for the eastern urban settlements. The four settlements located within the area known as the eastern catchments are the Te Puke urban settlement; and three small urban settlements: Paengaroa, Maketu / Little Waihi and Pukehina.

2.1 Background

A Catchment Management Plan (CMP) was prepared by Professional Management Services 2009 Ltd (PMS) in April 2013 (refer to ESZ1 – Te Puke; and ESZ2 – Small Settlements). It was based on the Bay of Plenty Regional Council (BOPRC) Guidelines for the Development of Comprehensive Stormwater Consent Applications and Catchment Management Plans No 2005/02 (BOPRC 2005/02) and Stormwater Management Guidelines for the Bay of Plenty Region No 2012/1 (BOPRC 2012/01).

AECOM New Zealand Limited (AECOM) was engaged to prepare an updated CMP for eastern catchments – Te Puke and small urban settlements (Paengaroa, Maketu / Little Waihi and Pukehina), i.e. this subject document. In preparing the updated CMP consideration has been given to the BOPRC guidelines identified above. The PMS documents are also available as reference documents.

A number of other documents have been considered in the development of the CMP, in particular the ones listed below:

- Comprehensive Stormwater Consents Application Eastern Catchments Urban Stormwater Catchment Management Plan No ESZ1 Catchment Te Puke Volumes 1 and 2, PMS, April 2013
- Comprehensive Stormwater Consents Application Eastern Catchments Urban Stormwater Catchment Management Plan No ESZ2 Catchment Small Settlements Volumes 1 and 2, PMS, April 2013
- WBOPDC, Te Puke Town Centre Plan, 2006
- Te Puke Built Environment Strategy 2008
- Te Puke Community Plan 20-Year Development Plan, WBOPDC, 2016
- Maketu Community Plan 20-Year Development Plan, WBOPDC, 2007
- Maketu Community Plan, 2014
- Paengaroa Community Plan 2015-2025 Development Plan, January 2015
- Cultural Impacts Assessment for Eastern Catchments, Te Runanga o Ngati Whakaue ki Maketu, Maria Horne, December 2013
- Kaituna, he taonga tuku iho , 1 August 2018
- Hapu / Iwi Resource Management Plans:
 - Tapuika Environmental Management Plan 2014 - 2024
 - Ngati Pukenga Resource Management Plan, 1993 - Western Bay of Plenty
 - Waitaha Iwi Management Plan 2014
 - Ngaiterangi Iwi Resource Management Plan, 1995 - Western Bay of Plenty/Tauranga
 - Voices Nga Korero Whakahiahia o Ngaiterangi me Ngati Pukenga, 1999 - Western Bay of Plenty/Tauranga
 - Ngapotiki Environmental Management Plan (Draft), 2001 - Western Bay of Plenty/Papamoa

- Te Rautau Te Rāhui Taketake Ngāti Whakaue ki Maketu Hapū Management Plan 2018-2028
- Te Arawa Trust Board Iwi Resource Management Strategy Plan, 1993 - Rotorua/Maketu
- Te Runanga o Ngati Pūkiao Iwi Resource Management Strategy Plan, 1993 - Rotorua/Te Puke/Maketu/Otamarakau (476KB, pdf)

An extensive list of references is provided in section 15 of this CMP.

2.2 CSC Application

This CMP supports the CSC application to the Bay of Plenty Regional Council which seeks resource consent within the urban areas of Te Puke and the small urban settlements, being Paengaroa, Maketu/Little Waihi and Pukehina, as depicted in catchment boundaries in Appendix A Figures A-1 to A-4 to:

- Discharge stormwater to land, wetlands, and water from multiple locations within the urban settlements of Te Puke; and for three small urban settlements of Paengaroa, Maketu/Little Waihi and Pukehina;
- To undertake associated land disturbing activities and activities within the Coastal Marine Area (CMA) and/or watercourses;
- To undertake maintenance activities on stormwater network, including ongoing operations and upgrades (replacements, demolition and improvement works)

There are a number of existing resource consents within the eastern catchments (identified in sections 5.2 of this CMP). A map illustrating the approximate location of the consents is also provided. All responsibilities for these consents will be surrendered pursuant to s138 RMA once the CSC is granted.

The CMP provides a snapshot of the current network for stormwater management; however it is unable to identify all of the further physical structures that will be required to meet the objectives of the CMP. It is anticipated that this will be an ongoing process and that each structure will be assessed for compliance with the required rules and whether there is a requirement for further consents.

2.3 Scope

The scope of the CMP and associated application for a CSC is to allow WBOPDC and Bay of Plenty Regional Council (BOPRC) to better control the discharge of stormwater from all the land within an urban catchment area.

Managing stormwater is a continuous improvement process. The strategic focus is on developing, continually improving and implementing actions for encouraging the protection of the stormwater receiving environment.

In order to better manage those activities, the CMP is to be developed, and then reviewed continually to incorporate any new knowledge gathered.

The CMP for eastern catchments:

- Describes its scope and purpose for implementation of stormwater management within eastern catchments.
- States appropriate management objectives.
- Identifies the legislative background and key stakeholders.
- Addresses cultural matters of importance.
- Describes the catchments.
- Identifies existing catchment conditions.
- Establishes the values of the catchments.

- Identifies management issues and causes.
- Assesses the effects on the environment and relevant catchment values.
- Evaluates potential management options.
- Presents recommendations for performance monitoring.

The CMP is focused on the existing and potential urban area of the eastern catchments, with the following assumptions, based on BOPRC Guidelines No 2005/002:

- different land use types (urban, or mix of land use types) exist within the eastern catchments, in particular Maketu/Little Waihi and Pukehina are coastal settlements, whereas Te Puke is more urbanised than other catchments;
- Coastal Marine Area (CMA) is defined under the Resource Management Act 1991 (RMA) as:
the foreshore, seabed, and coastal water, and the air space above the water—
 - a. *of which the seaward boundary is the outer limits of the territorial sea;*
 - b. *of which the landward boundary is the line of mean high water springs, except that where that line crosses a river, the landward boundary at that point shall be whichever is the lesser of—*
 - i. *1 kilometre upstream from the mouth of the river; or*
 - ii. *the point upstream that is calculated by multiplying the width of the river mouth by 5*

Note that as per the Bay of Plenty Regional Natural Resources Plan (BOPNRP)

In the Bay of Plenty region the river mouths have been defined by agreement between the Minister of Conservation, the Regional Council, and the appropriate city and district councils, in accordance with section 2(1) of the Act. Grid references of the river mouths have been scheduled in the Regional Coastal Environment Plan. In addition, the Regional Council has detailed maps and descriptions of the agreed river mouths and consequent landward edge of the Coastal Marine Area within the rivers of the region. These maps and descriptions can be viewed at the Whakatane office of Environment Bay of Plenty (now BOPRC).

- Stormwater discharge associated with greenfield activities in river beds, lakes and water courses for Te Puke will be included, with the exception of Te Puke West Structure Plan area (WBOPDC Notified Te Puke West Private Plan Change 70 App H Engineering Assessment; Connell Wagner Limited. 2007). Te Puke West industrial development is also excluded from the scope of this CMP (refer Figure A-1 attached in Appendix A).
- Stormwater discharge from land zoned industrial under the Western Bay of Plenty District Plan (WBOPDP) has been excluded from the CSC Application. In particular, the exclusion of Te Puke West (industrial area) and other industrial areas located to north of the catchment along Jellicoe Street and Atuaroa Avenue. References to Te Puke West have therefore not been provided as part of this CMP.
- Earthworks (bulk earthworks) are excluded – although earthworks associated with installation of stormwater infrastructure will be included as part of the CSC.

These exclusions remain under BOPRC's responsibility as linked to such commercial and industrial areas. However the remaining urban catchments should be included as part of the assessment of environmental effects on the catchment.

In this regard, the letter from WBOPDC to Te Puna Heartlands (dated 16 September 2014) in regards to central catchments CSC application (and applicable to eastern catchments CSC application) states that:

Council and BOPRC are in agreement that industrial and commercial zones will remain as BOPRC's responsibility and will require separate consents which will be assessed and monitored by qualified BOPRC resources. The effects of runoff from industrial zones are considered by the Regional Council who requires interceptors and similar treatment devices prior to discharge if there is a risk to the environment. If there are industrial/commercial areas that do discharge into

Council's network then these are considered in the analysis for pipe sizing. Both Councils are committed to integrated catchment management planning.

2.4 Consultation on the draft Catchment Management Plan

Consultation is an important part of the CMP process. For eastern catchments, Iwi and a wide range of people and organisations are interested in the future of the catchments, many of whom have extensive and important knowledge of the area. This includes Iwi/hapū landowners, Asset Managers from WBOPDC and BOPRC, the development community and residents and ratepayers.

Consultation was undertaken from July until November 2018. It included open days, presentations and hui with Iwi/hapū. A number of communication channels were utilised to engage with the community including the WBOPDC 'Have your say' website, the Te Puke Times and social media. A consultation log (Appendix B) provides an overview of the consultation undertaken.

The purpose of this consultation was to determine if the CMP accurately reflected the aspirations of these groups in regards to stormwater management. Where possible, the feedback as a result of this consultation has been incorporated into the CMP. In some instances the CMP was not the most suitable method to address the points raised. A summary of the feedback and the response from WBOPDC (including changes to the CMP) is included in Appendix B. Copies of the feedback are also included in Appendix B.

The key themes that emerged were:

- Support for a comprehensive and integrated approach to stormwater management
- The value and importance of the receiving environment
- The impact of stormwater management on cultural values and objectives, particularly in regards to the Kaituna River and the Maketu Estuary
- Importance of managing stormwater quality and quantity

3.0 Cultural values and objectives

A key theme that emerged from the consultation was the impact of stormwater management on cultural values and objectives. The CMP is one of many ways in which the Council can look to address the challenges identified by Iwi and hapū in respect of stormwater effects on the receiving environment. The implementation of the CMP will assist in achieving in part some of the outcomes sought by Iwi and hapū and should also provide a mechanism for Iwi and hapū to work with Council in this area.

Iwi/Hapu management plans and environment plans articulate values and objectives for the respective Iwi or hapū group. These plans also include a number of values and objectives which specifically address stormwater discharges and the effects on the receiving environment. Collectively the cultural values illustrate a strong relationship with the environment and a desire to protect it from the impacts of urban growth, land use change and inappropriate landuse. Examples of these references from the Iwi/hapū Management Plans are outlined below. It should be noted that these examples are not a complete list in terms of all the Iwi and hapū in the eastern catchments.

The Tapuika Environmental Management Plan 2014 – 2024 sets out the priority issues of significance to Tapuika. The key issues which strongly align with the CMP are the land use impacts on waterways and the coast, and the effects on the health and wellbeing of Tapuika. It is also noted that there needs to be greater recognition of Tapuika values and interests in freshwater management, particularly decision-making. Values identified in regards to waterways include Wahi Mahinga Kai, Settlement, Wahi Tapu, Ara Tawhito (Trails) and cultural resources. The plan also sets out a number of expected outcomes and policies for water some of which correspond to the objectives and actions set out in the CMP. This includes involving Tapuika in the resource management process, ensuring high water quality for swimming, food gathering and drinking water, and maintaining sufficient water flow to protect freshwater fisheries, customary resources and uses.

The Waitaha Iwi Management Plan 2014 sets out a number of tikanga (policies) that are included in the CMP. He mauri (recognizes the life force of all things) and has a desired outcome of restoring the mauri, enhancing the wellbeing, protecting and balancing the biodiversity of all indigenous species and their habitats. This outcome is also sought by the CMP in terms of mitigating the effects of poor water quality on the receiving environment. The management plan also identifies that Waitaha

‘do not support storm water run-off and want Councils to revisit and invest money into seeking better systems or technologies that divert from further waterway pollutant contributors’.

The integrated approach to stormwater management which is the foundation of the CMP will assist Council to respond to this issue and work toward better environmental outcomes.

Te Rautau Te Rāhui Taketake (Ngāti Whakaue ki Maketu Hapū Management Plan 2018-2028) sets out the kaupapa of Ngāti Whakaue ki Maketu in regards to the issues and challenges identified for the natural environment. The objectives in the hapū management plan are:

‘To take a more holistic and collective approach to sustainable land use and development within our rohe’ and to ‘Manage the effects of discharges on freshwater and coastal water quality’.

These objectives are reflective of the approach set out within the CMP.

In addition to these plans there have been a number of settlement acts which provide for statutory acknowledgement areas, a number of which are part of the eastern catchment receiving environment. Watercourses identified include the Kaituna River, the Waiari Stream, the Ohineangaanga Stream, Te Raparapa a Hoe Stream, the Pokopoko Stream and the coastal marine area from Little Waihi to Wairakei. Improving the quality of the stormwater discharge will have a positive impact on these watercourses.

The Tapuika Claims Settlement Act 2014 also provided for the establishment of the Kaituna River Authority. The authority has developed Kaituna, he taonga tuku iho – the Kaituna River Document which sets out the communities’ vision, objectives and desired outcomes for the Kaituna River and its tributaries. There are several objectives in this document which closely align with the objectives of the CMP including the restoration of water quality and the mauri of the water in the Kaituna River, the enhancement of the Kaituna River through improved land management practices and the restoration, protection and enhancement of the habitats that support indigenous vegetation and species.

Cultural catchment objectives are also articulated in a number of tables in section 8 and effects on cultural values are identified in section 10. It is recommended that the CMP be reviewed every five years to ensure cultural values are comprehensively addressed. It is also recommended that Iwi and hapū are consulted as to how matauranga can be incorporated into the monitoring of stormwater and the receiving environment.

4.0 Stormwater management objectives

High level stormwater management objectives for the catchments have been developed to express the outcomes WBOPDC and the community seek to achieve in relation to the protection of the resource values within the catchments identified in this CMP. As noted above the objectives in the CMP align with a number of values and objectives within Iwi and hapū management plans and environmental plans.

Stormwater management objectives include both long term commitments to a vision for the future of the catchments to be implemented in the Long Term Plan (LTP) and short term quantifiable measures towards these long term objectives. The short term objectives for stormwater management form the basis for identifying management actions that can be implemented into the Asset Management Plan (AMP) within a three to five year time period.

Specific and measurable objectives as part of the LTP are provided in section 13.0 of this CMP.

4.1 Long Term Objectives

The vision, as defined through Government regulations and the consultation process with Tangata Whenua and the community, is the sustainable development of the catchments so that the existing resource values can be enjoyed by future generations.

The four overall long term commitments have been defined as following:

- Provide for the integrated and comprehensive management of stormwater, based on the design philosophy of minimising runoff and maximising quality through low impact design solutions.
- Implement and maintain stormwater management methods that mitigate adverse effects on the water quality and water levels of the streams, the Pacific Ocean, and other receiving environments.
- Progressive improvement of the existing stormwater system.
- The protection of health through managing stormwater in a safe and effective manner while encouraging recreation and connectivity.

To achieve these overall long term commitments the following long term objectives in terms of water quantity, water quality, ecological and visual quality and recreational have been set:

4.1.1 Water Quantity Objectives

A major issue for stormwater management is to address the risk of flooding in the lower Kaituna catchment and small sub-catchments. Therefore, all actions for improvement in stormwater management aim to ensure consistency with the objectives of flood management and environmental flows.

The water quantity objectives most relevant to stormwater management in the eastern catchments include the following:

- Protection of the existing urban area from the effects of flooding as necessary by upgrading infrastructure and identifying secondary flow paths.
- Protection of water levels in natural wetlands.
- Protection of or restore a proportion of moderate flows and high flows.
- Maintain or restore the natural inundation patterns and distribution of flood waters supporting natural wetlands and floodplain ecosystems.
- Maintain the rates of rise and fall of stream water levels within natural bounds.
- Minimise the impact of instream structures.
- Maintain or rehabilitate estuarine processes and habitat.

4.1.2 Water Quality Objectives

The long term stormwater quality objectives aim to sustain current or likely future environmental values for natural water flows. The objectives are to be consistent with the National Water Quality Management Strategy (NWQMS) and the Australian and New Zealand Environment and Conservation Council's (ANZECC) guidelines for fresh and marine water quality 2000; as well as the National Policy Statement for Freshwater Management 2014.

The water quality objectives most relevant to stormwater management in the eastern catchments include the following:

- Protection and improvement of the aquatic ecosystems through appropriate stormwater treatment.
- Understand the links between human activity (both community and Tangata Whenua uses, including indigenous values associated with mahinga kai, waahi tapu and mauri) and water quality.
- Healthy ecosystems that promote the growth of tupuna kai (ancestral foods) such as tuna (eels) and the inanga (whitebait), and growing aquatic plants such as watercress
- Set effective management frameworks, including cooperative, regulatory, feedback and auditing mechanisms.
- Establish a Monitoring and Assessment Programme.
- Initiate appropriate management response.

4.1.3 Ecological Objectives

The ecological objectives for the eastern catchments are to protect and maintain the existing aquatic and riparian habitats for the waterways within the urban areas and the receiving environment (both freshwater and marine).

The ecological objectives identified for stormwater management in this CMP are limited to the interaction between stormwater and the ecosystem. The stormwater management objectives of the CMP are as follows:

- Minimise the loss of habitat quantity and the degradation of habitat quality of receiving environments, associated wetlands, riparian and coastal margins, and estuarine/harbour waters.
- Identify and implement riparian planting to areas where ecological gains are most likely to be generated.

4.1.4 Visual Quality and Recreational Objectives

Objectives have also been identified to maintain and enhance (where practical) the visual quality of the eastern catchments. The long term social objectives for stormwater are to maximise the visual amenity of the stormwater system and ensure stormwater quality is consistent with desired recreational uses.

- Avoid adverse effects on sites of significant cultural, historic and spiritual value.
- Maintain stormwater corridors and coastal margins that have identified recreational values.

4.2 Short Term Objectives

The four overall short term commitments for the eastern catchments have been defined as follows:

- Maintain Level of Service (LOS) and establish any necessary changes to WBOPDC's Stormwater Strategy, Asset Management Plan (AMP) and the standard practice codes.
- Undertake ongoing assessments in relation to primary and secondary flow paths.
- Establish a progressive capital works programme focused on upgrading infrastructure that is below WBOPDC's current LOS.
- Undertake baseline environmental and stormwater monitoring to establish areas for environmental enhancement.

These short term objectives are linked to existing catchment values with the overall aim being to improve water quality and maintaining the recreational values of the ecosystem within the urban areas of the catchment. The quantifiable short term commitments towards the long term objectives described above form the basis for the development of stormwater management actions.

4.2.1 Long Term and Short Term Objectives embedded in CMP

The purpose of this CMP is to develop an integrated management approach to stormwater in the Te Puke and small urban settlement catchments. This CMP outlines and incorporates the key stormwater issues and objectives for these catchments and addresses the effects of stormwater discharges on its receiving environments – comprising several open drains, pipes, Ohineangaanga Stream, Raparapahoe Stream, Waiari Stream, Kaituna River, Maketu Estuary, Waihi Estuary and the Pacific Ocean. Detail is provided on the suite of management methods implemented, programmed or available in the future to mitigate identified issues, including a means to evaluate proposed options leading to a preferred approach.

Catchment specific detail regarding receiving environments, environmental monitoring and consultation is included in this CMP as a range of catchment recommendations including a programme of works.

5.0 Legislative Framework and Context

This section provides an outline of regulatory framework and policy directions relevant to the eastern catchments.

5.1 National and Regional Regulatory framework

Appendix C provides detailed information on the relevant Resource Management Act 1991 (RMA) sections, the New Zealand Coastal Policy Statement 2010 (NZCPS), the National Policy Statement for Freshwater Management 2014 (NPSFM), the Bay of Plenty Regional Policy Statement 2014 (RPS), National Environmental Standards, the Bay of Plenty Regional Coastal Environment Plan (RCEP), the Bay of Plenty Regional Natural Resources Plan (RNRP), and the appropriate Bay of Plenty Regional technical publications.

WBOPDC has decided to split its district into four distinct areas for the purpose of applying for these comprehensive stormwater consents. These include the Western, Central, Eastern and Omokoroa catchments, with CMPs being prepared for each. The following relates specifically to the eastern catchments areas.

5.1.1 Integrated Management

One of the most significant principles driving the catchment management process is that of integrated management. Integrated management is identified in the RPS as being one of the significant resource management issues in the Region. It is described in the RPS as:

Integrated resource management refers to relationships between agencies, users and their values, legislation, policy statements, plans, resource consents, and other mechanisms, which enable the promotion of sustainable resource management.

Effective and efficient resource management requires taking an integrated approach and working with other parties. It also requires taking a non-regulatory approach to achieve desired outcomes. Taking an integrated resource management approach ensures the region's communities are not caught unprepared by sudden or cumulative changes either in the environment, or in the pressures and demands on resources.

Integrated resource management requires a holistic view that looks beyond organisational, spatial or administrative boundaries. For integrated management to be effective and efficient it requires a coherent and consistent approach with agencies involved in resource management working together in a collaborative manner.

The RPS recognises that integrated management is particularly important in relation to the coastal environment and acknowledges that there are several challenges here. One of which is the location of the jurisdictional boundary between district and regional councils as it does not mark the extent of the coastal environment. The objectives and policies focus on identifying and providing for consistent management - as well as providing for a collective approach to integrated management across the coastal environment; so as to improve the likelihood that the coastal environment is managed to recognise and value its distinctive characteristics, including the management of growth.

There are a number of different environmental components and “inputs” to the catchment planning process for the eastern catchments. To ensure the process results in a comprehensive consideration of catchment issues, all the individual components need to be brought together, analysed, and design solutions sought which meet multiple objectives. As part of the catchment planning process a number of environmental and development issues have been identified. The issues have been analysed through a number of ‘filters’ which include developing design solutions which enable land use, landscape, ecological and stormwater management objectives to be met.

Design solutions, or mitigation measures are discussed in the recommendation section 11.2 of this CMP. In order to meet the objectives in section 4, a range of mechanisms have been developed.

Integrated management is not simply an outcome of the catchment management process, but is an ongoing principle for the future management of the catchment. While the current catchment and district planning process has identified a series of goals, objectives and methods of implementation, there needs to be a significant level of certainty that these methods will be effective. Furthermore, it is

important that the administration/enforcement of the policy framework developed to date for the eastern catchments occurs in an integrated manner.

5.1.2 SmartGrowth Strategy

The SmartGrowth Strategy identified a number of Urban Growth Areas, which includes Te Puke (Dudley Vercoe Drive, MacLoughlin Drive, and No 1 Road Structure Plan areas). Refer to Appendix D of this CMP for the maps detailing the growth areas within the eastern catchments. In broad terms the Strategy identifies the need to provide certainty, to encourage a consolidated and compact urban form, to align infrastructure investment and growth with funding, and to manage the risk of natural hazards on the settlement pattern. Where urban expansion does occur within the eastern catchments it must make efficient use of resources, whether they are infrastructure or land. Also key to development within the eastern catchments is the management of natural hazards including flooding, coastal inundation, erosion, and instability.

5.1.3 Western Bay of Plenty District Plan (WBOPDP)

Under the WBOPDP, the underlying zones within the eastern catchments management boundaries include:

- **Te Puke** – Residential, Medium Density Residential, and Commercial. Also includes Structure Plans:
 - TP3-1 (zoned Residential and Medium Density Residential, located off MacLoughlin Drive),
 - TP3-2 (zoned Residential, located off MacLoughlin Drive),
 - TP3-3 (zoned Residential and Future Urban, located off Dunlop Road),
 - TP4 (zoned Residential, located off Dudley Vercoe Drive), and
 - TP5 (zoned Residential, located off No. 1 Road and Gannell Farm Drive).
- **Pukehina** – Residential and Commercial
- **Paengaroa** – Residential and Commercial
- **Maketu** – Residential, Rural Residential, Rural, Industrial and Commercial. Part of the Maketu Structure Plan (zoned Residential and Rural Residential, located off Arawa Avenue), is also located within the boundary of this CMP.
- **Little Waihi** – Residential

These CMP areas contain the following overlays under the WBOPDP that are relevant in terms of stormwater management and subdivision:

- **Te Puke** – Flood hazard, Reserves (including Proposed Reserves), Stormwater Ponds, Proposed Esplanade Strip / Reserve, Notable Trees (8, 10), and Built Heritage Features (30, 43, 44)
- **Pukehina** – Coastal Erosion Area – Primary Risk (3), Coastal Erosion Area – Secondary Risk (3), Coastal Inundation, Flood Hazard, and Reserves
- **Paengaroa** – Flood hazard and Reserves
- **Maketu** – Flood hazard, Stormwater Pond, Reserves, Stability Area – General, Stability Area – landslip, Cultural heritage Features (76, 81, 116, 117, 122), and Built Heritage Features (10, 11, 48, 50).
- **Little Waihi** – Flood Hazard, Significant Ecological Feature (RAP), Stability Area – General, and Reserve.

The Te Puke Catchment Management Boundary includes Te Puke Area 3, 4 and 5 Structure Plans. Within Structure Plan Area 3 (located off MacLoughlin Drive and Dunlop Road) the WBOPDP identifies seven stormwater ponds (SW Ponds 2, 3, 4, 5, 7, 8, and 9). Within Structure Plan Area 4 (located off Dudley Vercoe Drive), the map identifies a stormwater pond (SW Pond 4A). All three Te Puke Structure Plan Areas identify zoning and proposed roads, walkways, watermains, stormwater mains and sewer mains.

The WBOPDC Planning Maps identify a stormwater pond within the Maketu Structure Plan area.

A description of the environment and relevant characteristics of the eastern catchments areas is provided in section 6. The planning maps are included in Appendix A.

All subdivision requires resource consent and is required to be designed in general accordance with the WBOPDC provisions. Once a site has been created within the Residential zone, one dwelling per lot is a permitted activity (WBOPDC Rule 13.3.1). Any additional dwellings or minor dwellings require resource consent. It is acknowledged that once a site has been created through subdivision there is limited ability through the resource consent process under the current WBOPDC provisions to manage and treat stormwater. Therefore it is key that provision is made for stormwater treatment and management as part of the subdivision assessment and consent process.

Within the Residential zone the following minimum site areas are required:

- **Te Puke** – 350m²
- **Maketu** – 350m² minimum, 600m² average (within greenfield areas connected to a reticulated wastewater supply with a minimum parent lot size of 3,000m²)
- **All other areas** – 800m² (subject to compliance with Rule 12.4.6 and 12.4.7).

All subdivision, use and development within the identified structure plan areas shown on the Planning Maps (i.e. Te Puke and Maketu) is required to provide stormwater ponds / management reserves and access thereto, roading and road widening, walkways/cycleways, and water, stormwater, and sewage mains in the general locations shown on the Structure Plan and/or Planning Maps. Any non-compliance to a specific structure plan or to performance standards (12.4.1(g) or 12.4.3.3) is deemed to be a Non-Complying Activity unless otherwise stated (Rule 12.3.4.1).

Appendix C sets out the provisions of the WBOPDC that are relevant to subdivision and stormwater design and management.

This approach to stormwater management is consistent with approach of this CMP. The WBOPDC Development Code and the CMP used together for the eastern catchments would better achieve the sustainable stormwater management that aligns also with the higher order statutory documents, including meeting the purpose of the RMA.

5.1.4 WBOPDC Development Code (2009)

In addition to the WBOPDC, the WBOPDC Development Code (2009) (WBOPDC DC) provides a means of compliance when designing, constructing and maintaining engineering works that are required. The WBOPDC DC (section 4.5) provides design standards, construction standards, drawings and as built specifications for stormwater. Measures for stormwater management include pipe systems, swales, rain gardens, and stormwater ponds. The WBOPDC DC also includes provision for alternative and innovative stormwater disposal designs especially where sustainable, low impact disposal systems are proposed.

As noted above, this approach to stormwater management is consistent with the approach of this CMP. The WBOPDC DC and the CMP used together for the eastern catchments would better achieve the sustainable stormwater management that aligns also with the WBOPDC and the higher order statutory documents, including meeting the purpose of the RMA.

5.2 Existing Catchment Plans and Discharge Consents

Existing resource consents (stormwater discharges) for the eastern catchments (Te Puke and the small urban settlements) provided from the WBOPDC Consent Database (PMS 2013) are attached in Appendix E. A map illustrating the location of consents is included in Appendix E.

Note that these consents will be replaced by the CSC which is currently being processed by BOPRC.

6.0 Existing Environment

This section provides an overview of the study area, landuse, geology and receiving environment at the eastern catchments. It also provides a summary of all environmental monitoring investigation undertaken at the study area since 2010.

6.1 Study Area

The WBOPDC is located on the east coast of the North Island and extends from Waihi Beach in the northwest to Otamarakau in the south east. The eastern catchments of the WBOPDC consist of four identified urban areas. These include one major community, Te Puke, and three small urban settlements: Paengaroa, Maketu (including Little Waihi) and Pukehina.

The location of the study area and associated urban settlements are provided in AECOM Figures attached in Appendix F. WBOPDC provided shapefiles with delineation of catchments and subcatchments; WBOPDC Figures dated December 2017 and planning maps based on WBOPDC Plan are attached in Appendix C.

Relevant figures for eastern catchments are provided as follows:

- Figure 1 (refer to Figure F-1 in full resolution in Appendix F) provides delineation of all eastern catchments including Te Puke and small urban settlements stormwater catchments (Paengaroa, Maketu / Little Waihi and Pukehina);
- Figures 2 to 5 (Figures F-6 to F-9 in Appendix F) depict the receiving environment monitoring (stream locations) with locations sampled in 2018 by AECOM 2018 (Stream references IDs 'A' for upstream sites and 'B' for downstream sites) and stream bank erosion assessment done by WBOPDC in 2018 (refer to sections 6.6.2.3 and 6.6.2.4 for further details);
- Figures 9 to 12 (Figures F-10 to F-13 in Appendix F) provide the existing landuse at each eastern catchment;
- Figures 15 to 18 (Figures F-2 to F-5) provide delineation of each eastern catchments and their stormwater and waste water networks.

Planning maps provided by WBOPDC and WBOPDC GIS DP include:

- Figures A-1 to A-4 provide planning maps delineation of all eastern catchments including Te Puke and small urban settlements stormwater catchments (Paengaroa, Maketu / Little Waihi and Pukehina);
- Figure A-5 provides the map for infrastructure requirements for the Te Puke Structure Plan Areas.

Figure 1 Eastern stormwater catchments Source WBOPDC shape files 2017, AECOM 2018 (Figure F-1)



6.2 Overview of Eastern Catchments

The following description provides additional context to the study area and stormwater management catchments subject to this CSC application.

An overview of the eastern catchments is provided below:

- **Te Puke**

Te Puke is located approximately 25km southeast of central Tauranga, adjacent to the Kaituna-Pongakawa plains and Otawa-Otanewainuku Range. Surrounded by agricultural land, the township has an area of approximately 480ha which has been heavily modified and consists mainly of residential land uses and a small commercial area to the north. Industrial land uses are located directly northwest of the catchment. Te Puke is in the Kaituna River catchment.

- **Paengaroa**

Paengaroa is located approximately 33km southeast of central Tauranga, Paengaroa consists of a small urban settlement (approximately 35ha) surrounded by rural (farming and horticultural) land uses. Paengaroa catchment is predominantly zoned for residential land uses, with small areas around SH33 zoned for industrial and commercial uses. The urban catchment includes northern residential areas on the eastern side of Wilson Road South, from Hall Road to its intersection with McKenzie Road, and southern residential areas south of Hall Road, extending between Old Coach Road and SH33. This includes a small protrusion which extends east along Black Road. The catchment was identified as unsewered by PMS 2013 (Thiel-Lardon 2013b).

- **Maketu/Little Waihi**

This catchment consists of the Maketu township (approximately 128 ha), located approximately 39km east of central Tauranga, and Little Waihi (approximately 4ha), located approximately 700m east of Maketu. The Maketu/Little Waihi catchment (total area of 132ha) is comprised of a mix of residential and rural-residential land uses, surrounded by the coast (Maketu and Waihi estuaries) and rural (farming and horticultural) land uses. A small area zoned for commercial and industrial land uses is located at the western end of Little Waihi Road in Maketu.

The Maketu Catchment Management area borders on the edge of Maketu Estuary. This Estuary is identified as an 'area of significant conservation and cultural value' (ASCV-7) under the Bay of Plenty Regional Coastal Environment Plan (2011). The estuary provides important feeding and roosting grounds for a number of wading, wetland and shore bird species, and meets the Ramsar criteria (Ramsar Convention Secretariat 2013) for an internationally significant wetland.

The Little Waihi Catchment Management area borders onto the edge of Waihi Estuary. The Waihi Estuary and associated wetland margins are identified as an 'Area of Significant Conservation Value' (ASCV-7) with 'Significant Indigenous Vegetation Areas' (SSCMA-34) under the Bay of Plenty Regional Coastal Environment Plan (2011). The estuary provides feeding and roosting grounds for migratory and wading bird species, and contains representative saltmarsh vegetation which is still relatively intact.

- **Pukehina**

Pukehina is a coastal settlement located on a spit approximately 48km east of central Tauranga. The Pukehina catchment (approximately 71ha) is predominantly zoned for residential land uses, with two areas zoned for commercial land uses located at 66-68 and 500-504 Pukehina Parade. With a permanent population of 600 (Census 2013), the catchment largely consists of "holiday" homes which are not occupied year-round. The Pacific Ocean borders the catchment to the north, with Waihi Estuary surrounding the southwest tip of the catchment and rural land uses located to the south and east.

The catchments are generally urban-residential areas with a development potential that is relatively minor due to restrictions in the WBOPDC i.e. they are highly developed with limited opportunity for intensification. The presence of stormwater pipes, open drains and various streams was identified within the eastern catchments.

6.3 Eastern Catchments Receiving Environment

A description of the stormwater runoff receiving environment at each eastern catchment (AECOM 2018) is provided in the following Tables: Table 1 for Te Puke, Table 2 for Paengaroa and for the small urban settlements: Table 3 for Maketu and Little Waihi, and Table 4 for Pukehina. Full size copies of the figures referred to below can be found in Appendix F.

Table 1 Te Puke Stormwater Receiving Environment (from West to East)

Site Ref (refer Figure F-6)	Te Puke Streams	Streams Features	Receiving Environment
TP1A and TP1B	Raparapahoe Stream	It flows in a northerly direction into the Kaituna River. It is situated directly west of Te Puke. Moderate flow and moderate to poor riparian margins have been identified, with weed species.	Pacific Ocean
TP2A and TP2B	Ohineangaa Stream and tributaries	It mostly flows in a northerly direction before flowing west towards the Kaituna River. Two tributaries are referred to in various reports: - Western tributary (also referred to as Centennial Park waterway): Very short waterway flowing in a northerly direction appearing to be located off Centennial Park, in the western part of the catchment. - Eastern Tributary: also flowing in a northerly	Pacific Ocean

Site Ref (refer Figure F-6)	Te Puke Streams	Streams Features	Receiving Environment
		direction (in the centre of Te Puke).	
TP3A and TP3B	Cannell Farm Drive waterway	It flows in a northerly direction into the Kaituna River.	Pacific Ocean
N/A*	Unnamed waterways	A couple of unnamed waterways flow parallel to Cannell Farm Drive waterway and converge before joining Ohineanga Stream.	Pacific Ocean
TP4	Waiari Stream	Deep stream with moderate flow, excellent clarity. It flows in a northerly direction towards ultimate receiving environment. It is situated directly east of Te Puke.	Pacific Ocean
N/A*	Kaituna River	Kaituna River is located east of Te Puke. It flows northeast towards Te Tumu in a northerly direction where it discharges into the Pacific Ocean.	Pacific Ocean

* N/A meaning no monitoring has been undertaken in 2018 therefore not depicted in maps.

Table 2 Paengaroa Stormwater Receiving Environment

Site Ref (refer Figure F-7)	Paengaroa Streams	Streams Features	Receiving Environment
Pa1A and Pa1B	Pokopoko Stream	No waterway traversing the settlement; however, Pokopoko Stream lies approximately 1km downslope of the settlement (to the east). The stream runs parallel to Paengaroa and is the receiving environment for stormwater runoff. It flows in a north easterly direction until it joins Kaikokopu Canal.	Waihi Estuary

Table 3 Maketu/Little Waihi Stormwater Receiving Environment

Site Ref (refer Figure F-8)	Maketu / Little Waihi Streams*	Streams Features	Receiving Environment
Ma1A and Ma1B	Stream 1 – Little Waihi Road Stream*	It flows in a north west direction	Maketu Estuary
Ma2A and Ma2B	Stream 2 – Town Point Road Stream*	This drain flows westward, parallel to Maketu coast.	Maketu Estuary
Ma3A and Ma3B	Stream 3 – Newdicks Beach Stream*	This waterway flows parallel to Maketu catchment boundary to the west, in a northerly direction and discharges into the Pacific Ocean at Newdicks Beach (east of settlement).	Pacific Ocean
N/A	Little Waihi overland flow or piped discharge	There are no waterways within the Little Waihi sub catchment. Stormwater from the settlement flows directly into the Waihi Estuary, either via overland flow or as piped discharge.	Waihi Estuary

* There are no streams identified at Little Waihi. The streams identified at Maketu are unnamed streams and names references have been kept consistent with AECOM 2018 and Wildlands Te Puke (2006a) and Maketu (2006b) ecological assessments.

Table 4 Pukehina Stormwater Receiving Environment

Site Ref (refer Figure F-9)	Pukehina Streams / Drains	Streams Features	Receiving Environment
Pu1A and Pu1B	Stream 1 – unnamed canal (parallel to Pukehina Canal)* Other farm drains / canals parallel and south of Pukehina	No waterways have been identified in the catchment, but a number of farm drains are located to the south and receive stormwater runoff from the township. These drains flow in a northwesterly direction.	Waihi Estuary
N/A	Pukehina Canal	Flowing northwest, parallel to Pukehina Parade.	Waihi Estuary

* The streams identified at Pukehina are unnamed canals and names references have been kept consistent with AECOM 2018 and WBOPDC 2018 Stream Bank Erosion assessment.

Photographs of receiving environment at eastern catchments are provided in Appendix G, (G-1 AECOM 2018 Freshwater ecological and water quality assessment).

Details of social, cultural and heritage features are provided for each catchment in the catchment values section 8.0 of this CMP. A cultural impact assessment is also attached in Appendix H of this CMP.

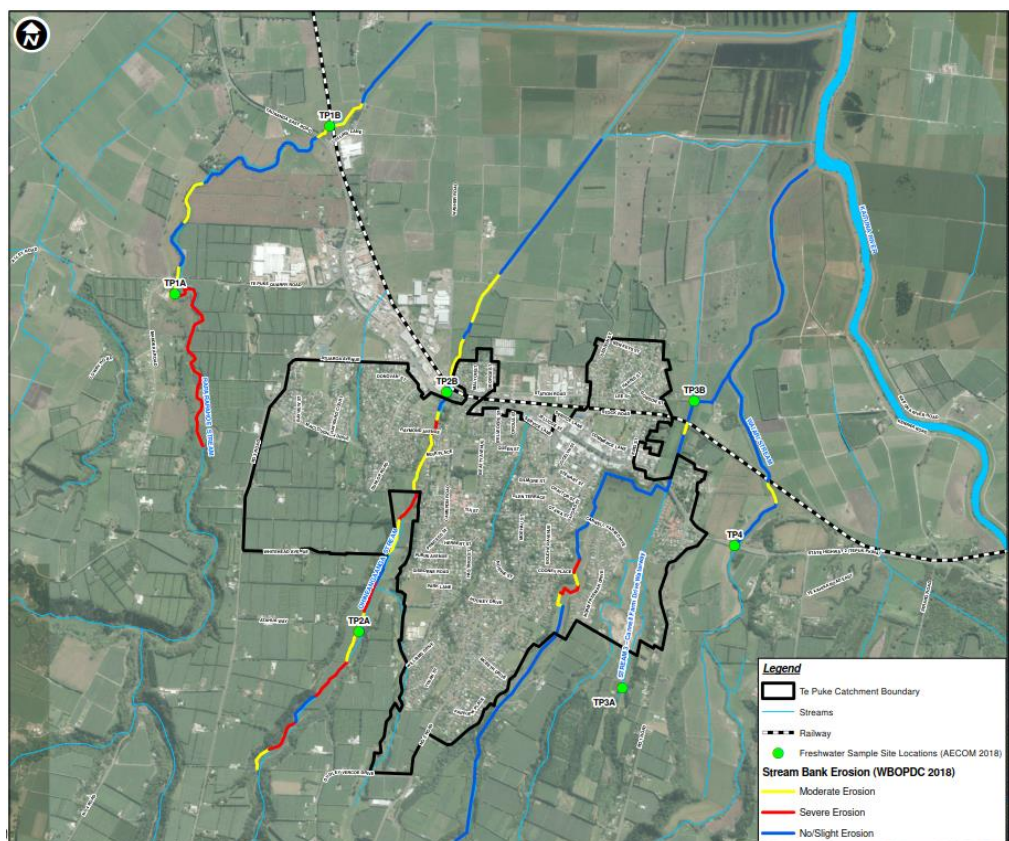
Figure 2 Te Puke Catchment and Receiving Environment (AECOM 2018) – Figure F-6 in Appendix F

Figure 3 Paengaroa Catchment and Receiving Environment (AECOM 2018) – Figure F-7 in Appendix F

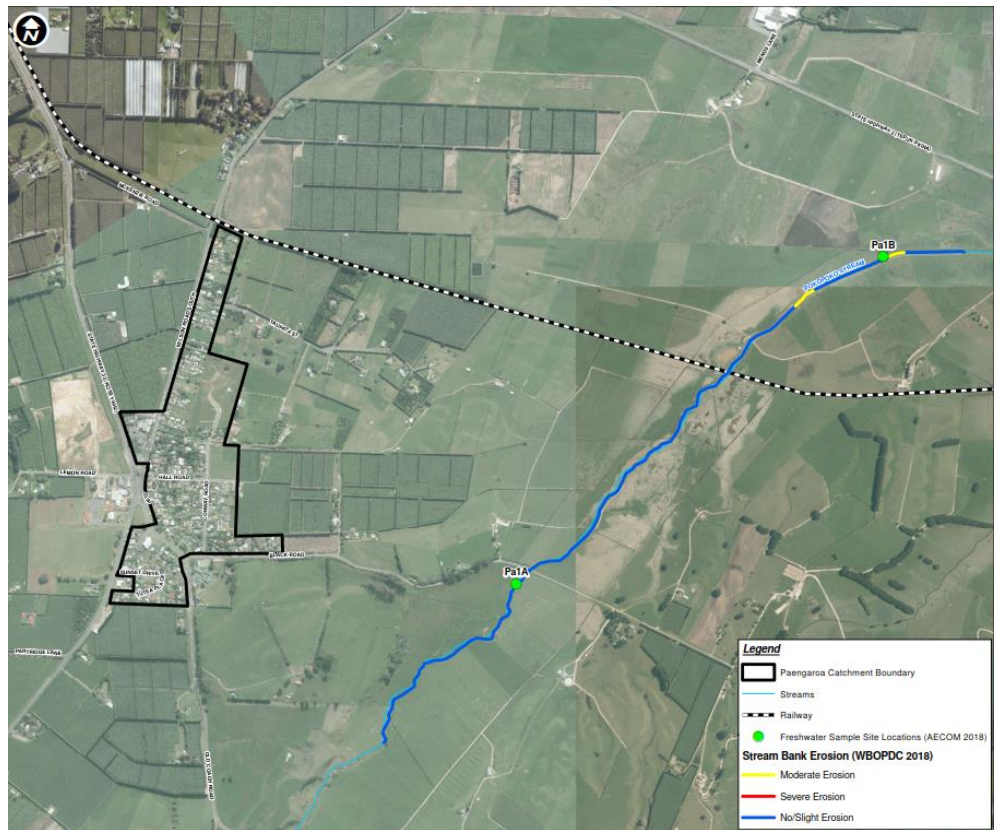


Figure 4 Maketu / Little Waihi Catchment and Receiving Environment (AECOM 2018) – Figure F-8 in Appendix F

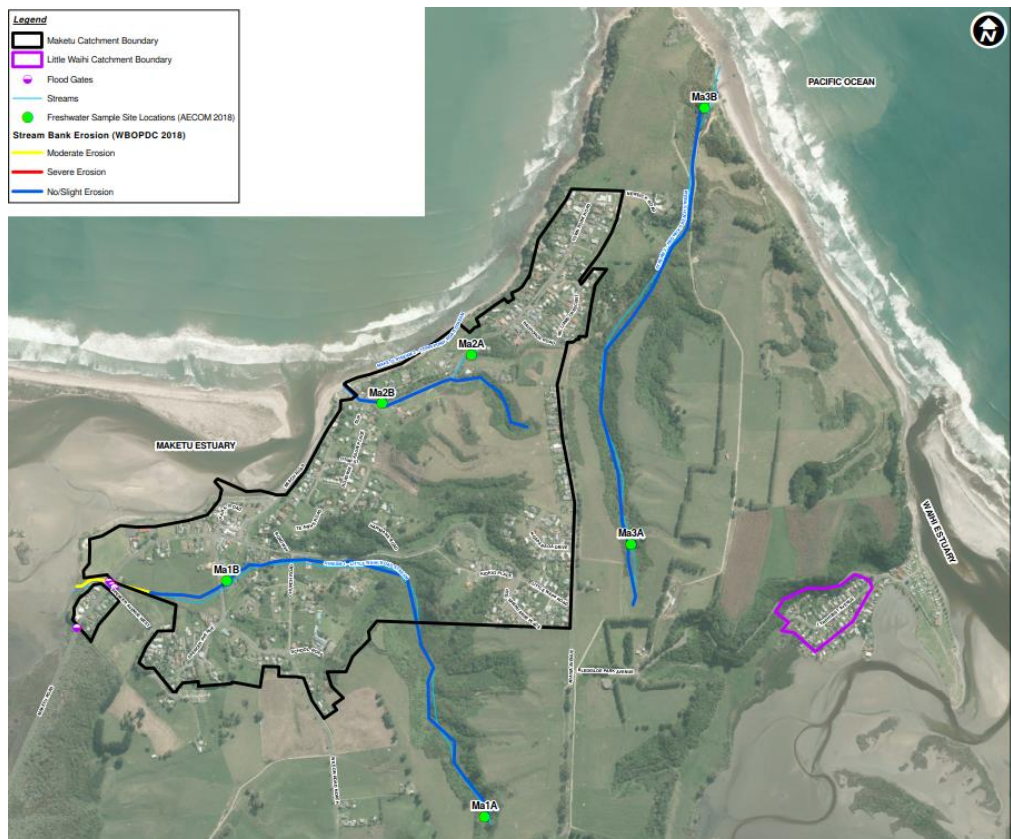


Figure 5 Pukehina Catchment and Receiving Environment (AECOM 2018) – Figure F-9 in Appendix F

6.4 Geology and Soil

The WBOPD is located on the east coast of the North Island. Covering an area of approximately 212,000ha, the district extends from Waihi Beach in the northwest to Otamarakau in the southeast.

The geology in the WBOPD is generally comprised of a late Pliocene to Pleistocene sequence of volcanic rocks and sediments derived from the southern Coromandel Volcanic Zone (CVZ) and the Taupo Volcanic Zone (TVZ) (White et al. 2009). The oldest rocks in the sequence consist of andesite and dacite lavas associated with the Kaimai Subgroup. Younger volcanic layers including the Ottawa Volcanics, Minden Rhyolite, ignimbrites (i.e. Waiteariki, Papamoa, Ongatiti) are also scattered around the District. Tauranga Group sediments and coastal and alluvial sediments of the late Pleistocene and Holocene dominate coastal areas (White et al. 2009). Figure 6 provides an overview of the geology in the WBOPD. Figure 7 provides soil orders within WBOPD. Higher resolution of figures 6 and 7 is also provided in Appendix D. Stability and coastal erosion areas are provided in the WBOPDC maps in Appendices A-1 to A-4.

Figure 6 Overview geology in the WBOPD (White et al. 2009)

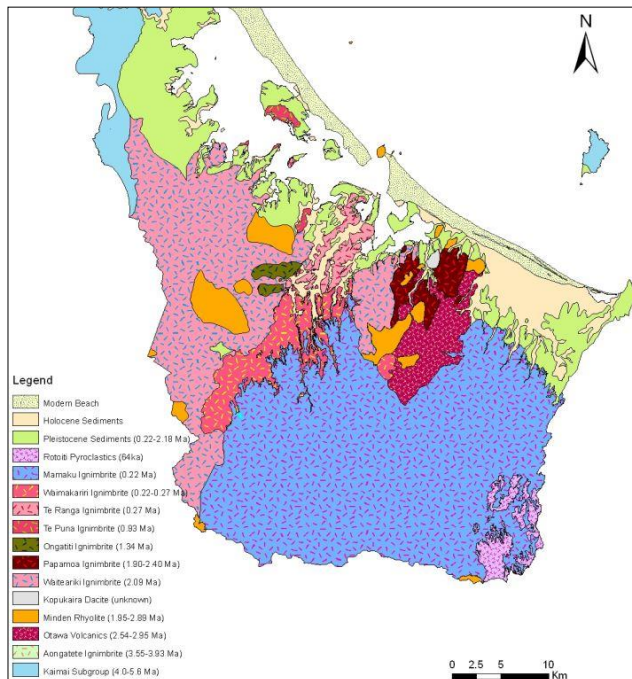
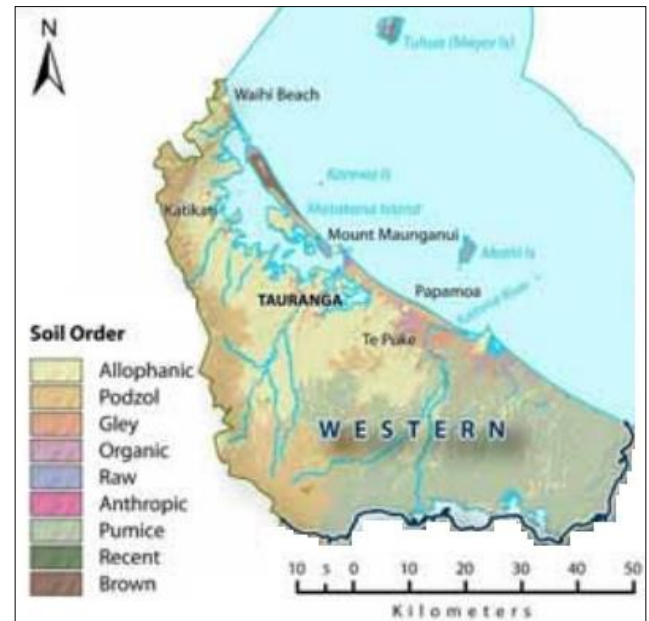


Figure 7 General soil map the WBOPD showing soil orders (Rijkse and Guinto 2010)



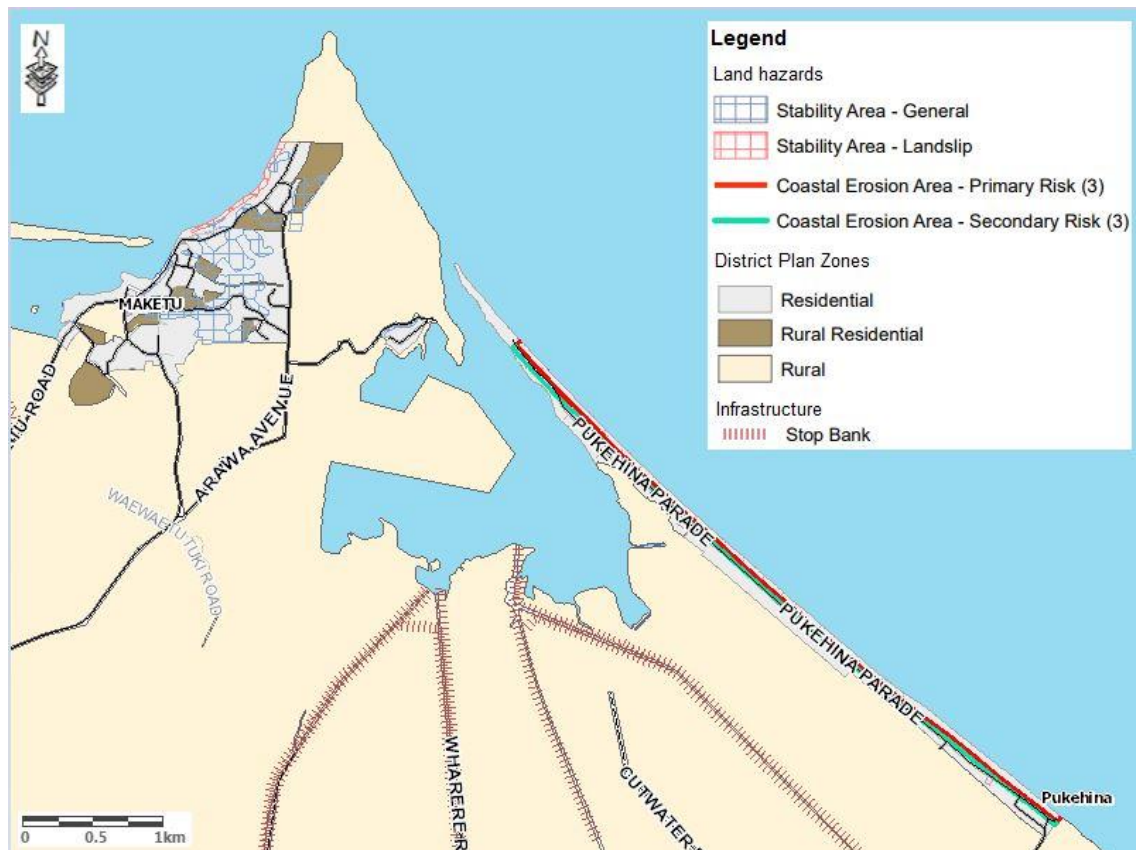
There are five main soils types within the Western Bay of Plenty District (Rijkse and Guinto 2010; Thiel-Lardon 2013a), these include (refer to Figure 7):

- **Allophanic soils** – Well-drained, with high macro-porosity which lends to high permeability. These soils have relatively high moisture retention (15-25% of soil volume); however, drainage can be impeded if soil layers become compacted. Allophanic soils are considered to be moderately to strongly leached with low levels of exchangeable group one and two elements. Available phosphorus is naturally low with high phosphate retention.
- **Gley soils** – Generally poor to very poorly-drained, with a high groundwater table. Essentially older wet mineral soils derived from a variety of parent materials, such as alluvium, colluvium and wind-blown coastal sands, this soil type occur in valley floors, coastal terraces and back swamps. Organic matter is usually high in these soils, with high intergrading into peat deposits
- **Pumice soils** – Dominated by pumice or pumice sand high in volcanic glass, this soil type is resistant to pugging and, like allophanic soils, have low to very low nutrient levels. These soils can drain excess water rapidly; however, erosion potential associated with water flow is high, especially when the surface vegetation and thin topsoil are removed. When soils are wetted they have high filtration rates, but when dry, water is repelled. This can result in flooding issues during high intensity rainfall events.
- **Organic soils** – Have high organic content, as well as peat accumulation in wet conditions. Occurring in low-lying depressions and former back swamps and valley floors, these soils are poorly-drained, with low aeration and fluctuating water tables.
- **Raw soils** – Lack distinctive topsoil development and are found in areas that are subject to erosion, deposition, rockiness or thermal activity, such as coastal dunes, estuaries and mountainous screes. This soil type is well-drained, with low water-holding capacity and high dry bulk densities. Subject to frequent flooding, excessive drainage and extreme salinity.

WBOPDC's online geographic information system (GIS) mapping tool, MAPI (WBOPDC 2017), identifies land hazards areas in the Maketu/Little Waihi and Pukehina catchments. Those identified in the Maketu/Little Waihi catchment are associated with landslides and general instability, while hazards identified in Pukehina are associated with coastal erosion (refer to Figure 8).

No land-based hazards were identified in the Te Puke and Paengaroa and catchments.

Figure 8 Land hazards identified in the Maketu/Little Waihi and Pukehina catchments, including associated District Plan zoning (WBOPDC 2017)



6.5 Landuse and Future Development

6.5.1 Existing Landuse

Table 5 provides a breakdown of existing land uses within the Te Puke, Paengaroa, Maketu/Little Waihi and Pukehina catchments. The land use types are derived from the urban catchment boundaries and GIS shape files provided by WBOPDC in December 2017.

**Table 5 Breakdown of existing land use types associated with urban settlements in the Eastern Catchments
(Landuse 2012 and WBOPDC GIS shapefiles 2017)**

Land use type	Te Puke		Paengaroa		Maketu/ Little Waihi		Pukehina	
	Area (ha)	% cover	Area (ha)	% cover	Area (ha)	% cover	Area (ha)	% cover
Built-up area	272.2	56.7	25.7	73.7	54.1	40.9	65.5	92.4
Urban parkland/ open space	33.4	7.0	-	-	-	-	-	-
High/ low producing exotic grassland	77.4	16.1	9.1	26.2	68.5	51.8	5.2	7.4
Orchard and other perennial crops	76.3	15.9	-	-	-	-	-	-
Exotic farm shelterbelts	1.0	0.2	-	-	-	-	-	-
Exotic forest	18.5	3.9	-	-	6.9	5.2	-	-
Indigenous forest	0.9	0.2	-	-	1.6	1.2	0.1	0.1
Herbaceous saline vegetation	-	-	-	-	-	-	0.04	0.06
Estuarine open water	-	-	-	-	1.1	0.8	-	-
Total	479.8	100.0	34.8	100.0	132.1	100.0	70.9	100.0
- means the land use type is not represented in the applicable catchment.								

Figures 9 to 12 (and full resolution in Figures F-10 to F-14 attached in Appendix F) depict the existing landuse at the eastern catchments.

Figure 9 Te Puke Catchment - existing landuse (AECOM 2018 mapping), refer Figure F-10 in Appendix F

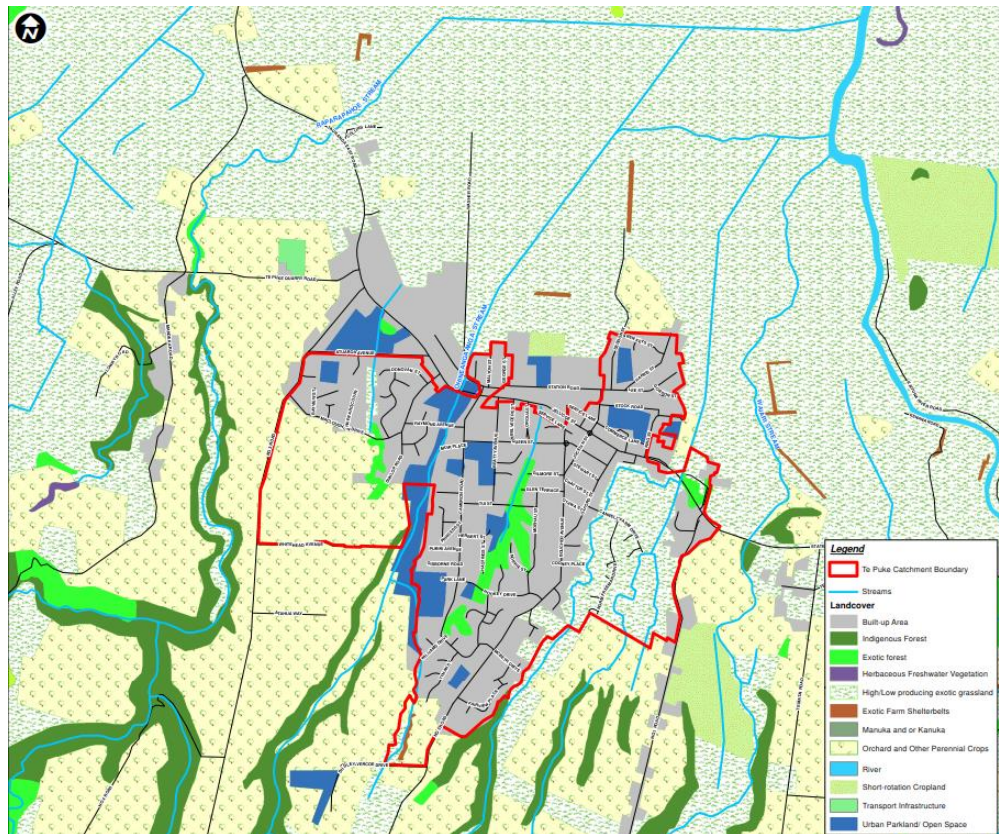


Figure 10 Paengaroa Catchment - existing landuse (AECOM 2018 mapping), refer Figure F-11 in Appendix F

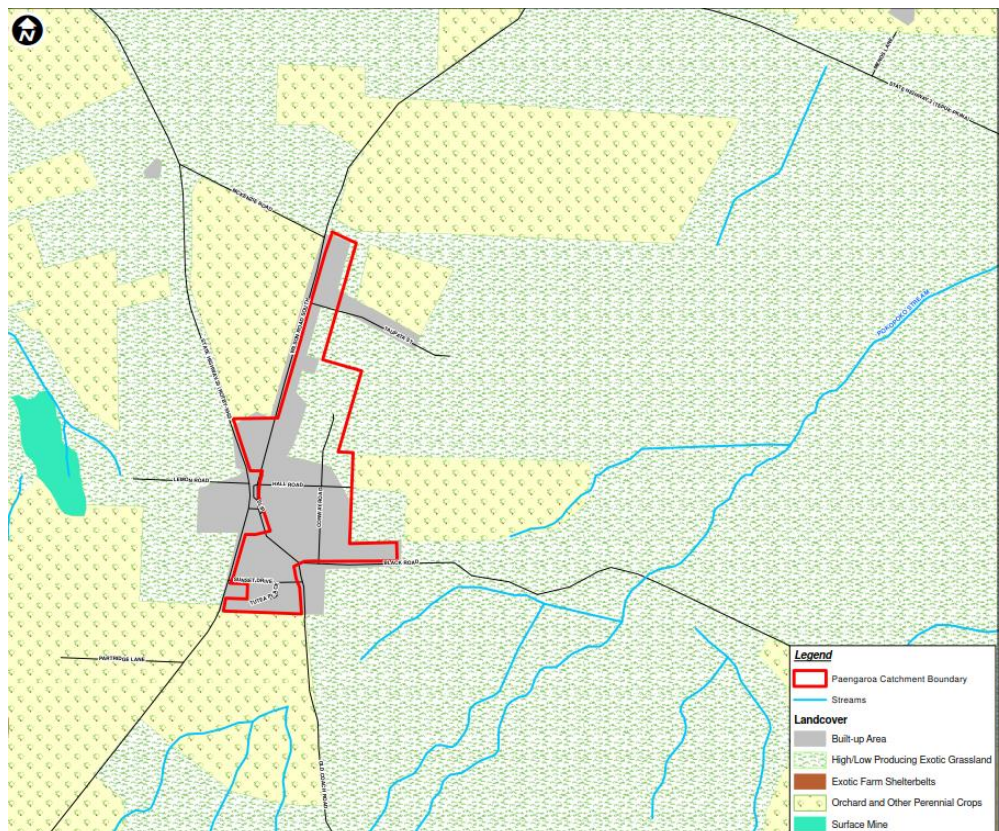


Figure 11 Maketu/Little Waihi Catchment - existing landuse (AECOM 2018 mapping), refer Figure F-12 in Appendix F

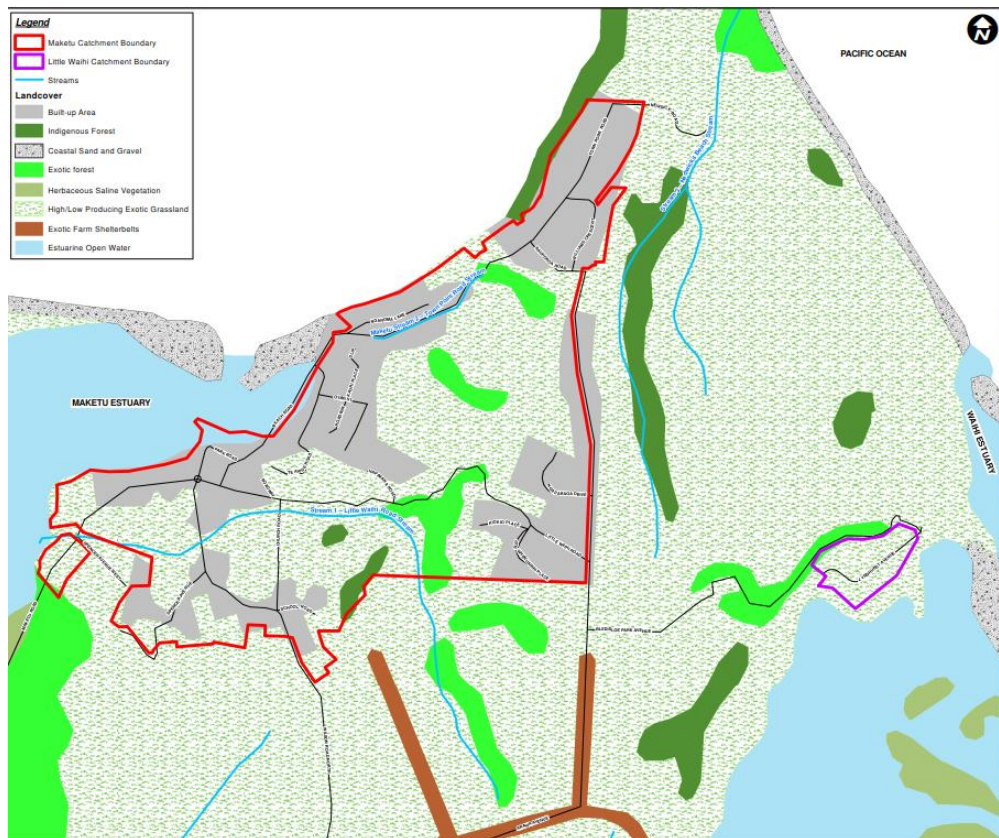
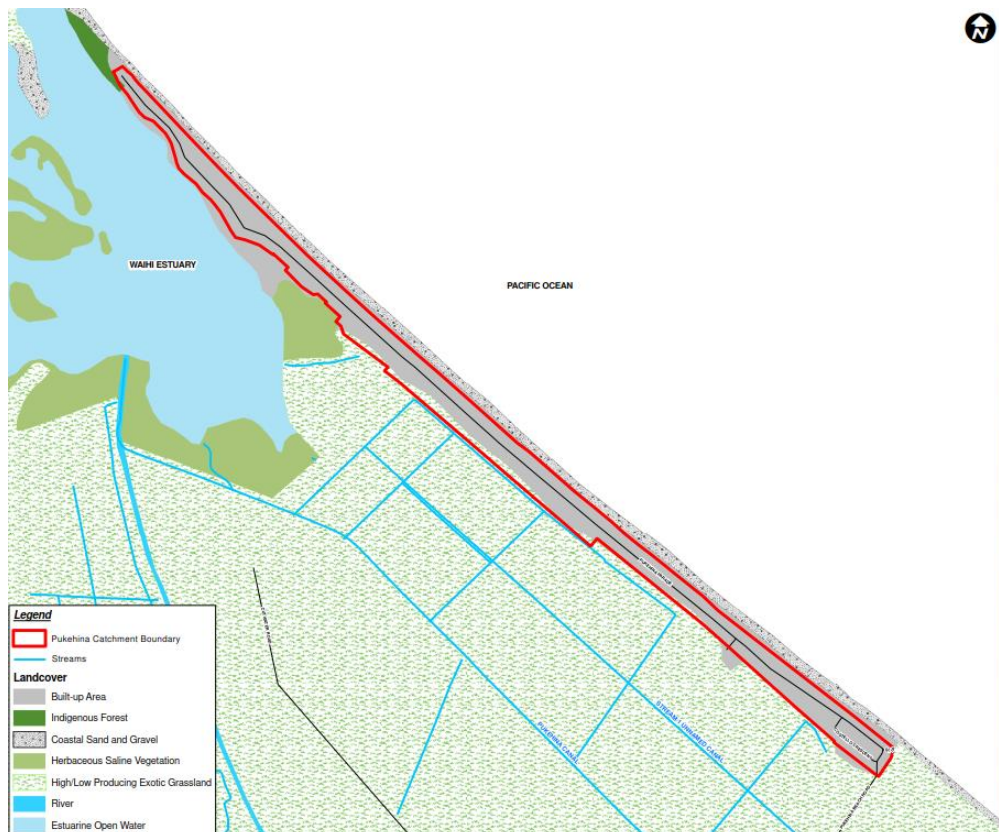


Figure 12 Maketu/Little Waihi Catchment - existing landuse (AECOM 2018 mapping), refer Figure F-13 in Appendix F



6.5.2 Future Development

Future development associated with urban settlements in the eastern catchments is fairly limited due to poor connectivity to municipal utilities, and cultural and environmental constraints (Thiel-Lardon 2013a; 2013b), with Te Puke recognised as the main growth area in the district.

The current land use zones and the potential for future development in each urban catchment are described by the following:

- **Te Puke**
 - Te Puke is predominantly zoned residential, with small pockets zoned for industrial and commercial land uses in the north of the catchment. Residential lots are generally low density, with an average section size of approximately 1,000m² (WBOPDC 2008). Currently, there are limited medium housing (i.e. townhouses and apartments) options in the catchment.
 - Future growth in the catchment is supported by the Te Puke Structure Plan (WBOPDC 2012) and includes Future Urban Growth and Medium Density Housing areas in the western part of the Te Puke catchment (i.e. Areas TP3-1, 3-2, 3-3, 4 and 5, refer to section 2.1.3. and to the WBOPDC Planning Maps in Appendix A1 to A5). This and additional growth in the catchment will be supported by new road developments, upgrades to the sewer network, installation of water mains and upgrades to the stormwater system. Further detail is provided in previous section 5.1.3 of this CMP.
- **Paengaroa:** Paengaroa is predominantly zoned residential, with three industrial and two commercial areas. The catchment is not supported by a municipal sewage network. As such, the development potential in this catchment is considered limited; particularly under requirements of the current district plan.
- **Maketu/Little Waihi:** Maketu and Little Waihi are both zoned residential and Maketu also has some rural-residential zoned land. The catchment has a strong Maori history. As noted in section 5.1.3, the WBOPDC Planning Maps identify three Structure Plan areas within Maketu, one of which is located within the CMP boundary and provides for residential development and associated infrastructure.
- **Pukehina:** Pukehina is zoned residential. The development potential of this catchment is restricted by physical limitations and the sensitive coastal environment. As such, the settlement has no identified areas for future development.

6.6 Receiving Environment Monitoring Results

Various reports have been prepared by local government and private organisations to describe the state of the environments receiving runoff from the urban settlements in the eastern catchments and have generally been completed as part of Bay of Plenty Regional Council's (BOPRC) Natural Environment Regional Monitoring Network (NERMN) programme and independent assessments.

The reports produced between 2010 and 2018 relevant to this CMP are listed below. This also includes ecological assessments undertaken for each urban settlement in 2005 and 2006, and various non-routine stormwater quality sampling events undertaken in the eastern catchments by WBOPDC:

- AECOM. 2015. Water quality, stream and terrestrial ecology assessment. Te Puke wastewater treatment plant resource consent renewal. Auckland: AECOM NZ Limited.
- AECOM. 2018. Freshwater ecological and water quality assessment. Auckland: AECOM NZ Limited. *This report is attached in Appendix G-1 of this CMP.*
- BOPRC. 2011. Coastal and estuarine benthic macrofauna monitoring report 2010. Environmental Publication 2012/03. Whakatane: Bay of Plenty Regional Council.
- BOPRC. 2012. Bathing and shellfish surveillance report 2011/2012. Environmental Publication 2012/09. Whakatane: Bay of Plenty Regional Council.

- BOPRC. 2013. NERMN groundwater monitoring report. Environmental Publication 2013/02. Whakatane: Bay of Plenty Regional Council.
- BOPRC. 2014. Bay of Plenty marine sediment contaminants survey 2012. Environmental Publication 2014/02. Whakatane: Bay of Plenty Regional Council.
- BOPRC. 2015. NERMN estuary water quality report 2014. Environmental Publication 2015/01. Whakatane: Bay of Plenty Regional Council.
- BOPRC. 2017. State and trends in river health (1992-2014) in the Bay of Plenty: Results from 22 years of the NERMN stream bio-monitoring programme. Environmental Publication 2017/01. Whakatane: Bay of Plenty Regional Council.
- Freshwater Solutions. 2012. Western Bay of Plenty comprehensive stormwater consents environmental assessment. Report submitted to CPG.
- WBOPDC. 2009-2017. Non-routine stormwater quality sampling in the eastern catchments.
- WBOPDC. 2018. Eastern catchments stream bank erosion drone survey. Tauranga: Western Bay of Plenty District Council. *This report is attached in Appendix G-2 of this CMP.*
- Wildlands. 2005a. Ecological Assessment of Stormwater Management at Pukehina, Western Bay of Plenty District. Report prepared for Duffill Watts and Kings Limited, Contract Report No. 1081. Tauranga, Wildlands Consultants Limited.
- Wildlands. 2005b. Ecological Assessment of Stormwater Management at Paengaroa, Western Bay of Plenty District. Report prepared for Duffill Watts and Kings Limited, Contract Report No. 1082. Tauranga, Wildlands Consultants Limited.
- Wildlands. 2006a. Ecological Assessment of Stormwater Management at Te Puke. Report prepared for Duffill Watts and Kings Limited, Contract Report No. 1316. Tauranga, Wildlands Consultants Limited.
- Wildlands. 2006b. Ecological Assessment of Stormwater Management at Maketu and Little Waihi. Report prepared for Duffill Watts and Kings Limited, Contract Report No. 1317. Tauranga, Wildlands Consultants Limited.

The results from these reports are summarised in the following subsections and provide an overall indication of freshwater, surface water and groundwater quality, ecology state and sediment quality in the receiving environments of Te Puke and Paengaroa and in the smaller urban settlements (Maketu/Little Waihi and Pukehina). Reference to the relevant reports (as listed above) is provided in the subsection heading.

6.6.1 Groundwater Monitoring

Groundwater monitoring was undertaken at Te Puke and Paengaroa. There was no groundwater monitoring information recorded for Maketu/Little Waihi and Pukehina catchments in BOPRC monitoring programme.

6.6.1.1 NERMN Groundwater Monitoring, Te Puke (BOPRC 2013)

As part of their monitoring programme BOPRC undertakes quarterly groundwater monitoring at various locations within the eastern catchments. This includes groundwater quality monitoring at four existing and three discontinued bores within the eastern catchments (Figure 13).

Samples were tested for enterococci, *E. coli*, heavy metals, nitrates, pH and temperature. Results were compared against Drinking Water Standards for New Zealand (MoH 2008), ANZECC (2000) guidelines and anthropogenic nitrogen levels (Daughney & Reeves 2005).

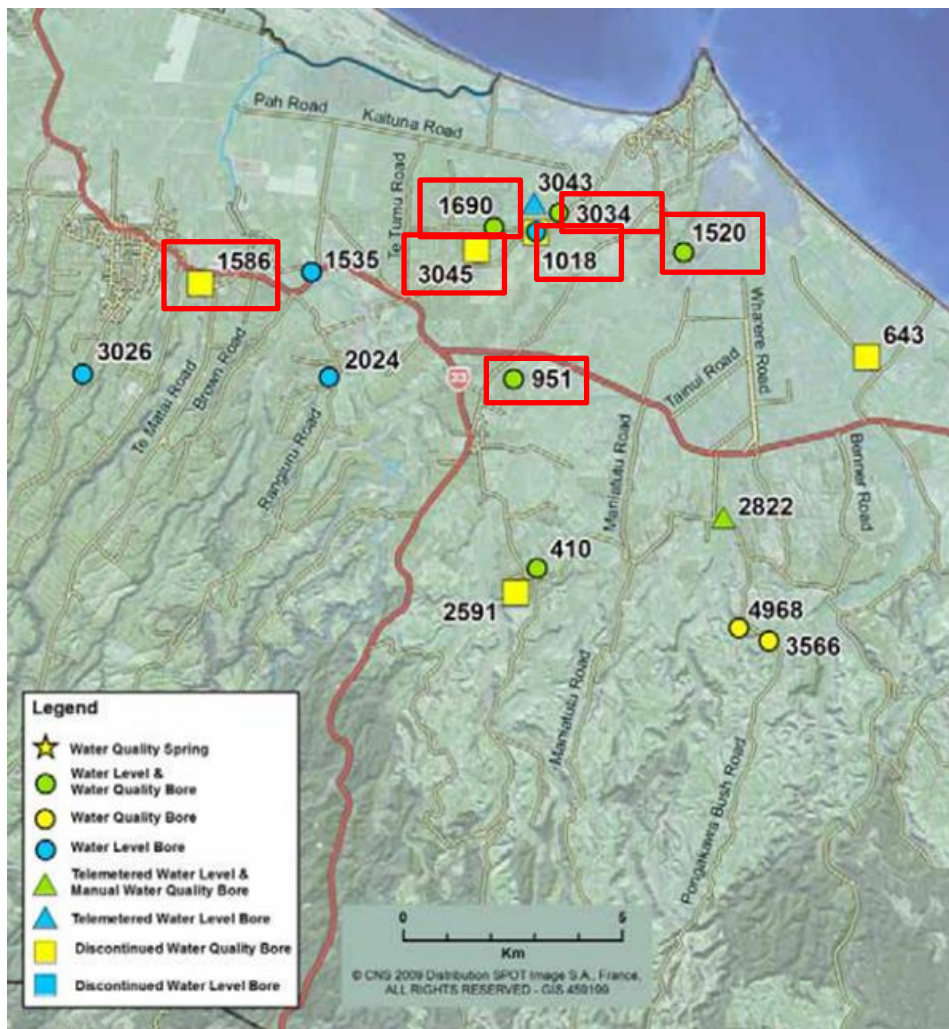
This report (BOPRC 2013 – refer to section 6.6) summarises groundwater quality results recorded at these sites from 1980 to 2012. Results applicable to the seven existing and discontinued water quality bore holes in the eastern catchments are summarised by the following:

- Median values for parameters tested in all bores were below Ministry of Health (MoH) health-related trigger levels for drinking water (MoH 2008), except for bores 951, 1690 in which median values for manganese exceeded trigger levels.

- Bores 1520, 3034 and 3045 recorded median pH levels that were above MoH 'aesthetic value' trigger levels for drinking water (MoH 2008). Bores 951, 1018, 1586 and 1690 had median values exceeding 'aesthetic value' trigger levels (MoH 2008) for pH, iron and manganese.
- Median nutrient values were below ANZECC (2000) trigger levels at all bore sites.

Groundwater quality associated with these bores has shown little to no change over time.

Figure 13 Existing and discontinued groundwater quality bores (in red boxes) in the eastern catchments (BOPRC 2013)



6.6.2 Freshwater Monitoring

6.6.2.1 Water Quality, Stream and Terrestrial Ecology Assessment, Te Puke (AECOM 2015)

Surface water quality and stream ecology were assessed at four locations in Waiari Stream (refer to Figure 14) and Kaituna River in 2015 to support a resource consent application for the operation of the Te Puke Wastewater Treatment Plant (WWTP) (AECOM 2015 – refer to section 6.6). Historical surface and groundwater monitoring results obtained by the WWTP were also analysed and included in the assessment (refer to Figure 14 for bore locations). As reference, these monitoring locations at Kaituna River and Waiari Stream are located on the north east of Te Puke urban stormwater catchment, both upstream and downstream of the catchment.

Figure 14 Water quality and freshwater sampling locations, Te Puke (AECOM 2015)



Table 6 summarises reported surface water and groundwater quality results relevant to the receiving environment in Te Puke. Results include the mean value of stream surface water parameters sampled in winter 2015, and mean values of stream surface water (2012-2015) and groundwater parameters (2007-2015) sampled by the WWTP. Parameters of interest included Total Suspended Solids (TSS), nitrogen and phosphorus levels and faecal coliforms. Results were compared against ANZECC 2000 water quality guideline thresholds for 95% protection of freshwater species and National Policy Statement for Freshwater Management (NPSFM) (MfE 2014) thresholds for 'Attribute State B (Green)'.

Table 6 Summary of mean surface and groundwater quality monitoring results, Te Puke 2015

Monitoring location	TSS (mg/L)	Total nitrogen (mg/L)	Ammoniacal-nitrogen (mg/L)	Nitrate nitrogen (mg/L)	Nitrate-N + Nitrite-N (mg/L)	Dissolved reactive phosphorus (mg/L)	Total phosphorus (mg/L)	Faecal coliforms (cfu/100mL)
AECOM surface water results 2015								
Kaituna River Upstream	<3	0.75	0.018	-	0.6	0.022	0.029	26.5
Kaituna River Downstream	<3	0.77	0.017	-	0.62	0.022	0.030	8
Waiari Stream Upstream	5	1.755	0.0125	1.075	1.13	0.035	0.041	23.5
Waiari Stream Downstream	<3	1.9	0.011	1.70	1.75	0.142	0.142	105
WWTP surface water results 2012-2015								
Waiari Stream Upstream	-	1.305	0.017	1.26	-	0.081	0.08	74.4
Waiari Stream Downstream	-	1.502	0.062	1.416	-	0.166	0.162	76.8
WWTP groundwater results 2007-2015								

Monitoring location	TSS (mg/L)	Total nitrogen (mg/L)	Ammoniacal-nitrogen (mg/L)	Nitrate nitrogen (mg/L)	Nitrate-N + Nitrite-N (mg/L)	Dissolved reactive phosphorus (mg/L)	Total phosphorus (mg/L)	Faecal coliforms (cfu/100mL)
Bore 1	-	2.34	2.73	-	-	0.03	-	477
Bore 2	-	3.35	2.97	-	-	0.12	-	59
Bore 3	-	4.52	0.29	-	-	0.03	-	25
Bore 4	-	2.28	0.45	-	-	0.03	-	570
ANZECC (2000) trigger level 95% protection	-	0.614	0.9	0.7	-	0.01	0.033	-
NPSFM (MfE 2014) thresholds	-	-	>0.03 & ≤0.24*	>1.0 & ≤2.4*	-	-	-	412**
* Attribute State B (Green) (annual median) for rivers, threshold for 95% species protection level. ** Attribute State B (Green), Level determined using the USEPA ratios of 126 E. coli per 200 faecal coliforms (for freshwater). This was indicative only and is used for comparative purposes only. Bold denotes results which are at or above ANZECC (2000) trigger levels and calculated NPSFM (MfE 2014) 'Green' attribute state thresholds faecal coliforms. - means no data were available for the parameter.								

The water quality results analysed in this report (AECOM 2015 – refer to section 6.6) indicate the following:

- Mean nitrogen and phosphorus levels recorded at upstream and downstream locations in Waiari Stream and Kaituna River exceeded ANZECC (2000) thresholds during AECOM and WWTP monitoring events, particularly in regards to total nitrogen and dissolved reactive phosphorus.
- Mean faecal coliform counts recorded at all stream locations were below the calculated 'Attribute State B (Green)' threshold in all cases.
- Mean nitrogen and phosphorus levels recorded by the WWTP from groundwater bores also exceeded ANZECC (2000) in most instances.
- Mean faecal coliform counts recorded in Bores 1 and 4 were above the calculated 'Attribute State B (Green)' threshold.

Table 7 summarises reported results for instream physico-chemical properties sampled in Waiari Stream and Kaituna River in 2015. Results were compared against ANZECC (2000) water quality guideline thresholds for lowland streams in New Zealand. Dissolved oxygen (DO) levels were compared against NPSFM (MfE 2014) thresholds for 'Attribute State A'.

Table 7 Summary of physico-chemical results, Te Puke 2015

Monitoring location	pH	Conductivity (µS/cm)	Salinity (ppt)	Temperature (°C)	Dissolved oxygen (% saturation)	Dissolved oxygen (mg/L)	Turbidity (NTU)
Kaituna River Upstream	6.8	162.8	0.08	12.2	110.7	11.9	<7
Kaituna River Downstream	6.6	164.9	0.08	11.5	100.9	11.0	<7
Waiari Stream Upstream	6.6	74.1	0.03	12.8	99.5	10.5	<7
Waiari Stream Downstream	6.5	83.2	0.04	12.8	98.2	10.4	<7

Monitoring location	pH	Conductivity (µS/cm)	Salinity (ppt)	Temperature (°C)	Dissolved oxygen (% saturation)	Dissolved oxygen (mg/L)	Turbidity (NTU)
ANZECC* trigger values	7.2 – 7.8	125 – 2,200*	-	21.5	98-105	-	5.6
NPSFM thresholds**	-	-	-	-	-	≥7.5	-
*ANZECC (2000) water quality guideline trigger levels for NZ lowland rivers. ** NPSFM (MfE 2014) 'Attribute State A' 1-day minimum level. Bold denotes results which are at or above ANZECC (2000) trigger levels and NPSFM (MfE 2014) 'Attribute State A' thresholds for dissolved oxygen. - means no data were available for the parameter.							

Where applicable, physico-chemical property results recorded in Waiari Stream and Kaituna River were generally within ANZECC (2000) and NPSFM (MfE 2014) guidelines; however, a number of values were outside of recommended thresholds. These included:

- pH levels at all sample locations which were below lower limit thresholds (ANZECC 2000).
- Conductivity levels in Waiari Stream below lower limit thresholds (ANZECC 2000).
- DO saturation (%) levels at the upstream monitoring location in Kaituna River were above upper limit thresholds (ANZECC 2000).

Table 8 summarises reported results for riparian and stream habitat assessments and instream macroinvertebrate communities sampled at Waiari Stream and Kaituna River monitoring locations in 2015. Riparian and stream habitat was assessed using a scoring and ranking system derived from methods used by the United States Environmental Protection Agency (USEPA 2006). Macroinvertebrate communities were analysed using variants of the Macroinvertebrate Community Index (MCI-sb and QMCI-sb) (Stark 1985; Stark and Maxted 2007).

Table 8 Summary of ecological results, Te Puke 2015

Monitoring location	Physical habitat		Macroinvertebrate community			
	Score	Ranking	MCI-sb score	Quality class	QMCI-sb score	Quality class
Kaituna River Upstream	29	Marginal	<80	Poor	<4	Poor
Kaituna River Downstream	31	Marginal	<80	Poor	<4	Poor
Waiari Stream Upstream	41	Marginal	<120	Good	>6	Excellent
Waiari Stream Downstream	43	Marginal	<100	Fair	<6	Good

The ecological results obtained in 2015 (AECOM – refer to section 6.6) indicated the following:

- Riparian and stream habitat quality at both Waiari Stream and Kaituna River was considered to be in 'Moderate' condition.
- The ecological health of Kaituna River was considered to be 'Poor'.
- The ecological health of Waiari Stream was considered to be 'Fair' to 'Excellent'.

Overall results indicate that the quality of surface water in Kaituna River and Waiari Stream, and groundwater is compromised by high nutrient levels and high faecal counts. Though the physico-chemical properties of the receiving environments were generally supportive of aquatic life, sampled macroinvertebrate communities indicated impacts from pollution, particularly Kaituna River. Results were considered to be typical of low lying streams and rivers draining predominantly agricultural catchments.

6.6.2.2 State and Trends in River Health, Te Puke and Paengaroa (BOPRC 2017)

As part of their NERMN programme, BOPRC undertakes annual ecological monitoring in the region's streams. This includes three stream sites associated with the Te Puke urban catchment and one downstream of Paengaroa in which macroinvertebrate communities were sampled and analysed.

This report (BOPRC 2017 – refer to section 6.6) summarised results obtained between 1992 and 2014. The monitoring sites associated with urban settlements in the eastern catchments included:

- **Te Puke:**
 - Waiari Stream tributary (monitoring site BOP_NERM_001);
 - Ohineangaanga Stream (monitoring site BOP_NERM_002); and
 - Raparapahoe Stream (monitoring site BOP_NERM_005).
- **Paengaroa:**
 - Kaikokopu Canal (monitoring site BOP_NERM_003) – further downstream of Pokopoko Stream, located north east of Paengaroa urban catchment.

Average values for all metrics recorded at each site associated with the Te Puke catchment were generally comparable to corresponding averages recorded for all streams across the region within agricultural catchments. Biological indices and percentage EPT taxa (by number) indicated these streams were considered to be in 'Fair' to 'Good' ecological health. Results for the Waiari tributary site indicated positive trends of minor significance in species richness and number of EPT taxa between 1992 and 2014.

Average values for metric recorded in Kaikokopu Canal, located downstream of the Paengaroa catchment, were generally below those recorded for all streams across the region within agricultural catchments. Biological indices and percentage EPT taxa (by number) indicated this stream was considered to be in 'Poor' to 'Fair' ecological health.

6.6.2.3 Freshwater Ecological and Water Quality Assessment, Eastern Catchments (AECOM 2018)

Ecological and water quality assessments were undertaken in 2018 on behalf of WBOPDC to obtain more recent information regarding the condition of key streams potentially impacted by the urban settlements of Te Puke, Paengaroa, Maketu/Little Waihi and Pukehina (AECOM 2018 – refer to section 6.6). This report is attached in Appendix G-1 of this CMP.

Table 9 summarises ecological results from freshwater environments receiving discharge from the four urban settlements. Ecological values were assessed using Rapid Habitat Assessments (RHA) methodologies (Clapcott 2015) and a variant of the Macroinvertebrate Community Index (MCI-sb) (Stark 1985; Stark and Maxted 2007). Water quality results were compared against ANZECC (2000) water quality guideline thresholds for lowland streams in New Zealand and NPSFM (MfE 2014) 'Attribute State D (Orange)' and 'Attribute State E (Red)' for *E. coli*.

Monitoring site locations are depicted in Figures F-6 to F-9 (attached in Appendix F of this CMP). Sites locations have been chosen to assess water quality upstream and downstream of the catchment. Waiari Stream has been chosen as reference and the monitoring location is situated upstream of the Te Puke Waste Water Treatment Plant (refer to section 6.6.2.1).

Full details of parameters analysed for and results is provided in Appendix G-1 of this CMP. Locations of monitoring sites are depicted in Figures F-6 to F-9 attached in Appendix F of this CMP.

Table 9 Summary of the ecological and water quality results, AECOM 2018

Parameters of interests		Biological		Physico-chemical	Water quality		
Trigger level source		RHA score	MCI-sb score & % EPT taxa	NPSFM (2014) & ANZECC (2000)	ANZECC (2000)*	NPSFM (2014)**	
Waterway	Site ID	Habitat value	Stream health	Below triggers	Heavy metals below triggers	<i>E. coli</i> below 'Orange' state	<i>E. coli</i> below 'Red' state
Waiari Stream	TP 4 (ref)	MODERATE	FAIR-GOOD	x	✓	✓	✓
Raparapahoe Stream	TP 1A	MODERATE	FAIR-GOOD	x	✓	x	✓
	TP 1B	GOOD	FAIR-GOOD	x	✓	x	x
Ohineangaanga Stream	TP 2A	GOOD	FAIR-GOOD	✓	✓	x	✓
	TP 2B	GOOD	POOR-FAIR	x	✓	x	x
Te Puke Stream 3 – Cannell Farm Drive waterway	TP 3A	MODERATE	POOR-FAIR	x	✓	x	x
	TP 3B	POOR	POOR	✓	✓	x	x
Pokopoko Stream	Pa 1A	MODERATE	FAIR-GOOD	x	✓	x	x
	Pa 1B	POOR	POOR-FAIR	x	✓	x	x
Maketu Stream 1 – Little Waihi Road Stream	Ma 1A	MODERATE	POOR-GOOD	✓	✓	x	✓
	Ma 1B	POOR	POOR	✓	✓	x	x
Maketu Stream 2 – Town Point Road Stream	Ma 2A	POOR	POOR	x	x	x	x
	Ma 2B	POOR	n/a	x	x	x	x
Maketu Stream 3 – Newdicks Beach Stream	Ma 3A	MODERATE	POOR-FAIR	✓	✓	x	x
	Ma 3B	GOOD	POOR-FAIR	✓	x	x	x
Pukehina Stream 1 – unnamed canal	Pu 1A	MODERATE	POOR	x	✓	x	✓
	Pu 1B	POOR	POOR-FAIR	x	x	x	x
Key: ✓ Recorded levels are below water quality guidelines x Recorded levels are above water quality guidelines *ANZECC (2000) trigger levels for freshwater species protection (95%) **NPSFM (MfE 2014) threshold level for the <i>E. coli</i> 'Attribute State D (Orange) and 'Attribute State E (Red) for human health for recreation							

Overall results indicated the following:

- The habitat value of the main receiving freshwater environments in the eastern catchments was considered to be of 'Poor' to 'Good' value, with streams associated with the Te Puke catchment generally providing the highest habitat value.
- Based on instream macroinvertebrate community assemblages, the health of sampled waterways were considered to be 'Poor' to 'Good'. Waterways in the Maketu subcatchment were considered to be in the worst ecological state.

- At least one waterway per urban catchment recorded physico-chemical levels that were above ANZECC (2000) and NPSFM (MfE 2014) water quality guidelines. Two streams in the Maketu catchment and one in the Pukehina catchment recorded heavy metal levels that were above ANZECC (2000) guidelines.
- All sampled waterways, except the reference site in Waiari Stream (Te Puke), recorded *E. coli* levels that were above NPSFM 'Attribute State D (Orange)' trigger levels (MfE 2014). Seventy percent (70%) of sampled stream recorded *E. coli* levels that were above NPSFM 'Attribute State E (Red)' trigger levels.

Overall, results indicated that sampled waterways were generally considered to be in 'Moderate' to 'Poor' condition; suggesting that most, if not all, urban waterways within eastern catchments have been negatively influenced in some way by agricultural runoff and land use intensification in the district.

6.6.2.4 Stream Bank Erosion Drone Survey, Eastern Catchments (WBOPDC 2018)

In 2018 WBOPDC (refer to section 6.6) undertook a series of drone surveys to assess stream bank erosion in a number of streams within the Te Puke, Paengaroa, Maketu/Little Waihi and Pukehina eastern catchments (also assessed for ecological value and water quality in separate investigations; refer to previous section 6.6.2.3). A copy of this report is provided in Appendix G-2 of this CMP.

Based on predefined criteria methodology provided by AECOM for assessing the degree of erosion present, results obtained within each urban settlement are summarised below:

- **Te Puke:**
 - Of the four catchments, the streams assessed in Te Puke had the highest frequency of observed erosion; particularly Ohineangaanga and Raparapahoe streams in which approximately 50% of the surveyed stream reach was subject to 'Moderate' levels of erosion. Erosion rates were generally higher in upstream sections of surveyed stream reach, located south of the urban catchment.
 - The majority of Ohineangaanga stream passing through Te Puke catchment was assessed as presenting moderate to severe erosion. The majority of the unnamed stream joining Cannel Farm Drive Waterway downstream of TP3A (upstream of TP3B) passing through the catchment presented no erosion with a small section around Cooney Place and Norm Freeman Drive presenting moderate/severe erosion. Cannel Farm Driveway waterway was assessed only from the railway line and did not appear to present any significant sign of erosion.
 - Only the downstream section of the Waiari Stream was assessed for the purpose of the stream bank assessment so no information was provided for the upstream part of the stream prior TP4.
 - Nine assets (outlet or outfall pipes) were identified in Ohineangaanga Stream and the Cannell Farm Drive Waterway, two of which were council-owned. All of which were associated with erosion.
- **Paengaroa:**

One stream, Pokopoko Stream, was surveyed for this catchment. The stream bank of the surveyed reach was largely homogenous, with 'slight to no erosion'. Small areas of 'Moderate' erosion were observed in the lower survey reach.
- **Maketu/Little Waihi:**

Dense vegetation in the upstream gullies of surveyed streams and high stream volumes in downstream reaches meant that streams in these catchments could not be properly assessed. The parts of the streams that could be surveyed were found to be largely unaffected by erosion; however, a small section in the downstream extent of the Little Waihi Road Stream showed 'Moderate' erosion. Little Waihi sub-catchment was not assessed as part of the 2018 stream bank assessment due to the fact that no stream is present within the sub-catchment.
- **Pukehina:**

The surveyed waterway was a low velocity farm drainage channel, as such 'slight to no erosion' was observed.

Table 10 provides a summary of this streams bank assessment, locations are depicted in Figures F-6, F-7, F-8 and F-9 provided in Appendix F of this CMP.

For further details, refer to the full methodology and report results in Appendix G-2 of this CMP.

Table 10 Eastern Catchments Stream Bank Erosion Summary 2018 (ref WBOPDC 2018)

Erosion	Te Puke				Pae.	Maketu			Puk.
	TP1	TP2	TP3	TP4	Pa1	Ma1	Ma2	Ma3	Pu1
Total Length Assessed (m)	4459	5012	4517	3014	3106	2062	739	1839	4005
No/slight Erosion length (m)	2125	1835	4012	2858	2924	1804	739	1839	4005
Moderate Erosion length (m)	971	1944	206	156	182	259	0	0	0
Severe Erosion length (m)	1364	1232	299	0	0	0	0	0	0
% erosion (Moderate & Severe)	52.3	63.4	11.2	5.2	5.9	12.5	0.0	0.0	0.0
% severe (%)	30.6	24.6	6.6	0.0	0.0	0.0	0.0	0.0	0.0

6.6.3 Marine Environment Monitoring

6.6.3.1 Coastal and Estuarine Benthic Macrofauna Monitoring, Maketu and Little Waihi (BOPRC 2011)

As part of their monitoring programme BOPRC undertakes annual monitoring of the benthic macrofauna communities in Maketu and Waihi estuaries to assess potential environmental changes in intertidal environments. This report (BOPRC 2011 – refer to section 6.6) summarised results from 1990 to 2010.

Results from four monitoring sites in Maketu Estuary indicate that results from across the years regarding species composition and sediment parameters are highly varied largely as a response to dynamic tidal processes. This included changes in sand erosion, deposition and migration caused by shifting channels and sand migration into the estuary. As such, the ability for macrofaunal and sediment data to detect catchment related water quality issues is severely limited and it was recommended monitoring at this location be suspended.

Waihi Estuary is a more stable environment. Although macrofauna species composition has shown some variation since 1990, diversity has remained relatively stable with no consistent trends over time. The number of individuals present has shown some decline, with bivalves and polychaetes (worms) dominant. No changes in sediment particle size were observed; however, a small decrease in Total Organic Carbon (TOC) was recorded. Overall, the changes observed are considered to be a result of estuarine processes, within macrofauna communities comparable to other sites in the region and as result, were not considered detrimental.

6.6.3.2 Bathing and Shellfish Surveillance, Te Puke, Maketu/Little Waihi and Pukehina (BOPRC 2012)

BOPRC undertakes annual water quality testing (October to March) at popular recreational (bathing) sites and shellfish beds in the region, with the aim of identifying potential risks to public health from faecal contamination. This includes water quality monitoring at marine sites adjacent to Maketu/Little Waihi and Pukehina, and freshwater sites adjacent to Te Puke and Pukehina. Shellfish testing was not undertaken in relation to the eastern catchments.

This report (BOPRC 2012 – refer to section 6.6) summarised water quality results obtained from these location during the 2011/2012 bathing season and makes comparison with past results (2008-2012).

Samples were tested for enterococci counts in marine environments and *E. coli* counts for freshwater environments. Results were compared against New Zealand microbiological water quality guidelines for recreational waters and the general condition of water quality at each site was assessed by calculating a 'Suitability for Recreation Grade' (MfE/MoH 2003). In addition, the 'Red' (unsafe mode,

'action') threshold levels (MfE/MoH 2003) was used to indicate were waters posed an unacceptable health risk to recreational water users.

Table 11 summarises the water quality results for monitoring sites within environments that are likely to receive runoff from urban settlements within the eastern catchments.

Table 11 Summary of water quality testing undertaken within the eastern catchments, BOPRC 2011/2012

Catchment	BOPRC site no.	Suitability for Recreation Grading	% samples below the 'Red' (Action Mode) 2011/2012	% samples below the 'Red' (Action Mode) 2008-2012	'Red' (Action Mode) thresholds
Marine environment					
Maketu	160017	Good	100	100	Enterococci counts >280cfu/100mL
Little Waihi	160016	Fair	100	97	
Pukehina	160170	Very Good	100	100	
Freshwater environment					
Te Puke	160129	Fair	90	95	<i>E. coli</i> counts >550 cfu/100mL
Pukehina	110030	Poor	89	93	

Notes: NPSFM (MfE 2014) threshold level for the E. Coli 'Red' Attribute state for human health for recreation is > 260 cfu/100mL. Threshold level for the E-coli 'Orange' Attribute state for human health for recreation is > 1300 cfu/100mL.

Results indicate that most sites relevant to the eastern catchments are generally suitable for bathing, based on MfE/MOH 2003, however, when comparing the results against the NPSFM (MfE 2014) which are more conservative (refer notes above), results indicate that some sites may not be as suitable for recreation purposes. Overall, Associated Suitability for Recreation Grades highlights that there is a higher risk to bathers using river and stream sites, than marine sites.

6.6.3.3 Marine Sediment Contamination, Maketu and Little Waihi (BOPRC 2014)

As part of their monitoring programme BOPRC undertakes regular monitoring of marine sediments at various locations in the region, including annual monitoring of Maketu and Waihi estuaries. Sediments were tested for heavy metal concentrations and TOC, and compared against ANZECC (2000) interim sediment quality guidelines (ISQG).

This report (BOPRC 2014 – refer to section 6.6) summarised results obtained during the 2012 monitoring event. Results from Maketu Estuary and Waihi Estuary are summarised below:

- Results for all tested heavy metal concentrations were below ISQG low level triggers and concentrations have remained relatively stable since 2006.
- TOC ranged between 0.15g/100g and 0.19g/100g in Maketu Estuary and measured 0.33g/100g in Waihi Estuary. This indicates that both estuaries are relatively sensitive to deposition of fine sediment and contaminants as indicated by the relatively high mud content.

6.6.3.4 NERMN Estuary Water Quality, Maketu and Little Waihi (BOPRC 2015)

As part of their NERMN programme BOPRC undertakes bi-monthly monitoring of estuarine water quality across the region, including estuaries associated with Kaituna River, Maketu and Little Waihi. Samples were tested for nutrient concentrations, physico-chemical properties, *E.coli*, faecal coliforms, enterococci and chlorophyll levels. Results were compared against ANZECC (2000) guidelines for slightly disturbed estuarine ecosystems.

This report (BOPRC 2015 – refer to section 6.6) summarised results obtained between 1990 and 2014. Those relevant to the eastern catchments are provided below:

- Kaituna River estuary (monitoring site BOP150020):
 - Significant decreasing trend observed for turbidity and chlorophyll-a, which appears to be partly explained by a reduction in cyano-bacterial blooms in Kaituna River.

- A significant increase in dissolved reactive phosphorus concentrations observed, while ammonium nitrogen (NH₄-N) levels show a significant decrease. These trends were associated with lower uptake of DRP by phytoplankton in the estuary and improved quality of discharge coming from a local business (Auckland Farmers Freezing Company - AFFCO) upstream.
- Significant increasing trends in total oxides of nitrogen (TOX-N) and enterococci levels were observed and were generally thought to reflect increasing agricultural intensity in the catchment.
- Maketu Estuary (monitoring site BOP150005):
 - Only one meaningful significant trend was observed over the period 1990 to 2013: increasing TSS. Potential sources were not identified and could have been attributed to a number of factors; however, similar trends were not observed in the Kaituna River estuary, suggesting the increase is a result of inflows from other sources.
 - Average turbidity levels (2006-2011) were below the ANZECC (2000) trigger level.
 - Average ammonium concentrations were above the ANZECC (2000) trigger levels; the highest average and highest maximum ammonium concentrations in eastern catchments estuaries (2006-2011).
 - Strong recent increases in total nitrogen were observed, with average concentrations of total oxides of nitrogen above ANZECC (2000) trigger levels.
 - Observations of the macro-algae *Gracilaria chilensis* signalled potential increased eutrophication in the upper estuary.
- Waihi Estuary (monitoring site BOP150006):
 - Average levels of indicator bacteria were the highest amongst eastern catchments estuaries and trends in all faecal indicators showed significant increases over the period 1990 to 2014. Pongakawa Stream provides the largest freshwater inputs into the estuary and had shown little change in indicator bacterial levels over this period, with increases in faecal contamination.
 - Increases in ammonium were observed between 2005 and 2010; however, trends were not significant. This could be potentially attributed to an increase in farming intensity in the catchment, or other sources of contamination.
 - Average turbidity levels (2006-2011) were below the ANZECC (2000) trigger level.
 - Average concentrations of total oxides of nitrogen above ANZECC (2000) trigger levels.
 - Observations of the macro-algae *Gracilaria chilensis* signalled potential increased eutrophication in the upper estuary.

6.6.4 Ecological Monitoring

Ecological Assessments were undertaken by Wildlands between 2005 and 2006 at all eastern catchments. Assessments aimed to provide a description of the vegetation, habitat types and species presence, and identify any areas of ecological significance. Summary of these assessments is provided in sections 6.6.4.1 to 6.6.4.4.

In addition, Freshwater Solutions Ltd also undertook ecological assessments combined with sediment and stormwater monitoring in 2012 at Te Puke; this is summarized in section 6.6.4.5.

A combined freshwater quality and ecological assessment was undertaken by AECOM in 2018 and results are provided in previous section 6.6.2.3 (and full report attached in Appendix G-1 of this CMP).

6.6.4.1 Ecological Assessment, Pukehina (Wildlands 2005a)

Ecological assessments were undertaken in relation to the Pukehina catchment to assess inflowing and receiving waterways (Wildlands 2005a – refer to section 6.6).

The assessment identified nine habitat types within the study area, mainly comprised of pasture and residential/commercial areas. Thirty-six native and 66 introduced vascular plant species were identified within Pukehina, including two dune species which were classified as 'Chronically Threatened' (de Lange et al. 2004). The study area also supported a number of common native bird and fish species. These included tui (*Prosthemadera novaeseelandiae*), fantail (*Rhipidura fuliginosa*), inanga (*Galaxias maculatus*) and short-finned eel (*Anguilla australis*).

Significant areas were identified in the estuary, freshwater wetlands, dunes and coastal cliffs due to the extent of loss and modification of these habitat types in the district. Waihi Estuary, and associated wetlands and coastal dunes, were identified as ecological constraints on potential stormwater management development in the area.

6.6.4.2 Ecological Assessment, Paengaroa (Wildlands 2005b)

Ecological assessments were undertaken in relation to the Paengaroa catchment to assess inflowing and receiving waterways (Wildlands 2005b – refer to section 6.6). The assessment identified five habitat types within the study area, mainly comprised of pasture and ungrazed grassland. Seven non-threatened native and 24 introduced vascular plant species were identified within the study area. The study area also supported a number of common native bird and fish species, including inanga and short-finned eel.

No significant habitat was identified; however, it was noted that the freshwater receiving environment is likely to be impacted by agricultural practices in the catchment and potential stormwater contamination from Paengaroa's urban settlement. Few ecological constraints regarding the development of a proposed stormwater detention system in the catchment were identified and opportunities for ecological enhancement were understood to be limited.

6.6.4.3 Ecological Assessment, Te Puke (Wildlands 2006a)

Ecological assessments were undertaken in relation to the Te Puke catchment to assess inflowing and receiving waterways (Wildlands 2006a – refer to section 6.6). The assessment identified eight habitat types within the study area, mainly comprised of urban built-up and open space areas. Six streams and waterways were identified as receiving environments in the study area. Few indigenous vascular plant species were observed and all were common species. A large number of non-native vascular plants were observed, including various weed species. Giant kokopu (*Galaxias argenteus*) were observed during fish surveys, as well as inanga and short-finned eel. Banded kokopu was classified as 'Chronically Threatened' species (Hitchmough et al. 2002).

The study area was highly modified, with no remaining examples of indigenous vegetation; however, some streams did provide habitat for a species of threatened native fish. There was no significant habitat identified in the study area. Due to their capacity to support native species, waterways in the Te Puke were considered to be of 'moderate' significance and presenting a potential ecological constraint on stormwater management development in the area. Enhancement opportunities included riparian margin and instream habitat restoration. Various opportunities to create detention ponds and wetland areas were also identified. Recommendations and opportunities are listed in section 11.2 of this CMP.

6.6.4.4 Ecological Assessment, Maketu/Little Waihi (Wildlands 2006b)

Ecological assessments were undertaken in relation to the Maketu/Little Waihi catchment to assess inflowing and receiving waterways (Wildlands 2006b – refer to section 6.6). The assessment identified nine habitat types in Maketu/Little Waihi. Few indigenous vascular plant species were observed and all were common species. A large number of non-native vascular plants were observed, including some weed species. The study area also supported a number of common native bird and fish species, including tui, silvereye (*Zosterops lateralis*), common bully (*Gobiomorphus cotidianus*) and short-finned eel. Giant kokopu, a threatened native species, was also recorded in the waterway discharging at Newdicks Beach.

With the exception of pohutukawa (*Metrosideros excelsa*) lined coastline, the study area was recognised as being highly modified, with limited remaining indigenous vegetation. The neighbouring estuaries (Maketu and Waihi) receive stormwater from the urban catchments and were considered areas of very high ecological value. The estuaries and pohutukawa treeland along the coast are considered highly significant features. Due to their capacity to support native species, waterways in

the study area were considered to be of 'moderate' significance. These were identified as ecological constraints for potential stormwater management development in the area. Enhancement opportunities included restoration of gullies and estuary margin, possum control in pohutukawa treeland and instream habitat restoration. Opportunities were also identified for the creation of wetland areas. Recommendations and opportunities are listed in section 11.2 of this CMP.

6.6.4.5 Ecological and Stormwater Assessment, Te Puke (Freshwater Solutions 2012)

Freshwater assessments were undertaken in two tributaries (western and eastern) of Ohineangaanga Stream in relation to the Te Puke urban catchment as part of an environmental assessment undertaken in the wider catchment (Freshwater Solutions 2012 – refer to section 6.6).

Investigations included assessment of stormwater and water quality, sediment quality and biological communities. Stormwater samples were also collected at selected stormwater discharge points and receiving environments during a significant rain event. Samples were tested for total heavy metals, total petroleum hydrocarbons (TPH) and polyaromatic (PAH), polychlorinated biphenyls (PCB) and physico-chemical properties. Results were compared against ANZECC (2000) guidelines.

Instream sediments were tested for total heavy metals, TPHs, PAHs and PCBs and compared to the National Oceanic and Atmospheric Administration (NOAA 1999) and ANZECC (2000) guidelines. Ecological surveys included habitat assessments and analysis of biological communities using variants of the MCI and QMCI (Stark 1985).

This report summarised results from surveys undertaken in 2010. The results from Ohineangaanga Stream tributaries in Te Puke are described below:

- **Water quality:** Recorded heavy metal concentrations which exceeded ANZECC (2000) guidelines for 90% species protection in some instances. The results indicated that elevated concentrations are likely a result of stormwater discharges from the urban catchment and may have been compromising the ecological potential of the Ohineangaanga Stream tributaries. No PAH, PCB or TPH were recorded.
- **Sediment quality:** Concentrations of arsenic were above ANZECC (2000) recommendations, while measures for zinc and copper were above the NOAA (1999) 'Effects Range Low' guideline. This suggested that stormwater discharges from Te Puke's urban catchment may be having a detectable effect on sediment quality downstream.
- **Ecological:** Ohineangaanga Stream tributaries are a highly modified waterbodies with degraded instream and riparian habitat. Upstream reaches provided significantly better habitat compared to stream reach downstream of the urban catchment. The stream was found to support a benthic macroinvertebrate community of relatively low diversity (mean 18 taxa), with moderate numbers of sensitive EPT taxa (mean 8 taxa). MCI and QMCI scores indicated 'Poor' to 'Fair' quality (Stark and Maxted 2007). Upstream sites scored higher than downstream sites. This was reflected in significantly poorer habitat quality, and water and sediment quality. Ohineangaanga Stream tributaries were also found to have moderate values for native fish.

6.6.5 Stormwater Monitoring, Eastern Catchments, Various dates (WBOPDC 2009-2017)

A number of non-routine stormwater sampling events were undertaken by WBOPDC (2009-2017 – refer to section 6.6) to obtain a snapshot of water quality parameters in stormwater discharge and receiving environments within each catchment. Details of the monitoring events and locations are as follows:

- **Te Puke:**
 - Stream samples at the 'SH2 Bridge Te Puke' site and 'Kaituna River Site' on 11, 12 and 15 September 2008.
 - Stormwater discharge samples from an outlet located at 33 King Street (lower catchment, on the north eastern side of the catchment) during rainfall events on 5 November 2009 and 2 February 2010, including 'first flush' and 'second sample' collection.
 - A one-off stormwater discharge sample at an outlet located between 54 and 56 Oxford Street (near Cannell Farm Drive Waterway, on the eastern side of the catchment) on 5 April 2017.
- **Paengaroa:** A one-off stormwater discharge sample at an outlet located at 15 Taupata Street on 25 August 2016.
- **Maketu:** A one-off stream sample at an unknown location on the 2 March 2010 therefore not relevant as cannot be assessed.
- **Pukehina:** Stormwater discharge samples from an outlet located at 340 Pukehina Beach Road (upper catchment, on the far eastern side of Pukehina) on the 12 August 2014, 15 April 2015, 26 April 2016, 17 May 2016 and 10 August 2016.

Tested parameters varied for each sample location. These included trace elements (i.e. heavy metals), pH, TSS, TPHs, TOC and turbidity (*E. coli* was analysed for only at Te Puke freshwater location). In general, all parameters were below ANZECC (2000) and NPSFM (MfE 2014) water quality guidelines; however, some exceedances were recorded. These included:

- Instream *E. coli* counts at 'Kaituna River Site' (Te Puke) that were above NPSFM (MfE 2014) 'Attribute State D (Orange)' limits (>130 cfu/100mL);
- Copper concentrations in stormwater samples collected from 33 King Street (Te Puke lower catchment) and 15 Taupata Street (Paengaroa lower catchment) that were above ANZECC (2000) 90% protection limits (>0.0014g/m³); and
- Zinc concentrations in stormwater samples collected from 33 King Street (Te Puke), 15 Taupata Street (Paengaroa) and 340 Pukehina Beach Rd (Pukehina upper catchment) that were above ANZECC (2000) 90% protection limits (>0.008g/m³).

Due to the low frequency of monitoring undertaken at each site it is not possible to determine the extent of any potential effects of stormwater discharge on the receiving environment at most sites.

Further stormwater sampling is recommended:

- It is proposed that monitoring sites chosen for Te Puke and Paengaroa be retained.
- For Pukehina an additional downstream sampling location is required to assess effects of stormwater given that only an upstream location has been sampled.
- No information was provided for Maketu and gap in stormwater sampling will require additional sampling.

Sampling recommendations are listed as Action No 13c in section 11.2 of this CMP and monitoring programme is suggested in section 12 of this CMP.

6.6.6 Summary of Receiving Environment Quality at Eastern Catchments

The following subsections provide catchment-based summaries of report results as described in Section 6.6.1 to 6.6.5.

6.6.6.1 Te Puke

The Te Puke catchment is largely comprised of built-up areas and urban open space, with vegetation largely composed of non-native vascular plants and weed species. Several freshwater environments are considered to receive runoff from the urban catchment, including Kaituna River, Waiari Stream, Ohineanga Stream and a series of modified drainage canals.

Sampled freshwater environments indicated that streams associated with the catchment are subject to elevated heavy metal concentrations, nutrient levels, pH measures and bacterial counts that are above water quality guideline recommendations (ANZECC 2000; MfE 2014; NOAA 1999). Despite this, the Kaituna River has a bathing quality grading of 'Fair'.

Riparian margins and waterways within the catchment provide marginal physical habitat; however, they still support a number of native bird and fish species, including 'Chronically Threatened' banded kokopu. Instream macroinvertebrate communities indicate that streams systems associated with the Te Puke catchment are generally of 'Poor' to 'Excellent' quality, depending on where samples were collected. Macroinvertebrate results were amongst the highest recorded within eastern catchments and were generally better at locations upstream of the catchment.

The presence of banded kokopu within associated streams presents a constraint to potential stormwater management development in the catchment. In addition, stream bank erosion (WBOPDC 2018) was identified as moderate/severe in more than half of some of the receiving streams in the catchment. Enhancement opportunities to restore riparian margins, stream banks and instream habitat were identified within the catchment (refer section 11.2).

Long-term groundwater monitoring in boreholes located downstream of the Te Puke catchment indicated median values recorded for pH and heavy metals that were above water quality guidelines (MoH 2008) in some instances; however, there have been no significant trends or changes in quality observed over time. Sampling of groundwater quality in bores within close proximity to the Te Puke WWTP found nutrient and faecal coliform levels that were above water quality guidelines (ANZECC 2000; MfE 2014).

The Kaituna River Estuary is the marine receiving environment for freshwater inputs. Long-term monitoring in the estuary indicates declining trends in turbidity and chlorophyll-a. Increasing trends in some nutrients and enterococci were also observed.

6.6.6.2 Paengaroa

The Paengaroa catchment and surrounding area is largely comprised of built-up areas, pasture and ungrazed grassland. Most vascular plants identified in the catchment are non-native species. There are no streams traversing the catchment; however, nearby waterways support common native fish species. Instream macroinvertebrate communities sampled in Pokopoko Stream and Kaikopu Canal located further downstream suggest that water quality is 'Poor' to 'Good' in potential freshwater receiving environments. Water quality parameters were generally below guideline values however some water quality field parameters and *E-coli* bacterial counts were detected above guidelines. Some reaches of Pokopoko Stream in the lower catchment, located north east of Paengaroa, were identified with moderate bank erosion.

Long-term groundwater monitoring in boreholes located downstream of the Paengaroa catchment indicated median values recorded for pH and heavy metals that were above water quality guidelines (MoH 2008) in some instances. Median nutrient levels were generally below water quality guidelines (MoH 2008).

The marine receiving environment for the catchment is Waihi Estuary (Pacific Ocean), more detail regarding the state of this system is provided in section 6.6.6.3.

6.6.6.3 Maketu/Little Waihi

The Maketu/Little Waihi catchment is largely comprised of built-up areas and pasture, with vegetation largely composed of non-native vascular plants and weed species. Three main waterways, supported by various drainage canals, receive runoff from the urban Maketu subcatchment. There are no streams within the Little Waihi subcatchment. Maketu and Waihi estuaries are the main marine receiving environments for inputs from this catchment.

Sampled freshwater environments within the catchment suggest that streams associated with the catchment are subject to elevated heavy metal concentrations and bacterial counts that are above water quality guidelines (ANZECC 2000). Sampled instream macroinvertebrate communities indicate that receiving freshwater environments are of 'Poor' to 'Good' quality and are generally considered to be in the worst state when compared to other stream in the eastern catchments. Despite this, streams in the catchment support common native fish species, including 'Chronically Threatened' banded kokopu.

Stream and coastal vegetation associated with the catchment are considered to be of high ecological value, with stream banks presenting moderate erosion close to Maketu Estuary. Therefore high ecological values in the catchment represent a constraint on stormwater management development in Maketu/Little Waihi catchment.

Long-term monitoring of the Maketu estuary indicates trends in increasing TSS and nutrient levels, with measures above water quality guidelines (ANZECC 2000). Increasing trends in some nutrients and enterococci were also observed. Trends in increasing eutrophication have also been observed in upper parts of the estuary. Long-term monitoring indicates that benthic macrofauna community and sediment composition varies within the estuary due to dynamic tidal processes. Maketu Estuary has a bathing quality grading of 'Good'.

Waihi Estuary located to the east of the catchment receives inputs from the Little Waihi township. Long-term monitoring indicates trends in increasing nutrient levels in the estuary and eutrophication in the upper estuary. A significant increase in faecal indicators has also been observed and estuary is recognised as having the highest measure of bacterial indicators in the eastern catchments. Long-term monitoring of benthic macrofauna communities indicates they are relatively stable, with no detrimental trends observed. Waihi Estuary has a bathing quality grading of 'Fair'.

6.6.6.4 Pukehina

The Pukehina catchment and surrounding area is largely comprised of built-up areas and pasture. Vascular plants identified in the catchment consist of a mix of native and non-native species (35% native, 65% non-native). This included two 'Chronically Threatened' dune species.

There are no streams traversing the catchment; however, a number of farm drains located south of the catchment receive runoff from the catchment. These waterways are known to support common native fish species. Sampled instream macroinvertebrate communities suggest that water quality in these canals is 'Poor' to 'Fair', with *E.coli* and heavy metal concentrations that are generally above water quality guidelines (ANZECC 2000; MfE 2014).

Pukehina Beach has a bathing quality grade of 'Very Good'.

7.0 Stormwater Network

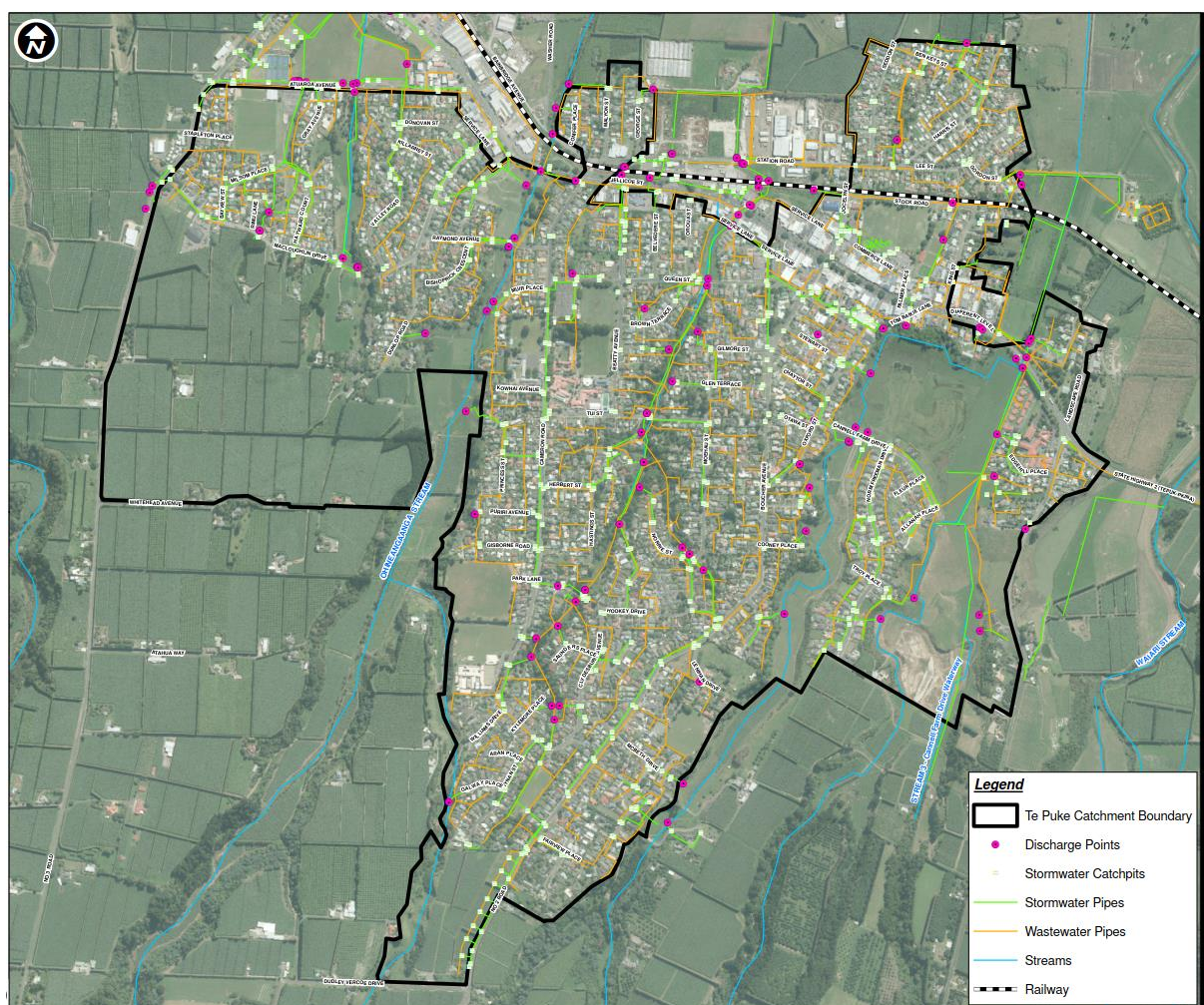
7.1 Existing Stormwater Network

7.1.1 Te Puke

Te Puke stormwater system has been modelled (Stage 1 to 7, by Opus, with the most recent Stage 7 modelling report completed in 2015). The modelled stormwater network consists of 181 open channels, 7 overland flow paths, 635 pipes and 825 nodes (of which 546 are manholes). A complete Te Puke stormwater drainage network is shown in Figure 15, which is taken from the Stage 7 modelling report (Opus 2015).

There are 75 soak holes located in urban Te Puke. However these soak holes were not included in the stormwater modelling work due to their unknown effect in reducing runoff for the relevant subcatchments. The previous stormwater assessment for Te Puke catchment has applied division of four main subcatchments based on the natural contour of the catchment. Stormwater runoff discharge into the receiving environment (refer to section 6.3 for details) via the network of stormwater pipes, urban and rural open drains.

Figure 15 Te Puke Stormwater Drainage Network, AECOM 2018

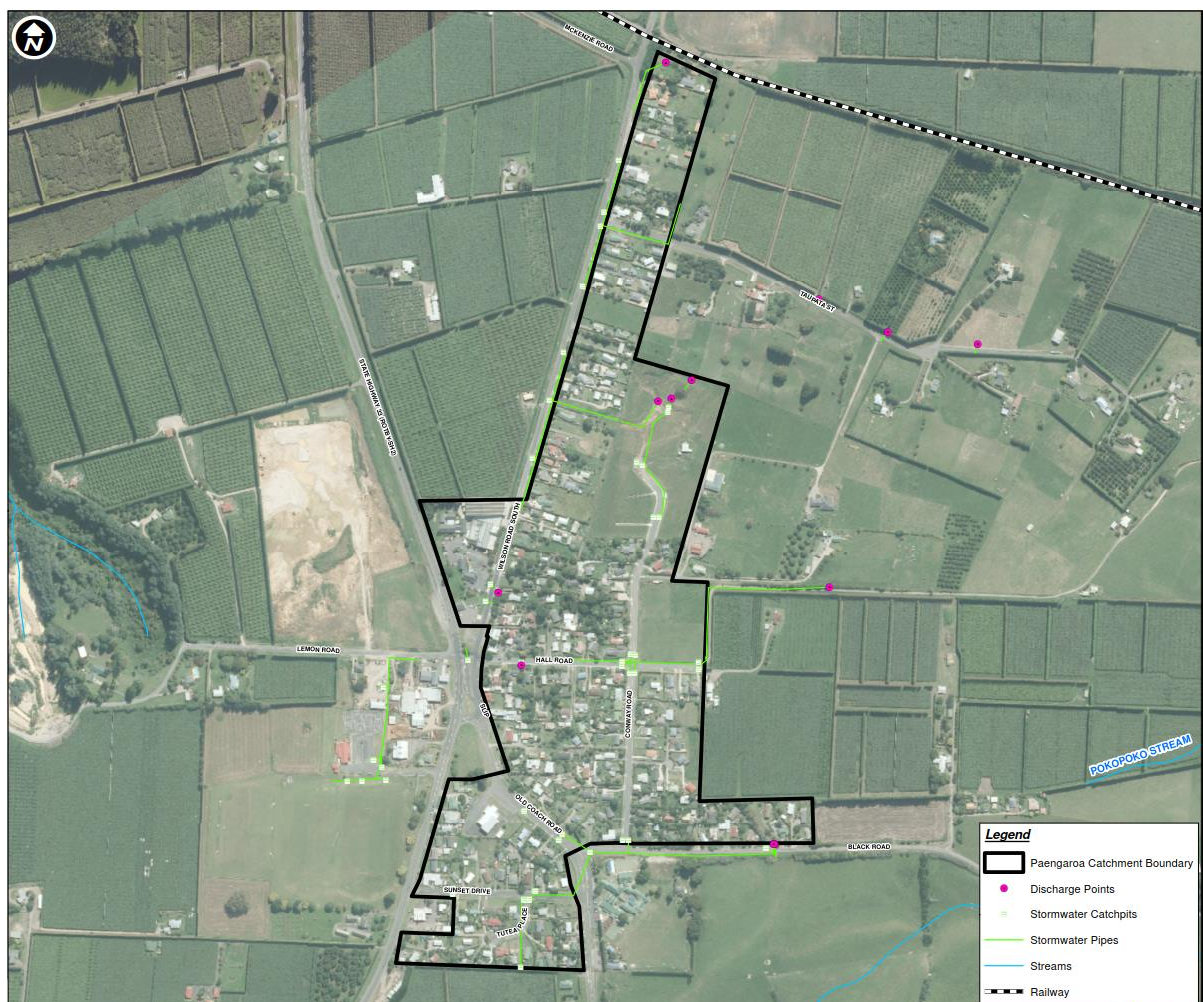


7.1.2 Paengaroa

The Paengaroa catchment network consists of 1,427 m of stormwater pipes, 9 manholes, 12 soak holes and 38 catchpits. The pipe diameters range from 150 mm to 375 mm with over 60% being 300 mm. The pipe material is dominantly concrete (Duffill Watts 2006). It is known that the majority of the stormwater in Paengaroa is discharged into soak holes, the gully in Lemon Rd and the Pokopoko Stream. The stream at the bottom of the gully discharges into the Kaituna River (Receiving Environment).

A complete Paengaroa stormwater reticulation network is shown in Figure 16.

Figure 16 Paengaroa Stormwater Drainage Network, AECOM 2018

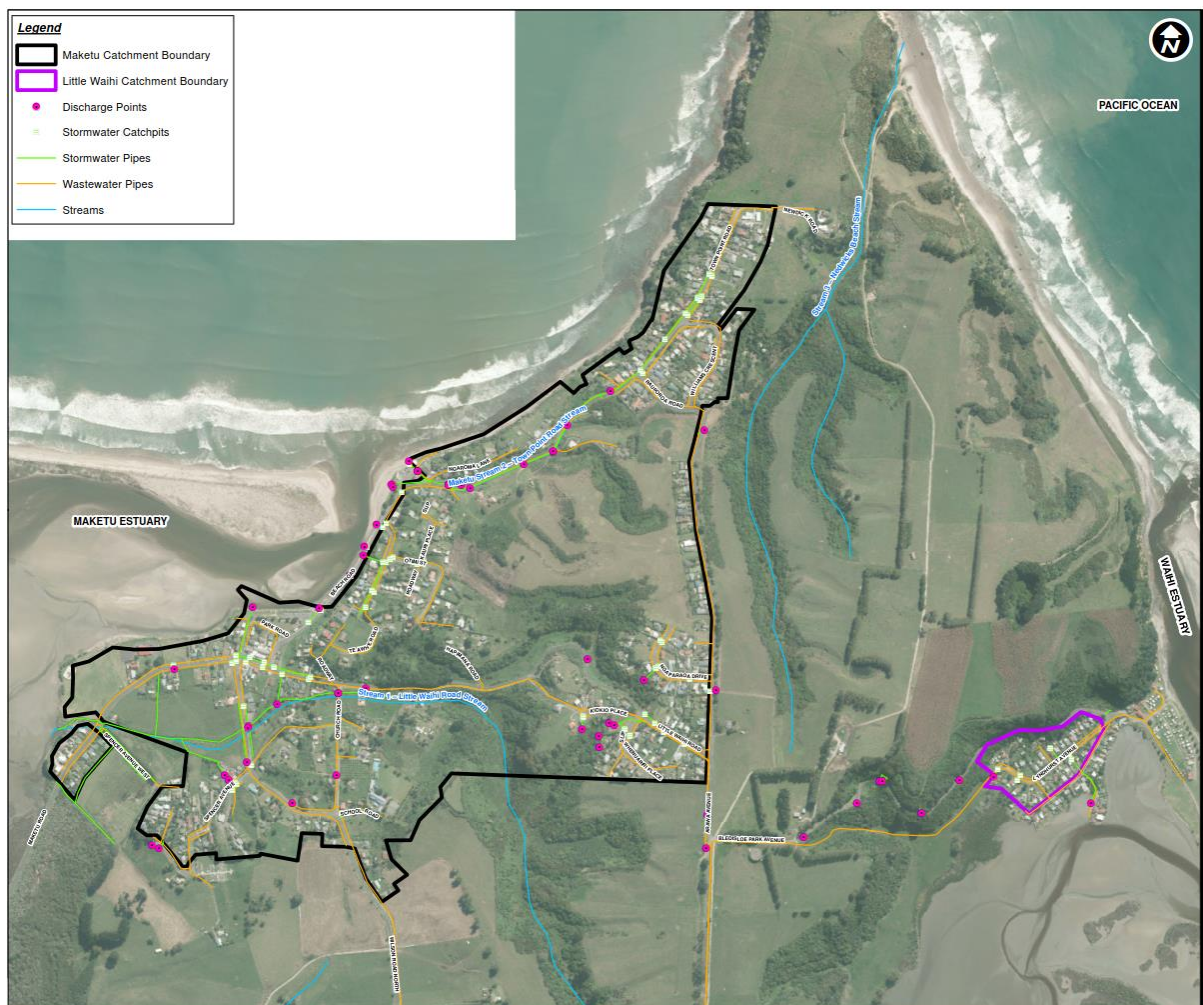


7.1.3 Maketu (including Little Waihi)

In Maketu, the primary stormwater system is made up of an estimated 1.5 km of pipes, 18 km of grassed drainage channels along roads and through private land, and another 2 km of roading concrete kerb and channel. Little Waihi, which is concentrated in a small medium density residential area, has 1 km of open drains along Lyndhurst Road and 0.3 km of piped reticulation to Little Waihi Estuary.

A complete Maketu/Little Waihi stormwater reticulation network is shown in Figure 17. Detail of the receiving environment is provided in section 6.3.

Figure 17 Maketu/Little Waihi Stormwater Drainage Network, AECOM 2018



7.1.4 Pukehina

The Pukehina catchment consists of 1,394 m of stormwater pipes, 22 manholes, 60 catch pits and 15 soak holes. The pipes within the catchment are between 150 mm and 750 mm in diameter, with the majority being 300 mm and mostly made of concrete (Duffill Watts 2008).

A complete Pukehina stormwater reticulation network is shown in Figure 18. Detail of the receiving environment is provided in section 6.3.

Figure 18 Pukehina Stormwater Drainage Network, AECOM 2018



7.2 Hydrological Modelling

7.2.1 Te Puke Hydrological Modelling

Te Puke stormwater system has been extensively modelled (Stage 1 to 7, by Opus, with the most recent being Stage 7 modelling report completed in 2015). The key completed modelling work is summarised as following:

1. Stage 1 – Gaps Analysis Report, 2011. This report summarised available data at that stage and provided recommendations for the modelling work to be carried out.
2. Stage 2 - Te Puke MIKE URBAN Stormwater Modelling Report, 2012. This report contains most of the stormwater drainage pipes, without rodding eyes, catchpits, or soak holes. Six overland flow paths were incorporated in the model to ensure model connectivity. The key boundary conditions have been identified in the model, including temporally-distributed rainfall (from HIRDS v1.5b, according to WBOPDC's Development Code 2009), inflows from upstream catchments and downstream water levels in the Kaituna River. Modelling results for 5, 10, 50, and 100-year

ARI rainfall events are provided in this report, highlighting significant bottlenecks within the network.

3. Stage 4 – Te Puke Stormwater Modelling Report and Network Upgrade Costings. This modelling work was built upon the Stage 2 model, but extended upstream to include some new District Plan zones with supplemental drainage assets supplied by WBOPDC. Two modelling scenarios (5-year and 50-year ARI) were simulated using MIKE URBAN and MIKE FLOOD. The bottlenecks in the existing network were identified and the upgrade work costings were estimated. Due to the larger catchment area in comparison with Stage 2 model, The Stage 4 MIKE URBAN model was augmented with additional pipes and open channels. The resultant model consisted of 181 open channels, 7 overland flow paths, 635 pipes and 825 nodes, of which 546 are manholes. In addition, a 2-m digital elevation model (DEM) was incorporated into MIKE FLOOD model and was used to derive flood water levels within the catchment.
4. Stage 7 – Te Puke Stormwater Modelling Report, 2015. This report was created following completion of Stage 5: Western Bay of Plenty Stormwater Modelling Guidelines (Opus 2014) and Stage 6 which involved some modifications to Stage 4 MIKE FLOOD model (i.e. moving open channels from MIKE URBAN to MIKE 21 surface for better presentation of the flood depth). Therefore essentially the same piped network at Stage 4 was adapted at Stage 7, but the open channels were transferred to MIKE 21 surface. Two scenarios (10-year and 50-year ARI, 24-hr nested storm duration) were simulated and presented in this report.

All the above modelling work was carried out for the existing catchment development with the existing stormwater network.

In addition to the catchment-wide modelling, a recent hydrological assessment was carried out in regards to the proposed development of Area 3 of the Te Puke Structure Plan. This is the area south of MacLoughlin Drive, to the west of No 3 Road, covering an area of approximately 71.4 ha. The potential future development is divided into three phases with a total of 521 potential residential lots, consisting of a mixture of Residential and Medium Density Residential Zones (both zones have a maximum allowable imperviousness of 50%). Building upon the verification of the flood modelling for the whole Te Puke catchment, the hydrological assessment was carried out using rainfall event generated by NIWA's HIRDS V3 software with climate change. Stormwater retention measures were proposed to ensure that the post-development 2% AEP peak flows do not exceed the pre-development scenario (Tonkin and Taylor 2016).

7.2.2 Small Urban Settlements Hydrological Modelling

7.2.2.1 Paengaroa

Paengaroa catchment hydrological modelling work was undertaken previously and summarised within the Paengaroa Stormwater Catchment Management Plan (Duffill and Watts 2005). This report provides an overview of the Paengaroa Stormwater catchment, describing the catchment's characteristics and stormwater network.

The existing stormwater network within Paengaroa was modelled using MOUSE. The analysis was based on existing and future development with a maximum impervious ratio of 35% adopted for future maximum probably development (MPD) scenario. The key development constraints identified within WBOPDC's Code of Practice and relevant District Plan rules have been adopted in this analysis. Other assumptions applied in the hydrological modelling included:

- Paengaroa population growth rate of 17% by year 2021, in comparison with 2001 census figure).
- Potential area of flooding was determined based on a 2% AEP (1 in 50 year storm event).

7.2.2.2 Maketu (Including Little Waihi)

The hydraulic modelling work for Maketu was carried out previous using MOUSE 4.01, with stormwater flows calculated and flood areas created. The modelling methodology and results are presented in the Maketu/Little Waihi Stormwater System Report (Harrison Grierson 2002). The rainfall intensity was derived from HIRDS version 1.50b High Rainfall Design System using coordinates Tauranga (Maketu). The analysis also assumed a 1 m high tide backup effect, which contributed to the flooding identified in the low lying end of Maketu Rd.

Flood maps were created in this study, showing the extent of flooding and the routes of the primary overland flow channels. The properties affected by 1 in 5 year and 1 in 50 year storm event are identified. Both primary stormwater system (reticulated pipes and critical drainage channels) and secondary overflow paths have been analysed in this study.

7.2.2.3 Pukehina

Hydraulic constraints analysis was carried out for Pukehina catchment by Duffill Watts (2008) and summarised within the Pukehina Stormwater Catchment Management Plan (Duffill Watts 2008). This report provides an overview of the Pukehina Stormwater catchment, describing the catchment's characteristics and stormwater network. The stormwater runoff was calculated using the rational method, assuming a maximum development potential (MDP) of 35%, in accordance with current Code of Practice and District Plan requirements. The 50-year flood hazard maps are also created within this study.

7.3 Existing Stormwater Management

Current stormwater management requirements are stipulated within the following guidelines:

- Bay of Plenty Regional Water and Land Plan (RWLP) 2008 - refer to Rules 30, 30A, 30B, 30C and 37 (now reformatted as the Regional Natural Resources Plan);
- Bay of Plenty Regional Coastal Environment Plan (BOPCP) amended 22 February 2011 refer Water Quality Policy WQ3 and Schedule 10 – Coastal Water Quality Classifications: Equivalent Qualitative and Quantitative Standards;
- Stormwater Management Guidelines for the Bay of Plenty Region Guideline 2012/01 dated April 2012;
- Western Bay of Plenty District (WBOPDC)'s Standard Requirements for Development – Subdivision and Development Code of Practice.

Proposed upgrades were recommended to take into account the existing stormwater management requirements, taking into consideration of the 2% AEP and stormwater constraints within the catchment.

7.4 Determination of 2% AEP Flood Levels

Following the modelling exercise completed to date, the flood levels for 2% AEP storm event have been identified. The identified potential flooding areas, with associated flood depths, are summarised in section 9.1.1.

8.0 Catchment Values

This section provides an overview of the catchment values at each of the eastern catchments, in particular it identifies the environmental, social, cultural, economic and public health values of each catchment. Based on these catchment values a range of catchment specific stormwater management objectives have been derived and reviewed, in order to maintain and protect stormwater management in each catchment.

Environment, social, cultural, public health and economic values for Te Puke and Small Settlements catchments are detailed in Table 12 to Table 15 and are based on review of the receiving environment monitoring information provided in section 6.6 and information from Community Development Plans (available for Te Puke, Paengaroa and Maketu). These plans provide details in terms of priorities and actions that the communities identified in relation with culture, recreation and leisure, urban areas, economy, environment, infrastructure, health and landuse. There is currently no community development plan for Pukehina.

Tangata Whenua / cultural values were initially provided for the eastern catchments area during preparation of the CSC application first lodged (refer Cultural Impact Assessment 2013). In addition, section 3 sets out the cultural values and objectives which align with the CMP.

Table 12 Te Puke Catchment Values

Well beings	Catchment Objectives	Identification of values within Te Puke Catchment	Location within Te Puke Catchment
Environment and Ecological	Original vegetation and creeklines Native water birds, fish, aquatic fauna and flora Visually attractive riparian vegetation along the river banks (weed free) Existing wetland areas and intertidal zone which attract large numbers of water birds Remains of vegetation and native animals of special conservation Natural creek banks as opposed to concrete and sheet piling Stream health and water quality Maintain groundwater quality and avoid any potential contamination to groundwater by restricting use and monitoring	Moderate flow upstream, large artificial cobbled area in downstream extent. Moderate (upstream) to poor (downstream) riparian margin of mature exotic trees (upstream only), long grass and weeds. In 2018, koura and common bully observed upstream, eel observed downstream. Good instream habitat and heterogeneity, artificial riffle areas at downstream site. Moderate Riparian margin consisting mainly of weeds, long grass, some exotic vegetation and sedges. Common bully observed in 2018. Small Spring fed stream upstream becoming farm drain choked with macrophytes and algae downstream. Moderate to very poor riparian margin ferns, long grass and mature exotic and native woody vegetation upstream, downstream mainly consisting of grazed pasture. Mosquito fish and an eel observed in 2018. It includes small artificial retention ponds. Deep with moderate flow, excellent clarity. Poor riparian margin of long grass and weeds. Some bankside macrophytes. Redfin bully, common bully and common smelt observed in 2018. Other streams identified however where values could not be assessed Chronically Threatened' banded kokopu present in waterways which is an ecological value for the catchment.	Raparapahoe Stream TP1A (upstream) TP1B (downstream) – West of the catchment Ohineangaanga Stream TP2A (upstream) TP2B (downstream) – Centre of the catchment Cannell Farm Drive waterway TP3A upstream TP3B downstream – East of the catchment Waiari Stream TP4 (reference monitoring site) – East, located outside of the urban catchment Unnamed drainage canals (South-north drainage corridor) and Centennial Park waterway.

Well beings	Catchment Objectives	Identification of values within Te Puke Catchment	Location within Te Puke Catchment
		Flood Hazards present in various areas of catchment correlating with lowest elevations around 12-14m amsl.	
Social	Boating and secondary contact recreation throughout the catchment Swimming Fishing and consumption of fish / shellfish. Recreational areas with water features which are visually pleasing and safe Walking and bike tracks following the River with no visual pollution. Facilities and use of waterways with environmental and cultural education and awareness themes.	Four reserves within the catchment Priority for the community (Te Puke Community Plan 2016) include: • Celebrate the Kiwifruit season • Promote and support community safety • Support youth development • Promote walkways and cycleways • Identify community needs and requirements for the provision of a Te Puke Aquatic and Action Centre • Create an attractive and vibrant atmosphere in the town centre • Promote Te Puke identity • Promote tourism • Ensure trees remain a part of Te Puke's identity • Ensure improvements to country roads, turnoffs and footpaths	South of Station Rd Catchment wide Walkways and cycleways to be established through reserves as per Te Puke Network Plan.
Tangata Whenua (Cultural)	Protecting the mana of the hapu; Maintaining our spiritual and physical cultural beliefs; Protecting the sensitive sites and burial grounds of our tupuna; Supporting and restoring abundant mahinga kai resources, particularly restoration in areas where they formerly flourished;	<u>Kaituna River</u>: tribes are joined together through whakapapa and united in their responsibility to ensure the River is protected for the generations still to come (D. Flavell). It is a Taonga kura (high valued treasure) of immeasurable importance, a fit from the Gods, imbued with great mana (authority). Its waters are as precious as the shimmering greenstone. Pa (communal) sites located on the coast include: • Te Makomako Pa	Kaituna River Eastern side of Kaituna River

Well beings	Catchment Objectives	Identification of values within Te Puke Catchment	Location within Te Puke Catchment
	Protecting the quality of the waters of Tauranga moana and our rivers and water linkages; Protecting wahi tapu / wahi taonga; Protecting cultural land and seascapes; Achieving a sufficient 'cap' on development in areas of cultural sensitivity; The Protection, enhancement and maintenance of Mauri; The protection of taonga (natural environment and resources) Enhancing access to areas of cultural significance and mahinga kai throughout our rohe tribal area.	- Te Ngaeo Pa: destroyed when flood protection scheme was implemented in the 1970s. <u>Waiari Stream:</u> Includes many Pa in the area that are sacred and significant to Tapuika, including: - Purunui pa of Ngati Totokau. - Te Totara is the urupa (cemetery). - Pa Waiwhero (downstream of Waiari), below the pa is the taunga ika (fishing ground) called Pukerimu. <u>Tributary of Waiari Stream:</u> - Te Raho of Totokau (the penis of Totokau, ancestor of Ngati Totokau) and Ngaengaenui (spring) are two wahi tapu (sacred sites). - Maioiro (wahi tapu) – burial ceremony site. <u>Further down the Kaituna river:</u> - Te arero of Ngakohua: ancient track used to travel from Te Puke inland towards Te Rerenga. - Tawakepito and Makahae: two Pa above Waiari located within Te Kahika settlement (urupa being respectively Taumata and Kahikatea).	Confluence of Kaituna River and Waiari Stream. Waiari Stream (it provided access via waka from Maketu to Te Puke township with landing place located at the foot of Te Kahika Pa). Tributaries of Waiari Stream.
Public Health	Watercourses safe for swimming, contact recreation and food gathering.	Good water quality and habitat recorded at Waiari Stream (upstream of WWTP). Te Puke streams are subject to elevated heavy metal concentrations, nutrient levels, pH measures and bacterial counts that are above water quality guideline recommendations	Waiari Stream – east of Te Puke catchment Catchment wide

Well beings	Catchment Objectives	Identification of values within Te Puke Catchment	Location within Te Puke Catchment
		(ANZECC 2000; MfE 2014; NOAA 1999). Despite this, the Kaituna River has a bathing quality grading of 'Fair'.	Receiving Environment – Kaituna River
Economic	Property values improved by waterway location or with views of waterways. Stormwater suitable for reuse.	• Program: 'Keep Te Puke Beautiful', and keep sites and premises tidy and safe • Attractive mix of high and low density living. • Greenfields development to be consistent with the District Plan. • Productive land value is identified and included in development and planning processes. • Ensure scenic 'view shafts' are protected in Te Puke. Submission to District Plan changes where relevant.	Catchment wide

Table 13 Paengaroa Catchment Values

Well beings	Catchment Objectives	Identification of values within Paengaroa Catchment	Location within Paengaroa Catchment
Environment and Ecological	Original vegetation and creeklines. Native water birds, fish, aquatic fauna and flora. Visually attractive riparian vegetation along the river banks (weed free). Existing wetland areas and intertidal zone which attract large numbers of water birds. Remains of vegetation and native animals of special conservation. Natural creek banks as opposed to concrete and sheet piling. Stream health and water quality. Maintain groundwater quality and avoid any potential contamination to groundwater by restricting use and monitoring.	No indigenous vegetation or habitat types. No threatened species of plants or birds. At least one flapgate identified on Kaituna River which present barrier for fish passage (outside of Paengaroa urban catchment). Western side of Conway road – grazed pasture (could be used for community-based planting project).	Kaituna River Pokopoko Stream
Social	Boating and secondary contact recreation throughout the catchment. Swimming. Fishing and consumption of fish / shellfish. Recreational areas with water features which are visually pleasing and safe. Walking and bike tracks following the River with	Community Amenity (hall on Old Coach Road) Western side of Conway road – grazed pasture (could be used for community-based planting project) The Paengaroa Domain and Eastern Districts Rugby Club Other Local Reserves: Conway Road Reserve - currently undeveloped	Catchment wide

Well beings	Catchment Objectives	Identification of values within Paengaroa Catchment	Location within Paengaroa Catchment
	no visual pollution. Facilities and use of waterways with environmental and cultural education and awareness themes.	Pokopoko Stream Reserve – currently road reserve.	
Tangata Whenua (Cultural)	Protecting the mana of the hapu; Maintaining our spiritual and physical cultural beliefs; Protecting the sensitive sites and burial grounds of our tupuna; Supporting and restoring abundant mahinga kai resources, particularly restoration in areas where they formerly flourished; Protecting the quality of the waters of Tauranga moana and our rivers and water linkages; Protecting wahi tapu / wahi taonga; Protecting cultural land and seascapes; Achieving a sufficient 'cap' on development in areas of cultural sensitivity; The Protection, enhancement and maintenance of Mauri; The protection of taonga (natural environment and resources) Enhancing access to areas of cultural	<u>State Highway / Paengaroa Historic Pa Waharoa</u> – the latest cultural addition to the Tauranga Eastern Link. The carving by local hapū depicts a Māori resident from the 1600's who had five sons. As the area was used for growing vegetables, the carving incorporates a wooden spade with a kumara in the middle of it and commemorates the site of an historic Māori village. <u>Paengaroa Radio Mast</u> – Visible from all parts of the village and the wider surrounding area, the 155m tall Radio NZ mast is an important part of the national communications network providing public news and information and also has a Civil Defence role in times of emergency.	Catchment wide

Well beings	Catchment Objectives	Identification of values within Paengaroa Catchment	Location within Paengaroa Catchment
	significance and mahinga kai throughout our rohe tribal area.		
Public Health	Watercourses safe for swimming, contact recreation and food gathering.	Macroinvertebrates scoring at Pokopoko Stream, indicate stream health 'Fair' to 'Good'. Water quality results in 2018 were below ANZECC (2000) recommended trigger levels, except for conductivity levels. Long-term groundwater monitoring in boreholes located downstream of the Paengaroa catchment indicated median values recorded for pH and heavy metals that were above water quality guidelines (MoH 2008) in some instances. Median nutrient levels were generally below water quality guidelines (MoH 2008).	Pokopoko Stream
Economic	Property values improved by waterway location or with views of waterways. Stormwater suitable for reuse.	Horticultural and agricultural community based around kiwifruit, avocado, natural bee products and dairying. Headquarters of the global natural health and beauty products company Comvita. Tourist attractions. SmartGrowth.	Catchment wide

Table 14 Maketu/Little Waihi Catchment Values

Well beings	Catchment Objectives	Identification of values within Maketu / Little Waihi Catchment	Location within Maketu / Little Waihi Catchment
Environment and Ecological	Original vegetation and creek lines. Native water birds, fish, aquatic fauna and flora. Visually attractive riparian vegetation along the river banks (weed free). Existing wetland areas and intertidal zone which attract large numbers of water birds. Remains of vegetation and native animals of special conservation. Natural creek banks as opposed to concrete and sheet piling. Stream health and water quality. Maintain groundwater quality and avoid any potential contamination to groundwater by restricting use and monitoring.	Highly significant features: terrestrial indigenous vegetation and habitat for threatened species, dunelands, estuarine ecosystems, streams, rivers and wetlands. It is largely composed of non-native vascular plants and weed species. Five natural areas identified as 'significant ecological features': • Maketu Estuary V14/2 • Arawa Wetlands (V14/3) botanical conservation ranking 'very high' and 'high') Pohutukawa Forest • Little Waihi Bush (V14/11) • Okurei Point (V14/12) • Little Waihi Estuary (V14/14) Elevated heavy metal concentrations and bacterial counts have been recorded above water quality guidelines (ANZECC 2000). Macroinvertebrate communities sampling indicate that receiving freshwater environments are of 'Poor' to 'Good' quality. Native fish species, including 'Chronically Threatened' banded kokopu are however present. Stream and coastal vegetation associated with the catchment are considered to be of high ecological value. Moderate significant features, degraded natural areas with potential for restoration, naturally established vegetation in the coastal and semi-coastal zone.	Maketu and Waihi Estuaries The Maketu and Waihi estuaries and pohutukawa treeland along the coast are considered highly significant features Arawa Wetland

Well beings	Catchment Objectives	Identification of values within Maketu / Little Waihi Catchment	Location within Maketu / Little Waihi Catchment
		Floodgates (Maketu Drain), velocity barriers and free-falling water from culverts (Newdick's beach stream) identified as potential barriers for fish passage.	
Social	Boating and secondary contact recreation throughout the catchment Swimming Fishing and consumption of fish / shellfish. Recreational areas with water features which are visually pleasing and safe Walking and bike tracks following the River with no visual pollution. Facilities and use of waterways with environmental and cultural education and awareness themes.	Maketu priorities identified in the Community Development Plan are: - Tino Rangatiratanga – Self Determination. - Walkways and cycleways – Develop walkways and cycleways within the village including to Okurei Point and Newdick's Beach. Connect to walk/cycleways being planned from Pukehina and Te Puke. Walkway to Little Waihi. - Map and directory – Develop a clear road map of Maketu together with a directory of historic locations, businesses and services. - Erect Signage – Establish welcoming signs at the entrances to the village. Work to ensure all signs in Maketu are bilingual including in shops, businesses and offices. - Clean up CBD – Work with the community to clean up the CBD and improve the image of Maketu for the visitor.	Catchment wide Walkways and cycleways (Maketu Strategy): (i) through from Arawa Avenue to Otimi Street over private land; and (ii) where Spencer Street is closed to traffic.
Tangata Whenua (Cultural)	Protecting the mana of the hapu; Maintaining our spiritual and physical cultural beliefs; Protecting the sensitive sites and burial grounds of our tupuna;	Maketu and Waihi Estuaries and the waters around Okurei point are an area of significant conservation or cultural value' (ASCV-7). Maketu Estuary has sustained the people since the landing of Te Arawa canoe at Maketu in 1350 AD.	Maketu Estuary (Maketu)

Well beings	Catchment Objectives	Identification of values within Maketu / Little Waihi Catchment	Location within Maketu / Little Waihi Catchment
	Supporting and restoring abundant mahinga kai resources, particularly restoration in areas where they formerly flourished; Protecting the quality of the waters of Tauranga moana and our rivers and water linkages; Protecting wahi tapu / wahi taonga; Protecting cultural land and seascapes; Achieving a sufficient 'cap' on development in areas of cultural sensitivity; The Protection, enhancement and maintenance of Mauri; The protection of taonga (natural environment and resources) Enhancing access to areas of cultural significance and mahinga kai throughout our rohe tribal area.	Kaituna re-diversion work (1957) has caused loss of kaimoana (seafood), continual silt build-up that occurs in the estuary and generally the loss of the Mauri (life essence). [note more recent river re-diversion works] Waihi Estuary appears as important as Maketu estuary due to its richness in food species. The estuary suffered from extensive agriculture, dairy, horticulture run-off and septic tank sewage spills. Evidence of pollutants at surface of water at estuary. In past Pongakawa River became a canal (and then floodplains / wetlands) when re-diversion was undertaken and swampland in Pukehina was reclaimed for dairy farming. Silt loading evidence in Pukehina area as well.	Waihi Estuary (Little Waihi)
Public Health	Watercourses safe for swimming, contact recreation and food gathering.	Long-term monitoring of the Maketu Estuary indicates: - trends in increasing suspended solids and nutrient levels, with measures above water quality guidelines (ANZECC 2000). - benthic macrofauna community and sediment composition varies within the estuary due to dynamic tidal processes. - Maketu Estuary has a bathing quality grading	Maketu Estuary

Well beings	Catchment Objectives	Identification of values within Maketu / Little Waihi Catchment	Location within Maketu / Little Waihi Catchment
		of 'Good'. Long-term monitoring of the Waihi Estuary indicates: - trends in increasing nutrient levels and eutrophication in the upper estuary. - a significant increase in faecal indicators has also been observed and Waihi Estuary is recognised as having the highest measure of bacterial indicators in the eastern catchments. - Waihi Estuary has a bathing quality grading of 'Fair'.	Waihi Estuary
Economic	Property values improved by waterway location or with views of waterways Stormwater suitable for reuse		Catchment wide

Table 15 Pukehina Catchment Values

Well beings	Catchment Objectives	Identification of values within Pukehina Catchment	Location within Pukehina Catchment
Environment and Ecological	Original vegetation and creeklines Native water birds, fish, aquatic fauna and flora Visually attractive riparian vegetation along the river banks (weed free) Existing wetland areas and intertidal zone which attract large numbers of water birds Remains of vegetation and native animals of special conservation Natural creek banks as opposed to concrete and sheet piling Stream health and water quality Maintain groundwater quality and avoid any potential contamination to groundwater by restricting use and monitoring	Network of freshwater drains / waterways draining into the estuary via Pukehina Canal but effectively isolated from estuary by series of embankments and a pumping scheme which discharges drainage flows (and prevents tidal inflows). Vascular plants identified in the catchment consist of a mix of native and non-native species (35% native, 65% non-native). This included to two 'Chronically Threatened' dune species. Highly constrained for future development due to presence of indigenous vegetation and habitats, including harbours and protected areas. Stream and riparian buffers are moderately constrained. Opportunities to restore currently degraded pasture habitats for improved stormwater management.	Network of freshwater drains / waterways Waihi estuary Pacific Ocean
Social	Boating and secondary contact recreation throughout the catchment Swimming Fishing and consumption of fish / shellfish. Recreational areas with water features which are visually pleasing and safe Walking and bike tracks following the River with no visual pollution.	Community groups at Pukehina include: • Pukehina School • Pukehina volunteer fire brigade • Pukehina Surf Lifesaving Club • Pukehina Beach Ratepayers' Association	

Well beings	Catchment Objectives	Identification of values within Pukehina Catchment	Location within Pukehina Catchment
	Facilities and use of waterways with environmental and cultural education and awareness themes.		
Tangata Whenua (Cultural)	Protecting the mana of the hapu; Maintaining our spiritual and physical cultural beliefs; Protecting the sensitive sites and burial grounds of our tupuna; Supporting and restoring abundant mahinga kai resources, particularly restoration in areas where they formerly flourished; Protecting the quality of the waters of Tauranga moana and our rivers and water linkages; Protecting wahi tapu / wahi taonga; Protecting cultural land and seascapes; Achieving a sufficient 'cap' on development in areas of cultural sensitivity; The Protection, enhancement and maintenance of Mauri; The protection of taonga (natural environment and resources) Enhancing access to areas of cultural significance and mahinga kai throughout our rohe tribal area.	Waihi Estuary is rich in food species. Suffers from extensive agriculture, dairy, horticulture run-off and septic tank sewage spills. Evidence of pollutants at surface of water at estuary. In past Pongakawa river became a canal (and then floodplains / wetlands) when re-diversion was undertaken and swampland in Pukehina was reclaimed for dairy farming. Silt loading evidence in Pukehina area as well.	Waihi Estuary

Well beings	Catchment Objectives	Identification of values within Pukehina Catchment	Location within Pukehina Catchment
Public Health	Watercourses safe for swimming, contact recreation and food gathering.	Sampled instream macroinvertebrate communities suggest that water quality in these canals is 'Poor' to 'Fair', with <i>E.coli</i> and heavy metal concentrations that are generally above water quality guidelines (ANZECC 2000; MfE 2014). Pukehina Beach has a bathing quality grade of 'Very Good'.	Catchment wide
Economic	Property values improved by waterway location or with views of waterways Stormwater suitable for reuse	Appropriate implementation of stormwater management into existing areas and future development. Potential use of rain tanks to collect runoff for reuse where appropriate.	Catchment wide

9.0 Identification of Stormwater Management Issues

This section identifies the stormwater management issues within the eastern catchments, based on the assessment of the achievements of the objectives covered in sections 4 and 8. Suggested improvement methods are also provided in order to address those stormwater management issues.

9.1 Stormwater Quantity

This section describes the stormwater quantity issues that have been identified for the eastern catchments, including flooding issues, stream bank erosion, and the improvement methods to reduce these issues.

9.1.1 Flooding

9.1.1.1 Te Puke Flood Hazard Maps

As summarised briefly in section 7.2.1, Te Puke stormwater system has been extensively modelled (Stage 1 to 7, by Opus, with the most recent Stage 7 modelling report completed in 2015). Particularly during Stage 4 modelling, the existing stormwater drainage network were modelled with various scenarios including 5-year ARI and 50-year ARI, both with a 30-minute storm duration. This study identified stormwater pipes and manholes that require upgrading in order to pass the 5-year ARI storm even without surcharging. It also provided a list of assets that require upgrading.

The flood depth map for the 50-year, 30 minute scenario (existing scenario) was presented in the Stage 4 Modelling Report (Opus 2014). Following some modification of the modelling work in Stage 6 (i.e. moving open channels from MIKE URBAN to MIKE 21 surface for better mapping purpose), new updated flood maps for Te Puke catchment were produced in Stage 7, for the following scenarios:

- 50-year ARI, 24 hr duration nested storm;
- 10-year ARI, 24 hr duration nested storm.

The 50-year ARI flood map is shown below in Figure 19. The flood mapping for the 50-year ARI, 24 hr duration nested rainfall event showed that shallow surface flooding occurs in the vicinity of residential areas, with deeper flooding largely confined to rural areas, park land and open channels (Opus 2015). The flood depths within the catchment for a 50-year ARI, 30-min duration storm is shown in Figure 20 (Opus 2014).

Figure 19 Flood extent for the 50-year ARI, 24-hr duration design nested storm rainfall event (from Opus 2015)

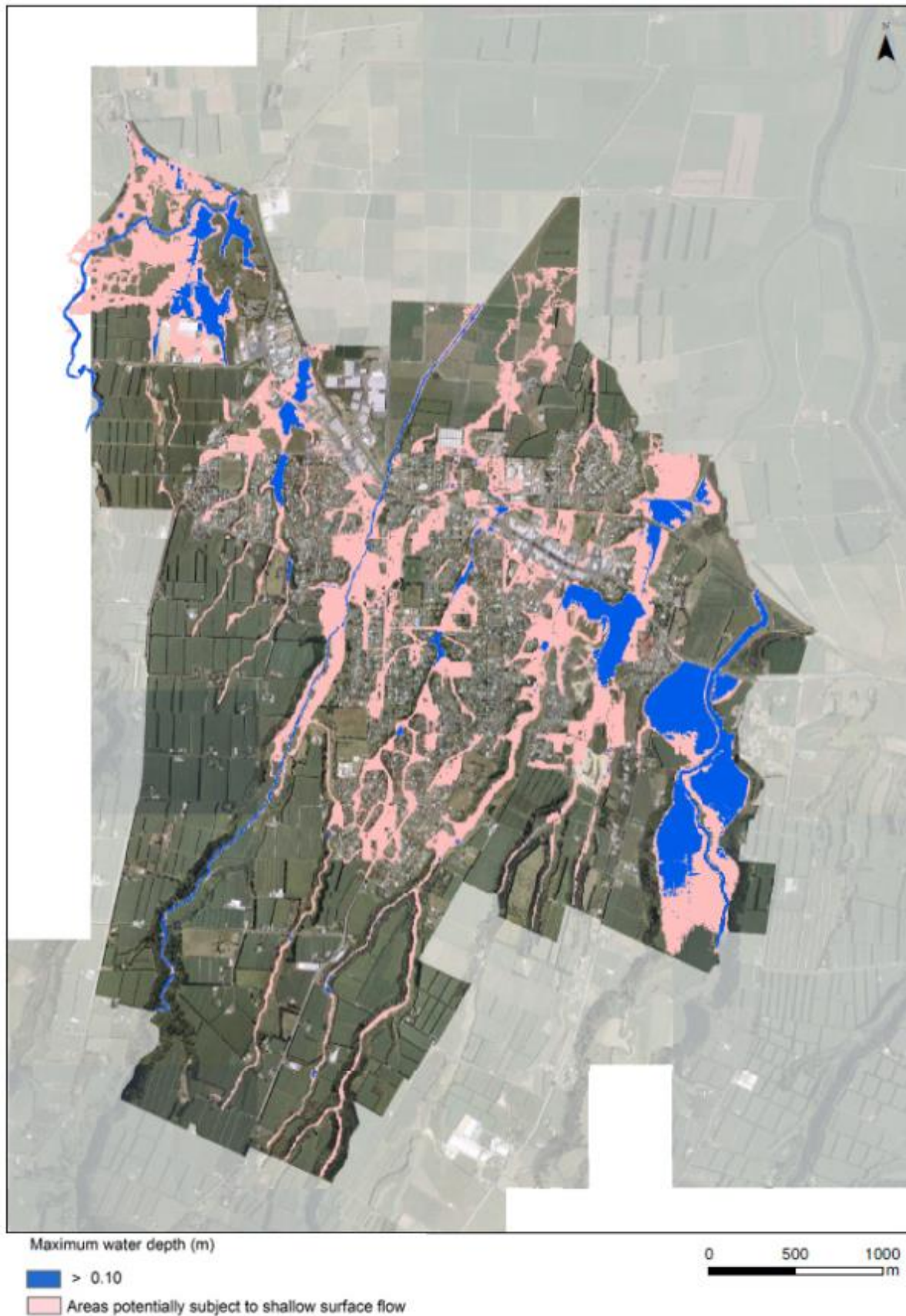
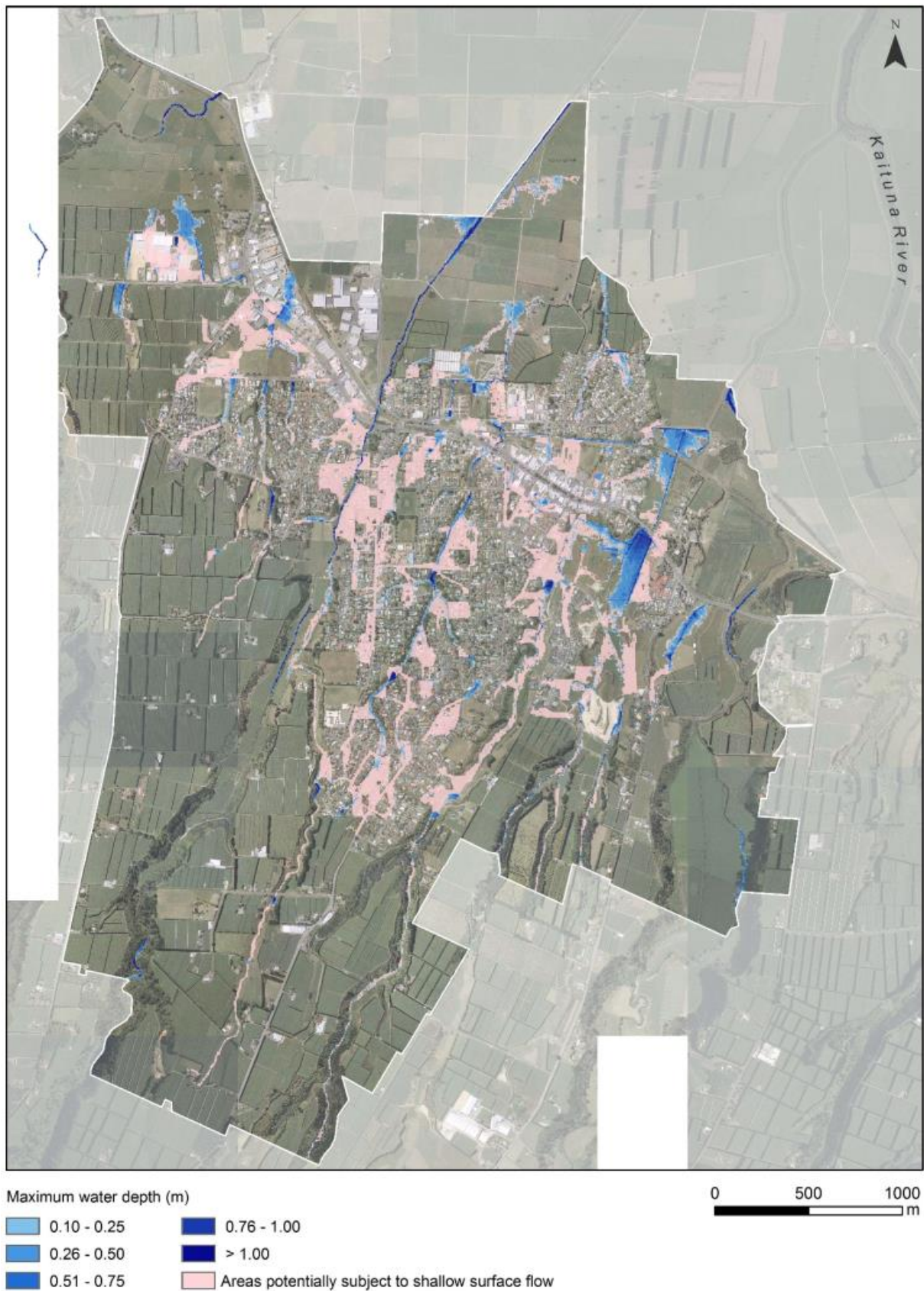


Figure 20 Flood depth for the 50-year ARI, 30-min duration design nested storm rainfall event (from Opus 2014)



As a result of the hydrological and hydraulic modelling, a total number of 275 pipes were identified in the Stage 4 modelling work for upgrading (Opus 2014). In addition, 207 manholes were identified for upgrading in Te Puke catchment (Opus 2014).

Specific bottleneck areas within the network were identified, with respect to the 50-year ARI storm, during Stage 2 modelling work (Opus 2012). These include the following:

- No 3 Road
- Atuaroa Avenue
- Ben Keys Street
- Boucher Avenue
- Cameron Road
- Commerce Lane & Jocelyn Street
- Dunlop Road
- Princess Street
- Queen Street
- Slater Place
- Valley Road.

The current asset management programme as documented in the WBOPDC Long-term Plan 2018 - 28 (LTP) CAPEX Programme includes a variety of stormwater upgrade projects for the Te Puke catchment. This programme primarily addresses the bottleneck issues identified previously and other related safety and drainage issues. These are listed in Table 16 and recommendations are provided in section 11.2 of this CMP (refer actions No 2 and 5). Additional modelling work incorporating the proposed upgrade projects may be required to assess the significance of the proposed projects in alleviating the flooding issue within the catchment.

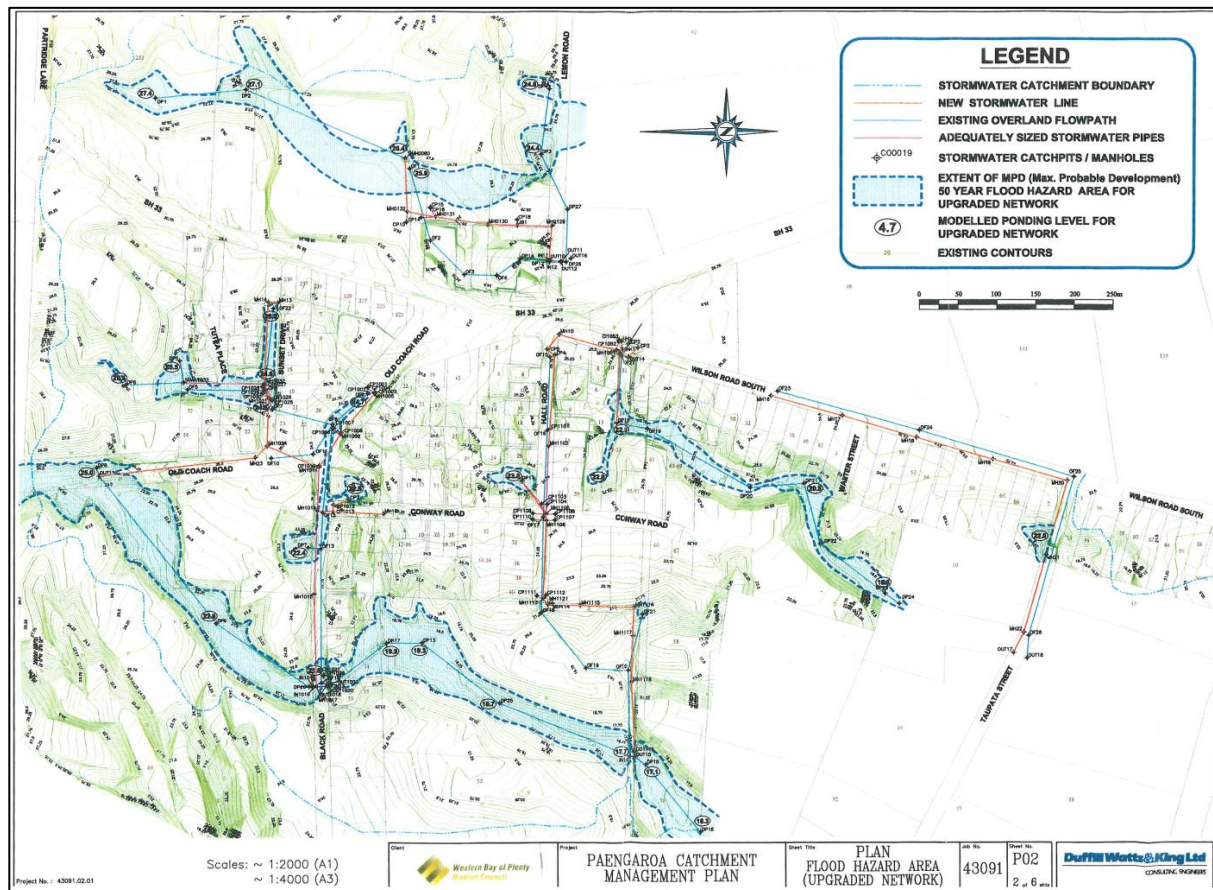
Table 16 Te Puke stormwater asset upgrade projects, WBOPDC LTP 2018 - 28

Project Name	Project Details
Lee St, Harris St	Pipe network and catchment improvement - pipes too small, inlet capacity limited, ponding, excess overland flow
Princess St, Saunders Pl	Pipes too small, excess overland flow
Seddon St, Raymond, Dunlop, Bishoprick	Pipe network and catchment improvement - pipes too small, ponding, excess overland flow
Williams Dr	Pipe network and catchment improvement
Open Drain Safety Improvements	Amending safety issues
Oxford St/Boucher Ave	Pipe network undersized
King St Outfall	Pipe network improvement
Galway Pl	Trapped cul de sac, no overland flowpath, system at capacity
Stormwater network upgrades Queen St	Pipe network improvement - undersized pipes
Ohineangaanga Stream upper catchment screen device	To catch debris from upstream
Stormwater Relating to Subdivision	100% Growth funded

9.1.1.2 Paengaroa Flood Hazard Maps

The extent of 50-year ARI flood hazard area for Paengaroa area is provided in the Paengaroa Stormwater Catchment Management Plan and is shown below in Figure 21 (Duffill Watts 2005).

Figure 21 Flood map of Paengaroa Catchment (50-year ARI storm event, figure taken from Duffill Watts 2005)



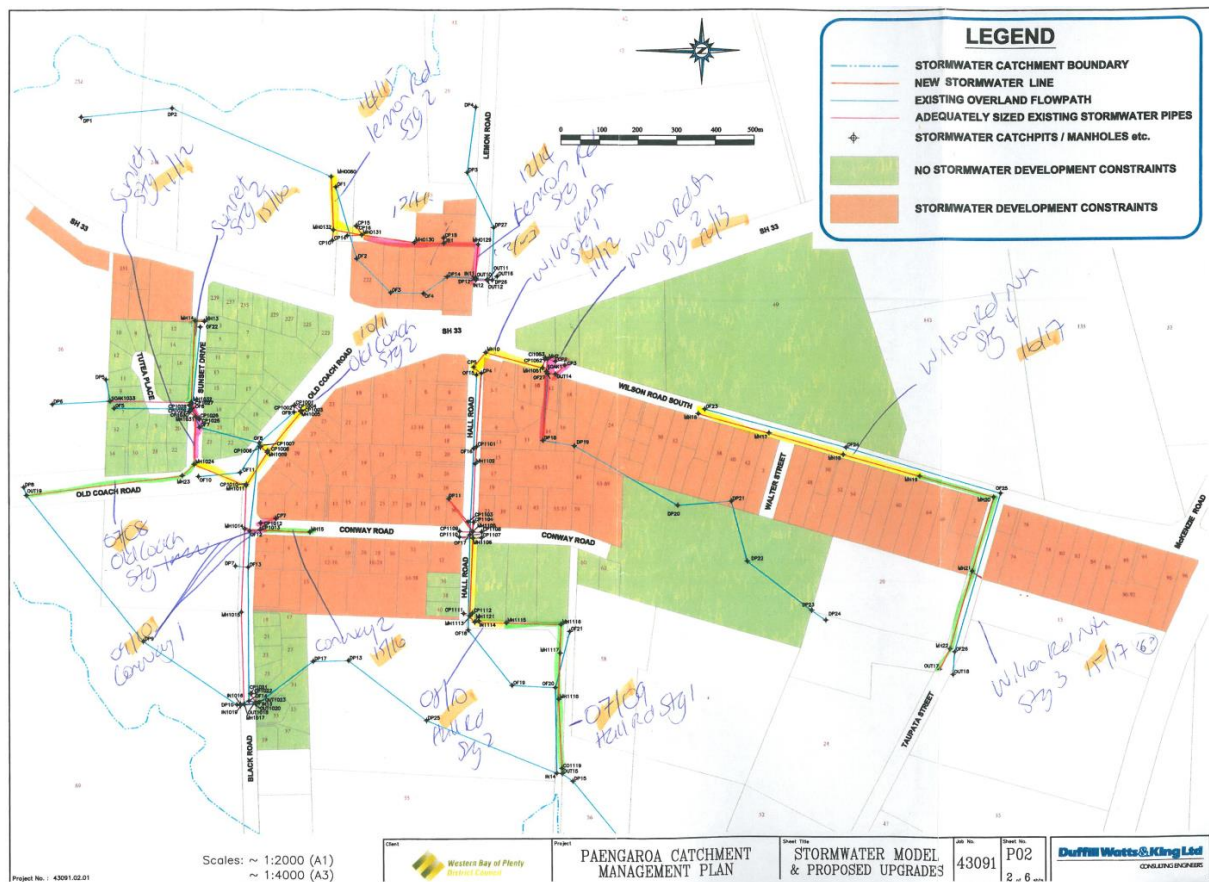
No specific property or flood depths have been provided in the previous investigations. As an outcome of the network modelling work, stormwater network upgrades were recommended. The recommended network upgrades were based on maximum probable development scenario based on WBOPDC's Code of Practice and District Plan constraints.

The key recommended stormwater upgrade projects are summarised in Table 17, with the locations of the projects shown in Figure 22. Additional modelling work incorporating the proposed upgrade projects may be required to assess the significance of the proposed projects in alleviating the flooding issue within the catchment.

Table 17 Paengaroa stormwater asset upgrade projects, WBOPDC LTP 2018 - 28

Project Name	Project Details
Halls Road Stage 1	pipe upgrade
Halls Road Stage 2	new pipe and existing pipe upgrade
Black Road Outlet	Conway Road reserve planting, Lemon Road gully part restoration

Figure 22 Location of stormwater network upgrade projects within Paengaroa Catchment (Duffill Watts 2005)



These stormwater upgrades were partially completed between 2012 and 2014. Further work is to be undertaken between 2026 and 2034 (i.e. Halls Rd Stage 1 and Stage 2 upgrade).

In addition, an ecological project has been identified within WBOPDC's LTP 2018 - 28 (i.e. Paengaroa Restoration), including Conway Rd Reserve Planting and Lemon Rd Gully part restoration (located on the western boundary of Paengaroa catchment). This Paengaroa Restoration project is scheduled to be completed in 2019, refer CMP Recommendations section 11.2 (Action No 3).

9.1.1.3 Maketu/Little Waihi Flood Hazard Maps

Flood maps for Maketu catchment were created previously by Harrison Grierson (2002), which are included in the Maketu/Little Waihi Stormwater System (Harrison Grierson 2002). The extent of flooding (for both 5-year and 50-year ARI) and the routes of the primary and secondary overland flow channels are shown in the maps. These maps are attached in Appendix I.

The properties affected by 1 in 5 year and 1 in 50 year storm event are identified with the flood depth estimated. These included:

- Properties affected by 1 in 5 year storm event:
 - 7 Town Point Rd (60 mm depth of flooding): nuisance flooding
 - Maori land adjacent to 7 Town Point Rd (60 mm depth of flooding): nuisance flooding
 - 660 Maketu Rd (125 mm depth of flooding): building flooding
 - 664 Maketu Rd (125 mm depth of flooding): building flooding
 - 668 Wilson Rd North – Fire Station (40 mm depth of flooding): building flooding
 - 35 Little Waihi Rd/Church Rd culvert (80 mm depth of flooding): nuisance flooding
- Properties affected by 1 in 50 year storm event (in addition to the properties above):

- 660 Wilson Rd – private dwelling (250 mm depth of flooding): building flooding
- 670 Wilson Rd North – Childcare Centre (250 mm depth of flooding): building flooding
- 59 Spencer Rd (370 mm depth of flooding): building flooding

In addition, stormwater scouring or stormwater ponding at driveway entrances was identified as an issue at Williams Crescent, the top end of Little Waihi Road, and the top end of Wilson Road North.

Recommended options for Maketu/Little Waihi included:

- Town Point Rd/Wilson Road North area: Installation of four larger pipes (*This was completed by 2011/2012*).
- Maketu Road area: no appropriate remedial option has been identified due to tidal influence.
- Fire Station, Childcare Centre, Wilson Road North properties: Council's Purchase of 35 Little Waihi Rd as a flood detention basin (*Outside of LTP, to be completed by 2022/2023, Little Waihi Rd Kerb and Channelling was completed by 2013/2014*).
- For the stormwater scouring/ponding at several road table drains around Maketu: Regrade or kerb and channel the table drains (Harrison Grierson 2002, Maketu Roding Stormwater Improvements). (*Completed by 2012/2013*)

An upper catchment attenuation project is currently scheduled for Maketu catchment in the WBOPDC LTP 2018 - 28, to be completed in 2022. This will help attenuate the stormwater at the upper catchment, alleviating the downstream flooding issues due to the undersized network. This action is listed as No 4 in section 11.2 of this CMP.

9.1.1.4 Pukehina Flood Hazard Maps

The 50-year flood hazard maps for Pukehina area were created previously and included in the Pukehina Stormwater Catchment Management Plan (Duffill Watts 2008). The flood hazard maps are attached in Appendix I within this CMP. However no flood depths have been reported.

Recommended stormwater upgrade options and costs were also presented in this report, along with costs, including Pukehina Parade Stage 1 to Stage 16. The maps of the upgrade works are also provided in this report. Note that the recommended remedial options were alleged to cater for potential maximum development with a maximum impervious ratio of 35%.

According to the WBOPDC LTP 2018 - 28, Pukehina Parade Stage 1 and Gardiner Rd upgrade works were to be completed by 2011/2012. All other stages including Beach Rd Stage 2 to Stage 8 and Pukehina Gardiner Place upgrade are to be completed between 2023 and 2027 (refer Action No 5 in CMP Recommendations section 11.2). All other upgrade works are to be managed outside of LTP.

9.1.2 Erosion

9.1.2.1 Stream Bank Erosion

Assessment of stream bank erosion provides an indication of potential alteration of stormwater quantity within the catchments. Stream bank erosion is often associated with changing land use. As a catchment becomes more developed peak flows increase during wet weather. As flow rates and the volume of water increase stream channels change shape, often widening through erosion to accommodate the flows. This process is exacerbated by the removal of riparian vegetation.

A summary of the recent stream bank assessment undertaken by WBOPDC in 2018 is provided in section 6.6.2.4 of this CMP, with the full report attached in Appendix G-2.

The conclusion of the assessment indicates that the streams of assessed in Te Puke had the highest frequency of observed erosion; particularly Ohineangaanga and Raparapahoe streams in which approximately half of the surveyed stream reach was subject to 'Moderate' levels of erosion. Erosion rates were generally higher in upstream sections of surveyed stream reach, located south of the urban catchment (Ohineangaanga Stream) and west of the catchment (Raparapahoe Stream).

Paengaroa, Maketu and Pukehina streams banks assessed generally indicated none to slight erosion (with very small reaches indicating moderate erosion) throughout the streams/canals monitored. Pukehina canal did not present any erosion. Paengaroa presented small areas of 'Moderate' erosion

were observed in the lower survey reach of Pokopoko Stream. Maketu could not be fully assessed due to the density of vegetation however, a small section in the downstream extent of the Little Waihi Road Stream (on the western end of the catchment at the discharge to the receiving environment with Maketu Estuary, downstream of Ma1B) showed 'Moderate' erosion.

In addition, consideration was given to WBOPDC owned assets identified through GIS and presenting any potential sign of erosion. The survey indicated that nine assets (outlet or outfall pipes) were identified in Te Puke Catchment at Ohineangaanga Stream and the Unnamed Waterway joining Cannell Farm Drive Waterway. All of which were associated with erosion.

Outfall erosion can contribute to the amount of sediment discharged into the receiving watercourse. Outfalls with severe erosion have the potential to discharge many cubic metres of sediment, which can smother stream channels and affect conveyance capacity by altering channel morphology. Outfall erosion also has the potential to compromise the structural integrity of an asset, causing pipes to become misaligned or hydraulic conditions in the channel to change, further accelerating erosion.

9.1.2.2 Coastal Erosion and Inundation

The WBOPDC Planning Maps show land that is susceptible to coastal erosion and coastal inundation (flooding) over the next 100 years (following Plan Change 74 to the WBOPDC, operative on 17 September 2016.). The Pukehina coastline has been the subject of a detailed study commissioned by WBOPDC to identify land at risk to these coastal hazards over 0-50 and 50-100 years. The Coastal Erosion Areas have been divided into primary risk and secondary risk based on 0-50 year and 50-100 year risk timeframes with more restrictive rules in the WBOPDC applying in the primary risk area. Coastal inundation hazard is also identified on the WBOPDC Planning Maps. This hazard shows the risk to people and property from coastal flooding, including storm surge and sea level rise.

9.1.3 Stormwater Quantity Improvement Methods

The following stormwater quantity improvement methods have been identified to be potentially implemented within the eastern catchments:

- Ponds
- Wetlands
- Low Impact Design (LID) and Water Sensitive Urban Design (WSUD)
- Rainwater tanks
- Land soakage
- Ecological river engineering

This section is intended to provide generic methods for improvement in terms of stormwater quantity. Additional modelling work incorporating the proposed upgrade projects may be required to assess the significance of the proposed projects in alleviating the flooding issue within the catchments. This will enable to provide specific methods for improvements for the catchments.

Stormwater management guidelines No 2012/001 for the Bay of Plenty Region provide for implementation of a treatment train approach and standards in terms of water quantity and water quality. Stormwater quantity can generally be managed using various approaches such as:

- **Ponds**

Ponds provide stormwater quantity attenuation and can release flows at a rate that matches predevelopment hydrology. Water quality ponds are generally categorised as either wet ponds (with a permanent pool) or dry/detention ponds that detain water for a period after rainfall events. The primary mechanism for contaminant removal is sedimentation. As with wetlands the need for land to construct a pond is often a constraint. For instance four ponds (either using existing natural storage space or a new constructed facility) have been proposed to attenuate the projected peak stormwater runoff flow from the proposed development area 3 of the Te Puke Structural Plan (T&T 2016).

- **Wetlands**

In addition to the primary functionality of providing treatment, attenuation of peak stormwater flows can be provided by limiting the discharge of treated stormwater into the receiving environment.

The attenuation element of a stormwater device should be designed to manage the volume that would otherwise contribute to flooding during rain events. Constructed wetlands consist of shallow vegetated pond areas. Wetlands are only practicable where space is available for construction. Wetlands remove contaminants through a combination of mechanisms including sedimentation, aerobic digestion and adhesion of contaminants to vegetation.

- **Low Impact Design (LID) and Water Sensitive Urban Design (WSUD)**

LID and WSUD are a design philosophy that can be applied at both a local and catchment level. The LID approach takes the natural features of a catchment and focuses on enhancement and protection of these being incorporated to the design. Guideline Document GD04 “Auckland Council Guideline for Water Sensitive Design” provides detailed information on this design approach (mainly for residential land development). In addition, Stormwater Management Guidelines 2012/01 for BOPR emphasize the importance of considering LID as a design element to reduce increases in stormwater runoff volume and provides design procedures for incorporation of LID into site design.

Management principles that would apply under an LID or WSUD approach include:

- Minimise disturbance of soils;
- Preserve and recreate natural landscape features;
- Reduce effective impervious cover;
- Stormwater disposal should mimic, to the extent possible, the natural drainage processes that currently exist;
- Modifications to existing natural drainage patterns should be kept to a minimum;
- Riparian margins to be designated, planting and protected;
- Effective impervious area increases should be kept to a minimum;
- Disconnect impervious surfaces;
- Utilise conveyance and stormwater treatment methods that also provide ecological and amenity benefits;
- Appropriate methods to hold stormwater back (detention) before dispersal into waterways should be employed.

- **Rainwater tanks**

Where rainwater is collected from the roof areas and used for non-potable water uses such as toilet flushing, laundry and outdoor use, then this stormwater does not enter the stormwater system. Instead it is returned to the soil, enters the wastewater pipe network and is treated at the wastewater treatment plant. Accordingly rainwater tanks can reduce the treatment requirements for other downstream systems.

The implementation of rainwater tanks for all plumbing within all proposed buildings could attenuate the 2year ARI to pre developed levels. Part of Maketu includes “greenfield areas” that could offer the potential to implement these systems in the planning/design stages at more affordable costs compared to retrofitting existing developments.

Other stormwater quantity improvement methods include:

- **Land soakage**

If soil conditions are suitable, soakage chambers (trenches) can be installed within the property, at 3 metres from any downstream building/boundary, with overflow via an interlot drainage system, constructed in accordance with AS/NZS 3500.3.2 Parts 6.4 and 6.5.

- **Ecological river engineering**

Ecological river engineering can be defined as the design and implementation of river works and river restoration works for the sustainable ecological functions of a river, such as its habitats preservation and flood control. The flow resistance due to vegetation along the riparian corridor as part of an ecological enhancement initiative can provide additional measures in attenuation of potential flooding issues within the catchment.

9.2 Stormwater Quality

This section describes the stormwater quality issues that have been identified for the eastern catchments, including potential sources of contamination, contaminant load modelling, current contamination issues and description of the wastewater network, as well as the improvement methods to reduce these issues.

9.2.1 Current Stormwater Quality Management

There are currently a few stormwater treatment devices within eastern catchments, including ponds and swales. However locations have not been clearly identified therefore could not be clarified and displayed on a Figure. The current WBOPDC Development Code (2009) provides the design standards for the stormwater treatment devices.

With respect to public awareness and education; the WBOPDC CSC Brochure dated May 2014 promotes to the community the following actions to maintain/enhance stormwater quality:

- Never put anything into a storm drain;
- Direct downpipes away from paved surfaces and/or use a rain tank;
- Vegetate bare ground with native plants;
- Use pesticides and fertilisers sparingly;
- Properly dispose of hazardous house-hold waste.

As described in the CMP, the stormwater quality objectives are to be consistent with ANZECC (2000) guidelines and compliant with NPSFM (MfE 2014) thresholds (refer section 6.6 for further details). Additional stormwater treatment requirements have been listed in section 9.2.3 of this CMP.

9.2.2 Potential Sources of Contamination

This section provides an indication of potential sources of contamination within the eastern catchments in terms of contaminant load modelling, wastewater contamination

9.2.2.1 Contaminant Load Modelling

A Contaminant Load Model (CLM) 2006 was carried out (as part of the PMS 2013 application for CSC) to determine the annual concentrations of TSS, Zinc, Copper and Total Petroleum Hydrocarbons (TPH) generated for:

- Te Puke catchment,
 - at Ohineangaanga Stream eastern tributary (outfall SWCO0941), near Jellicoe Street and Cameron Road intersection (within Te Puke catchment boundary) – referred to as TP-E below; and
 - at Ohineangaanga Stream western tributary/ Centennial Park waterway (outfall SWCO0922), near Jellicoe street/No 3 Road intersection (outside the Te Puke catchment boundary and capturing runoff from industrial activities in Te Puke West) – referred to as TP-W below; and
- Maketu catchment, outfall SWCO1045 at Park Road / Maketu Estuary.

Concentrations of contaminants in regard to the landuse for Te Puke and Maketu catchments are provided in Tables 18 and 19.

Notes: Te Puke and Maketu areas (TP-W: 59.1 ha, TP-E: 7.5 ha and Maketu: 3.6 ha) as defined in CLM 2006 are significantly different than the total catchment area calculated by GIS and based on the

catchment boundaries of eastern urban stormwater catchments. Therefore results do not provide a clear assessment of contaminant load at those catchments. In addition, CLM was not available for Paengaroa and Pukehina. Paved surfaces other than roads in results below include residential, industrial and commercial areas; industrial and commercial areas are excluded from this CMP (refer section 1.3) and therefore excluded from the assessment below.

The 2006 CLM approach assumed that no treatment was implemented within those catchments. Results of the 2006 CLM indicate:

- Urban grass lands is the main source for TSS generation, approximately 70%;
- Zinc is mostly generated by roads. Zinc concentration generated by paved areas other than roads (residential only) in Te Puke is 13-18% and for Maketu 20%. In addition roofs represent 11% to 20% of the zinc source generation at both catchments.
- Roads generally generate the most copper with other paved areas (residential) and a slight portion from roofs runoff (less than 3% for both catchments); where paved surface generate the most copper, it is understood to be due to industrial and commercial areas (which are excluded of the CMP).
- TPH are only generated by roads for both catchments.

Table 18 Te Puke Contaminant loading (Ref CLM based on ARC guidelines – May 2006) based on 5 year 10 minutes first flush event i.e. western tributary: flow rate of 7,882L/s and event volume of 4,729m³; eastern tributary: flow rate of 1,266L/s and event volume of 759m³.

Land Use	Area (ha)		Contaminant Load (kg per year) for Te Puke							
			TSS		Zinc		Copper		Total Petroleum Hydrocarbons (TPH)	
	W	E	W	E	W	E	W	E	W	E
Roofs (avg)	7.86	1.6	393.1	78.2	3.1	0.6	0.06	0.01	-	-
Roads (total)	4.71	1.4	3,299.1	233.2	11.9	0.8	3.9	0.3	59.7	4.5
Paved Surfaces other than roads	12.90	2.1	4,973.3	1,533.9	11.3	1.2	10.8	0.79	-	-
Urban Grass lands	33.64	2.5	19,346.3	872.0	-	-	-	-	-	-
Urban Stream Channel	0	0	-	-	-	-	-	-	-	-
Total Area and Total Loads	59.1	7.6	28,011.7	2,717.4	26.48	2.7	14.8	1.1	59.7	4.5
<u>Note:</u> Shaded values are of interest for this CMP given the location of the outlet.										

Table 19 Maketu Contaminant loading (Ref CLM based on ARC guidelines – May 2006) based on 5 year 10 minutes first flush event i.e. flow rate of 438L/s and event volume of 263m³.

Land Use	Area (ha)	Contaminant Load (kg per year) for Maketu			
		TSS	Zinc	Copper	TPH
Roofs	0.3	16.6	0.1	-	-
Roads (total)	0.6	167.8	0.6	0.2	3.1
Paved Surfaces other than roads	0.4	124.2	0.2	-	-
Urban Grass lands	2.3	807.5	-	-	-
Urban Stream Channel	0	-	-	-	-
Total Area and Total Loads	3.6	1,116.2	0.9	0.2	3.1

The average contaminant concentrations of zinc, copper and TPH for Te Puke and Maketu is summarised in Table 20. When compared to the ANZECC 2000 guidelines, it indicates that concentrations of zinc are below the trigger levels recommended, however concentrations of copper appear above guidelines (bold values).

Table 20 Average contaminant concentrations at Te Puna and Minden catchments (Ref ARC CLM 2006)

	Average Concentrations (µg/L)		
	Zinc	Copper	Total Petroleum Hydrocarbons (TPH)
Te Puke – Ohineangaanga Stream Western Tributary	6.7	4.7	1.8
Te Puke – Ohineangaanga Stream Eastern Tributary	7.1	3.5	1.4
Maketu	6.2	2.1	2.3
Guidelines (ANZECC 2000)	8	1.3	-

In summary, for the CLM study area of Te Puke and Maketu, the CLM results indicate that the sources of contaminants are:

- Urban grass lands are the most significant sources of TSS;
- Roads and paved surfaces other than roads (including residential) are the primary sources of zinc (roofs being a secondary source);
- Roads are by far the most significant contributor of copper to stormwater contamination (if industrial and commercial activities are excluded from the assessment as these represent the majority of copper contamination generation as paved surface other than roads);
- Roads are the sole source of TPH in the study catchment.

9.2.2.2 Wastewater Contamination: Wastewater Network and Septic tanks

9.2.2.2.1 Wastewater Network

Based on GIS, Te Puke and Maketu have an existing wastewater network, with reduced risks of wastewater overflow into the stormwater system. Reduction or avoidance of potential sewage overflow within the existing wastewater reticulation system, and emergency procedures in response to any accidental sewage spillage, are in place as part of contamination source control measures.

Paengaroa and Pukehina do not have any sewer system developed. Additional wastewater contamination issues may be present in Paengaroa and Pukehina and have the potential to enter the stormwater and receiving environment.

9.2.2.2.2 Septic Tanks

It is unknown whether septic tanks are largely used within eastern catchments.

Given that lots or properties are not connected to wastewater network (Paengaroa and Pukehina), it is assumed that those would have septic tank or other onsite wastewater system.

9.2.3 Stormwater Treatment Requirements

The stormwater treatment requirements for WBOPDC are currently stipulated in the Design Standard 5 of the Development Code (2009). This design standards cover the key components of stormwater treatment system, including primary/secondary drainage systems, and important stormwater detention/treatment devices. The Code was developed largely in line with the specifications provided in current versions of the following key publications:

- The IPENZ Procedure for Hydrological Design of Urban Stormwater Systems, December 1980
- The Building Industry Authority's (E1 Surface Water)
- TP10 (Stormwater Management Devices; Design Guidelines Manual)
- TP124 (Low Impact Design Manual).

9.2.4 Stormwater Quality Improvement Methods

The following stormwater quality improvement methods have been identified to be potentially implemented within the eastern catchments.

- Vegetative Filter Strips and Swales
- Permeable Pavement
- Filter Devices (e.g. raingardens)
- Wetlands
- Ponds
- Proprietary Treatment Devices (e.g. StormFilters).

As the eastern catchments are small urban settlements (although Te Puke, Paengaroa, Maketu/Little Waihi and Pukehina have significant different landuses), there are numerous options available for stormwater treatment. BOPRC and WBOPDC support, where practical a "treatment train" approach,

that is, a range of stormwater management practices providing the best all round solution, with no heavy dependence on any one individual system (refer Stormwater Management Guidelines 2012/01 for BOPRC).

As stated in BOP RWLP 2014 (section 4.2.5, paragraph 8):

it is the intent of this regional plan to encourage the discharge of stormwater to land soakage, where this is appropriate to the environmental limitations of the site. Land soakage is preferable to discharges to surface water bodies. Low Impact Design of urban areas (e.g. minimising the area of impermeable surfaces and retaining natural flood retention areas), and innovative management of stormwater (e.g. swales, land soakage, wetlands, infiltration systems, reuse of stormwater) are emphasised in Methods 119, 120, 138, 139 and 140 in section 4.2.4.

A range of practices is discussed in general terms below:

- Vegetative Filter Strips and Swales

These options rely on the passage of water across areas of dense vegetation cover to reduce contaminant loading. They generally do not provide the desired suspended solid removal on their own, though they can reduce the size requirements for any treatment device installed downstream. Vegetative filter strips and swales also aid in the infiltration of stormwater runoff and can be aesthetically appealing. The devices are particularly appropriate for use around heavily trafficked road, carparks and storage areas.

Vegetative filter strips and swales are more commonly used where grades are less than approximately 5%. However, with the use of regular riprap drop structures, swales can be applied to sites with overall ground slope of up to 10% while keeping the swale grades of up to 5%. The Te Puke, Paengaroa and Pukehina urban catchments are generally flat therefore this will make the application of swales to provide an element of stormwater quality for the roading network ideal. Maketu urban catchment includes steep gradients, therefore swales would not be easily applied everywhere in the urban catchment.

- Permeable Pavement

Permeable pavement designs allow stormwater to infiltrate through the paving surface into the sub-base. Potential benefits are primarily associated with stormwater treatment by filtration through the pavement structure in particular the sub-base, and lesser runoff rates and volumes than conventional pavement due to infiltration and storage of stormwater within the sub-base. Permeable paving is best suited to parking areas rather than heavily trafficked roads.

The only evident application in the eastern catchments would be the Te Puke catchment, due to the more urban landuse than other catchments.

- Filter Devices

This option involves the construction of structures that filter the contaminants by filter mediums. These devices range from concrete chambers that can be placed online on existing stormwater pipe systems to a more natural “rain garden” approach comprising a small depression infilled with a sand/soil filter/growing medium. These could be potentially applied to all eastern catchments, where feasible, depending on soil type and drainage qualities.

- Wetlands

Wetlands rely on the slowing down of stormwater runoff in shallow impoundment devices that are densely vegetated to allow some settlement or adhesion of the suspended solids to the vegetation. If properly constructed, these devices can have a high aesthetic and habitat value.

- Ponds

Ponds were historically used to manage stormwater quality and quantity and, similar to wetlands, their functionality is reliant on impoundment of contaminants within excavations. The depth of these devices is prone to fluctuating thermal dynamics and can contribute to reduce Dissolved Oxygen downstream.

Stormwater detention ponds have been identified as feasible in Te Puke Area 3 (T&T 2016); pipe upgrades are planned for Paengaroa (WBOPDC LTP 2018 - 28) and upper catchment attenuation for

Maketu (WBOPDC LTP 2018 - 28). Pukehina appears to be heavily constrained with land availability and therefore stormwater detention pond is unlikely to be a feasible solution in this catchment.

- Proprietary Treatment Devices

Another stormwater quality treatment option is the use of Proprietary Treatment Devices. Various 'off the shelf' stormwater treatment devices are currently available in the marketplace i.e. StormFilters, SandFilters, Downstream Defenders, Continuous Deflector Separator (CDS) units and catchpit filter bag systems. These devices have both high capital and maintenance costs and are generally more appropriate for infill development situations. These devices are mostly implemented in commercial and industrial areas and therefore may not be applicable to most of the eastern catchments where built-up areas are mostly used as residential areas.

Te Puke and Paengaroa may present the opportunity for proprietary treatment devices if commercial /industrial activities are anticipated to be developed in those urban catchments.

9.3 Summary of Stormwater Management Issues

A summary of all stormwater management issues and quantity and quality improvement options at eastern catchments identified in previous sections is provided in Table 21.

Table 21 Description of Stormwater Management Issues and Typical Mitigation Measures for the Eastern Catchments

Issue	Stormwater Issue		Description	Typical Mitigation
	Quality	Quantity		
Flooding	✓	✓	- Stream flooding can affect ecology and cause bank and bed erosion - Increased volumes of runoff from increase in impervious area can result in higher frequency of property inundation - Damage to riparian margin due to flooding - Increase in flow velocities in streams which may lead to erosion	- Exclude development from sensitive areas - Include stormwater mechanisms to integrate public amenity and increase ecological value - Protect streams and enhance riparian environments
Overland flow paths	✓	✓	Damage to natural overland flow paths, which leads to reduced stormwater conveyance capacity and loss of natural features	- Maintain overland flow paths for stormwater conveyance - Restore reaches of overland flow path that link to intermittent streams - Where overland flow paths cannot be accommodated in the road corridor, exclude development that reduces their conveyance capacity
Steep slopes	✓	✓	Steep slopes are associated with high flow velocities and greater erosion potential. This can lead to incised streams and slope instability.	- Enhance riparian margins to slow flow velocities and reduce erosion - Minimise earthworks on steep sites
Contaminant generation	✓		Increased contaminant generation and load to freshwater and stream environments	- Educate residents on ways to reduce contaminant loads in stormwater - Incorporate stormwater systems into recreational areas and greenspaces to improve water quality - Monitor water quality in the receiving environment and develop mitigation options if required.

10.0 Assessment of Environmental Effects

This section describes the actual and potential effects on the respective catchments from development across the catchment with respect to flooding and stormwater quantity, water and sediment quality, ecology and habitat, and social and cultural values, as well as public health. A statutory assessment is provided in Appendix C.

The following sections provide an assessment of effects based on risks and effects ranking from low, medium, high (major) risks of effects occurring at each catchment. Methodology for assessment of level of risks and effects is based on PMS 2013 and ICMP for Central Catchments (PMS 2014 and AECOM 2017).

Potential effects and levels of risk have been assessed ranging from 'Low' to 'Medium – High' but not very low (negligible), nor very high for current and potential effects due to development. In some instances, levels of risks have been identified over two scales due to the spatial differences occurring in the catchment and scale of effects depending on type of catchment values affected.

10.1 Te Puke Assessment of Environmental Effects

An Assessment of Environmental Effects on Te Puke catchment values due to actual and potential development (including operations), and current landuse effects (e.g. agriculture / horticulture) is provided in Table 22. This effectively creates a baseline, or snap-shot of the current situation.

Table 22 Te Puke Assessment of Effects

Catchment Values	Related Risks and Effects	Details of Potential Effect at Te Puke	Levels of Risk	Potential applicable location
Environment	Water quantity / Flooding	Increased impervious areas will increase runoff rates and volumes at outlets	Medium - High	Catchment wide
		Infilling of natural flow paths and increase of floodable areas	Medium - High	Catchment wide vulnerable areas for flooding, existing OLFP
Environment / Social and cultural		Flooding due to natural disaster, climate change, sea level rise	Low	Catchment wide vulnerable areas for flooding, existing OLFP
Environment	Stream and Receiving environment	Reduction in riparian vegetation (indigenous biodiversity) and habitat, i.e. loss of shading, increased stream bank erosion, sediment loads and turbidity	Medium - High	All waterways
		Reduction in catchment vegetation (indigenous biodiversity) and habitat	Medium - High	All waterways
		Disturbance of stream connectivity and habitat, creation of barriers to fish passage	Medium - High	All waterways
		Stream channel erosion, land stability	Medium - High	All waterways
Environment	Water Quality / Receiving environment	Impacts on water quality and ecological habitats from construction activities and increased runoff from development (increased impervious areas will generate accumulation of pollutants onto and wash off in stormwater runoff)	Medium - High	Catchment wide

Catchment Values	Related Risks and Effects	Details of Potential Effect at Te Puke	Levels of Risk	Potential applicable location
Environment	Water Quality / Contaminant Management	Contamination from erosion and sedimentation (lack of silt control) during construction (earthworks)	Medium - High	Catchment wide
		Air Pollution (development, industrial activities, increased motor vehicle emissions, fire) and deposit of contaminant in waterways through stormwater runoff	Low	Catchment wide
		Discharges from domestic and industrial activities	Medium - High	Te Puke West - Landuse specific (outside of catchment)
		Contamination of water quality due to presence of livestock	Medium	Landuse specific, some areas are more at risk than others (e.g. Cannell Farm Drive Waterway)
		Contamination from dumping of Waste (entering groundwater and stormwater systems)	Medium	Catchment wide
		Contamination of water quality due to use of pesticides, insecticides and fertilisers	Medium	Landuse specific
		Contamination of water quality due to presence of pest animal (possums, rodents, etc.)	Low	Landuse specific
		Contamination from Contaminated Sites	Medium	Catchment wide
Environment, Public Health and Cultural	Contaminant Management / Groundwater Hazards	Contamination from wastewater reticulation system issues (sewer overflows) and leakage from septic tanks (not being maintained appropriately and regularly) - potential effects on environment, public health and community engagement/programs	Medium - High	Catchment wide
Environment, Public health, social and cultural	Stream, Public health and Social	Poor water quality including alga blooms has the potential to impact public health and social/cultural values	Medium	All waterways, especially those used for recreational purposes
Social and Environment	Stream and Receiving environment	Invasion of Pest plants (weeds): effects on habitat and recreational areas	Medium	All waterways
Public health	Contaminant Management and Public health	Inadequate management of litter and discharge to waterways	Low - Medium	All waterways
Public health	Public health and Safety	Accidents related to natural disaster and vandalism	Low - Medium	Catchment wide

Catchment Values	Related Risks and Effects	Details of Potential Effect at Te Puke	Levels of Risk	Potential applicable location
		Accidents related to construction		
Cultural and Public health	Cultural and Public health	Limited knowledge of sensitive cultural areas and human impacts due to extensive development and tourism	Low - Medium	Catchment wide
Cultural	Impervious areas impacting cultural values	Cultural Values of historical and spiritual significance could be impacted by uncontrolled development.	Medium	Catchment wide
Social, Regulatory and Economic	Impervious areas impacting social and economic values	Reduction in harvesting of food products will impact community's income Reduction in tourism activities	Low	Landuse specific
Regulatory and Environment	Regulatory and Receiving Environment	Potential adverse effects on the receiving environment due to a lack of consistent and regular monitoring	Medium	Catchment wide
Regulatory and Economic	Regulatory	Fines or prosecution under the RMA (e.g. uncontrolled development, adverse effects on the environment etc.)	Low	Catchment wide
Regulatory and Social	Stormwater Strategy Implementation	Community consultation and engagement for stormwater strategy implementation	Medium	Catchment wide

10.2 Paengaroa Assessment of Environmental Effects

An Assessment of Environmental Effects on Paengaroa catchment values due to actual and potential development is provided in Table 23.

Table 23 Paengaroa Assessment of Effects

Catchment Values	Related Risks and Effects	Details of Potential Effect at Paengaroa	Levels of Risk	Potential applicable location
Environment	Water quantity / Flooding	Increased impervious areas will increase runoff rates and volumes at outlets	Medium	Catchment wide
		Infilling of natural flow paths and increase of floodable areas	Medium - High	Catchment wide vulnerable areas for flooding, existing OLFP
Environment / Social and cultural		Flooding due to natural disaster, climate change, sea level rise	Low	Catchment wide vulnerable areas for flooding, existing OLFP
Environment	Stream and Receiving	Reduction in riparian vegetation (indigenous biodiversity) and habitat,	Low - Medium	Only one waterway (Pokopoko) located

Catchment Values	Related Risks and Effects	Details of Potential Effect at Paengaroa	Levels of Risk	Potential applicable location
	environment	i.e. loss of shading, increased stream bank erosion, sediment loads and turbidity		to the east of Paengaroa catchment
		Reduction in catchment vegetation (indigenous biodiversity) and habitat	Low - Medium	Pokopoko Stream
		Disturbance of stream connectivity and habitat, creation of barriers to fish passage	Low - Medium	Pokopoko Stream
		Stream channel erosion, land stability	Medium	Pokopoko Stream
Environment	Water Quality / Receiving environment	Impacts on water quality and ecological habitats from construction activities and increased runoff from development (increased impervious areas will generate accumulation of pollutants onto and wash off in stormwater runoff)	Medium	Catchment wide
Environment	Water Quality / Contaminant Management	Contamination from erosion and sedimentation (lack of silt control) during construction (earthworks)	Medium - High	Catchment wide
		Air Pollution (development, industrial activities, increased motor vehicle emissions, fire) and deposit of contaminant in waterways through stormwater runoff	Low	Catchment wide
		Discharges from domestic and industrial activities	Medium - High	Landuse specific
		Contamination of water quality due to presence of livestock	Medium	Landuse specific
		Contamination from dumping of waste (entering groundwater and stormwater systems)	Medium	Catchment wide
		Contamination of water quality due to use of pesticides, insecticides and fertilisers	Medium	Landuse specific
		Contamination of water quality due to presence of pest animal (possums, rodents, etc.)	Low	Landuse specific
		Contamination from Contaminated Sites	Medium - High	Catchment wide
Environment, Public Health and Cultural	Contaminant Management / Groundwater Hazards	Contamination from lack of wastewater reticulation system and leakage from septic tanks (not being maintained appropriately and regularly) - potential effects on environment, public health and community engagement/programs	Medium - High	Catchment wide
Environment, Public health, social and cultural	Stream, Public health and Social	Poor water quality including alga blooms has the potential to impact public health and social/cultural values	Medium - High	Pokopoko Stream, especially areas used for recreational

Catchment Values	Related Risks and Effects	Details of Potential Effect at Paengaroa	Levels of Risk	Potential applicable location
				purposes
Social and Environment	Stream and Receiving environment	Invasion of Pest plants (weeds): effects on habitat and recreational areas	Medium - High	All waterways
Public health	Contaminant Management and Public health	Inadequate management of litter and discharge to waterways	Low - Medium	Pokopoko Stream
Public health	Public health and Safety	Accidents related to natural disaster and vandalism Accidents related to construction	Low - Medium	Catchment wide
Cultural and Public health	Cultural and Public health	Limited knowledge of sensitive cultural areas and human impacts due to extensive development and tourism	Low - Medium	Catchment wide
Cultural	Impervious areas impacting cultural values	Cultural Values of historical and spiritual significance could be impacted by uncontrolled development.	Medium	Catchment wide
Social, Regulatory and Economic	Impervious areas impacting social and economic values	Reduction in harvesting of food products will impact community's income Reduction in tourism activities	Medium	Landuse specific
Regulatory and Environment	Regulatory and Receiving Environment	Potential adverse effects on the receiving environment due to a lack of consistent and regular monitoring	Low - Medium	Catchment wide
Regulatory and Economic	Regulatory	Fines or prosecution under the RMA (e.g. uncontrolled development, adverse effects on the environment etc.)	Low	Catchment wide
Regulatory and Social	Stormwater Strategy Implementation	Community consultation and engagement for stormwater strategy implementation	Medium	Catchment wide

10.3 Maketu / Little Waihi Assessment of Environmental Effects

An Assessment of Environmental Effects on Maketu / Little Waihi catchment values due to actual and potential development is provided in Table 24.

Table 24 Maketu / Little Waihi Assessment of Effects

Catchment Values	Related Risks and Effects	Details of Potential Effect at Maketu/Little Waihi	Levels of Risk	Potential applicable location
Environment Environment / Social and cultural	Water quantity / Flooding	Increased impervious areas will increase runoff rates and volumes at outlets	Medium - High	Catchment wide
		Infilling of natural flow paths and increase of floodable areas	Medium - High	Catchment wide vulnerable areas for flooding, existing OLFP
		Flooding due to natural disaster, climate change, sea level rise	Medium	Catchment wide vulnerable areas for flooding, existing OLFP
Environment	Stream and Receiving environment	Reduction in riparian vegetation (indigenous biodiversity) and habitat, i.e. loss of shading, increased stream bank erosion, sediment loads and turbidity	Medium - High	All waterways
		Reduction in catchment vegetation (indigenous biodiversity) and habitat	Medium - High	All waterways
		Disturbance of stream connectivity and habitat, creation of barriers to fish passage	Medium - High	All waterways
		Stream channel erosion, land stability	Medium - High	All waterways
Environment	Water Quality / Receiving environment	Impacts on water quality and ecological habitats from construction activities and increased runoff from development (increased impervious areas will generate accumulation of pollutants onto and wash off in stormwater runoff)	Medium - High	Catchment wide
Environment	Water Quality / Contaminant Management	Contamination from erosion and sedimentation (lack of silt control) during construction (earthworks)	Medium - High	Catchment wide
		Air Pollution (development, industrial activities, increased motor vehicle emissions, fire) and deposit of contaminant in waterways through stormwater runoff	Low	Catchment wide
		Discharges from domestic and industrial activities	Medium	Landuse specific
		Contamination of water quality due to presence of livestock	High	Landuse specific, some areas are more at risk than others (e.g. Little Waihi Rd Stream lower catchment)

Catchment Values	Related Risks and Effects	Details of Potential Effect at Maketu/Little Waihi	Levels of Risk	Potential applicable location
		Contamination from dumping of Waste (entering groundwater and stormwater systems)	Medium	Catchment wide
		Contamination of water quality due to use of pesticides, insecticides and fertilisers	Medium	Landuse specific
		Contamination of water quality due to presence of pest animal (possums, rodents, etc.)	Medium	Landuse specific
		Contamination from Contaminated Sites	Medium	Catchment wide
Environment, Public Health and Cultural	Contaminant Management / Groundwater Hazards	Contamination from wastewater reticulation system issues (sewer overflows) and leakage from septic tanks (not being maintained appropriately and regularly) - potential effects on environment, public health and community engagement/programs	Medium - High	Catchment wide
Environment, Public health, social and cultural	Stream, Public health and Social	Poor water quality including alga blooms has the potential to impact public health and social/cultural values	Medium - High	All waterways, especially those used for recreational purposes (lower catchments)
Social and Environment	Stream and Receiving environment	Invasion of Pest plants (weeds): effects on habitat and recreational areas	Medium - High	All waterways
Public health	Contaminant Management and Public health	Inadequate management of litter and discharge to waterways	Low - Medium	All waterways
Public health	Public health and Safety	Accidents related to natural disaster and vandalism Accidents related to construction	Low - Medium	Catchment wide
Cultural and Public health	Cultural and Public health	Limited knowledge of sensitive cultural areas and human impacts due to extensive development and tourism	Low - Medium	Catchment wide
Cultural	Impervious areas impacting cultural values	Cultural Values of historical and spiritual significance could be impacted by uncontrolled development.	Medium	Catchment wide
Social, Regulatory and Economic	Impervious areas impacting social and economic values	Reduction in harvesting of food products will impact community's income Reduction in tourism activities	Low	Landuse specific
Regulatory	Regulatory	Potential adverse effects on the	Medium	Catchment wide

Catchment Values	Related Risks and Effects	Details of Potential Effect at Maketu/Little Waihi	Levels of Risk	Potential applicable location
and Environment	and Receiving Environment	receiving environment due to a lack of consistent and regular monitoring		
Regulatory and Economic	Regulatory	Fines or prosecution under the RMA (e.g. uncontrolled development, adverse effects on the environment etc.)	Low	Catchment wide
Regulatory and Social	Stormwater Strategy Implementation	Community consultation and engagement for stormwater strategy implementation	Medium	Catchment wide

10.4 Pukehina Assessment of Environmental Effects

An Assessment of Environmental Effects on Pukehina catchment values due to actual and potential development is provided in Table 25.

Table 25 Pukehina Assessment of Effects

Catchment Values	Related Risks and Effects	Details of Potential Effect at Pukehina	Levels of Risk	Potential applicable location
Environment	Water quantity / Flooding	Increased impervious areas will increase runoff rates and volumes at outlets	Medium	Catchment wide
		Infilling of natural flow paths and increase of floodable areas	Medium - High	Catchment wide vulnerable areas for flooding, existing OLFP
Environment / Social and cultural		Flooding due to natural disaster, climate change, sea level rise	Low	Catchment wide vulnerable areas for flooding, existing OLFP
Environment	Stream and Receiving environment	Reduction in riparian vegetation (indigenous biodiversity) and habitat, i.e. loss of shading, increased stream bank erosion, sediment loads and turbidity	Medium - High	All drainage canals and receiving environment
		Reduction in catchment vegetation (indigenous biodiversity) and habitat	Medium - High	All drainage canals and receiving environment
		Disturbance of stream connectivity and habitat, creation of barriers to fish passage	Medium - High	All drainage canals and receiving environment
		Stream channel erosion, coastal erosion and land stability	Medium - High	All drainage canals and receiving environment
Environment	Water Quality / Receiving environment	Impacts on water quality and ecological habitats from construction activities and increased runoff from development (increased impervious areas will generate accumulation of pollutants onto and wash off in	Medium - High	Catchment wide

Catchment Values	Related Risks and Effects	Details of Potential Effect at Pukehina	Levels of Risk	Potential applicable location
		stormwater runoff)		
Environment	Water Quality / Contaminant Management	Contamination from erosion and sedimentation (lack of silt control) during construction (earthworks)	Medium - High	Catchment wide
		Air Pollution (development, industrial activities, increased motor vehicle emissions, fire) and deposit of contaminant in waterways through stormwater runoff	Low	Catchment wide
		Discharges from domestic and industrial activities	Medium - High	Landuse specific
		Contamination of water quality due to presence of livestock	Medium - High	Landuse specific
		Contamination from dumping of Waste (entering groundwater and stormwater systems)	Medium	Catchment wide
		Contamination of water quality due to use of pesticides, insecticides and fertilisers	Medium - High	Landuse specific
		Contamination of water quality due to presence of pest animal (possums, rodents, etc.)	Low	Landuse specific
		Contamination from Contaminated Sites	Medium	Catchment wide
Environment, Public Health and Cultural	Contaminant Management / Groundwater Hazards	Contamination from lack of wastewater reticulation system and leakage from septic tanks (not being maintained appropriately and regularly) - potential effects on environment, public health and community engagement/programs	Medium - High	Catchment wide
Environment, Public health, social and cultural	Stream, Public health and Social	Poor water quality including alga blooms has the potential to impact public health and social/cultural values	Medium - High	All drainage canals and receiving environment, especially areas used for recreational purposes
Social and Environment	Stream and Receiving environment	Invasion of Pest plants (weeds): effects on habitat and recreational areas	Medium	All drainage canals and receiving environment
Public health	Contaminant Management and Public health	Inadequate management of litter and discharge to waterways	Low - Medium	All drainage canals and receiving environment
Public health	Public health and Safety	Accidents related to natural disaster, coastal erosion and vandalism Accidents related to construction	Low - Medium	Catchment wide
Cultural and Public health	Cultural and Public health	Limited knowledge of sensitive cultural areas and human impacts	Low - Medium	Catchment wide

Catchment Values	Related Risks and Effects	Details of Potential Effect at Pukehina	Levels of Risk	Potential applicable location
		due to extensive development and tourism		
Cultural	Impervious areas impacting cultural values	Cultural Values of historical and spiritual significance could be impacted by uncontrolled development.	Medium	Catchment wide
Social, Regulatory and Economic	Impervious areas impacting social and economic values	Reduction in harvesting of food products will impact community's income Reduction in tourism activities	Low	Landuse specific
Regulatory and Environment	Regulatory and Receiving Environment	Potential adverse effects on the receiving environment due to a lack of consistent and regular monitoring	Medium	Catchment wide
Regulatory and Economic	Regulatory	Fines or prosecution under the RMA (e.g. uncontrolled development, adverse effects on the environment etc.)	Low	Catchment wide
Regulatory and Social	Stormwater Strategy Implementation	Community consultation and engagement for stormwater strategy implementation	Medium	Catchment wide

To address potential effects on the catchment values, as identified in previous sections 10.1 to 10.4, suggested options and recommendations are listed in section 11, with suggested monitoring in section 12.

11.0 Option Evaluation and Recommendations

Section 11 provides an evaluation of a range of potential management options against catchment objectives and stormwater quantity and quality requirements. Assessment has been made against economic, environmental, social, cultural and public health factors.

This section also identifies catchment specific recommendations for mitigation through appropriate stormwater management approaches. In particular these may be either implemented or programmed for implementation. Further non-structural and structural recommendations for the management of stormwater quantity, quality and stream improvements, may also be referenced.

In addition to the solutions outlined below and in Table 26 and 27, Ngati Whakaue ki Maketu submitted a number of initiatives which have been incorporated into Table 28.

11.1 Option Evaluation

Option evaluation will include assessment of stormwater treatment methods and stormwater quantity improvement methods, based on the current landuse of the eastern catchments and the catchment values identified in section 8.0.

This section will evaluate both engineering and non-engineering solutions.

11.1.1 Engineering Solutions

Future development areas such as Te Puke Structure Plan Area 3 (refer to maps in Appendix A) could include Water Sensitive Urban Design (WSUD) options such as bioretention devices, green roofs, rainwater tanks and reduction of impervious areas in order to treat at source and reduce any potential leaching of contaminants from roof materials. More traditional engineering solutions such as ponds, wetlands and swales would also be applicable.

Within the Te Puke Structure Plan Areas, Paengaroa and Maketu upper catchment areas, it is noted that gullies and streams within the catchments and sub catchments may be suitable, for use as components of the management approach for stormwater retention, conveyance and treatment, when combined with associated riparian planting and enhancement.

Proprietary devices and treatment swales are appropriate measures to manage sediment, heavy metals and TPH contaminants from highly traffic roads. Te Puke and Paengaroa appear to be the only catchments where those proprietary devices may be applicable, provided further assessment is undertaken.

Stormwater pipework upgrades have been assessed as required in a few areas in Te Puke and Pukehina. In addition, installation of a wastewater network within Paengaroa and Pukehina will help mitigate any potential effects on the receiving environment and groundwater hazards due to wastewater contamination.

11.1.2 Non Engineering Solutions

In addition to engineered solutions a range of non-engineering approaches to stormwater management should also be considered. These include:

- Monitoring performance against levels of service for stormwater and waste water systems (including septic tanks).
- Implementation of a clear stormwater management strategy for the WBOPD including policies, SMART objectives, monitoring performance, reporting and review.
- Clear District Plan policy, objectives and rules to encourage the implementation of stormwater management devices in order to manage the effects of future development and the development of higher risk activity zones such as industrial areas.
- Public awareness and education with respect to discharge of contaminants which can be entrained in stormwater and the effects that they have on the community values and the environment.

- Implementation of programmes for community engagement in riparian planting and stream enhancement, in particular to address the stream banks erosion in Te Puke and Maketu.
- Targeted regular environmental monitoring programmes to determine the levels of stream erosion, contamination of water sources and overall stream health. This would be helpful in setting environmental baselines in areas earmarked for future development or where high risk activities occur. Environmental trends over time can then be monitored. This could also include a follow up of water quality monitoring in drains following installation of waste water reticulation system.
- Clear strategy and rules around identification of flood prone areas and flood plains associated with rules to manage development in such areas.

WBOPDC has already begun to implement non engineering approaches through the Community Plans and the Te Puke Built Environment Strategy and the Stormwater Strategy which sets out the following objectives landuse strategy and priorities:

- Recognise the relationship and values of Tangata Whenua to the built and natural environment.
- Ensure that the scale of new development is in relation to the existing built environment.
- Ensure the development of functional, safe and quality open space systems.
- Avoid or mitigate adverse effects of development on the natural environment.
- Encourage wetlands as a stormwater cleansing system.
- Protect and preserve the water in our rivers and streams.
- Urban development is avoided in flood prone areas unless mitigation measures can be provided that do not affect the capacity/effective functioning of existing downstream stormwater systems.

Table 26 presents the assessment matrix for each of the different stormwater management options and their applicability to the land use of the subject catchments. It highlights the following points:

- Biofiltration (swales and filter strips) have the highest overall treatment value due to their relatively low cost and good level of contaminant removal for the most important attached pollutants and fine sediments.
- Wetlands, pervious paving and rain gardens are second highest, all with approximately the same rating. Although the wetlands and rain gardens have higher removal efficiency, they have a higher cost.
- Extended detention ponds have approximately the same rating as wetlands and rain gardens but have the added benefit of effectively managing large volumes of stormwater runoff to enable discharges to better mimic the natural hydrological regime.
- Proprietary devices such as Sand Filters, StormFilters and primary separators have the lowest rating with only low to medium removal efficiencies and relatively high cost.
- Source control is used to reduce contaminants at source such as zinc leaching products that could be contaminating stormwater from roof run off. Retrofitting of existing buildings would not be a feasible solution therefore this should only be implemented on new development.
- Riparian management and planting are ecological opportunities that provide benefits to enhance stream quality, contaminant removal, ecological enhancement, public health and social/cultural benefits.

A range of stormwater management options that could potentially be applied by retrofitting within existing urban areas or in response to new development is provided in Table 27 (with ✓ indicating potential applicability and — indicating potentially difficult to implement / landuse not applicable). It is noted that the majority of the contaminants of concern are associated with roads and paved surfaces other than roads with zinc leaching occurring from roofs in some areas (refer section 9.2.2.1). The evaluation of stormwater management devices is focussed on the treatment of these sources.

Table 26 Eastern Catchments - Stormwater Quantity and Quality Assessment Matrix per landuse

Stormwater Management Device	Applicability	Impacts on the Catchment Values				
		Environmental	Economic	Social	Cultural	Public Health
Construction wetland/retention basin	All landuse with sufficient area for wetland footprint. Community Device for catchment/sub catchment scale.	★ High removal efficiency	▲ High costs ¹	● Slight positive impact	● Slight positive impact	★ Positive impact
Extended detention basin	All landuse with sufficient area for pond footprint. Community Device for catchment/sub catchment scale.	● Medium removal efficiency	● Medium costs ¹	● Slight positive impact	● Slight positive impact	★ Positive impact
Rain gardens & bioretention basins	Urban Areas: Residential, commercial industrial. Smaller sub catchment scale.	★ High removal efficiency	▲ High costs	★ Positive impact	★ Positive impact	● Slight positive impact
Stormwater swales	Urban and Residential Areas. Road side. Smaller sub catchment scale.	● Medium removal efficiency	★ Low costs ²	● Slight positive impact	● Slight positive impact	★ Positive impact
Pervious paving for parking areas	Urban Areas: Commercial Areas and higher density residential development.	● Medium removal efficiency	● Medium costs	▲ No impact	▲ No impact	▲ No impact
Riparian buffers (riparian management and planting)	Stream and Gullies	★ Positive impact	● Medium costs	★ Positive impact	★ Positive impact	● Slight positive impact
Rainwater tanks	Urban Areas: Residential, commercial industrial.	● Medium removal efficiency	● Medium costs	● Slight positive impact	● Slight positive impact	★ Positive impact
Primary Separators (StormFilters Enviropod)	Industrial Areas	▲ Low removal efficiency	★ Low costs ²	▲ No impact	▲ No impact	★ Positive impact
Source Control	New Development: Residential, commercial industrial areas.	● Medium removal efficiency	▲ High costs ³	▲ No impact	▲ No impact	★ Positive impact

1. Higher cost per unit constructed, but serves a larger number of properties.

2. Lower cost per unit installed, but only single or a small number of properties served.

3. It would be difficult to enforce new roof construction, and this could therefore generate more costs.

Table 27 Eastern Catchments Stormwater Quality Assessment per well being

Stormwater Treatment Approach	Assessment Criteria against Wellbeings				Recommended Use for Eastern Catchments			
	Environment	Economic	Social/Cultural	Public Health	Te Puke	Paengaroa	Maketu / Little Waihi	Pukehina
Constructed wetland/ retention pond	High removal efficiency	High cost	Slight positive impact	Positive impact	✓	✓	✓	—
	- Improve water quality through settlement, adsorption and biological processes - Storage of peak runoff volumes for release after storm events - Design can provide fish passage when connected to streams - Improved water quality of receiving streams and less potential for stream erosion - Significant earthworks required for construction - Sediment, traffic and noise management required during construction	- Significant footprint of wetland for large catchment or sub-catchment scale which may require purchasing of land - Each wetland will be relatively costly to construct and maintain but serves multiple properties as “community” scale device	- Can be applied at catchment or larger sub-catchment scale - Typically managed by WBOPDC - Awareness and education of public water quality issues - Offers opportunity for improved amenity and aesthetics of device - Can effectively manage flood risk	- Provide amenity - Improve the water quality of receiving environment, decreasing likelihood of human contact with contaminated water	- Apply for community/catchment scale stormwater management - WBOPDC to specify design construction requirements/ controls in Contract Conditions. - Contractors to carry out work during low flow periods to minimise sediment transport. - Device to be vested in WBOPDC to facilitate effective operations and maintenance. - Health and safety requirements to be incorporated into design. Signage to warn public of stormwater discharge during flood events.			
Detention Basin	Medium removal efficiency	Medium cost	Slight positive impact	Positive impact	✓	✓	✓	—
	- Provide effective water quantity and peak flow management as well as treatment. - Improved water quality of streams and less potential for stream erosion. - Significant earthworks required for construction - Sediment, traffic and noise management required during construction	- Significant development required to allow footprint of pond - Each pond will be relatively costly to construct and maintain but serves multiple properties as “community” scale device	- Can be applied at catchment or larger sub-catchment scale - Typically managed by WBOPDC - Visible stormwater treatment increases awareness and education of public water quality issues - Designed correctly, there is the opportunity for improved amenity and aesthetics of device - Can effectively manage flood risk, reducing damage to public and private property.	- Provide amenity - Improved water quality of receiving environment, decreasing likelihood of human contact with contaminated water	- Apply for community/catchment scale stormwater management - WBOPDC to specify design construction requirements/ controls in Contract Conditions. - Contractors to carry out work during low flow periods to minimise sediment transport. - Device to be vested in WBOPDC to facilitate effective operations and maintenance. - Health and safety requirements to be incorporated into design. Signage to warn public of stormwater discharge during flood events.			

Stormwater Treatment Approach	Assessment Criteria against Wellbeings				Recommended Use for Eastern Catchments			
	Environment	Economic	Social/Cultural	Public Health	Te Puke	Paengaroa	Maketu / Little Waihi	Pukehina
Rain gardens & bioretention basins (Bioretention basins act as large rain gardens that periodically receive & contain runoff for treatment)	High removal efficiency - Improved water quality of streams and less potential for stream erosion. - Minimal earthworks - Some potential dust, noise and traffic issues but of short duration during construction	Positive impact - Land required for rain garden, but option for creation of common greenspace area within the development - Lower per unit cost relative to wetlands and ponds but each unit only manages runoff from single or few properties. - Potential increase in WBOPDC performance management and enforcement costs.	Positive impact - Typically applied close to source and involves multiple devices serving relatively small catchments - Often owned privately or by body corp - Enforcement & control of maintenance & operation can be challenging. - Visible stormwater treatment increases awareness of public water quality issues - There is the opportunity for improved amenity and aesthetics of device - At source treatment aligns with design approach aims	Slight positive impact - Provide amenity - Improved water quality of receiving environment, decreasing likelihood of human exposure to contaminated water	✓	✓	✓	✓
Stormwater swales (Can be located both within the road corridor and alongside driveways)	Medium removal efficiency - Contaminant removal before discharging to receiving environment - Minimal earthworks required for construction - Some potential dust, noise and traffic issues but of short duration during construction	Low costs - Often located within road reserve, reducing the need to purchase land - Lower per unit cost relative to wetlands and ponds but each unit only manages runoff from single or few properties. - Potential increase in WBOPDC performance management and enforcement costs.	Slight positive impact - Requires commitment to implementing WSUD in development - Typically applied close to source and involves multiple devices serving relatively small catchments - Often private or body corporate ownership - Enforcements and control over maintenance and operation can be challenging. - Visible stormwater treatment increases awareness and education of public water quality issues - At source treatment aligns with design approach aims	Positive impact - Increased amenity - Improved water quality of receiving environment, decreasing likelihood of human exposure to contaminated water	✓	✓	—	✓
	- Construct along where the grade is less than 5% or provide erosion protection. - WBOPDC to specify design and construction requirements/ controls in Contract Conditions. - Contractors to carry out work to minimise sediment release.							

Stormwater Treatment Approach	Assessment Criteria against Wellbeings				Recommended Use for Eastern Catchments			
	Environment	Economic	Social/Cultural	Public Health	Te Puke	Paengaroa	Maketu / Little Waihi	Pukehina
Pervious paving for parking areas	Medium removal efficiency	Medium costs	No impact	No impact	✓	—	—	—
	- Improved runoff quality from removal of gross pollutants prior to discharge to stormwater system - Moderate earthworks	- Need to incorporate outside of high traffic areas. - Relatively high construction and maintenance costs compared to conventional road structure.	- Visible stormwater treatment increases awareness and education of public water quality issues - Can improve amenity - Usually located within private developments and managed as such. - Less effectively manage flood risk for large storm events	No impact	- Construct along with roads and within lots in low traffic environments - WBOPDC to specify construction requirements/controls in Contract Conditions. - Contractors to carry out work to minimise sediment release.			
Riparian Buffers (Riparian Management & Planting)	High removal efficiency	Medium costs	Positive impact	Slight positive impact	✓	✓	✓	✓
	- Improvements to instream ecosystem, water quality and erosion protection. - Restoration opportunities.	- High potential of Riparian management, planting and enhancement within Minden catchment - Potential to increase property values. - Relatively low cost to implement especially with community involvement.	- Potential to increase recreational and amenity value - Stream restoration/enhancement aligns with design approach	- Improved amenity - Improved instream water quality lessens impact on human health when interacting with waterways	- Community participation to be encouraged. - WBOPDC to specify construction requirements/controls in Contract Conditions. - Contractors to carry out work using less intrusive transport.			
Rainwater tanks	Medium removal efficiency	Medium costs	Slight positive impact	Positive impact	✓	✓	✓	✓
	Peak discharge management for smaller storms and resultant potential to reduce downstream erosion effects	- Land required for tank - Cost per property to install - Potential for reduced use of potable water.	Opportunities for water reuse	Provides water source for landscape irrigation	Minimise aesthetic and land effects by incorporating into the architectural design of buildings.			
Primary separators (StormFilters Enviropod)	Low removal efficiency	Low costs	No impact	Positive impact	✓	✓	—	—
	- Separators and enviropods provide stormwater pre-treatment only solids removal - Treatment at source	Installation and operational costs for developers and property owners	No benefits on social/recreational unless coupled with other management options	Reduces gross litter in public waterways	Minimise aesthetic and land effects by incorporating into the architectural design of buildings.			
Source control	Medium removal efficiency	High costs	No impact	Positive impact	✓	✓	✓	✓
	Contaminant removal at source - TSS, zinc and copper	Difficult to enforce, must be implemented on new roof construction	- Treatment at source can offer improved accountability of property owners for stormwater management - Can reduce choice of building materials to limit potential leaching of zinc and copper. - At source treatment aligns with design approach	Contaminant removal at source eliminates opportunity for human contact further down stormwater treatment train	Minimise land effects by incorporating into the concept design of subdivision and building design.			

11.2 Recommendations

This section summarises proposed recommendations to be implemented at specific locations in order to manage and /or improve stormwater discharges, and plan for implementation as part of the CMP for eastern catchments, refer Table 28 Although water quantity actions are listed first it should be noted that there is an equal emphasis on implementing both the water quality and quantity recommendations and actions.

Table 28 Recommendations Summary for the Eastern Catchments

Recommended Action No.	Related Issues	Issue Types	Opportunities	Location	Description of the Action	Relevant Objective(s)
1	Water Quantity / Flooding	Potential Flooding	To be defined depending on Hydraulic modelling results Maintain OLFP	Catchment wide	Update catchment hydraulic Modelling to incorporate 1% AEP storm event flood hazard mapping. Provide recommendation to address any potential flooding issue Review of the stormwater network	Mitigate the adverse effects of impervious surface on minimum flows and flooding issue
2	Water Quantity / Flooding	Drainage	Stormwater detention	Te Puke No 3 Rd and south of MacLoughlin Drive (Area 3 within Te Puke Structure Plan)	A series of stormwater detention ponds to the south of MacLoughlin Drive are proposed to be implemented.	Alleviate flooding potential as result of proposed development.
3	Water Quantity / Flooding	Drainage	Stormwater detention and treatment systems installation, combined with ecological restoration opportunities (e.g. associated riparian planting and enhancement – refer Stream Actions No 15).	Paengaroa Restoration (Black Rd outlet): Conway Rd reserve planting and Lemon Rd gully part restoration.	Stormwater detention and treatment systems installation, combined with ecological opportunities for creation of vegetation and habitat provision (e.g. saline wetland, freshwater wetland and terrestrial coastal communities). It would provide habitat for indigenous fish.	Provide a recharge of Stream
4	Water Quantity / Flooding	Drainage	Stormwater detention	Maketu Upper Catchment Attenuation	Stormwater Detention in ponds where suitable within upper catchment area of Maketu. Consider rock formations in Maketu/Little Waihi that may slow the flow effect of the water and reduce sedimentation.	Alleviate downstream flooding issues due to the undersized network.
5	Water Quantity / Flooding	Drainage	Stormwater pipework upgrade	- Te Puke: Lee St, Harris St, Noel Bowyer Park, Fairview Pl, Brown T, Princess St, Saunders Pl, Seddon St, Raymond Dunlop, Bishoprick, Williams Dr, Oxford St, Boucher Av, King St, Beatty Av, Galway Pl, Queen St, Norrie St, Commerce Ln, Jocelyn St, Washer Pl, Clydesburn Av, Malyon St, Tynan St, Stewart St, Hayward Ct to Atuaroa Av, Jellicoe St, Muir Pl, No 3 Rd. Paengaroa: Upgrades Halls Rd - Pukehina: Beach Rd Stage 2-8 - Pukehina: Parade Stage 6, 10, and 13	Stormwater pipe network upgrade to rectify undersizing issues	Network and catchment drainage improvement. Reduce overland flow.
6	Water Quality / Contaminant Load Modelling	Contaminant Management	Opportunity to gain an understanding of stormwater discharge quality in order to target any potential treatment management option for each catchment.	Catchment wide Update of CLM Te Puke (TP-E) and Maketu, and undertake CLM for Paengaroa and Pukehina.	CLM was undertaken only at Te Puke and Maketu (date unknown) and included industrial and commercial landuse (refer section 9.2.2.1 of this CMP). No CLM for Paengaroa and Pukehina. Undertake CLM at all catchments covering the entire catchment boundaries as defined in Appendices A-1 to A-4. CLM will normally address both current and	Provide a better picture of the contaminant load modelling in the eastern catchments in order to target adequate stormwater management and treatment measures.

Recommended Action No.	Related Issues	Issue Types	Opportunities	Location	Description of the Action	Relevant Objective(s)
					future scenario with and without stormwater management in place.	
7	Water Quality / Receiving Environment	Contamination Management	Stormwater Treatment Combination of community and at source devices for new development or high risk areas (existing and new development).	Identified in all eastern catchments, as applicable to Te Puke (refer Actions No 2, 5 and 6), Paengaroa (refer Actions No 3 and 6), Maketu (refer Actions No 4 and 6) and Pukehina (refer Actions No 5 and 6). Specific locations to be identified when further studies undertaken and further details of proposed development are available.	Install a combination of stormwater treatment pond/wetland with various LID biofiltration devices (swales, raingardens) in order to reduce contaminant discharge / improve stormwater quality. This will be based on the implementation of previous actions recommended (Actions No 2 to 6).	Reduce Contaminant Discharge, improve water quality and aesthetics
8	Water Quality / Wastewater / Groundwater Hazards	Contamination Management	Install wastewater network and improve Wastewater Treatment Reticulation. Opportunity for community engagement: inform residents of sewerage options.	Throughout Paengaroa and Pukehina Catchments	Install wastewater reticulation system within Paengaroa and Pukehina to provide level of service and avoid potential contamination of groundwater, stormwater and receiving environment.	Reduce Contaminant Discharge
9	Water Quality / Receiving Environment / Groundwater Hazards	Contamination Management	Septic tanks to be emptied, inspected, repaired and reported on at regular intervals.	Paengaroa and Pukehina Catchments as priority while wastewater network not installed. Where applicable in Te Puke and Maketu / Little Waihi.	Monitor and maintain septic tanks to avoid potential contamination of groundwater, stormwater and receiving environment.	Reduce Contaminant Discharge
10	Water Quality / Receiving Environment	Stormwater Discharge of Contaminants and Waste	Stream screen device fitting	Te Puke: Ohineangaanga Stream upper catchment	Fitting of screen device within stream	Catch debris from upstream
11a	Water Quality	Maintenance Action	Swales / Stormwater treatment devices regular maintenance	Various locations within the catchments.	Various stormwater treatment devices installation to reduce the discharge of contaminants - Swales maintenance plan	Maintain high water quality by avoiding, remedying or mitigating contaminant inputs Protect human health
11b	Water Quality / Asset Maintenance / Erosion	Maintenance Action	Outlets maintenance for reduction of stream bank erosion and reduction of discharge of suspended solids	Nine assets were identified in Te Puke catchment at Ohineangaanga Stream and the Cannell Farm Drive Waterway as requiring maintenance; all of which were associated with erosion. This could apply to other locations and catchments however no relevant information was provided to define those locations.	Undertake maintenance at stormwater outlets and outfall pipes. This will reduce stream bank erosion and suspended solids being discharged into waterways and the receiving environment.	Maintain high water quality by avoiding, remedying or mitigating contaminant inputs
12	Receiving Environment / Regulatory	Erosion and Sediment Control / Regulatory	Consistent specification of requirements to control sediment release during construction.	Priority should be given to all streams and drains which have the potential to be affected by construction throughout the catchments (in particular within the Te Puke Structure Plan area where residential growth is anticipated). This should be linked to review of subdivision and resource consent application with construction operations monitoring and management (regulatory). Note: Te Puke West (Commercial/industrial area: Raparapahoe Stream) is outside of	Erosion and Sediment Control should be implemented as priority during construction. For areas where commercial/industrial activities are to be undertaken (Te Puke west being outside of the scope of this CMP), specific environmental management to be implemented to reduce any potential sediment release into drains and streams. Additional preventive actions for potential	Mitigate potential sedimentary related effects associated with land disturbing activities

Recommended Action No.	Related Issues	Issue Types	Opportunities	Location	Description of the Action	Relevant Objective(s)
				the catchment and other commercial areas are located downstream of the catchment. Drains and streams within Paengaroa, Maketu and Pukehina should also be maintained and monitored.	stream bank instability and erosion such as riparian planting, improved riparian management of gullies and streams, and fencing streams where cattle are present.	
13	Receiving Environment / Public Health / Regulatory	Quality of Receiving Environment and potential impact on public health	Water Quality Monitoring Programmes: E. coli sampling in surface water and groundwater to be undertaken at all catchments (refer Action No 13a). - Recreational areas to be monitored (refer Action No 13b). - Stormwater sampling (refer Action No 13c).	All catchments – Repeat and implement regular Water Quality Monitoring Priority to be given to Maketu waterways where levels of metals were recorded.	Implement quality monitoring programs within all eastern catchments to understand seasonal differences i.e. repeat sampling rounds throughout the year to increase understanding of the water quality issues and assess any potential impact on the receiving environment and public health. Coordinate WBOPDC monitoring programs with BOPRC monitoring programs to allow for consistent monitoring of the receiving environment.	Identify any changes in water quality and thus reduce any potential impact on receiving environment and public health
13a	Receiving Environment / Groundwater Hazards	Contamination Management	<i>E. coli</i> monitoring in surface water has been identified as an environment monitoring action to be undertaken at all catchments. Groundwater monitoring of nutrients and <i>E. coli</i> to be undertaken for comparison. This will allow an assessment of potential contamination effects on stormwater and receiving environment.	All catchments Priority to be given to groundwater and water quality analysis to be undertaken for nutrients and <i>E. coli</i> at Maketu and Pukehina to assess potential effects (and causes) of contamination in stormwater – where waste water network not currently available.	Repeat monitoring of surface water (to be undertaken during various seasons throughout the year) and monitoring of groundwater to assess any potential contamination in streams and drains. This will allow understanding of potential contamination source: agricultural landuse, wastewater contamination (septic tanks leakage) or a cumulative effect.	Reduce Contaminant Discharge
13b	Public Health / Social / Regulatory	Stormwater Discharge of Contaminants	Environmental Monitoring targeted to areas used for recreational purposes to reduce any potential effect on public health.	Maketu and Pukehina present potential areas used for swimming and recreational usages. Other areas (freshwater/ coastal) in eastern catchments may be used for recreational areas, to be confirmed. Monitoring for <i>E. coli</i> include: - Te Puke (Raparapahoe Stream downstream), Cannell Farm Drive waterway - Paengaroa: Pokopoko Stream; - All streams in Maketu; and - Pukehina (unnamed canal).	Undertake water quality sampling at sites used for recreational purposes within Maketu and Pukehina in accordance with BOPRC monitoring programmes, parameters and sites. This will allow for public health risk assessment.	Reduce any potential effect on public health and receiving environment
13c	Receiving Environment / Public Health	Stormwater Discharge of Contaminants	Undertake stormwater discharge sampling at outlets. Monitor any potential impact on streams due to increased levels of metals and/or <i>E.coli</i> which could be attributed to surrounding landuse and / groundwater contamination.	To be undertaken at all catchments, i.e. including (but not limited to) proposed locations (TBC): - near Ohineangaanga Stream / Cannell Farm Drive waterway (Te Puke) and downstream location previously sampled (King Street). - outlet at north eastern boundary of Paengaroa catchment previously sampled (Tuapata Street), - outlet near Park Road/Maketu Estuary,	Undertake stormwater discharge sampling, if feasible, at locations where water quality guidelines were exceeded, particularly in relation to elevated heavy metal levels and <i>E. coli</i> . Feasibility will depend on asset locations. Resampled some of the relevant locations sampled in the past and additional sampling points have been proposed. Refer section 9 for proposed monitoring	Target stormwater management actions and treatment to landuse and sub catchment

Recommended Action No.	Related Issues	Issue Types	Opportunities	Location	Description of the Action	Relevant Objective(s)
				and outlet at Little Waihi (Waihi Estuary) – not sampled previously. discharge point at discharge point close to unnamed canal parallel to Pukehina canal (PA1B) in lower Pukehina catchment to compare with upper catchment sampling location on 340 Pukehina Beach Road (to be resampled as well for comparison). Priority is to be given to Maketu (Park Rd / Town Point Road Stream, Newdicks Beach Stream) and Pukehina (lower catchment).	programme.	
14	Streams	Stream Bank instability and erosion	Stream banks have been assessed in 2018 at a number of streams throughout the catchments. Results indicated that Te Puke streams present moderate to high erosion at western sections of the catchment. Maketu could not be fully assessed however moderate erosion was identified closed to the discharge to Maketu Estuary. Paengaroa and Pukehina did not present extensive erosion however north east of Pokopoko Stream in Paengaroa presented moderate erosion. Opportunities for improvement of stream bank instability exist throughout the eastern catchments and stream bank locations priorities have been identified. Plants to be utilised include native plants that can be used for rongoa (medicinal purposes) or are edible (kai) or that can be used for weaving whariki within the whare tupuna.	Te Puke streams of priority include: - Ohineangaanga stream (including upstream/throughout and downstream of the catchment where moderate and severe erosion was consistently identified) - Maintain Cannel Farm Driveway and unnamed waterway joining it. - Raparapahoe stream (severe erosion) on the western and north western end of the catchment. – however outside of CMP. Paengaroa: Pokopoko Stream downstream of the railway line in the vicinity of the Pa1B monitoring location. Maketu/Little Waihi: Further assessment will confirm details of action however lower reach of Little Waihi Beach Stream downstream of Ma1B is a priority. The Waitepuia Drain which discharges into the Maketu estuary has also been identified as a priority. The drain is located behind the Maketu Reserve / Whakaue Kaipapa Marae. Gullies and stormwater drains should be maintained throughout all catchments (including Little Waihi and Pukehina which do not present any stream locations to be targeted).	Preventive actions for potential stream bank instability and erosion such as riparian planting of 20m setback, improved riparian management of gullies and streams, in particular stream fencing in areas where cattle is present. Further bank erosion assessment should be targeted to assess: - any streams not included in the 2018 survey (i.e. Cannel Farm Driveway in its entirety, Wairoa River upstream of TP4, and other unnamed streams) through drone survey; and - Maketu waterways (through site walkover due to limitation of drone).	Reduce any potential stream bank instability and erosion
15	Streams	Fish Barrier	Ecological Opportunity	Any existing fish barriers within the eastern catchments, in particular review and maintenance of floodgates at Maketu as these were previously identified as potentially presenting a barrier to fish passage, and free-falling water from culverts (Newdick's beach stream)	Removal of fish barriers within eastern catchment to be addressed: floodgates, velocity barriers and free-falling water from culverts identified as potential barriers for fish passage.	Maintain or enhance fish passage for appropriate species by avoiding, remedying or mitigating effects of artificial barriers

Recommended Action No.	Related Issues	Issue Types	Opportunities	Location	Description of the Action	Relevant Objective(s)
16	Streams / Regulatory	Mitigation and Enhancement	Riparian Planting: Enhance and widen riparian margins where practicable (at urban areas) and ensure measures to protect riparian margins are implemented in current green field areas to minimise further impacts on neighbouring waterways. Riparian planting of 20m setback has been proposed in other areas throughout WBOPD. Include Iwi and hapu in the design concept for riparian planting and determine coordination of the planting. Consider a soft infrastructure approach especially discharging points before the Maketu estuary.	Various locations throughout eastern catchments but priority should be given to: - enhancement and widening at areas zoned for future urban development; - protection of riparian margins in current green field areas where urban growth and subdivision is expected.	Riparian planting (as part of ecological opportunities): Gully sides should be planted with locally-sourced indigenous species and opportunities for fish passage need to be considered and addressed if/when stormwater ponds are constructed. Implementation of programmes for community engagement in riparian planting and stream enhancement. Utilise overhanging evergreen foliage that promotes shade to the drains so that the drain ecosystems have places of shade away from te whiti o te rā (rays of the sun) and tawhirimatea (winds). Develop a management system for weed control of unwanted weeds such as pampus growing near drains in Maketu.	Reduce instream temperatures and improve reach connectivity by planting or enhancing riparian vegetation.
17	Streams / Social and Cultural	Potential Development Action	Cycling, Walking Tracks Te Puke Strategy provides priority that is relevant to the CMP, that is to establish walking and cycling links through reserves as per the Te Puke Network Plan. Within Maketu the Strategy provides two priorities that are relevant to the CMP boundary (refer proposed location).	Various locations in eastern catchments, Te Puke walking and cycling links through reserves as per the Te Puke Network Plan. Maketu: (i) through from Arawa Avenue to Otimi Street over private land; and (ii) where Spencer Street is closed to traffic. Paengaroa have cycleways proposed in its community development plan.	Opportunity for creating potential interlinked network of walking and cycling tracks, when gully systems will be retired and planted.	Provide recreational area with social/cultural benefits Drains that are visually appealing to look at, that have some form of Mātauranga Māori aspect to offer young children
18	Social / Public Health	Riparian Margins Protection	Create community initiatives to encourage local land owners to fence off streams from cattle and protect existing riparian margins.	Various locations in catchments, with specific locations examples identified: - Te Puke (Cannell Farm Drive Waterway), - Maketu (Little Waihi Road stream lower catchment).	Community Initiatives to encourage local land owners to protect streams and riparian margins.	
19	Social / Public Health	Stormwater Discharge of Contaminants	Social Opportunity	Applicability throughout WBOPD	Public awareness and education with respect to discharge of contaminants which can be entrained in stormwater and the effects that they have on the community values and the environment.	Reduce dumping waste into stormwater and maintaining protection of the environment.
20	Cultural	Stormwater Discharge of Contaminants	Cultural Opportunity	Catchment wide (refer section 8 of CMP and Community Development Plans for details of proposed locations)	Actions for protection and awareness of cultural values within the catchments, combined with environmental protection and reduction of potential contaminants discharge in stormwater.	
21	Environment / Social	Stormwater Discharge of Contaminants	Social Opportunity	Catchment wide (refer section 8 of CMP and Community Development Plans for details of proposed locations)	Prioritise environmental and social actions to be implemented in order to mitigate any potential impacts on the receiving	

Recommended Action No.	Related Issues	Issue Types	Opportunities	Location	Description of the Action	Relevant Objective(s)
					environment.	
22	Economic / Regulatory	Flooding - Economic	Community Engagement	Flood prone areas and flood plains areas within eastern catchments Note also coastal erosion risk areas for Pukehina. Hazard areas shown on WBOPDC planning maps. Refer to Appendix D.	Clear strategy and rules around identification of flood prone areas and flood plains associated with rules to manage development in such areas. Adopt a similar approach to coastal erosion risk for Pukehina.	Provide regulatory background to manage development in flood prone areas and flood plains; and also for coastal erosion risk for Pukehina.
23	Economic / Regulatory	Stormwater Strategy - Economic	Community Engagement Implement stormwater management strategies to improve catchment-wide water quality.	Applicability throughout the eastern catchments, placing priority in Maketu and Pukehina where ecological and water quality scored the poorest results.	Implementation of a clear stormwater management strategy for the WBOPD including policies, SMART objectives, monitoring performance, reporting and review.	Compliance with Stormwater CSC conditions Benefits to economic, environmental, cultural, social and public health values.

12.0 Monitoring Procedures and Review

This section describes the programme of environmental and hydrological monitoring that will (likely) be required by the CSC that will measure the level to which the objectives set out in section 8.0 are being achieved. The monitoring locations and outcome of monitoring carried out throughout the catchment have been identified, as per the actions recommended in section 11.2 of this CMP.

12.1 Background of discussions with BOPRC

It is understood that most of the stormwater discharges within the district are from stormwater catchments that are unlikely to result in significant effects in the receiving environment and do not warrant intensive sampling at this time.

Following discussions with BOPRC's Consent Officer, Environmental Scientist and Pollution and Prevention Manager, associated with the central catchment CMP, the following requirements in relation to the monitoring to support the comprehensive stormwater consent application were agreed upon:

- In each of the major settlements (Waihi Beach, Katikati and Te Puke) choose the watercourse which receives most of the stormwater and/or the poorest quality of stormwater (e.g. from industrial or commercial use {note these are not part of the CMP}, high traffic volume roads and/or dense residential areas) and provide justification for choosing the particular watercourse as being the worst case scenario.
- Take one upstream and one downstream sediment sample during late summer (March/April) and during winter (June/July) and analyse the samples for the 6 most common metals (Zinc, Copper, Chromium, Lead, Nickel, Arsenic) and total hydrocarbons.
- Undertake a Benthic Invertebrate Community Assessment of samples taken at the same locations as the sediment samples above. Benthic invertebrate (incl. Insects, worms and molluscs) are a key part of a stream ecosystem. Monitoring their presence and health is a powerful tool to assess background water quality.
- Undertake initial "first flush" sampling of key stormwater discharges points (outlets) coupled with a desktop assessment of the likely stormwater contaminant levels from within each of the key stormwater catchments in order of identifying discharges and therefore receiving environments of potential concerns.
- Provide any other supporting information from other sources such as compliance monitoring results, fish surveys, environmental assessments etc.

WBOPDC will discuss a District wide monitoring programme with the BOPRC.

12.2 Stormwater Monitoring

Table 29 provides a proposed monitoring programme for eastern catchments. This is based on the review of all receiving environment monitoring results.

It is proposed that monitoring sites chosen for Te Puke and Paengaroa (sampled by WBOPDC, refer section 6.6.5) be retained. For Pukehina, an additional downstream sampling location is required to assess effects of stormwater given that only an upstream location was sampled. At this stage additional sampling will be required for the Maketu stormwater sampling.

Table 29 Eastern Catchments CSC Monitoring and Review

CSC Monitoring and Review Conditions	Conditions comments
Develop a monitoring program including sampling locations, frequency, process and reporting.	Water quality of the stormwater is recommended to be monitored regularly during wet weather events at winter and summer seasons in order to detect any potential contamination and enhance the quality of water bodies. It is recommended that at least key contaminants of concern for urbanised catchments be monitored: • pH, Total Suspended Solids; <i>E.coli</i>, (potentially enterococci and Faecal coliforms for sewer contamination investigation at Paengaroa and Pukehina); • Metals (Zinc, Copper) and • Total Petroleum Hydrocarbons (TPH). Proposed locations of potential worst case contamination in stormwater discharge are proposed at representative outlets/discharge points within each eastern catchments (feasibility of locations to be confirmed with topography, flow during wet weather, access and suitability): • near Ohineangaanga Stream / Cannell Farm Drive waterway (Te Puke) and downstream location previously sampled (King Street). • outlet at north eastern boundary of Paengaroa catchment previously sampled (Tuapata Street), • outlet near Park Road/Maketu Estuary, and outlet at Little Waihi (Waihi Estuary) – not sampled previously. • discharge point close to unnamed canal parallel to Pukehina canal (PA1B) in lower Pukehina catchment to compare with upper catchment sampling location on 340 Pukehina Beach Road (to be resampled as well for comparison). Report results to BOPRC annually unless exceedances to trigger levels reported and non-compliance actions to be implemented and reported. It is also proposed that Iwi and hapū are consulted as to how matauranga can be incorporated into the monitoring of stormwater and the receiving environment. It is proposed that a condition in the comprehensive stormwater consent provides for an annual update to Iwi and hapū on the progress in implementing the catchment management plan. This annual update would also provide an opportunity for Iwi and hapū to liaise with Council on ongoing issues or concerns of cultural importance.
Compliance of monitoring and definition of trigger levels	Trigger levels for stormwater sampling to be defined for freshwater and marine waters (after ten rounds of baseline monitoring) based on: ANZECC (2000) guidelines, NPSFM (MfE 2014) and Bay of Plenty Regional Coastal Environment Plan (BOPCP).

Actions in case of non-compliance	Actions to be developed such as: • Response to pollution incidents and tracking of causes (including bathing water quality where appropriate); • Additional targeted stormwater monitoring to isolate the cause of any adverse trend; • Correlation with other freshwater monitoring and marine monitoring at recreational areas. • Signage to inform the public in recreational areas; • Other specific actions could include stormwater treatment devices check and maintenance (performance upgrades for devices monitored); • Enforcement against polluters; etc.
Review of monitoring program	Timeframe, frequency, reviewers will be proposed and specific non-compliance events will trigger shorter timeframes.

12.3 Other Recommended Monitoring

Based on the review of all receiving environmental monitoring results, monitoring other than stormwater sampling is recommended (refer sections 6.6 and 11.2 of this CMP) as follow:

- Repeat freshwater quality sampling rounds throughout the year (following methodology used in AECOM 2018) to increase understanding of the water quality issues and assess any potential impact on the receiving environment and public health.
- Undertake water quality sampling at sites used for recreational purposes within Maketu and Pukehina to inform public health risk assessment. WBOPDC to coordinate with BOPRC monitoring programme.
- Carry out groundwater and water quality analysis for nutrients and *E. coli* at Maketu/Little Waihi and Pukehina to assess potential contamination (and whether stormwater management issues are likely due to surrounding landuse or wastewater leakage).

13.0 CMP Review

The CMP will be managed by the Three Waters Compliance Team Leader who reports to the Utilities Manager.

Performance review of CSC and CMP for eastern catchments will include:

- Revision and update of the CMP: proposed every 5 years; including recognition of cultural values.
- Review of the CSC conditions – frequency and conditions of review will be provided in the CSC by using a standard s128 RMA review clause;
- Compliance with the LTP 2018-28 Stormwater Goals and Targets, as follows;
 - Flood events
 - The number of times flooding occurs outside identified flood-prone urban areas during a one-in-50 year or less storm event will be limited to 3 events per year for 2019, 2020 and 2021, 3 events for the period 2022-24 and 3 events for the period 2025-28. This performance measure is assessed on a per event basis i.e. flooding in more than one location in a single event will be counted as 1.
 - Resident satisfaction level with stormwater systems, as monitored by the Annual Residents Survey; percentage of residents who are “very satisfied” or “satisfied”: greater or equal to ≥65% for 2019, 2020 and 2021, 2022-24 and 2025-28.
 - Stormwater Assets Level of Service
 - Based on the number of flooding events that occur within the District. For each flooding event (district wide), the number of habitable floors affected (expressed per 1,000 properties connected to Council’s stormwater system): shall not exceed 30 (3%) per event per year in 2019, 2020 and 2021, and shall not exceed 25 (3%) per event for the periods 2022-24 and 2025-28.
 - For a one in ten year flooding event, the number of habitable floors affected (expressed per 1,000 properties connected to Council’s stormwater system) shall not exceed 30 (3%) per event per year in 2019, 2020 and 2021, and shall not exceed 30 (3%) per event for the periods 2022-24 and 2025-28.
 - Compliance with Council’s resource consents for discharge from our stormwater system, measured by the number of 0 abatement notices, 0 infringement notices, 0 enforcement orders, and 0 convictions received by Council in relation to those resource consents for the period 2019-28.
 - Customer Responses to Stormwater Issues
 - The median response to attend a flooding event, measured from the time that Council receives the notification to the time that service personnel reach the site shall not exceed 120 minutes for the period 2018-228.
 - The number of complaints received by Council about the performance of its stormwater system, expressed per 1,000 properties connected to the Councils stormwater system shall not exceed 30 for 2019, 2020 and 2021 and shall not exceed 20 for the periods 2022-24 and 2025 - 28.

14.0 Standard Limitation

AECOM has prepared this CMP in accordance with the usual care and thoroughness of the consulting profession for the use of WBOPDC, and only those third parties who have been authorised in writing by AECOM to rely on this CMP.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this CMP.

It is prepared in accordance with the scope of work and for the purpose outlined in the eastern catchments Contract variation dated 20 December 2017.

Where this CMP indicates that information has been provided to AECOM by third parties (in particular for Floodmaps, modelling reports, environmental monitoring reports and results, erosion assessment, cultural impact assessment, community plans), AECOM has made no independent verification of this information except as expressly stated in the CMP. AECOM assumes no liability for any inaccuracies in or omissions to that information.

The draft CMP was prepared between and February and June 2018 and is based on the conditions encountered during the January 2018 site visit and information reviewed at the time of preparation. The draft CMP was updated in December 2018 following consultation with Iwi and the community. AECOM disclaims responsibility for any changes that may have occurred after this time.

This CMP should be read in full. No responsibility is accepted for use of any part of this CMP in any other context or for any other purpose or by third parties. This CMP does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Except as required by law, no third party may use or rely on this CMP unless otherwise agreed by AECOM in writing. Where such agreement is provided, AECOM will provide a letter of reliance to the agreed third party in the form required by AECOM.

To the extent permitted by law, AECOM expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this CMP. AECOM does not admit that any action, liability or claim may exist or be available to any third party.

Except as specifically stated in this section, AECOM does not authorise the use of this CMP by any third party.

It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the site.

15.0 References

- AECOM, Integrated Catchment Management Plan (ICMP) for Central Catchments (Te Puna and Minden urban catchments), Addendum to PMS CMP, 6 March 2017 for Resource Consent lodgement.
- AECOM. 2018. Freshwater ecological and water quality assessment. Auckland: AECOM NZ Limited.
- ANZECC 2000. Australian and New Zealand guidelines for fresh and marine water quality: Volume 1. Canberra, Australian and New Zealand Environment and Conservation Council.
- National Water Quality Management Strategy – Australian and New Zealand Guidelines for Fresh and Marine Water Quality trigger values, ARC 2006
- BOPRC 2005/002. Bay of Plenty Regional Council (BOPRC) Guidelines for the Development of Comprehensive Stormwater Consent (CSC) Applications and Catchment Management Plans (CMPs) No 2005/002
- BOPRC 2011. Regional Coastal Environment Plan. Environmental Publication 2003/08. Volume 1, updated 22 February 2011. Whakatane: Bay of Plenty Regional Council.
- Bay of Plenty Regional Council. 2009. <https://www.boprc.govt.nz/our-region-and-environment/coast/kaituna-maketu-and-pongakawa-waitahanui-catchments/kaituna-river-re-diversion-and-ongatoromaketu-estuary-enhancement-project/>
- BOPRC 2012/01. Bay of Plenty Regional Council. Stormwater Management Guidelines for the Bay of Plenty Region, Guideline 2012/01, April 2012.
- Clapcott J. 2015. National rapid habitat assessment protocol development for streams and rivers. Cawthron Report No. 2649. Prepared for Northland Regional Council. Nelson, Cawthron Institute.
- Connell Wagner Limited. 2007. Technical Engineering Report to support Te Puke West Private Plan Change Request to Western Bay of Plenty District Council for West Te Puke Industrial Park Te Puke Quarry Road, Te Puke. 2007
- Daughney CJ, Reeves R. 2005. Definition of hydrochemical facies in the New Zealand national groundwater monitoring Programme. Journal of Hydrology New Zealand Vol 44: 105-130.
- De Lange PJ, Norton DA, Heenan PB, Courtney SP, Molloy BPJ, Ogle CC, Rance BD, Johnson PN, Hitchmough R. 2004. Threatened and uncommon plants of New Zealand. New Zealand Journal of Botany: 42 (1): 45-76.
- Duffill Watts & King Ltd 1998. Report on Stormwater Management in Maketu, November 1998.
- Duffill Watts & King Ltd 2002. Report on Stormwater Management in Te Puke, May 2002.
- Duffill Watts & King Ltd 2005. Paengaroa Stormwater Catchment Management Plan, August 2005.
- Duffill Watts 2008. Pukehina Stormwater Catchment Management Plan, April 2008.
- Duffill Watts 2008. Review of the Waihi Land Drainage District, August 2008.
- Harrison Grierson 2002. Maketu/Little Waihi Stormwater System, May 2002.
- Harrison Grierson 2002. Maketu Roding Stormwater Improvements, July 2002.
- Hitchmough R, Bull L, Cromarty P. 2002. New Zealand threat classification system lists. Threatened species occasional publication, 23.
- Horne M. 2013. Cultural Impact Assessment Eastern Catchments. Prepared for WBOPDC Utilities Department.
- Maketu Projects Team and Maketu Community Board. 2014: Maketu Comprehensive Development Plan 2014 review.
- MfE [Ministry for the Environment] 2014. National Policy Statement for Freshwater Management 2014. Wellington, New Zealand Government.

- Ministry of Health. 2008. Drinking water standards for New Zealand 2005. Revised version 2008. Wellington: Ministry of Health.
- Ministry for the Environment and Ministry of Health. 2003. Microbiological water quality guidelines for marine and freshwater recreational areas. Ministry for the Environment Publication number: ME 474. Wellington: Ministry for the Environment.
- NOAA. 1999. Sediment Quality Guidelines Developed for the National Status and Trends Program. Report by the National Oceanic and Atmospheric Administration. Maryland: National Ocean Service.
- Opus 2012. Te Puke MIKE URBAN Stormwater Modelling Stage 2: Modelling Report: Te Puke Stormwater Model Build, November 2012
- Opus 2014. Te Puke Stormwater Modelling Stage 4: Modelling Report and Network Upgrade Costings, April 2014.
- Opus 2015. Te Puke Stormwater Modelling Stage 7: Modelling Report, May 2015.
- Paengaroa Community Representatives (Community Association Inc, School, Kindergarten, Hall Committee, Local Church Groups, Eastern Districts Rugby Club, comvita, local businesses). 2015. Paengaroa Community Plan 2015-2025. www.paengaroa.co.nz
- PMS 2013. Professional Management Services 2009 Ltd, Western Bay of Plenty District Council Comprehensive Stormwater Consents Application – Eastern Catchments Urban stormwater Catchment Management Plan No ESZ1 Catchment Te Puke, April 2013*
- PMS 2013. Professional Management Services 2009 Ltd, Western Bay of Plenty District Council Comprehensive Stormwater Consents Application – Eastern Catchments Urban stormwater Catchment Management Plan No ESZ2 Catchments Small Settlements, April 2013*
- PMS 2014. Professional Management Services 2009 Ltd, Western Bay of Plenty District Council Comprehensive Stormwater Discharge Consent Central Catchments, Urban Stormwater Catchment Management Plan (CMP) CSZ1-Small Settlements on behalf of WBOPDC version 2, PMS dated July 2014
- Ramsar Convention Secretariat. 2013. The Ramsar Convention Manual: a guide to the Convention on Wetlands (Ramsar, Iran, 1971), 6th ed. Switzerland: Ramsar Convention Secretariat.
- Rijkse WC, Guinto DF. 2010. Soils of the Bay of Plenty. Volume 1: Western Bay of Plenty. Environmental Publication 2010/11-1. June 2010. Whakatane: Environment Bay of Plenty.
- Stark JD 1985. A Macroinvertebrate Community Index of Water Quality for Stony Streams. Water & Soil Miscellaneous Publications, 87, 1-53.
- Stark JD, Maxted JR 2007. A biotic index for New Zealand's soft bottom streams. New Zealand Journal of Marine and Freshwater Research, 41, 43-61.
- Te Puke Community Board. 2016. Te Puke 20 Year Community Plan 2016 review.
- Thiel-Lardon K. 2013a. Comprehensive Stormwater Consents Application: Eastern Catchments. Urban stormwater catchment management plan no. ESZ1: Catchment Te Puke. Prepared on behalf of the Western Bay of Plenty District Council. Papamoa: Professional Management Services 2009 Ltd.
- Thiel-Lardon K. 2013b. Comprehensive Stormwater Consents Application: Eastern Catchments. Urban stormwater catchment management plan no. ESZ2: Catchment Small settlements. Prepared on behalf of the Western Bay of Plenty District Council. Papamoa: Professional Management Services 2009 Ltd.
- Tonkin and Taylor 2016. Te Puke Structure Plan Area 3 Stormwater Review, Report prepared for WBOPDC, February 2016.
- [USEPA] United States Environmental Protection Agency. 2006. National Recommended Water Quality Criteria 2006. EPA-822-R-02-047. USA: Office of Water and Office of Science and Technology, USEPA.

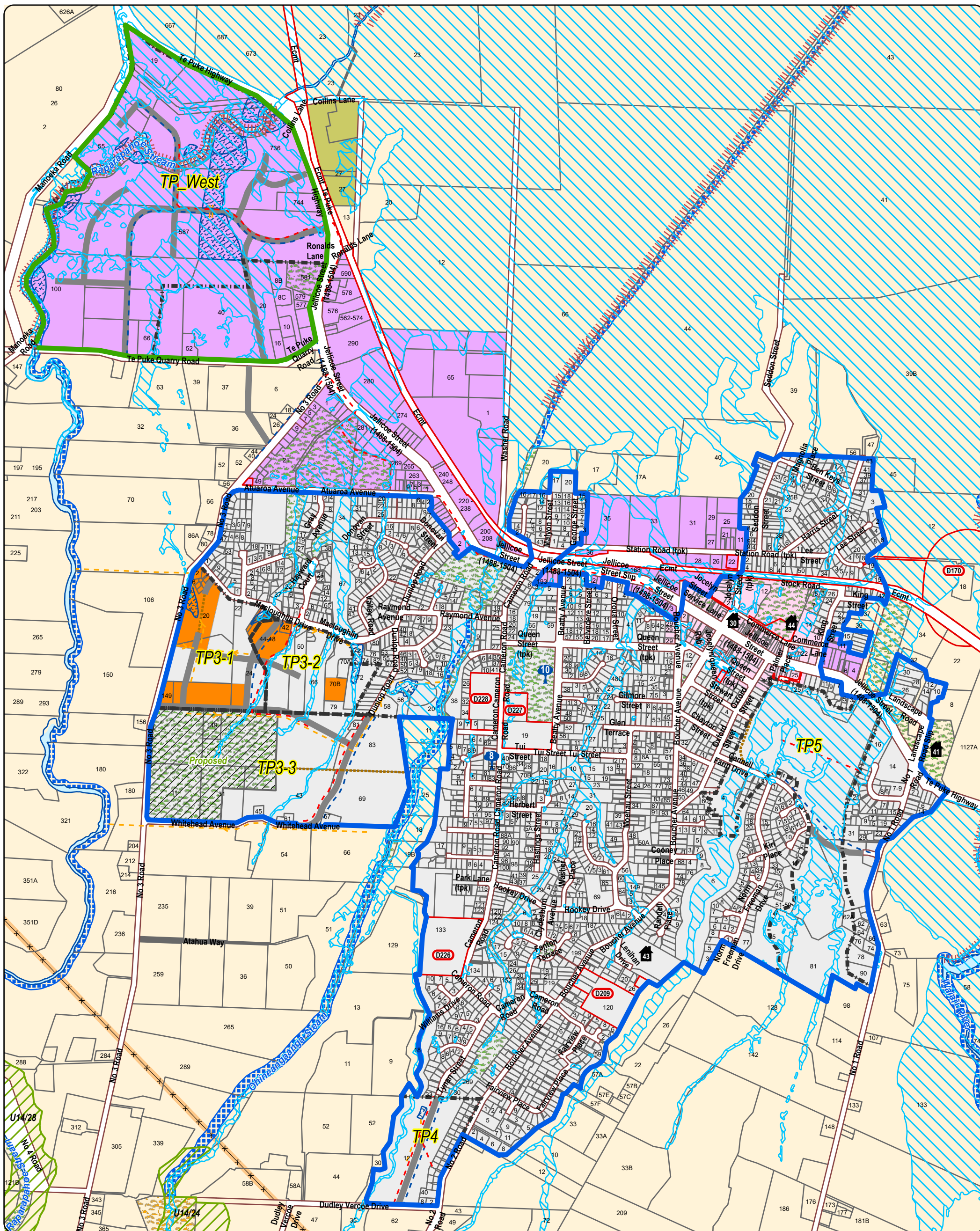
- WBOPDC Maketu Comprehensive Development plan Draft Version July 2007.
- WBOPDC. 2006. Te Puke Town Centre Plan.
- WBOPDC. 2008. Te Puke built environment strategy. Tauranga: Western Bay of Plenty District Council.
- WBOPDC. 2012. Te Puke Structure Plan/Te Puke Lifestyle Zone. Appendix 7, Section 8 and 9 in the Western Bay of Plenty operative district plan 2012. Tauranga: Western Bay of Plenty District Council.
- WBOPDC. 2017. MAPI - ArcMap & Geocortex Licenced to WBOPDC/BOPLASS. Revision Date: 29 July 2017. Western Bay of Plenty District Council.
- WBOPDC. 2018 - 28 Long Term Plan.
- White A, Mailhac C, Zemansky G, Kilgour G. 2009. Groundwater resource investigations of the Western Bay of Plenty area stage 1 – conceptual geological and hydrological models and preliminary allocation assessment. GNS Science Consultancy Report 2008/240, April 2009. Taupo: GNS Science Consultancy

Notes:

- * Referred to as PMS 2013 collectively defining the PMS CMP for eastern catchments dated 2013.

Appendix A

WBOPDC Planning Maps



Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
Date: 12/7/2017
Operator: jdm1
Map: E:\Shape\JDM\Pro Projects\Eastern CMP Paengaroa boundaries\Eastern CMP Paengaroa

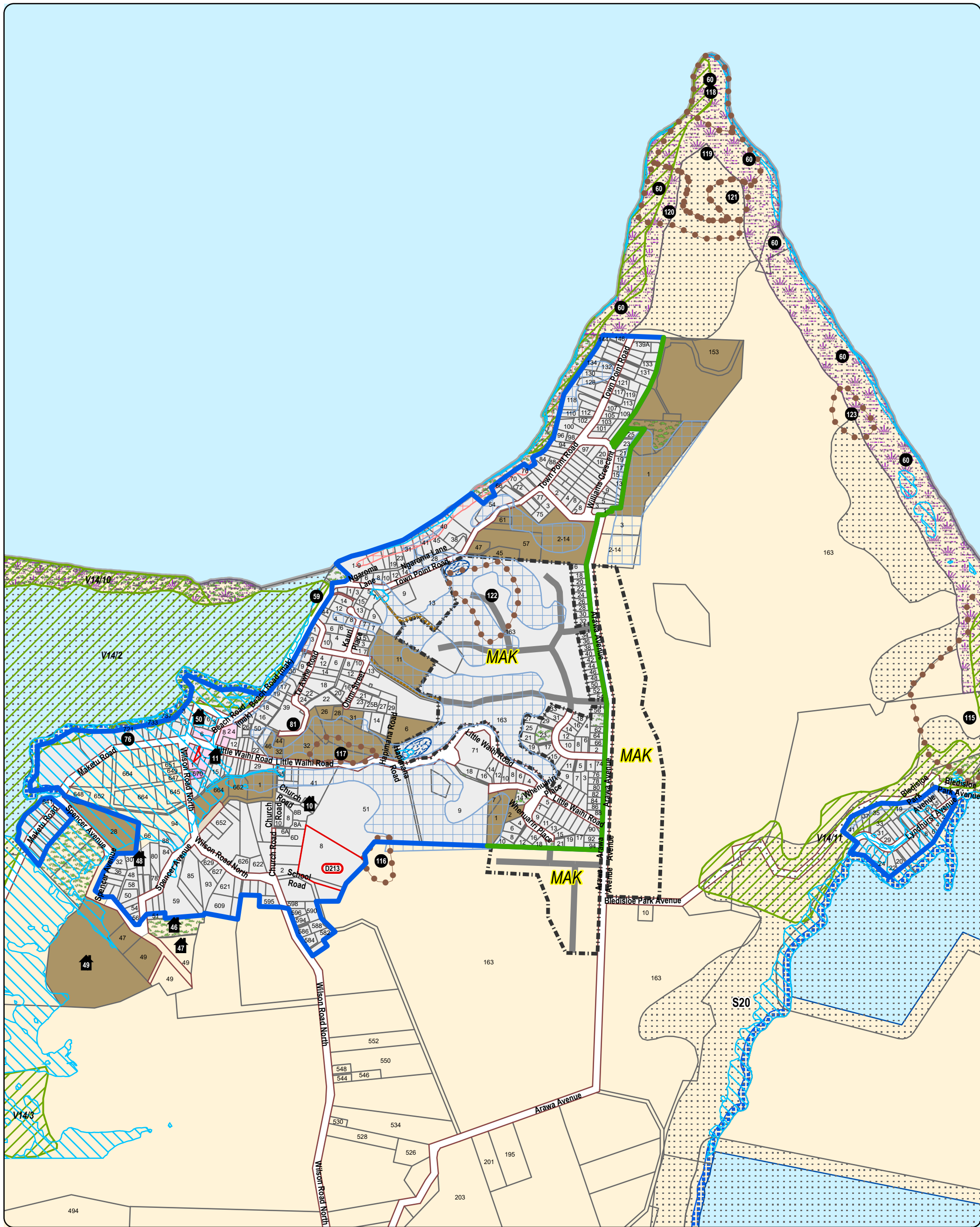
Scale A3 - 1:13,717

0 50 100 200 300 Meters

Te Puke Eastern Catchment Management Plan boundaries



**Western Bay of Plenty
District Council**



Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
Date: 12/7/2017
Operator: jdm1
Map: E:\Shape\JDM\Pro Projects\Eastern CMP Paengaroa boundaries\Eastern CMP Paengaroa

Scale A3 - 1:9,989

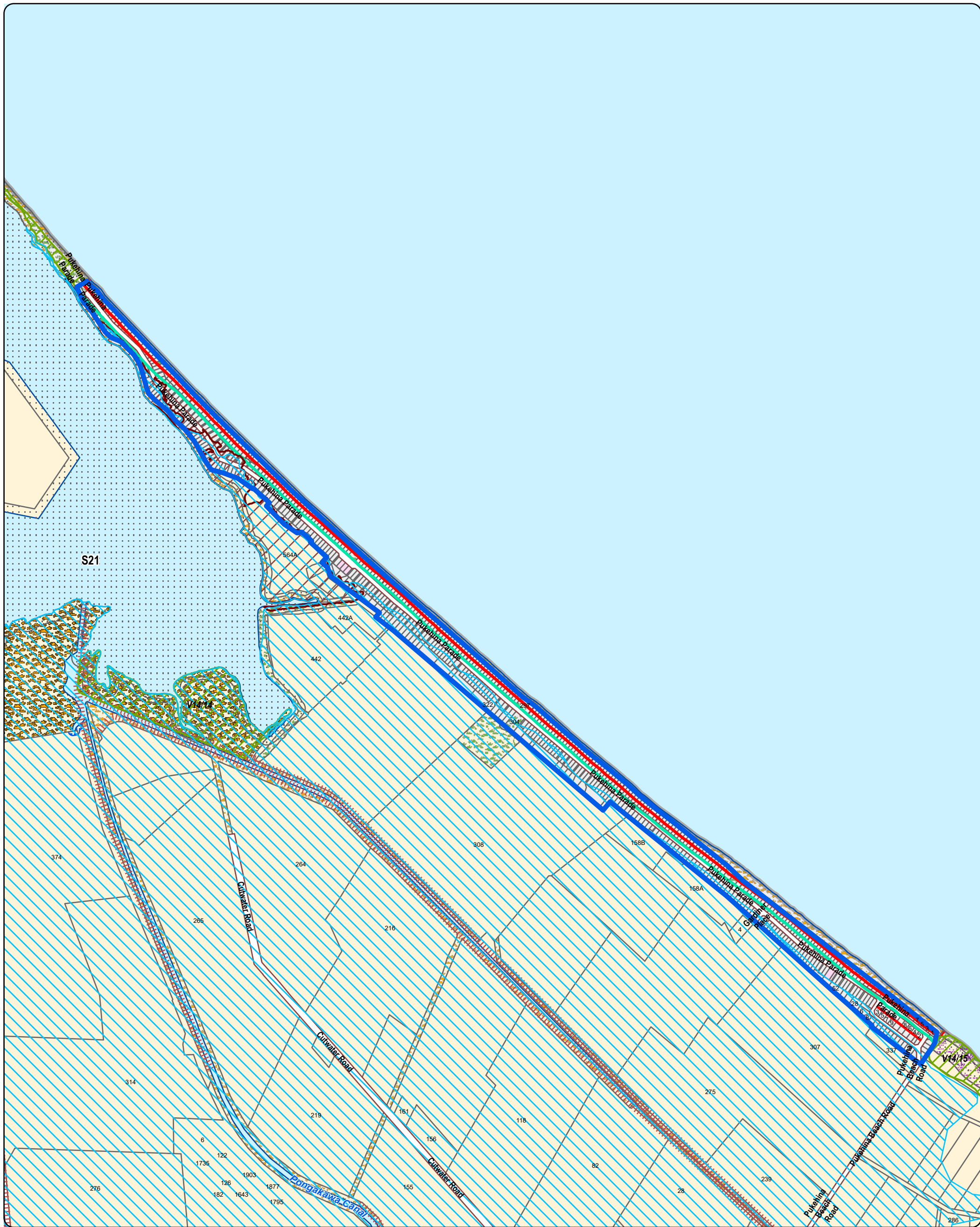
0 50 100 200 300 Meters

Maketu Eastern Catchment Management Plan boundaries



**Western Bay of Plenty
District Council**





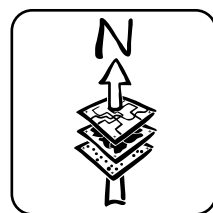
Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
Date: 12/4/2017
Operator: jdm1
Map: E:\Shape\JDM\Pro Projects\Eastern CMP Paengaroa boundaries\Eastern CMP Paengaroa

Scale A3 - 1:16,103
0 50 100 200 300 Meters



Pukehina Eastern Catchment Management Plan boundaries



Infrastructure		Airport Approach Surface
		Designation
		Formed Roads
		Limited Access
Reserves		Stop Bank
		Esplanade Strip
		Priority proposed esplanade strip/reserve
		Proposed esplanade strip/reserve
		Kaimai - Mamaku Forest Park Boundary
		Reserve
Significant Features		Reserve, Department of Conservation
		Viewshaft
		Significant Ecological Feature / RAP
		Outstanding Landscape Feature - 50m (S7a & S8a) - 40m (S9a)
		Outstanding Landscape Feature
		Cultural Heritage Feature Boundary
Structure Plan		Built Heritage Feature
		Cultural Heritage Feature
		Notable Trees
		Structure Plan Boundary
		Greenlane
		Road
Structure Plan		Stormwater
		Wastewater
		Water Supply
		Walk/Cycleway
		Reserve Area
		Stormwater Pond
Structure Plan		Minden Lifestyle Structure Plan Area Overland Flowpaths & Local Ecological Features

Bay of Plenty Regional Council should be consulted before undertaking any activity in the vicinity of Mean High Water Springs to establish the actual line of Mean High Water Springs.

Formed roads are indicated as white shading on the road land parcels. Unformed roads have the underlying zone indicated.

(1) Compliance with NZECP 34:2001 is required in this area for *buildings/structures* and *earthworks*. The distance quoted is from the centreline of the transmission line.

(2) The identified areas include; the community service area at Rangiora, the central hub site within the All Terrain Park and buffer zones in Stage 2 Omokoroa and Binnie Road.

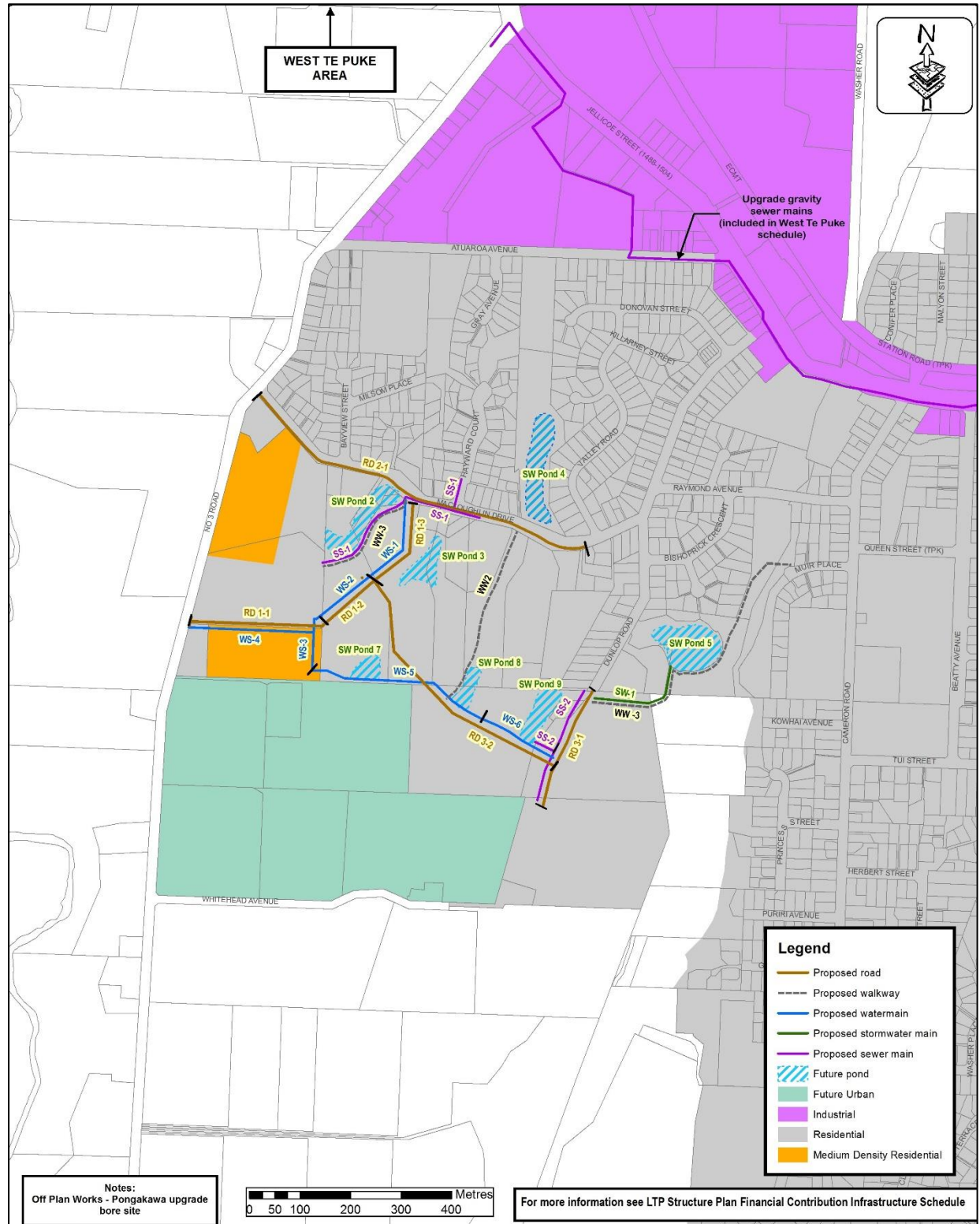
Legend

Land Hazards		Coastal Erosion Area - Primary Risk (3)
		Coastal Erosion Area - Secondary Risk (3)
		Coastal Erosion Area - Access Yard
		Coastal Erosion Area - Rural
		Coastal Inundation Area
		Flood Hazard
		Stability Area - Minden A
		Stability Area - Minden B1
		Stability Area - Minden B2
		Stability Area - Minden C
Zones		Stability Area - Minden U
		Stability Area - General
		Stability Area - Landslip
		All Terrain Park (ATP)
		Commercial
		Commercial Transition
		Horticultural Post Harvest
		Industrial
		Residential
		Medium Density Residential
Zone Overlays		Rural Residential
		Rural
		Lifestyle
		Future Urban
		District Boundary
		Electricity Transmission Line
		Electricity Transmission Line Buffer 16m (1)
		Firing Range Exclusion Zone
		Identified Area (2)
		Quarry Effects Management Area
Zone Overlays		TNL 100m Building Line Setback
		Town Centre Boundary
		Matakana Island Forested Sand Barrier

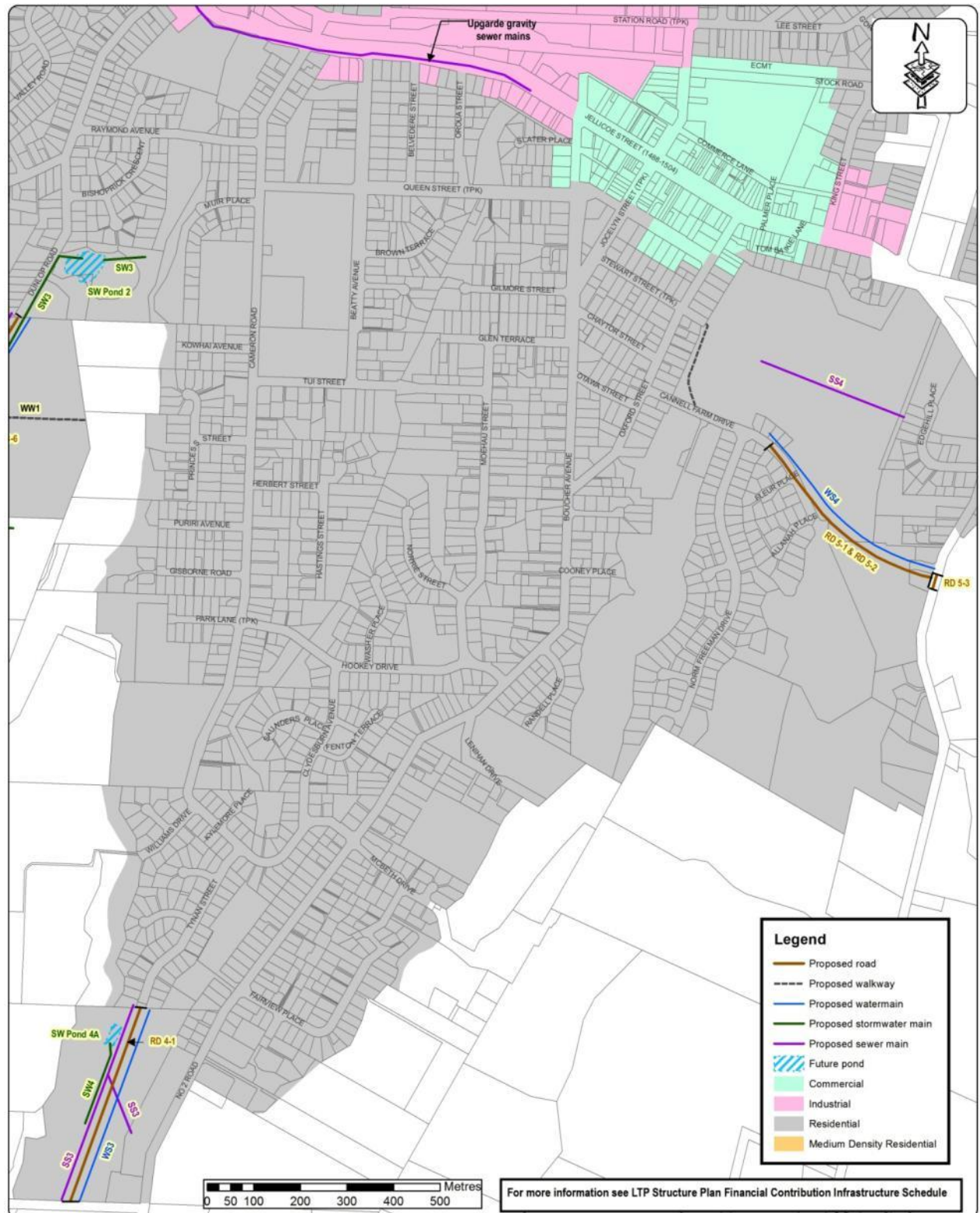
(3) Primary risk includes the whole of the red line and the land towards the sea. Secondary risk includes the whole of the green line up to the edge of the red line.

8. Te Puke Structure Plan

8.1 Te Puke Area 3 Structure Plan – Infrastructure



8.2 Te Puke Area 4 and 5 Structure Plan - Infrastructure



Appendix B

Consultation

Consultation Log - Eastern draft Catchment Management Plan

Date	Comments
12 July 2018	Cancelled - Tauranga Moana / Te Arawa ki Takutai Partnership Forum
24 July 2018	Presented to the Maketu Community Board
26 July 2018	Presented to the Te Puke Community Board
13 August 2018	Pukehina Residents and Ratepayers meeting, Pukehina Community Centre
15 August 2018	Open day – Paengaroa Community Hall, 5pm – 7pm
15 August – 16 Nov 2018	Councils Have Your Say Western Bay site set up: https://haveyoursay.westernbay.govt.nz/cmp
28 August 2018	Emails sent to Iwi and stakeholders (see table below for Iwi and stakeholders).
14 September 2018	Hui organised, cancelled due to lack of attendance
16 September 2018	Open day – Maketu Community Market Day
19 September 2018	Follow-up with stakeholders as follows: Department of Conservation – email sent directly to Jessica Bernard. Fish and Game NZ – spoke to Lyn and then Andy Garrick. Andy is going to look at the original email. Toi Te Ora Public Health – called and spoke to Charmaine. She was unable to determine who the email may have been forwarded to and the person who may have known was away in training. Ariell left contact number and asked her to follow up and call back. Forest and Bird – spoke to Peter Fergusson who suggested that Linda Conning was the correct person, email sent to Linda. Linda advised that the Te Puke branch was the correct contact. Forwarded email to the Te Puke branch on 20 September 2018.
20 September 2018	Open day - Te Puke Library and service centre, 5pm – 7pm
21 September 2018	Anneke Davis (Toi te Ora Health) called, discussed the proposal and process for providing feedback. Anneke's number is 07 378 5160.
2 October 2018	Presentation to Tauranga Moana / Te Arawa ki Takutai Partnership Forum (members outlined below)
19 October 2018	Presentation to the Te Maru o Kaituna River Authority (members outlined below)
26 October 2018	Hui with Iwi, Tapuika Boardroom Invited included; Vivienne Robinson, Hohepa Maxwell, Maria Horne, Elva Conroy, Raiha Biel, Kepa Morgan, Anthony Wihapi, Dean Flavell. In Attendance was Hohepa Maxwell.

26 October 2018	Hui with Ngati Pikiao
31 October 2018	Meeting with BOPRC including Asset Managers
1 November	Hui with Ngati Whakaue ki Maketu
August/September/October	Other channels as appropriate e.g. Council's Website, Te Puke District Update, Facebook, display at the Te Puke library

Iwi contacts

<u>Iwi name</u>	<u>Contact details</u>
Te Kapu o Waitaha	Contact: Vivienne Robinson Phone: 07 573 5314 Email: vivienne@waitaha-iwi.org.nz
Tapuika	Contact: Hohepa Maxwell Phone: 07 573 5351 Email: hohepa@tapuika.iwi.nz
Ngati Pikiao	Contact: Raewyn Bennett Phone: 07 533 2373 Email: raewynbennett@actrix.co.nz
Ngati Whakaue ki Maketu	Contact: Maria Horne Phone: 07 533 2101 Email: runanga@actrix.co.nz
Ngati Whakahemo	Contact: James Anderson Phone: 021 0227 4613 Email: resource@ngatiwhakahemo.org
Ngati Makino	Contact: Dr. Kepa Morgan Phone: 07 573 3370 Email: kepa@ngatimakino.co.nz
Ngati Rangitihi	Contact: Christopher Clarke Phone: 07 322 2453 Email: administrator@ngatirangitihi.iwi.nz
Te Pumautanga o Te Arawa Trust	office@tpota.org.nz
Te Arawa Lakes Trust	karen@tearawa.iwi.nz

Stakeholders

<u>Stakeholder name</u>	<u>Contact details</u>
Te Maru o Kaituna	Email info@kaituna.org.nz
Department of Conservation	Email: tauranga@doc.govt.nz 07 578 7677
Fish and Game NZ	eastern@fishandgame.org.nz 07 357 5501
Toi Te Ora Public Health	Email: enquiries@toiteora.govt.nz 0800 221 555
Forest and Bird	easternbayofplenty@forestandbird.org.nz tepuke.branch@forestandbird.org.nz

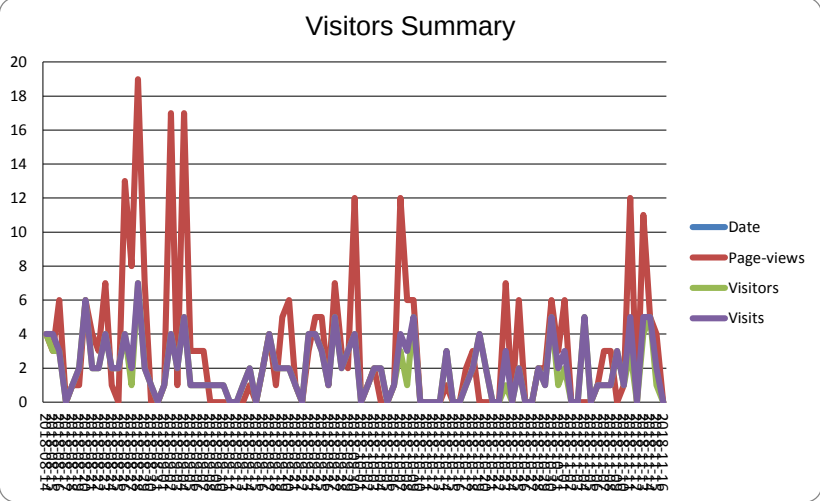
Te Maru O Kaituna members

Tapuika Iwi Authority Trust	Te Tāhuhu o Tawakeheimoa Trust – (Ngāti Rangiwewehi)
Te Kapu Ō Waitaha/Tapuika Iwi Authority Trust	Te Komiti Nui o Ngāti Whakaue
Te Pumautanga o Te Arawa Trust	Bay of Plenty Regional Council
Rotorua Lakes Council	Western Bay of Plenty District Council
Tauranga City Council	

Tauranga Moana / Te Arawa ki Takutai Partnership Forum members

Tauranga Moana	Tapuika Iwi Authority	Ngati Tauaiti
Te Arawa Ki Takutai	Ngai Tamawhariua	Te Runanga o Pirirakau
Ngati Ranginui	Nga Potiki	Waitaha
Ngati Tuheke	Ngati Whakaue	Te Whanau o Tauwhao
Ngati Pikia	Ngai Tuwhiwhia	Ngati Rangiwewehi
Ngati Taka	Ngati Pukenga	Ngati Whakahemo
Ngai Tamarawaho	Ngati Te Wai	Tuhourangi
Western Bay of Plenty District Council		

Project Report:	Managing our stormwater - have your say on the Draft Catchment	15-Aug-2018	to	16-Nov-2018
-----------------	--	-------------	----	-------------



Project Highlights

Total Visits	185
New Registrations	7
Video views	0
Photo Views	0
Document Downloads	79

Admin Notes

ENGAGED PARTICIPANTS	2		
Engaged Actions Performed	Registered	Unverified	Anonymous

Contributed on Forums	0	0	0
Participated in Surveys	2	0	0
Contributed to Newsfeeds	0	0	0
Participated in Quick Polls	0	0	0
Posted on Guestbooks	0	0	0
Contributed to Stories	0	0	0
Asked Questions	0	0	0
Placed Pins on Places	0	0	0
Contributed to Ideas	0	0	0

INFORMED PARTICIPANTS	45
Informed Actions Performed	Participants

Viewed a video	0
Viewed a photo	0
Downloaded a document	39
Visited the Key Dates page	2
Visited an FAQ list Page	0
Visited Instagram Page	0
Visited Multiple Project Pages	43
Contributed to a tool (engaged 2	

AWARE PARTICIPANTS	135
Aware Actions Performed	Participants

Visited at least one Page	135
---------------------------	-----

ENGAGEMENT TOOLS SUMMARY									
Forum Topics	0	Guestbooks	0	Maps	0	News Feeds	0	Ideas	0
Qandas	0	Quick Polls	0	Stories	0	Survey Tools	1		

Tool Type	Engagement Tool Name	Tool Status	Visitors	Contributors		
				Registered	Unverified	Anonymous

SurveyTools	Feedback form: Draft Catchment Management Plan archived		10	2	0	0
-------------	---	--	----	---	---	---

INFORMATION WIDGET SUMMARY									
DOCUMENTS	3	PHOTOS	0	VIDEOS	0	FAQS	0	KEYDATES	1

Widget Type	Engagement Tool Name	Visitors	Downloads/Views
-------------	----------------------	----------	-----------------

Document	Draft CMP - summary document	26	33
Document	Draft CMP - full document	22	29
Document	Maps	15	17
Key Dates	Key Date	2	2

Eastern draft Catchment Management Plan - Summary of feedback

Submitter name	Summary	Proposed response
1. Eastpack Limited	Submitter owns large existing Kiwifruit Post Harvest Sites within Industrial Zoned land at Washer Road & Te Puke Quarry Road, Te Puke and a facility at Collins Lane, Te Puke currently within the Post-Harvest Zone. Submitter notes that their site receives water from upstream properties including an area of Jellicoe Street (Catchment plan provided). It is noted that the WBOPDC GIS shows the drains downstream of the site as Council assets and submitter expects that these assets and associated discharges would be provided in a stormwater management plan. Submitter requests the following: • CMP should include Industrial Zoned land within the Te Puke Urban Catchment with regards to water quantity • Updated flood modelling is carried out within the catchment • That any downstream mitigation works for water quantity includes industrial land • Mitigation should be required for existing development Submitter would like to be kept informed regarding this project.	Council do not intend to include Industrial Zoned land within the Te Puke Urban Catchment with regards to water quantity. The WBOPDC and BOPRC have a historical agreement that <i>‘industrial and commercial zones will remain as BOPRC’s responsibility and will require separate consents which will be assessed and monitored by qualified BOPRC resources.’</i> However we do intend to take a joint approach to managing stormwater. The exclusion of industrial areas is predominately due to quality issues rather than the quantity of stormwater. Therefore if there is a mitigation measure that could be implemented (such as attenuation) we will take into account the full catchment in developing this solution (including the industrial site). We note that Council does not have any assets within the Eastpack site. We do maintain the drains directly downstream from Eastpack as Council has other discharges into these drains. This is a combination of both commercial and industrial land. We have commissioned rapid flood modelling in regard to the upstream Te Puke catchment and it includes industrial land. We would be happy to share the results of the modelling with you. In terms of requiring mitigation from existing developments, this is a matter that can be further investigated when further information is available as a result of the monitoring that we intend to undertake. We will keep you informed in regards to this project.

Submitter name	Summary	Proposed response
2. Te Mana o Ngati Rangitihi Trust	Submitter supports the stance of the local iwi concerning the updated draft CMP. This area is within the Area of Interest (AOI) for Ngati Rangitihi and they support the local iwi when it comes to matters concerning Maketu, Te Puke, Paengaroa and Pukehina.	We note your support for the local iwi in Maketu, Te Puke, Paengaroa and Pukehina. We will also keep you updated regarding the application for a comprehensive stormwater consent.
3. Dawn McNaughton	Submitter notes that on the northern side of Heritage Park Papamoa there have been changes in water runoff including blocked streams, excess silt build up in neighbouring farms watercourses and slips. Also notes that the road to the top of the park on this side has not been maintained with blocked and broken culverts and visible scouring. Notes that since the pine trees were harvested off the park that the existing water courses are no longer sufficient for the volume of runoff from catchment on the northern side.	Thank you for the information you provided regarding changes on the northern side of Heritage Park. We will need to undertake further investigations to determine if the culverts you are referring to are Council's or if they are owned and managed by landowners. We note that this area is within the rural environment and as such is not covered specifically by the catchment management plan as the water course do not run into the urban catchment.
4. Rochelle Carter	Submitter would like to be kept informed regarding this project.	We will keep you informed in regards to this project.
5. Freda Woisin	Submitter agrees that a comprehensive stormwater consent for Eastern districts is needed. Submitter notes that it is challenging to understand which authority to discuss respective requests for action (e.g. erosion, rubbish dumped on embankments, gullies on private land). Believes that an inclusive approach will provide for better outcomes for the environment. Notes the progressive and evolving leadership from a number of entities. Submitter notes that there should be alignment with the Waste Minimisation and Management Act 2008 and relevant Council	We appreciate your support for a comprehensive stormwater consent for the eastern part of the district, including the objectives set out in the catchment management plan. The catchment management plan has been aligned with the relevant legislation and Council documents. We agree that there are a number of ways to reduce water use including the ones you have suggested. We have a demand management plan that sets out a combination of what Council is currently doing and what else should be done to contribute to the overall conservation of water and the sustainable use of water sources in the District. We also note that a number of these are included in our Development Code of Practice.

Submitter name	Summary	Proposed response
	documents, specifically in regards to reducing pollution to the environment. Submitter suggests other options for reducing water use including the reuse of laundry water, storage of rain runoff etc. should be incorporated into the Building Code. Submitter supports the objectives proposed in the draft CMP. Submitter notes the modification of the environment in the past and that the rehabilitation is overdue. Submitter notes that the draft CMP questions whether septic tanks are used within the catchment (page 73). Asks if this can be clarified. Submitter hopes that it will be possible to collect more information to help with planning for a sustainable healthy environment in the future. Notes that the area is not an isolated district but part of the whole ecosystem.	We confirm that septic tanks are used within the catchment. We note that these are managed by the Bay of Plenty Regional Council rules. We also note and agree with your comments that the area is not an isolated district but part of the whole ecosystem. It is intended that the catchment management plan will provide for an integrated approach to stormwater management.
6. Toi Te Ora Public Health	Submitter notes the importance of protecting the environment and improving the sustainability of the natural environment to protect human health. Supports the long term and short term objectives in the draft CMP. Submitter suggested that the objectives include 'the protection of health through managing stormwater in a safe and effective manner while encouraging recreation and connectivity'. Notes that stormwater management is an essential component of sanitary services and outlines the value of effective stormwater treatment. Notes that stormwater ponds should be constructed and designed so they do not give rise to the breeding of flies, mites, ticks, mosquitoes or other insects (which may cause a nuisance to public health).	We note your support for the long term and short term objectives within the catchment management plan. We have included the objective you suggested - 'the protection of health through managing stormwater in a safe and effective manner while encouraging recreation and connectivity'. We agree with your comments that stormwater ponds should be constructed and designed so they do not give rise to the breeding of flies, mites, ticks, mosquitoes or other insects (which may cause a nuisance to public health). This information will be taken into consideration during the design phase of any new stormwater ponds alongside the requirements set out in our Development Code of Practice. We also noted your comment that these ponds should not be promoted or permitted to be

Submitter name	Summary	Proposed response
	Submitter would like monitoring of stormwater discharges at the site where it is generated, the point of discharges to the stormwater system and at the point of discharge to the environment. Notes the effect of poor quality stormwater and sewage related contamination on the shellfish in the Tauranga Harbour. Also notes that urban stormwater contains heavy metals and disease causing organisms which are harmful to health when ingested through recreational water contact, food gathered e.g. watercress and shellfish, or groundwater sourced for drinking. Submitter advises that stormwater ponds should not be promoted or permitted to be used for recreational contact activities such as swimming and that contact with the water should be deterred. Submitter encourages the use of the stormwater environment on land to be designed to maximise connectivity and promotes active transport including the use of wide boardwalks and linkages between reserves. Notes that sludge removed from stormwater ponds has the potential to become a risk to health and that it should be removed immediately if located in a public area. Advises that if the sludge is placed alongside a stormwater pond to dry that there should be no human contact until the area is stabilised and sown with grass. This may include preventative measures such as fencing. Submitter would like to be kept informed about the next steps of this project including notification of the resource consent application. Submitter would like conditions of a Comprehensive Stormwater Consent to include sampling parameters for the bacterial indicator	used for recreational contact activities such as swimming and that contact with the water should be deterred. These matters can also be addressed at the time of design and incorporated into the design of the wider recreational network, including connectivity and linkages between reserves. In regards to the monitoring of stormwater discharges, it is intended that a comprehensive approach to monitoring will be prepared and is likely to be included as a condition of the comprehensive stormwater consent. The monitoring regime will determine the best location to monitor discharges to ensure that the information collected is able to assist in the decision making process regarding future stormwater improvements. We can also confirm that the monitoring will include sampling for <i>e.coli</i> and trigger limits based on ANZECC (2000) guidelines, NPS-FM (2017) and the Bay of Plenty Regional Coastal Environment Plan. In regards to sludge removed from stormwater ponds we have noted your comments regarding the potential risk to health. We are mindful of this issue and will ensure that any maintenance works undertaken on stormwater ponds manage this risk appropriately. We note your recommendation that we take all practicable measures to prevent stormwater discharges which result in water unsuitable for recreational water activities. We agree and note that implementing and maintaining stormwater management methods that mitigate adverse effects on water quality is included in the catchment management plan. We note your support for an ongoing education programme. Public awareness and education is recommended as part of the catchment management plan and we would welcome your input in development and implementation.

Submitter name	Summary	Proposed response
	E.coli and include a quality trigger value as well as limits for the quality of a discharge. Recommends that council take all practicable measures to prevent a discharge of stormwater from its stormwater system to the receiving environment, which results in elevated indicator organisms which render the water unsuitable for recreational water activities. Submitter supports the inclusion of an ongoing education programme in the CMP. This programme could highlight ways the public can assist council to maintain an effective and safe stormwater system while highlighting potential risks to health.	We will keep you informed regarding this project including notification of the resource consent application.
7. Ngati Tuheke	Submitter provided feedback regarding the availability and content of the information available. Notes the exclusion of the Te Puke industrial area and thinks this is in contravention with the overall purpose of the CMP which is "to provide for an integrated and comprehensive approach to the management of stormwater". Submitter notes that a reason for this is provided but thinks that the CMP should look at the whole stormwater network regardless of who holds the consents. Submitter notes that the draft CMP includes a list of Iwi Management Plans from the BOPRC website. Notes that it would be good to see the plans reflected in the CMP itself, specifically the particular references to discharges and water quality. There is no reference in the draft CMP to the culturally significant waterways which are subject to statutory acknowledgements under the Tapuika Claims Settlement Act. Does not support that Iwi and hapū been categorised as, or	We note your comment regarding the exclusion of the Te Puke industrial areas from the catchment management plan. We agree that this challenges the overall purpose of an integrated and comprehensive approach. However it also recognises that the stormwater discharges (which generally contain higher levels of contaminants than from residential properties) from these areas are managed via consents with the regional council. We have amended the catchment management plan to recognise that there are specific references to discharges and water quality in Iwi Management Plans and <i>Kaituna, he taonga tuku iho</i>. This includes recognition of the strong alignment between the values and objectives of these plans and the objectives of the catchment management plan. We have included references to the statutory acknowledgement areas which are within the areas covered by the catchment plan. We have also included a recommendation that further iterations of the CMP provide for greater reflection of cultural values. We note that Council is also going to review their Stormwater Strategy and it is intended that this strategy will recognise the relationship and values of Tangata

Submitter name	Summary	Proposed response
	referred to, as "stakeholders/community/community group". Submitter would like to see cultural values reflected more genuinely within the CMP. This includes acknowledging Iwi Management Plans and our culturally significant awa. Submitter would like to see a cultural values assessment to reflect changes since the 2013 document, including new Iwi and hapū management plans and treaty settlements with the recommendations reflected in the CMP. Submitter would like to know if there is a role for Iwi and hapū in Plan implementation e.g. incorporating matauranga in stormwater and receiving water monitoring.	Whenua to the built and natural environment and align with the CMP. We have also amended the way that Iwi and hapū are referred to when discussing the consultation on the draft CMP. A recommendation has been included in the CMP that Iwi and hapū are consulted as to how matauranga can be incorporated into the monitoring of stormwater and the receiving environment.
8. Bay of Plenty Regional Council's Rivers and Drainage Section (BOPRC-RAD)	Submitter notes that they are affected by WBOPDC stormwater management decisions. Submitter appreciates that significant work has been undertaken towards catchment planning for the eastern catchment since the original lodgement in 2013. Notes that to date that they have not seen an assessment of the effects on the Kaituna Catchment Control Scheme or how WBOPDC is intending to mitigate the effects. Submitter appreciates that this is a complex issue and as the managers of the Kaituna Catchment Control Scheme any additional stormwater being generated from new and infill developments in the Te Puke area is creating significant stormwater management issues and is adversely affecting downstream landowners and the performance of BOPRC-RAD's flood protection and water control assets (see attached map for RAD assets impacted by increased stormwater in the Te Puke	We have noted your comments regarding the effects of stormwater on the Kaituna Catchment Control Scheme. As you are aware this is an ongoing issue and the stormwater flows in the Te Puke urban area are currently being assessed. We have commissioned rapid flood modelling to assist in our understanding of this issue. We understand that the BOPRC have also recently begun work on flood modelling in this area. Further modelling is likely to be undertaken and will include consideration of the recommendations you have provided in this regard. On completion of the modelling it is anticipated that the effects on the scheme will be able to be quantified and works identified, if required, to mitigate any effects. We would expect that this would be an ongoing discussion with the regional council. The 50% contribution from WBOPDC for the installation of two stationary pumps on the Armer and Marshall Drains and the capital expenditure programme in the BOPRC LTP 2018 -28

Submitter name	Summary	Proposed response
	area). Short-term mitigation works have recently been completed by BOPRC-RAD with the installation of two stationary pumps on the Armer and Marshall Drains at a cost to the scheme of \$320,000. We are seeking a 50% contribution from WBOPDC toward the cost of this short-term mitigation works. Funding for investigation and construction of a longer—term solution has been included in BOPRC’s LTP 2018-2028 in Years 1 to 3 under the Kaituna Catchment Control Scheme’s capital works programme totalling \$2.8 million which BOPRC-RAD will also be seeking to recover from WBOPDC. Significant technical discussions between BOPRC and WBOPDC staff on stormwater and flood modelling requirements have been undertaken already. Notes that stormwater and flood modelling work should continue as per the following recommendations during these discussions: - The flood model needs to be undertaken for the 1% AEP event for the critical storm of the Kaituna Catchment (72-hour storm) for pre-, current- and future-development scenarios to assess the effects on the flood protection assets. - Flood modelling in areas that affect the rural stopbank area should also be undertaken for the 5% AEP to ensure that the level of service to remove excess water of a three day design rainfall as set in the Rivers and Drainage Asset Management Plan can continue to be met. - The flood model should include all areas contributing to the catchment flow (including industrial and rural areas).	cannot be specifically addressed by the CMP. We will however continue to discuss funding and capital expenditure with you and determine a way forward. We have noted your comments regarding the flood risk in urban catchments and the potential effect on existing infrastructure. These matters will be considered as part of an ongoing assessment of levels of service, maintenance of existing assets and will inform our capital works programmes. It is proposed that the catchment management plan will be reviewed and updated on a five yearly basis and it is anticipated that these matters could be included at that time.

Submitter name	Summary	Proposed response
	- The model should be calibrated to ensure it is fit for purpose. The CMP should quantify the effects on the Scheme and propose an action plan (e.g. effects mitigation options and timeframes). In addition to the requirements of the Scheme, BOPRC Engineering is also concerned in regards to the general Flood Risk in the urban catchments. In particular, increased runoff has resulted in road culverts being insufficient and roads being overtopped in large flood events, which could lead to embankment failures and culvert blowouts. Some of these embankments are very high and potentially having large amounts of water sitting behind them. While this attenuation is desired to mitigate downstream effects, WBOPDC needs to ensure that the attenuation areas are formalised and embankments are structurally able to withstand the damming effect. The CMP should identify such infrastructure and propose an action plan (e.g. risk mitigation options and timeframes).	
9. Te Runanga o Ngati Whakaue	Submitter refers to 'Te Ara Mua' which was adopted by WBOPDC and supports the approach of Te Ara Mua in recognising tangata whenua, their role within this comprehensive stormwater consent and their status as kaitiaki (guardians). For Ngati Whakaue ki Maketu the area of Maketu / Little Waihi is the catchment management area where we should be recognised as tangata whenua. Initiatives that the submitter supports for the CMP: - Soft infrastructure approach especially discharging points before the Maketu estuary. More riparian planting and possibly a design concept where we can have input and	We appreciate your time and the feedback you have provided on the draft catchment management plan, particularly for Maketu and Little Waihi. The initiatives you have identified have been incorporated throughout the catchment management plan. These initiatives will also inform our capital expenditure in this area for managing stormwater quality and quantity. Implementation of the catchment management plan will be an ongoing process and we would value your input as we make a start on the actions and recommendations in the plan. We have proposed a condition in the comprehensive stormwater consent

Submitter name	Summary	Proposed response
	coordinate the planting - Plants that are native, that can be used for rongoa (medicinal) or that are edible (kai) or that can be used for weaving our whariki within our whare tupuna. We support plants that can act as cleansing agents - Healthy ecosystems that promote the growth of tupuna kai (ancestral foods) such as tuna (eels) and the inanga (whitebait), and growing aquatic plants such as watercress - Overhanging evergreen foliage that promotes shade to the drains so that the drain ecosystems have places of shade away from te whiti o te rā (rays of the sun) and tawhirimatea (winds). - Rock formations that may slow the flow effect of the water and reduce sedimentation. - Good management system in place, weed control of unwanted weeds such as pampus growing near drains in Maketu. - Drains that are visually appealing to look at, that have some form of Maturanga Maori aspect to offer young children. - Cultural monitoring in areas where there is cultural heritage or is an important area for Ngati Whakaue ki Maketu. - Where should the council start in Maketu / Little area? The Waitepuia Drain which discharges into the Maketu	that provides for an annual update to lwi and hapū on the progress in implementing the catchment management plan and also to provide an opportunity for lwi and hapū to let us know what other actions or physical works have been identified.

Submitter name	Summary	Proposed response
	estuary. The drain is located behind the Maketu Reserve / Whakaue Kaipapa Marae. - Funding allocated to programmes that will benefit Maketu / Little Waihi comprehensive stormwater catchment.	
10. Te Maru o Kaituna River Authority	<i>Kaituna, he taonga tuku iho</i> – the Kaituna River Document (KRD) came into effect on 1 August 2018 and sets the communities vision, objectives and desired outcomes for the Kaituna River and its tributaries. The vision is ‘the Kaituna River (and its tributaries) is in a healthy state and protected for current and future generations.’ Objectives and outcomes most relevant to urban stormwater management and discharges include Objectives 3, 4 & 5 about water quality and quantity and Objective 7 about ecosystem health. Best practice stormwater management and discharges could enhance the KRD outcomes, particular those about limiting contaminants to ensure the awa in our catchment is safe for swimming, suitable for cultural ceremonies and suitable to sustain plentiful and safe kai. Stormwater management solutions could also contribute positively to the ecosystem health objective and desired outcome of exploring opportunities to create, increase and enhance the extent and quality of wetlands. TMoK requests the draft Catchment Management Plan be amended so the final version makes reference to <i>Kaituna, he taonga tuku iho</i> and demonstrates regard has been had to the relevant parts of the river document.	There is a strong alignment between a number of the objectives in <i>Kaituna, he taonga tuku iho</i> – the Kaituna River Document (KRD) and the catchment management plan, specifically objectives 3, 4, 5 and 7. We anticipate that the implementation of the catchment management plan and the likely conditions of a comprehensive stormwater consent will assist in achieving the outcomes sought for the Kaituna River. We will amend the catchment management plan to include acknowledgement and reference to <i>Kaituna, he taonga tuku iho</i>. Our intention is that the long-term objectives of the catchment management plan will ensure that the stormwater management in urban areas mitigates adverse effects on water quality and quantity. Issues such as growth, development, changing land use, changing weather patterns and climate change will all be considered as we implement the catchment management plan. We understand that TMoK would like stormwater from commercial and industrial areas to be included in the CMP. We agree that the exclusion of these areas challenges the overall purpose of an integrated and comprehensive approach. However it also recognises that the stormwater discharges (which generally contain higher levels of contaminants than from residential properties) from these areas are managed via consents with the regional council.

Submitter name	Summary	Proposed response
	TMoK would like the final version of the CMP to demonstrate that urban areas are ‘doing their bit’ and tangibly contributing actions to restoring water quality, the mauri and ecosystem health within our waterways at each step from short term to the longer term objectives and also within the comprehensive stormwater catchment resource consent application that follows. TMoK wants to ensure that growth, development, changing land use, changing weather patterns and climate change are all built into stormwater management solutions for the Kaituna catchment in an integrated and comprehensive way. TMoK would like WBOPDC to consider amending the CMP to include stormwater from all ‘built’ up areas including stormwater from commercial and industrial uses regardless of which council is responsible, to ensure a ‘whole’ of catchment integrated approach to stormwater management is the result for the awa in the catchment. TMoK requests that the CMP be amended to include specific timeframes for completion of the short and long term objectives and recommendations so opportunities are taken for urban stormwater management to make a tangible contribution to restoring, protecting and enhancing our awa in as short a time as possible. TMoK support amending the CMP to include specific timeframes for completion of each of the recommended actions. The recommendations table doesn’t say actions are in priority order but appear to have water quantity actions ahead of water quality actions. TMoK request tangible water quality actions be given equal or heightened priority over water quantity actions. TMoK are keen to see measureable improvements in stormwater	We noted your requests that the CMP include specific timeframes for completion of the short and long term objectives and recommendations. The short-term objectives are to provide direction over the next three to five years and will inform Council’s capital expenditure programme in the Long-term Plan 2021 – 31. The long-term objectives will be consistent with the length of the intended comprehensive stormwater consent and will be reviewed every five years as part of the catchment management plan. Timeframes for the recommendations and actions will be determined following the granting of the comprehensive consent as this will be the starting point for a number of them. We have included a comment in the recommendations section which outlines that there is an equal emphasis on implementation of both water quality and quantity recommendations and actions. We are also keen to see improvements in the short-term but need to ensure that any solutions or mitigations that are undertaken provide for a long-term outcome. We would also welcome the opportunity to work with you on the Kaituna River Document’s action plan. As you have noted, there are a number of areas where we could work collaboratively to achieve the objectives of the Kaituna River Document and the catchment management plan. We acknowledge your support for low impact and water sensitive urban design, improving ecological protection and the development and implantation of a monitoring programme. We will continue to work with you to achieve improved environmental outcomes for the Kaituna River and communities in the eastern part of our district.

Submitter name	Summary	Proposed response
	discharge outcomes in the short term rather than the short term only delivering information gathering & further studies to inform solutions in the short term. TMoK concur with the draft CMP's finding that the current conditions of the streams/rivers is causing impacts on mahinga kai, natural character and the health of the awa and Maketū estuary with declining water quality, land use intensification and development placing pressure on wetlands and increased sedimentation. TMoK support as methods included in the CMP such as low impact and water sensitive urban design as well as focussing on methods to improve ecological protection. Support for developing and implementing a comprehensive stormwater monitoring program and filling gaps as outlined in the CMP including more complete catchment modelling. TMoK welcome the opportunity to work with WBOPDC on the recommended actions which could contribute to the Kaituna River Document's action plan currently being developed. Actions are expected to contribute to the objectives over the short (within 3yrs), medium (within 6yrs) and long terms (9 years plus). For example actions within the draft CMP included under the sections cultural/social/ public health aspects as well as community participation in environmental protection, public access may be areas TMoK and / or iwi could work on collectively with WBOPDC. Areas where we consider the CMP could contribute positively to the outcomes sought by <i>Kaituna, he taonga tuku iho</i>: • Natural / low impact and water sensitive urban design, utilising soft infrastructure including wetlands, stormwater ponds, rains gardens, swales and riparian buffers over hard engineered	

Submitter name	Summary	Proposed response
	solutions • Solutions which are fish passage and habitat friendly • Explore opportunities to use wetlands to manage or treat stormwater, increase public and iwi connectivity with the awa and improvement in habitats • Stormwater discharges which ensure our kai awa and kai moana is plentiful and safe to eat, • Stormwater systems which are protected from wastewater infiltration which may impact on the wai being safe to swim TMoK welcome further discussion about how the Catchment Management Plan, the comprehensive stormwater consent application and combined actions could closely align with <i>Kaituna, he taonga tuku iho</i>.	

628697-M-P-C001

10 October 2018

Western Bay of Plenty District Council
Private Bag 12803
Tauranga Mail Centre
Tauranga 3143



Attention: Project & Design Engineer Team Leader – Coral-Lee Ertel

Dear Coral-Lee,

Eastpack Limited
Comments/Submission on Draft Eastern Catchment Management Plan

Our clients, Eastpack Ltd, own large existing Kiwifruit Post Harvest Sites within Industrial Zoned land at Washer Road & Te Puke Quarry Road, Te Puke as well as a facility at Collins Lane, Te Puke currently within the Post-Harvest Zone. Eastpack are a major operator within the Kiwifruit Industry which is highly important to the economy of the Western Bay of Plenty.

Eastpack have been actively involved in discussions with WBOPDC and BOPRC for the last 18 months regarding stormwater discharge and flooding matters on the land downstream of the Eastpack Washer Road and Collins Lane sites.

On behalf of Eastpack, we have reviewed the draft eastern catchment management plan (CMP) which at this stage does not include any of the Industrial zoned land within the Te Puke urban area. We understand from our discussions with you that this is primarily based on concerns with water quality resulting from Industrial Activities.

We note that the draft CMP at this time does not include any discharge calculations and we understand that this will be completed along with updated flood modelling in the downstream catchment.

In our opinion it would be remiss of WBOPDC not to include the entire Te Puke urban catchment (including the Industrial Zoned land) within the CMP, particularly in relation to water quantity for the downstream catchment. By zoning land Industrial WBOPDC, has permitted activities that require large areas of hard surfacing and the urban stormwater contribution to the catchment needs to be considered as a whole, including possible mitigation options to address downstream flooding. It is acknowledged that water quality will need to be addressed by individual site owners.

In the case of the Eastpack Washer Road site, the site receives water from upstream properties including an area of Jellicoe Street, as per the catchment plan attached. The WBOPDC GIS shows the drains downstream of the site currently as Council assets and

accordingly it would be expected that WBOPDC would include these assets and associated discharges in any overall urban stormwater management plan.

We note that there is currently provision within the CMP to mitigate stormwater from Greenfield residential development however there is no apparent provision for mitigation required for existing development.

Eastpack are currently mitigating stormwater as best possible on their Washer Road site through a series of stormwater attenuation ponds designed and constructed to comply with BOPRC permitted stormwater volumes.

In summary, EastPack requests that:

1. The CMP be updated to include Industrial Zoned land within the Te Puke Urban Catchment with regards to water quantity;
2. Updated flood modelling is carried out within the catchment
3. That any downstream mitigation works for water quantity includes industrial land.

Eastpack are willing to work with WBOPDC to achieve practical and efficient solutions for stormwater control from their sites located within the Industrial Zone and requests that WBOPDC give consideration to the above matters.

Summary

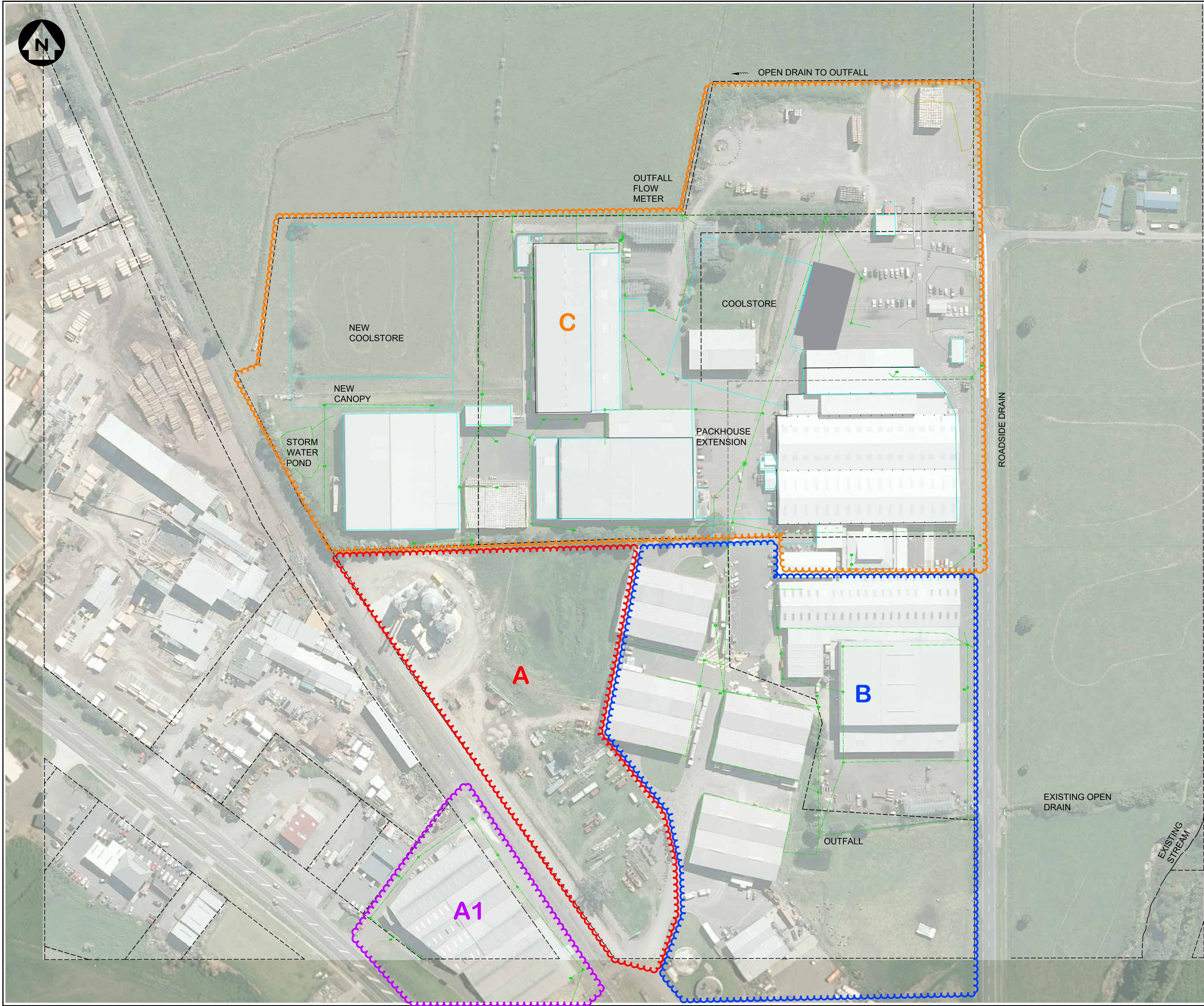
We trust this information outlines the position of Eastpack Ltd in relation to the Draft Eastern CMP and we are happy to discuss matters further as required.

Yours faithfully

Stratum Consultants Ltd



Associate Principal



DRAWN: DU		DESIGNED: -	
CHECKED: -		SURVEYED BY: DRU	
OFFICE OF ORIGIN - TE PUKE Ph 07 573 7717			
No.	Date	By	Issue/Revision
A	26.07.17	DRU	DRAFT
B	-	-	-

NOTES/KEY:

1. AREAS AND MEASUREMENTS ARE APPROXIMATE AND SUBJECT TO SURVEY.

2. LEVELS ARE IN TERMS OF MOTURIKI DATUM.

3. CONTOUR INTERVAL IS 0.2m.

NOTES/KEY:

STORM WATER PIPE

STORM WATER MANHOLE

STORM WATER CESS PIT



EASTPACK LIMITED
WASHER ROAD
TE PUKE

TOPOGRAPHIC SURVEY
OF STORMWATER
UTILITIES AND LAYOUT



From: Nicki Turner <Nicola.Turner@westernbay.govt.nz>
Sent: Thursday, 13 September 2018 4:21 p.m.
To: Shaw, Bob; King, Ariell
Subject: FW: 2018-08-28 Eastern Catchment Plan Letter to Ngati Rangitihi.pdf

Hi Bob & Ariell,

I believe the below email will be of use to you.

Thanks

Nicki Turner

Team Personal Assistant/Administrator
Kaiāwhina Tumuaki/Kaiwhakahaere
DD 07 579 6705
Barkes Corner,
1484 Cameron Road,
Greerton, Tauranga
Private Bag 12803, Tauranga Mail Centre, Tauranga 3143
E nicki.turner@westernbay.govt.nz



Please consider the environment before printing this email.

From: Christopher Clarke <kaitiaki@ngatirangitihi.iwi.nz>
Sent: Monday, 10 September 2018 9:07 AM
To: Nicki Turner <Nicola.Turner@westernbay.govt.nz>
Subject: Re: 2018-08-28 Eastern Catchment Plan Letter to Ngati Rangitihi.pdf

Morena Nicki

Firstly, thank you for contacting Te Mana o Ngati Rangitihi Trust concerning the draft Catchment Management Plan. Te Mana o Ngati Rangitihi Trust would like to officially support the stance of the local iwi concerning the updated draft for the Catchment Management Plan (CMP).

Although this area is within the Area of Interest (AOI) for Ngati Rangitihi, Ngati Rangitihi support the local iwi when it comes to matters concerning Maketu, Te Puke, Paengaroa and Pukehina.

Nga mini
Christopher Clarke
Environmental Consultant for
Te Mana o Ngati Rangitihi Trust
Matata.

On 4 September 2018 at 12:52, Christopher Clarke <kaitiaki@ngatirangitihi.iwi.nz> wrote:

Received, thank you.

On Tue, 4 Sep 2018 at 11:30 AM, Nicki Turner <Nicola.Turner@westernbay.govt.nz> wrote:

Hi Chris

As per our conversation, please find attached the original letter that went out to iwi with regards to the Eastern Catchment Management Plan.

I hope this answers your query.

Regards

Nicki Turner

Team Personal Assistant/Administrator
Kaiāwhina Tumuaki/Kaiwhakahaere
DD 07 579 6705
Barkes Corner,
1484 Cameron Road,
Greerton, Tauranga
Private Bag 12803, Tauranga Mail Centre, Tauranga 3143
E nicki.turner@westernbay.govt.nz



Please consider the environment before printing this email.

The information contained in this message (and any accompanying documents) is CONFIDENTIAL and may also be LEGALLY PRIVILEGED, intended only for the recipient(s) named above.

If the reader of this message is not the intended recipient, you are notified that any use, copying, disclosure, retention or distribution by any means of the information is strictly prohibited.

If you have received this message in error, please notify the writer immediately and destroy the original(s).

The information contained in this message (and any accompanying documents) is CONFIDENTIAL and may also be LEGALLY PRIVILEGED, intended only for the recipient(s) named above.

If the reader of this message is not the intended recipient, you are notified that any use, copying, disclosure, retention or distribution by any means of the information is strictly prohibited.

If you have received this message in error, please notify the writer immediately and destroy the original(s).

From: Coral-Lee Ertel <Coral-Lee.Ertel@westernbay.govt.nz>
Sent: Friday, 7 September 2018 6:39 a.m.
To: Shaw, Bob
Cc: King, Ariell
Subject: FW: WBOPDC Website - Contact Us Online Form ref: WBOPDC-QF-180905-61KMW-1A81

Hi Bob/Ariell

Some feedback for the ECMP.

Coral-Lee

From: Western Bay of Plenty District Council <do.not.reply@westernbay.govt.nz>
Sent: Wednesday, 5 September 2018 10:15 AM
To: Customer Service <Customer.Service@westernbay.govt.nz>
Subject: WBOPDC Website - Contact Us Online Form ref: WBOPDC-QF-180905-61KMW-1A81

WBOPDC Website - Contact Us Online Form

Reference: WBOPDC-QF-180905-61KMW-1A81
Attachment: not attached

What is your enquiry about?: Report a problem

Please detail exact location of problem for a Request for Service (please be as descriptive as possible)

Northern side of Heritage Park Papamoa:
Changes in Water runoff from Heritage Park = blocked streams and excess silt build up in neighbouring farms watercourses, slips.
Road to top of Park on this side has not been maintained = culverts blocked/broken? Water runoff makes its way down and over road at various points = scouring visible.

Enter your comments in the space provided below:
Coral-Less Ertel may be interested that since the Pine Trees were harvested off the Heritage Park in Papamoa the water courses which worked during the past (since 1939) are no longer sufficient to take the runoff water containing silt and rubbish from the Hills catchment on the Northern side.

Your full name:: Dawn Elaine McNaughton

Your address:: 1194 Welcome Bay Road, RD7, Te Puke 3187

Email:: dawnzartnz@gmail.com

Telephone (Day):: 07 5420763

Telephone (After Hours):: 07 5420763

Mobile:: not supplied

The information contained in this message (and any accompanying documents) is CONFIDENTIAL and may also be LEGALLY PRIVILEGED, intended only for the recipient(s) named above.

If the reader of this message is not the intended recipient, you are notified that any use, copying, disclosure, retention or distribution by any means of the information is strictly prohibited.

If you have received this message in error, please notify the writer immediately and destroy the original(s).

From: Have Your Say Western Bay of Plenty <notifications@engagementhq.com>
Sent: Monday, 3 September 2018 9:47 p.m.
To: King, Ariell; Shaw, Bob; Coral-Lee.Ertel@westernbay.govt.nz
Subject: Ricksta completed Feedback form: Draft Catchment Management Plan

Ricksta just submitted the survey 'Feedback form: Draft Catchment Management Plan ' with the responses below.

Please provide your comments on the short term commitments in the draft Catchment Management Plan including maintaining the current level of service, assessing the primary and secondary flow paths and continuing to monitor water quality and ecological values.

No Answer

Please provide your comments on the long term objectives in the draft Catchment Management Plan which include the use of low impact design solutions, improvement of the existing stormwater system and utilising the stormwater environment for recreational uses e.g. reserve areas, boardwalks.

No Answer

Please provide any other feedback on the Draft Catchment Management Plan.

No Answer

If you would like to be kept informed about the next steps of this project, please provide your name:

Rochelle Carter

Your email address:

rochelle.carter001@gmail.com

From: Have Your Say Western Bay of Plenty <notifications@engagementhq.com>
Sent: Tuesday, 9 October 2018 2:58 p.m.
To: King, Ariell; Shaw, Bob; Coral-Lee.Ertel@westernbay.govt.nz
Subject: Tina completed Feedback form: Draft Catchment Management Plan

Tina just submitted the survey 'Feedback form: Draft Catchment Management Plan' with the responses below.

Please provide your comments on the short term commitments in the draft Catchment Management Plan including maintaining the current level of service, assessing the primary and secondary flow paths and continuing to monitor water quality and ecological values.

As a "eastern" catchment resident(Te Puke) in WBDC jurisdiction, agree with the consultants (EACOM) draft proposal on behalf of WBDC. A comprehensive stormwater consent for Eastern districts is urgently needed. *The present system with some responsibilities resting with BOPRC, NIWA, DOC, private landowners and others with the WBDC, indicated. As a citizen, find it hard to pin down the various authorities to action a request.(eg. erosion, rubbish dumped on embankments, gullies on private land) hopefully with an all encompassing, integrated inclusive of land owners, business, urban dwellers, model we all can be responsible for our water/stormwater/ rivers/drains/aquifers/ estuaries/ ocean on the Motu that gives us sustenance and shelter. Progressive, evolving leadership from the present Govt, Regional council(On site effluent treatment plan change 7, Resource consent plan change 9), Te Maru o Kaituna River/Awa Authority document, Smart Growth Tauranga Moana, Priority one, Landcare Trust, QE2, along with citizen initiated projects, Iwi/Tangata Whenua consultation, Treaty of Waitangi. * As an extension of this plan would hope the "Waste minimisation and Management" Act 2008, pertaining to WBDC recent review, also takes on these objectives with greater involvement, comprehensive overhaul, integration and implementation with the CMP/CSC in reducing pollution to our environment also. * 6.0. Identification of stormwater issues. Is it not time that new housing estates/ urban development stopped encouraging the use of water flushing toilets?, Started reusing laundry water? storage of rain runoff in tanks for showering, swimming pools? into our building codes (in other words evolving/ normalizing new methods of constructing "Eco friendly" homes, buildings etcetera). The urban development in Tauriko, Omokoroa, Bethlehem, Paengaroa, Pukehina, could have these alternatives and no doubt other innovations and designs, with low impact on our environment , in my view.

Please provide your comments on the long term objectives in the draft Catchment Management Plan which include the use of low impact design solutions, improvement of the existing stormwater system and utilising the stormwater environment for recreational uses e.g. reserve areas, boardwalks.

It gives me hope to see such forward encompassing, objectives, proposed in the CMP draft plan and possible solutions. Ref. 5.0 Catchment values As a child in the 1940's & 50's saw the drainage of the wetlands, cutting down/burning all the bush, loss of native flora and fauna, the inconsiderate modification of our environment by we humans in such a short time without thought to future unintended consequences. The development of riparian reserves, lagoons, reparation, rehabilitation is long over due. * 3.0 The existing environment P.10 . Apparently at present, studies show stormwater, run off, drains, streams in and around Te Puke (excluded in the study - western Te Puke industrial, sawmill, metal recycling, kiwifruit industry, dairying, etcetera, that has runoff monitored under resource consent - a problem.) health of the environment could be better. Now as a community, hopefully in the near future we will have a framework of proposed objectives and solutions to collaboratively "clean up" our environment making us all responsible (including private/commercial land/waterways/aquifers that pass though them). 6.0 Identification of stormwater management issues. P.60. * 6.2.2.2.1 Septic tanks. P.73. Quote " Septic tanks. Unknown if septic tanks are used within the Eastern catchment". Can this be clarified please? Do hope it is now possible to collect more information, data, trends and better plan for a sustainable healthy environment in the future.

Please provide any other feedback on the Draft Catchment Management Plan.

* Te Puke, Paengaroa, Maketu, Pukehina have documented short term and long term plans. Recently there was a community representation review. We have no excuses (the cry money, rates, who's paying are red herrings when our environment is at stake. We degraded her, we need to fix it) to not get on with implementing these inevitable changes proposed by The Eastern catchment draft plan. We are not an isolated district/rohe, but part of a whole ecosystem/ environment, Toi Moana, Aotearoa/New Zealand and our decisions impact on our future generations, We're all in this waka together.

If you would like to be kept informed about the next steps of this project, please provide your name:

Freda Woisin

Your email address:

rinasclan@gmail.com

Toi Te Ora feedback
Received via email 19 Oct 2018

Hello Ariell

Thank you for informing me of the opportunity to provide feedback to the draft plan.

The reason for this feedback is to promote, protect and improve population health, prevent ill health and minimise the risk of disease and injury through population based interventions. Managing stormwater effectively is a population based intervention.

Protecting the environment from contamination is a necessity for current and future populations. Improving the sustainability of the natural environment wherever possible will in the long-term protect public health and environments should improve not harm our health. For these reasons the long term and short term objectives are supported. I suggest that the objectives include the protection of health through managing stormwater in a safe and effective manner while encouraging recreation and connectivity.

Stormwater management is an essential component of sanitary services. Waters used for recreational purposes require protection from contamination so that contact recreation and food gathering activities do not cause illness. Stormwater can contaminate drinking-water sources. Effective stormwater treatment and effective drainage reduces the risk to health from heavy rain and also reduces the risk from pooling of water which can become breeding grounds for disease-causing organisms and pests.

1. *Please provide your comments on the short term commitments in the draft Catchment Management Plan including maintaining the current level of service, assessing the primary and secondary flow paths and continuing to monitor water quality and ecological values.*

A well-managed and operated stormwater system will identify elevated discharge quality levels to enable prompt public health advice to be provided and potential contamination sources to be investigated and rectified.

For the protection of public health we would like to see monitoring the discharge quality parameters at the site generated, at the point of discharge to the stormwater system and also at the point of discharge to the environment. This approach will support the identification of site management issues and cross connections with the sewerage network for instance.

2. *Please provide your comments on the long term objectives in the draft Catchment Management Plan which include the use of low impact design solutions, improvement of the existing stormwater system and utilising the stormwater environment for recreational uses e.g. reserve areas, boardwalks.*

It is widely known that the Medical Officer of Health advises the public not to consume shellfish collected within Tauranga Harbour due to the significant risk to health, and also for people not to have contact with recreational water for 48 hours after a heavy rainfall event. This is in part to the ongoing impact on water quality by stormwater and sewage-related contamination.

Stormwater ponds and other infrastructure have from time to time been promoted to the public for recreational water activities by developers and local authorities. Council are encouraged to ensure that stormwater ponds will not be promoted or permitted to be used for recreational contact activities such as swimming and that contact with the water will be deterred.

On the other hand, we encourage the use of the stormwater environment on land to be designed in a way that maximises connectivity and promotes active transport. We encourage active transport principles which can reduce motor vehicle car trips, congestion and our carbon footprint. Wide boardwalks and linkages between reserves that help people move around the district are supported.

3. *Please provide any other feedback on the Draft Catchment Management Plan.*

It is widely accepted that urban stormwater will contain heavy metals and disease causing organisms are harmful to health when ingested through recreational water contact, food gathered eg watercress and shellfish, or groundwater sourced for drinking.

Toi Te Ora Public Health is responsible for the surveillance of exotic mosquitoes at high-risk points of entry into New Zealand such as the Port of Tauranga. Toi Te Ora Public Health Service is responsible for the interception and incursion response should an exotic mosquito that is capable of transmitting disease be identified. To reduce the likelihood of an exotic mosquito becoming established in New Zealand, we work to increase awareness of this biosecurity risk and reduce mosquito breeding habitats. Bearing this in mind, the development of stormwater infrastructure such as ponds have the potential to create habitat and also cause a public health nuisance. To avoid this, stormwater ponds should be constructed and designed in such a way that the ponds do not give rise or are capable of giving rise, to the breeding of flies, mites, ticks, mosquitoes or other insects, which may cause a nuisance to public health, and also reduce potential breeding sites for exotic mosquitoes that will assist their establishment.

The removal of sludge as part of any on-going routine maintenance has the potential to become a risk to health unless managed appropriately. Ideally, sludge from stormwater ponds should be removed immediately if it located in a public area. However should stormwater sludge be placed alongside a stormwater pond for the purposes of drying, no public contact with this material is paramount until stabilised and sown with grass. This may include preventative measures such as fencing off the sludge so the public do not have access to it.

4. Toi Te Ora wish to be kept informed about the next steps of this project including notification of the resource consent application. You may contact me in the first instance or email enquiries@toiteora.govt.nz

As council progresses towards a Comprehensive Stormwater Consent we would like to see conditions that include Stormwater sampling parameters for the bacterial indicator E.coli and include a quality trigger value as well as limits for the quality of a discharge. In addition it is recommended that council take all practicable measures to prevent a discharge of stormwater from its stormwater system to the receiving environment, which results in elevated indicator organisms which render the water unsuitable for recreational water activities.

Finally we would like to see the management plan include an ongoing education programme highlighting ways the public can assist council maintain an effective and safe stormwater system while highlighting potential risks to health. For instance, raising awareness that people should not to have contact with water in the vicinity of a stormwater outlet.

I hope this feedback is useful. If you have any questions please call me.

Regards
Annaka.



Annaka Davis

Health Protection Officer

Phone: 07 378 5160 (extn 6360)

Mobile: 021 223 3144

Website: www.toiteora.govt.nz

Notice of Legal Status and Confidential Information: This electronic mail message and any accompanying attachments may contain information that is privileged and CONFIDENTIAL. If you are not the intended recipient you are advised that any use, review, dissemination, distribution or reproduction of the information is strictly prohibited and may be unlawful. If you have received this document in error, please notify the sender immediately and destroy the message.

This email has been scrubbed for your protection by SMX. For more information visit smxemail.com

From: Coral-Lee Ertel <Coral-Lee.Ertel@westernbay.govt.nz>
Sent: Thursday, 25 October 2018 6:28 a.m.
To: King, Ariell; Shaw, Bob
Subject: Fwd: Stormwater discharge hui and comments

FYI

Begin forwarded message:

From: Elva Conroy <elva.conroy@gmail.com<<mailto:elva.conroy@gmail.com>>>
Date: 24 October 2018 at 9:26:25 PM NZDT
To: Petera Tapsell <Petera.Tapsell@westernbay.govt.nz<<mailto:Petera.Tapsell@westernbay.govt.nz>>>, Chris Nepia <Chris.Nepia@westernbay.govt.nz<<mailto:Chris.Nepia@westernbay.govt.nz>>>
Cc: Coral-Lee Ertel <Coral-Lee.Ertel@westernbay.govt.nz<<mailto:Coral-Lee.Ertel@westernbay.govt.nz>>, Vivienne Robinson <vivienne@waitaha-iwi.org.nz<<mailto:vivienne@waitaha-iwi.org.nz>>>, Hohepa Maxwell <Hohepa@tapuika.iwi.nz<<mailto:Hohepa@tapuika.iwi.nz>>>, Maria Home <runanga@actrix.co.nz<<mailto:runanga@actrix.co.nz>>>, Raiha Biel <raiha.biel@gmail.com<<mailto:raiha.biel@gmail.com>>>, resource@ngatiwhakahemo.org<<mailto:resource@ngatiwhakahemo.org>>, Anthony.Wihapi@westernbay.govt.nz<<mailto:Anthony.Wihapi@westernbay.govt.nz>>, Dean Flavell <DeanF@tauranga.govt.nz<<mailto:DeanF@tauranga.govt.nz>>>
Subject: Re: Stormwater discharge hui and comments

Kia ora Petera

Arohamai for the late notice but I will be unable to attend the hui tomorrow. I've been pulled into an Iwi Authority hui in Rotorua which is at the same time. The invite only came a few hours ago.
My alternate - Dean - will also be in Auckland tomorrow so won't be able to attend either.

Please take this email as comments from Ngati Tuheke. You are welcome to read/distribute at the hui.

I have:

- * seen presentations about this proposal at both our Forum Hui and the recent Te Maru o Kaituna hui.
- * read the summary paper about the draft CMP. I don't think it provides enough useful detail as a 'snapshot' of the draft CMP let alone to be used for engagement purposes as an information sheet.
- * very briefly skimmed the draft CMP. It's a very large document.

Comments about the draft CMP:

- * Exclusion of Te Puke industrial area: I understand that the CMP is "to provide for an integrated and comprehensive approach to the management of stormwater". It is odd that the Te Puke industrial area is excluded. The reason is provided on pg 3 (as it is BOPRC's responsibility) but the plan scope also talks about allowing "WBOPDC and Bay of Plenty Regional Council (BOPRC) to better control the discharge of stormwater from all the land within a catchment area. For this CMP to be truly integrated and comprehensive, it would look at the whole stormwater network regardless of who is responsible and/or holds the consent.
- * Pg 1 includes a list of Iwi Management Plans from the BOPRC website. This is good but I don't really see these Plans reflected within the Plan itself. Many of our Plans refer specifically to discharges and water quality.
- * Section 3.0 Existing Environment - There is no reference to our culturally significant waterways which are subject to statutory acknowledgements under the Tapuika Claims Settlement Act. The attachments provide greater detail but it is completely
- * pg 101-103: I don't really like that Iwi and hapu are categorised as, or referred to, as "stakeholders/community/community group".

It would be great to:

- * see cultural values reflected more genuinely within this Plan (not just attached to the Plan). This includes acknowledging our Iwi Management Plans and our culturally significant awa.
- * see an cultural values assessment to reflect changes since the 2013 document, including new Iwi and hapu management plans and treaty settlements. The recommendations of this must be reflected in the Plan.
- * to know if there is a role for Iwi and hapu in Plan implementation e.g. incorporating matauranga in stormwater and receiving water monitoring.

Nga mihi mahana

Elva Conroy
Ngati Tuheke representative
022 070 4652

On Thu, Oct 18, 2018 at 11:49 AM Petera Tapsell <Petera.Tapsell@westernbay.govt.nz<<mailto:Petera.Tapsell@westernbay.govt.nz>>> wrote:
Kia ora koutou te whanau

Please note the change of date from the Thursday to Friday. If you cannot make it please ensure your alternate will be attending. It is important for your Iwi/hapu to have their say.

Nga mihi

Petera

The information contained in this message (and any accompanying documents) is CONFIDENTIAL and may also be LEGALLY PRIVILEGED, intended only for the recipient(s) named above.

If the reader of this message is not the intended recipient, you are notified that any use, copying, disclosure, retention or distribution by any means of the information is strictly prohibited.

If you have received this message in error, please notify the writer immediately and destroy the original(s).

The information contained in this message (and any accompanying documents) is CONFIDENTIAL and may also be LEGALLY PRIVILEGED, intended only for the recipient(s) named above.

If the reader of this message is not the intended recipient, you are notified that any use, copying, disclosure, retention or distribution by any means of the information is strictly prohibited.

If you have received this message in error, please notify the writer immediately and destroy the original(s).

Your Ref:

Our Ref:



16 November 2018

Western Bay of Plenty Regional Council

Attention: Coral-Lee Ertel

haveyoursay@westernbay.govt.nz

Coral-Lee.Ertel@westernbay.govt.nz

Dear Coral-Lee

**Draft Catchment Management Plan (CMP) for the “Eastern Catchments”
Te Puke, Maketu, Little Waihi, Pukehina and Paengaroa**

Thank you for your presentation to our team on the 31 October 2018 on the above topic.

Bay of Plenty Regional Council's Rivers and Drainage Section (BOPRC-RAD) are affected by Western Bay of Plenty District Council's (WBOPDC) stormwater management decisions.

The following letter sets out BOPRC-RAD's position on the matter.

We appreciate significant work has been undertaken towards catchment planning for the “Eastern Catchment” area already since the lodgement of the Comprehensive Stormwater Consent and the first Catchment Management Plan in 2013.

However, to date, we have not seen an assessment of the effects on the Kaituna Catchment Control Scheme nor how WBOPDC is intending to mitigate the effects.

BOPRC-RAD appreciates that this is a complex issue, however, as the managers of the Kaituna Catchment Control Scheme any additional stormwater being generated from new and infill developments in the Te Puke area is creating significant stormwater management issues and is adversely affecting downstream landowners and the performance of BOPRC-RAD's flood protection and water control assets (see attached map for RAD assets impacted by increased stormwater in the Te Puke area).

Short-term mitigation works have recently been completed by BOPRC-RAD with the installation of two stationary pumps on the Armer and Marshall Drains at a cost to the scheme of \$320,000. We are seeking a 50% contribution from WBOPDC toward the cost of this short-term mitigation works.

Funding for investigation and construction of a longer-term solution has been included in BOPRC's LTP 2018-2028 in Years 1 to 3 under the Kaituna Catchment Control Scheme's capital works programme totaling \$2.8 million which BOPRC-RAD will also be seeking to recover from WBOPDC.

Significant technical discussions between BOPRC and WBOPDC staff on stormwater and flood modelling requirements have been undertaken already.

In this regard, stormwater and flood modelling work should continue as per recommendation during these discussions.

Objective ID: A3048108

A summary of which can be found below:

- The flood model needs to be undertaken for the 1% AEP event for the critical storm of the Kaituna Catchment (72-hour storm) for pre-, current- and future-development scenarios to assess the effects on the flood protection assets.
- Flood modelling in areas that affect the rural stopbank area should also be undertaken for the 5% AEP to ensure that the level of service to remove excess water of a three day design rainfall as set in the Rivers and Drainage Asset Management Plan can continue to be met.
- The flood model should include all areas contributing to the catchment flow (including industrial and rural areas).
- The model should be calibrated to ensure it is fit for purpose.

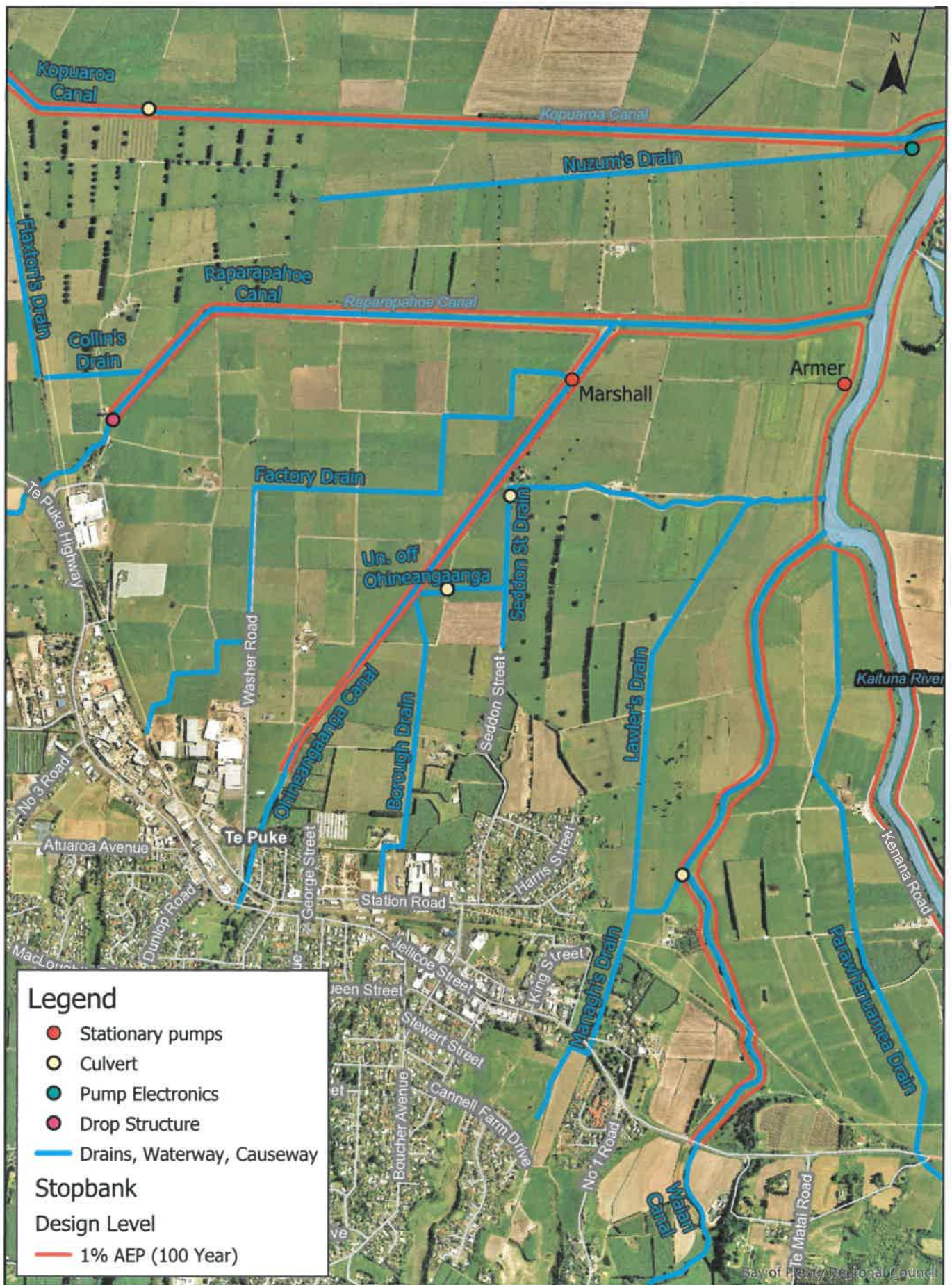
The CMP should quantify the effects on the Scheme and propose an action plan (e.g. effects mitigation options and timeframes).

In addition to the requirements of the Scheme, BOPRC Engineering is also concerned in regards to the general Flood Risk in the urban catchments. In particular, increased runoff has resulted in road culverts being insufficient and roads being overtopped in large flood events, which could lead to embankment failures and culvert blowouts. Some of these embankments are very high and potentially having large amounts of water sitting behind them. While this attenuation is desired to mitigate downstream effects, WBOPDC needs to ensure that the attenuation areas are formalised and embankments are structurally able to withstand the damming effect. The CMP should identify such infrastructure and propose an action plan (e.g. risk mitigation options and timeframes).

Kind regards



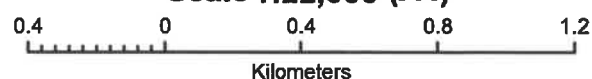
Kirsty Brown
Rivers and Drainage Asset Manager (Acting)
for General Manager Integrated Catchments



Rivers and Drainage Assets Impacted by Increased Stormwater in Te Puke area

DRAFT 15/11/2018

Scale 1:22,000 (A4)



GSP-574380

Sheet 1 of 1

Printed 15/11/2018

05 November 2018

Ariell King
Principal Planner
AECOM

Tēnā Koe Ariell

Re: Submission to Stormwater Consent

Te Runanga o Ngati Whakaue thank you for the consultation hui which was held at WBOPDC on Thursday, 01 November 2018.

We refer to Te Ara Mua plan which was adopted by WBOPDC. We support the approach of Te Ara Mua in recognising tangata whenua and their role within this comprehensive stormwater consent.

Te Ara Mua emphasises tangata whenua involvement in planning and their status as kaitiaki (guardians). For Ngati Whakaue ki Maketu the area of Maketu / Little Waihi is the catchment management area where we should be recognised as tangata whenua.

Initiatives that Te Runanga o Ngati Whakaue ki Maketu support for the catch management scheme:

- Soft infrastructure approach especially discharging points before the Maketu estuary. More riparian planting and possibly a design concept where we can have input and coordinate the planting;
- Plants that are native, that can be used for rongoa (medicinal) or that are edible (kai) or that can be used for weaving our whariki within our whare tupuna. We support plants that can act as cleansing agents;
- Healthy ecosystems that promote the growth of tupuna kai (ancestral foods) such as tuna (eels) and the inanga (whitebait), and growing aquatic plants such as watercress.
- Overhanging evergreen foliage that promotes shade to the drains so that the drain ecosystems have places of shade away from te whiti o te rā (rays of the sun) and tawhirimatea (winds).
- Rock formations that may slow the flow effect of the water and reduce sedimentation.
- Good management system in place, weed control of unwanted weeds such as pampus growing near drains in Maketu.
- Drains that are visually appealing to look at, that have some form of Mātauranga Māori aspect to offer young children.
- Cultural monitoring in areas where there is cultural heritage or is an important area for Ngati Whakaue ki Maketu.
- Where should the council start in Maketu / Little area? The Waitepuia Drain which discharges into the Maketu estuary. The drain is located behind the Maketu Reserve / Whakaue Kaipapa Marae.
- Funding allocated to programmes that will benefit Maketu / Little Waihi comprehensive stormwater catchment.



Te Runanga o
Ngati Whakaue
ki Maketu

We can be contacted by email runanga@actrix.co.nz or on 027 2910737.

Maria Horne

Manager

Te Runanga o Ngati Whakaue ki Maketu

027 2910737

16 November 2018

Western Bay District Council
Private Bag 12803
Tauranga Mail Centre
Tauranga 3143



Te Maru
o Kaituna

Attn: Coral-Lee Ertel

Feedback on the Draft Catchment Management Plan (CMP) for Te Puke, Maketū, Paengaroa and Pukehina urban areas

Thank you for your letter of 28 August 2018 seeking Te Maru o Kaituna River Authority's (TMoK) input into the draft Catchment Management Plan (CMP). We appreciate you taking the time to present to our committee on 19 Oct 2018 and also extending the time to allow TMoK to consider the draft CMP and provide feedback.

As you are aware *Kaituna, he taonga tuku iho* – the Kaituna River Document came into effect on 1 August 2018 and sets the communities vision, objectives and desired outcomes for the Kaituna River and its tributaries. Our collective vision is that 'the Kaituna River (and its tributaries) is in a healthy state and protected for current and future generations.' Objectives and their desired outcomes most relevant to urban stormwater management and discharges include Objectives 3, 4 & 5 about water quality and quantity and Objective 7 about ecosystem health. In our view, best practice stormwater management and discharges could enhance the KRD outcomes, particular those about limiting contaminants to ensure the awa in our catchment is safe for swimming, suitable for cultural ceremonies and suitable to sustain plentiful and safe kai. Stormwater management solutions could also contribute positively to the ecosystem health objective and desired outcome of exploring opportunities to create, increase and enhance the extent and quality of wetlands.

- i. TMoK requests the draft Catchment Management Plan be amended so the final version makes reference to *Kaituna, he taonga tuku iho* and demonstrates regard has been had to the relevant parts of the river document.
- ii. We are keen to see that the final version of the CMP demonstrates urban areas are 'doing their bit' and tangibly contributing actions to restoring water quality, the mauri and ecosystem health within our waterways at each step from short term to the longer term objectives and also within the comprehensive stormwater catchment resource consent application that follows.
- ii. We note that the draft CMP only covers the four urban areas. TMoK highlights the importance of ensuring not only the current extent of the four urban areas are included but also ensures growth, development, changing land use, changing weather patterns and climate change are all built into stormwater management solutions for the Kaituna catchment in an integrated and comprehensive way. The draft CMP states that it excludes stormwater discharges from the Te Puke West industrial development, land zone industrial because these areas remain under BOPRC's responsibility. TMoK urge WBOP to consider amending the CMP to include stormwater from all 'built' up area including stormwater from commercial and industrial uses regardless of which council is responsible, to ensure a 'whole' of catchment integrated approach to stormwater management is the result for the awa in the catchment.
- iii. The draft CMP contains short and long term objectives. We are concerned that there does not appear to be clear timeframes for the short term and long term objectives to be met by. TMoK are keen to ensure recommended stormwater management improvements are implemented for the good of the awa as soon as possible timeframe. TMoK requests the CMP be amended to include specific timeframes for completion of the short and long term objectives and recommendations so opportunities are taken for urban stormwater management to make a tangible contribute to restoring, protecting and enhancing our awa in as short a time a possible.

- iv. TMoK support amending the CMP to include specific timeframes for completion of each of the recommended actions. The recommendations table doesn't say actions are in priority order but appear to have water quantity actions ahead of water quality actions. TMoK request tangible water quality actions be given equal or heightened priority over water quantity actions. TMoK are keen to see measureable improvements in stormwater discharge outcomes in the short term rather than the short term only delivering information gathering & further studies to inform solutions in the short term.
- v. TMoK are pleased to see the catchment monitoring work to date has included not only the Kaituna River but Raparapahoe, Ohineangaanga, Waiari, Little Waihi Rd and Town Point Road Streams and note the results indicate streams investigated are generally considered to be in a 'moderate' to 'poor' condition. TMoK concur with the draft CMP's finding that the current condition is causing impacts on mahinga kai, natural character and the health of the awa and Maketū estuary with declining water quality, land use intensification and development placing pressure on wetlands and increased sedimentation.
- vi. TMoK support as naturalised an approach as possible for urban stormwater improvements and support methods included in the CMP such as low impact and water sensitive urban design as well as focussing on methods to improve ecological protection. We also support WBOP developing and implementing a comprehensive stormwater monitoring program and filling gaps outlined in the CMP including more complete catchment modelling.
- vii. TMoK welcome the opportunity to work with WBOP district council on some of the recommended actions which could contribute to the Kaituna River Document's action plan currently being developing. The KRD Action Plan is expected to set key actions contributing to the objectives over the short (within 3yrs), medium (within 6yrs) and long terms (9 years plus). For example actions within the draft CMP included under the sections cultural/social/ public health aspects as well as community participation in environmental protection, public access may be areas TMoK and / or iwi could work on collectively with WBOP.

Areas where we consider the CMP could contribute positively to the outcomes sought by *Kaituna, he taonga tuku iho*

- Natural / low impact and water sensitive urban design, utilising soft infrastructure including wetlands, stormwater ponds, rains gardens, swales and riparian buffers over hard engineered solutions
- Solutions which are fish passage and habitat friendly
- Explore opportunities to use wetlands to manage or treat stormwater, increase public and iwi connectivity with the awa and improvement in habitats
- Stormwater discharges which ensure our kai awa and kai moana is plentiful and safe to eat,
- Stormwater systems which are protected from wastewater infiltration which may impact on the wai being safe to swim

Te Maru o Kaituna welcome further discussion about how the Catchment Management Plan, the comprehensive stormwater consent application and our combined actions could closely align with *Kaituna, he taonga tuku iho*. We look forward to working together as co governance partners in our freshwater mahi.



Nāku noa iti nei

Dean Flavell, Chair Te Maru o Kaituna River Authority

Appendix C

Statutory Assessment

1.0 Statutory Assessment

In addition to **Section 5.0 Legislative Framework and Context**, within the main CMP document, the following statutory analysis has been undertaken. The CMP forms part of the Comprehensive Stormwater Consent (CSC) application to the Bay of Plenty Regional Council, which seeks resource consent to:

- Discharge stormwater to land, wetlands, and water from multiple locations within the urban settlements of Te Puke; and for three small urban settlements of Paengaroa, Maketu/Little Waihi and Pukehina;
- To undertake associated land disturbing activities and activities within the Coastal Marine Area (CMA) and/or watercourses; and
- To undertake maintenance activities on stormwater network;

Stormwater discharge from land zoned industrial under the WBOPDP has been excluded from this CSC application; i.e. within the urban areas of Te Puke and the small urban settlements, being Paengaroa, Maketu, Little Waihi and Pukehina, as depicted in catchment boundaries in Figures C-1 to C-4. Separate discharge consents will be required for industrial activities, as necessary, and coordinated by the industrial operators themselves.

There are a number of existing resource consents within the eastern catchments (identified in section 5.2 of this CMP). As identified in the main CMP document, all responsibilities for these consents will be surrendered pursuant to s138 RMA once the CSC is granted.

1.1 Resource Management Act 1991

1.1.1 Part 2 Matters

The purpose and principles of the Act 1991 (RMA) are contained in Part 2. The following section provides an analysis against the relevant provisions of Part 2:

Section 5 – Purpose of the RMA

The purpose of the RMA is to “*promote the sustainable management of natural and physical resources*” [s.5(1)].

Sustainable management is defined in section 5 of the Act as follows:

In this Act, “sustainable management” means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while-

- Sustaining the potential of natural and physical resources) excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
- Safeguarding the life supporting capacity of air, water, soil, and ecosystems; and*
- Avoiding, remedying, or mitigating any adverse effects of activities on the environment.”*

As discussed in **Section 5.0** of the main CMP document, through the implementation of the CMP for the proposed CSC any adverse effects will be adequately managed and mitigated. Therefore, the proposed CSC will ensure the sustainable management of the land and water resource, enabling people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety.

1.1.2 Matters of National Importance and Other Matters

In addition to section 5 of the Act that defines its purpose, section 6 identifies matters of national importance. In relation to the eastern catchments, a number of these matters are important.

Section 6 states that in relation to managing the use, development, and protection of natural and physical resources, the following matters must be recognised and provided for:

- (a) *The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:*
- (b) *The protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development:*
- (c) *The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:*
- (d) *The maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers:*
- (e) *The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.*

A number of these matters have been provided for through the eastern catchments CMP. In particular, the preservation of the stream systems in the catchments, areas of indigenous vegetation and the provision of access to the stream systems provide practical recognition of these issues. It is intended that WBOPDC will continue to work with Iwi and hapu in the implementation of the CMP and that this will assist in recognising the matters outlined above.

As indicated in **section 11.2 Recommendations** of this report, the proposed CMP recognises and provides for the identified Matters of National Importance, through the relevant, proposed management, monitoring and mitigation measures.

Section 7 of the Act provides for a number of other matters which are to be given particular regard to when considering the use, development, and protection of natural and physical resources. These matters include:

- (a) *Kaitiakitanga:*
 - [(aa) *The ethic of stewardship:*
- (b) *The efficient use and development of natural and physical resources:*
- (c) *The maintenance and enhancement of amenity values:*
- (d) *Intrinsic values of ecosystems:*
- (e) *Recognition and protection of the heritage values of sites, buildings, places, or areas:*
- (f) *Maintenance and enhancement of the quality of the environment:*
- (g) *Any finite characteristics of natural and physical resources:*
- (h) *The protection of the habitat of trout and salmon.*

Kaitiakitanga will be recognised through Tangata Whenua consultation and will continue to be provided for through the CSC conditions and the CMP.

Section 8 of the RMA requires consideration to be given to the Treaty of Waitangi:

In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).

One of the significant principles of good practice arising from resource management is that tangata whenua should be consulted and have an active role in the process. **Section 2.4 Consultation on the draft Catchment Management Plan and Appendix B** provide the details of the consultation undertaken on the draft CMP. It is intended that the consultation will be ongoing with Iwi and hapu.

1.1.3 Section 104 - Consideration of Application

Under s.104(1) of the RMA, when considering an application for resource consent, a consent authority must, subject to the Part 2 RMA matters outlined above, have regard to:

- (a) *any actual and potential effects on the environment of allowing the activity; and*
- (b) *Any relevant provisions of –*
 - (i) *a national environmental standard:*

(ii) other regulations;

(iii) a national policy statement;

(iv) a New Zealand coastal policy statement;

(v) a regional policy statement or proposed regional policy statement;

(vi) a plan or proposed plan; and

(c) Any other matter the consent authority considers relevant and reasonably necessary to determine the application.

Under s.104B of the RMA, after considering an application for a Discretionary Activity, a consent authority:

(a) May grant or refuse the application; and

(b) If it grants the application, may impose conditions under s.108 RMA.

The existing environment comprises the existing uses, those permitted in the future by a rule in the plan, and consented activities (including those yet to be implemented). Substantial change has occurred within the environment in recent years, and as such is considered modified from its original state. It is not, therefore this original environment as it may have been many years ago before development within the central catchment was established, nor the environment as it might be at some point in the future if, for example, substantial change has occurred.

1.1.4 S.105 RMA: Matters relevant to certain applications

This application is for a CSC (discharge permits), and the consent authority must therefore, in addition to the matters in section 104(1), have regard to—

- *the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and*
- *the applicant's reasons for the proposed choice; and*
- *any possible alternative methods of discharge, including discharge into any other receiving environment.*

In this regard, the impact on the receiving environment has been assessed through the investigations undertaken as part of the CMP process. Such investigations include but are not limited to, the Freshwater Ecological and Water Quality Assessment (29 March 2018), the Eastern Catchment Stream Bank Erosion Drone Survey (15 March 2018) for the eastern catchment areas (as contained within Appendix E), hydraulic modelling, an overview of the discharge points and relevant community plans/visions.

An assessment of environmental effects has been undertaken in section 10.0 of the CMP and options have been evaluated in section 11.0.

1.1.5 S.107 RMA: Restriction on grant of certain discharge permits

The effects of the proposed CSC sought have been assessed (refer to section 10.0 of the CMP) to ensure that potential adverse effects on the environment will not result in the conditions described under Section 107, which are set out below, for ease of reference:

1. *Except as provided in subsection (2), a consent authority shall not grant a discharge permit [or a coastal permit to do something that would otherwise contravene section 15 or section 15A allowing—*
 - (a) The discharge of a contaminant or water into water; or*
 - (b) A discharge of a contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water; or*

- (ba) The dumping in the coastal marine area from any ship, aircraft, or offshore installation of any waste or other matter that is a contaminant, -*
- if, after reasonable mixing, the contaminant or water discharged (either by itself or in combination with the same, similar, or other contaminants or water), is likely to give rise to all or any of the following effects in the receiving waters:*
- (c) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials:*
- (d) Any conspicuous change in the colour or visual clarity:*
- (e) Any emission of objectionable odour:*
- (f) The rendering of fresh water unsuitable for consumption by farm animals:*
- (g) Any significant adverse effects on aquatic life.*
2. *A consent authority may grant a discharge permit or a coastal permit to do something that would otherwise contravene section 15 or section 15A that may allow any of the effects described in subsection (1) if it is satisfied—*
- (a) That exceptional circumstances justify the granting of the permit; or*
- (b) That the discharge is of a temporary nature; or*
- (c) That the discharge is associated with necessary maintenance work—*
- and that it is consistent with the purpose of this Act to do so.*
3. *In addition to any other conditions imposed under this Act, a discharge permit or coastal permit may include conditions requiring the holder of the permit to undertake such works in such stages throughout the term of the permit as will ensure that upon the expiry of the permit the holder can meet the requirements of subsection (1) and of any relevant regional rules.*

Given the assessments undertaken in relation to the proposed CSC application, and all the information provided including in the CMP document, the effects in the receiving waters, after reasonable mixing will be acceptable.

1.2 New Zealand Coastal Policy Statement 2010

The New Zealand Coastal Policy Statement 2010 (NZCPS) provides direction for the management of the coastal environment.

Policy statements and plans produced by the regional and territorial authorities are required to give effect to the NZCPS. Matters addressed in the NZCPS include:

- Preservation of the natural character of the coastal environment;
- Protection of those characteristics of the coastal environment that have special value to tangata whenua;
- Provision for appropriate subdivision, use and development of the coastal environment; and
- The Crown's interest in the land in the Coastal Marine Area (CMA).

These matters are addressed in the objectives, policies, rules and other provisions of the Bay of Plenty Regional Policy Statement (RPS) and the Bay of Plenty Regional Coastal Environment Plan (RCEP).

A number of objectives and policies within the NZCPS are particularly relevant to the proposed CSC including:

- Objective 1 – To safeguarding the integrity, form, functioning and resilience of the coastal environment and sustaining its ecosystems, including marine and intertidal areas, estuaries, dunes and land.
- Objective 2 – To preserve the natural character of the coastal environment and protect natural features and landscape values.

- Objective 3 – To take account of the principles of the Treaty of Waitangi, recognise the role of tangata whenua as kaitiaki and provide for tangata whenua involvement in management of the coastal environment.
- Objective 5 – To ensure that coastal hazard risks taking account of climate change are managed.
- Objective 6 – To enable people and communities to provide for their social, economic, and cultural wellbeing and their health and safety, through subdivision, use, and development.
- Policy 1 – Extent and characteristics of the coastal environment.
- Policy 2 - The Treaty of Waitangi, tangata whenua and Māori heritage.
- Policy 3 – Precautionary approach.
- Policy 4 – Integration.
- Policy 6 – Activities in the coastal environment.
- Policy 11 – Indigenous biological diversity (biodiversity).
- Policy 13 – Preservation of natural character.
- Policy 14 – Restoration of natural character.
- Policy 15 – Natural features and natural landscapes.
- Policy 21 – Enhancement of water quality.
- Policy 22 – Sedimentation.
- Policy 23 – Discharge of contaminants.
- Policy 24 – Identification of coastal hazards.
- Policy 25 – Subdivision, use, and development in areas of coastal hazard risk.
- Policy 26 – Natural defences against coastal hazards.
- Policy 27 – Strategies for protecting significant existing development from coastal hazard risk.

The proposed CSC is in keeping with the relevant objectives and policies of the NZCPS. As discussed in **section 10.0** of the CMP, the works will address any potential adverse effects on the integrity, form and function of the coastal environment.

1.3 National Policy Statement Freshwater Management 2014

The NPS for Freshwater Management was made operative on 1 August 2014¹ and sets out the objectives and policies for freshwater management under the Resource Management Act 1991. The NPS for Freshwater Management states:

This national policy statement recognises Te Mana o te Wai and sets out objectives and policies that direct local government to manage water in an integrated and sustainable way, while providing for economic growth within set water quantity and quality limits. The national policy statement is a first step to improve freshwater management at a national level.

This national policy statement provides a National Objectives Framework to assist regional councils and communities to more consistently and transparently plan for freshwater objectives. Te Mana o te Wai is an integral part of the framework that forms the platform for community discussions about the desired state of fresh water relative to the current state. New Zealanders generally aspire to high standards for our waterways and outcomes that are better than those achieved under the status quo. Freshwater planning will require an iterative approach that tests a range of possible objectives, limits and methods for their achievement, including different timeframes for achieving objectives. This ensures that the implications of proposed freshwater objectives are clear for councils and communities.

With regards to national bottom lines, this NPS has identified two compulsory values for freshwater management:

- Ecosystem health; and
- Human health for recreation.

In terms of tangata whenua values, the NPS states:

Iwi and hapū have a kinship relationship with the natural environment, including fresh water, through shared whakapapa. Iwi and hapū recognise the importance of fresh water in supporting a healthy

¹ As amended on 7 September 2017

ecosystem, including human health, and have a reciprocal obligation as kaitiaki to protect freshwater quality.

In this regard, Appendix 1 of this NPS sets out the national values and uses for freshwater; including such compulsory aspects as:

- the health and mauri of water (ecosystem health), and
- the health and mauri of people (human health for recreation).

Other additional values include:

- the health and mauri of the environment (natural form and character);
- food gathering, places of food (mahinga kai, fishing);
- cultivation (irrigation and food production, animal drinking water);
- Sacred waters / Wahi Tapu;
- Municipal and domestic water supply;
- economic or commercial development (commercial and industrial use, hydro-electric power generation); and
- Navigation (transport and tauranga waka).

As demonstrated in the information provided in the main CMP document, the proposed CSC will not result in adverse effects that are contrary to relevant policy directions in the NPS for Freshwater Management. A number of these matters were also raised during consultation on the draft CMP (details provided in section 2.4 and Appendix B).

1.4 National Environmental Standards

The National Environmental Standards (NES) that are relevant to the proposed CSC include the following:

National Environmental Standard for Sources of Human Drinking Water 2008

The NES for Sources of Human Drinking Water came into effect 20 June 2008 and relates to a natural water body such as a lake, river or groundwater; used to supply a community with drinking water. It complements Ministry of Health legislation for improving drinking water supply and delivery. This ensures a comprehensive approach to managing drinking water from source to tap. The NES requires regional councils to ensure that effects of activities on drinking water sources are considered in decisions on resource consents and regional plans. There are also relevant drinking water standards to address water quality and health related aspects (Ministry of Health legislation).

The Ministry for the Environment (MfE) are currently evaluating how well the NES is being implemented, which will be followed by an evaluation of the effectiveness of the NES in 2018.

Proposed National Environmental Standard on Ecological Flows and Water Levels 2008

There is also a proposed NES on Ecological Flows and Water Levels to promote consistency in the way decision are made on whether the variability and quantity of water flowing in rivers, ground water systems, lakes and wetlands is sufficient. The proposed NES is currently on-hold pending decisions on the Government's freshwater reform programme.

NES for Measurement of Water Takes

The previously proposed NES for Measurement of Water Takes is now a regulation under section 360(1)(d) of the RMA:

“s360(1)(d) - requiring the holders of water permits, discharge permits, coastal permits, or land use consents granted for any activity that would otherwise contravene section 13, to keep records for any purpose under this Act, and prescribing the nature of records, information, and returns, and the form, manner, and times in or at which they shall be kept or furnished.”

As demonstrated in the information provided in the main CMP document, the proposed CSC will not result in any adverse effects that are contrary to the NES for Sources of Human Drinking Water.

1.5 Operative Regional Policy Statement

The Bay of Plenty Regional Policy Statement (RPS) is a document prepared under the Resource Management Act 1991 (RMA) to sustainably manage the region's natural and physical resources. The second generation RPS became operative on 1 October 2014. The RPS has been amended since by Plan Change 1 (Coastal Policy), Plan Change 2 (Natural Hazards), and Plan Change 3 (Rangitaiki River). Plan Change 4 (Tauriko West Urban Limit) is currently proposed (publically notified 22 May 2018, submissions close 4 July 2018).

In terms of the proposed CSC, the relevant provisions of the RPS include the following sections:

- Section 2.2 – Coastal environment
- Section 2.5 – integrated resource management
- Section 2.6 – Iwi resource management
- Section 2.7 – Matters of National Importance
- Section 2.8 – Urban and rural growth management
- Section 2.9 – Water quality and land use
- Section 2.10 – Water quantity
- Section 2.11 – Natural hazards

As demonstrated in the information provided in the main CMP document, the proposed CSC is generally consistent with the relevant objectives and policies of the RPS.

1.6 Bay of Plenty Regional Coastal Environment Plan

The Bay of Plenty Regional Coastal Environment Plan (amended 22 February 2011) (RCEP) will remain active until any appeals on the Proposed Bay of Plenty Regional Coastal Plan have been resolved (Council decisions were released 1 September 2015).

Under the RCEP, the Eastern Catchment discharges into areas identified as:

- Site of District or Local Significance (in the Coastal Marine Area) (Areas SSCMA33, 34 & 36 within the Waihi Estuary, as per Sheet 16B of the Planning Maps);
- Site of Significance (on Land) (Areas SSL 35 and 36 within the Maketu and Waihi Estuaries, as per Sheet 16B of the Planning Maps);
- Area of Significant Conservation or Cultural Value (in the Coastal Marine Area) (Area extending from the Kaituna River to Pukehina Beach (as per Sheet 16B of the Planning Maps));
- Regionally Significance Feature and Landscape (S10 and 11 around Okurei Point and within the Waihi Estuary, as per Sheet 16C of the Planning Maps);

The Maketu Catchment Management area borders on the edge of Maketu Estuary. This Estuary is identified as an 'area of significant conservation and cultural value' (ASCV-7) under the RCEP. The estuary provides important feeding and roosting grounds for a number of wading, wetland and shore bird species, and meets the Ramsar criteria (Ramsar Convention Secretariat 2013) for an internationally significant wetland.

The Little Waihi Catchment Management area borders on the edge of Waihi Estuary; as does the Pukehina Catchment Management area. The Waihi Estuary and associated wetland margins are identified as an 'Area of Significant Conservation Value' (ASCV-7) with 'Significant Indigenous Vegetation Areas' (SSCMA-34) under the RCEP. The estuary provides feeding and roosting grounds for migratory and wading bird species, and contains representative saltmarsh vegetation which is still relatively intact.

Works within the CMA include:

- Installation and maintenance of inlet and outfall structures and associated scour protection
- Installation and maintenance of energy dissipation devices and fish passages
- Installation and maintenance of treatment devices/swales, debris deflectors
- Construction, operation and maintenance of stopbanks, floodgates, spillways, pump stations, retention and detention structures and dams, and weirs/measurement stations to protect property from flooding and to safeguard communities.
- Piping of watercourses/artificial lining, widening and channelling
- Sediment management, including channel realignment, diversions and sediment relocation and, installation and maintenance of rock revetment, training groynes and enhanced due care
- Weed control by herbicide, Vegetation removal and Vegetation planting
- Pipeline crossings of streams/watercourses
- Maintenance of flood ways/secondary flow paths
- Mitigation works and ecological enhancement works in streams and watercourses
- Earthworks associated with installation of stormwater infrastructure including detention dams, swale construction, protection works, mitigation works, and flood ways

With regard to these works, the following chapters and specific objectives and policies are relevant to this CSC:

- Chapter 9: Coastal Discharges, specifically Objective 9.2.2 and Policies 9.2.3 (a-d, h);
- Chapter 11: Coastal Hazards, specifically Objective 11.2.2 and Policies 11.2.3 (a, d - g);
- Chapter 12: Occupation of Space, specifically Objective 12.2.2 and Policies 12.2.3 (a);
- Chapter 13: Structures, specifically Objective 13.2.2 and Policies 13.2.3 (a, e, g, h-l);
- Chapter 14: Disturbance and Deposition, specifically Objective 14.2.2 (a) and Policies 14.2.3 (a, e-g); and
- Chapter 18: Historic and Cultural Heritage, specifically Objective 18.2.2 and Policies 18.2.3 (a, c - e),

The proposal has been assessed with reference to the following Schedules of the RCEP:

- Ninth Schedule – Information Requirements for Coastal Permit Applicants;
- Thirteenth Schedule – Water Quality Standards; and
- Fourteenth Schedule – Areas of Significant Cultural Value.

With regard to the above, given the proposed management and mitigation measure identified in **section 11.2** of the CMP document, it is considered that works and structures within the CMA will be generally consistent with the relevant objectives, policies and schedules identified above. A number of these matters were discussed and included in the feedback on the draft CMP. See details in section 2.4 and Appendix B.

1.7 Bay of Plenty Regional Water and Land Plan

The Bay of Plenty Regional Natural Resources Plan (RNRP) replaces the Regional Water and Land Plan (RWLP). As part of the change, no rules, objectives or policies in the RWLP were changed, only the layout was improved and it was renamed as the Regional Natural Resources Plan.

Chapter 6 of the RNRP addresses discharges to water and to land. The proposed CSC has been assessed against the relevant Objectives (DW O8 – DW O15) and relevant Policies (DW P14 – P21) of this Chapter. In this regard the following relevant comments are made:

- The proposed CSC has been assessed against the relevant objectives and policies set out above. Section 10.0 of the CMP addresses potential adverse effects on the environment due to actual and potential development within the eastern catchment. Proposed recommendations to be implemented at specific locations to manage and /or improve stormwater discharges are listed in Section 11.2 (Table 28).
- As indicated in the CMP, the effects on water quality within the eastern catchment can be mitigated to be less than minor and to acceptable levels, subject to appropriate stormwater management (refer section 11.2). Overall, the CSC will not have an adverse effect on the life-supporting capacity of fresh water, including on any ecosystem associated with fresh water.
- Overall, given the assessment of effects detailed in section 10.0, the proposed CSC will be consistent with the relevant objectives and policies of Parts 4.12 and 4.13 of the RNRP.
- The discharge of stormwater to surface water is permitted under Rule DW R20, provided certain criteria are met.
- Rule DW R21 provides for the discharge of stormwater to surface water as a Restricted Discretionary activity, provided certain criteria are met relating to rate of discharge, and suspended solids concentrations, amongst other criteria. Where the discharge does not fully comply with Rules DW R20 and DW R21, it is a Discretionary activity under Rule DW R8 (refer to Flow diagram DW1 – Stormwater Discharges, RWLP). In this regard, Rule DW R21 provides for known discharges easily assessed and addressed by way of consent conditions, whereas Rule DW R8 (Discretionary) applies to (but is not limited to) comprehensive catchment discharge consents for stormwater, as well as for large scale applications (trade and industrial premises, contaminated sites).
- Rules DW R22 and DW R23 address the discharge of stormwater to land soakage as a Permitted activity and Restricted Discretionary activity respectively, depending on meeting certain criteria.
- Rule DW R6 provides for the discharge of water to water as a Permitted activity where the discharge is to the same surface water body and the water quality is the same as the receiving waters.
- Rule DW R8 addresses all other discharges to water or land, which identifies such discharges as Discretionary; and requires an assessment of Schedule 9 and the Water Classification Map. As noted above, Rule DW R8 provides for comprehensive catchment discharge consents for stormwater, such as this application seeking CSC consent.
- Within the Te Puke Catchment Management area, the Ohineagaanga Stream is identified as an Aquatic Ecosystem (Bay of Plenty) south of State Highway 2 and as a Modified Watercourse with Ecological Values north of State Highway 2 (refer to Water Classification Map - BOP Region Plan U14, scale 1:50 000, referenced No C2165, dated November 2008, contained in Appendix D3 to D4).
- Other streams and tributaries within the eastern catchment are classified as Bay of Plenty Regional Base Line (refer to Water Classification Maps - BOP Region Plan U14, V14, and V15, scale 1:50 000, referenced No C2165 dated November 2008, contained in Appendix D3 to D4).
- Under Schedule 9 – Water Quality Classification Standards and Criteria, Section 4 addresses the Aquatic Ecosystem (Bay of Plenty) Water Quality Classification, Section 7 addresses the Modified Watercourse with Ecological Values, and Section 9 addresses Regional Baseline (Bay of Plenty) Water Quality Classification. These sections set out the required standards to be addressed by the discharge after reasonable mixing of the discharge with the receiving water.

This aspect has been taken into account within the CSC documentation and supporting appendices, along with the management, monitoring and mitigation measures proposed. Given this, the effects on water quality in the receiving waters after reasonable mixing, will be acceptable.

- Rule WL R9 (Chapter 9 – Wetlands) addresses any modifications to wetlands as a Discretionary activity;

These matters can be addressed through consultation to be undertaken with regards to the CSC; as well as through further Iwi/Hapu participation.

With regard to the above, given the proposed management and mitigation measures identified in **section 11.2** of the CMP, it is considered that works and structures within the CSC will be generally consistent with the direction of the RNRP.

1.8 Stormwater Management Guidelines for the Bay of Plenty Region (Guideline 2012/01)

The purpose of the Stormwater Management Guidelines (SMG) is to provide a guideline for stormwater management within the Bay of Plenty Region. In particular, the SMG provides guidance on design for both stormwater quality treatment and for stormwater quantity treatment. The objectives of the SMG include:

- To provide the reader with a summary of the principles of stormwater management including an outline of environmental effects and management concepts,
- To outline the statutory process and provide consent for the guidelines in relation to stormwater discharges,
- To provide a resource guideline for those involved with the design of stormwater management practices, and
- To minimise adverse environmental effects of stormwater discharges through appropriate site design and design of stormwater management practices.

The option evaluation in **section 11.0** and recommendations in **section 11.2** of the CMP have been drafted following a review of the SMG.

1.9 SmartGrowth

The SmartGrowth 50-year Strategy and Implementation Plan was published in May 2004 and is a growth strategy for the Western Bay of Plenty sub-region. The SmartGrowth Strategy is a joint initiative between Bay of Plenty Regional Council, Western Bay of Plenty District Council (WBOPDC), Tauranga City Council (TCC), and tangata whenua. The Smart-Growth Strategy identifies a number of methods that can be used to achieve its vision and outcomes. One such method is the implementation of a subregional stormwater strategy, including education, which anticipates future growth needs.

SmartGrowth provides six principles to govern stormwater management in the Western Bay of Plenty sub-region. These principles are:

- (i) *Stormwater is viewed as a resource.*
- (ii) *Stormwater is treated to protect the environment.*
- (iii) *Forward planning and implementation of a stormwater system with sufficient capacity to support intensified urban development.*
- (iv) *Pollution of the Tauranga Harbour is actively avoided.*
- (v) *Flood protection meets or exceeds legislative requirements.*
- (vi) *Water quality in the coastal marine area is maintained and enhanced.*

SmartGrowth recognises that increased intensification may cause accelerated stormwater run-off, so infrastructural requirements for growth need to be planned for. SmartGrowth proposes careful management and assessment of effects of intensification on stormwater runoff through long-term implementation plans.

The SmartGrowth Strategy drives towards managing growth and development in a way that ensures that adverse environmental effects are minimised. The use of CSCs that embody the six principles is an effective way to manage the effects of stormwater.

Within the eastern catchment area there are a number of Urban Growth Areas identified within the SmartGrowth Strategy, namely within Te Puke (Dudley Vercoe Drive, MacLoughlin Drive, and No 1 Road Structure Plan areas). Appendix D contains the maps detailing the growth areas within the eastern catchments. In this regard and key to development within the eastern catchments is the management of natural hazards including flooding, coastal inundation, erosion, and instability.

With regard to the above, given the proposed management and mitigation measures identified in **section 11.2** of the CMP, it is considered that stormwater management within the eastern catchment will be generally consistent with the six principles identified in the SmartGrowth Strategy.

1.10 Bay of Plenty Regional Stormwater Strategy

This Stormwater Strategy (October 2005) (SS) outlines the stormwater issues confronting the Bay of Plenty region. The purpose of the SS is to assist the region's Territorial Authorities (TAs) by providing a framework they can use to produce their own localised stormwater strategies and action plans. The SS promotes using the principles outlined in the document to ensure stormwater is managed consistently across the region, and ensure that the effects of stormwater discharges are dealt with adequately. It recognises the statutory responsibilities the different authorities have, and the benefits of addressing stormwater management on a comprehensive basis across the Bay of Plenty; i.e. this supports the CSC approach here.

The SS also meets an objective of the Smart-Growth Strategy and Implementation Plan (as discussed above). The SS provides useful information and guidance details, particularly in relation to managing stormwater within the eastern catchment on a comprehensive basis.

The SS sets out a Stormwater Strategy Vision that provides a framework for stormwater management issues to be addressed in an integrated, comprehensive and consistent manner throughout the Bay of Plenty region. The SS contains Issues, Objectives and policies, and also sets out Options, Methods, and Monitoring to implement the region's goals and objectives for stormwater management.

With regard to the above, given the proposed management and mitigation measures identified in **section 11.2** of the CMP, it is considered that stormwater management within the eastern catchment, adopting the CSC approach, will be generally consistent with the SS.

1.11 Western Bay of Plenty District Plan

Under the WBOPDP, the underlying zones within the eastern catchments management boundaries include:

- **Te Puke** – Residential, Medium Density Residential, and Commercial. Also includes Structure Plans:
 - TP3-1 (zoned Residential and Medium Density Residential, located off MacLoughlin Drive),
 - TP3-2 (zoned Residential, located off MacLoughlin Drive),
 - TP3-3 (zoned Residential and Future Urban, located off Dunlop Road),
 - TP4 (zoned Residential, located off Dudley Vercoe Drive), and
 - TP5 (zoned Residential, located off No. 1 Road and Gannell Farm Drive).
- **Pukehina** – Residential and Commercial
- **Paengaroa** – Residential and Commercial
- **Maketu** – Residential, Rural Residential, Rural, Industrial and Commercial. Part of the Maketu Structure Plan (zoned Residential and Rural Residential, located off Arawa Avenue), is also located within the boundary of this CMP.
- **Little Waihi** – Residential

These CMP areas contain the following overlays under the WBOPDP that are relevant in terms of stormwater management and subdivision:

- **Te Puke** – Flood hazard, Reserves (including Proposed Reserves), Stormwater Ponds, Proposed Esplanade Strip / Reserve, Notable Trees (8, 10), and Built Heritage Features (30, 43, 44)

- **Pukehina** – Coastal Erosion Area – Primary Risk (3), Coastal Erosion Area – Secondary Risk (3), Coastal Inundation, Flood Hazard, and Reserves
- **Paengaroa** – Flood hazard and Reserves
- **Maketu** – Flood hazard, Stormwater Pond, Reserves, Stability Area – General, Stability Area – landslip, Cultural heritage Features (76, 81, 116, 117, 122), and Built Heritage Features (10, 11, 48, 50).
- **Little Waihi** – Flood Hazard, Significant Ecological Feature (RAP), Stability Area – General, and Reserve.

The Te Puke Catchment Management Boundary includes Te Puke Area 3, 4 and 5 Structure Plans. Within Structure Plan Area 3 (located off MacLoughlin Drive and Dunlop Road) the WBOPDP identifies seven stormwater ponds (SW Ponds 2, 3, 4, 5, 7, 8, and 9). Within Structure Plan Area 4 (located off Dudley Vercoe Drive), the map identifies a stormwater pond (SW Pond 4A). All three Te Puke Structure Plan Areas identify zoning and proposed roads, walkways, watermains, stormwater mains and sewer mains.

The WBOPDP Planning Maps identify two stormwater ponds within the Maketu Structure Plan area.

A description of the environment and relevant characteristics of the eastern catchments areas is provided in section 6.0.

All subdivision requires resource consent and is required to be designed in general accordance with the WBOPDP provisions. Once a site has been created within the Residential zone, one dwelling per lot is a permitted activity (WBOPDP Rule 13.3.1). Any additional dwellings or minor dwellings require resource consent. It is acknowledged that once a site has been created through subdivision there is limited ability through the resource consent process under the current WBOPDP provisions to manage and treat stormwater. Therefore it is key that provision is made for stormwater treatment and management as part of the subdivision assessment and consent process.

Within the Residential zone the following minimum site areas are required –

- **Te Puke** – 350m²
- **Maketu** – 350m² minimum, 600m² average (within greenfield areas connected to a reticulated wastewater supply with a minimum parent lot size of 3,000m²)
- **All other areas** – 800m² (subject to compliance with Rule 12.4.6 and 12.4.7).

All subdivision, use and development in within the identified structure plan areas shown on the Planning Maps (i.e. Te Puke and Maketu) is required to provide stormwater ponds / management reserves and access thereto, roading and road widening, walkways/cycleways, and water, stormwater, and sewage mains in the general locations shown on the Structure Plan and/or Planning Maps. Any non-compliance to a specific structure plan or to performance standards (12.4.1(g) or 12.4.3.3) is deemed to be a Non-Complying Activity unless otherwise stated (Rule 12.3.4.1).

The proposed CMP will also reflect WBOPDC direction through alignment with a number of objectives and policies of the District plan; in particular those contained within Section 10 - *Infrastructure, Network Utilities & Designations* – including objectives 10.2.1(1), 10.2.1(2), 10.2.1(5) and policies 10.2.2(1) and 10.2.2(2). The proposed CMP which involves the identified management and mitigation measures (refer to **section 11.2** of the CMP), is directly related to the provision, operation and maintenance of stormwater infrastructure required to efficiently and effectively meet the current and foreseeable needs of the District.

The WBOPDP subdivision objectives (12.2.1) seek that:

- *Infrastructure and services are designed and constructed to minimum standards which will result in improved environmental outcomes without significant additional cost to the community.*
- *Sufficient infrastructure capacity is provided to ensure the efficient and equitable provision of services to all land in the catchment.*

- *Comprehensive assessment of development proposals to ensure that the full effect of the proposal is able to be determined.*
- *Subdivision and development that minimises the effects from stormwater run-off.*

The WBOPDP subdivision policies (12.2.2) seek that:

- *The design of subdivision is in accordance with structure plans.*
- *Require subdivision to be undertaken in accordance with any staging requirements to ensure the effective and efficient servicing of land within the catchment.*
- *Require subdivision and development to provide infrastructure and services to meet the reasonably foreseeable needs of other land in the vicinity of the development.*
- *Require subdivision and development to comply with the minimum standards in the Development Code for the provision of infrastructure and services, or to an alternative standard which is as effective and efficient in the long term and results in improved environmental outcomes.*
- *Require all subdivision and development proposals submitted to Council to include a comprehensive assessment prepared in accordance with the information requirements of the Development Code.*
- *Subdivision and development practices that take existing topography, drainage and soil conditions into consideration with the aim of minimising the effects of stormwater run-off.*

The WBOPDP requires subdivision applications to provide reports by suitably qualified and experienced persons on (Rule 12.3.8):

- *Description of any natural hazards or other physical constraints affecting the land to be subdivided and how these constraints are to be addressed.*
- *Stormwater reticulation, treatment and disposal are to be addressed in accordance with Section 12.4 and Council's Development Code. A detailed description shall be given of how these are to be provided for as appropriate.*
- *Aspects such as source of supply, discharge points, quantities likely, consents required and the location of any waterways, wetlands and ponding areas shall be addressed in the report.*

Section 12.4.5 Stormwater requires –

A stormwater reticulation and disposal system shall be provided that is adequate to safeguard people from injury or illness and to protect property from damage caused by surface water.

A primary flow path for flood waters shall be provided as a system of stormwater pipes (or other alternative proven designs, including swales and wetlands, giving regard to operation and maintenance approved by Council) designed to cope with the runoff from the design flood.

A secondary flow path shall be provided as the overland route taken by floodwaters when the primary path is unable to cope either because of blockages or because the hydraulic capacity of the primary path is exceeded by a larger than design flood.

The secondary flowpaths shall be designed and sized assuming full blockage of the upstream reticulation system.

Where practical, overland stormwater flowpaths shall be combined with pedestrian or cycle access if these are required.

Where flowpaths provide connection to only one existing or proposed road or other feature and otherwise run through private property (e.g. private way) the flowpath shall be within a defined channel or swale including calculation and design of capacity. The flowpath shall be protected by an easement in favour of Council and a consent notice on the title prohibiting ground re-shaping and the erection of any barriers to the flowpath.

Where a dwelling is to be built in an area that is not possible to be serviced with a stormwater system, a stormwater disposal system shall be provided exclusive of any identified natural hazard area that will safeguard people from injury or illness and protect property from damage caused by surface water.

In addition to the above, the subdivision section (Part 12.4.10) of the WBOPDP sets out the stormwater treatment and management measures that are required as part of subdivision within structure plan areas. These include:

- *Establishing stormwater management reserves (as per the WBOPDP Maps). Stormwater management reserves are required to be vested in Council.*
- *Establishing a combination of swales, reticulated pipework and open channels where appropriate.*
- *Designing for attenuation of the defined return period storm event (AEP) to pre-development levels (achieved through a combination of subdivision design, land use restrictions, drainage design features (e.g. low impact design and end of pipe solutions).*
- *Treatment of stormwater for the removal of sediment to a standard of at least 75 percent (with reference made to Auckland Regional Council TP10). Methods to achieve this include a combination of drainage design features (e.g. swales) and end-of-pipe solutions (e.g. ponds).*
- *A requirement to demonstrate how they will address on or adjacent to the site:*
 - *Passage of surface flows from upstream and from the site itself to avoid the risk of erosion and flooding.*
 - *Protection of houses from flooding in the defined storm AEP event.*
 - *Improvement of stormwater quality.*
 - *Management of runoff peaks to downstream so they are no greater than prior to development, or are fully managed through to the receiving environment (e.g. the Tauranga Harbour).*
 - *All site developments (both subdivision earthworks and subsequent building excavations and earthworks) shall comply with the provisions of the Bay of Plenty Regional Council “Erosion and Sediment Control Guidelines No 2001/3” and subsequent revisions.*
 - *Mitigate any detrimental effects of flow concentration at outlets.*

The proposed CMP is not contrary to the purpose and direction of the WBOPDP, including that for the Residential, Medium Density Residential, Rural Residential and Future Urban zones. In particular, the CMP provides for a range of stormwater management measures, including utilising low impact design (refer to sections 9.1.3 (quantity) and 9.2.4 (quality)).

Overall, it is considered that the proposed CMP through the proposed CSC will achieve the sustainable management purposes of the RMA, which is the ultimate objective to be achieved through the implementation of the WBOPDP.

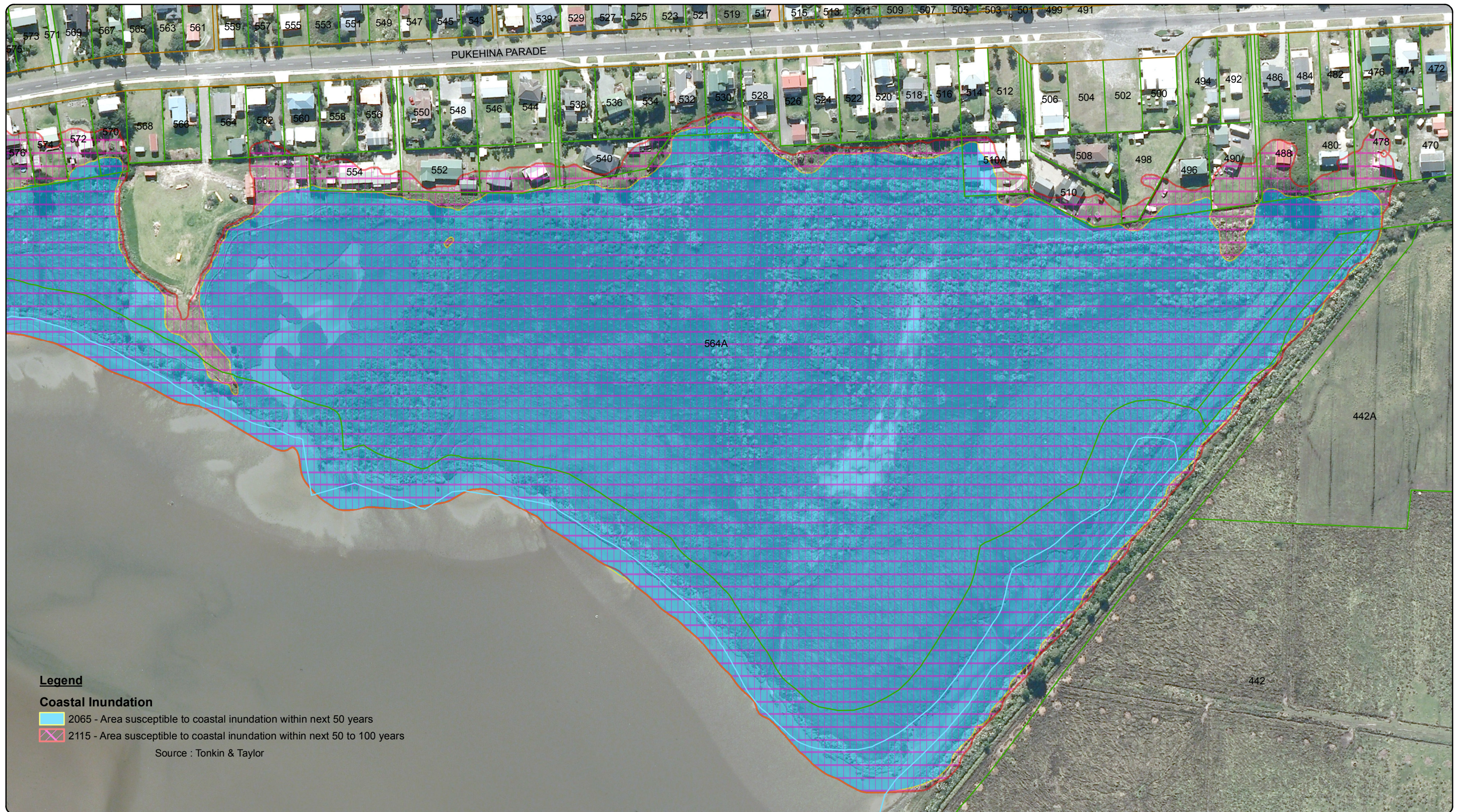
1.12 WBOPDC Development Code (2009)

In addition to the WBOPDP, the WBOPDC Development Code (2009) (WBOPDC DC) provides a means of compliance when designing, constructing and maintaining engineering works that are required. The WBOPDC DC (section 4.5) provides design standards, construction standards, drawings and as built specifications for stormwater. Measures for stormwater management include pipe systems, swales, rain gardens, and stormwater ponds. The WBOPDC DC also includes provision for alternative and innovative stormwater disposal designs especially where sustainable, low impact disposal systems are proposed.

This approach to stormwater management discussed in the WBOPDC DC is consistent with the approach of this CMP. The WBOPDC DC and the CMP used together for the eastern catchments will achieve the sustainable stormwater management that aligns also with the WBOPDP and the higher order statutory documents, including meeting the purpose of the RMA.

Appendix D

Other relevant maps
(various sources)

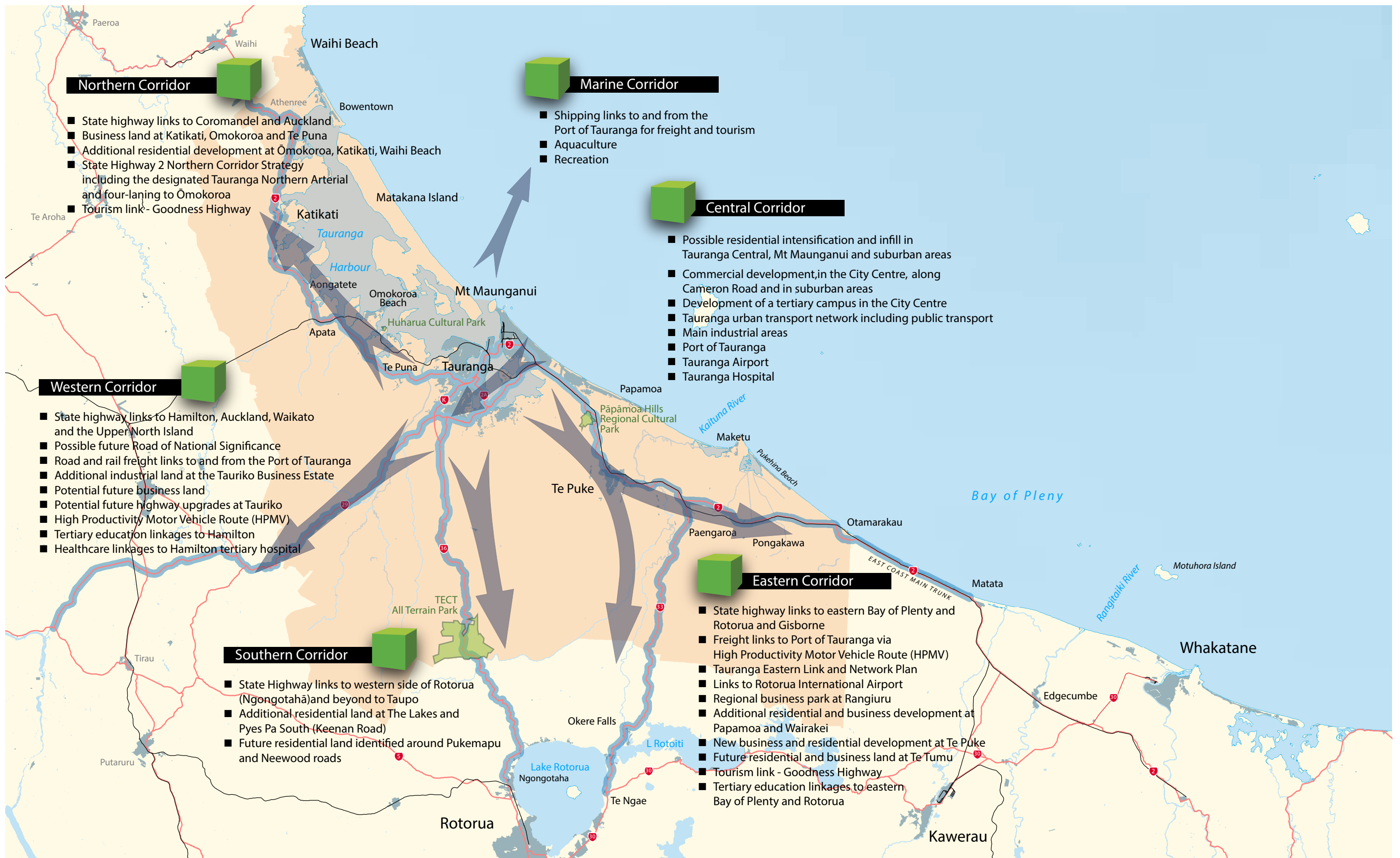


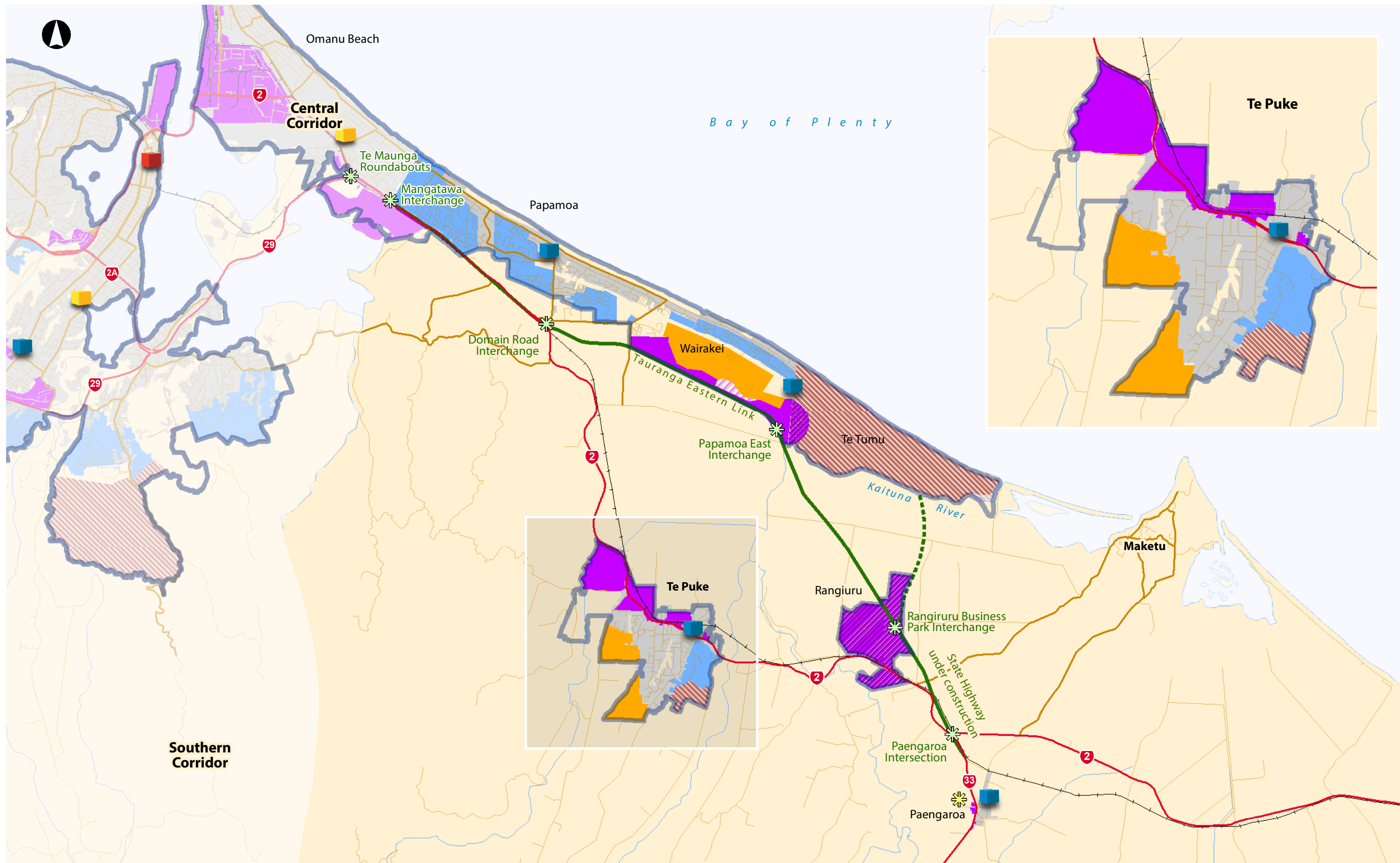
Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
Date: 11/05/2015
Operator: mlb
Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection Change Inundation.mxd

Scale A3 - 1:2,000

0 25 50 100 150 200 250 Meters





Commercial Centres

- City Centre
- Sub-Regional Centre
- Town Centre

Industrial Land

- Current Industrial
- Identified Future Industrial

Residential Land

- Generation 1
- Generation 2
- Generation 3
- Generation 4 - Identified Urban Growth Areas
- Land not currently identified in Settlement Pattern, but subject to Strategic Investigation as per Action 20.B.1

- Sub-regional Urban Limits
- State Highway
- Road (Arterial and Local)
- River
- Future Interchange
- Proposed/designated Future Road
- Possible/Not designated Future Road
- East Coast Main Trunk Railway

Map 6
Eastern Corridor

Water Quality Classification

- Fish Spawning Purposes Upper Tarawera River
- Fish Puropes Lower Tarawera River
- Natural State (Lake)
- Natural State (River)
- Managed State (Lake)
- Modified Watercourses with Ecological Values
- Drain Water Quality
- Aquatic Ecosystem (Bay of Plenty)
- Contact Recreation
- Water Supply
- Bay of Plenty Regional Base Line
- Unclassified Water Body

- Environment Bay of Plenty Regional Bdy
- State Highway
- Roading (metal surface)
- Indigenous Forest
- Planted Forest
- Urban Area

Checked: Environmental Planning Section, Environmental Planning,
Environment Bay of Plenty.
Approved: Bay of Plenty Regional Council, Environment Bay of Plenty.
Date: November 2008

North Points
Magnetic North on this map is 2d42° E of Grid North during 2000
increasing at the rate of approximately 1°22' over 33 years.

Projection and Grid Information
This map is drawn on the New Zealand Map Grid Projection, a
minimum error conformal projection. The grid is the New Zealand
Grid, showing co-ordinates in metres in terms of the Geodetic
Datum 1949, based on the International (Hayford) Spheroid.

Grid Reference Reading
The grid reference on this map (1:50 000) can only be read to the nearest 100 metres

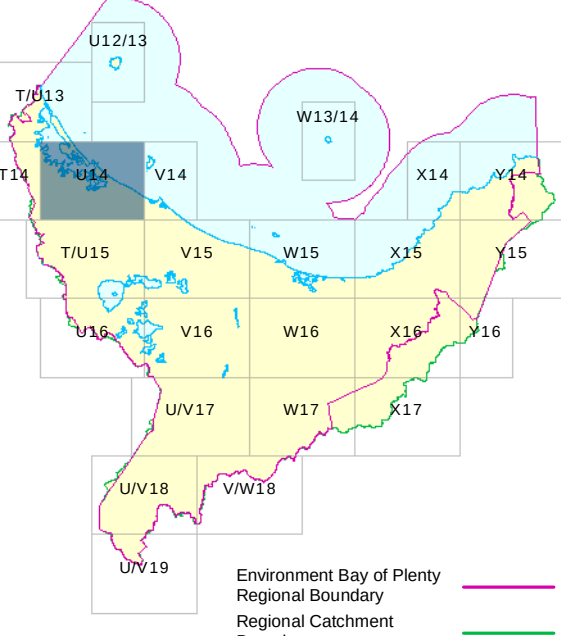
Full grid reference (7 digits)

eg 2852500, 6341300
(Easting, Northing)

Short grid reference (3 digits)

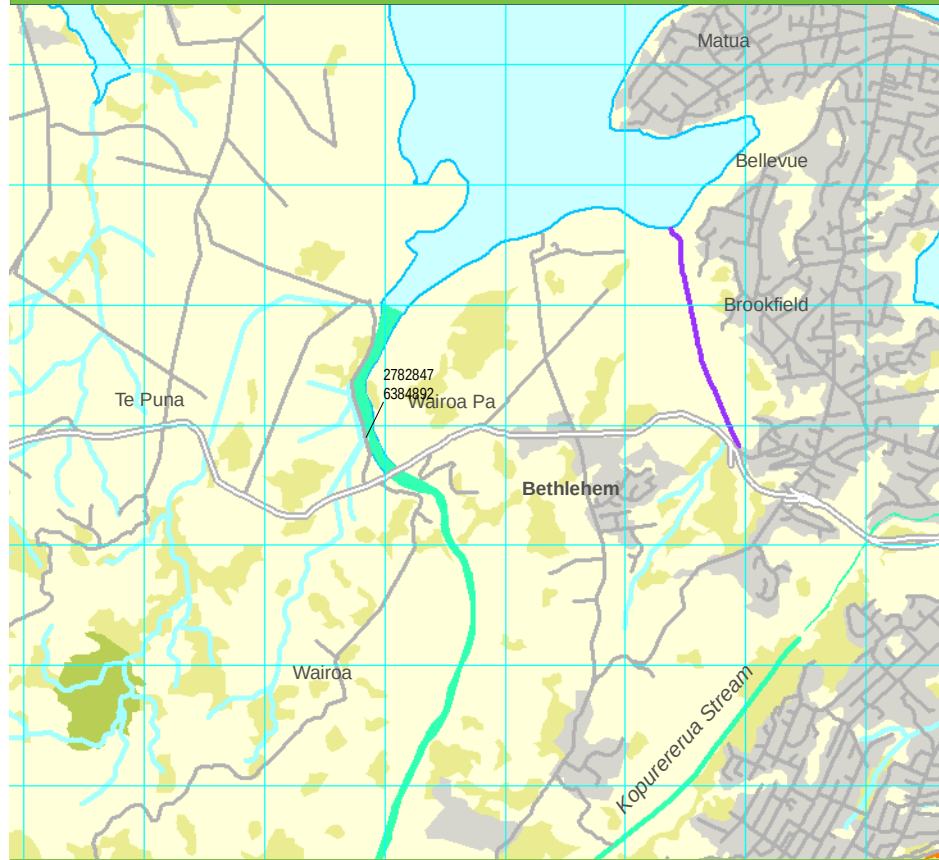
eg W15 X25 413
(Sheet number, Easting, Northing)

Bay of Plenty Region



Water Quality Classification Map

Tauranga



1 : 50 000
Sheet U14
Tauranga

C2165
November 2008

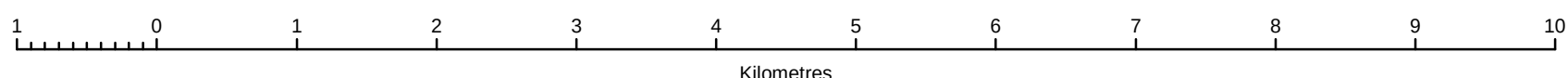


Working with our communities for a better environment
E mahi ngātahi e pua ki te taiao

Projection and Grid Information

This map is drawn on the New Zealand Map Grid Projection, a minimum error conformal
projection. The grid is the New Zealand Map Grid, showing co-ordinates in metres in terms of
the Geodetic Datum 1949, based on the International (Hayford) Spheroid.

Scale 1:50 000



Water Quality Classification Map - Tauranga

1:50 000
Sheet U14
Tauranga

Water Quality Classification

- Fish Spawning Purposes Upper Tarawera River

Fish Puropses Lower Tarawera River

Natural State (Lake)

Natural State (River)

Managed State (Lake)

Modified Watercourses with Ecological Values

Drain Water Quality

Aquatic Ecosystem (Bay of Plenty)

Contact Recreation

Water Supply

Bay of Plenty Regional Base Line

Unclassified Water Body

- Environment Bay of Plenty Regional Bdy

State Highway

Roading (metal surface)

Indigenous Forest

Planted Forest

Urban Area

Checked:

Environmental Planning Section,Environmental Planning,
Environment Bay of Plenty.

Approved:

Bay of Plenty Regional Council, Environment Bay of Plenty.

Date:

November 2008

North Points

Magnetic North on this map is 20°1/2° E of Grid North during 2000
increasing at the rate of approximately 1/2° over 33 years.

Projection and Grid Information

This map is drawn on the New Zealand Map Grid Projection, a
minimum error conformal projection. The grid is the New Zealand
Grid, showing co-ordinates in metres in terms of the Geodetic
Datum 1949, based on the International (Hayford) Spheroid.

Grid Reference Reading

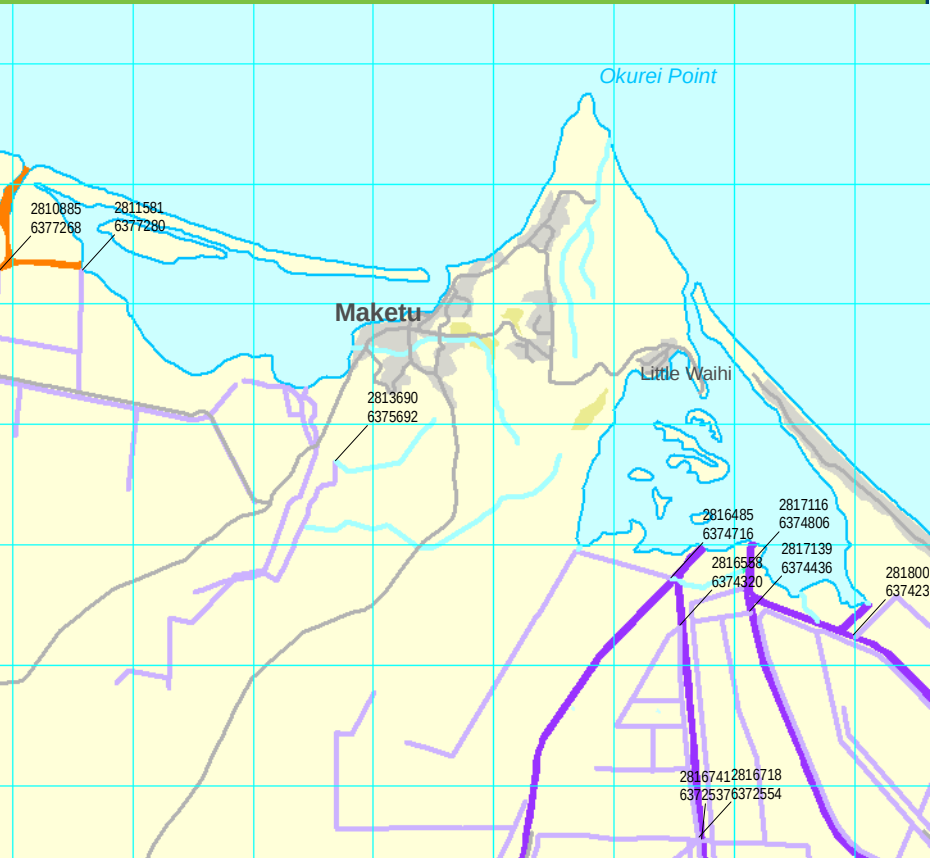
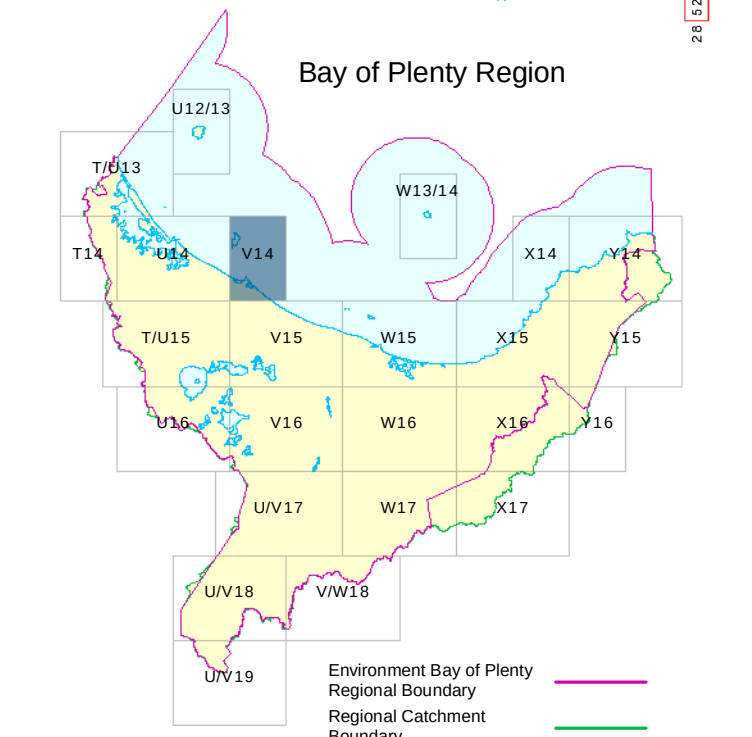
The grid reference on this map (1:50 000) can only be read to the nearest 100 metres

Full grid reference (7 digits)

eg: 2852600, 6341300
(Easting, Northing)

Short grid reference (3 digits)

eg: W15 526 413
(Sheet number, Easting, Northing)



1 : 50 000

Sheet V14

Maketu

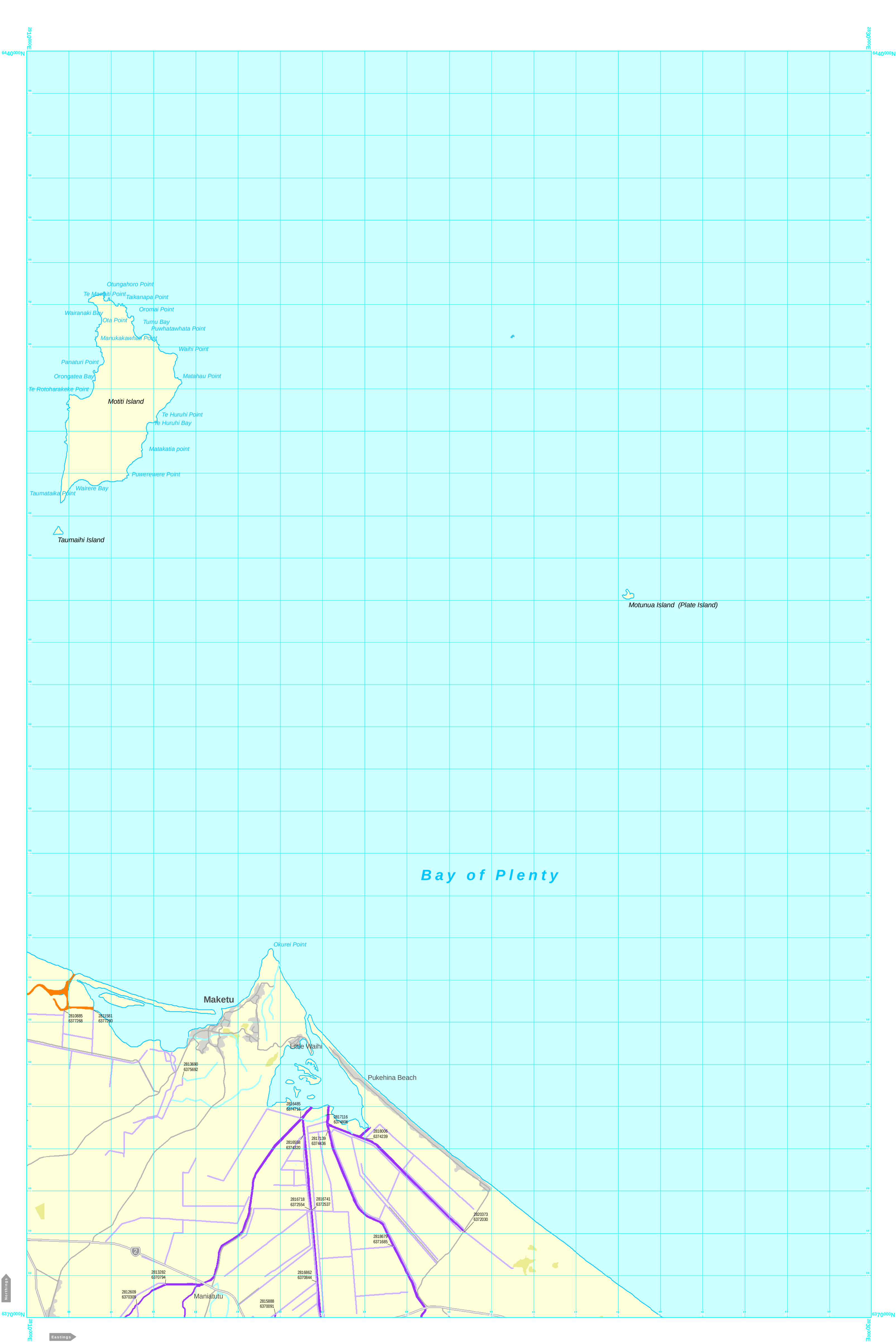
C2165

November 2008



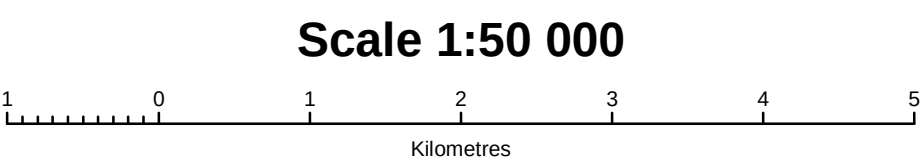
Working with our communities for a better environment

E mahi ngatahi e pai a ke ai te taiao



Projection and Grid Information

This map is drawn on the New Zealand Map Grid Projection, a minimum error conformal
projection. The grid is the New Zealand Map Grid, showing co-ordinates in metres in terms of
the Geodetic Datum 1949, based on the International (Hayford) Spheroid.



Water Quality Classification Map - Maketu

1:50 000
Sheet V14
Maketu



Water Quality Classification

- Fish Spawning Purposes Upper Tarawera River
- Fish Puropes Lower Tarawera River
- Natural State (Lake)
- Natural State (River)
- Managed State (Lake)
- Modified Watercourses with Ecological Values
- Drain Water Quality
- Aquatic Ecosystem (Bay of Plenty)
- Contact Recreation
- Water Supply
- Bay of Plenty Regional Base Line
- Unclassified Water Body

Environment Bay of Plenty Regional Bdy

State Highway

Roading (metal surface)

Indigenous Forest

Planted Forest

Urban Area

Checked: Environmental Planning Section, Environmental Planning,
Environment Bay of Plenty.

Approved: Bay of Plenty Regional Council, Environment Bay of Plenty.

Date: November 2008

North Points

Magnetic North on this map is 2d.42° E of Grid North during 2000 increasing at the rate of approximately 1/2° over 33 years.

Projection and Grid Information

This map is drawn on the New Zealand Map Grid Projection, a minimum error conformal projection. The grid is the New Zealand Grid, showing co-ordinates in metres in terms of the Geodetic Datum 1949, based on the International (Hayford) Spheroid.

Grid Reference Reading

The grid reference on this map (1:50 000) can only be read to the nearest 100 metres

Full grid reference (7 digits)

eg 2825000, 6341300 (Easting, Northing)

Short grid reference (3 digits)

eg V15 326 413 (Sheet number, Easting, Northing)

Bay of Plenty Region

Water Quality Classification Map

EdgECumbe

1 : 50 000

Sheet V15

EdgECumbe

C2165

November 2008

Working with our communities for a better environment
E mahi ngatahi e pai a ke ai te taiao

Scale 1:50 000

Water Quality Classification Map - EdgECumbe

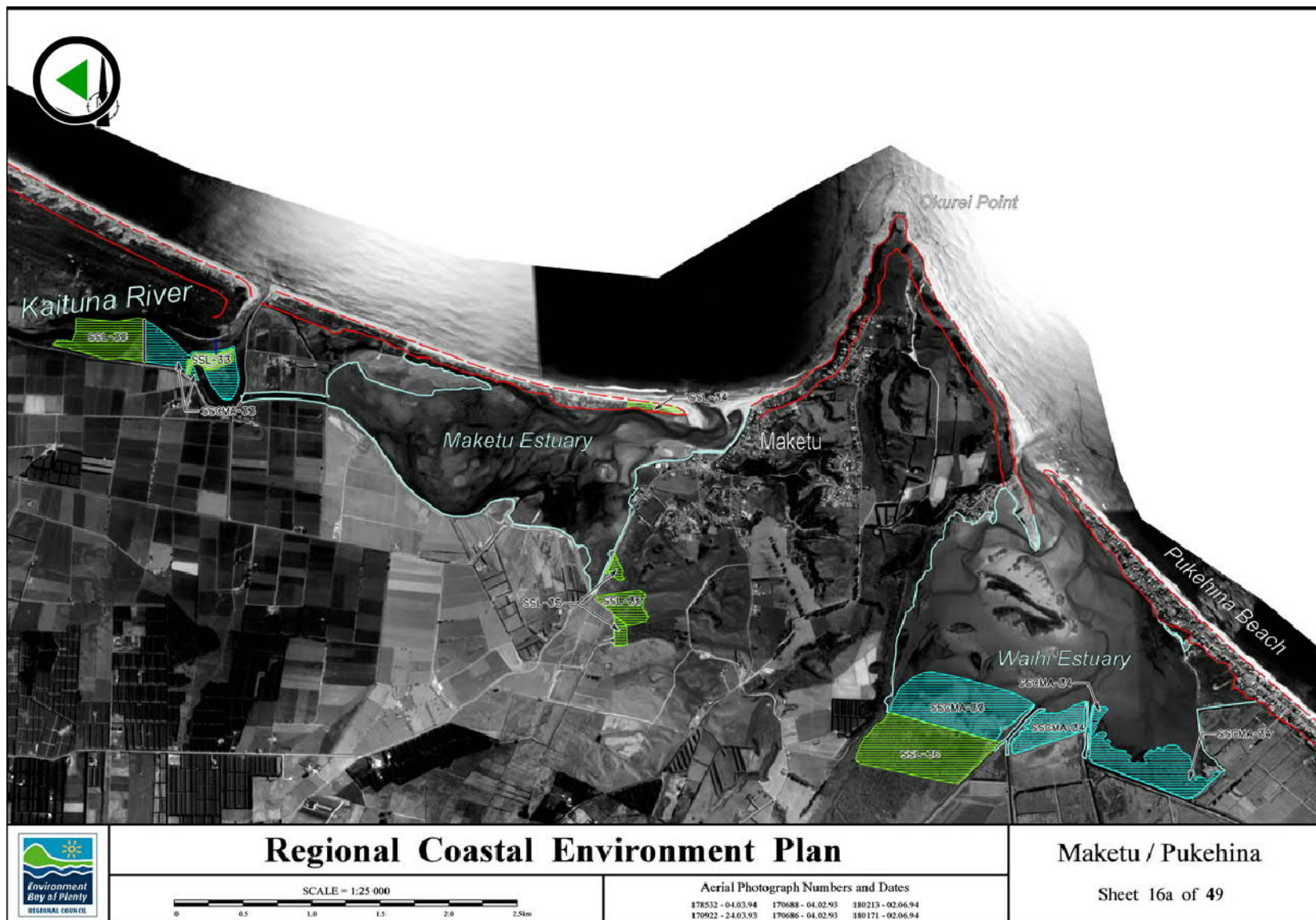
Projection and Grid Information

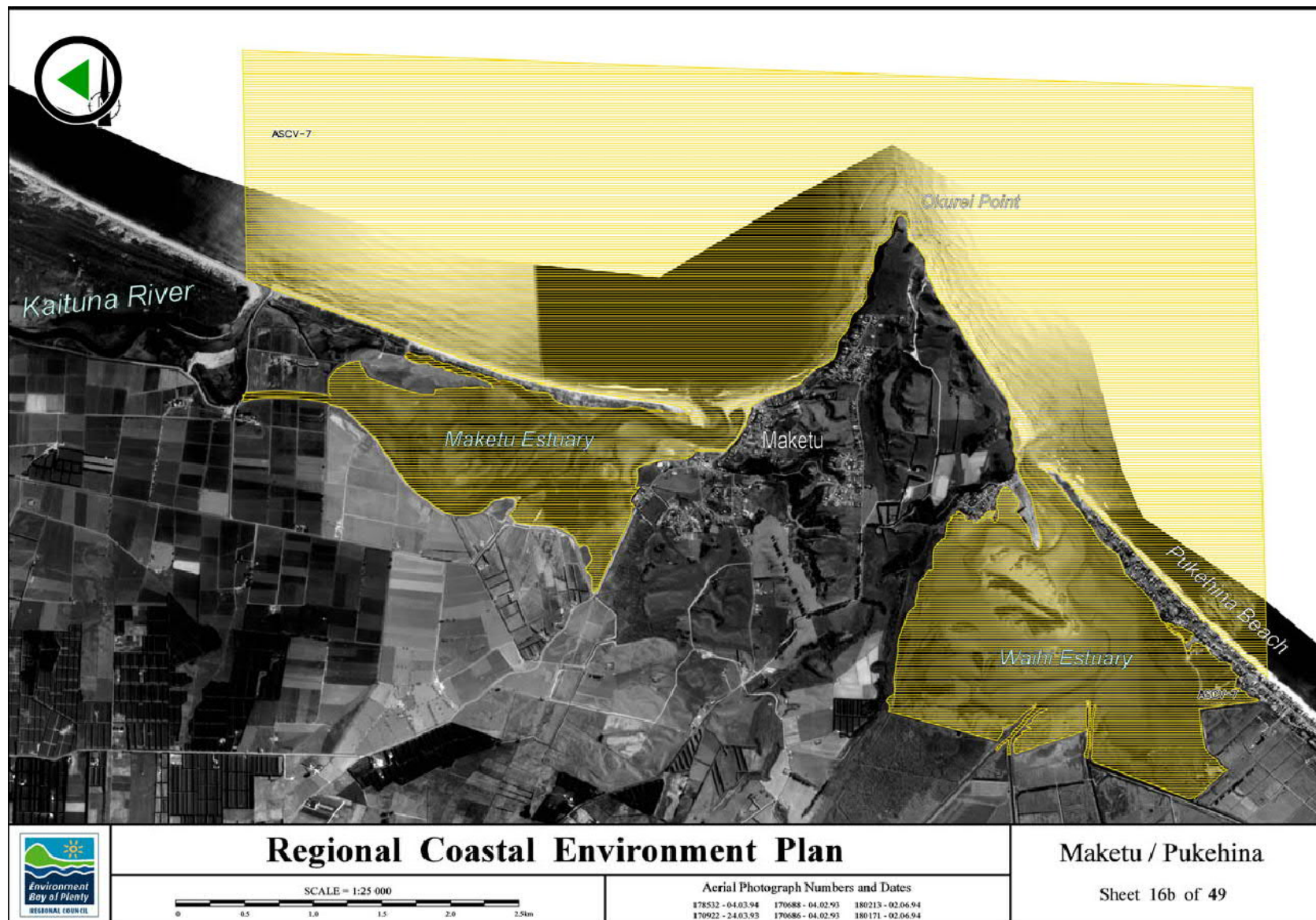
This map is drawn on the New Zealand Map Grid Projection, a minimum error conformal projection. The grid is the New Zealand Map Grid, showing co-ordinates in metres in terms of the Geodetic Datum 1949, based on the International (Hayford) Spheroid.

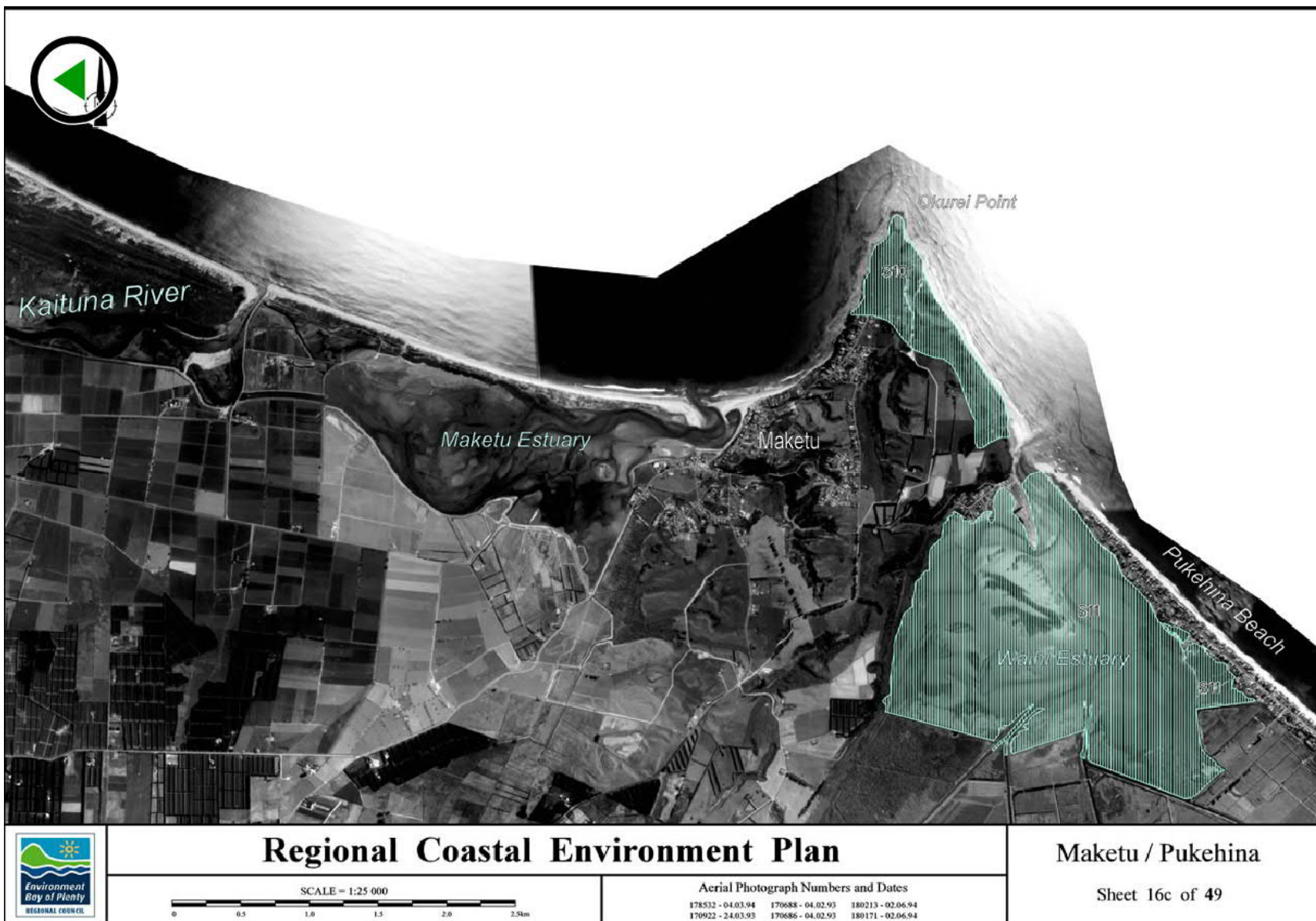
Scale 1:50 000

Kilometres

1:50 000
Sheet V15
EdgECumbe







LEGEND

NOTE -- Coastal Management Zone - anywhere in the Bay of Plenty Coastal Marine Area that is not identified as any of the following three zones

 Coastal Habitat Preservation Zone (in the Coastal Marine Area) (see Chapter 6)

 Port Zone

 Harbour Development Zone

 Area of Significant Conservation or Cultural Value (in the Coastal Marine Area) (see Chapter 6 and 8)



Ship Wreck

 Site of District or Local Significance (in the Coastal Marine Area) (see Chapter 6)

 Site of Significance (on Land) (see Chapter 6)

 Regionally Significant Feature and Landscape (see Chapter 5)

 Outstanding Natural Feature and Landscape (see Chapter 5)

 Area Occupied by the Port of Tauranga in Accordance with Section 384A RMA

 Port Noise Contour



Indicative Ski Area

Note: The actual boundaries of ski lanes in the indicative ski areas may vary depending on weather and tidal conditions.



Indicative Personal Watercraft Area



Mooring



Specified Airport Slopes and Surfaces of Tauranga Airport



Area Sensitive to Coastal Hazards (ASCH)

Note: The ASCH between Mount Maunganui and Maketu (on maps 12a-16a) is subject to a reference to the Environment Court by WK Skinner and therefore the ASCH shown on those maps is not operative and remains proposed. The provisions of Chapter 11 of the Plan - Coastal Hazards are also subject to that reference and remain proposed.



Coastline



Harbour Coastline



Coastal Marine Area Boundary at River Mouth

Note: As agreed by the relevant District Council, Department of Conservation and Bay of Plenty Regional Council prior to public notification of this Plan.



River Mouth



Environment B · O · P Regional Boundary



Bathymetry (depth in metres)

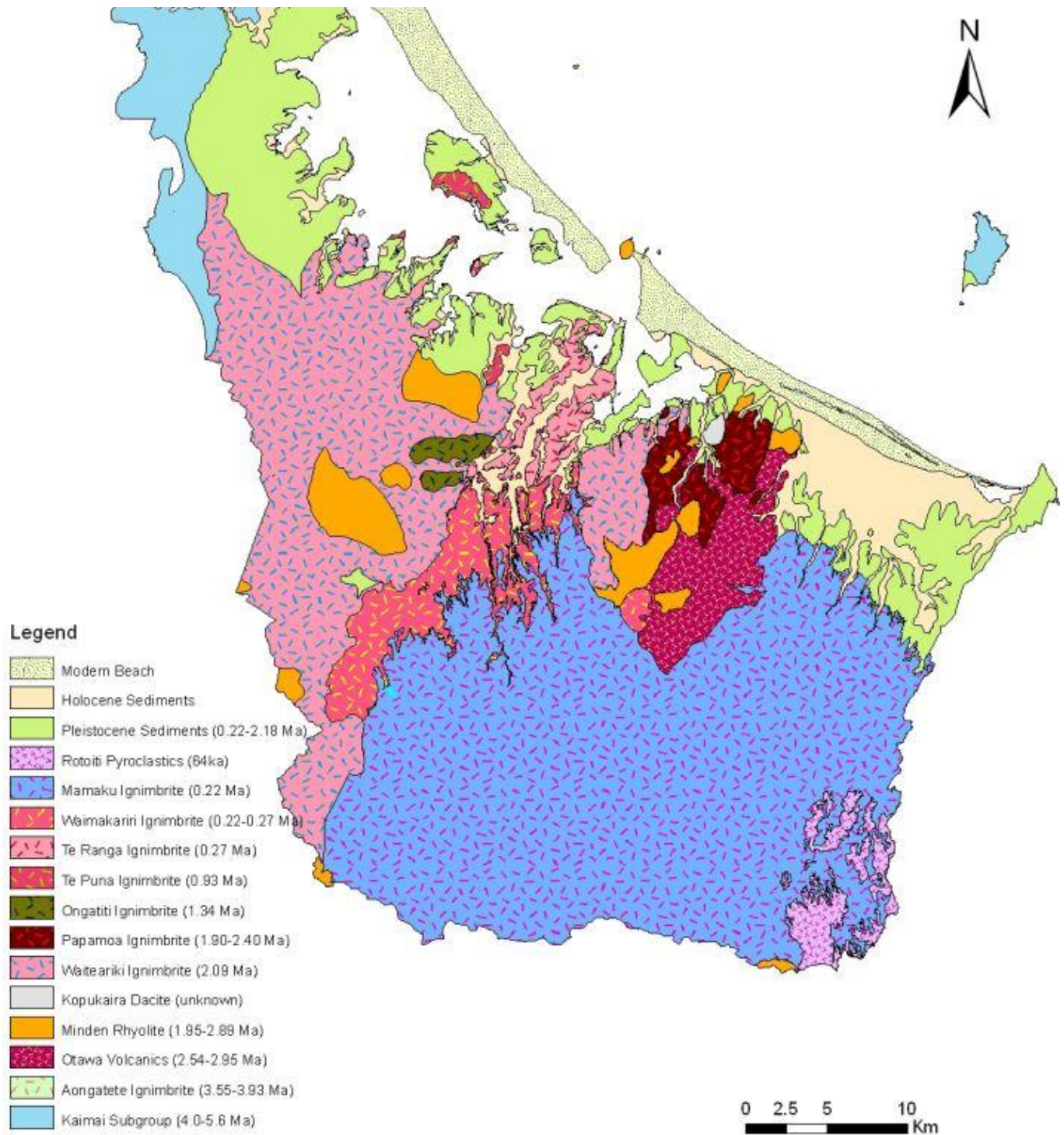
Note: Bathymetry information derived from 1:200 000 marine chart.

ACCURACY STATEMENT

The majority of data shown on these maps has been on-screen digitised with an accuracy of $\pm 5\text{m}$ relative to the Regional Digital Aerial Mosaic (RDAM) data. The RDAM has been registered to the DCDB with 90% of the data falling within $\pm 10\text{m}$, but with occasional displacements up to $\pm 25\text{m}$. The spatial accuracy of the DCDB is up to $\pm 20\text{m}$. The spatial accuracy of the data shown on these maps may therefore vary up to a maximum of $\pm 50\text{m}$.

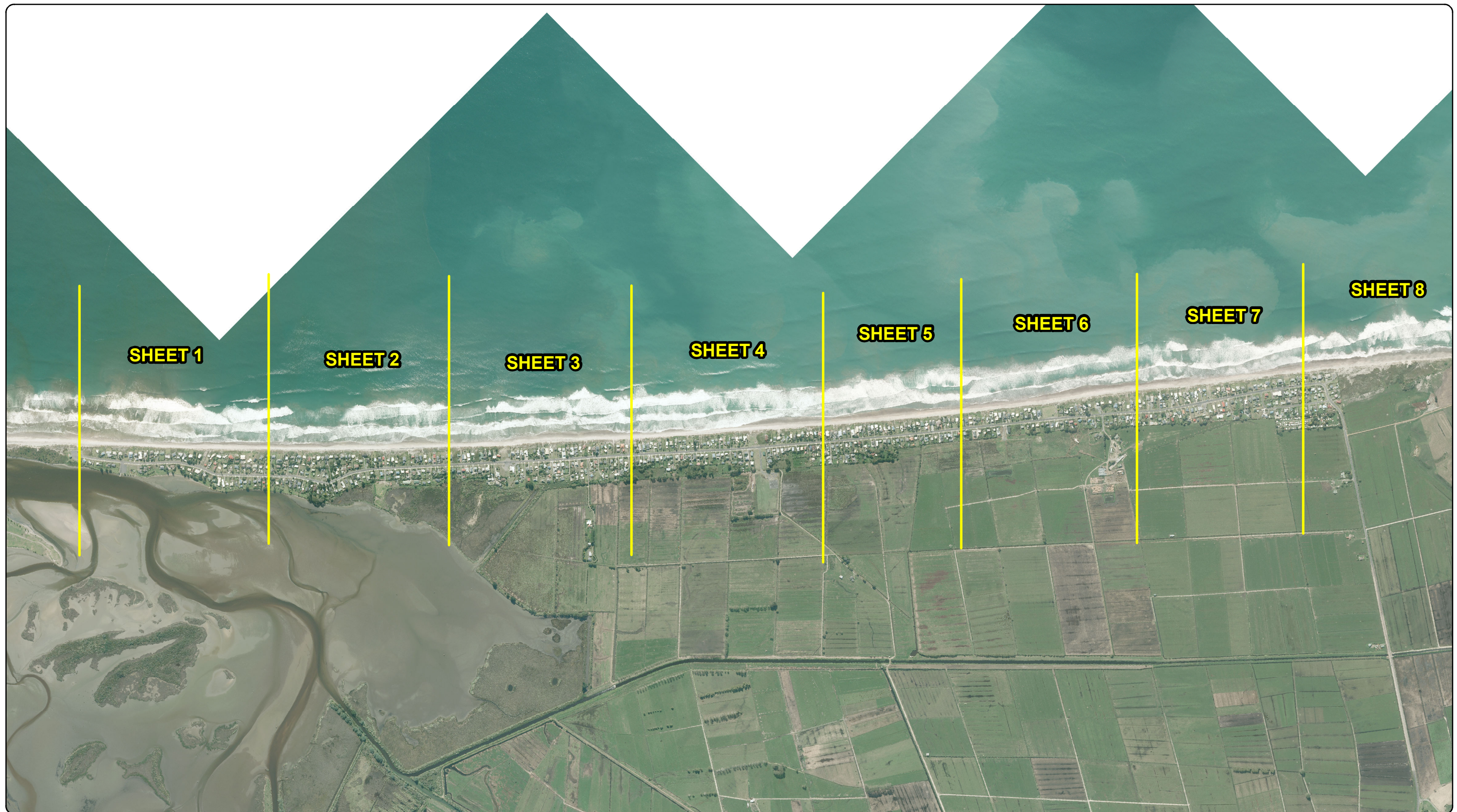
Appendix D-7 Catchments)

Overview geology in the WBOPD (White et al. 2009 Eastern



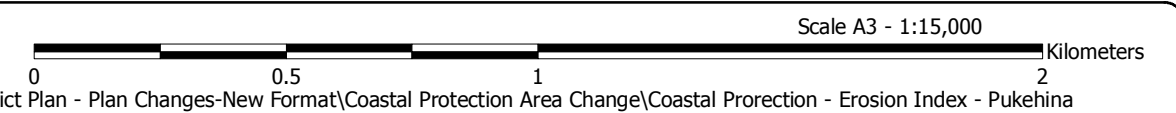
Appendix D-8 General soil map the WBOPD showing Soil orders (Rijkse and Guinto 2010)



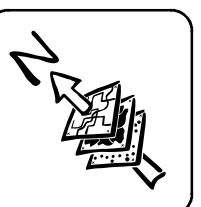


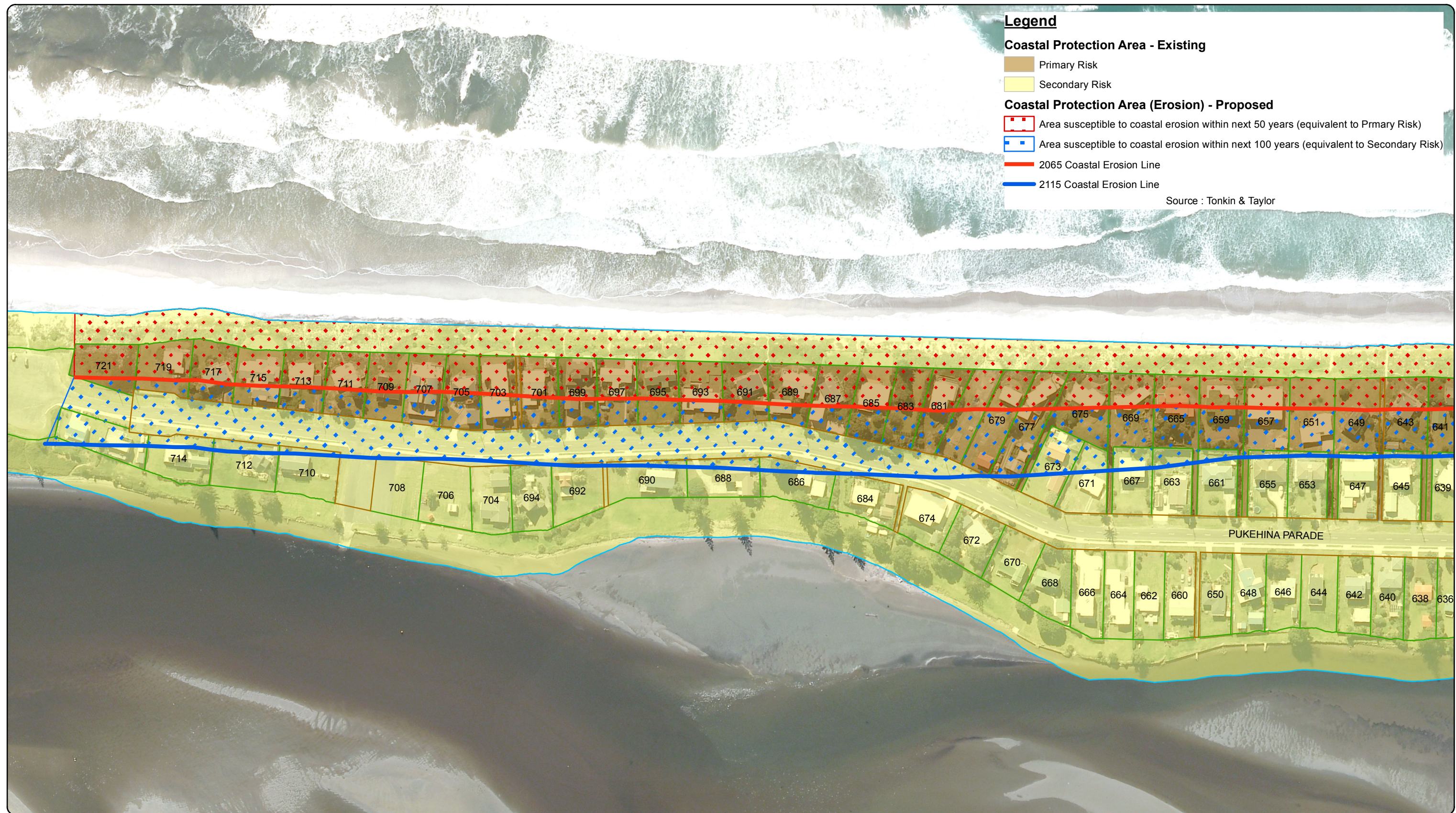
Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
 Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
 Location of services is indicative only. Council accepts no liability for any error.
 Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
 Date: 1/05/2015
 Operator: mlb
 Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection - Erosion Index - Pukehina



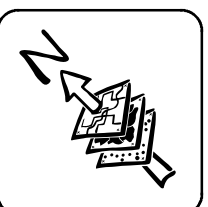
COASTAL PROTECTION - EROSION INDEX PUKEHINA BEACH





Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
 Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
 Location of services is indicative only. Council accepts no liability for any error.
 Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
 Date: 14/05/2015
 Operator: mlb
 Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection Erosion - Pukehina Beach.mxd

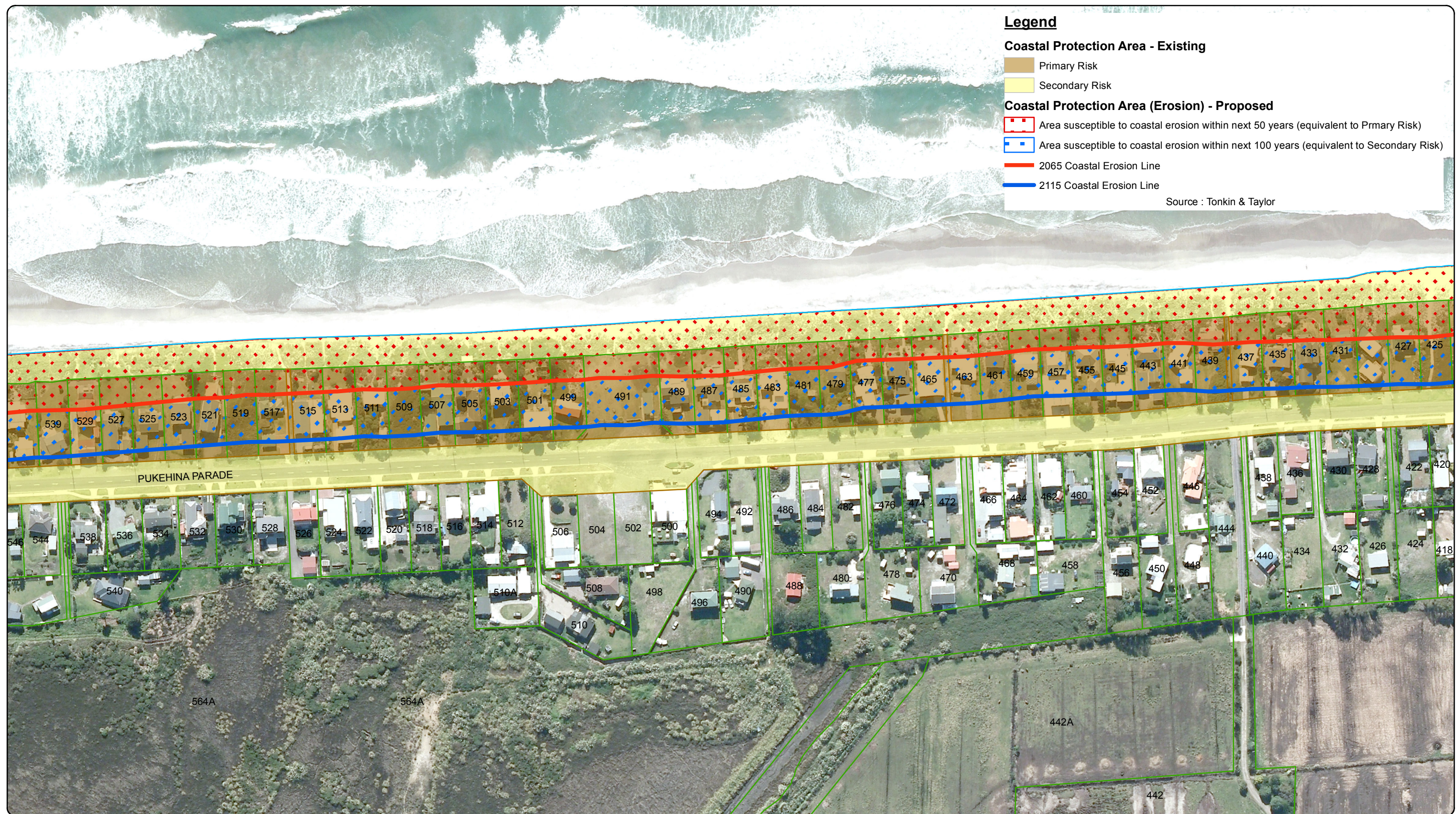




Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

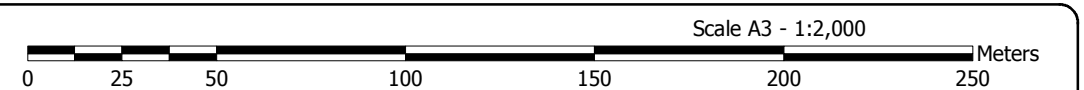
Email: gis@westernbay.govt.nz
Date: 14/05/2015
Operator: mlb
Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection Erosion - Pukehina Beach.mxd

Scale A3 - 1:2,000
0 25 50 100 150 200 250 Meters

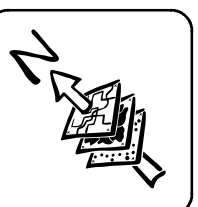


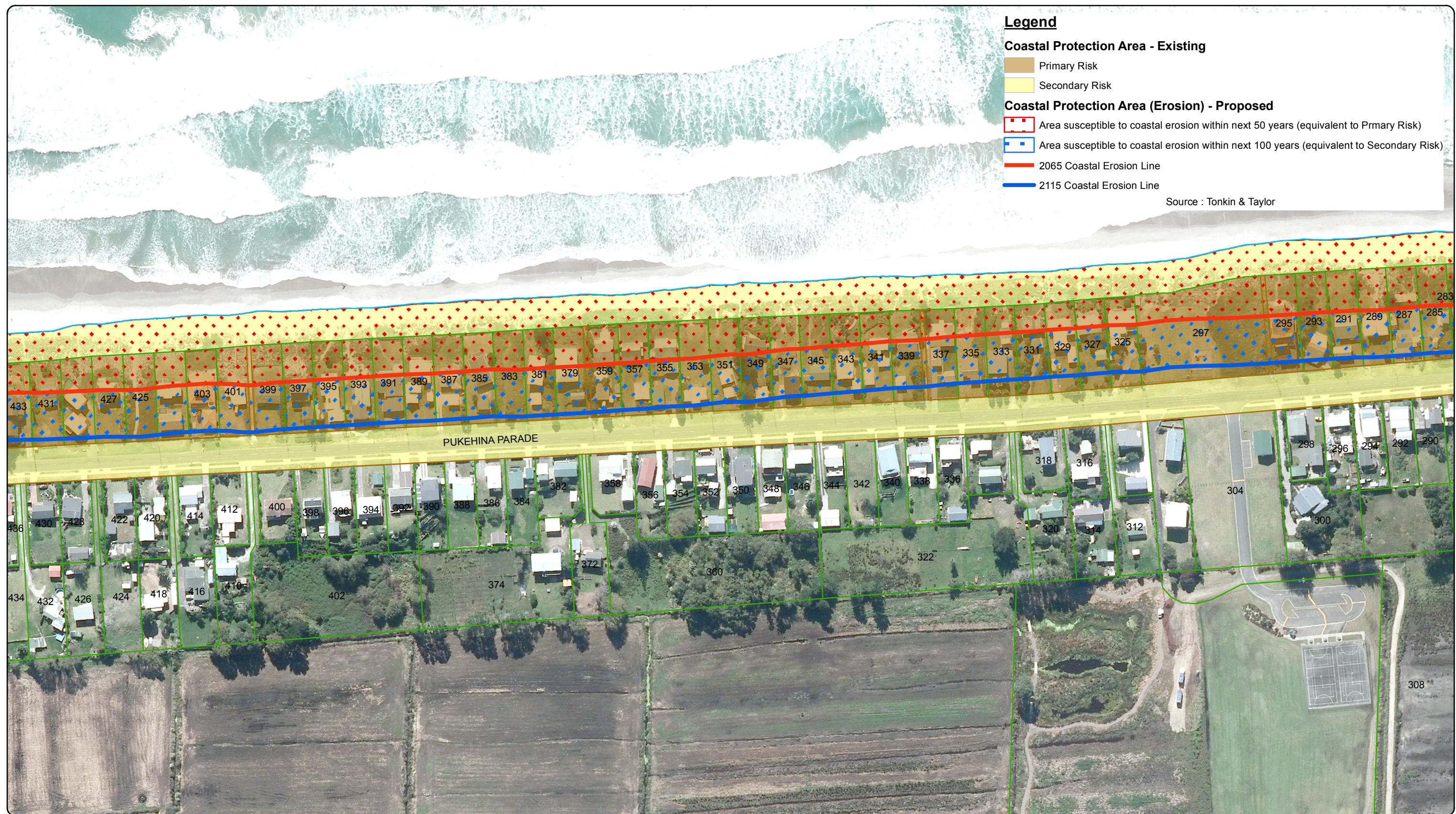
Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
Date: 14/05/2015
Operator: mlb
Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection Erosion - Pukehina Beach.mxd



COASTAL EROSION EXISTING AND PROPOSED PUKEHINA BEACH - SHEET 3

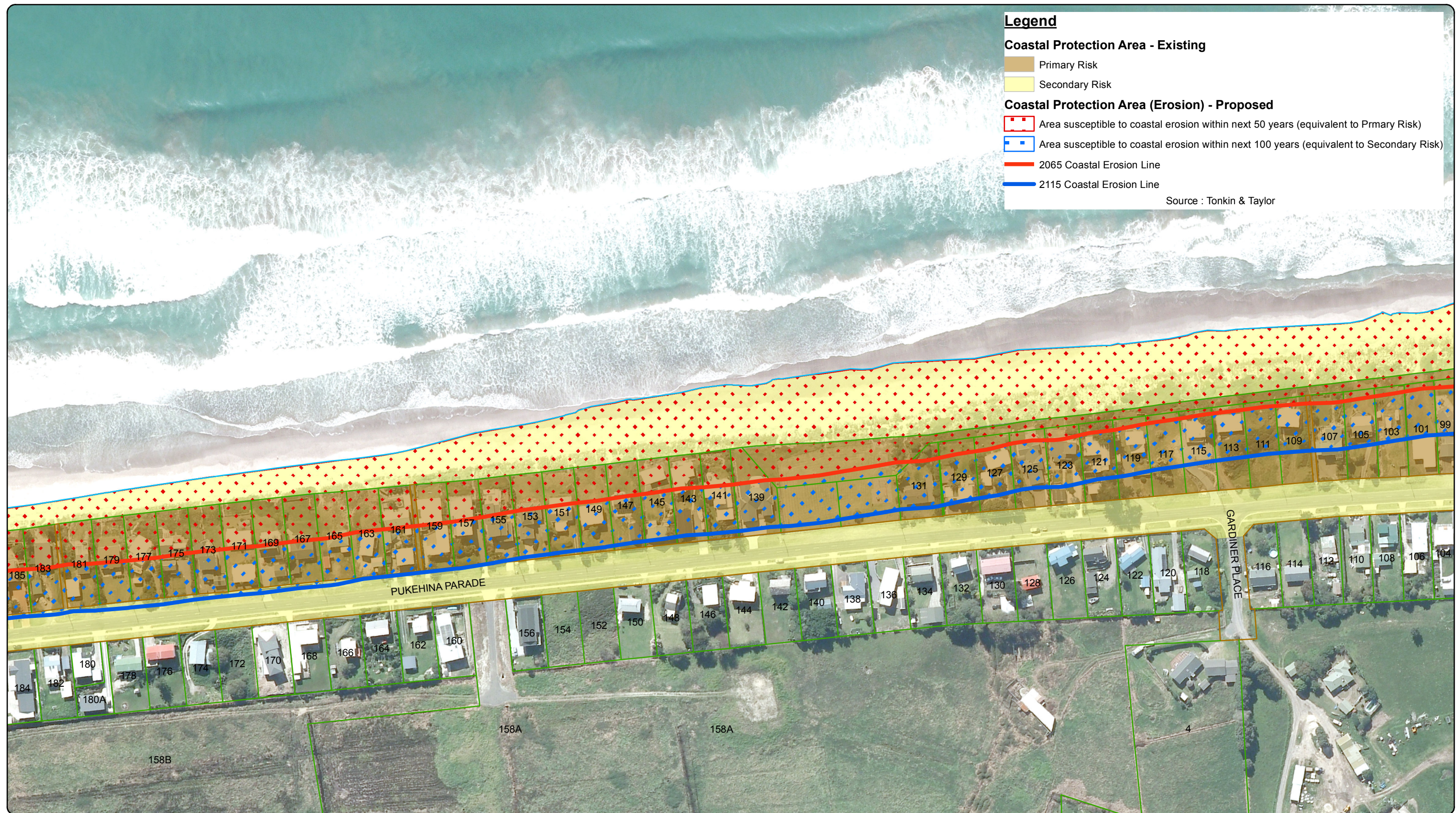




Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
Date: 14/05/2015
Operator: mlb
Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection Erosion - Pukehina Beach.mxd

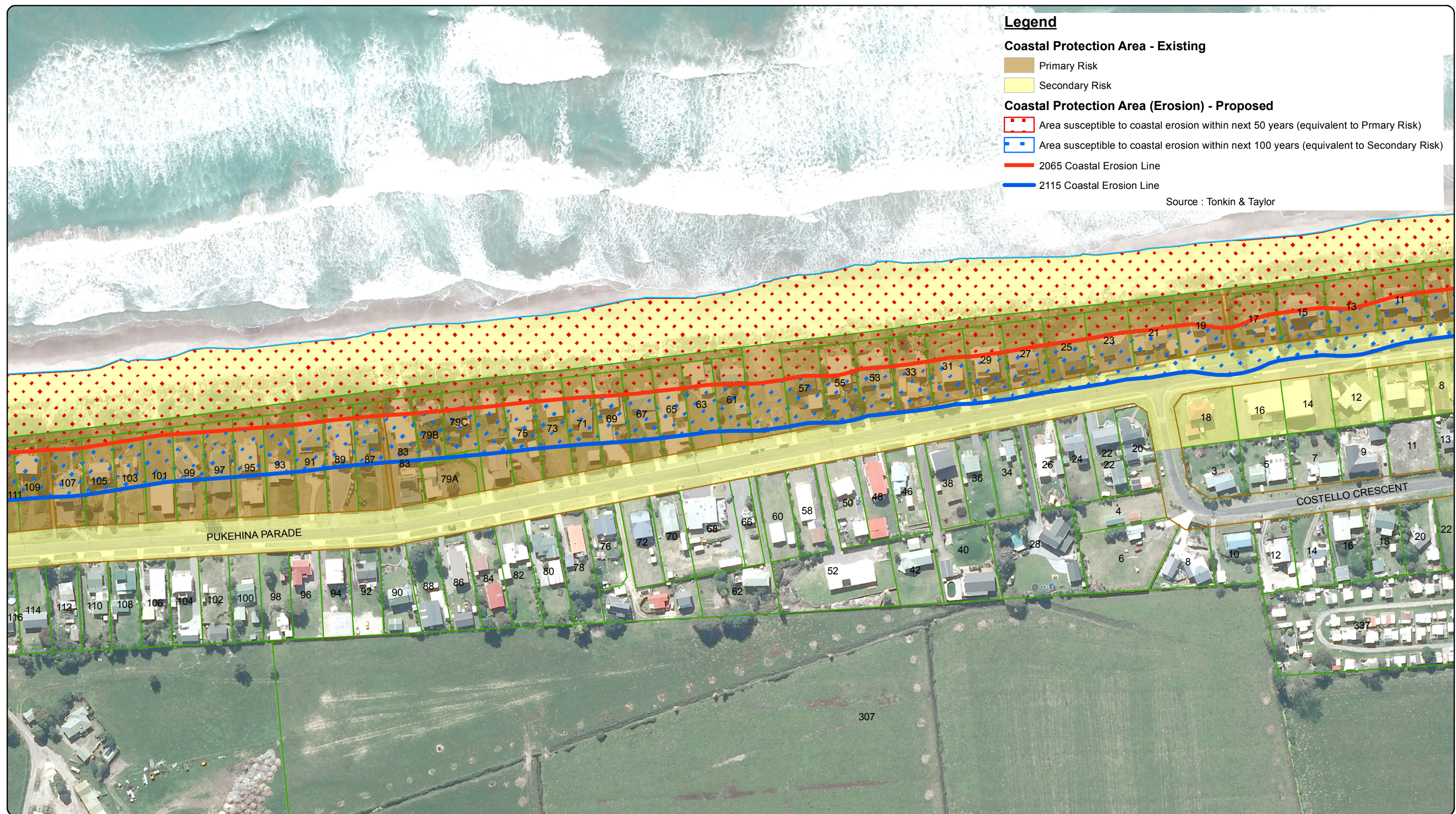
Scale A3 - 1:2,000
0 25 50 100 150 200 250 Meters



Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

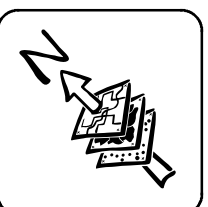
Email: gis@westernbay.govt.nz
Date: 14/05/2015
Operator: mlb
Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection Erosion - Pukehina Beach.mxd

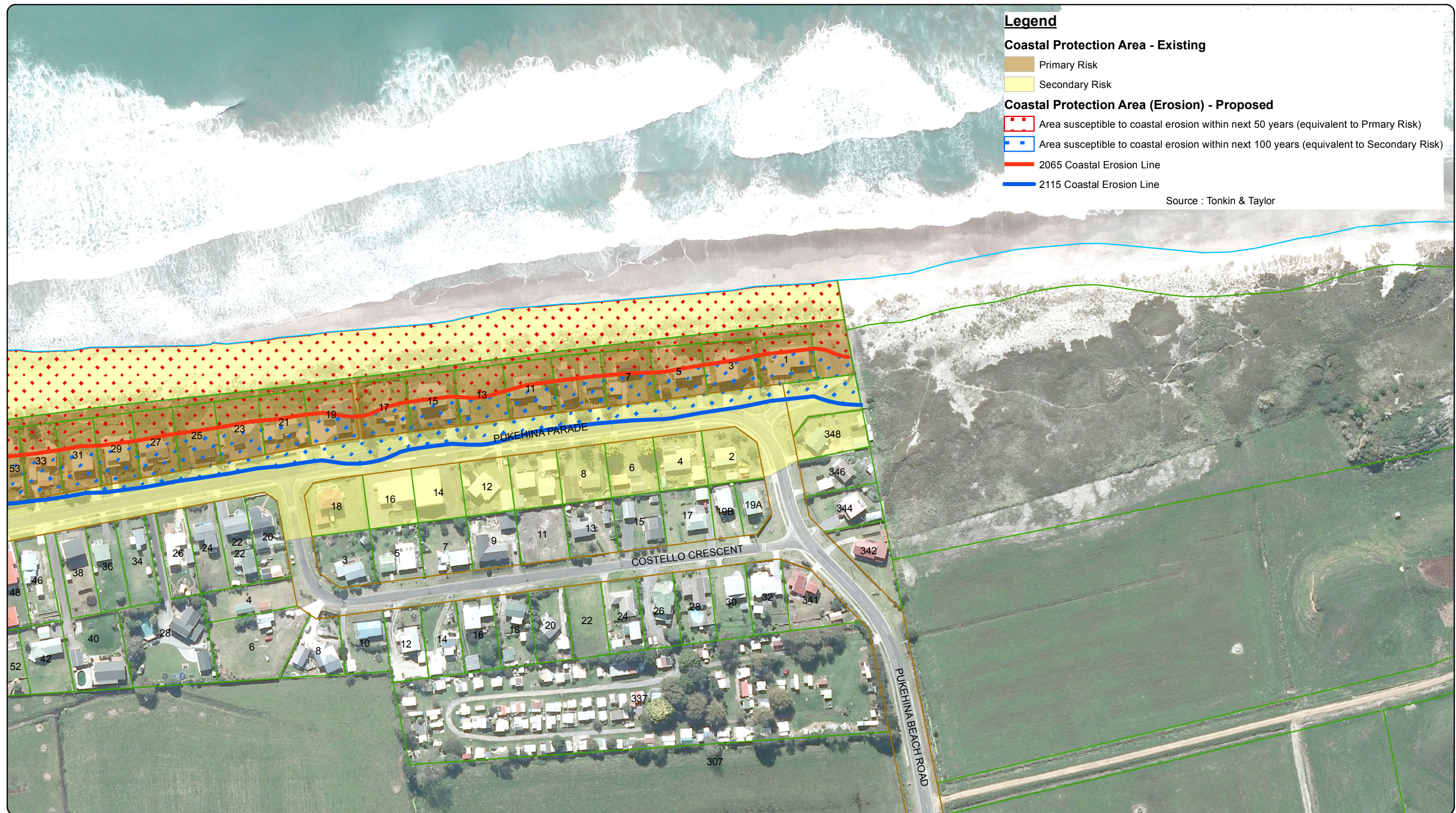
Scale A3 - 1:2,000
0 25 50 100 150 200 250 Meters



Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
 Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
 Location of services is indicative only. Council accepts no liability for any error.
 Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

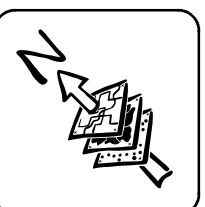
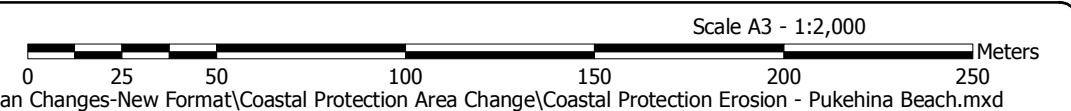
Email: gis@westernbay.govt.nz
 Date: 14/05/2015
 Operator: mlb
 Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection Erosion - Pukehina Beach.mxd





Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
 Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
 Location of services is indicative only. Council accepts no liability for any error.
 Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
 Date: 14/05/2015
 Operator: mlb
 Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection Erosion - Pukehina Beach.mxd



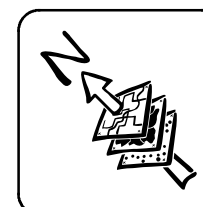


Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
 Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
 Location of services is indicative only. Council accepts no liability for any error.
 Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz Scale A3 - 1:5,000
 Date: 1/05/2015
 Operator: mlb
 Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection - Inundation Index - Pukehina



COASTAL PROTECTION - INUNDATION INDEX PUKEHINA BEACH





Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
 Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
 Location of services is indicative only. Council accepts no liability for any error.
 Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
 Date: 11/05/2015
 Operator: mlb
 Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection Change Inundation.mxd

Scale A3 - 1:2,000

0 25 50 100 150 200 250 Meters

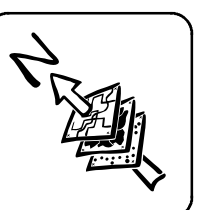


Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
Date: 11/05/2015
Operator: mlb
Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\Coastal Protection Area Change\Coastal Protection Change Inundation.mxd

Scale A3 - 1:2,000

0 25 50 100 150 200 250 Meters



Appendix E

Existing Consents

Existing Consents for Eastern Catchments (to be updated as relevant), PMS 2013

Eastern Catchments Current Existing Consents (Te Puke Catchment) – source: WBOPDC Consent Database, PMS 2013

Existing Stormwater Consents

Note:

The list includes existing consents (incl. expired consents where the activity is still continuing) as per WBOPDC's Consent Database.

It is understood that the list might not be complete and/or might include Consents outside of the urban areas to be covered in the CSC.

CMP application shall include all Stormwater Related Consents currently listed by the Regional Council as WBOPDC owned within the urban limits.

The

Consent No	Associated Consents	Catchment	Asset No.	Consent	Purpose	Description	Consent Status	Expiry Date	Issue Date
20188		TPK		Te Puke; discharge Stormwater	Discharge from residential subdivision Cameron/Boucher Ave	Pipe size 450mm ,max rate of discharge 297 l/sec. Transferred from Clydesburn Farms Ltd 15 June 1993. Legal Description: Part Section 15, Block II, Maketu SD, and Point of Discharge: Lot 2, DPS 7727, Block II, Maketu SD	Current	01-Oct-26	04-Mar-76
20192		TPK		Te Puke; discharge Stormwater from Harris Street	Transferred from EMR & SL Paterson 15 June 1993.	Point of Discharge: The discharge shall be into an open drain to be constructed on the boundary of the Grantee's property and thence into an existing drain on the property of LC Lawler.	Current	01-Oct-26	05-Jun-75
20197		TPK		Te Puke: Stormwater discharge from a residential subdivision	For the purpose of discharging stormwater from the Grantees' residential subdivision on the east side of Seddon Street, Te Puke.	The legal description of the subdivision is Lots 10, 11 and Part Lot 9, DP 7034, Block II, Maketu SD (Te Puke Borough). The legal description of the property at the point of discharge is Part 2, DP 12589, Block II, Maketu SD (Tauranga County).	Current	01-Oct-26	22-Jul-75
20336		TPK		Te Puke; discharge Stormwater to Ohineangaanga Stream	For the purpose of discharging stormwater from Drainage Areas 1 and 2 of Te Puke Borough as shown on Worley Downey Muir and Associates Drawing No T 285/1 submitted with the application	Max rate of discharge 4m3/sec Map Reference at Outfall: N67: 793476	Current	01-Oct-26	27-Jan-78
22191		TPK		Te Puke; discharge Stormwater to Managh's Drain	Discharge s/w from residential/commercial areas/roads to Managh's Drain then Waiari Stream	Max discharge rate 588 l/sec Legal Description at Point of Discharge: Pt Lot 59, DP 6908, Block II, Maketu SD	Current	01-Oct-26	06-Jul-89
24135		TPK		Te Puke; discharge Stormwater & overflow water & scour water, Waiari Stream	For the purpose of discharging reservoir overflow water and stormwater to the Waiari Stream, and discharge of scour water to ground soakage on the Mutton's property, Number 1 Road, Te Puke.	Quality of discharge to Waiari Str not to exceed a suspended solids of 10g/m3, Ammended 29 July 1995 Legal Description: Section 3, SO3077, Block VI, Maketu SD	Surrendered	31-Dec-10	21-Dec-94
24276		TPK		Te Puke; discharge uncontaminated Stormwater	Discharge from Cameron/Barrow/Princess Sts, Te Puke to Ohineangaanga Str.	Max discharge rate 870 l/sec except where design rainfall of 1 in 5 yr freq is exceeded. Legal Description: Lot 5, DPS 10177	Expired	30-Apr-10	10-May-95
24890		TPK		Te Puke, discharge contaminated Stormwater	Associated with discharge of s/w from construction of subsurface wetland to Waiari Stream	Max discharge rate 500m3/day Legal Description: Lot 1, DPS 37512, Lot 2, DPS 63396, Block II, Maketu SD	Expired	31-Dec-99	30-Jun-98
24912		TPK		Te Puke; discharge Stormwater to tributary of Kaituna River	To discharge clean stormwater from 4.98ha urban subd from outfall at Tui St, Te Puke	Legal Description: Road Reserve being Lot 2, DPS 8639, Block II, Maketu SD	Expired	28-Feb-12	06-Mar-97

24988	TPK	Discharge Stormwater to land in circumstances where it may enter the Waiari Stream.	For the purpose of discharging stormwater from a 1.7 Hectare urban residential catchment.	Stormwater shall be discharged to an unnamed ephemeral tributary of the Waiari Stream, as shown on the Martin McCauley Morton Limited drawing number 68411 sheet 1. Legal Description: Part Section 27B Numbers 1, 2B and 2A, Block II, Maketu SD (Western Bay)	Expired	30-Sep-07	22-Apr-98
60058	TPK	To discharge sediment contaminated stormwater to land where it may enter Raymond's Drain, a tributary of the Waiari Stream and stormwater into water where it may enter Raymond's Drain, a tributary of the Waiari Stream.	To discharge sediment contaminated stormwater from six sediment retention ponds during the development of a residential subdivision and permanent stormwater from the completed residential subdivision to Raymond's Drain, a tributary of the Waiari Stream.	Legal Description: Lot 2 DPS 11712, Lot 1 DPS 11598, Lot 1 DPS 16061, Lot 2 DPS 11175, Lot 13 DPS 8007, Pt Sec 20 Lot 2 DPS 14559, Block II, Maketu SD Village Heights Subdivision, Te Puke.	Expired	31-Jan-04	22-Mar-99
60206	60205	TPK	Te Puke; discharge sedimented Stormwater	To discharge sediment contaminated stormwater from sediment retention ponds during earthworks. Legal Description: Lot 1, DPS 66933, Block VII, Otanewainuku SD	Expired	30-Jun-00	09-Apr-99
61027	TPK	Discharge Stormwater to the Raparapahoe Stream and tributaries of the Kaituna River; Discharge Stormwater to land where it may enter the Ohineangaanga Stream; Place and use a structure on the bed of a tributary of the Kaituna River; Disturb the bed of the	For the purpose of discharging stormwater from the catchment area between No 3 Road, Te Puke and the Ohineangaanga Stream, Raparapahoe Stream, and tributaries of the Kaituna River	Part Lot 1 DPS 75749 Block 11 Maketu SD (WBOPD) Part Lot 50 DPS 9315 Block 11 Maketu SD (WBOPDC) Lot DP 14390 Lot 2 DPS 87722 Block 11 Maketu SD (WBOPDC) (MacLoughlin Dr, No 3 Rd, Whitehead Ave.)	Current	30-Jun-41	25-Aug-06
61258	TPK	Install and use Gabion Basket and Reno Mattress Structures in the Bed of the Ohineangaanga Stream and Disturb the be of the Ohineangaanga Stream.	To provide for stream abnck protection work on the left and right banks of the Ohineangaanga Stream.	Legal Description: Local Purpose Reserve, Lot 13 DPS 67754, Block II Maketu SD Map Reference: NZMS 260 U14 0220 7435	Current	31-May-36	31-May-01
62134	TPK	Discharge Stormwater into water where it may enter Raymond Drain, a tributary of the Waiari Stream.	For the purpose of authorising the discharge of stormwater from the village heighs residential subdivision at Te Puke into Raymond Drain, a tributary of the Waiari Stream via four outfall structures.	Map Reference: A NZMS260 U14 0318-7383 B NZMS260 U14 0328-7386 C NZMS260 U14 0322-7383 C NZMS260 U14 0332-7328 Legal Description: Lot 2, DPS11712; Lot , DPS 11598; Lot 2, DPS 11175; Lot 13, DPS 8007; Lot	Current	31-Jan-15	15-Feb-05
62642	TPK	Discharge Stormwater to the Ohineaganga Stream.	For the Purpose of discharging stormwater from part of the Raymond Avenue and Bishoprick Crescent catchment, Te Puke into the Ohineangaanga Stream.	Location: At Raymond Avenue, Te Puke as shown on BOPRC RC plan no. 62642. Rate of Discharge: The maximum rate of discharge shall not exceed 610 litres per second except where the design event of a 20 minute one in five year storm is exceeded. Legal Descrri	Current	30-Apr-24	07-Jun-04
62643	TPK	Discharge Stormwater to an Unnamed Drain, in the catchment of the Kaituna River.	For the purpose of discharging stormwater from part of a residential catchment into and unnamed drain, in the catchment of the Kaituna River.	Location: At the northern end of Magnolia Place , Te Puke, as shown on the BOPRC RC Plan No. 62634/1. Rate of Discharge: The masximum rate of discharge shall not exceed 590 litres per second except where the design event of a 15 minute one in five year st	Current	30-Apr-24	28-May-04

64683	TPK	Discharge Stormwater to an un-named tributary of the Waiari Stream	For the purpose of discharging stormwater from stage 3 of the Fairview estate subdivison at Te Puke residential catchment area (approx 1.7 hectares) to an un-named ephemeral tributary of the Waiari Stream	Map reference: NZMS 260 U14: 0270-7270	Current	31-Mar-27	03-May-07
65098	TPK	A discharge permit pursuant to section 15(1)(a) of the Resource management Act 1991 to undertake discretionary activity being to Discharge Stormwater to an Unnamed Farm Drain which Discharges to the Waiari Stream	For the purpose of discharging stormwater from the No 1 Road carriageway and the surrounding rural/residential area	At or about map reference NZMS 260 U14:0384-7333. Part Lot 2 DP 23816 Block II, Maketu SD, (Western Bay of Plenty District)	Current	30-Oct-27	21-Nov-07

Eastern Catchments Current Existing Consents (small settlements Catchments) – source: WBOPDC Consent Database, PMS 2013

Existing Stormwater Consents

Note:

The list includes existing consents (incl. expired consents where the activity is still continuing) as per WBOPDC's Consent Database. It is understood that the list might not be complete and/or might include Consents outside of the urban areas to be covered in the CSC. CMP application shall include all Stormwater Related Consents currently listed by the Regional Council as WBOPDC owned within the urban limits.

The

Consent No	Associated Consents	Catchment	Asset No.	Consent	Purpose	Description	Consent Status	Expiry Date	Issue Date
20087		MAK		Maketu/ Little Waihi; discharge Stormwater	provide extra gravity drainage; Fords Rd drain to Maketu Estuary	Legal Description: Legal Road adjacent to Part Section 2, Block VI, Te Tumu SD. RC Transferred to EBOP and surrendered 5 August 1993	Surrendered	01-Oct-26	05-Jul-73
23590		PUK		Maketu/Little Waihi; discharge Stormwater, Pukehina Beach	discharge to open farm drain from Pukehina Parade	Max discharge rate 260 l/sec. Legal Description: Pt Sec 65, subject to and interest in ROW Block I, Waihi South SD	Expired	07-Sep-03	07-Sep-93
24927		PAE		Te Puke; discharge Stormwater to water; Paengaroa	Right to drain s/w from Council's Reserve & surrounding areas to culvert under Lemon Rd, Paengaroa.	Max rate of discharge 1140 l/sec unless design rainfall is of a 10 yr, 60min storm is exceeded. Legal Description: Council Road Reserve (Lemon Road), Paengaroa	Current	31-Jul-17	25-Jul-97
25178		PAE		Discharge Stormwater to a Drainage Easement, Black Road, Paengaroa	To discharge stormwater from the existing reticulated urban area of Paengaroa, to the Drainage Easement, as shown on BOPRC plan number RC 25178-1, submitted with the application.	Point of discharge to land legally described as: 2,507 square metres more or less being Lot 8, DPS 24477 and being part Section 23, Block VIII, Maketu SD (Western Bay of Plenty District). Suspended Solids shall not exceed 150 grams per cubic metre	Current	31-Aug-15	14-Sep-00
40125		MAK		Excavate Sediment From Maketu Estuary	For the purpose of excavating sediment from the boat ramp to the dive platform in the southern channel of the Maketu Estuary to provide sufficient depth for boat access.	Legal Description: Channel Bed Adjacent To Town Point Road, Block VI, Te Tumu Sd (Western Bay Of Plenty District) Property Address: Maketu Estuary Map Reference: V14:144-770	Expired	25-Nov-93	05-Nov-93
40238		MAK		Augering Holes In Beach For Samples	For the purpose of drilling test boreholes in Maketu Estuary.	Legal Description: Maketu Estuary Road Reserve Block VI Te Tumu Sd Property Address: Beach Road, Maketu Map Reference: V14:146-772	Expired	30-Nov-96	12-Sep-96
60705		PUK		Construct an outfall and to discharge Stormwater to the Little Waihi estuary	For the purpose of erecting an outfall and discharging stormwater.	Legal Description: Crown Land, Block I, Otutara SD	Current	31-Mar-20	26-Apr-00
61260		PAE		Discharge Stormwater to Land, Hall Road, Paengaroa.	For the purpose of discharging stormwater from the Hall/Conway Road Reticulated urban area of Paengaroa to the land as shown on BOPRC Plan No. RC 61260-1, submitted with the application.	Map Reference: NZMS 260 V14: 1102-7008 Legal Description: (point of discharge) Lot 15, DPS 62053, Block VII, Maketu SD	Current	31-Aug-15	30-Jan-02
61872		MAK		Remove and Replace Culverts within the Drainage Reserve, Wilson Road North, Maketu.			Surrendered		
62142		PUK		Discharge Stormwater to an Open Drain, a Tributary of the Pukehina Canal	For the purpose of discharging stormwater from Pukehina Parade to an open drain, a Tributary of the Pukehina Canal.	Legal Description: Sec 1 and 2 of SO 60193 Block 1 Waihi South SD and Lot 2 DPS 71006 Pt Sec 65 SO 52031 Block 1 Waihi South SD	Current	30-Jun-38	08-Jul-03

65381	MAK	Place, use and maintain a culvert and erosion protection structures on and over the bed of an unnamed tributary to Maketu estuary; and Disturb the bed of an unnamed tributary to Maketu estuary; and Temporarily dam and divert an unnamed tributary to Maketu	For the purpose of authorising activities associated with the placement and use of a culvert over the bed of an unnamed tributary to maketu Estuary, including the placement and use of associated erosion protection structures. The authorised activities inc	At Wilson Road North, Maketu as shown on BOPRC Plan Number RC65381/1. At or about map reference NZMS 260 V14:1430 7664 - Legal description Wilson Road North Reserve (WBOPD)	Current	30-Sep-43	20-Oct-08
-------	-----	---	---	---	---------	-----------	-----------



Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
Date: 12/11/2018
Operator: NK1
Map: E:\NK1\Consents.mxd



Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
 Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
 Location of services is indicative only. Council accepts no liability for any error.
 Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
 Date: 12/11/2018
 Operator: NK1
 Map: E:\NK1\Consents.mxd



Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
 Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
 Location of services is indicative only. Council accepts no liability for any error.
 Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
 Date: 12/11/2018
 Operator: NK1
 Map: E:\NK1\Consents.mxd



Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
Location of services is indicative only. Council accepts no liability for any error.
Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
Date: 12/11/2018
Operator: NK1
Map: E:\NK1\Consents.mxd



Produced using ArcMap by the Western Bay of Plenty District Council GIS Team.
 Crown copyright reserved. LINZ digital license no. HN/352200/03 & TD093522.
 Location of services is indicative only. Council accepts no liability for any error.
 Archaeological data supplied by NZ Archaeological Assoc/Dept. of Conservation.

Email: gis@westernbay.govt.nz
 Date: 12/11/2018
 Operator: NK1
 Map: E:\NK1\Consents.mxd

Appendix F

Eastern Catchments
AECOM Figures

Appendix F Eastern Catchments AECOM Figures

- Figure F-1 Overview of Eastern Catchments**
- Figure F-2 Te Puke Stormwater and Wastewater Networks**
- Figure F-3 Paengaroa Stormwater and Wastewater Networks**
- Figure F-4 Maketu/Little Waihi Stormwater and Wastewater Networks**
- Figure F-5 Pukehina Stormwater and Wastewater Networks**
- Figure F-6 Te Puke Receiving Environment Monitoring 2018**
- Figure F-7 Paengaroa Receiving Environment Monitoring 2018**
- Figure F-8 Maketu/Little Waihi Receiving Environment Monitoring 2018**
- Figure F-9 Pukehina Receiving Environment Monitoring 2018**
- Figure F-10 Te Puke Existing Landuse**
- Figure F-11 Paengaroa Existing Landuse**
- Figure F-12 Maketu/Little Waihi Existing Landuse**
- Figure F-13 Pukehina Existing Landuse**

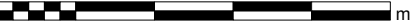


AECOM

PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

CLIENT
 **Western Bay of Plenty
District Council**

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE
Scale: 1:62,500 (A3 size)
650 325 0 650 1,300 1,950 2,600
 m
Map features depicted in terms of NZTM 2000 projection.
Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT			
Approved	CS	Date	25/05/2018
Checked	CS	Date	25/05/2018
Designed	SS	Date	25/05/2018
Drawn	SS	Date	25/05/2018

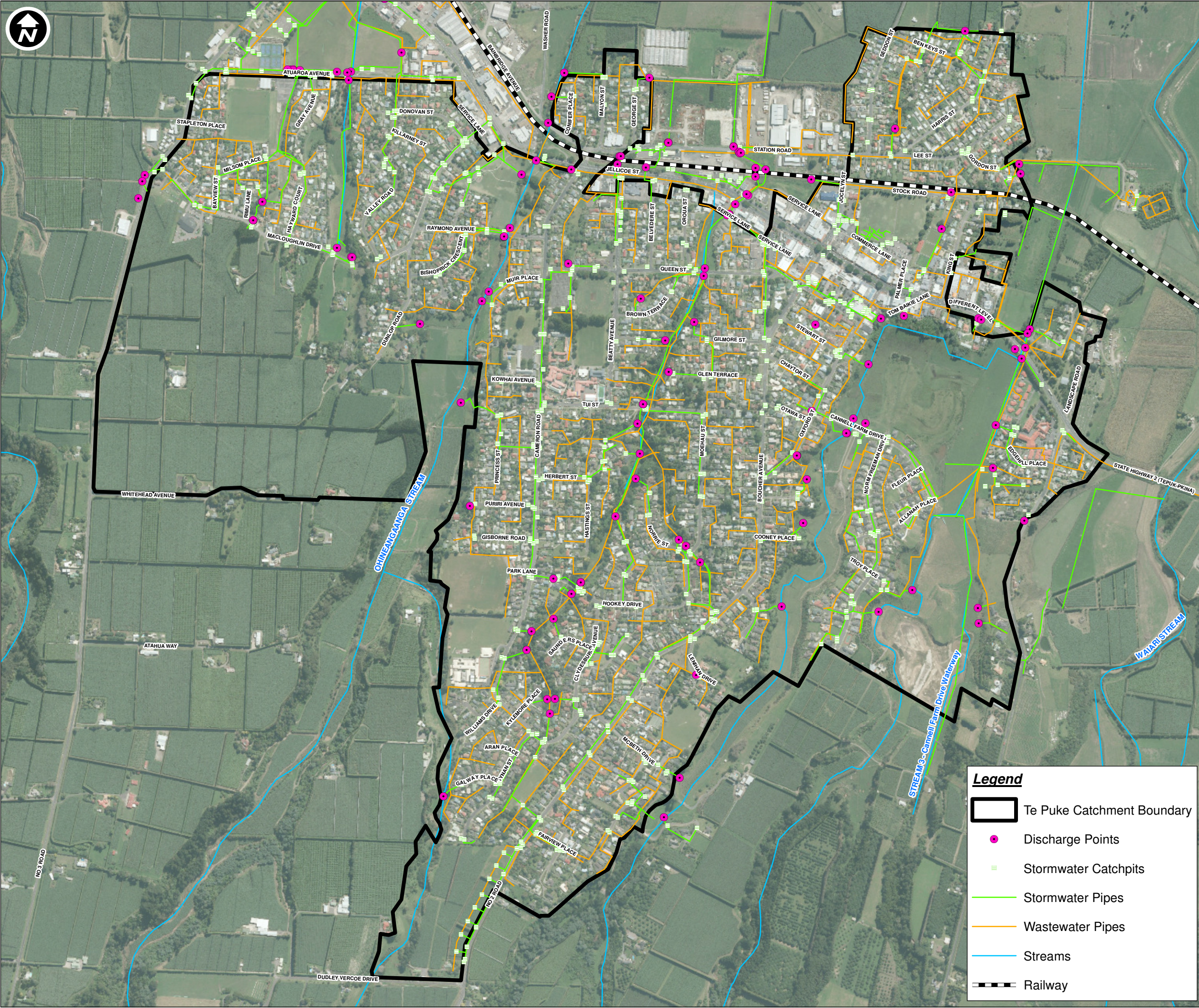
ISSUE/REVISION		
A	25/05/2018	FINAL
Rev	Date	Description



PROJECT NUMBER
60548000
SHEET TITLE
EASTERN CATCHMENT LOCATIONS
OVERVIEW MAP
MAP NUMBER
FIGURE F-1

Legend
 Catchment Boundary

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



AECOM

PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

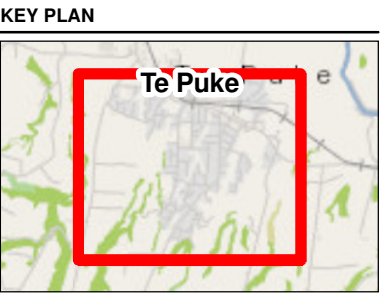
CLIENT
 Western Bay of Plenty
District Council

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE
Scale: 1:11,000 (A3 size)
110 55 0 110 220 330 440 m
Map features depicted in terms of NZTM 2000 projection.
Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

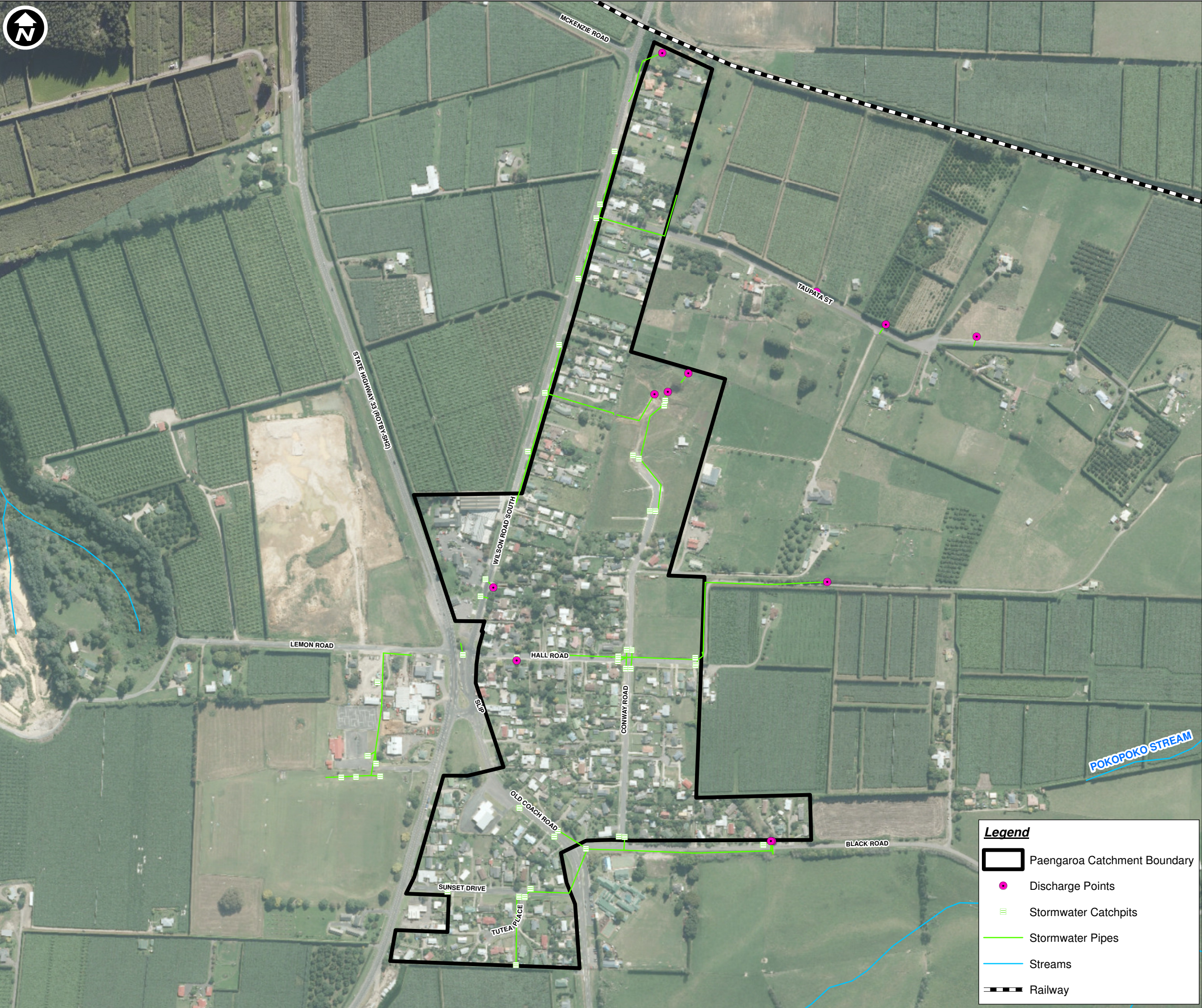
PROJECT MANAGEMENT			
Approved	CS	Date	25/05/2018
Checked	CS	Date	25/05/2018
Designed	SS	Date	25/05/2018
Drawn	SS	Date	25/05/2018

ISSUE/REVISION		
A	25/05/2018	FINAL
Rev	Date	Description



PROJECT NUMBER
60548000
SHEET TITLE
TE PUKE CATCHMENT
MANAGEMENT PLAN
MAP NUMBER
FIGURE F-2

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



Legend

- Paengaroa Catchment Boundary
- Discharge Points
- Stormwater Catchpits
- Stormwater Pipes
- Streams
- Railway



PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

CLIENT

Western Bay of Plenty
District Council

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:5,500 (A3 size)

50 25 0 50 100 150 200 m

Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT

Approved	CS	Date	25/05/2018
Checked	CS	Date	25/05/2018
Designed	SS	Date	25/05/2018
Drawn	SS	Date	25/05/2018

ISSUE/REVISION

A	25/05/2018	FINAL
Rev	Date	Description

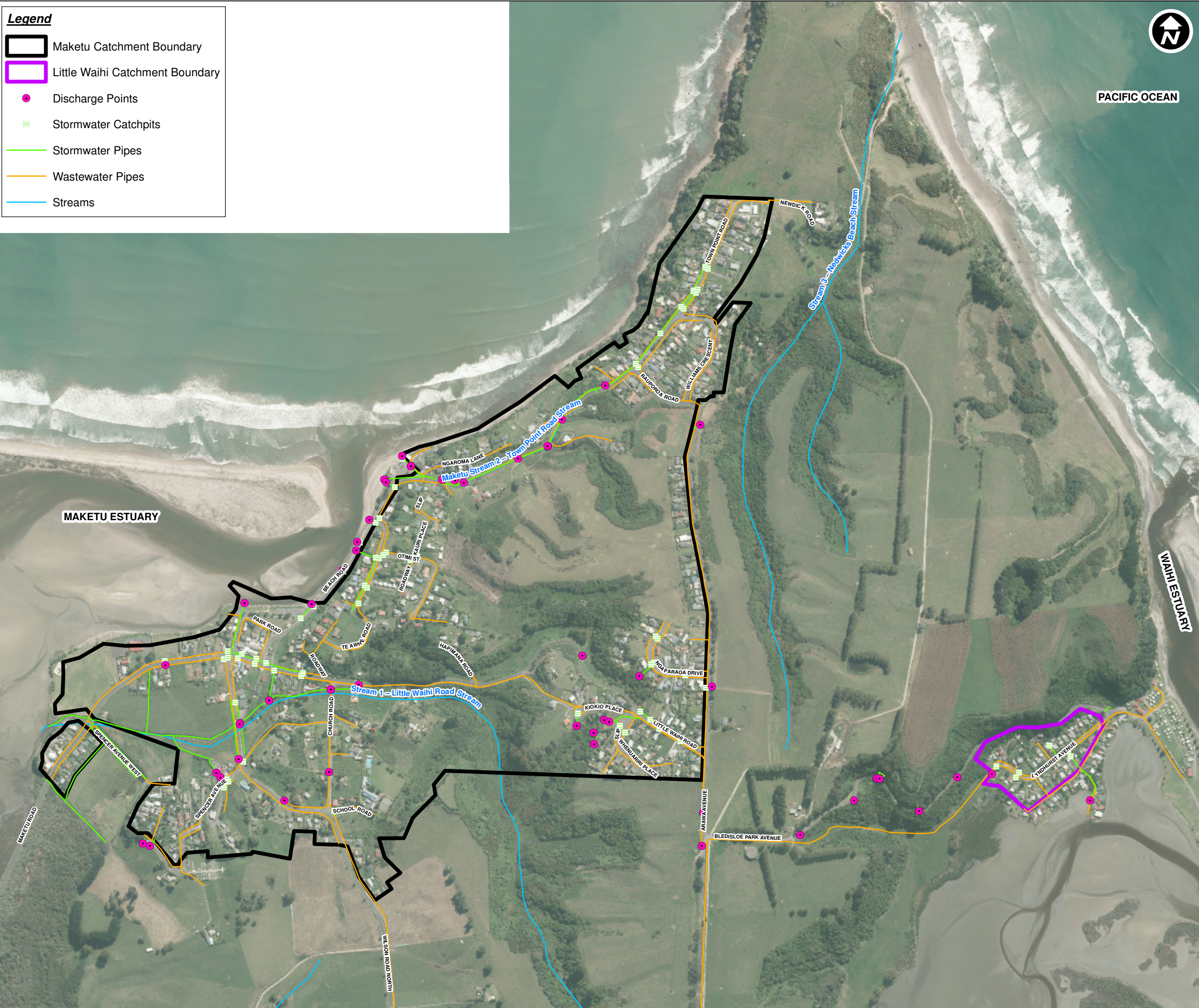


PROJECT NUMBER
60548000

SHEET TITLE
PAENGAROA CATCHMENT
MANAGEMENT PLAN

MAP NUMBER
FIGURE F-3

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



Legend

- Maketu Catchment Boundary
- Little Waihi Catchment Boundary
- Discharge Points
- Stormwater Catchpits
- Stormwater Pipes
- Wastewater Pipes
- Streams



AECOM

PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

CLIENT

Western Bay of Plenty
District Council

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:9,000 (A3 size)

90 45 0 90 180 270 360 m

Map features depicted in terms of NZTM 2000 projection.

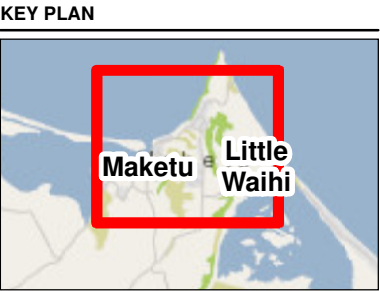
Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT

Approved	CS	Date	25/05/2018
Checked	CS	Date	25/05/2018
Designed	SS	Date	25/05/2018
Drawn	SS	Date	25/05/2018

ISSUE/REVISION

A	25/05/2018	FINAL
Rev	Date	Description



PROJECT NUMBER
60548000

SHEET TITLE
MAKETU/LITTLE WAIHI CATCHMENT
MANAGEMENT PLAN

MAP NUMBER
FIGURE F-4

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



Legend

Pukehina Catchment Boundary

Discharge Points

Stormwater Catchpits

Stormwater Pipes

Streams



AECOM

PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

CLIENT

Western Bay of Plenty
District Council

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:15,000 (A3 size)

150

75

0

150

300

450

600

m

Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT

Approved	CS	Date	25/05/2018
Checked	CS	Date	25/05/2018
Designed	SS	Date	25/05/2018
Drawn	SS	Date	25/05/2018

ISSUE/REVISION

A	25/05/2018	FINAL
Rev	Date	Description

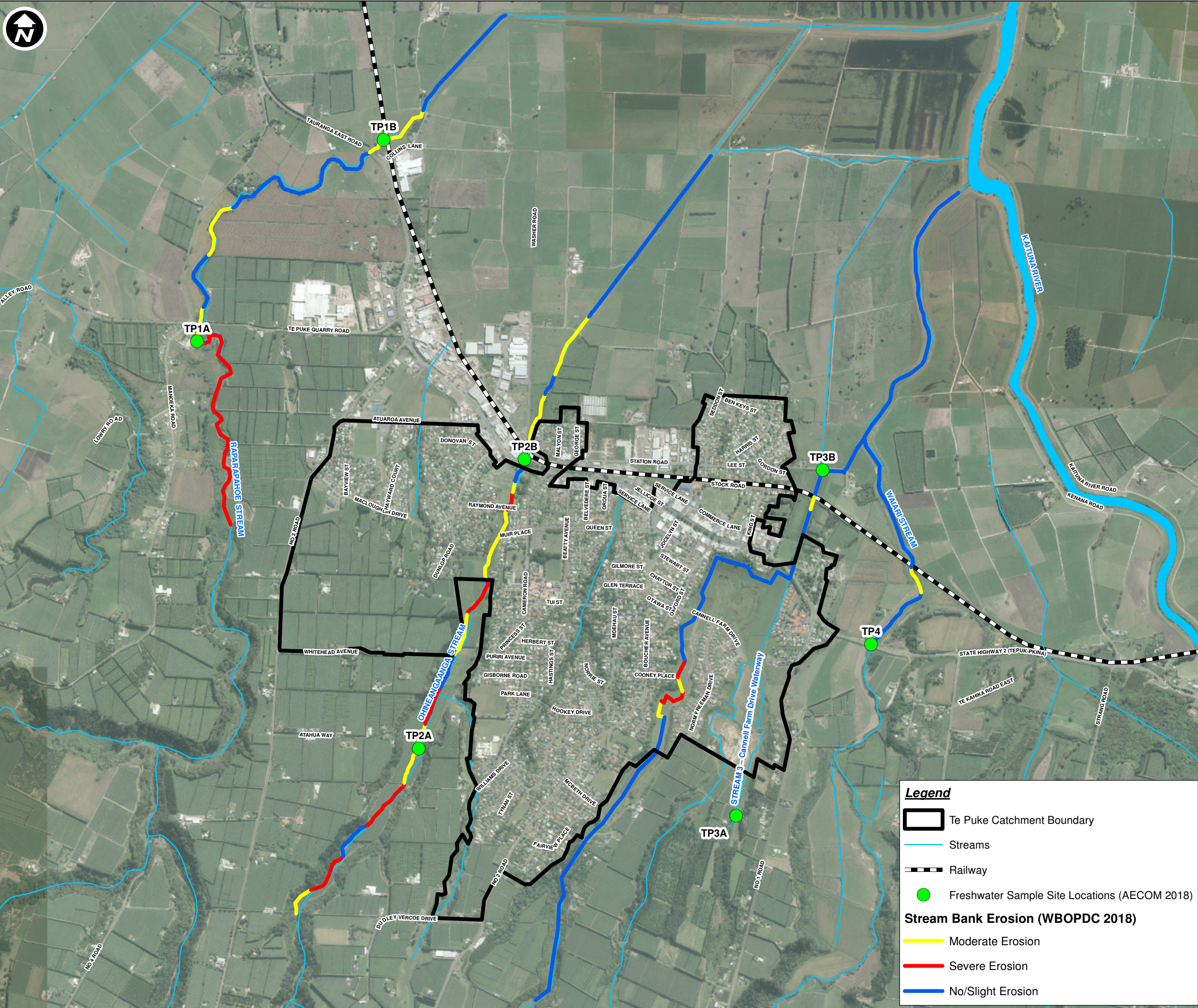
KEY PLAN

PROJECT NUMBER
60548000

SHEET TITLE
PUKEHINA CATCHMENT
MANAGEMENT PLAN

MAP NUMBER
FIGURE F-5

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



Legend

- Te Puke Catchment Boundary
- Streams
- Railway
- Freshwater Sample Site Locations (AECOM 2018)

Stream Bank Erosion (WBOPDC 2018)

- Moderate Erosion
- Severe Erosion
- No/Slight Erosion



PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

CLIENT

Western Bay of Plenty
District Council

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:20,000 (A3 size)

210 105 0 210 420 630 840 m

Map features depicted in terms of NZTM 2000 projection.

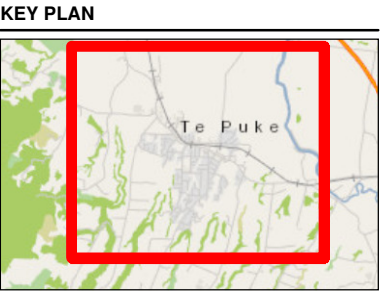
Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT

Approved	CS	Date	25/05/2018
Checked	CS	Date	25/05/2018
Designed	SS	Date	25/05/2018
Drawn	SS	Date	25/05/2018

ISSUE/REVISION

A	25/05/2018	FINAL
Rev	Date	Description

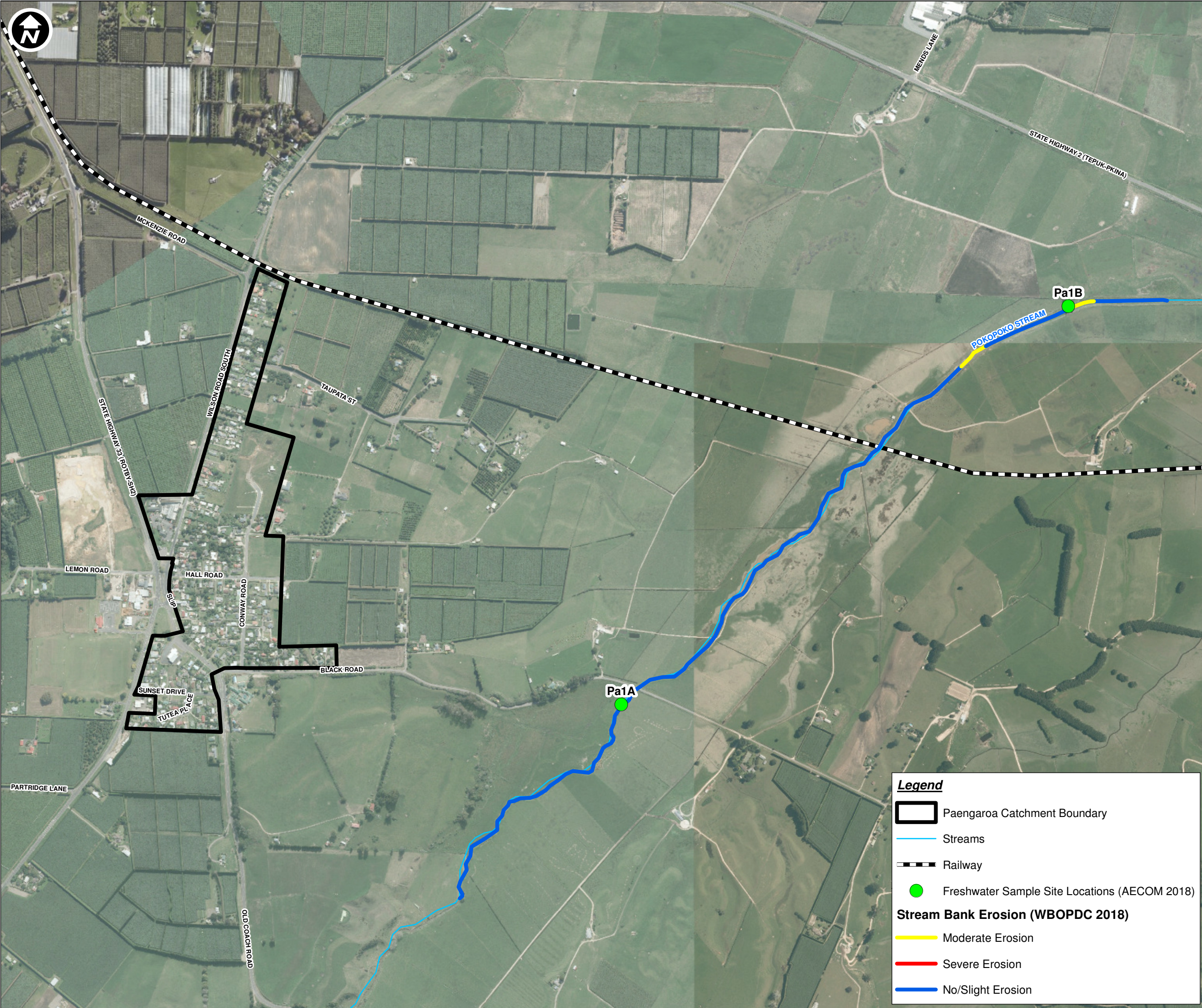


PROJECT NUMBER
60548000

SHEET TITLE
TE PUKE CATCHMENT ENVIRONMENT
MONITORING LOCATIONS

MAP NUMBER
FIGURE F-6

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



Legend

- Paengaroa Catchment Boundary
- Streams
- Railway
- Freshwater Sample Site Locations (AECOM 2018)

Stream Bank Erosion (WBOPDC 2018)

- Moderate Erosion
- Severe Erosion
- No/Slight Erosion



PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

CLIENT

Western Bay of Plenty
District Council

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:11,000 (A3 size)

110 55 0 110 220 330 440 m

Map features depicted in terms of NZTM 2000 projection.

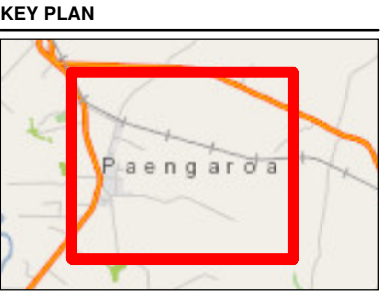
Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT

Approved	CS	Date	25/05/2018
Checked	CS	Date	25/05/2018
Designed	SS	Date	25/05/2018
Drawn	SS	Date	25/05/2018

ISSUE/REVISION

A	25/05/2018	FINAL
Rev	Date	Description



PROJECT NUMBER
60548000

SHEET TITLE
PAENGAROA CATCHMENT
ENVIRONMENT MONITORING
LOCATIONS

MAP NUMBER
FIGURE F-7

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



Legend

- Maketu Catchment Boundary
- Little Waihi Catchment Boundary
- Flood Gates
- Streams
- Freshwater Sample Site Locations (AECOM 2018)

Stream Bank Erosion (WBOPDC 2018)

- Moderate Erosion
- Severe Erosion
- No/Slight Erosion

PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

CLIENT
 Western Bay of Plenty
District Council

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:10,000 (A3 size)

100 50 0 100 200 300 400 m

Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT

Approved	CS	Date	25/05/2018
Checked	CS	Date	25/05/2018
Designed	SS	Date	25/05/2018
Drawn	SS	Date	25/05/2018

ISSUE/REVISION

A	25/05/2018	FINAL
Rev	Date	Description

KEY PLAN

PROJECT NUMBER
60548000

SHEET TITLE
MAKETU/LITTLE WAIHI CATCHMENT
ENVIRONMENT MONITORING
LOCATIONS

MAP NUMBER
FIGURE F-8

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



Legend

- Pukehina Catchment Boundary
- Streams
- Freshwater Sample Site Locations (AECOM 2018)
- Stream Bank Erosion (WBOPDC 2018)**
- Moderate Erosion
- Severe Erosion
- No/Slight Erosion



AECOM

PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

CLIENT
 **Western Bay of Plenty
District Council**

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE
Scale: 1:16,000 (A3 size)
160 80 0 160 320 480 640 m
Map features depicted in terms of NZTM 2000 projection.
Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT			
Approved	CS	Date	25/05/2018
Checked	CS	Date	25/05/2018
Designed	SS	Date	25/05/2018
Drawn	SS	Date	25/05/2018

ISSUE/REVISION		
A	25/05/2018	FINAL
Rev	Date	Description

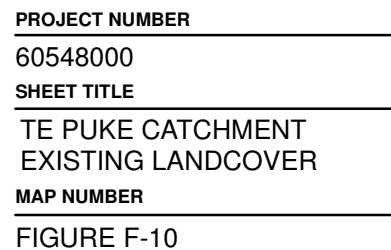
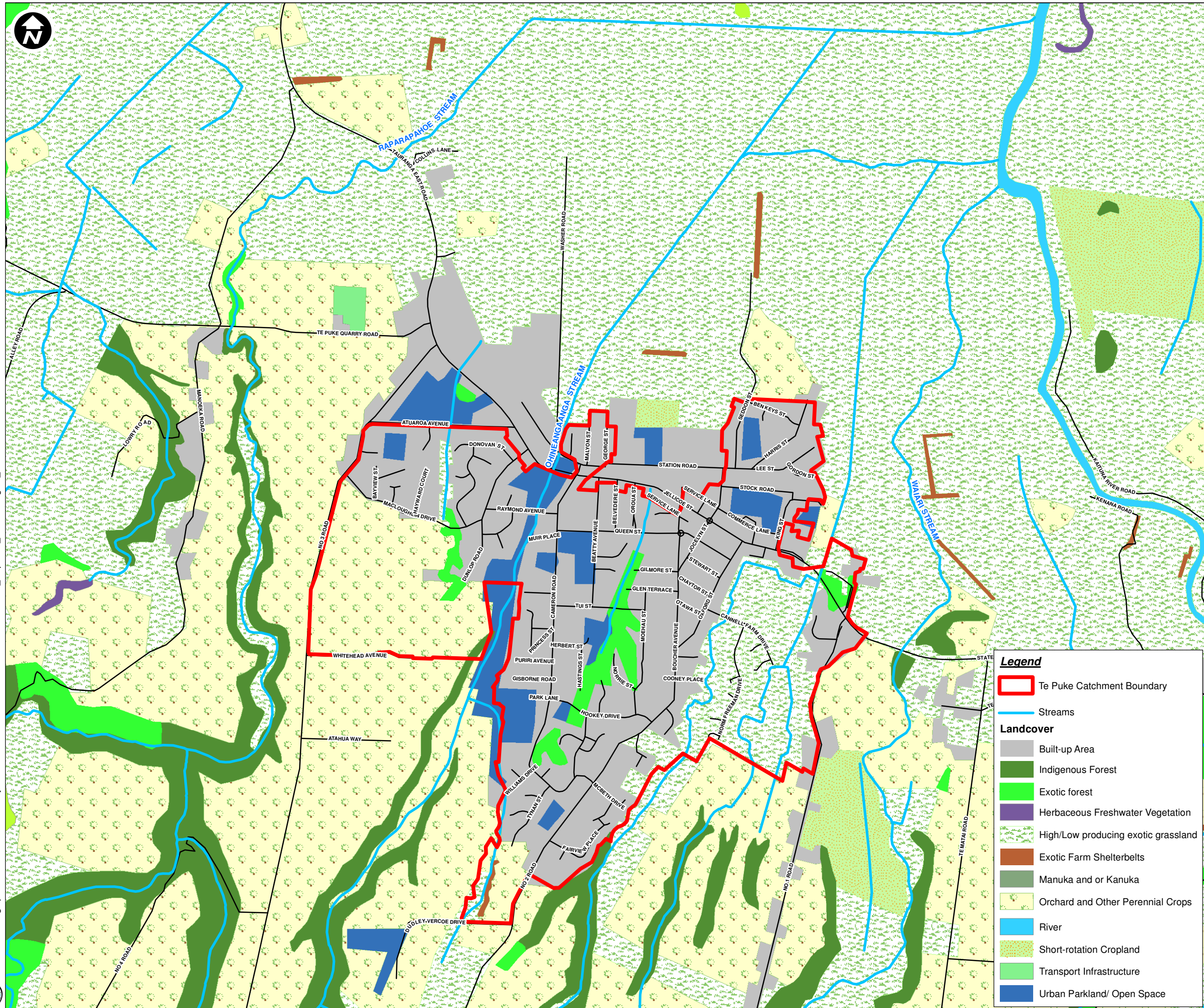


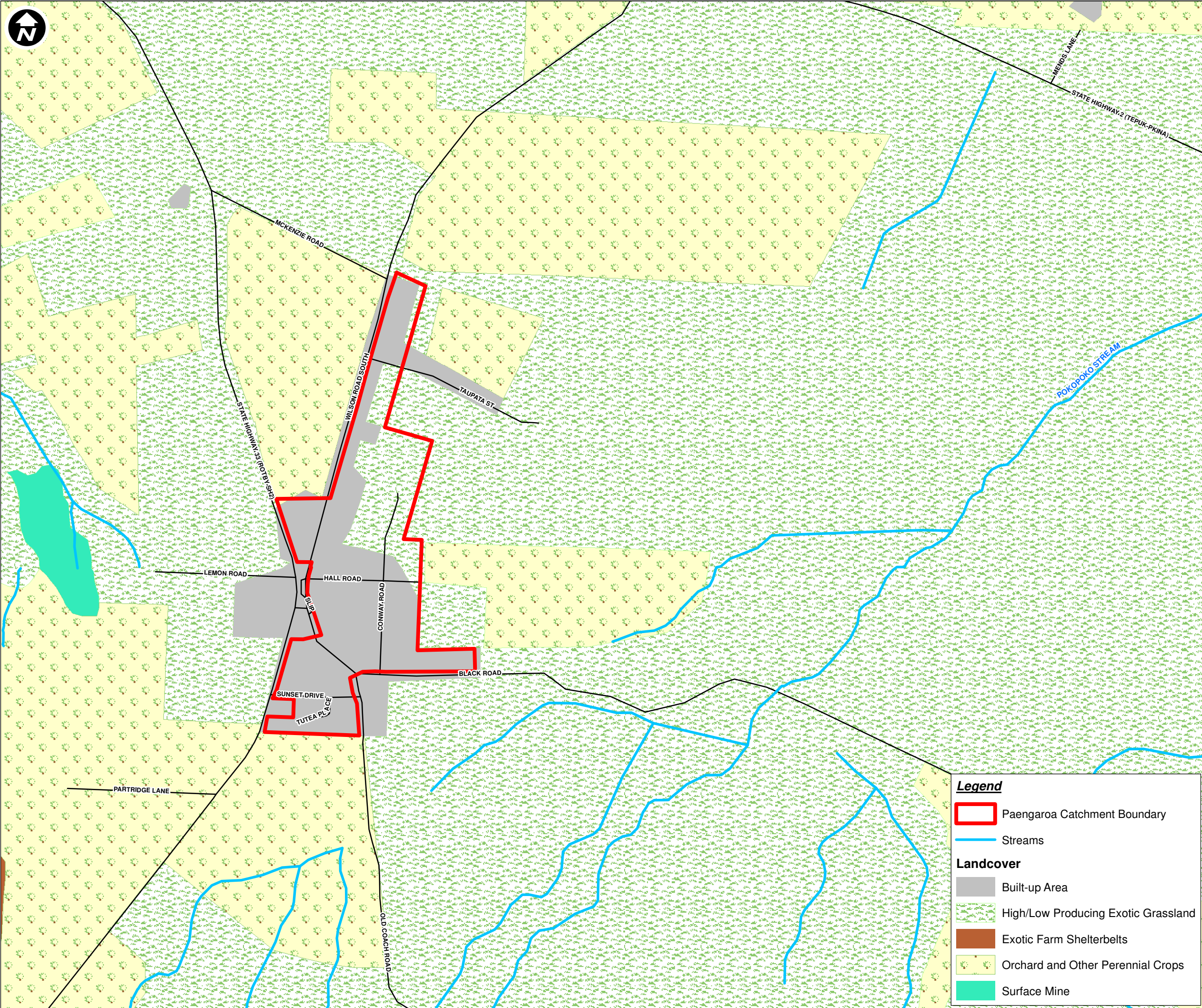
PROJECT NUMBER
60548000
SHEET TITLE
PUKEHINA CATCHMENT ENVIRONMENT
MONITORING LOCATIONS

MAP NUMBER

FIGURE F-9

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.





© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.

AECOM

PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

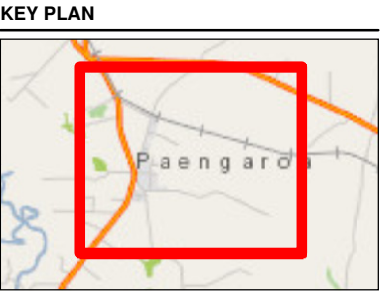
CLIENT
 **Western Bay of Plenty
District Council**

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE
Scale: 1:11,000 (A3 size)
110 55 0 110 220 330 440 m
Map features depicted in terms of NZTM 2000 projection.
Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT			
Approved	CS	Date	28/05/2018
Checked	CS	Date	28/05/2018
Designed	SS	Date	28/05/2018
Drawn	SS	Date	28/05/2018

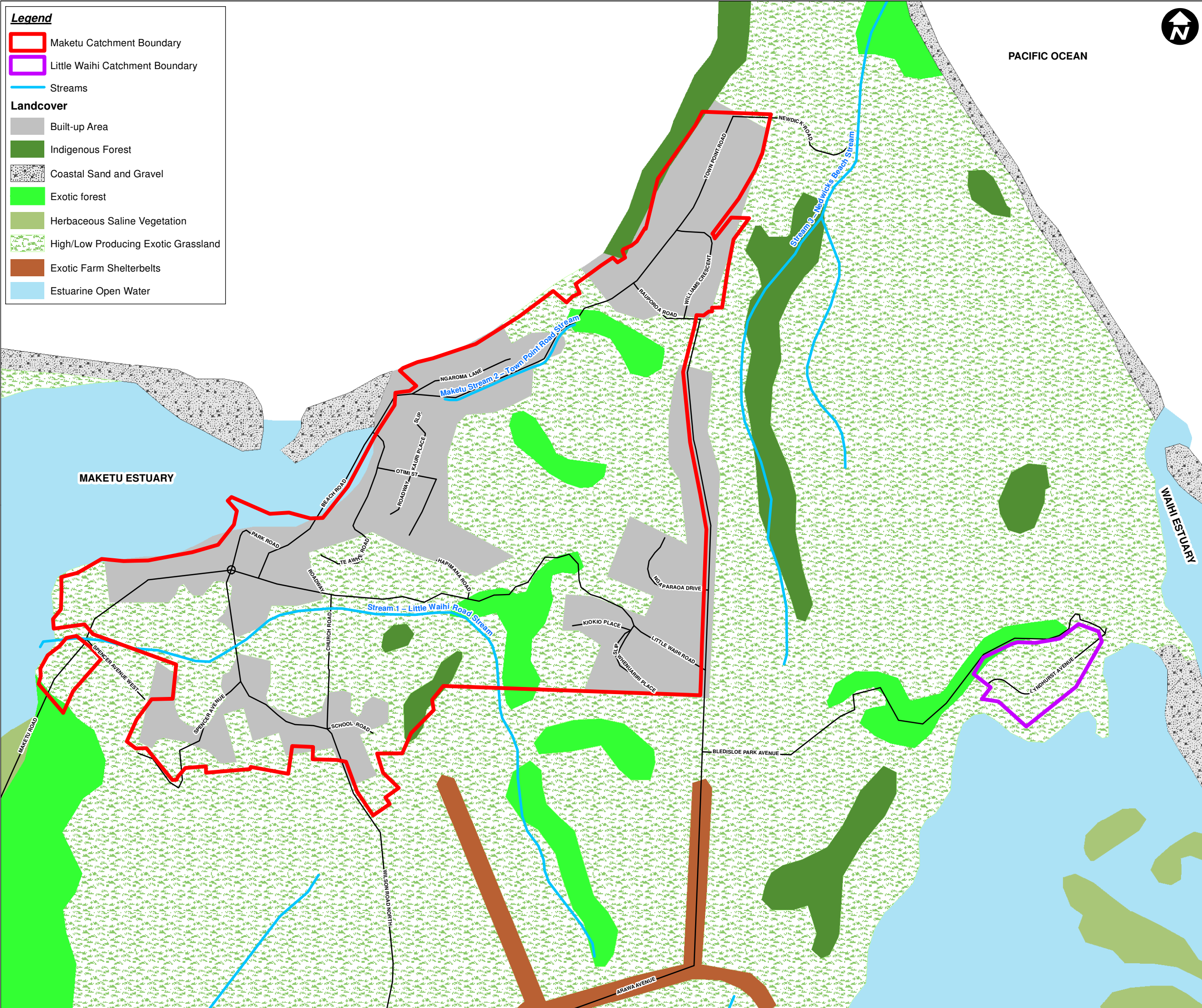
ISSUE/REVISION		
A	28/05/2018	FINAL
Rev	Date	Description



PROJECT NUMBER
60548000

SHEET TITLE
PAENGAROA CATCHMENT
EXISTING LANDCOVER

MAP NUMBER
FIGURE F-11



Legend

- Maketu Catchment Boundary
- Little Waihi Catchment Boundary
- Streams

Landcover

- Built-up Area
- Indigenous Forest
- Coastal Sand and Gravel
- Exotic forest
- Herbaceous Saline Vegetation
- High/Low Producing Exotic Grassland
- Exotic Farm Shelterbelts
- Estuarine Open Water



PACIFIC OCEAN

AECOM

PROJECT

WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

CLIENT



CONSULTANT

AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:9,000 (A3 size)
90 45 0 90 180 270 360
m
Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT

Approved	CS	Date	28/05/2018
Checked	CS	Date	28/05/2018
Designed	SS	Date	28/05/2018
Drawn	SS	Date	28/05/2018

ISSUE/REVISION

A	28/05/2018	FINAL	
Rev	Date	Description	

KEY PLAN



PROJECT NUMBER

60548000

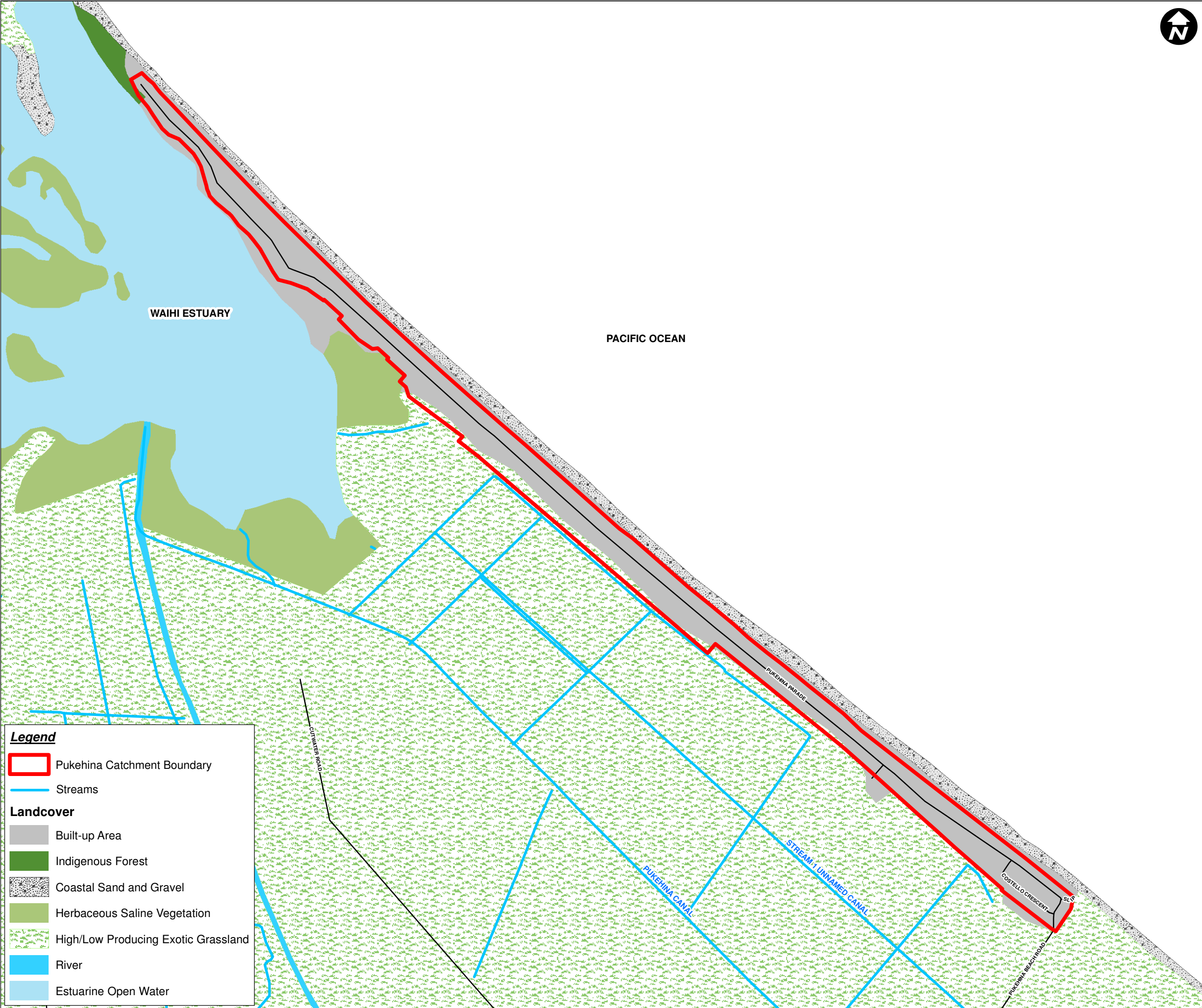
SHEET TITLE

MAKETU/LITTLE WAIHI CATCHMENT
EXISTING LANDCOVER

MAP NUMBER

FIGURE F-12

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



Legend

Pukehina Catchment Boundary

Streams

Landcover

Built-up Area

Indigenous Forest

Coastal Sand and Gravel

Herbaceous Saline Vegetation

High/Low Producing Exotic Grassland

River

Estuarine Open Water



AECOM

PROJECT
WBOPDC EASTERN CATCHMENTS
CATCHMENT MANAGEMENT PLAN

CLIENT

**Western Bay of Plenty
District Council**

CONSULTANT
AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:15,000 (A3 size)

150

75

0

150

300

450

600

m

Map features depicted in terms of NZTM 2000 projection.

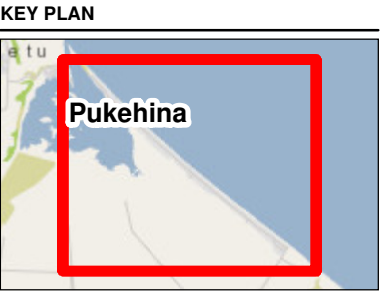
Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT

Approved	CS	Date	28/05/2018
Checked	CS	Date	28/05/2018
Designed	SS	Date	28/05/2018
Drawn	SS	Date	28/05/2018

ISSUE/REVISION

A	28/05/2018	FINAL
Rev	Date	Description



PROJECT NUMBER
60548000

SHEET TITLE
PUKEHINA CATCHMENT
EXISTING LANDCOVER

MAP NUMBER
FIGURE F-13

Appendix G

Eastern Catchments –
Receiving Environment
Monitoring 2018 Reports

Freshwater Ecological and Water Quality Assessment

Western Bay of Plenty - Eastern Catchments



Freshwater Ecological and Water Quality Assessment

Western Bay of Plenty - Eastern Catchments

Client: Western Bay of Plenty District Council

Co No.: N/A

Prepared by

AECOM New Zealand Limited
8 Mahuhu Crescent, Auckland 1010, PO Box 4241, Auckland 1140, New Zealand
T +64 9 967 9200 F +64 9 967 9201 www.aecom.com

29-Mar-2018

Job No.: 60548000

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

© AECOM New Zealand Limited (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

Quality Information

Document Freshwater Ecological and Water Quality Assessment

Ref 60548000

Date 29-Mar-2018

Prepared by Angela Chaffe

Reviewed by Caroline Secretin and Fiona Davies

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	26-Mar-2018	Draft for Internal Review	Bob Shaw Associate Director - Water	
B	29-Mar-2018	Final	Bob Shaw Associate Director - Water	

Table of Contents

Executive Summary	i
1.0 Introduction	1
1.1 Context	1
1.1.1 Project Background	1
1.2 Scope and Purpose	1
2.0 Project Description	2
2.1 Study Area	2
2.2 Catchment Description	2
2.2.1 Te Puke	2
2.2.2 Paengaroa	2
2.2.3 Maketu and Little Waihi	3
2.2.4 Pukehina	3
3.0 Methodology	4
3.1 Review of Existing Information	4
3.2 Field Investigations Methodologies	5
3.2.1 Freshwater Ecological Sampling Methodology	5
3.2.2 Water Quality Sampling Methodology	7
4.0 Results	7
4.1 Sampling Locations and Assumptions	7
4.2 Freshwater Ecological Sampling Results	9
4.2.1 National Rapid Habitat Assessment (RHA) results	9
4.2.2 Macroinvertebrate Sampling Results	11
4.2.3 Physico-chemical Parameter Field Sampling Results	14
4.3 Water Quality Sampling Results	15
5.0 Conclusion	17
6.0 Recommendations	19
7.0 References	20
Appendix A	
Figure A - Eastern Catchments Project Area	A
Appendix B	
2018 Freshwater Sampling Locations	B
Appendix C	
2018 Freshwater Sampling Site Photographs	C
Appendix D	
2018 Macroinvertebrate Sampling Results	D
Appendix E	
2018 Water Quality Certificates of Analysis	E

Executive Summary

Western Bay of Plenty District Council (WBOPDC) has engaged AECOM New Zealand Limited (AECOM) to undertake additional environmental surveys to fill existing knowledge gaps in background information for the Eastern Catchments. The surveys focused on the main freshwater environments associated with four stormwater urban catchments in the area: Te Puke, Paengaroa, Maketu (and Little Waihi) and Pukehina. The information presented in this report will feed into the draft Catchment Management Plan (CMP) for the eastern catchments, which will support a Comprehensive Stormwater Consent application for WBOPDC's eastern catchments.

The purpose of this Freshwater Ecological and Water Quality Assessment undertaken in 2018 is to provide a recent snapshot of the ecological values and water quality of key streams impacted by the urban settlements of Te Puke, Paengaroa, Maketu/Little Waihi and Pukehina. The assessments are based on regional and national standards and evaluate instream and riparian values to further understand the potential adverse effects of stormwater runoff on the receiving freshwater environment.

Rapid Habitat Assessments (RHA), and macroinvertebrate and water quality sampling were undertaken at 17 sites across the four settlements. This included upstream (control) and downstream (impacted) sample sites in eight impacted streams and one reference site in a tributary of Kaituna River, located to the east of the Te Puke settlement (not impacted by Te Puke).

Results obtained from the waterways included in these investigations are generally considered to be in 'Moderate' to 'Poor' condition. This would suggest that most, if not all, urban waterways within Eastern Catchments in Western Bay of Plenty have been negatively influenced in some way by land use intensification in the region.

Overall, the average RHA scores and low percentage EPT taxa recorded at upstream sites indicate that all the waterways assessed in the Eastern Catchments have been impacted by land uses in the wider landscape outside of urban areas. RHA scores below 70 and macroinvertebrate communities dominated by pollution tolerant species of *Diptera*, *Mollusca* and *Crustacea* indicate adverse impacts within all streams as a result of loss or disturbance of riparian margins and non-urban contaminant inputs. The ecological health observed at sample locations downstream of the urban catchments was generally found to be more degraded than the upstream control within the same waterway. In instances where recorded heavy metal concentrations and *E. coli* levels exceeded water quality recommendations set by the Australian and New Zealand Environment and Conservation Council (ANZECC 2000) and National Policy Statement for Freshwater Management (NPSFM) (MfE 2014), exceedances were generally higher at downstream locations; particularly in regards to *E. coli* counts.

Streams in Te Puke were generally considered to be in the best condition of all surveyed waterways despite exhibiting pH and conductivity levels outside the ANZECC (2000) guidelines. Streams in this catchment generally had 'Moderate' to 'Good' instream habitat and were of 'Fair' to 'Good' stream quality; indicating mild to moderate pollution levels.

Streams within the Maketu catchment were considered to be in the worst ecological condition with generally 'Poor' to 'Moderate' instream habitat and suffering from mild to severe pollution. With the exception of sample site Pu 1B in Stream 1 – unnamed canal at Pukehina, sampled waterways in Maketu were the only waterways to record elevated heavy metals levels above ANZECC (2000) guidelines. Physico-chemical parameters were generally below recommended trigger levels, with the exception of pH and conductivity levels at Ma 2A and Ma 2B.

The condition of the receiving environment of Pukehina was considered to be in similar condition to sampled waterways in Maketu, with MCI scores indicating 'Poor' to 'Fair' ecological condition and physico-chemical parameters that exceeded ANZECC (2000) trigger levels. The ecological condition of Pokopoko Stream in Paengaroa was slightly better, with MCI scores indicating stream health was 'Fair' to 'Good'. Water quality results were below recommended trigger levels, except for conductivity levels which exceeded ANZECC (2000) recommendations.

All sample sites except TP 4 in Waiari Stream recorded *E. coli* levels which were above threshold levels for the 'Orange' attribute state (>130cfu per 100ml). Twelve were above threshold levels for the 'Red' attribute state (>260cfu per 100ml).

In order to improve outcomes in receiving environments and ensure regional policy objectives for improving water quality in the district are met, it is recommended that measures are taken to further manage urban stormwater runoff in the Eastern Catchments. Such measures may include:

- Implement quality monitoring programs within all Eastern Catchments, i.e. this could include:
 - Repeat sampling rounds throughout the year to increase understanding of the water quality issues and assess any potential impact on the receiving environment and public health.
 - Undertake water quality sampling at sites used for recreational purposes within Maketu and Pukehina to inform public health risk assessment.
 - Carry out groundwater and water quality analysis for nutrients and *E. coli* at Maketu and Pukehina to assess whether stormwater management issues.
- Enhance and widen riparian margins where practicable, particularly in areas zoned for future urban development, and ensure measures to protect riparian margins are implemented in current green field areas.
- Implement stormwater management strategies to improve catchment-wide water quality, placing priority in Maketu and Pukehina where ecological and water quality scored the poorest results.
- Create community initiatives to encourage local land owners to fence off streams from cattle and protect existing riparian margins.
- Identify any potential site specific actions that would improve discharges to streams and plan for implementation.

1.0 Introduction

1.1 Context

Western Bay of Plenty District Council (WBOPDC) has engaged AECOM New Zealand Limited (AECOM) to undertake additional environmental surveys to fill existing knowledge gaps in the Eastern Catchments. The surveys focused on the main freshwater environments associated with four urban catchments in the area: Te Puke, Paengaroa, Maketu (and Little Waihi) and Pukehina. This will build upon works previously completed by Wildlands Consultants Limited (2005a; 2005b; 2006a; 2006b) and will provide for a more representative summary of existing ecological values within the receiving environments of each settlement.

The information presented in this report will feed into the draft Catchment Management Plan (CMP) for the Eastern Catchments, which will support the consenting process moving forward (refer to Section 1.1.1).

1.1.1 Project Background

WBOPDC lodged a series of applications for Renewal of Stormwater Discharge Consents for all urban settlements within the district with Bay of Plenty Regional Council (BOPRC) in 2001. In 2005, BOPRC published the 'Regional Stormwater Strategy' (Bay of Plenty Regional Council, 2005) with the aim of improving the management of urban stormwater runoff and water quality in the region. As a result, WBOPDC is now required to approach the consent applications in a more inclusive manner. This includes the preparation of Comprehensive Stormwater Consents (CSCs) for urban areas in each district.

In 2013, Professional Management Services 2009 Limited (PMS) lodged a CSC application on behalf of WBOPDC for the Eastern Catchments. Following a technical review gap analysis (dated 9 August 2017) undertaken by AECOM, the supporting information was found to be incomplete. This included environmental data for receiving freshwater environments. This prompted the preparation of this 2018 Freshwater Ecological and Water Quality Assessment and a drone survey for bank erosion assessment (Western Bay of Plenty District Council 2018). Upon AECOM's recommendations the PMS CSC application has been put on hold until the draft CMP is prepared by AECOM on behalf of WBOPDC for submission to BOPRC.

1.2 Scope and Purpose

The purpose of this Freshwater Ecological and Water Quality Assessment is to provide a recent snapshot of the ecological values and water quality of key streams impacted by the urban settlements of Te Puke, Paengaroa, Maketu/Little Waihi and Pukehina. The assessments are based on regional and national standards and evaluate instream and riparian values to further understand the potential adverse effects of stormwater runoff on the receiving freshwater environment.

The scope of freshwater investigations includes:

- Assessment of the instream habitat condition of identified streams at locations upstream and downstream of each settlement/catchment using National Rapid Habitat Assessment (RHA) criteria (Clapcott 2015);
- Sampling of instream macroinvertebrate communities at upstream and downstream sample locations, and analysis using Macroinvertebrate Community Index (MCI) to denote overall stream health;
- Sampling and analysis of life-supporting physio-chemical parameters (i.e. temperature, pH, dissolved oxygen and conductivity) to provide an indication of the biological and ecological stressors within impacted streams; and
- Water quality sampling and laboratory analyses to test for potential land based contaminants, including heavy metals (in particular copper, lead and zinc), *Escherichia coli* (*E. coli*), pH, total suspended solids (TSS) and Total Petroleum Hydrocarbons (TPH).

2.0 Project Description

2.1 Study Area

The Western Bay of Plenty District is located on the east coast of the North Island and extends from Waihi Beach in the northwest to Otamarakau in the south east.

The Eastern Catchments of the Western Bay of Plenty District consists of four identified urban areas. These include one major community, Te Puke, and three small settlements: Paengaroa, Maketu (including Little Waihi) and Pukehina. Little Waihi does not have any streams within or adjacent to its catchment and, therefore, is not included in this Freshwater Ecological and Water Quality Assessment.

The location of the Project area and associated urban settlements are provided in Appendix A.

2.2 Catchment Description

The Eastern Catchments are located in the Tauranga Ecological District. The district is comprised of rolling and hilly country inland, and low shallow plains and sand dunes towards the coast. The climate is generally sunny, with a strong maritime influence (McEwen 1987). Summers are typically warm, with mild winters and an annual rainfall of between 1,400mm and 1,800mm. Formerly composed of flax swamps, fern and scrub, much of the vegetation has since been cleared for farming. Pockets of remnant forest are present in the high country.

2.2.1 Te Puke

Te Puke is the western most urban settlement in WBOPDC's Eastern Catchments. Located approximately 25km southeast of central Tauranga, Te Puke is situated adjacent to the Kaituna-Pongakawa plains and Ottawa-Otanewainuku Range. Surrounded by agricultural land, the township has an area of approximately 480ha which has been heavily modified and consists of mainly of residential land uses and a small commercial area to the north. Industrial land uses are located directly northwest of the catchment (to the east of Raparapahoe Stream).

Te Puke is in the Kaituna River catchment. Ohineangaanga Stream, Raparapahoe Stream, Waiari Stream and a number of small waterways run through or adjacent to the settlement, with Kaituna being the main freshwater receiving environment. The Kaituna River flows northeast towards Te Tumu where it discharges into the Pacific Ocean.

Twelve native fish species have been recorded in the waterways associated with the catchment (Wildlands Consultants Limited 2006a). Six of these species: giant kokopu (*Galaxias argenteus*), inanga (*G. maculatus*), koaro (*G. brevipinnis*), redfin bully (*G. huttoni*), longfin eel (*Anguilla dieffenbachia*) and torrentfish (*Cheimarrichthys fosteri*); have a threat classification of 'At Risk', while lamprey (*Geotria australis*) are 'Nationally vulnerable' (Goodman, *et al.* 2013). All others are unthreatened common native species.

A summary of the fish species recorded and their conservation threat status (Goodman, *et al.* 2013) is provided in Table 1.

2.2.2 Paengaroa

Paengaroa is located approximately 33km southeast of central Tauranga and consists of a small urban settlement (approximately 35ha) surrounded by rural land uses. The landscape is heavily modified and consists of residential and commercial land uses.

There are no waterways traversing the settlement; however, Pokopoko Stream lies approximately 1km downslope of the settlement. The stream runs parallel to Paengaroa and is the likely receiving environment for stormwater runoff. Pokopoko Stream flows in a northeasterly direction until it joins Kaikokopu Canal before discharging into Waihi Estuary. Waihi Estuary is identified as an 'Area of Significant Conservation Value' (ASCV-7) with 'Significant Indigenous Vegetation Areas' (SSCMA-34) under the Bay of Plenty Regional Coastal Environment Plan (2011). The estuary provides feeding and roosting grounds for migratory and wading bird species, and contains representative saltmarsh vegetation which is still relatively intact.

Ten native fish species have been recorded in the Pokopoko Stream and adjoining Kaikokopu Canal (NIWA 2016). Four of these, inanga, koaro, redfin bully, longfin eel and torrentfish, have a threat status of 'At Risk' (refer to Table 1). All other species are common throughout New Zealand. Two additional species, giant kokopu and giant bully (*Gobiomorphus gobioides*) have also been recorded in other streams within the Waihi Estuary catchment.

2.2.3 Maketu and Little Waihi

Maketu is located approximately 39km east of central Tauranga, adjacent to Okurei Point. The settlement has an area of approximately 128ha which is heavily modified and consists of residential and agricultural land uses. Little Waihi (approximately 4ha) is located approximately 700m east of Maketu. Comprised of residential land uses, the catchment has also been heavily modified.

There are three main unnamed waterways running through or adjacent to the settlement. Two flow westward through the settlement to discharge into Maketu Estuary. Maketu Estuary is identified as an 'area of significant conservation and cultural value' (ASCV-7) under the Bay of Plenty Regional Coastal Environment Plan (2011). The estuary provides important feeding and roosting grounds for a number of wading, wetland and shore bird species, and meets the Ramsar criteria (2013) for an internationally significant wetland. The third flows parallel to the settlements' eastern boundary, discharging into the Pacific Ocean at Nedwicks Beach to the north.

There are no waterways within the Little Waihi catchment. Stormwater from the settlement flows directly into Waihi Estuary, either via overland flow or as piped discharge.

Four species of native fish have been recorded in the waterways associated with the Maketu settlement (Wildlands Consultants Limited 2006b). Eight additional species have also been recorded in the Maketu Estuary catchment; however, these were in the Kaituna River system.

A summary of the fish species recorded and their conservation threat status (Goodman, *et al.* 2013) is provided in Table 1.

2.2.4 Pukehina

Pukehina is located on a spit approximately 48km east of central Tauranga. The settlement consists of a 71ha residential community surrounded by rural land uses.

There are no waterways traversing the settlement; however, a number of farm drains are located to the south and receive stormwater runoff from the township.

Only two species of native fish have been recorded in the Pukehina drain system (refer to Table 1); however, seven additional species have been recorded in the Pongakawa Stream which adjoins Pukehina Canal (Wildlands Consultants Limited 2005a).

Table 1 provides a summary of all native fish species observed in waterways associated with urban areas in Western Bay of Plenty District's Eastern Catchments according to previous investigations undertaken by Wildlands Consultants Limited (2005a; 2006a; 2006b) and the NIWA Freshwater Fish Database (2016).

Table 1 Native fish species observed in waterways associated with urban areas in Western Bay of Plenty District's Eastern Catchments

Fish species	Threat status	Eastern Catchments			
		Te Puke	Paengaroa	Maketu	Pukehina
Banded kokopu (<i>Galaxias fasciatus</i>)	Not Threatened	✓	✓		
Common bully (<i>Gobiomorphus cotidianus</i>)	Not Threatened	✓	✓	✓	
Common smelt (<i>Retropinna retropinna</i>)	Not Threatened	✓	✓		
Estuarine triplefin (<i>Grahamina spp.</i>)	Not Threatened		✓		
Giant kokopu (<i>Galaxias argenteus</i>)	Threatened – At Risk	✓		✓	
Grey mullet (<i>Mugil cephalus</i>)	Not Threatened	✓			
Inanga (<i>Galaxias maculatus</i>)	Threatened – At Risk	✓	✓	✓	✓
Koaro (<i>Galaxias brevipinnis</i>)	Threatened – At Risk	✓			
Lamprey (<i>Geotria australis</i>)	Threatened – Nationally vulnerable	✓			
Longfin eel (<i>Anguilla dieffenbachia</i>)	Threatened – At Risk	✓	✓		
Redfin bully (<i>Gobiomorphus huttoni</i>)	Threatened – At Risk	✓	✓		
Shortfin eel (<i>Anguilla australis</i>)	Not Threatened	✓	✓	✓	✓
Torrentfish (<i>Cheimarrichthys fosteri</i>)	Threatened – At Risk	✓	✓		
Yelloweye mullet (<i>Aldrichetta forsteri</i>)	Not Threatened		✓		

3.0 Methodology

3.1 Review of Existing Information

Reports from previous ecological investigations (Wildlands Consultants Limited 2005a; 2005b; 2006a; 2006b) undertaken in the Project area as part of the initial consent application (refer to Section 1.1.1) were reviewed to identify potential gaps in supporting information. Results were used to inform the direction of further investigations (refer to Section 3.2).

Report results were also compared against aerial imagery and WBOPDC online mapping system maps (MAPI) to identify the main waterways receiving stormwater runoff from each urban catchment. Based on the extent of each catchment, potential upstream (control) and downstream (impacted) of catchment sample sites were identified in these waterways (AECOM 2018). The actual locations were reassessed and confirmed in the field (refer to Section 4.1). These locations were also used to inform the start and end points for the drone survey undertaken by WBOPDC (2018) in January/February 2018.

3.2 Field Investigations Methodologies

AECOM staff undertook a series of site investigations between the 31 January and 7 February 2018 under overcast or sunny conditions. This included visual inspection of riparian vegetation and instream habitat, and sampling of surface water flows and instream macroinvertebrate fauna. Results were used to describe overall stream health and the potential downstream effects of stormwater runoff within each catchment.

Assessment methodologies are described in the following subsections.

3.2.1 Freshwater Ecological Sampling Methodology

3.2.1.1 National Rapid Habitat Assessment (RHA) Methodology

The RHA provides a standardised protocol for making quick assessments of instream habitat quality. Though still in its draft form, trials in New Zealand indicate correlations between RHA assessment scores and measured visual and modelled estimates of stream habitat characteristics (Clapcott 2015). Overall, the RHA protocols are considered to provide a representative assessment of stream habitat quality (Clapcott 2015).

The RHA parameters are designed to represent distinct structural and functional aspects of a stream environment (Clapcott 2013). The approach uses 10 key parameters to describe stream attributes, including habitat provision, sedimentation, filtering capacity sediment, nutrients, and organic matter inputs. The parameters of interest include:

- Sediment deposition;
- Invertebrate habitat diversity;
- Invertebrate habitat abundance;
- Fish cover diversity;
- Fish cover abundance;
- Hydraulic heterogeneity;
- Banks erosion;
- Bank vegetation;
- Riparian margin width; and
- Riparian shade.

Based on visual observations, each of the above parameters are allocated a score rating of between 1 to 10. Once the RHA has been completed, the scores are summed to produce an overall RHA habitat quality score between 10 and 100 which can be used to infer instream habitat quality; refer to Table 2.

Table 2 Interpretation of RHA habitat quality score

RHA habitat quality score	Overall habitat value
10 – 40	Poor
41 – 60	Moderate
61 – 80	Good
81 +	Excellent

An RHA was completed for each of the upstream and downstream sample locations in main waterways for each catchment. These scores were compared against a reference site in Waiari Stream, a tributary of the Kaituna River (refer to Section 4.1). The stream is located to the east of Te Puke and is isolated from any potential inputs from the nearby Te Puke community. The area of

stream assessed has not been impacted by urban development and its inclusion in the study is intended to improve the integrity of the habitat scores of impacted streams (Harding, *et al.* 2009).

3.2.1.2 Macroinvertebrate Sampling Methodology

Freshwater macroinvertebrates have varied sensitivity to pollution and other instream conditions and the presence or absence of different taxa can be used to describe localised stream health. As such, macroinvertebrate community assemblages are commonly used as biological indicators for water quality and are widely used in New Zealand to assess the condition of waterways.

Instream macroinvertebrate communities were sampled at each sample location following protocols developed for the sampling of macroinvertebrates in wadeable streams in New Zealand (Stark *et al.* 2001). Using protocol C2 (soft-bottomed, semi-quantitative) a substrate area of approximately 3m² was manually disturbed at various locations at each site. Dislodged organisms and materials were then swept up using a D-net (0.5mm mesh). Sampled substrate types varied according to availability at each site, but included submerged wood and macrophytes, banks margins and overhanging vegetation.

Composite samples were preserved on site in ethanol and shipped to a qualified macroinvertebrate taxonomist where they were processed following protocol P3 (full count with subsampling option) to provide a direct measure of abundance and percentage composition. Sample results were analysed using the Macroinvertebrate Community Index for soft-bottomed streams (MCI-sb) (Stark 1985; Stark and Maxted 2007) and community composition, including percentage of *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies) and *Trichoptera* (caddisflies) (EPT) taxa.

Like RHA, MCI-sb describes stream health by using a scoring system that assigns scores to each taxon based on their tolerance to pollution. Scores are summed to produce an overall score between 1 and 10. The community composition of taxa also provide an indication of stream health and water quality, particularly EPT taxa which are especially sensitive to the effects of land use changes and are generally found at lower densities in streams draining urban catchments.

Table 3 provides a summary of how MCI scores and percentage of EPT taxa can be interpreted to provide an indication of stream water quality within each catchment.

Table 3 Interpretation of MCI-sb scores and EPT taxa percentages (%)

MCI-sb scores	% EPT taxa	Quality class	Description
<80	<25	Poor	Probable severe pollution
80-99	25-50	Fair	Probable moderate pollution
100-120	51-70	Good	Doubtful quality/possible mild pollution
>120	>70	Excellent	Clean water

3.2.1.3 Physico-chemical Parameters Field Sampling Methodology

The physico-chemical properties of streams, such as dissolved oxygen (DO) and temperature, can provide an indication of potential stressors present within a waterway. These stressors can have direct or indirect effects which can negatively impact the biological and ecological health of a stream.

Four key physico-chemical parameters were measured and recorded in the field. This was undertaken at an upstream location at each of the 17 sampling site using a calibrated YSI Pro Plus hand-held multi-meter meter.

The parameters of interest included:

- Temperature (°C);
- pH;
- DO (concentration in mg/L); and
- Conductivity (µS/cm).

The ANZECC¹ (2000) water quality guidelines state that where regional trigger values exist these are to be given precedence over ANZECC (2000) thresholds. The National Policy Statement for Freshwater Management (NPSFM) (MfE 2014) provides required bottom lines for DO; however, it does not provide for trigger levels for pH, temperature or conductivity. As such, recorded DO levels were compared against NPSFM bottom lines, and pH, temperature and conductivity were compared against ANZECC (2000) trigger levels.

3.2.2 Water Quality Sampling Methodology

Stream water quality analysis can indicate potential sources of contamination within streams and provides further information on factors influencing the state of freshwater systems.

For the more stable parameters, instream water samples were collected from an upstream location at each sampling site using a 'Mighty Gripper'. Following collection, samples were chilled on ice and transported to Analytica Laboratories in Hamilton for laboratory analysis of the following parameters:

- Dissolved heavy metals (arsenic (As), beryllium (Be), boron (B), cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb), zinc (Zn)) (g/m³);
- Total heavy metals (As, Be, B, Cd, Cr, Cu, Ni, Pb, Zn) (g/m³);
- Total Petroleum Hydrocarbons (TPH) (g/m³);
- pH;
- Total Suspended Solids (TSS) (g/m³); and
- *E. coli* (colony forming units (cfu)/100ml) – outsourced to Shared Services Laboratory in Hamilton.

Where applicable, results were compared against:

- ANZECC (2000) trigger values for:
 - Ninety-five percent (95%) protection level for freshwater species and ecosystems; and
 - Recreational purposes.
- NPSFM (MfE 2014) water quality guidelines for human health for recreational purposes, including comparison against 'Orange' and 'Red' attribute states.

For accurate comparison against NPSFM guidelines (MfE 2014) *E. coli* should be analysed across multiple samples in order to capture 95th percentile and median values and provide reliable water quality information. However due to the nature of the surveys only one sample was obtained for analysis and comparison at each sample location for reporting purposes.

4.0 Results

4.1 Sampling Locations and Assumptions

There were three main waterways identified in both Te Puke and Maketu which were considered likely to receive the majority of runoff from the urban catchments (Table 4).

Sampled waterways in the Te Puke catchment consisted of three tributaries of the Kaituna River (Waiari, Raparapahoe and Ohineangaanga streams) and a network of unnamed farm canals (Stream 3 – Cannell Farm Drive waterway). It was noted that Raparapahoe Stream was located approximately 500m west of the catchment and is unlikely to receive urban runoff directly from the catchment; however, the stream is likely to receive runoff from the industrial area (refer to Section 2.2.1) and included in this study to obtain a better understanding of the potential water quality issues associated with the Te Puke settlement.

¹ the Australian and New Zealand Environment and Conservation Council (ANZECC) 2000 water quality guidelines
P:\605X\60548000\6. Draft Docs\6.1 Reports\Fresh Water Monitoring\Freshwater Eco and WQ Assessment_Final 29 March 18 (60548000-005b).docx
Revision B – 29-Mar-2018
Prepared for – Western Bay of Plenty District Council – Co No.: N/A

No waterways were found to be directly receiving stormwater from Paengaroa; however, Pokopoko stream is located approximately 1km east of the settlement and is the closest receiving environment to the catchment. As such, two sampling points were established in this stream.

Sampled waterways impacted by the Maketu settlement consisted of three unnamed spring-fed streams: Stream 1 – Little Waihi Road Stream, Stream 2 – Town Point Road Stream and Stream 3 – Nedwicks Beach Stream. Due to environmental conditions Site Ma 2B was not sampled for macroinvertebrates (refer to Section 4.2.2).

Similarly, there were no waterways traversing the Pukehina settlement; however, one receiving waterway was identified just south of the Pukehina catchment. This consisted of a farm canal running parallel to the southern boundary of the catchment (Stream 1 – Unnamed canal) and was used for the sampling sites in this study.

Upstream and downstream sample locations were identified and confirmed for each of the waterways. A reference site was also identified in Waiari Stream, a tributary of Kaituna River located to the east and upstream of potential inputs from the Te Puke settlement. It is worth noting that the Stream 2 – Town Point Road Stream in Maketu was relatively short in length and therefore the upstream sampling point was actually located approximately 500m from the receiving environment; this needs to be taken into account when comparing all upstream sampling points.

Overall, 17 sites were identified for sampling (including the reference site) across the Eastern Catchments; these are described in Table 4 and depicted in Appendix B.

Table 4 Summary of the 2018 sampling locations for waterways in WBOPDC Eastern Catchments

Catchment	Waterway	Site ID	NZTM Easting	NZTM northing
Te Puke	Waiari Stream	TP 4 (reference)	1894019	5812207
		TP 1A	1890272	5813890
	Raparapahoe Stream	TP 1B	1891309	5815011
		TP 2A	1891504	5811628
	Ohineangaanga Stream	TP 2B	1892093	5813234
		TP 3A	1893269	5811252
Paengaroa	Pokopoko Stream	TP 3B	1893749	5813174
		Pa 1A	1901698	5808095
Maketu	Stream 1 – Little Waihi Road Stream*	Pa 1B	1903063	5809311
		Ma 1A	1904995	5814404
	Stream 2 – Town Point Road Stream*	Ma 1B	1904138	5815188
		Ma 2A	1904951	5815938
	Stream 3 – Nedwicks Beach Stream*	Ma 2B	1904654	5815776
		Ma 3A	1905482	5815308
Pukehina	Stream 1 – unnamed canal (parallel to Pukehina Canal)*	Ma 3B	1905726	5816758
		Pu 1A	1910535	5811020
		Pu 1B	1908231	5813084
Notes: IDs 'A' are upstream sampling locations and IDs 'B' are downstream sampling locations. * These unnamed streams have been referenced based on Wildlands Te Puke (2006a) and Maketu (2006b) ecological assessments, and AECOM memo for Eastern Catchments bank assessment drone survey and environmental monitoring (2018).				

4.2 Freshwater Ecological Sampling Results

4.2.1 National Rapid Habitat Assessment (RHA) results

The 17 stream reaches sampled during field investigations scored RHA scores between 24 and 69. Streams in the Te Puke catchment were considered to be in 'Poor' to 'Good' condition. Sites classified as having 'Good' habitat value were located in Raparapahoe and Ohineangaanga streams (refer to Appendix B), with higher scores relating to increased hydraulic heterogeneity created by natural and artificial instream structures. The reference site in Waiari Stream, TP 4, scored lower than these sites; however, this was largely due to uniform hydraulic function and low quality riparian vegetation.

Pokopoko Stream sampled in Paengaroa was considered to have 'Moderate' to 'Poor' habitat value, with the downstream reach scoring lower than the upstream location. Sampled streams in Maketu were generally found to have 'Poor' to 'Moderate' habitat quality. One site in Stream 3 – Nedwicks Beach Stream, (Ma 3B) adjacent to Nedwicks Beach, received a rating of 'Good'. This was largely as a result of relatively intact riparian margin which included native shrubs and trees, as well as a small instream waterfall. Stream 1 – unnamed canal assessed in Pukehina has been heavily modified and has 'Poor' to 'Moderate' habitat value.

Overall, 78% of the stream habitats sampled at locations upstream of the urban catchments were considered to be in 'Moderate' condition, while 56% of downstream locations were considered to have 'Poor' habitat value.

A summary of RHA results is provided in Table 5; supporting photographs are provided in Appendix C.

Table 5 Summary of 2018 RHA results from WBOPDC Eastern Catchments

Waterway	Site ID	RHA Score	Overall habitat value	General comments
Waiari Stream	TP 4 (ref)	47	Moderate	Deep with moderate flow, excellent clarity. Poor riparian margin of long grass and weeds (<i>Rubus fruticosus</i> agg and <i>Salix fragilis</i>). Some bankside macrophytes. Redfin bully (<i>Gobiomorphus huttoni</i>), common bully (<i>G. cotidianus</i>) and common smelt (<i>Retropinna retropinna</i>) observed.
Raparapahoe Stream	TP 1A	58	Moderate	Moderate flow. Moderate riparian margin of mature exotic trees (<i>Populus</i> spp.), long grass and weeds (i.e. <i>Crocasmia x crocosmiiflora</i> and <i>Tradescantia fluminensis</i>), grass. Koura (<i>Paranephrops planifrons</i>) and common bully observed.
	TP 1B	64	Good	Large artificial cobbled area in downstream extent. Poor riparian margins of long grass and weed species (<i>C. x crocosmiiflora</i> , <i>R. fruticosus</i> agg and <i>S. fragilis</i>). Eel (<i>Anguilla</i> spp.) observed.
Ohineangaanga Stream	TP 2A	69	Good	Good instream habitat and heterogeneity. Riparian margin consisting mainly of weeds, long grass, some exotic vegetation (<i>Populus</i> spp.).
	TP 2B	62	Good	Artificial riffle areas. Moderate riparian margin of sedges, mature exotic trees (<i>S. babylonica</i>). Common bully observed.
Te Puke Stream 3 – Cannell Farm Drive waterway	TP 3A	47	Moderate	Small Spring fed stream. Moderate riparian margin ferns, long grass and mature exotic and native woody vegetation.

Waterway	Site ID	RHA Score	Overall habitat value	General comments
Stream 3 – Cannell Farm Drive waterway (continued)	TP 3B	24	Poor	Farm drain choked with macrophytes & algae. Riparian margin very poor, mainly consisting of grazed pasture. Mosquito fish and an eel observed.
Pokopoko Stream	Pa 1A	46	Moderate	Fast flowing, high turbidity. Poor riparian margin of long grass and weeds (i.e. <i>Persicaria maculosa</i> and <i>R. fruticosus agg.</i>).
	Pa 1B	28	Poor	Fast flowing, high turbidity. Deposited mounds of sand on banks suggest regular dredging. Poor riparian margin of long grass and some exotic shrubs.
Maketu Stream 1 – Little Waihi Road Stream	Ma 1A	48	Moderate	Possible intermittent flow. Very good riparian margin consisting of sedges (<i>Carex spp.</i>), weeds (<i>R. fruticosus agg.</i> and <i>Calystegia spp.</i>), and native shrubs and trees (<i>Melicytus ramiflorus</i> and <i>Coprosma spp.</i>). Some stock impact.
	Ma 1B	29	Poor	Artificially straightened stormwater. Poor riparian margin of ungrazed pasture, flax (<i>Phormium tenax</i>) and weeds (i.e. <i>Ulex europaeus</i> and <i>Ipomoea indica</i>). Mosquito fish observed.
Maketu Stream 2 – Town Point Road Stream	Ma 2A	29	Poor	Spring fed roadside channel. Upper reach heavily impacted by stock. Very poor riparian margin of grazed and long grass.
	Ma 2B	24	Poor	Artificially lined stormwater channel. Riparian margin very poor, consisting of mown and long grass weeds.
Maketu Stream 3 – Nedwicks Beach Stream	Ma 3A	43	Moderate	Small incised stream. Very good riparian margin consisting of sedges (<i>Carex spp.</i>), weeds (<i>R. fruticosus agg.</i> and <i>Calystegia spp.</i>), and native and exotic trees (<i>M. ramiflorus</i> and <i>Eucalyptus spp.</i>). Possible intermittent flow.
	Ma 3B	64	Good	Beachside stream, Good riparian margin of native trees and shrubs (i.e. <i>Metrosideros excelsa</i> and <i>Coprosma spp.</i>) with weedy understorey (i.e. <i>T. fluminensis</i>).
Pukehina Stream 1 – Unnamed canal	Pu 1A	42	Moderate	Farm drain. Poor riparian margin of long grass and weeds (i.e. <i>R. fruticosus agg.</i>). Low flow, macrophyte (<i>Persicaria maculosa</i>) encroachment. Raupo (<i>Typha orientalis</i>) growing in adjoining drain. Mosquito fish observed.
	Pu 1B	31	Poor	Farm drain, poor riparian margin of shrubs (<i>Coprosma spp.</i>), sedges (<i>Cyperus ustulatus</i>) and long grasses. Low flow with deep layer of sediment. Low flow, some areas stagnant. Possible saline influence. Mosquito fish observed.

4.2.2 Macroinvertebrate Sampling Results

Macroinvertebrate sampling was undertaken at 16 of the 17 identified sample sites. Site observations made during the site investigations indicated that stream flow present at site Ma 2B in Maketu Stream 2 – Town Point Road Stream was due only to rainfall which occurred the night prior to sampling. Due to the short timeframe elapsed between water being present in the downstream reach of the waterway and sampling, it was concluded that the period would be insufficient to allow for sufficient macroinvertebrate colonisation; subsequently, this site was excluded from analyses as it would not be representative of macroinvertebrate community presence.

Based on macroinvertebrate community results, waterways assessed in Te Puke were considered to be in 'Good' to 'Fair' condition (refer to Table 3). In general, downstream locations scored lower than upstream locations, both in terms of both MCI-sb scores and the percentage of EPT taxa. The exception was the downstream site in Raparapahoe Stream, TP 1B (refer to Appendix B), which scored higher than its upstream control site. This was considered to be due to a high number of the true fly taxa *Polypedilum* which has an MCI-sb score of 8, helping to increase the overall MCI-sb score. Community assemblages in the Te Puke catchment were largely composed of *Diptera* (true fly) and molluscs.

Maketu waterways were considered to be of 'Good' to 'Poor' quality, generally receiving an MCI-sb score lower than 100. Upstream sites were considered to be of better quality than downstream locations. Species of *Diptera* and *crustacea* which are tolerant of mild pollution dominated community composition.

The macroinvertebrate community sampled in the Pokopoko Stream at Paengaroa was considered to be in 'Good' to 'Poor' condition, with the downstream location being in poorer ecological condition than the upstream control. Community composition was dominated by *crustacea* at both up and downstream locations. These largely consisted of shrimps (*Paratya*) which are a pollution tolerant species.

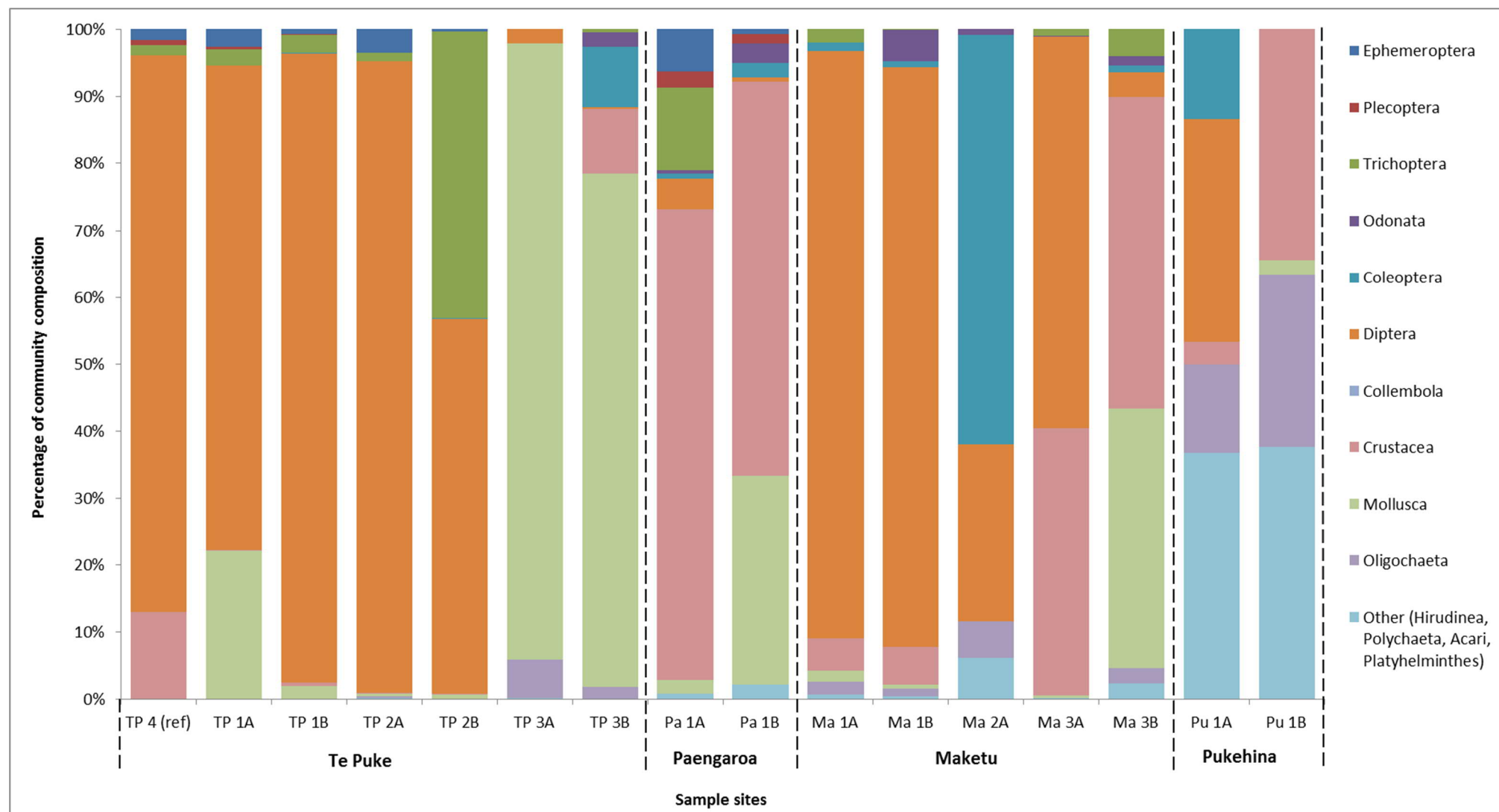
Stream 1 – unnamed canal sampled at Pukehina was considered to be in 'Fair' to 'Poor' condition. The sampled macroinvertebrate community was dominated by taxa within the 'Other' category, these largely consisted of *Hirudinea* (leeches) and *Polychaeta* (paddle worms), taxa which are highly tolerant of pollution. No EPT taxa were recorded at these sites.

Table 6 provides a summary of the MCI-sb scores and percentage of EPT taxa (by number of taxa) recorded at each site. Figure 1 describes the overall structure of macroinvertebrate communities sampled at each site.

Table 6 Summary of 2018 macroinvertebrate results from WBOPDC Eastern Catchments

Waterway	Site ID	MCI-sb score	MCI-sb quality class	% EPT taxa (by number)	% EPT quality class
Waiari Stream	TP 4 (ref)	114.6	Good	50.0	Fair
Raparapahoe Stream	TP 1A	114.3	Good	50.0	Fair
	TP 1B	116.5	Good	45.5	Fair
Ohineangaanga Stream	TP 2A	100.8	Good	40.9	Fair
	TP 2B	83.0	Fair	22.2	Poor
Te Puke Stream 3 – Cannell Farm Drive waterway	TP 3A	83.1	Fair	0	Poor
	TP 3B	40.5	Poor	9.1	Poor
Pokopoko Stream	Pa 1A	108.7	Good	47.4	Fair
	Pa 1B	86.5	Fair	16.7	Poor
Maketu Stream 1 – Little Waihi Road Stream	Ma 1A	113.7	Good	2.0	Poor
	Ma 1B	79.7	Poor	0.1	Poor

Waterway	Site ID	MCI-sb score	MCI-sb quality class	% EPT taxa (by number)	% EPT quality class
Maketu Stream 2 – Town Point Road Stream	Ma 2A	67.1	Poor	0	Poor
	Ma 2B	Not sampled for MCI and EPT taxa			
Maketu Stream 3 – Nedwicks Beach Stream	Ma 3A	98.2	Fair	1.0	Poor
	Ma 3B	95.0	Fair	4.1	Poor
Pukehina Stream 1 – unnamed canal	Pu 1A	77.0	Poor	0	Poor
	Pu 1B	93.7	Fair	0	Poor

Figure 1 Macroinvertebrate community composition (%) recorded in 2018 at sample sites in WBOPDC Eastern Catchments

4.2.3 Physico-chemical Parameter Field Sampling Results

All sites were found to have DO levels above the daily minimum threshold recommended by the NPSFM (MfE 2014); however, most sites in Te Puke and Pukehina were outside ANZECC (2000) trigger levels for pH in lowland streams. Five sites in the Te Puke catchment were found to be mildly acidic, while both sites sampled in Pukehina were found to be slightly alkaline. Water temperatures at Pukehina were also above ANZECC (2000) trigger levels.

Fifty-nine percent of sites recorded conductivity levels which were outside recommended ANZECC (2000) thresholds for lowland streams; particularly the Pukehina downstream site which had an extremely high reading (refer to Table 7), suggesting saline influences from the adjacent estuary.

All but the downstream location in Te Puke Stream 3 – Cannell Farm Drive waterway, and Streams 1 and 2 in Maketu (refer to Appendix B) had physico-chemical characteristics which were above or outside recommended guidelines. This would suggest that aspects of the surrounding catchments are negatively influencing instream health and may be having and adverse effects on instream species composition and abundance.

Table 7 provides a summary of the physico-chemical measurements obtained during sampling at Eastern Catchment locations.

Table 7 Summary of 2018 physico-chemical parameters field sampling results in WBOPDC Eastern Catchments

Waterway	Stream ID	Temperature (°C)	Dissolved oxygen (mg/L)	pH	Conductivity (µS/cm)
Waiari Stream	TP 4 (ref)	14.9	10.8	6.5	58.9
Raparapahoe Stream	TP 1A	18.0	9.1	6.5	63.5
	TP 1B	18.3	8.9	6.9	65.3
Ohineangaanga Stream	TP 2A	16.9	9.8	7.0	80.2
	TP 2B	17.8	9.3	6.4	85.5
Te Puke Stream 3 – Cannell Farm Drive waterway	TP 3A	17.1	7.8	6.2	115.6
	TP 3B	20.6	8.9	7.3	125.7
Pokopoko Stream	Pa 1A	17.2	9.3	7.0	100.7
	Pa 1B	21.1	8.8	7.2	120.4
Maketu Stream 1 – Little Waihi Road Stream	Ma 1A	17.1	8.5	7.2	307.8
	Ma 1B	19.6	4.7	7.3	230.1
Maketu Stream 2 – Town Point Road Stream	Ma 2A	19.8	5.1	6.9	315.0
	Ma 2B	20.9	4.3	7.5	80.9
Maketu Stream 3 – Nedwicks Beach Stream	Ma 3A	18.0	6.75	7.5	470.3
	Ma 3B	19.6	8.7	7.6	307.0
Pukehina Stream 1 – unnamed canal	Pu 1A	24.4	10.2	8.3	479.0
	Pu 1B	26.6	8.1	8.3	3,659.1
ANZECC trigger levels*		21.5	-	7.2 – 7.8	125 – 2,200*
NPSFM bottom lines		-	4.0**	-	-
* ANZECC (2000) trigger levels are for lowland streams in New Zealand; except conductivity for which NZ trigger values are not currently available. As recommended, the south-east Australian value for lowland rivers was used as an interim trigger level. ** The lowest daily minimum across the whole summer period (1 November to 30 April). Bold denotes results which exceed or are outside of ANZECC (2000) trigger levels. All results for DO were above the NPSFM (MfE 2014) bottom line.					

4.3 Water Quality Sampling Results

The level of heavy metals detected at each sample location were generally found to be lower than ANZECC (2000) thresholds for 95% protection of freshwater species and trigger levels for recreational purposes; however, a small number of sites were found to have elevated levels of boron, chromium, copper and zinc. Details of these exceedances are summarised in Table 8 and described below.

Heavy metal exceedances included:

- Levels of dissolved (2.39g/m^3) and total (2.57g/m^3) boron recorded at the downstream sample site in Pukehina Stream 1 – unnamed canal (Pu 1B) were well above ANZECC (2000) trigger levels for species protection and recreational purposes. This could potentially be linked to marine influence, given the proximity of the site to the Waihi Estuary;
- Levels of total chromium (0.0076g/m^3) recorded upstream in Stream 2 – Town Point Road Stream at Maketu (Ma 2A) was above trigger levels for species protection;
- All Maketu downstream sites (Ma 1B, Ma 2B and Ma 3B) and Ma 2A (Stream 2 – Town Point Road Stream) at Maketu had dissolved and total copper levels ($\geq 0.0014\text{g/m}^3$) that were at or above 95% trigger levels for species protection; and
- Two downstream sites in Maketu in streams 1 and 2 (Ma 1B and Ma 2B) recorded zinc levels at or slightly above the 95% trigger levels for species protection (0.008g/m^3).

pH measures at all sample sites were within recommended ANZECC (2000) thresholds for recreational purposes. There are no trigger levels for TPH or TSS; however, measures for these parameters were relatively low at all sites. All recorded levels of TPH were below 0.5g/m^3 , (laboratory reporting limit) while TSS at all sites ranged between less than 3g/m^3 and 101g/m^3 . Sample sites within the Te Puke catchment had the lowest recorded TSS levels ($<3\text{g/m}^3$) and sites in Pukehina and Maketu had the highest TSS concentrations.

Generally where exceedances of chemical concentrations have been recorded, these were marginally higher than trigger levels. These were localised mainly in Maketu and Pukehina catchments. It is recommended that further sampling be undertaken at eastern catchments, and particularly in those two catchments as priority.

E. coli counts at all downstream sites were notably higher than at their upstream control locations, at minimum doubling in most instances. The Te Puke reference site (TP 4) had the lowest count with just 88cfu per 100ml, while Ma 1B had the highest with 8,664 *E. coli* per 100ml; over 33 times the recommended limit. Seventy-one percent (71%) of sampled sites had measures of *E. coli* that were above the threshold levels for the 'Red' attribute state ($>260\text{cfu per 100 ml}$) for human health for recreation (MfE 2014), predicting that the average Campylobacter infection risk to swimmers is above 7%. This included four sites in the Te Puke catchment, two in Paengaroa, five in the Maketu catchment and one in Pukehina. Ninety-four percent (94%) of sites were above MfE (2014) threshold levels for the 'Orange' attribute state ($>130\text{cfu per 100ml}$), predicting the average infection risk to swimmers is at between 3% and 7%. Only the reference site in Waiari Stream (TP 4) measured below these values at 88cfu per 100ml.

Results for *E. coli* provide a current indication as a snapshot of potential effects from waste water contamination and/or effects from landuse, in particular in relation to agricultural/cattle grazing activities. These results would need further sampling rounds throughout the year(s) at various seasons to be able to fully assess any potential effects on the receiving environment and public health. Where sites are used for recreational purposes (in particular Maketu and Pukehina downstream locations, and potential streams within Te Puke/Paengaroa used for swimming), further sampling is recommended and prioritised at these locations.

Correlation of groundwater and surface water levels as well as analysis for *E. coli* and nutrients in groundwater bores and surface water/freshwater samples could provide an indication of whether high levels of *E. coli* are likely due to agricultural landuse, wastewater contamination (septic tanks leakage) or a cumulative effect.

In addition, further water sampling is recommended at various time of the year and potentially targeted with any cropping seasons.

Table 8 Summary of 2018 water quality from laboratory parameter sampling results in WBOPDC Eastern Catchments

Catchment	Site ID	Dissolved heavy metals (g/m ³)									Total heavy metals (g/m ³)									Total Petroleum Hydrocarbons (g/m ³)	pH	Total Suspended Solids (g/m ³)	E. coli
		As	Be	B	Cd	Cr	Cu	Ni	Pb	Zn	As	Be	B	Cd	Cr	Cu	Ni	Pb	Zn				
Waiari Stream	TP 4 (ref)	<0.0005	<0.00001	0.0059	<0.00001	<0.0002	<0.0002	<0.0002	<0.00005	<0.001	<0.0005	0.00003	0.007	0.00001	<0.0002	<0.0002	<0.0002	<0.00005	0.001	<0.5	7.3	<3	88
Raparapahoe Stream	TP 1A	<0.0005	<0.00001	0.0068	<0.00001	<0.0002	0.0003	<0.0002	<0.00005	<0.001	<0.0005	0.00002	0.008	<0.00001	<0.0002	<0.0002	<0.0002	<0.00005	<0.001	<0.5	7.1	<3	166
	TP 1B	<0.0005	<0.00001	0.007	0.0001	<0.0002	0.0002	<0.0002	0.00005	<0.001	<0.0005	0.00001	0.008	0.00001	<0.0002	<0.0002	<0.0002	<0.00005	<0.001	<0.5	7.2	<3	411
Ohineangaanga Stream	TP 2A	<0.0005	<0.00001	<0.005	0.0001	<0.0002	<0.0002	<0.0002	<0.00005	0.0011	<0.0005	0.00003	0.014	0.00002	<0.0002	0.0004	<0.0002	0.00029	0.005	<0.5	7.1	<3	144
	TP 2B	<0.0005	<0.00001	0.012	0.0001	<0.0002	0.0002	<0.0002	<0.00005	0.0029	<0.0005	0.00002	0.013	0.00001	<0.0002	<0.0002	<0.0002	<0.00005	0.003	<0.5	7.0	<3	579
Te Puke Stream 3 – Cannell Farm Drive waterway	TP 3A	<0.0005	0.00003	0.01	0.0003	<0.0002	<0.0002	<0.0002	<0.00005	0.0027	<0.0005	0.00005	0.011	0.00002	<0.0002	<0.0002	<0.0002	<0.00005	0.002	<0.5	6.8	<3	1,046
	TP 3B	0.0005	<0.00001	0.015	<0.00001	<0.0002	0.0007	<0.0002	0.00006	0.001	0.0006	<0.00001	0.016	0.00001	<0.0002	0.0004	0.0006	0.00007	0.005	<0.5	7.6	<3	>2,420
Pokopoko Stream	Pa 1A	0.0014	<0.00001	0.041	0.0001	<0.0002	<0.0002	<0.0002	<0.0005	<0.001	0.0024	0.00002	0.044	0.00001	<0.0002	0.0002	<0.0002	0.00014	0.001	<0.5	7.5	21	488
	Pa 1B	0.0016	<0.00001	0.035	0.0002	<0.0002	<0.0002	<0.0002	<0.0005	0.0014	0.0039	0.00002	0.068	<0.00001	<0.0002	0.0003	0.0003	0.00007	0.003	<0.5	7.4	30	921
Maketu Stream 1 – Little Waihi Road Stream	Ma 1A	<0.0005	<0.00001	0.013	0.00001	<0.0002	0.0005	<0.0002	<0.00005	<0.001	<0.0005	0.00001	0.015	<0.00001	<0.0002	0.0003	<0.0002	0.00012	0.001	<0.5	7.4	101	214
	Ma 1B	0.0011	0.00001	0.031	0.00002	<0.0002	0.0018	0.0003	0.0001	0.0039	0.0016	0.00004	0.034	0.00003	0.00037	0.0023	0.0003	0.00099	0.009	<0.5	7.0	11	8,664
Maketu Stream 2 – Town Point Road Stream	Ma 2A	0.0015	<0.00001	0.027	0.00003	0.0005	0.0022	<0.0002	<0.00005	0.002	0.0052	0.00002	0.031	0.00001	0.0076	0.0189	<0.0002	0.00022	0.005	<0.5	6.9	21	677
	Ma 2B	0.0011	<0.00001	0.01	<0.00001	0.0003	0.0014	<0.0002	0.00008	0.0044	0.0011	0.00002	0.012	0.00002	0.00038	0.0017	<0.0002	0.0006	0.008	<0.5	7.2	3	4,352
Maketu Stream 3 – Nedwicks Beach Stream	Ma 3A	<0.0005	<0.00001	0.016	0.00001	<0.0002	0.0005	<0.0002	<0.00005	0.0014	<0.0005	0.00002	0.019	<0.00001	<0.0002	0.0013	<0.0002	0.00015	0.005	<0.5	7.7	28	488
	Ma 3B	0.0007	<0.00001	0.024	0.00001	<0.0002	0.0027	<0.0002	0.00007	0.002	0.0009	0.00005	0.026	0.00002	0.00025	0.0034	<0.0002	0.00083	0.007	<0.5	7.7	39	5,172
Pukehina Stream 1 – unnamed canal	Pu 1A	0.0021	0.00006	0.068	0.0007	<0.0002	0.0003	0.0003	0.0008	<0.001	0.0032	0.00002	0.07	<0.00001	<0.0002	0.0002	0.0002	<0.00005	0.002	<0.5	7.8	70	138
	Pu 1B	<0.0050	<0.0001	2.39	<0.0001	<0.002	<0.002	<0.002	<0.0005	<0.01	<0.005	<0.0001	2.57	<0.0001	<0.002	<0.002	<0.002	<0.0005	<0.01	<0.5	7.9	58	>2,420
Laboratory reporting limit		0.005	0.00001	0.005	0.00001	0.0002	0.0002	0.0002	0.00005	0.001	0.005	0.00001	0.005	0.00001	0.0002	0.0002	0.0002	0.00005	0.001	0.5	1	3	1 cfu per 100ml
ANZECC (2000) trigger levels for freshwater species protection (95%)		0.024	-	0.37 *	0.0002	0.001	0.0014	0.011	0.0034	0.008	0.024	-	0.37 *	0.0002	0.001	0.0014	0.011	0.0034	0.008	-	-	-	-
ANZECC (2000) trigger levels for recreational purposes		0.05	-	1	0.005	0.05	1.0	0.1	0.05	5.0	0.05	-	1	0.005	0.05	1.0	0.1	0.05	5.0	-	6.5 – 8.5	-	-
NPSFM (MfE 2014) threshold level for the E. coli ‘Orange’ attribute state for human health for recreation		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	>130 cfu per 100ml **
NPSFM (MfE 2014) threshold level for the E. coli ‘Red’ attribute state for human health for recreation		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	>260 cfu per 100ml ***

* Figure may not protect key test species from chronic toxicity.
** 20-30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average Campylobacter infection risk to swimmers is >3% based on random exposure on a random day.
*** For more than 30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average Campylobacter infection risk to swimmers is >7%based on random exposure on a random day. Also MfE (2003) guidelines for recreational purposes and above the level of ‘no calculated level of risk’.
Bold denotes results which are at or above ANZECC (2000) trigger levels or the NPSFM (MfE 2014) threshold level for the ‘Red’ attribute state for human health for recreation. **Orange bold** denotes results which are above the threshold level for the ‘Red’ attribute state for human health for recreation.

5.0 Conclusion

Results from this Freshwater Ecological and Water Quality Assessment undertaken in 2018 indicate that the waterways included in investigations are generally considered to be in 'Moderate' to 'Poor' condition. This would suggest that most, if not all, urban waterways within Eastern Catchments in Western Bay of Plenty have been negatively influenced in some way by land use intensification in the district. It is recommended that these freshwater ecological and water quality monitoring results be assessed in correlation with the results of the bank erosion survey conducted by WBOPDC early 2018.

Site TP 4 located in Waiari Stream is isolated from the urban settlement in Te Puke and was used as a reference site for these investigations; particularly in regards to the Te Puke settlement. Although some parameters measured at this site were outside of recommended trigger levels, TP 4 was found to have the lowest recorded levels of *E. coli*, the lowest instream temperature and highest instream DO, amongst the lowest results for heavy metal concentrations, TSS and TPH, and amongst the highest for total macroinvertebrate community MCI-sb score and percentage EPT taxa. These characteristics suggest that this location would provide a sufficient baseline from which streams impacted by urban land uses within the Eastern Catchments could be compared.

Overall, the average RHA scores and low percentage EPT taxa recorded at upstream sites indicate that all the waterways assessed in the Eastern Catchments have been impacted by land uses in the wider landscape outside of urban areas. RHA scores below 70 (out of 100) and macroinvertebrate communities dominated by pollution tolerant species of *Diptera*, *Mollusca* and *Crustacea* indicate adverse impacts as a result of loss or disturbance of riparian margins and non-urban contaminant inputs. The ecological health observed at sample locations downstream of the urban catchments was generally found to be more degraded than the upstream control within the same waterway. In instances where recorded heavy metal concentration and *E. coli* levels exceeded water quality recommendations, these were generally higher at downstream locations; particularly in regards to *E. coli* counts.

Streams in Te Puke were generally considered to be in the best condition of all surveyed waterways, despite exhibiting pH and conductivity levels outside the ANZECC (2000) recommendations. Streams in this catchment generally had 'Moderate' to 'Good' instream habitat and were of 'Fair' to 'Good' stream quality; indicating mild to moderate pollution levels.

Streams within the Maketu catchment were generally considered to be in the worst ecological condition with generally 'Poor' to 'Moderate' instream habitat and suffering from mild to severe pollution. With the exception of sample site Pu 1B in Stream 1 – unnamed canal at Pukehina, sampled waterways in Maketu were the only waterways to record elevated heavy metals levels above ANZECC (2000) guidelines. Physico-chemical parameters were generally below recommended trigger levels, with the exception of pH and conductivity levels at Ma 2A and Ma 2B.

The condition of the receiving environment of Pukehina was considered to be in similar condition to sampled waterways in Maketu, with MCI scores indicating 'Poor' to 'Fair' ecological condition and physico-chemical parameters that exceeded ANZECC (2000) trigger levels. The ecological condition of Pokopoko Stream, Paengaroa was slightly better, with MCI scores indicating stream health was 'Fair' to 'Good'. Water quality results were below recommended trigger levels, except for conductivity levels which exceeded ANZECC (2000) recommendations.

All sample sites except TP 4 in Waiari Stream recorded *E. coli* levels which were above threshold levels for the 'Orange' attribute state. Twelve were above threshold levels for the 'Red' attribute state.

This water quality sampling snapshot in the eastern catchments does not allow for a full assessment of potential effects on the receiving environment, however provides an idea on what further sampling is recommended and where to prioritize it (coastal settlements). Table 9 provides a summary of the key results obtained during sampling in WBOPDC Eastern Catchments during sampling in January and February 2018. Generally where exceedances of chemical concentrations have been recorded, these were marginally higher than trigger levels. These were localised mainly in Maketu and Pukehina catchments. Recommendations for further sampling are provided in section 6.0.

Table 9 Summary of the ecological and water quality results obtained during 2018 sampling

Parameters of interests		Biological		Physico-chemical	Water quality		
Trigger level source		RHA score	MCI-sb score & % EPT taxa	NPSFM (2014) & ANZECC (2000)	ANZECC (2000)	NPSFM (2014)	
Waterway	Site ID	Habitat value	Stream health	Below triggers	Heavy metals below triggers	<i>E. coli</i> below 'Orange' state	<i>E. coli</i> below 'Red' state
Waiari Stream	TP 4 (ref)	MODERATE	FAIR-GOOD	✗	✓	✓	✓
Raparapahoe Stream	TP 1A	MODERATE	FAIR-GOOD	✗	✓	✗	✓
	TP 1B	GOOD	FAIR-GOOD	✗	✓	✗	✗
Ohineangaanga Stream	TP 2A	GOOD	FAIR-GOOD	✓	✓	✗	✓
	TP 2B	GOOD	POOR-FAIR	✗	✓	✗	✗
Te Puke Stream 3 – Cannell Farm Drive waterway	TP 3A	MODERATE	POOR-FAIR	✗	✓	✗	✗
	TP 3B	POOR	POOR	✓	✓	✗	✗
Pokopoko Stream	Pa 1A	MODERATE	FAIR-GOOD	✗	✓	✗	✗
	Pa 1B	POOR	POOR-FAIR	✗	✓	✗	✗
Maketu Stream 1 – Little Waihi Road Stream	Ma 1A	MODERATE	POOR-GOOD	✓	✓	✗	✓
	Ma 1B	POOR	POOR	✓	✓	✗	✗
Maketu Stream 2 – Town Point Road Stream	Ma 2A	POOR	POOR	✗	✗	✗	✗
	Ma 2B	POOR	n/a	✗	✗	✗	✗
Maketu Stream 3 – Nedwicks Beach Stream	Ma 3A	MODERATE	POOR-FAIR	✓	✓	✗	✗
	Ma 3B	GOOD	POOR-FAIR	✓	✗	✗	✗
Pukehina Stream 1 – unnamed canal	Pu 1A	MODERATE	POOR	✗	✓	✗	✓
	Pu 1B	POOR	POOR-FAIR	✗	✗	✗	✗
Key: ✓ Recorded levels are below water quality guidelines ✗ Recorded levels are above water quality guidelines							

6.0 Recommendations

In order to improve overall outcomes in receiving environments and ensure regional policy objectives for improving water quality in the district are met, it is recommended that measures are taken to further manage urban stormwater runoff in the Eastern Catchments. Such measures may include, but are not limited to:

- Implement quality monitoring programs within all Eastern Catchments to understand seasonal differences i.e. repeat sampling rounds throughout the year to increase understanding of the water quality issues and assess any potential impact on the receiving environment and public health.
- Undertake water quality sampling at sites used for recreational purposes within Maketu and Pukehina in accordance with BOPRC monitoring programmes, parameters and sites. This will allow for public health risk assessment.
- Carry out groundwater and water quality analysis for nutrients and *E. coli* at Maketu and Pukehina to assess whether stormwater management issues are likely due to surrounding landuse, wastewater contamination or a cumulative effect.
- Undertake stormwater discharge sampling, if feasible, at locations where water quality guidelines were exceeded, particularly in relation to elevated heavy metal levels and *E. coli*. Feasibility will depend on asset locations.
- Enhancement and widening of riparian margins as required and where practicable, particularly in areas zoned for future urban development.
- Implement stormwater management strategies to improve catchment-wide water quality, placing priority in Maketu and Pukehina where ecological and water quality scored the poorest results.
- Create community initiatives to encourage local land owners to fence off streams from cattle and protect existing riparian margins.
- Compare results of this 2018 Freshwater Assessment Report with results obtained during the Bank Erosion Drone Survey (Western Bay of Plenty District Council 2018) to prioritise environmental and social actions to be implemented in order to mitigate any potential impacts on the receiving environment.
- Ensure measures to protect riparian margins are implemented in current green field areas where urban growth and subdivision is expected to minimise further impacts on neighbouring waterways.

Identify any potential site specific actions that would improve discharges to streams and plan for implementation (e.g. stormwater management for quality and quantity).

7.0 References

- AECOM 2018. Memorandum: Proposed drone survey locations and ecological/water quality monitoring locations at Eastern Catchments. 60548000M003b. Dated 11 January 2018.
- AECOM 2015. Te Puke Waste Water Treatment Plan – AEE Assessment. Water Quality, Stream and Terrestrial Ecology Assessment 60435436R001b. Dated 16 October 2015.
- ANZECC 2000. Australian and New Zealand guidelines for fresh and marine water quality: Volume 1. Canberra, Australian and New Zealand Environment and Conservation Council.
- Bay of Plenty Regional Council 2005. Stormwater Strategy for the Bay of Plenty Region. Environmental Publication 2005/20. Whakatane, Bay of Plenty Regional Council.
- Bay of Plenty Regional Council 2011. Regional Coastal Environment Plan. Environmental Publication 2003/08. Volume 1, updated 22 February 2011. Whakatane, Bay of Plenty Regional Council.
- Clapcott JE 2013. Rapid habitat assessment workshop. Prepared for Hawkes Bay Regional Council. Cawthron Report No. 2445. Nelson, Cawthron Institute.
- Clapcott J 2015. National rapid habitat assessment protocol development for streams and rivers. Cawthron Report No. 2649. Prepared for Northland Regional Council. Nelson, Cawthron Institute.
- Goodman J, Dunn NR, Ravenscroft PJ, Allibone RM, Boubee JAT, David BO, Griffiths M, Ling N, Hitchmough RA, Rolfe JR 2013. Conservation status of New Zealand freshwater fish, 2013. Wellington, Department of Conservation.
- Harding J, Clapcott J, Quinn J, Hayed J, Joy M, Storey R, Greig H, Hay J, James T, Beech M, Ozane R, Meredith A, Boothroyd I 2009. Stream Habitat Assessment Protocols for wadeable rivers and streams in New Zealand. University of Canterbury, School of Biological Sciences.
- McEwen WM 1987. Ecological regions and districts of New Zealand. New Zealand Biological Resources Centre Publication, 5, Part 2. Wellington, Department of Conservation.
- MfE [Ministry for the Environment] 2003. Microbiological water quality guidelines for marine and freshwater recreational areas. Wellington, New Zealand Government.
- MfE [Ministry for the Environment] 2014. National Policy Statement for Freshwater Management 2014 (Updated August 2017 to incorporate amendments from the National Policy Statement for Freshwater Amendment Order 2017). Wellington, New Zealand Government.
- NIWA 2016. The New Zealand Freshwater Fish Database. Retrieved from: <https://www.niwa.co.nz/our-services/online-services/freshwater-fish-database>.
- Ramsar Convention Secretariat 2013. The Ramsar Convention Manual: a guide to the Convention on Wetlands (Ramsar, Iran, 1971), 6th ed. Switzerland: Ramsar Convention Secretariat.
- Stark JD 1985. A Macroinvertebrate Community Index of Water Quality for Stony Streams. Water & Soil Miscellaneous Publications, 87, 1-53.
- Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR 2001. Protocols for sampling macroinvertebrates in wadeable streams (New Zealand Macroinvertebrate Working Group Report No. 1). Prepared for the Ministry for the Environment: Sustainable Management Fund Project No. 5103. Wellington, Ministry for the Environment.
- Stark JD, Maxted JR 2007. A biotic index for New Zealand's soft bottom streams. New Zealand Journal of Marine and Freshwater Research, 41, 43-61.
- Western Bay of Plenty District Council 2014. MAPI: WBOPDC web mapping. Retrieved from: <http://map.westernbay.govt.nz/Html/>.
- Western Bay of Plenty District Council 2018. Eastern Catchment stream bank erosion drone survey. Tauranga, WBOPDC.

Wildlands Consultants Limited 2005a. Ecological Assessment of Stormwater Management at Pukehina, Western Bay of Plenty District. Report prepared for Duffill Watts and Kings Limited, Contract Report No. 1081. Tauranga, Wildlands Consultants Limited.

Wildlands Consultants Limited 2005b. Ecological Assessment of Stormwater Management at Paengaroa, Western Bay of Plenty District. Report prepared for Duffill Watts and Kings Limited, Contract Report No. 1082. Tauranga, Wildlands Consultants Limited.

Wildlands Consultants Limited 2006a. Ecological Assessment of Stormwater Management at Te Puke. Report prepared for Duffill Watts and Kings Limited, Contract Report No. 1316. Tauranga, Wildlands Consultants Limited.

Wildlands Consultants Limited 2006b. Ecological Assessment of Stormwater Management at Maketu and Little Waihi. Report prepared for Duffill Watts and Kings Limited, Contract Report No. 1317. Tauranga, Wildlands Consultants Limited.

8.0 Standard Limitation

AECOM has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of WBOPDC, and only those third parties who have been authorised in writing by AECOM to rely on this report.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

It is prepared in accordance with the scope of work and for the purpose outlined in the Eastern Area Contract variation dated 20 December 2017.

Where this report indicates that information has been provided to AECOM by third parties (in particular for taxa / MCI counts and laboratory analyses), AECOM has made no independent verification of this information except as expressly stated in the report. AECOM assumes no liability for any inaccuracies in or omissions to that information.

This report was prepared between 23 January and 29 March 2018 and is based on the conditions encountered during the January 2018 field work and information reviewed at the time of preparation. AECOM disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Except as required by law, no third party may use or rely on this report unless otherwise agreed by AECOM in writing. Where such agreement is provided, AECOM will provide a letter of reliance to the agreed third party in the form required by AECOM.

To the extent permitted by law, AECOM expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this report. AECOM does not admit that any action, liability or claim may exist or be available to any third party.

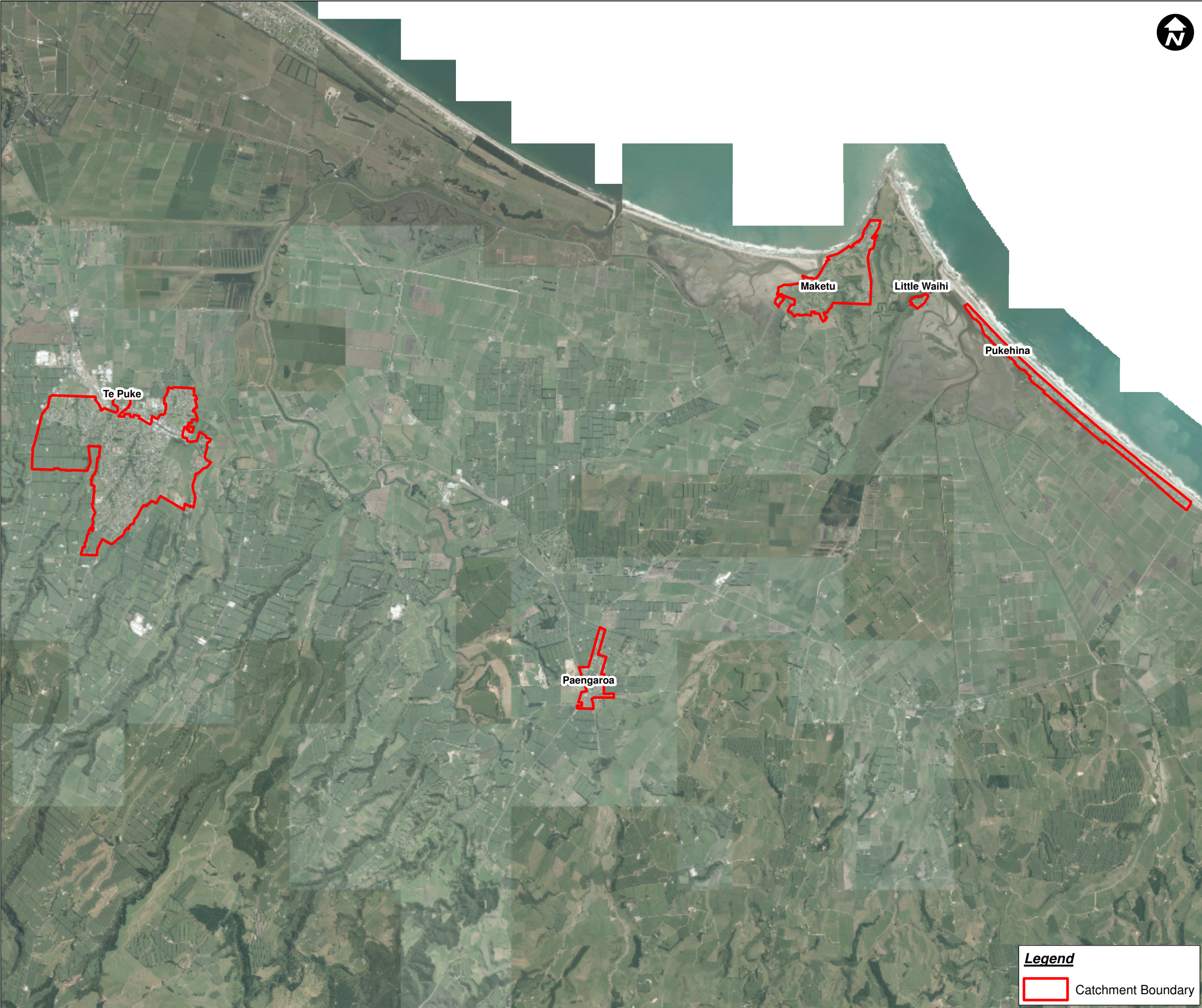
Except as specifically stated in this section, AECOM does not authorise the use of this report by any third party.

It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the site.

Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

Appendix A

Figure A - Eastern
Catchments Project
Area



AECOM

PROJECT

WBOPDC EASTERN
CATCHMENTS

CLIENT



CONSULTANT

AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:62,500 (A3 size)
650 325 0 650 1,300 1,950 2,600
m

Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

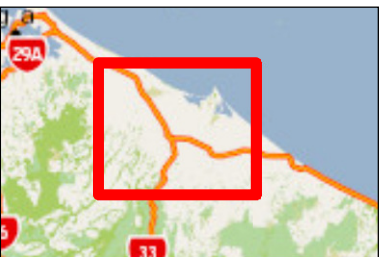
PROJECT MANAGEMENT

Approved	CS	Date	29/03/2018
Checked	AC	Date	29/03/2018
Designed	SS	Date	29/03/2018
Drawn	SS	Date	29/03/2018

ISSUE/REVISION

A	29/03/2018	FINAL
Rev	Date	Description

KEY PLAN



PROJECT NUMBER

60548000

SHEET TITLE

EASTERN CATCHMENT LOCATIONS
OVERVIEW MAP

MAP NUMBER

FIGURE A

Legend

 Catchment Boundary

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.

Appendix B

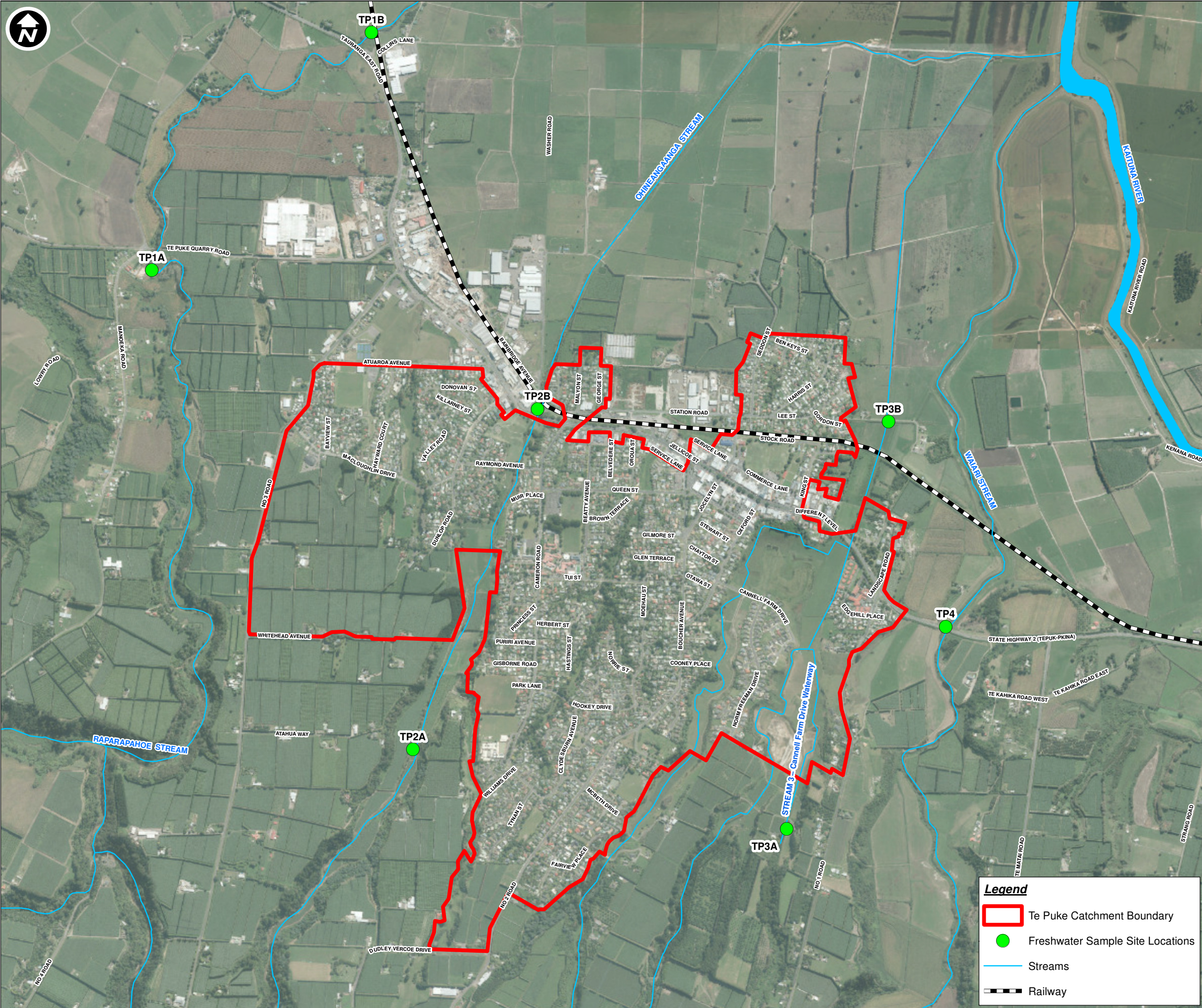
2018 Freshwater Sampling Locations

Figure B-1 – Te Puke Freshwater Sampling Locations

Figure B-2 – Paengaroa Freshwater Sampling Locations

Figure B-3 – Maketu/Little Waihi Freshwater Sampling Locations

Figure B-4 – Pukehina Freshwater Sampling Locations



AECOM

PROJECT

WBOPDC EASTERN
CATCHMENTS

CLIENT



CONSULTANT

AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:17,000 (A3 size)
180 90 0 180 360 540 720 m

Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

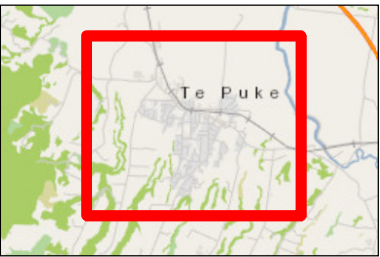
PROJECT MANAGEMENT

Approved	CS	Date	29/03/2018
Checked	AC	Date	29/03/2018
Designed	SS	Date	29/03/2018
Drawn	SS	Date	29/03/2018

ISSUE/REVISION

A	29/03/2018	FINAL	
Rev	Date	Description	

KEY PLAN



PROJECT NUMBER

60548000

SHEET TITLE

TE PUKE CATCHMENT
SAMPLE LOCATIONS

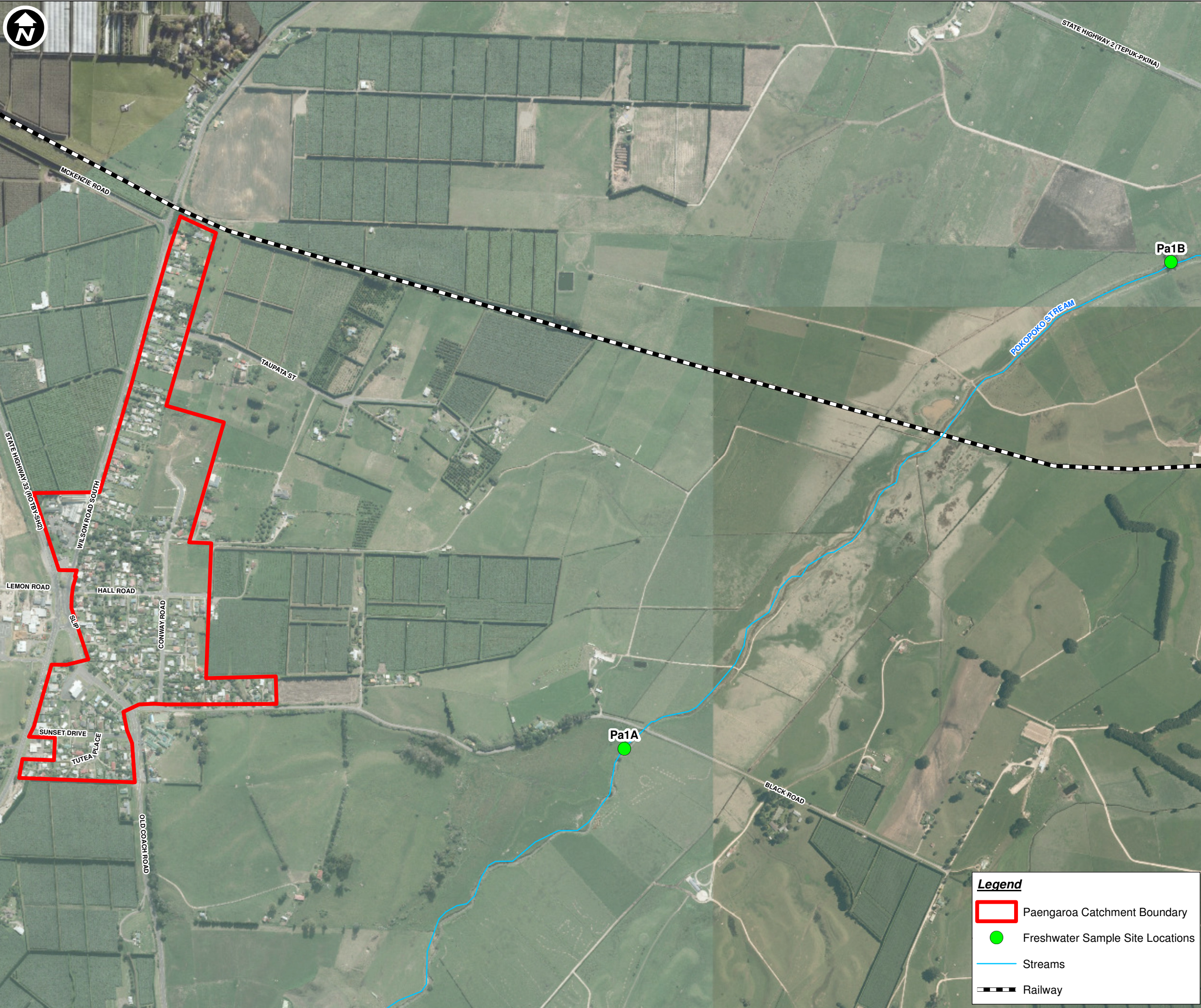
MAP NUMBER

FIGURE B-1

Legend

- Te Puke Catchment Boundary
- Freshwater Sample Site Locations
- Streams
- Railway

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



Legend

- Paengaroa Catchment Boundary
- Freshwater Sample Site Locations
- Streams
- Railway



PROJECT

WBOPDC EASTERN
CATCHMENTS

CLIENT



CONSULTANT

AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:9,000 (A3 size)
90 45 0 90 180 270 360
m

Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

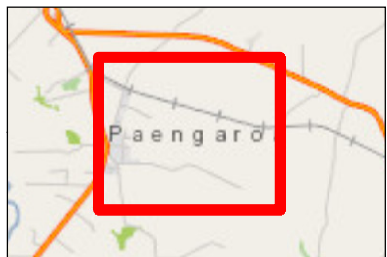
PROJECT MANAGEMENT

Approved	CS	Date	29/03/2018
Checked	AC	Date	29/03/2018
Designed	SS	Date	29/03/2018
Drawn	SS	Date	29/03/2018

ISSUE/REVISION

A	29/03/2018	FINAL
Rev	Date	Description

KEY PLAN



PROJECT NUMBER

60548000

SHEET TITLE

PAENGAROA CATCHMENT
SAMPLE LOCATIONS

MAP NUMBER

FIGURE B-2

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



AECOM

PROJECT

WBOPDC EASTERN
CATCHMENTS

CLIENT



CONSULTANT

AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:9,000 (A3 size)
90 45 0 90 180 270 360
Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT

Approved	CS	Date	29/03/2018
Checked	AC	Date	29/03/2018
Designed	SS	Date	29/03/2018
Drawn	SS	Date	29/03/2018

ISSUE/REVISION

A	29/03/2018	FINAL	
Rev	Date	Description	

KEY PLAN



PROJECT NUMBER

60548000

SHEET TITLE

MAKETU/LITTLE WAIHI
CATCHMENT SAMPLE LOCATIONS

MAP NUMBER

FIGURE B-3

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.



Legend

Pukehina Catchment Boundary

Freshwater Sample Site Locations

Streams



AECOM

PROJECT

WBOPDC EASTERN
CATCHMENTS

CLIENT



CONSULTANT

AECOM New Zealand Limited
www.aecom.com

SPATIAL REFERENCE

Scale: 1:15,500 (A3 size)
160 80 0 160 320 480 640 m

Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2018

PROJECT MANAGEMENT

Approved	CS	Date	29/03/2018
Checked	AC	Date	29/03/2018
Designed	SS	Date	29/03/2018
Drawn	SS	Date	29/03/2018

ISSUE/REVISION

A	29/03/2018	FINAL
Rev	Date	Description

KEY PLAN



PROJECT NUMBER

60548000

SHEET TITLE

PUKEHINA CATCHMENT
SAMPLE LOCATIONS

MAP NUMBER

FIGURE B-4

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.

Appendix C

2018 Freshwater
Sampling Site
Photographs

Appendix C 2018 Freshwater Sampling Site Photographs

Te Puke sample locations



Waiari Stream TP 4 (reference site)



Raparapahoe Stream TP 1A (upstream)

Raparapahoe Stream TP 1B (downstream)



Ohineangaanga Stream TP 2A (upstream)

Ohineangaanga Stream TP 2B (downstream)

Te Puke sample locations (continued)



Stream 3 – Cannell Farm Drive waterway TP 3A
(upstream)



Stream 3 – Cannell Farm Drive waterway TP 3B
(downstream)

Paengaroa sample locations



Pokopoko Stream Pa 1A (upstream)



Pokopoko Stream Pa 1B (downstream)

Maketu sample locations



Stream 1 – Little Waihi Road Stream Ma 1A
(upstream)



Stream 1 Ma – Little Waihi Road Stream 1B
(downstream)

Maketu sample locations (continued)



Stream 2 – Town Point Road Stream Ma 2A
(upstream)



Stream 2 – Town Point Road Stream Ma 2B
(downstream)



Stream 3 – Nedwicks Beach Stream Ma 3A
(upstream)



Stream 3 Ma 3B – Nedwicks Beach Stream
(downstream)

Pukehina sample locations



Stream 1 – unnamed canal Pu 1A (upstream)



Stream 1 – unnamed canal Pu 1B (downstream)

Appendix D

2018
Macroinvertebrate
Sampling Results

Appendix D Macroinvertebrate Sampling Results

Taxa	MCI-sb score	TP 4 (ref)	TP1A	TP 1B	TP 2A	TP 2B	TP 3A	TP 3B	Pa 1A	Pa 1B	Ma 1A	Ma 1B	Ma 2A	Ma 2B	Ma 3A	Ma 3B	Pu 1A	Pu 1B
Mayfly Austroclima	6.5	2	17	5	24	2			2									
Mayfly Austronella	4.7	1																
Mayfly Coloburiscus	8.1			1														
Mayfly Deleatidium	5.6				15	1												
Mayfly Nesameletus	8.6	1																
Mayfly Zephlebia	8.8	2	20	3	9				13	1								
Stonefly Megaleptoperla	7.3				1													
Stonefly Taraperla	8.3		7															
Stonefly Zelandobius	7.4	3		1					6	2								
Caddisfly Aoteapsyche	6		3	2					3									
Caddisfly Edpercivalia	6.3			2	4				5									
Caddisfly Hudsonema	6.5								10									
Caddisfly Hydrobiosis	6.7	1		1	2				5									
Caddisfly Oeconesidae	6.4		1													4		
Caddisfly Oxyethira	1.2			26	6	448		2										

Taxa	MCI-sb score	TP 4 (ref)	TP1A	TP 1B	TP 2A	TP 2B	TP 3A	TP 3B	Pa 1A	Pa 1B	Ma 1A	Ma 1B	Ma 2A	Ma 2B	Ma 3A	Ma 3B	Pu 1A	Pu 1B
Caddisfly Plectrocnemia	6.6										5				18			
Caddisfly Polyplectropus	8.1															8		
Caddisfly Psilochorema	7.8		1	1							8			NOT SAMPLED	5			
Caddisfly Pycnocentrella	9		1															
Caddisfly Pycnocentria	6.8	3		1								1						
Caddisfly Pycnocentrodes	3.8	1			3				1						1			
Caddisfly Triplectides	5.7	1	28		1	15			6									
Damselfly Xanthocnemis	1.2							8		4		41	2					
Dragonfly Antipodochlora	6.3															1		
Dragonfly Hemicordulia	0.4								1									
Dragonfly Procordulia	3.8															1		
Bug Anisops	2.2							10										
Bug Diaprepocoris	4.7										8				1			
Bug Microvelia	4.6									1						2		
Bug Sigara	2.4							25				8					2	

Taxa	MCI-sb score	TP 4 (ref)	TP1A	TP 1B	TP 2A	TP 2B	TP 3A	TP 3B	Pa 1A	Pa 1B	Ma 1A	Ma 1B	Ma 2A	Ma 2B	Ma 3A	Ma 3B	Pu 1A	Pu 1B
Beetle Dytiscidae	0.4					1							10					
Beetle Elmidae	7.2				1				2				2					
Beetle Hydrophilidae	8			1						2			120				9	
Beetle Liodessus	4.9		1										5				1	
Beetle Staphylinidae	6.2															1		
True Fly Aphrophila	5.6			3	5						4			NOT SAMPLED				
True Fly Austrosimulium	3.9	37	920	420	360	336			1									
True Fly Chironomus	3.4	82	3		360	204						760	42				29	
True Fly Corynoneura	1.7	1				3						2						
True Fly Culicidae	1.2												2					
True Fly Eriopterini	7.5					1												
True Fly Hexatomini	6.7															4		
True Fly Limonia	6.3			1														
True Fly Maoridiamesa	4.9			1	8	1												
True Fly Mischoderus	5.9			1	1					1	3	1						
True Fly Molophilus	6.3											1						
True Fly Muscidae	1.6				7	14	8						7					

Taxa	MCI-sb score	TP 4 (ref)	TP1A	TP 1B	TP 2A	TP 2B	TP 3A	TP 3B	Pa 1A	Pa 1B	Ma 1A	Ma 1B	Ma 2A	Ma 2B	Ma 3A	Ma 3B	Pu 1A	Pu 1B
True Fly Nothodixa	9.3	1																
True Fly Orthocladiinae	3.2	60	1	280		26			1				3			1	1	
True Fly Paradixa	8.5					2					1					2		
True Fly Polypedilum	8	73	128	440	560	11	1		5		400	1			1360			
True Fly Psychodidae	6.1															1		
True Fly Sciomyzidae	3												1					
True Fly Tanypodinae	6.5	2		3					3		160				35			
True Fly Tanytarsini	4.5	63		2	6	7	5	1	1			2	4	NOT SAMPLED				
True Fly Zelandotipula	3.6										4					3		
Crustacea Isopoda	4.5										15				1	4	1	30
Crustacea Ostracoda	1.9				3			38				4			920	121	2	
Crustacea Paracalliope	5.5										16				30	13		1
Crustacea Paratya	3.6	50	3	7		1			170	83		46						
Crustacea Talitridae	5																	1
MITES	5.2															4	13	3
SPIDERS Dolomedes	6.2				2		1		2	2	4	3			4	2		
TARDIGRADES	4.5															1		
Mollusc Ferrissia	2.4					1												

Taxa	MCI-sb score	TP 4 (ref)	TP1A	TP 1B	TP 2A	TP 2B	TP 3A	TP 3B	Pa 1A	Pa 1B	Ma 1A	Ma 1B	Ma 2A	Ma 2B	Ma 3A	Ma 3B	Pu 1A	Pu 1B
Mollusc Gyraulus	1.7							12		27								
Mollusc Lymnaeidae	1.2							5		14								
Mollusc Physella	0.1							132				5				8		
Mollusc Potamopyrgus	2.1		320	24	5	6	608	150	5	3					1	106		2
Mollusc Sphaeriidae	2.9						1				11				8	1		
OLIGOCHAETES	3.8		1		3		38	7			13	11	12		1	7	12	24
LEECHES	1.2									1			14				20	
PADDLEWORMS	6.7																	32

MCI-sb results	TP 4 (ref)	TP1A	TP 1B	TP 2A	TP 2B	TP 3A	TP 3B	Pa 1A	Pa 1B	Ma 1A	Ma 1B	Ma 2A	MA 2B	Ma 3A	Ma 3B	Pu 1A	Pu 1B
Number of taxa	18	16	22	22	18	7	11	19	12	14	14	13	NOT SAMPLED	13	21	10	7
EPT value	9	8	10	9	4	0	1	9	2	2	1	0		3	2	0	0
Number of individuals	384	1455	1226	1386	1080	662	390	242	141	652	886	224		2385	295	90	93
% EPT (taxa number)	50.0	50.0	45.5	40.9	22.2	0.0	9.1	47.4	16.7	2.0	0.1	0.0		1.0	4.1	0.0	0.0
Sum of recorded scores	103.1	91.4	128.1	110.9	74.7	29.1	22.3	103.3	51.9	79.6	55.8	43.6		63.8	99.7	38.5	32.8
MCI-sb score value	114.6	114.3	116.5	100.8	83.0	83.1	40.5	108.7	86.5	113.7	79.7	67.1		98.2	95.0	77.0	93.7

Appendix E

2018 Water Quality Certificates of Analysis



Certificate of Analysis

AECOM New Zealand Ltd
Level 1, 115 Cameron Road
Tauranga 3110
Attention: Rita Martin
Phone: 021 804561
Email: rita.martin@aecom.com

Lab Reference: 18-03347
Submitted by: Rita Martin
Date Received: 2/02/2018
Date Completed: 8/02/2018
Order Number:
Reference: 60548000

Sampling Site: Western Bay of Plenty

Water Aggregate Properties and Nutrients

Client Sample ID			PB.1A	PB.1B	PA.1B
Date Sampled			31/01/2018	31/01/2018	31/01/2018
Analyte	Unit	Reporting Limit	18-03347-1	18-03347-2	18-03347-3
pH	pH	1	7.8	7.9	7.4
Total Suspended Solids	g/m ³	3	70	58	30

Soluble Heavy Metals in Water

Client Sample ID			PB.1A	PB.1B	PA.1B
Date Sampled			31/01/2018	31/01/2018	31/01/2018
Analyte	Unit	Reporting Limit	18-03347-1	18-03347-2	18-03347-3
Arsenic	g/m ³	0.0005	0.0021	<0.005	0.0016
Beryllium	g/m ³	0.00001	0.00006	<0.0001	<0.00001
Boron	g/m ³	0.005	0.068	2.39	0.035
Cadmium	g/m ³	0.00001	7 x 10 ⁻⁵	<0.0001	2 x 10 ⁻⁵
Chromium	g/m ³	0.0002	<0.0002	<0.002	<0.0002
Copper	g/m ³	0.0002	0.0003	<0.002	<0.0002
Lead	g/m ³	0.00005	8 x 10 ⁻⁵	<0.0005	<0.00005
Mercury	g/m ³	0.0001	<0.0001	<0.001	<0.0001
Nickel	g/m ³	0.0002	0.0003	<0.002	<0.0002
Zinc	g/m ³	0.001	<0.001	<0.01	0.0014

Total Heavy Metals in Water

Client Sample ID			PB.1A	PB.1B	PA.1B
Date Sampled			31/01/2018	31/01/2018	31/01/2018
Analyte	Unit	Reporting Limit	18-03347-1	18-03347-2	18-03347-3
Arsenic	g/m ³	0.0005	0.0032	<0.005	0.0039
Beryllium	g/m ³	0.00001	0.00002	<0.0001	0.00002
Boron	g/m ³	0.005	0.070	2.570	0.068
Cadmium	g/m ³	0.00001	<0.00001	<0.0001	<0.00001

Total Heavy Metals in Water

Client Sample ID			PB.1A	PB.1B	PA.1B
Date Sampled			31/01/2018	31/01/2018	31/01/2018
Chromium	g/m ³	0.0002	<0.0002	<0.002	<0.0002
Copper	g/m ³	0.0002	0.0002	<0.002	0.0003
Lead	g/m ³	0.00005	<0.00005	<0.0005	0.00007
Mercury	g/m ³	0.0001	<0.0001	<0.001	<0.0001
Nickel	g/m ³	0.0002	0.0002	<0.002	0.0003
Zinc	g/m ³	0.001	0.002	<0.01	0.003

Total Petroleum Hydrocarbons - Water

Client Sample ID			PB.1A	PB.1B	PA.1B
Date Sampled			31/01/2018	31/01/2018	31/01/2018
Analyte	Unit	Reporting Limit	18-03347-1	18-03347-2	18-03347-3
C7-C9	g/m ³	0.2	<0.2	<0.2	<0.2
C10-C14	g/m ³	0.2	<0.2	<0.2	<0.2
C15-C36	g/m ³	0.3	<0.3	<0.3	<0.3
C7-C36 (Total)	g/m ³	0.5	<0.5	<0.5	<0.5

Method Summary

pH	Samples measured as received using a conventional pH electrode. APHA 4500 H+ B. (22 nd edition).
Total Suspended Solids	Samples filtered, TSS determined by gravimetric analysis. APHA 2540 D. (22 nd edition) - Modified.
Soluble Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following a 0.45µm membrane filtration (except when field filtered). US EPA method 200.8.
Recoverable Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following an acid digestion. US EPA method 200.8.
TPH in Water	Solvent extraction, silica cleanup, followed by GC-FID analysis (C7-C36). MFE Petroleum Industry Guidelines.

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at Analytica Laboratories. Samples were in acceptable condition unless otherwise noted on this report.

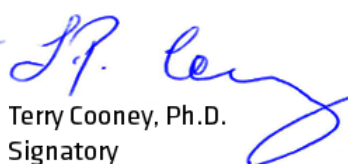
The validated reporting limits listed for Total Recoverable Heavy Metals and Soluble Heavy Metals are elevated 10-fold for sample 18-03347-2 (PB.1B) as sample required a further dilution prior to analysis due to matrix effects.



Elizabeth Fitzgerald, B.Sc.
Inorganics Team Leader



Tom Featonby, (M.Sc.)
Technologist



Terry Cooney, Ph.D.
Signatory

Analysis Report

Analytica Laboratories Ltd

10 Bisley Road, Private Bag 3123
Hamilton

Attention: Rachael Casey

Report Number: 5690
Date Issued: 5/02/2018



Shared Services Laboratory
Pukete Rd, RD8, Hamilton
Ph 07-985-5870

2018000798 PB.1A 18-03347 31/01/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	138	MPN/100mL	IANZ
Temperature On Arrival	2.2	°C	IANZ

2018000799 PB.1B 18-03347 31/01/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	>2420	MPN/100mL	IANZ
Temperature On Arrival	2.2	°C	IANZ

2018000800 PA.1B 18-03347 31/01/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	921	MPN/100mL	IANZ
Temperature On Arrival	2.2	°C	IANZ

Test Methodology

Test	Method	Detection Limit
Temperature	APHA Standard Methods 22nd ed. 2500 B	
E.coli enumerated	APHA Standard Methods 22nd ed. 9223 B	1 MPN/100mL

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Tania Williams
Key Technical Personnel



The tests reported herein have been performed in accordance with the laboratory's scope of accreditation, with the exception of tests marked "not IANZ" which are outside the scope of this laboratory's accreditation. This report may not be reproduced, except in full, without written consent of the signatory.



Certificate of Analysis

AECOM New Zealand Ltd
Level 1, 115 Cameron Road
Tauranga 3110
Attention: Rita Martin
Phone: 021804561
Email: Rita.Martin@aecom.com

Lab Reference: 18-03529
Submitted by:
Date Received: 2/02/2018
Date Completed: 8/02/2018
Order Number:
Reference: 60548000

Sampling Site: Western Bay of Plenty

Water Aggregate Properties and Nutrients

Client Sample ID			PA.1A	TP.2A	TP.1A	TP.1B	TP.2B
Date Sampled			1/02/2018	1/02/2018	1/02/2018	1/02/2018	1/02/2018
Analyte	Unit	Reporting Limit	18-03529-1	18-03529-2	18-03529-3	18-03529-4	18-03529-5
pH	pH	1	7.5	7.1	7.1	7.2	7.0
Total Suspended Solids	g/m ³	3	21	<3	<3	<3	<3

Water Aggregate Properties and Nutrients

Client Sample ID			TP.4	TP.3A	TP.3B
Date Sampled			1/02/2018	1/02/2018	1/02/2018
Analyte	Unit	Reporting Limit	18-03529-6	18-03529-7	18-03529-8
pH	pH	1	7.3	6.8	7.6
Total Suspended Solids	g/m ³	3	<3	<3	<3

Soluble Heavy Metals in Water

Client Sample ID			PA.1A	TP.2A	TP.1A	TP.1B	TP.2B
Date Sampled			1/02/2018	1/02/2018	1/02/2018	1/02/2018	1/02/2018
Analyte	Unit	Reporting Limit	18-03529-1	18-03529-2	18-03529-3	18-03529-4	18-03529-5
Arsenic	g/m ³	0.0005	0.0014	<0.0005	<0.0005	<0.0005	<0.0005
Beryllium	g/m ³	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Boron	g/m ³	0.005	0.041	<0.005	0.0068	0.0070	0.012
Cadmium	g/m ³	0.00001	1 x 10 ⁻⁵	1 x 10 ⁻⁵	<0.00001	1 x 10 ⁻⁵	1 x 10 ⁻⁵
Chromium	g/m ³	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Copper	g/m ³	0.0002	<0.0002	<0.0002	0.0003	0.0002	0.0002
Lead	g/m ³	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Mercury	g/m ³	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	g/m ³	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Zinc	g/m ³	0.001	<0.001	0.0011	<0.001	<0.001	0.0029

Soluble Heavy Metals in Water

Client Sample ID			TP.4	TP.3A	TP.3B
Date Sampled			1/02/2018	1/02/2018	1/02/2018
Analyte	Unit	Reporting Limit	18-03529-6	18-03529-7	18-03529-8
Arsenic	g/m ³	0.0005	<0.0005	<0.0005	0.0005
Beryllium	g/m ³	0.00001	<0.00001	0.00003	<0.00001
Boron	g/m ³	0.005	0.0059	0.010	0.015
Cadmium	g/m ³	0.00001	<0.00001	3 x 10 ⁻⁵	<0.00001
Chromium	g/m ³	0.0002	<0.0002	<0.0002	<0.0002
Copper	g/m ³	0.0002	<0.0002	<0.0002	0.0007
Lead	g/m ³	0.00005	<0.00005	<0.00005	6 x 10 ⁻⁵
Mercury	g/m ³	0.0001	<0.0001	<0.0001	<0.0001
Nickel	g/m ³	0.0002	<0.0002	<0.0002	<0.0002
Zinc	g/m ³	0.001	<0.001	0.0027	0.0010

Total Heavy Metals in Water

Client Sample ID			PA.1A	TP.2A	TP.1A	TP.1B	TP.2B
Date Sampled			1/02/2018	1/02/2018	1/02/2018	1/02/2018	1/02/2018
Analyte	Unit	Reporting Limit	18-03529-1	18-03529-2	18-03529-3	18-03529-4	18-03529-5
Arsenic	g/m ³	0.0005	0.0024	<0.0005	<0.0005	<0.0005	<0.0005
Beryllium	g/m ³	0.00001	0.00002	0.00003	0.00002	0.00001	0.00002
Boron	g/m ³	0.005	0.044	0.014	0.008	0.008	0.013
Cadmium	g/m ³	0.00001	0.00001	0.00002	<0.00001	0.00001	0.00001
Chromium	g/m ³	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Copper	g/m ³	0.0002	0.0002	0.0004	<0.0002	<0.0002	<0.0002
Lead	g/m ³	0.00005	0.00014	0.00029	<0.00005	<0.00005	<0.00005
Mercury	g/m ³	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	g/m ³	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Zinc	g/m ³	0.001	0.001	0.005	<0.001	<0.001	0.003

Total Heavy Metals in Water

Client Sample ID			TP.4	TP.3A	TP.3B
Date Sampled			1/02/2018	1/02/2018	1/02/2018
Analyte	Unit	Reporting Limit	18-03529-6	18-03529-7	18-03529-8
Arsenic	g/m ³	0.0005	<0.0005	<0.0005	0.0006
Beryllium	g/m ³	0.00001	0.00003	0.00005	<0.00001
Boron	g/m ³	0.005	0.007	0.011	0.016
Cadmium	g/m ³	0.00001	0.00001	0.00002	0.00001
Chromium	g/m ³	0.0002	<0.0002	<0.0002	<0.0002
Copper	g/m ³	0.0002	<0.0002	<0.0002	0.0004
Lead	g/m ³	0.00005	<0.00005	<0.00005	0.00007
Mercury	g/m ³	0.0001	<0.0001	<0.0001	<0.0001
Nickel	g/m ³	0.0002	<0.0002	<0.0002	0.0006
Zinc	g/m ³	0.001	0.001	0.002	0.005

Total Petroleum Hydrocarbons - Water

Client Sample ID			PA.1A	TP.2A	TP.1A	TP.1B	TP.2B
Date Sampled			1/02/2018	1/02/2018	1/02/2018	1/02/2018	1/02/2018
Analyte	Unit	Reporting Limit	18-03529-1	18-03529-2	18-03529-3	18-03529-4	18-03529-5
C7-C9	g/m ³	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
C10-C14	g/m ³	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m ³	0.3	<0.3	<0.3	<0.3	0.4	<0.3

Total Petroleum Hydrocarbons - Water

Client Sample ID			PA.1A	TP.2A	TP.1A	TP.1B	TP.2B
Date Sampled			1/02/2018	1/02/2018	1/02/2018	1/02/2018	1/02/2018
C7-C36 (Total)	g/m ³	0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Total Petroleum Hydrocarbons - Water

Client Sample ID			TP.4	TP.3A	TP.3B
Date Sampled			1/02/2018	1/02/2018	1/02/2018
Analyte	Unit	Reporting Limit	18-03529-6	18-03529-7	18-03529-8
C7-C9	g/m ³	0.2	<0.2	<0.2	<0.2
C10-C14	g/m ³	0.2	<0.2	<0.2	<0.2
C15-C36	g/m ³	0.3	<0.3	<0.3	<0.3
C7-C36 (Total)	g/m ³	0.5	<0.5	<0.5	<0.5

Method Summary

pH	Samples measured as received using a conventional pH electrode. APHA 4500 H+ B. (22 nd edition).
Total Suspended Solids	Samples filtered, TSS determined by gravimetric analysis. APHA 2540 D. (22 nd edition) - Modified.
Soluble Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following a 0.45µm membrane filtration (except when field filtered). US EPA method 200.8.
Recoverable Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following an acid digestion. US EPA method 200.8.
TPH in Water	Solvent extraction, silica cleanup, followed by GC-FID analysis (C7-C36). MFE Petroleum Industry Guidelines.

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at Analytica Laboratories. Samples were in acceptable condition unless otherwise noted on this report.

Elizabeth Fitzgerald, B.Sc.
Inorganics Team Leader

Sharelle Frank, B.Sc. (Tech)
Technologist

Tom Featonby, (M.Sc.)
Technologist

Analysis Report

Analytica Laboratories Ltd

10 Bisley Road, Private Bag 3123
Hamilton

Attention: Rachael Casey

Report Number: 5691
Date Issued: 5/02/2018



Shared Services Laboratory
Pukete Rd, RD8, Hamilton
Ph 07-985-5870

2018000801 PA.1A 18-03529 01/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	488	MPN/100mL	IANZ
Temperature On Arrival	16.8	°C	IANZ

2018000802 TP.2A 18-03529 01/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	144	MPN/100mL	IANZ
Temperature On Arrival	16.8	°C	IANZ

2018000803 TP.1A 18-03529 01/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	166	MPN/100mL	IANZ
Temperature On Arrival	16.8	°C	IANZ

2018000804 TP.1B 18-03529 01/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	411	MPN/100mL	IANZ
Temperature On Arrival	16.8	°C	IANZ

2018000805 TP.2B 18-03529 01/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	579	MPN/100mL	IANZ
Temperature On Arrival	16.8	°C	IANZ

2018000806 TP.4 18-03529 01/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	88	MPN/100mL	IANZ
Temperature On Arrival	16.8	°C	IANZ

2018000807 TP.3A 18-03529 01/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	1046	MPN/100mL	IANZ
Temperature On Arrival	16.8	°C	IANZ

2018000808 TP.3B 18-03529 01/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	>2420	MPN/100mL	IANZ
Temperature On Arrival	16.8	°C	IANZ

Test Methodology

Test	Method	Detection Limit
Temperature	APHA Standard Methods 22nd ed. 2500 B	
E.coli enumerated	APHA Standard Methods 22nd ed. 9223 B	1 MPN/100mL

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.



Tania Williams
Key Technical Personnel



The tests reported herein have been performed in accordance with the laboratory's scope of accreditation, with the exception of tests marked "not IANZ" which are outside the scope of this laboratory's accreditation. This report may not be reproduced, except in full, without written consent of the signatory.



Certificate of Analysis

AECOM New Zealand Ltd
Level 1, 115 Cameron Road
Tauranga 3110
Attention: Rita Martin
Phone: 021804561
Email: rita.martin2@aecom.com

Lab Reference: 18-03730
Submitted by: Rita MArtin
Date Received: 5/02/2018
Date Completed: 12/02/2018
Order Number:
Reference: 60548000

Sampling Site: Western Bay of Plenty

Water Aggregate Properties and Nutrients

Client Sample ID			MA.1B	MA.2B	MA.2A	MA.3B
Date Sampled			2/02/2018	2/02/2018	2/02/2018	2/02/2018
Analyte	Unit	Reporting Limit	18-03730-1	18-03730-2	18-03730-3	18-03730-4
pH	pH	1	7.0	7.2	6.9	7.7
Total Suspended Solids	g/m ³	3	11	3	21	39

Total Heavy Metals in Water

Client Sample ID			MA.1B	MA.2B	MA.2A	MA.3B
Date Sampled			2/02/2018	2/02/2018	2/02/2018	2/02/2018
Analyte	Unit	Reporting Limit	18-03730-1	18-03730-2	18-03730-3	18-03730-4
Arsenic	g/m ³	0.0005	0.0016	0.0011	0.0052	0.0009
Beryllium	g/m ³	0.00001	0.00004	0.00002	0.00002	0.00005
Boron	g/m ³	0.005	0.034	0.012	0.031	0.026
Cadmium	g/m ³	0.00001	0.00003	0.00002	0.00001	0.00002
Chromium	g/m ³	0.0002	0.00037	0.00038	0.0076	0.00025
Copper	g/m ³	0.0002	0.0023	0.0017	0.0189	0.0034
Lead	g/m ³	0.00005	0.00099	0.00060	0.00022	0.00083
Mercury	g/m ³	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	g/m ³	0.0002	0.0003	<0.0002	<0.0002	<0.0002
Zinc	g/m ³	0.001	0.009	0.008	0.005	0.007

Soluble Heavy Metals in Water

Client Sample ID			MA.1B	MA.2B	MA.2A	MA.3B
Date Sampled			2/02/2018	2/02/2018	2/02/2018	2/02/2018
Analyte	Unit	Reporting Limit	18-03730-1	18-03730-2	18-03730-3	18-03730-4
Arsenic	g/m ³	0.0005	0.0011	0.0011	0.0015	0.0007
Beryllium	g/m ³	0.00001	0.00001	<0.00001	<0.00001	<0.00001
Boron	g/m ³	0.005	0.031	0.010	0.027	0.024
Cadmium	g/m ³	0.00001	2 x 10 ⁻⁵	<0.00001	3 x 10 ⁻⁵	1 x 10 ⁻⁵

Soluble Heavy Metals in Water

Client Sample ID			MA.1B	MA.2B	MA.2A	MA.3B
Date Sampled			2/02/2018	2/02/2018	2/02/2018	2/02/2018
Chromium	g/m ³	0.0002	<0.0002	0.0003	0.0005	<0.0002
Copper	g/m ³	0.0002	0.0018	0.0014	0.0022	0.0027
Lead	g/m ³	0.00005	0.0001	8 x 10 ⁻⁵	<0.00005	7 x 10 ⁻⁵
Mercury	g/m ³	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	g/m ³	0.0002	0.0003	<0.0002	<0.0002	<0.0002
Zinc	g/m ³	0.001	0.0039	0.0044	0.0020	0.0020

Total Petroleum Hydrocarbons - Water

Client Sample ID			MA.1B	MA.2B	MA.2A	MA.3B
Date Sampled			2/02/2018	2/02/2018	2/02/2018	2/02/2018
Analyte	Unit	Reporting Limit	18-03730-1	18-03730-2	18-03730-3	18-03730-4
C7-C9	g/m ³	0.2	<0.2	<0.2	<0.2	<0.2
C10-C14	g/m ³	0.2	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m ³	0.3	<0.3	<0.3	<0.3	<0.3
C7-C36 (Total)	g/m ³	0.5	<0.5	<0.5	<0.5	<0.5

Method Summary

pH	Samples measured as received using a conventional pH electrode. APHA 4500 H+ B. (22 nd edition).
Total Suspended Solids	Samples filtered, TSS determined by gravimetric analysis. APHA 2540 D. (22 nd edition) - Modified.
Recoverable Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following an acid digestion. US EPA method 200.8.
Soluble Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following a 0.45µm membrane filtration (except when field filtered). US EPA method 200.8.
TPH in Water	Solvent extraction, silica cleanup, followed by GC-FID analysis (C7-C36). MFE Petroleum Industry Guidelines.

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at Analytica Laboratories. Samples were in acceptable condition unless otherwise noted on this report.

Elizabeth Fitzgerald, B.Sc.
Inorganics Team Leader

Tom Featonby, (M.Sc.)
Technologist

Analysis Report

Analytica Laboratories Ltd

10 Bisley Road, Private Bag 3123
Hamilton

Attention: Rachael Casey

Report Number: 5693
Date Issued: 7/02/2018



Shared Services Laboratory
Pukete Rd, RD8, Hamilton
Ph 07-985-5870

2018000874 MA.1B 18-03730 2/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	8664	MPN/100mL	IANZ
Temperature On Arrival	9.3	°C	IANZ

2018000875 MA.2B 18-03730 2/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	4352	MPN/100mL	IANZ
Temperature On Arrival	10.1	°C	IANZ

2018000876 MA.2A 18-03730 2/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	677	MPN/100mL	IANZ
Temperature On Arrival	9.1	°C	IANZ

2018000877 MA.3B 18-03730 2/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	5172	MPN/100mL	IANZ
Temperature On Arrival	9.0	°C	IANZ

Test Methodology

Test	Method	Detection Limit
Temperature	APHA Standard Methods 22nd ed. 2500 B	
E.coli enumerated	APHA Standard Methods 22nd ed. 9223 B	1 MPN/100mL

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Tania Williams
Key Technical Personnel



The tests reported herein have been performed in accordance with the laboratory's scope of accreditation, with the exception of tests marked "not IANZ" which are outside the scope of this laboratory's accreditation. This report may not be reproduced, except in full, without written consent of the signatory.



Certificate of Analysis

AECOM New Zealand Ltd
Level 1, 115 Cameron Road
Tauranga 3110
Attention: Bob Shaw
Phone: 021 811891
Email: rita.martin2@aecom.com

Lab Reference: 18-03990
Submitted by: Ange Chaffe
Date Received: 8/02/2018
Date Completed: 14/02/2018
Order Number:
Reference: 60548000

Sampling Site: Western Bay of Plenty

Water Aggregate Properties and Nutrients

Client Sample ID			MA.3A	MA.1A
Date Sampled			7/02/2018	7/02/2018
Analyte	Unit	Reporting Limit	18-03990-1	18-03990-2
pH	pH	1	7.7	7.4
Total Suspended Solids	g/m ³	3	28	101

Total Heavy Metals in Water

Client Sample ID			MA.3A	MA.1A
Date Sampled			7/02/2018	7/02/2018
Analyte	Unit	Reporting Limit	18-03990-1	18-03990-2
Arsenic	g/m ³	0.0005	<0.0005	<0.0005
Beryllium	g/m ³	0.00001	0.00002	0.00001
Boron	g/m ³	0.005	0.019	0.015
Cadmium	g/m ³	0.00001	<0.00001	<0.00001
Chromium	g/m ³	0.0002	<0.0002	<0.0002
Copper	g/m ³	0.0002	0.0013	0.0003
Lead	g/m ³	0.00005	0.00015	0.00012
Mercury	g/m ³	0.0001	<0.0001	<0.0001
Nickel	g/m ³	0.0002	<0.0002	<0.0002
Zinc	g/m ³	0.001	0.005	0.001

Soluble Heavy Metals in Water

Client Sample ID			MA.3A	MA.1A
Date Sampled			7/02/2018	7/02/2018
Analyte	Unit	Reporting Limit	18-03990-1	18-03990-2
Arsenic	g/m ³	0.0005	<0.0005	<0.0005
Beryllium	g/m ³	0.00001	<0.00001	<0.00001
Boron	g/m ³	0.005	0.016	0.013
Cadmium	g/m ³	0.00001	1 x 10 ⁻⁵	1 x 10 ⁻⁵

Soluble Heavy Metals in Water

Client Sample ID			MA.3A	MA.1A
Date Sampled			7/02/2018	7/02/2018
Chromium	g/m ³	0.0002	<0.0002	<0.0002
Copper	g/m ³	0.0002	0.0005	0.0005
Lead	g/m ³	0.00005	<0.00005	<0.00005
Mercury	g/m ³	0.0001	<0.0001	<0.0001
Nickel	g/m ³	0.0002	<0.0002	<0.0002
Zinc	g/m ³	0.001	0.0014	<0.001

Total Petroleum Hydrocarbons - Water

Client Sample ID			MA.3A	MA.1A
Date Sampled			7/02/2018	7/02/2018
Analyte	Unit	Reporting Limit	18-03990-1	18-03990-2
C7-C9	g/m ³	0.2	<0.2	<0.2
C10-C14	g/m ³	0.2	<0.2	<0.2
C15-C36	g/m ³	0.3	<0.3	<0.3
C7-C36 (Total)	g/m ³	0.5	<0.5	<0.5

Method Summary

pH	Samples measured as received using a conventional pH electrode. APHA 4500 H+ B. (22 nd edition).
Total Suspended Solids	Samples filtered, TSS determined by gravimetric analysis. APHA 2540 D. (22 nd edition) - Modified.
Recoverable Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following an acid digestion. US EPA method 200.8.
Soluble Trace Elements	Samples were analysed as received by the laboratory using ICP-MS following a 0.45µm membrane filtration (except when field filtered). US EPA method 200.8.
TPH in Water	Solvent extraction, silica cleanup, followed by GC-FID analysis (C7-C36). MFE Petroleum Industry Guidelines.

Report Comments

Samples were collected by yourselves (or your agent) and analysed as received at Analytica Laboratories. Samples were in acceptable condition unless otherwise noted on this report.



Sharelle Frank, B.Sc. (Tech)
Technologist



Tom Featonby, (M.Sc.)
Technologist

Analysis Report

Analytica Laboratories Ltd

10 Bisley Road, Private Bag 3123
Hamilton

Attention: Rachael Casey

Report Number: 5706
Date Issued: 9/02/2018



Shared Services Laboratory
Pukete Rd, RD8, Hamilton
Ph 07-985-5870

2018001029 MA.3A 18-03990 7/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	488.4	MPN/100mL	IANZ
Temperature On Arrival	10.8	°C	IANZ

2018001030 MA.1A 18-03990 7/02/2018			
Parameter Name	S Result	Units	Accreditation Status
E.coli Enumerated	214.2	MPN/100mL	IANZ
Temperature On Arrival	11.3	°C	IANZ

Test Methodology

Test	Method	Detection Limit
Temperature	APHA Standard Methods 22nd ed. 2500 B	
E.coli enumerated	APHA Standard Methods 22nd ed. 9223 B	1 MPN/100mL

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Tania Williams
Key Technical Personnel



The tests reported herein have been performed in accordance with the laboratory's scope of accreditation, with the exception of tests marked "not IANZ" which are outside the scope of this laboratory's accreditation. This report may not be reproduced, except in full, without written consent of the signatory.

Report Number: 5706



**Western Bay of Plenty
District Council**

Te Kaunihera a rohe mai i nga Kuri-a-Whare ki Otamarakau ki te Uru



EASTERN CATCHMENT STREAM BANK EROSION DRONE SURVEY

Eastern Catchment Management Plan

Eastern Catchment Stream Bank Erosion Drone Survey

Prepared for
AECOM

By
JONO MAGSON
WESTERN BAY OF PLENTY DISTRICT COUNCIL

15-March-2018

CONTENTS

1. INTRODUCTION

2. METHODOLOGY

- 2.1 Study Sites
- 2.2 Drone Survey
- 2.3 Stream Bank Erosion Assessment

3. ANALYSIS & RESULTS

- 3.1 Te Puke Catchment
- 3.2 Maketu Catchment
- 3.3 Pukehina Catchment
- 3.4 Paengaroa Catchment

4. DISCUSSION & OUTCOME

1. INTRODUCTION

A survey using a drone, or Unmanned Aerial Vehicle (UAV), was used to assess stream bank erosion for several streams within the Te Puke, Maketu, Pukehina and Paengaroa eastern catchments in the Western Bay of Plenty District between January 11 2018 and February 8 2018. This involved using a drone to capture footage of the stream bank along the survey area then analysing the videos to determine levels of erosion, with the main parameters being stream bank erosion location and if erosion was associated with natural stream bank or artificial features.

The non-porous surfaces of urban environments leads to increased stormwater run-off and has the potential to exacerbate stream bed erosion. The aim of the drone survey was to provide a baseline to assess the potential effects of increasing stormwater run-off due to urbanization on stream bank erosion. The outcome of the report will be used to inform decisions on the Eastern Catchment Management Plan.

2. METHODOLOGY

2.1 Study sites

Nine streams were surveyed in the four eastern catchment areas in the Western Bay of Plenty District (Table 1). The proposed start and end locations of the survey for the streams of interest were provided by AECOM New Zealand Limited (AECOM).

Table 1 –Streams surveyed in Erosion Assessment.

Stream Name	ID
Te Puke	
Raparapahoe Stream	TPK1
Ohineangaanga Stream	TPK2
Cannell Farm Drive Waterway	TPK3
Waiari River	TPK4
Maketu	
Little Waihi Road Stream	MKT1
Town Point Road Stream	MKT2
Nedwicks Beach Stream	MKT3
Pukehina	
Pukehina Unnamed Canal	PKH
Paengaroa	
Pokopoko Stream	PNG

2.2 Drone Survey

A DJI Phantom 3s and DJI Phantom 4 pro were used to capture video footage of the stream bank. The flights were undertaken between January 11 2018 and February 8 2018. The video was captured in 1080p quality and video captions were enabled in the DJI app (drone flight software) which stores GPS information as video subtitles so the spatial location of the video can be extracted. Videos were captured of approximately 50-200m reaches of the stream at a time.

2.3 Stream Bank Erosion Assessment

Using ArcPro, the GPS coordinates from the start and end of each video were used to divide the stream into reaches. Each reach was given an ID based on the catchment area and the order in which the streams were surveyed. An attribute for the start and end of each reach was added.

The video footage was analysed to identify reaches with significant erosion based on training provided by AECOM. Erosion was defined as an area where slumping and/or exposed soil surfaces are identified. Erosion was classified as no/slight, moderate or severe (Table 2). If it was determined that the reach had moderate or severe erosion, photos were extracted from the video to highlight key areas of erosion.

If an asset was found along the stream, such as outlets or outfalls, it was noted if erosion was associated with the asset and whether it was owned by the Council or not (its GIS ID was provided if so). Assets were considered to be associated with erosion if erosion was present within 5 meters of the asset.

Table 2 - Stream Bank Erosion Assessment Criteria. Provided by AECOM.

Erosion Criteria	Identification	Report in Drone Survey
None	- No Sign of erosion scars - Bank lining or artificial material	No
Slight	- Less than 20% of the banks have erosion scars. - Stable banks and stream bed. - Evidence of soil being washed away.	No
Moderate	- Between 20 and 50% of the banks have erosion scars. - Evidence of some bank slumping. - Noticeable area of bare / eroded soil or bank. - Some undercutting of structures.	Yes
Severe	- Over 50% of the banks have erosion scars. - Heavy Sediment deposits dominating the stream bed. - Unstable banks throughout the reach. - Collapsing of bank vegetation into the stream. - Undercutting of bank and / or structures.	Yes

3. ANALYSIS & RESULTS

Table 3 - Summary of Stream Bank Erosion assessment.

Erosion	TPK1	TPK2	TPK3	TPK4	PNG	PKH	MTK1	MTK2	MTK3
No/slight length (m)	2124.89	1835.47	4012.09	2857.86	2923.83	4004.79	1803.57	738.86	1839.48
moderate length (m)	970.77	1944.16	205.77	155.83	182.3	0	258.56	0	0
Severe length (m)	1363.53	1232.42	299.22	0	0	0	0	0	0
% erosion	52.35%	63.38%	11.18%	5.17%	5.87%	0.00%	12.54%	0.00%	0.00%
% severe	30.58%	24.59%	6.62%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
length Surveyed (m)	4459.19	5012.05	4517.08	3013.69	3106.13	4004.79	2062.13	738.86	1839.48

3.1 Te Puke Catchment

Raparapahoe Stream and Ohineangaanga Stream in the Te Puke catchment were the most affected by erosion with over ~50% of the stream length surveyed being classed as having at least moderate erosion (Table 3). The banks on these streams were high and in some places severely affected by erosion scars eroding away the cliff, especially on the upstream sections of the survey area. In some parts this erosion was starting to encroach on kiwi fruit farms (Image 1).

The erosion was most significant on the upstream sections of these two streams where the streambeds ran mostly adjacent to kiwifruit orchards. The down stream sections north of Te Puke ran mostly adjacent to livestock farms, in these areas the banks were lower and less affected by erosion. The stream beds in the upstream sections of these streams were more natural whereas the downstream sections were managed into canal ways which may have impacted this observation.

The Cannell Farm Drive Waterway and the Waiari River showed mostly low levels of erosion (Table 3). The upstream section of Cannell Farm Drive Waterway is a wash and only temporarily flows with water after rainfall. The paddocks on the property on the Cannell Farm Drive Waterway where the only erosion was found on this stream (Figure 1) had multiple large erosion scars.

Four assets in Ohineangaanga Stream and five in Cannell Farm Drive Waterway were found to be associated with erosion, two of these were confirmed to be owned by council. These were all either outlet pipes or outfall pipes.

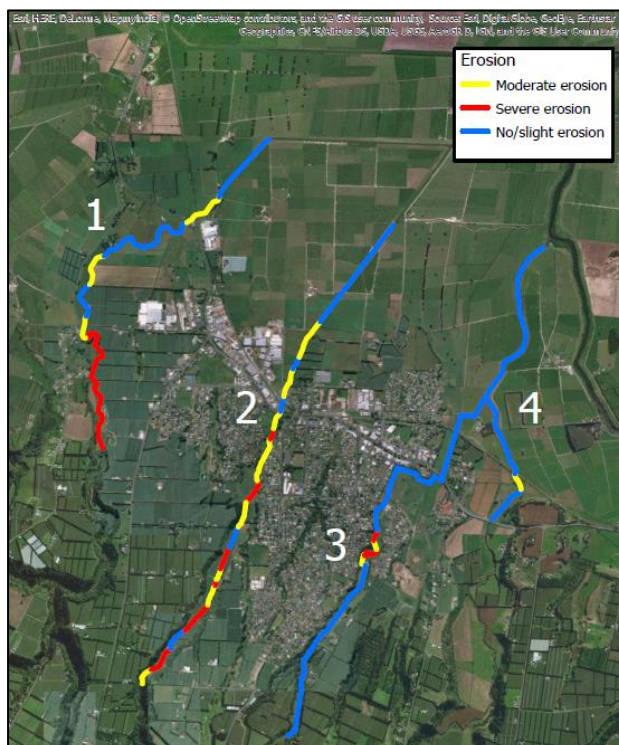


Figure 1 - Map showing stream bank erosion of streams surveyed in the Te Puke Catchment. 1 - Raparapahoe Stream. 2 - Ohineangaanga Stream. 3 - Cannell Farm Drive Waterway. 4 - Waiari River.



Image 1 - Example of erosion encroaching on Kiwifruit orchard at Ohineangaanga Stream.

3.2 Maketu Catchment

The erosion at Little Waihi Road Stream and Town Point Road Stream could not be fully assessed due to dense vegetation covering the stream bed in the upstream gullies where the streams originate. The section near the mouth at Little Waihi Road Stream was flooded over the banks and also couldn't be fully assessed. It is therefore possible that there may have been some issues with erosion at these streams that were not detected in this survey.

The parts of the Maketu streams that could be surveyed were largely unaffected by moderate or severe erosion, only the reach near the mouth of Little Waihi Road Stream was determined to show moderate erosion (Figure 2). All these streams had very little water flow, except Little Waihi Road Stream which had other streams flowing into it near the mouth.



Figure 2 - Map showing stream bank erosion of streams surveyed in the Maketu Catchment. 1 - Little Waihi Road Stream. 2 - Town Point Road Stream. 3 - Nedwicks Beach Stream.

3.3 Pukehina Catchment

No reaches were classified as having moderate or severe erosion in the unnamed stream surveyed in the Paengaroa catchment (Figure 3). Tussocks were planted as riparian vegetation along most of the stream bank and it was in good condition with minimal signs of erosion.



Figure 3. Map showing stream bank erosion of the unnamed canal in the Pukehina Catchment.

3.4 Paengaroa Catchment

The stream bank erosion of Pokopoko Stream is mostly homogenous along the entire survey length. Although it was determined to have mostly no/slight erosion (Figure 4), the stream bed appears to have expanded and is encroaching on the adjacent farmland but the banks appear to be in good condition.

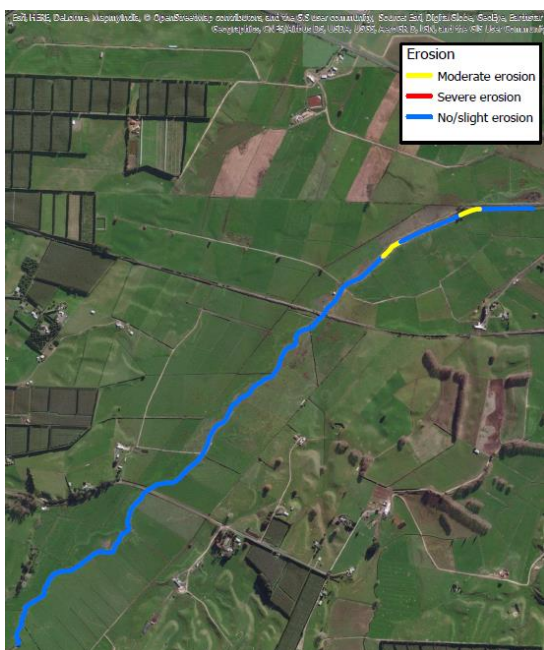


Figure 4. Map showing stream bank erosion of Pokopoko Stream in the Paengaroa Catchment.

4. DISCUSSION & OUTCOME

Stream banks in the Te Puke catchment were found to have the most severe erosion, especially Raparapahoe Stream and Ohineangaanga Stream which had over 50% of their survey reach showing at least moderate erosion. All other streams in the study were found to have less than 13% erosion. It was observed that where streams had large and natural banks, i.e. the upstream sections of Raparapahoe Stream and Ohineangaanga Stream, there was higher levels of erosion while areas where the banks were managed (as canals/drains etc.) there was less significant erosion. Vegetation cover and flooded areas meant that parts of surveyed Maketu streams could not be accurately assessed therefore erosion may be underestimated in these streams.

Eight assets were found to be associated with erosion. All of these were in the Te Puke catchment on Ohineangaanga Stream and Cannell Farm Drive Waterway. These two streams ran near the urban areas of Te Puke and therefore had more stormwater assets associated with them compared to other streams that ran through rural areas.

The use of drones was an effective means of assessing stream bank erosion. The main advantages of using a drone survey over conventional methods are overcoming accessibility problems and reduced time in the field. The drone can efficiently capture footage/images of lengths of stream that would otherwise be difficult and time consuming to survey.

Perhaps the greatest challenge is the flying conditions of stream environments. The drone is often required to fly in close-quarters to riparian vegetation and the risk of a collision is high. Although modern drones often have object avoidance systems, the current technology is not so effective against objects like thin tree branches.

Filming from a drone provides a wider and more detailed perspective of the stream banks than what would be visible from conventional methods. There is also the advantage of being able to store the footage permanently, this allows footage to be analysed more accurately in the lab and provides a complete record for the future. Enabling video captions in the DJI app allows GPS locations to be extracted from the footage, this is a highly effective way of locating erosion back in the lab and should always be used in future drone surveys of this kind.

A difficulty in using a drone survey like this is separating the stream into equal reaches during analysis. Video overlay software, such as [Dashware](#) and [Mappazzo](#), provides an overlay of the drone's flightpath and position using the video caption file. This could potentially be an effective way of identifying location and separating the stream into reaches during analysis.

3d imagery software, such as [Drone2map](#) and [DroneDeploy](#), are being used to create 3d models of stream banks to provide a way of analysing erosion. 3d models are generated from a point cloud constructed from overlapping photos, these are geotagged which overcomes the issue of determining position when analysing raw video footage. In future, stream surveys of this kind should consider 3D imagery technology, however, it may be impractical and too processing intensive when surveying large areas like in this study.

Contaminant Load Model
(based on ARC guidelines - CLM May 2006)

Catchment: Te Puke/ Ohineangaanga Stream – western tributary
Outfall: SWCO0922

	Catchment Area (m²)		591114.8	Total Suspended Solids (TSS)		Zinc		Cooper		Total Petroleum Hydrocarbons (TPH)	
Source	Source Type		Source Area (m²)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)
Roofs (average)			78615.4	5.00	393077.07	0.04	3144.62	0.00	62.89		
Roads	Vehicles per day	Length (m)									
	<1000		19101.5	4.00	76405.80	0.02	401.13	0.01	133.71	0.11	2101.16
	1000-5000		19101.5	30.00	573043.50	0.11	2043.86	0.03	666.64	0.54	10314.78
	5000-20000		0.0	150.00	0.00	0.54	0.00	0.17	0.00	2.68	0.00
	20000-50000		8861.7	299.00	2649648.30	1.07	9464.30	0.35	3076.78	5.34	47321.48
	50000-100000			300.00	0.00	2.28	0.00	0.74	0.00	11.41	0.00
	>100000		0.0	300.00	0.00	3.53	0.00	1.15	0.00	17.66	0.00
Roads (sum)			47064.6		3299097.60		11909.28		3877.13		59737.42
Paved Surfaces other than roads	Residential		49188.3	20.00	983765.92	0.07	3443.18	0.01	491.88		
	Industrial		79789.1	50.00	3989455.65	0.10	7978.91	0.13	10372.58		
	Commercial			100.00	0.000	0.05	0.00	0.05	0.00		
Urban Grass lands	Slope	<10	168228.7	35.00	5888004.27		0.00		0.00		
		10 to 20	168228.7	80.00	13458295.48		0.00		0.00		
		>20	0.0	160.00	0.00		0.00		0.00		
Urban Stream Channel	length x width		0.0	6000.00	0.00		0.00		0.00		
Urban area without construction sides			591114.8		28011696.0		26476.0		14804.5		59737.4
Catchment Totals				Total Suspended Solids (TSS)		Zinc		Cooper		Total Petroleum Hydrocarbons (TPH)	
Outfall Loads (g*a ⁻¹)					28011695.99		26475.99		14804.49		59737.42
Outfall Loads (kg*a ⁻¹)					28011.70		26.48		14.80		59.74
Average Yield (g*ha*a ⁻¹)				47387.91		447.90		250.45		1010.59	
Average Yield (kg*ha*a ⁻¹)				473.88		4.48		2.50		10.11	
Event Volume [m3]	4729.029	Event Volume (L)	4729028.9								
Average Mass - Load (mg)											
Average Mass - Load (g)											
Average Mass - Load (kg)											
Density (g*cm ⁻³)							7.14		8.96		0.83
Density (kg*m ⁻³)							7140.00		8960.00		830.00
Note: Concentrations do not include any pretreatment.											
Average concentrations (mg*kg-1)							945.18		528.51		2132.59
Average concentrations (mg*m ⁻³)							6748558.43		4735459.68		1770048.45
Average concentrations (µg*L ⁻¹)							6.74856		4.73546		1.77005
Average concentrations (g*m ⁻³)							0.95		0.53		2.13
Guideline concentrations (µg*L ⁻¹)							<8		<1.3		
Guideline concentrations (g*m ⁻³)					<150						<15

NATIONAL WATER QUALITY MANAGEMENT STRATEGY

Australian and New Zealand Guidelines for Fresh and Marine Water Quality - trigger values

Arsenic

A high reliability freshwater trigger value of 24 µg/L was derived for arsenic (III) using the statistical distribution method with 95% protection.
An Environmental Concern Level (ECL, see Section 8.3.4.5) of 2.3 µg/L was derived for As (III) in marine waters, using an AF of 100. This figure could be adopted as a marine low reliability trigger value, to be used only as an indicative interim working level.
Further review at a later revision may produce a more reliable trigger value.

Chromium

A low reliability freshwater trigger value for chromium (III) of 3.3 µg/L was derived using the AF method (a factor of 20 was applied to the lowest, O. mykiss figure, from a limited set of chronic data). This applies to low hardness water at 30 mg/L as CaCO3. This figure should only be used as an indicative interim working level.
A marine moderate reliability trigger value for chromium (III) of 10 µg/L was derived, using the statistical distribution method with 95% protection and an ACR of 77.6.
A freshwater high reliability trigger value for chromium (VI) of 1.0 µg/L was derived using the statistical distribution method at 95% protection.
A marine high reliability trigger value for chromium (VI) of 4.4 µg/L was derived using the statistical distribution method at 95% protection.

Copper

A freshwater high reliability trigger value for copper of 1.4 µg/L was derived using the statistical distribution method with 95% protection. This applies to waters of hardness of 30 mg/L as CaCO3.
A marine high reliability trigger value for copper of 1.3 µg/L was derived using the statistical distribution method with 95% protection. This figure is above the converted NOEC for Mytilus edulis but below the experimental EC50 (2 µg/L) and is considered appropriate for slightly-moderately disturbed systems.

Lead

A high reliability freshwater trigger value for lead of 3.4 µg/L was calculated using the statistical distribution method at 95% protection. This applies to waters of low hardness, 30 mg/L as CaCO3.
A marine high reliability trigger value for lead of 4.4 µg/L was calculated using the statistical distribution method with 95% protection.

Nickel

A freshwater high reliability trigger value of 11 µg/L was calculated for nickel using the statistical distribution method at 95% protection. This applies to low hardness waters, 30 mg/L as CaCO3.

Zinc

A freshwater high reliability trigger value of 8 µg/L was calculated for zinc using the statistical distribution method with 95% protection. This applies at hardness of 30 mg/L of CaCO3.
A marine high reliability trigger value of 15 µg/L was calculated for zinc using the statistical distribution method with 95% protection.

Metal	Marine water (µg/L)	Estuarine water (µg/L)	Fresh water (µg/L)	Country
Arsenic	1.0–1.6 ^a	1.0–3.3 ^m	NI	Australia
Cadmium	0.01–0.2 ^b	NI	0.002–0.08 ^b	USA
	0.001–1.1 ^c	NI	0.01 ^d ; 0.002–0.1 ^e ; 0.08 ^k	World
	0.002–0.7 ^{a,f}	0.002–0.026 ^{g,m}	0.001 ^g	Australia
		0.51–1.2 ^h		
	NI	NI	0.008 ⁱ	New Zealand
Copper	0.1–3 ^b	NI	0.4–4 ^b	USA
	0.003–0.37 ⁱ	NI	1.5 ^d	World
	0.025–0.38 ^a	0.06–1.3 ^{g,m}	0.11 ^g	Australia
	0.1–0.2 ^j	NI	0.15 ⁱ	New Zealand
Chromium	0.062–0.1 ^a	0.01–0.1 ^m	NI	Australia
Iron	0.006–0.14 ^c	<0.04–13.7 ^m	40 ^d	World
	NI	0.76–67 ^{g,m}	NI	Australia
Lead	0.01– 1 ^b	NI	0.01–0.19 ^b	USA
	<0.006–0.03 ^a	0.02–0.13 ^m	NI	Australia
	NI	NI	0.02–0.03 ⁱ	New Zealand
Manganese	0.003–0.38 ^c	NI	1.5 ^d	World
	NI	0.55–3.1 ^g	NI	Australia
Mercury	NI	0.0007–0.003 ^m	0.01 ^k	World
	NI	0.0017 ^m	NI	Australia
Nickel	0.3–5 ^b	NI	1–2 ^b	USA
	0.12–0.7 ^c	NI	0.5 ^d ; 3.3 ^k	World
	0.13–0.5 ^a	0.14–1.10 ^{g,m}	0.10 ^g	Australia
	0.33 ^j	NI	0.1–0.15 ⁱ	New Zealand
Silver	0.006–0.2 ^b	NI	NI	USA
	<0.0005 ^a	NI	NI	Australia
Zinc	0.1–15 ^b		0.03–5 ^b	USA
	0.003–0.59 ^c		0.6 ^d ; 2.8 ^k	World
	<0.022–0.1 ^a	0.39–3.8 ^{g,m}	0.9 ^g	Australia
		0.4–1.8 ^h		
	0.005–0.02 ^j		0.15–0.2 ⁱ	New Zealand

Footnotes: NI = No information found. References: a = Apte et al. 1998; b = Prothro 1993; c = Bruland 1983; d = 'World average' Martin & Windom 1991; e = Canada: Stephenson & Mackie 1988; f = NW Shelf, Australia: Mackey 1984; g = Bathurst Harbour & Old River, Tasmania: Mackey et al. 1996; h = Higgins & Mackey 1987; i = Ahlers et al. 1991; j = Dickson & Hunter 1981; k = Geometric mean in The Netherlands: RIVM 1999; m = Port Phillip Bay: CSIRO 1996.

Runoff	Rain Event	Time [s]	Time [a]		Intensity I [mm/h]	Stormwater Runoff Flow		Event	Event Volume [m3]
	5yr - 10min	600	0.00002		90.0				
Area AC			Run-off coefficient C			Run-off Qci [m3/s]		Qci [l/s]	
No.	[m2]	[ha]	Coef.	slope [%]	Slope cor.	per Area	total		
Roofs									
Roofs (average)	78615	7.86	0.90	10.0	0	1.769	1.769	1768.847	1061.308
Roads - Vehicles per day									
<1000	19101	1.91	0.90	10.0	0	0.430	0.430	429.783	257.870
1000-5000	19101	1.91	0.90	10.0	0	0.430	0.430	429.783	257.870
5000-20000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
20000-50000	8862	0.89	0.90	10.0	0	0.199	0.199	199.388	119.633
50000-100000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
>100000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
Roads (sum)	47065	4.71	0.90	10.0	0	1.059	1.059	1058.954	635.372
Paved Surfaces other than roads									
Residential	49188	4.92	0.85	10.0	0	1.045	1.045	1045.251	627.151
Industrial	79789	7.98	0.85	10.0	0	1.696	1.696	1695.519	1017.311
Commercial	0	0.00	0.85	10.0	0	0.000	0.000	0.000	0.000
Urban Grass lands									
<10	168229	16.82	0.25	10.0	0	1.051	1.051	1051.429	630.858
10 to 20	168229	16.82	0.25	12.5	0.05	1.262	1.262	1261.715	757.029
>20	0	0.00	0.25	25.0	0.1	0.000	0.000	0.000	0.000
Urban Stream Channel	0	0.00	0.70	10.0	0	0.000	0.000	0.000	0.000
Urban area without construction sides							7.882	7881.715	4729.029

First flush volume
1hour storm

Rainfall Intensity Charts	
5yr - 10min	
Urban	
Te Puke	90

28374

Contaminant Load Model
(based on ARC guidelines - CLM May 2006)

Catchment: Te Puke/ Ohineangaanga Stream – eastern tributary
Outfall: SWCO0941

	Catchment Area (m²)		75438.9	Total Suspended Solids (TSS)		Zinc		Cooper		Total Petroleum Hydrocarbons (TPH)	
Source	Source Type		Source Area (m²)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)
Roofs (average)			15638.4	5.00	78192.08	0.04	625.54	0.00	12.51		
Roads	Vehicles per day	Length (m)									
	<1000		6858.1	4.00	27432.24	0.02	144.02	0.01	48.01	0.11	754.39
	1000-5000		6858.1	30.00	205741.80	0.11	733.81	0.03	239.35	0.54	3703.35
	5000-20000			150.00	0.00	0.54	0.00	0.17	0.00	2.68	0.00
	20000-50000			299.00	0.00	1.07	0.00	0.35	0.00	5.34	0.00
	50000-100000			300.00	0.00	2.28	0.00	0.74	0.00	11.41	0.00
	>100000			300.00	0.00	3.53	0.00	1.15	0.00	17.66	0.00
Roads (sum)			13716.1		233174.04		877.83		287.35		4457.74
Paved Surfaces other than roads	Residential		7287.1	20.00	145741.40	0.07	510.09	0.01	72.87		
	Industrial			50.00	0.00	0.10	0.00	0.13	0.00		
	Commercial		13882.1	100.00	1388210.000	0.05	694.11	0.05	694.11		
Urban Grass lands	Slope	<10	24915.2	35.00	872032.95		0.00		0.00		
		10 to 20	0.0	80.00	0.00		0.00		0.00		
		>20	0.0	160.00	0.00		0.00		0.00		
Urban Stream Channel	length x width		0.0	6000.00	0.00		0.00		0.00		
Urban area without construction sides			75438.9		2717350.5		2707.6		1066.8		4457.7
Catchment Totals				Total Suspended Solids (TSS)		Zinc		Cooper		Total Petroleum Hydrocarbons (TPH)	
Outfall Loads (g*a ⁻¹)					2717350.47		2707.57		1066.84		4457.74
Outfall Loads (kg*a ⁻¹)					2717.35		2.71		1.07		4.46
Average Yield (g*ha*a ⁻¹)				36020.53		358.91		141.42		590.91	
Average Yield (kg*ha*a ⁻¹)				360.21		3.59		1.41		5.91	
Event Volume [m3]	759.625	Event Volume (L)	759625.3								
Average Mass - Load (mg)											
Average Mass - Load (g)											
Average Mass - Load (kg)											
Density (g*cm ⁻³)							7.14		8.96		0.83
Density (kg*m ⁻³)							7140.00		8960.00		830.00
Note: Concentrations do not include any pretreatment.											
Average concentrations (mg*kg-1)							996.40		392.60		1640.47
Average concentrations (mg*m ⁻³)							7114296.57		3517720.25		1361592.26
Average concentrations (µg*L ⁻¹)							7.11430		3.51772		1.36159
Average concentrations (g*m ⁻³)							1.00		0.39		1.64
Guideline concentrations (µg*L ⁻¹)							<8		<1.3		
Guideline concentrations (g*m ⁻³)					<150						<15

NATIONAL WATER QUALITY MANAGEMENT STRATEGY

Australian and New Zealand Guidelines for Fresh and Marine Water Quality - trigger values

Arsenic

A high reliability freshwater trigger value of 24 µg/L was derived for arsenic (III) using the statistical distribution method with 95% protection.
An Environmental Concern Level (ECL, see Section 8.3.4.5) of 2.3 µg/L was derived for As (III) in marine waters, using an AF of 100. This figure could be adopted as a marine low reliability trigger value, to be used only as an indicative interim working level.
Further review at a later revision may produce a more reliable trigger value.

Chromium

A low reliability freshwater trigger value for chromium (III) of 3.3 µg/L was derived using the AF method (a factor of 20 was applied to the lowest, O. mykiss figure, from a limited set of chronic data). This applies to low hardness water at 30 mg/L as CaCO3. This figure should only be used as an indicative interim working level.
A marine moderate reliability trigger value for chromium (III) of 10 µg/L was derived, using the statistical distribution method with 95% protection and an ACR of 77.6.
A freshwater high reliability trigger value for chromium (VI) of 1.0 µg/L was derived using the statistical distribution method at 95% protection.
A marine high reliability trigger value for chromium (VI) of 4.4 µg/L was derived using the statistical distribution method at 95% protection.

Copper

A freshwater high reliability trigger value for copper of 1.4 µg/L was derived using the statistical distribution method with 95% protection. This applies to waters of hardness of 30 mg/L as CaCO3.
A marine high reliability trigger value for copper of 1.3 µg/L was derived using the statistical distribution method with 95% protection. This figure is above the converted NOEC for Mytilus edulis but below the experimental EC50 (2 µg/L) and is considered appropriate for slightly-moderately disturbed systems.

Lead

A high reliability freshwater trigger value for lead of 3.4 µg/L was calculated using the statistical distribution method at 95% protection. This applies to waters of low hardness, 30 mg/L as CaCO3.
A marine high reliability trigger value for lead of 4.4 µg/L was calculated using the statistical distribution method with 95% protection.

Nickel

A freshwater high reliability trigger value of 11 µg/L was calculated for nickel using the statistical distribution method at 95% protection. This applies to low hardness waters, 30 mg/L as CaCO3.

Zinc

A freshwater high reliability trigger value of 8 µg/L was calculated for zinc using the statistical distribution method with 95% protection. This applies at hardness of 30 mg/L of CaCO3.
A marine high reliability trigger value of 15 µg/L was calculated for zinc using the statistical distribution method with 95% protection.

Metal	Marine water (µg/L)	Estuarine water (µg/L)	Fresh water (µg/L)	Country
Arsenic	1.0–1.6 ^a	1.0–3.3 ^m	NI	Australia
Cadmium	0.01–0.2 ^b	NI	0.002–0.08 ^b	USA
	0.001–1.1 ^c	NI	0.01 ^d ; 0.002–0.1 ^e ; 0.08 ^k	World
	0.002–0.7 ^{a,f}	0.002–0.026 ^{g,m}	0.001 ^g	Australia
		0.51–1.2 ^h		
	NI	NI	0.008 ⁱ	New Zealand
Copper	0.1–3 ^b	NI	0.4–4 ^b	USA
	0.003–0.37 ⁱ	NI	1.5 ^d	World
	0.025–0.38 ^a	0.06–1.3 ^{g,m}	0.11 ^g	Australia
	0.1–0.2 ^j	NI	0.15 ⁱ	New Zealand
Chromium	0.062–0.1 ^a	0.01–0.1 ^m	NI	Australia
Iron	0.006–0.14 ^c	<0.04–13.7 ^m	40 ^d	World
	NI	0.76–67 ^{g,m}	NI	Australia
Lead	0.01– 1 ^b	NI	0.01–0.19 ^b	USA
	<0.006–0.03 ^a	0.02–0.13 ^m	NI	Australia
	NI	NI	0.02–0.03 ⁱ	New Zealand
Manganese	0.003–0.38 ^c	NI	1.5 ^d	World
	NI	0.55–3.1 ^g	NI	Australia
Mercury	NI	0.0007–0.003 ^m	0.01 ^k	World
	NI	0.0017 ^m	NI	Australia
Nickel	0.3–5 ^b	NI	1–2 ^b	USA
	0.12–0.7 ^c	NI	0.5 ^d ; 3.3 ^k	World
	0.13–0.5 ^a	0.14–1.10 ^{g,m}	0.10 ^g	Australia
	0.33 ^j	NI	0.1–0.15 ⁱ	New Zealand
Silver	0.006–0.2 ^b	NI	NI	USA
	<0.0005 ^a	NI	NI	Australia
Zinc	0.1–15 ^b		0.03–5 ^b	USA
	0.003–0.59 ^c		0.6 ^d ; 2.8 ^k	World
	<0.022–0.1 ^a	0.39–3.8 ^{g,m}	0.9 ^g	Australia
		0.4–1.8 ^h		
	0.005–0.02 ^j		0.15–0.2 ⁱ	New Zealand

Footnotes: NI = No information found. References: a = Apte et al. 1998; b = Prothro 1993; c = Bruland 1983; d = 'World average' Martin & Windom 1991; e = Canada: Stephenson & Mackie 1988; f = NW Shelf, Australia: Mackey 1984; g = Bathurst Harbour & Old River, Tasmania: Mackey et al. 1996; h = Higgins & Mackey 1987; i = Ahlers et al. 1991; j = Dickson & Hunter 1981; k = Geometric mean in The Netherlands: RIVM 1999; m = Port Phillip Bay: CSIRO 1996.

Runoff	Rain Event	Time [s]	Time [a]		Intensity I [mm/h]	Stormwater Runoff Flow		Event	Event Volume [m3]
	5yr - 10min	600	0.00002		90.0				
Area AC			Run-off coefficient C			Run-off Qci [m3/s]		Qci [l/s]	
No.	[m2]	[ha]	Coef.	slope [%]	Slope cor.	per Area	total		
Roofs									
Roofs (average)	15638	1.56	0.90	10.0	0	0.352	0.352	351.864	211.119
Roads - Vehicles per day									
<1000	6858	0.69	0.90	10.0	0	0.154	0.154	154.306	92.584
1000-5000	6858	0.69	0.90	10.0	0	0.154	0.154	154.306	92.584
5000-20000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
20000-50000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
50000-100000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
>100000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
Roads (sum)	13716	1.37	0.90	10.0	0	0.309	0.309	308.613	185.168
Paved Surfaces other than roads									0.000
Residential	7287	0.73	0.85	10.0	0	0.155	0.155	154.850	92.910
Industrial	0	0.00	0.85	10.0	0	0.000	0.000	0.000	0.000
Commercial	13882	1.39	0.85	10.0	0	0.295	0.295	294.995	176.997
Urban Grass lands									0.000
<10	24915	2.49	0.25	10.0	0	0.156	0.156	155.720	93.432
10 to 20	0	0.00	0.25	12.5	0.05	0.000	0.000	0.000	0.000
>20	0	0.00	0.25	25.0	0.1	0.000	0.000	0.000	0.000
Urban Stream Channel	0	0.00	0.70	10.0	0	0.000	0.000	0.000	0.000
Urban area without construction sides							1.266	1266.042	759.625

First flush volume
1hour storm

Rainfall Intensity Charts	
5yr - 10min	
Urban	
Te Puke	90

Contaminant Load Model
(based on ARC guidelines - CLM May 2006)

Catchment: Maketu
Outfall: SWCO1045

	Catchment Area (m ²)		36323.1	Total Suspended Solids (TSS)		Zinc		Cooper		Total Petroleum Hydrocarbons (TPH)	
Source	Source Type	Source Area (m ²)		Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)	Yield (g*m ⁻² a ⁻¹)	Load (g*a ⁻¹)
Roofs (average)		3329.5		5.00	16647.46	0.04	133.18	0.00	2.66		
Roads	Vehicles per day	Length (m)									
	<1000		953.2	4.00	3813.00	0.02	20.02	0.01	6.67	0.11	104.86
	1000-5000		5467.0	30.00	164009.38	0.11	584.97	0.03	190.80	0.54	2952.17
	5000-20000			150.00	0.00	0.54	0.00	0.17	0.00	2.68	0.00
	20000-50000			299.00	0.00	1.07	0.00	0.35	0.00	5.34	0.00
	50000-100000			300.00	0.00	2.28	0.00	0.74	0.00	11.41	0.00
	>100000			300.00	0.00	3.53	0.00	1.15	0.00	17.66	0.00
Roads (sum)			6420.2		167822.37		604.99		197.47		3057.03
Paved Surfaces other than roads	Residential		2823.6	20.00	56471.90	0.07	197.65	0.01	28.24		
	Industrial			50.00	0.00	0.10	0.00	0.13	0.00		
	Commercial		677.4	100.00	67741.680	0.05	33.87	0.05	33.87		
Urban Grass lands	Slope	<10	23072.3	35.00	807532.17		0.00		0.00		
		10 to 20	0.0	80.00	0.00		0.00		0.00		
		>20	0.0	160.00	0.00		0.00		0.00		
Urban Stream Channel	length x width		0.0	6000.00	0.00		0.00		0.00		
Urban area without construction sides											
			36323.1		1116215.6		969.7		262.2		3057.0
Catchment Totals											
			Total Suspended Solids (TSS)		Zinc		Cooper		Total Petroleum Hydrocarbons (TPH)		
Outfall Loads (g*a ⁻¹)					1116215.58		969.69		262.24		3057.03
Outfall Loads (kg*a ⁻¹)					1116.22		0.97		0.26		3.06
Average Yield (g*ha*a ⁻¹)				30730.20		266.96		72.20		841.62	
Average Yield (kg*ha*a ⁻¹)				307.30		2.67		0.72		8.42	
Event Volume [m3]											
			262.780	Event Volume (L)	262780.4						
Average Mass - Load (mg)											
Average Mass - Load (g)											
Average Mass - Load (kg)											
Density (g*cm ⁻³)							7.14		8.96		0.83
Density (kg*m ⁻³)							7140.00		8960.00		830.00
Note: Concentrations do not include any pretreatment.											
Average concentrations (mg*kg-1)							868.73		234.94		2738.74
Average concentrations (mg*m ⁻³)							6202714.28		2105038.42		2273155.64
Average concentrations (µg*L ⁻¹)							6.20271		2.10504		2.27316
Average concentrations (g*m ⁻³)							0.87		0.23		2.74
Guideline concentrations (µg*L ⁻¹)											
Guideline concentrations (g*m ⁻³)					<150		<8		<1.3		<15

NATIONAL WATER QUALITY MANAGEMENT STRATEGY

Australian and New Zealand Guidelines for Fresh and Marine Water Quality - trigger values

Arsenic

A high reliability freshwater trigger value of 24 µg/L was derived for arsenic (III) using the statistical distribution method with 95% protection.
An Environmental Concern Level (ECL, see Section 8.3.4.5) of 2.3 µg/L was derived for As (III) in marine waters, using an AF of 100. This figure could be adopted as a marine low reliability trigger value, to be used only as an indicative interim working level.
Further review at a later revision may produce a more reliable trigger value.

Chromium

A low reliability freshwater trigger value for chromium (III) of 3.3 µg/L was derived using the AF method (a factor of 20 was applied to the lowest, O. mykiss figure, from a limited set of chronic data). This applies to low hardness water at 30 mg/L as CaCO3. This figure should only be used as an indicative interim working level.
A marine moderate reliability trigger value for chromium (III) of 10 µg/L was derived, using the statistical distribution method with 95% protection and an ACR of 77.6.
A freshwater high reliability trigger value for chromium (VI) of 1.0 µg/L was derived using the statistical distribution method at 95% protection.
A marine high reliability trigger value for chromium (VI) of 4.4 µg/L was derived using the statistical distribution method at 95% protection.

Copper

A freshwater high reliability trigger value for copper of 1.4 µg/L was derived using the statistical distribution method with 95% protection. This applies to waters of hardness of 30 mg/L as CaCO3.
A marine high reliability trigger value for copper of 1.3 µg/L was derived using the statistical distribution method with 95% protection. This figure is above the converted NOEC for Mytilus edulis but below the experimental EC50 (2 µg/L) and is considered appropriate for slightly-moderately disturbed systems.

Lead

A high reliability freshwater trigger value for lead of 3.4 µg/L was calculated using the statistical distribution method at 95% protection. This applies to waters of low hardness, 30 mg/L as CaCO3.
A marine high reliability trigger value for lead of 4.4 µg/L was calculated using the statistical distribution method with 95% protection.

Nickel

A freshwater high reliability trigger value of 11 µg/L was calculated for nickel using the statistical distribution method at 95% protection. This applies to low hardness waters, 30 mg/L as CaCO3.

Zinc

A freshwater high reliability trigger value of 8 µg/L was calculated for zinc using the statistical distribution method with 95% protection. This applies at hardness of 30 mg/L of CaCO3.
A marine high reliability trigger value of 15 µg/L was calculated for zinc using the statistical distribution method with 95% protection.

Metal	Marine water (µg/L)	Estuarine water (µg/L)	Fresh water (µg/L)	Country
Arsenic	1.0–1.6 ^a	1.0–3.3 ^m	NI	Australia
Cadmium	0.01–0.2 ^b	NI	0.002–0.08 ^b	USA
	0.001–1.1 ^c	NI	0.01 ^d ; 0.002–0.1 ^e ; 0.08 ^k	World
	0.002–0.7 ^{a,f}	0.002–0.026 ^{g,m}	0.001 ^g	Australia
		0.51–1.2 ^h		
	NI	NI	0.008 ⁱ	New Zealand
Copper	0.1–3 ^b	NI	0.4–4 ^b	USA
	0.003–0.37 ⁱ	NI	1.5 ^d	World
	0.025–0.38 ^a	0.06–1.3 ^{g,m}	0.11 ^g	Australia
	0.1–0.2 ^j	NI	0.15 ⁱ	New Zealand
Chromium	0.062–0.1 ^a	0.01–0.1 ^m	NI	Australia
Iron	0.006–0.14 ^c	<0.04–13.7 ^m	40 ^d	World
	NI	0.76–67 ^{g,m}	NI	Australia
Lead	0.01– 1 ^b	NI	0.01–0.19 ^b	USA
	<0.006–0.03 ^a	0.02–0.13 ^m	NI	Australia
	NI	NI	0.02–0.03 ⁱ	New Zealand
Manganese	0.003–0.38 ^c	NI	1.5 ^d	World
	NI	0.55–3.1 ^g	NI	Australia
Mercury	NI	0.0007–0.003 ^m	0.01 ^k	World
	NI	0.0017 ^m	NI	Australia
Nickel	0.3–5 ^b	NI	1–2 ^b	USA
	0.12–0.7 ^c	NI	0.5 ^d ; 3.3 ^k	World
	0.13–0.5 ^a	0.14–1.10 ^{g,m}	0.10 ^g	Australia
	0.33 ^j	NI	0.1–0.15 ⁱ	New Zealand
Silver	0.006–0.2 ^b	NI	NI	USA
	<0.0005 ^a	NI	NI	Australia
Zinc	0.1–15 ^b		0.03–5 ^b	USA
	0.003–0.59 ^c		0.6 ^d ; 2.8 ^k	World
	<0.022–0.1 ^a	0.39–3.8 ^{g,m}	0.9 ^g	Australia
		0.4–1.8 ^h		
	0.005–0.02 ^j		0.15–0.2 ⁱ	New Zealand

Footnotes: NI = No information found. References: a = Apte et al. 1998; b = Prothro 1993; c = Bruland 1983; d = 'World average' Martin & Windom 1991; e = Canada: Stephenson & Mackie 1988; f = NW Shelf, Australia: Mackey 1984; g = Bathurst Harbour & Old River, Tasmania: Mackey et al. 1996; h = Higgins & Mackey 1987; i = Ahlers et al. 1991; j = Dickson & Hunter 1981; k = Geometric mean in The Netherlands: RIVM 1999; m = Port Phillip Bay: CSIRO 1996.

Runoff	Rain Event	Time [s]	Time [a]		Intensity I [mm/h]	Stormwater Runoff Flow		Event	Event Volume [m3]
	5yr - 10min	600	0.00002		90.0				
Area AC			Run-off coefficient C			Run-off Qci [m3/s]		Qci [l/s]	
No.	[m2]	[ha]	Coef.	slope [%]	Slope cor.	per Area	total		
Roofs									
Roofs (average)	3329	0.33	0.90	10.0	0	0.075	0.075	74.914	44.948
Roads - Vehicles per day									
<1000	953	0.10	0.90	10.0	0	0.021	0.021	21.448	12.869
1000-5000	5467	0.55	0.90	10.0	0	0.123	0.123	123.007	73.804
5000-20000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
20000-50000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
50000-100000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
>100000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
Roads (sum)	6420	0.64	0.90	10.0	0	0.144	0.144	144.455	86.673
Paved Surfaces other than roads									
Residential	2824	0.28	0.85	10.0	0	0.060	0.060	60.001	36.001
Industrial	0	0.00	0.85	10.0	0	0.000	0.000	0.000	0.000
Commercial	677	0.07	0.85	10.0	0	0.014	0.014	14.395	8.637
Urban Grass lands									
<10	23072	2.31	0.25	10.0	0	0.144	0.144	144.202	86.521
10 to 20	0	0.00	0.25	12.5	0.05	0.000	0.000	0.000	0.000
>20	0	0.00	0.25	25.0	0.1	0.000	0.000	0.000	0.000
Urban Stream Channel	0	0.00	0.70	10.0	0	0.000	0.000	0.000	0.000
Urban area without construction sides							0.438	437.967	262.780

First flush volume
1hour storm

Rainfall Intensity Charts	
5yr - 10min	
Urban	
Te Puke	90

Appendix H

Cultural Impact
Assessments, Eastern
Catchments, 2013

Received in the Month
26/11/2013 JGH
Copy 2



Eastern Catchment

December 2013



Prepared by Maria Horne

This report has been prepared for the purpose of providing advice to WBOPDC, Utilities Department. The information contained within this report should not be used outside of its original purpose, than that outlined in this report. Any other use of this information must be confirmed in writing by the author of the document.

Table of Contents

Cultural Impact Assessment	4
Executive Summary.....	4
1.0 Introduction.....	6
1.1 Project Brief.....	6
1.2 Scope of the Project.....	7
2.0 Legislation	13
2.1 Resource Management Act 1991	13
2.2 Iwi Resource Management Plans	14
2.3 Iwi Resource Management Plans currently lodged with Regional Council.....	15
2.4 Hapu Management Plans currently lodged with WBOPDC	16
3.0 Treaty Claims Statutory Acknowledgments	17
3.1 Deed of Settlements	17
3.2 Not Settled Claims	19
4.0 Primary Affected Tangata Whenua Groups	20
4.1. Tapuika.....	21
4.2 Ngāti Whakaue	22
4.3 Ngāti Whakahemo	24
4.4 Waitaha.....	25
4.5 Other Iwi Interests in the Eastern Catchment.....	26
5.0 Māori Values & Cultural Connections.....	27
5.1 Te Taiao (The Environment).....	28
5.2 Kaituna River	28
5.2.1 Significance to Tapuika	29
5.2.1 Significance to Waitaha	30
5.3 Maketu Estuary (Te Awa Kari o Ngātoroirangi).....	31
5.4 Waihi Estuary	33
5.5 Waiari Stream.....	34
5.6 Ohineangaanga Stream.....	38
5.7 Te Raparapa-ā-Hoe Stream	39
5.8 Kirikiri Stream	40
6.0 Historical Accounts of Land Areas	42
6.1 Te Puke.....	42

6.1.1	Pukehina Peninsula.....	43
6.1.3	Paengaroa	45
7.0	Key Issues	48
8.0	Mitigation of Effects	50
8.1	Wetlands	50
9.0	Consultation	52
9.1	Iwi Authorities	52
9.2	Joint Consultation	53
10.0	Cultural Heritage.....	54
10.1	Cultural Heritage	54
11.0	Recommendations.....	63
11.1	Recommendations to Consenting Authority (Council / HPT)	63
11.2	Recommendations to the Applicant.....	63
12.0	Contacts List	65
	References & Resources	66
	Appendix One (Glossary)	66
	Appendix Two (Abbreviations).....	68
	Appendix Three (Gazette Notice).....	69

Cultural Impact Assessment

Executive Summary

The purpose of this cultural impacts assessment is to provide a guideline for the Western Bay of Plenty Council (WBOPDC) utilities department in managing the consultation process with the affected Iwi (tribes) in implementing the Eastern Catchment comprehensive storm-water catchment.

The Eastern Catchment will include the township of Te Puke, and the rural communities of Maketu, Little Waihi, Paengaroa and Pukehina.

The consultation process affects at least four Iwi with 'ahikā roa' (long occupation) in the areas between Te Puke to Pukehina. There is also Statutory Acknowledgements along the coastal line to consider and Iwi Management Plans that have already been lodged with Regional Council, Bay of Plenty.

The cultural effects that are of main concern to tangata whenua (people of the land) are on the waterways in each area. There are wāhi tapu (sacred areas) and wāhi whakahirahira (places of importance) that have been identified, and supported by archeological maps. The historical accounts are based on tribal and archived history. One concern in particular is for the Pukehina peninsula where a major battle took place which was described of a 'large magnitude' however there are no archeological sites recorded with NZHPT.

There is opposition to direct discharge of storm water into the waterways. This assessment suggests natural cleansing methods be carried out that include the use of wetlands and swales; Tangata whenua (people of the land) regard a site visit with WBOPDC utilities staff to familiarize and understand the comprehensive storm-water consent as imperative.

The earthworks that are undertaken must have a cultural monitor present. Also the debris that is removed from these works is disposed of after consultation has taken place. There was also concern on the ecology and habitats of the waterways that are affected by this consent.

Tangata whenua want to see the qualitative data of an ecology report carried out on the well-being of the eels, fish, shellfish and wildlife. The waterways must be able to sustain themselves and all the living beings within the environment.

The Iwi groups have highlighted they support an education package being formed that will promote and educate the planting of wetland areas and the recording cultural heritage discoveries and sharing that information with the district schools as relevant.

The Eastern Catchment may have an impact on an increase in rates. The communities and tangata whenua (people of the land) are concerned with the affordability of rates. This requires further consultation with the communities that will be affected.

The overall impression of the Eastern Catchment to tangata whenua (people of the land) is that because of the size of this catchment and the duration of the consent, Iwi (tribes) support the formation of a 'Kaitiakitanga Komiti' (guardianship committee) that is resourced by the WBOPDC to work alongside council on this project, to design a protocol that satisfies councils requirements and the affected tangata whenua (people of the land) to ensure that this comprehensive storm-water consent is based on a definite need that will be of benefit to the waterways, the environment and the communities.

1.0 Introduction

1.1 Project Brief

The Western Bay of Plenty District Council (WBOPDC) has commissioned the writer to carry out a cultural impacts assessment with Hapu (waterways) and Iwi (tribes) that are the main tribal groups within the Eastern Catchment. It is their intention to apply for resource consent for a proposed term of 35 years under the Resource Management Act 1991 to carry out a comprehensive storm-water catchment within the following areas:

- Te Puke
- Paengaroa
- Maketu / Waihi
- Pukehina

In 2005, the Bay of Plenty Regional Council published a Regional Storm-water Strategy in collaboration with WBOPDC. It aims to better manage storm-water and improve water quality discharges into waterways which in turn will create efficient capital expenditure and savings. Historically storm-water consents are administered individually with specific terms and conditions associated with each application. This is difficult to manage effectively. Better management of the storm-water catchment can lead to improvements in water quality, a reduction in flooding and the effective use of funding for storm-water upgrades.

The WBOPDC commissioned the writer to assist the council staff in identifying the cultural impacts that the comprehensive storm-water catchment will have on Hapu (waterways) and Iwi (tribe) whom reside within the boundaries of the WBOPDC Eastern Catchment.

Those Iwi / Hapu that have contributed to this assessment include:

- i. Tapuika Iwi Authority & the Resource Management Unit (RMU) representative
- ii. Te Raupatu o Waitaha RMU representative & Kaumatua (elders)
- iii. Te Rūnanga o Ngāti Whakahemo RMU and Kaumatua
- iv. Te Rūnanga o Ngāti Whakaue ki Maketu & Kaumatua

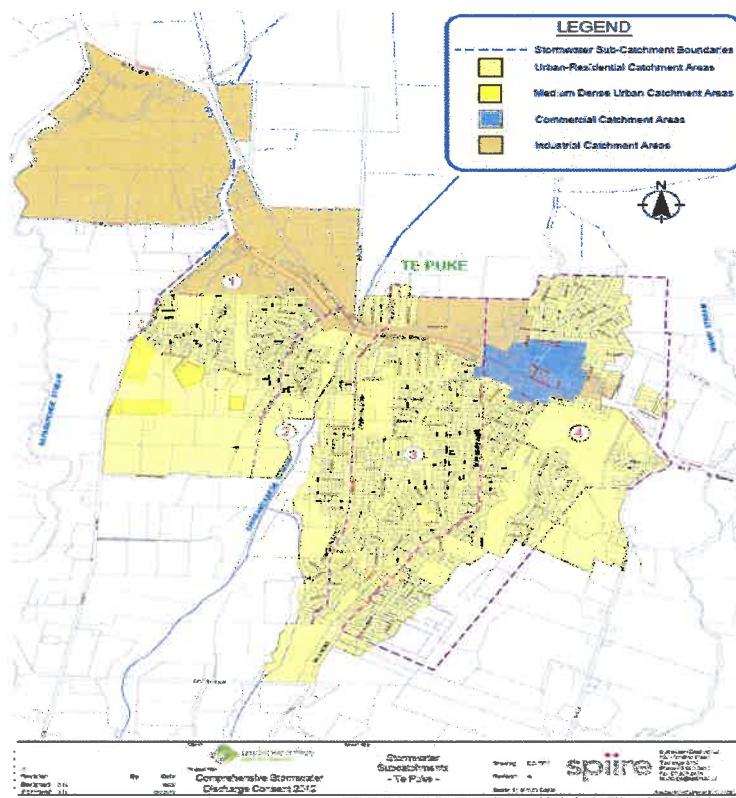
1.2 Scope of the Project

Streams Impacted by the Eastern Comprehensive Storm-water Catchment are located in the following areas:-

a. Te Puke

The streams / tributaries that will be affected by the Eastern Catchment and in accordance with the ecological assessment provided by WBOPDC are:-

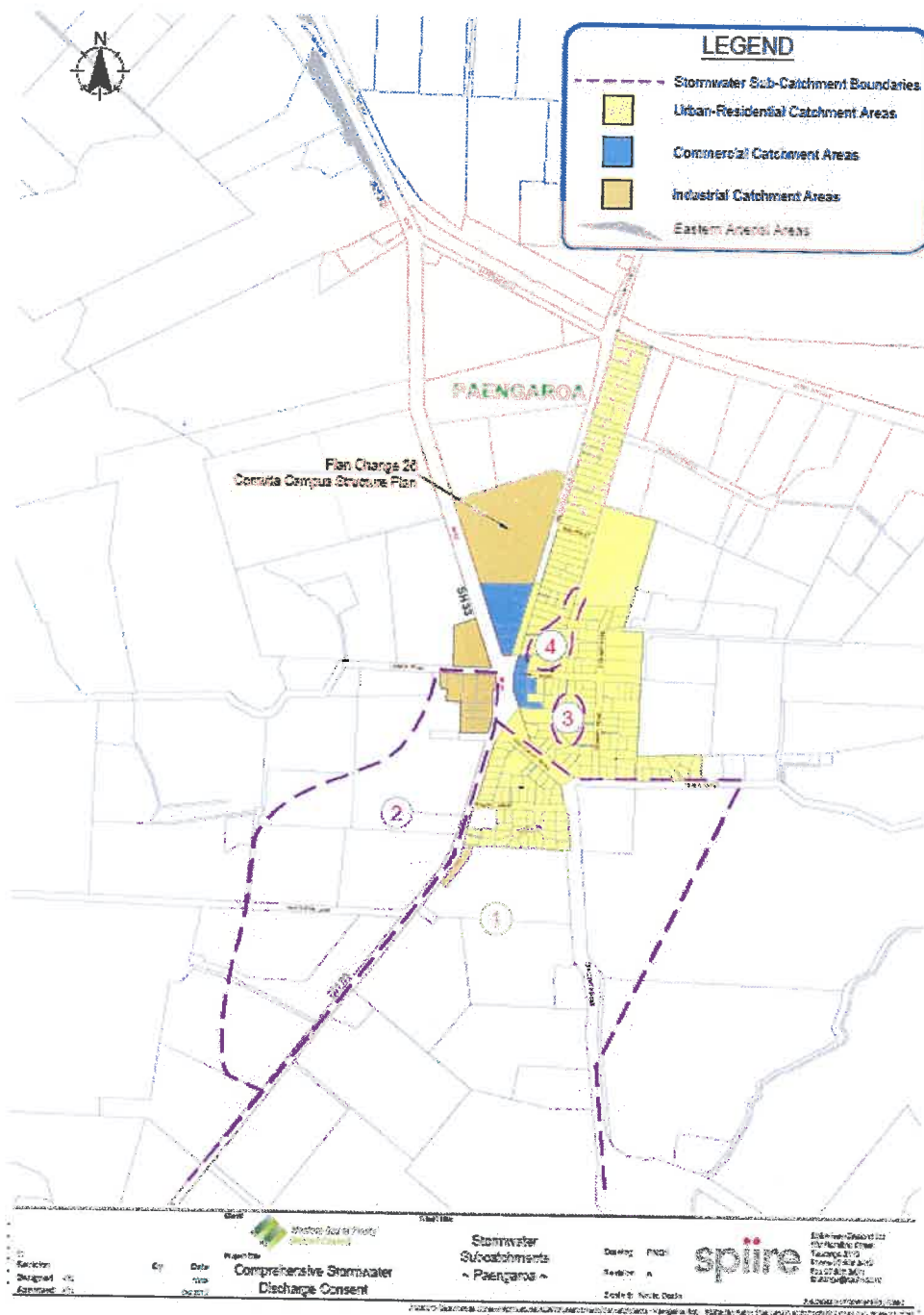
- Kirikiri Stream
- Centennial Park Waterways
- Ohineangaanga Stream
- South-North Drainage Corridor
- Cannell Farm Drive Waterways
- Waiari Stream



Map 1: Te Puke Stormwater Sub Catchment

b. Paengaroa

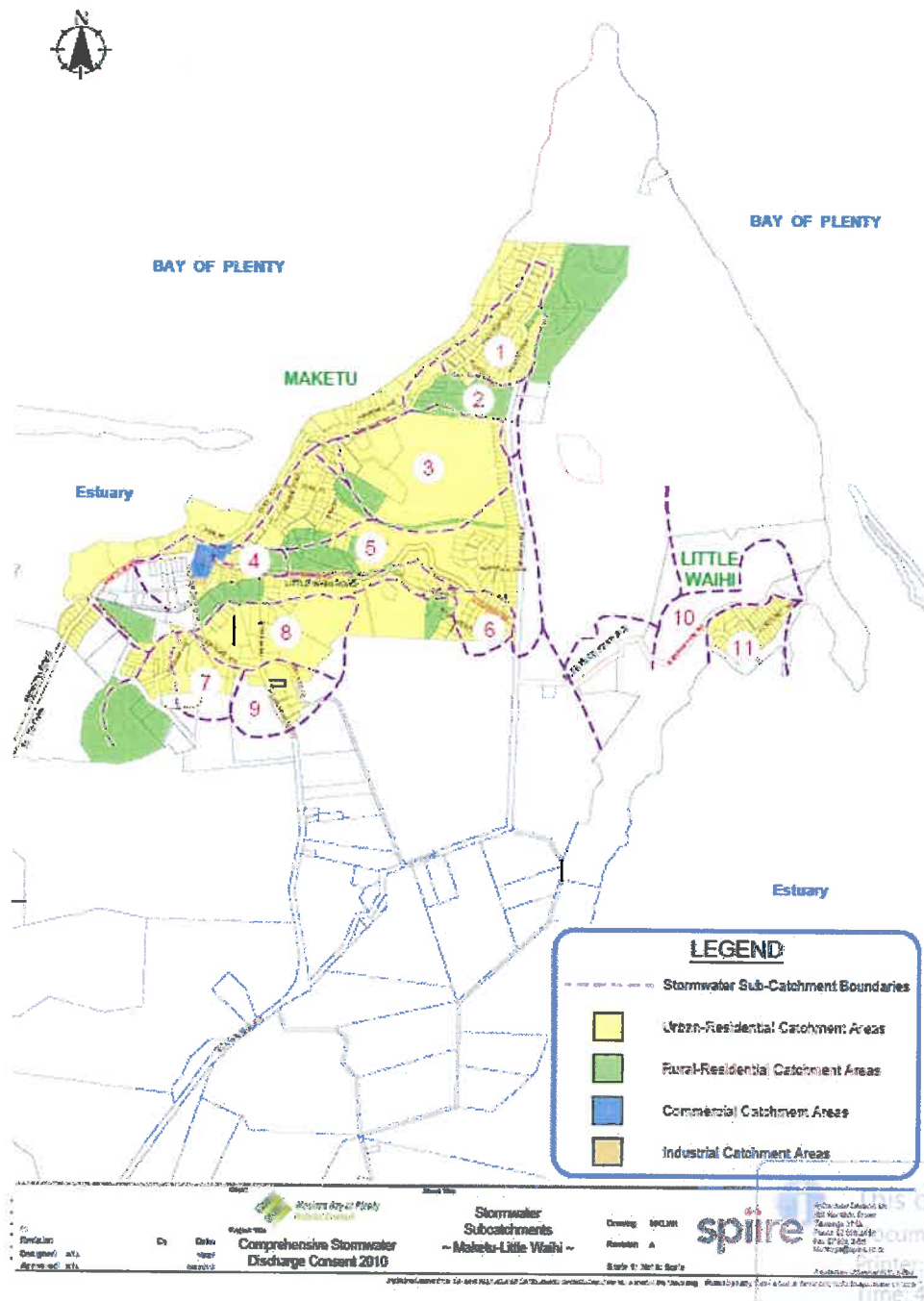
Run-off from Paengaroa is discharged into the Kaituna River and the Kaikokopu Canal and their tributaries draining into the Maketu and Waihi Estuaries.



Map 2: Paengaroa Stormwater Subcatchment

c. Maketu / Waihi

Run-off from Maketu is discharged into various unnamed canals, draining either into the open sea and / or the Maketu and Waihi estuaries.



Map 3: Maketu & Little Waihi Stormwater Subcatchments

d. Pukehina

Run off from the Pukehina discharged into the Pukehina Canal and their distributaries, draining into the Waihi estuary.



Map 4: Pukehina Stormwater Subcatchments

1.3 Methodology

In preparing this cultural impact assessment the following methodology was carried out.

Task	Description
1	Hui and interviews were held with representatives from the above mentioned Iwi / Hapu and with WBOPDC. Ngāti Whakahemo kaumatua – Willoughby Horne Waitaha – Maru Tapsell Tapuika – Dean Flavell, Geoff Rice, Teia Williams Waitaha Kaumatua – Punohu & Tame McClausland Ngāti Whakaue kaumatua – Te Wano Walters Te Rūnanga o Ngāti Whakaue ki Maketu Board Te Rūnanga o Ngāti Whakahemo – James Anderson Iwi Representatives Hui to review and approve draft – 10 Oct 13 WBOPDC – Utilities staff
2	Emails were sent to affected Iwi / Hapu to inform them of the following information: CIA writer approval Cultural effects questionnaire Progress Update of CIA Hui to review CIA in Draft Process 10 Oct, Te Puke Library Those that responded to these emails include: RMU Tapuika – Hohepa Maxwell Tapuika Iwi Authority – Dean Flavell / Geoff Rice Whakahemo Iwi Authority – James Anderson Whakaue Iwi Authority – Maria Horne
3	Telephone conversations with affected Iwi / Hapu as a follow-up: Waitaha Rautapu Office Tapuika Resource Management Unit

4	Desktop Literature Treaty of Waitangi Claims – Statutory Acknowledgements Reviewed. Iwi Resource Management Plans & Environmental Plans lodged with WBOPDC staff and Regional Council. Archeological Sites researched with NZHPT Poutama Unit.
5	Field Research Interviews with Hapu, Iwi kaumatua (elders) and their representatives. Site visits to – Pukehina, Paengaroa, Lemon Road, Te Puke, Ohineangaanga Stream, Maketu and Waihi estuaries, Pukehina culverts and the drains that discharge into the Waihi estuary.
6	Development of assessment framework include: - Executive summary - Legal framework - Affected Hapu and Iwi. - Historical Accounts - Issues - Mitigation Action - Arch Sites recorded - Recommendations
7	Drafting Report - Historical Accounts provided - Charts, photographs, images used to provide visual understanding - Use of registered archaeological sites lodged with NZHPT - Use of writers knowledge - Use of knowledge provided by Hapu and Iwi representatives - Use of WBOPDC information
8	Final draft to client for comment - Presentation of a DRAFT in consultation with the Utilities Manager - Presentation of the DRAFT report to Hapu and Iwi affected for feedback
9	Final Report presented to WBOPDC Utilities Manager

2.0 Legislation

2.1 *Resource Management Act 1991*

Resource Management Act 1991ⁱ

- a) Section 36A – Consultation with tangata whenua is specifically required in response to the policy and planning instrument by virtue of clause 31 (1) (d) of the First Schedule to the RMA. In any event, consultation can be an important means of achieving the RMA Part 2 (and other) Māori considerations.
- b) Section 61, 66 and 74 – Recognition of Iwi Resource Management Plans.
- c) Sections 6 & 7 – The protection of Maori beliefs, values and cultural integrity with their ancestral treasures and the rights to be guardians over such treasures.
- d) Section 8 – Treaty of Waitangi Principles – A High Court finding has stated it is the responsibility of the successors to the Crown, which in this context are the regional and local district councils to accept responsibility for delivering on the Article 2 promise.

Principles

The principles of this cultural impact assessment:-

- a. Rangatiratanga – The right to exercise our right to make final decisions on how a taonga (treasure) are managed developed, used, enhanced and protected.
- b. Kaitiakitanga – The guardianship of the natural resources we are obligated to protect through whakapapa (genealogy) and mana whenua (authority over the land).
- c. Wairuatanga – The respect of the spiritual connection hapu, Iwi have with the natural resources, land and environment.
- d. Manaakitanga – The cooperation of hapu, Iwi, councils and Government to care for the rights and responsibilities of the natural resources, land and environment.
- e. Whanaungatanga – The right to exercise our rights and responsibilities in a way that acknowledges the whakapapa (genealogy) of whanau (family) to the whenua (land) and moana (sea), land, natural resources and environment.
- f. Kotahitanga – The rights and responsibilities in a way that strives towards collective goals whilst recognising the autonomy and needs of each participant.

2.2 Iwi Resource Management Plans

What is an IMP?

A hapū/Iwi resource management plan is a document developed and approved by hapū and/or Iwi. It describes resource management issues of importance to them as tangata whenua (people of the land). The plans may contain information relating to specific cultural values, historical accounts and descriptions of areas of interest.

Hapū and Iwi resource planning documents are recognised by an Iwi Authority that provides a mechanism in which tangata whenua (people of the land) interests can be considered in council decision-making. Specific legislation requires councils to take these plans into account. In practice local authorities must balance a number of competing interests including hapū/Iwi plansⁱⁱ.

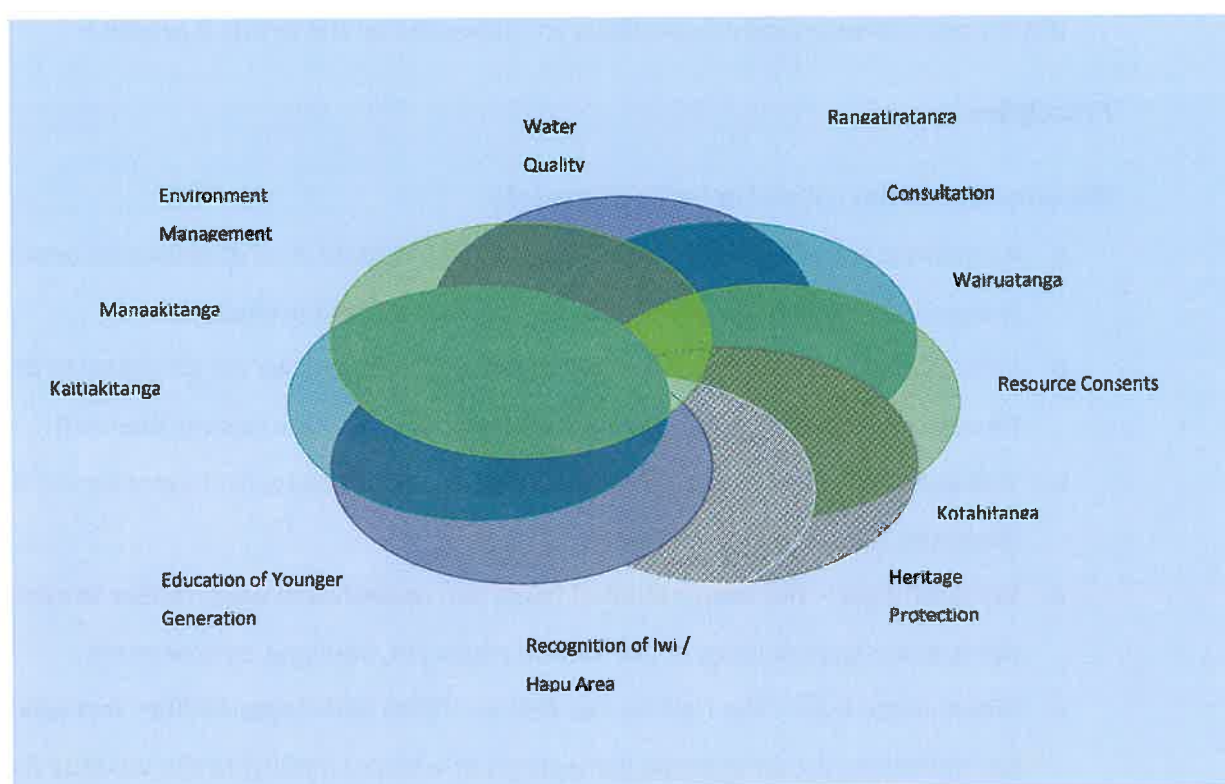


Chart 1: Overarching layers of an Iwi Resource Management Plan.

2.3 Iwi Resource Management Plans currently lodged with Regional Council

Iwi Authority	Plan Name
Te Mana o Ngāti Rangitihi Trust 3 Onewairere Place Phone 07 322 24521 Email: info@ngatirangitihi.iwi.nz	Ngati Rangitihi Iwi Environmental Plan 2011.
Te Rūnanga o Ngāti Whakaue ki Maketu, c/- The Landing Maketu 3138 1 School Rd Maketu Phone 027 2910737 Email runanga@actrix.co.nz	Ngati Whakaue ki Maketu Hapu Iwi Resource Management Plan 2009, Reviewed 2011/2012.
Tapuika Iwi Authority PO Box 15 19 Jellicoe St Te Puke Phone 07 5735351 Email:info@tapuika.iwi.nz	Ngā Aukati Taonga o Tapuika me Waitaha, 1993 - Te Puke/Maketu.
Waitaha Raupatu Trust PO Box 220 10/50 Jellicoe St Te Puke Phone 07 5737483 admin.waitaha@gmail.com	Ngā Aukati Taonga o Tapuika me Waitaha, 1993 - Te Puke/Maketu.

2.4 Hapu Management Plans currently lodged with WBOPDC

Iwi Authority	Plan Name
Te Rūnanga o Ngāti Whakaue ki Maketu, c/- The Landing Maketu 3138 1 School Rd Maketu Phone 027 2910737 Email runanga@actrix.co.nz	Lodged 2008 plan. Awaiting 2011 plan.
Tapuika Iwi Authority PO Box 15 19 Jellicoe St Te Puke Phone 07 5735351 Email:info@tapuika.iwi.nz	No plan lodged. Processing a plan currently.
Waitaha Raupatu Trust PO Box 220 10/50 Jellicoe St Te Puke Phone 07 5737483 Email: admin.waitaha@gmail.com	No plan lodged. Processing a plan currently.
Te Runanga o Ngāti Whakahemo c/- PO Box 4 Te Puke SH2 Pukehina Phone	No plan lodged. Planned for 2014.

Staff should be aware that some Iwi are currently collating and putting a plan together. They have also applied to WBOPDC Hapu Management Plan fund so this gives an indication that at some time in the near future a plan will be lodged and under the RMA 1991 Council will be obligated to recognize the plan.

3.0 Treaty Claims Statutory Acknowledgments

The following Deed of Settlements and in particular Statutory Acknowledgments have been researched to verify which tribes, where and what are the acknowledgments that WBOPDC should be aware of when carrying out the consenting process.

Iwi	Stage of Treaty Claim	Statutory Acknowledgement
Ngāti Pukenga	DoS signed 7 April 2012	Coastal Area Acknowledgement
Tapuika	DoS 16 Dec 2012	Waterways and coastal
Waitaha	DoS November 2011	Waterways and coastal
Ngāti Makino	DoS 13 November 2010	Not affected
Te Pumautanga o Te Arawa	DoS 11 June 2008	Part of Kaituna River
TKNoNW (Ngati Whakaue)	Terms of Negotiation Stage	Will require acknowledgment in the future.
Ngāti Whakahemo	Discussing High Court Act against the Crown	Depending on High Court action, this tribe will require an acknowledgement in the future.

Table 1: Iwi Treaty of Waitangi Claim Settlements

3.1 Deed of Settlements

The Iwi that have negotiated Statutory Acknowledgements within the Eastern Catchment boundaries and the waterways / coastal areas subjected to the Act.

Iwi	Stage of Treaty Claim
Ngāti Pukenga	Deed of Settlement signed 7 April 2012
Tapuika	Deed of Settlement signed 16 Dec 2012
Waitaha	Deed of Settlement signed November 2011

3.1.1 Ngāti Pukenga

A Statutory Acknowledgement of the coastal area only.

Statutory Coastal Area
Te Tumu to Waihi Estuary

3.1.2 Tapuika

The Statutory Reserves, Waterways and the Coastal Marine area.

Maketu Wildlife Management Reserve	Waihi Estuary Wildlife Management Reserve
Kaituna River	Waiari Stream
Ohineangaanga Stream	Te Raparapa-Ā-Hoe Stream
Pokopoko Stream & Scenic Reserve	Mangorewa Stream
Te Rerenga Stream	Kiwi Stream
Whataroa Stream	Ohaupara Stream
Mangatoa Stream	Kaokaonui Stream
Ruato Stream	Onaia Stream
Coastal Marine Area	Coastal area from Wairakei Stream to Waihi Estuary

Table 2: Tapuika Deed of Settlement Waterways

Deed of Settlement also recognizes that the settlement legislation for Tapuika was also to establish a Statutory body called Te Maru o Kaituna (the ⁱⁱⁱKaituna River Authority). This purpose of this authority co-governance body is to encourage the restoration, protection and enhancement of the environmental, cultural and spiritual wellbeing of the Kaituna River.

3.1.3 Waitaha

The Statutory Reserves, Waterways and the Coastal Marine area.

Part of Kaituna River	Waimapu River
Waiari Stream	Te Raparapa-ā-Hoe Stream
Ohineangaanga Stream	Te Rerenga Stream
Te Kopuaroa Stream	Kaiate Stream
Wairakei Stream	
Statutory area (coastal)	Coastal marine area from Mauao to Maketu

Table 3: Waitaha Statutory Acknowledgement Waterways

3.1.4 Te Pumautanga o Te Arawa (TPoTA)

The Statutory Acknowledgment is part of a Watercourse being the Kaituna River probably in the upper river catchment area. TPoTA forms part of the co-governance Kaituna River Authority.

Watercourse
Part of Kaituna River

3.2 Not Settled Claims

3.2.1 Ngāti Whakaue

Ngāti Whakaue are currently addressing their Waitangi Claims through a larger tribal entity called 'Te Komiti Nui o Ngāti Whakaue' (TKNoNW) they are at the Terms of Negotiation phase and are expecting to enter into negotiations with the Crown at the end of 2013.

3.2.2 Ngāti Whakahemo

Ngāti Whakahemo Treaty of Waitangi issues are complicated. This tribe is still deciding on its course of action on whether to seek High Court Action against the Official of Treaty Settlements.

4.0 Primary Affected Tangata Whenua Groups

The tribal groups that are affected by the Eastern Catchment comprehensive storm-water catchment because of their 'ahikāroa' (long occupation) and their tribal history to the lands within this district are the main groups who WBOPDC should carry out the process of consultation. The Iwi Authorities are the first point of call, thereafter it would be at the Authorities direction on whom, how and where they would like the consultation process to proceed.

Iwi Authority	Contact Person
Tapuika Iwi Authority PO Box 15 19 Jellicoe St Te Puke	Resource Management Unit Phone 07 5735351 Email: info@tapuika.iwi.nz
Te Rūnanga o Ngāti Whakaue ki Maketu, c/- The Landing Maketu 3138 1 School Rd Maketu	Maria Horne Phone 0272910737 Email runanga@actrix.co.nz
Te Runanga o Ngāti Whakahemo c/- PO Box 4 Te Puke SH2 Pukehina	James Anderson Phone 07 5334167 or 0223577455 Email rmu.whakahemo@gmail.com
Waitaha Raupatu Trust PO Box 220 10/50 Jellicoe St Te Puke	Veroni Clarke Phone 07 5737483 Email: admin.waitaha@gmail.com

4.1. Tapuika

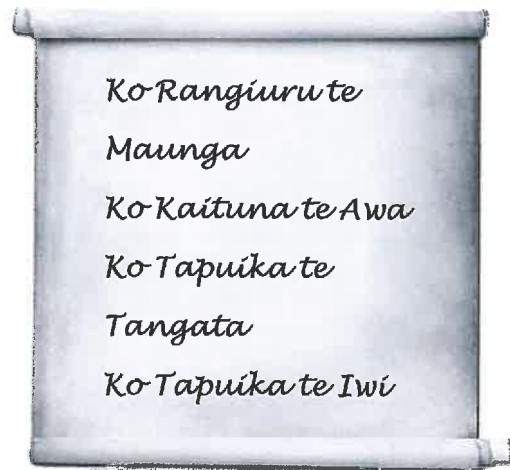


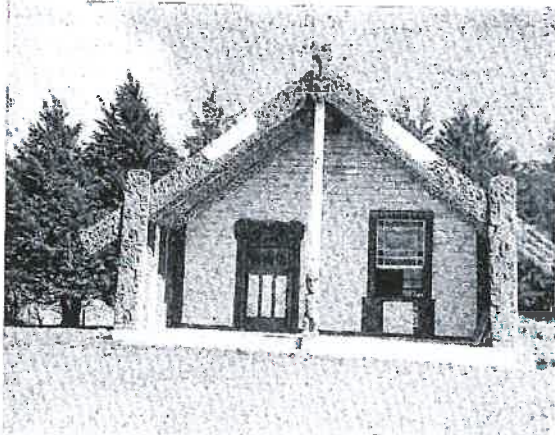
Photo 1: Tia, near Te Puke, showing new carvings

This photo is of Tia Marae which is located at Te Paamu, Rangiuru Road, Te Puke, and is owned by the Ngati Marukukere hapu (waterways) of Tapuika Iwi.

Tia was the Uncle of Tamatekapua. He claimed all the lands upon sailing past the coastal area of Papamoa on board the Arawa canoe under 'Te Takapu-o-Tapu-ika', (the abdomen of Tapuika). The land Tia claimed was for his son Tapuika.

When Tia claimed the lands he also claimed the rivers, streams, wetlands, lands and natural resources within the Takapū o Tapuika. The natural resources were an important source of food gathering, building materials, transport, clothing and dyes, recreation and life in general. Waterways and water bodies were the centre of social interaction and cultural purposes. The relationship between Tapuika and their hapu (sub-tribes) with their waterways was not solely constrained to food gathering and other uses but also incorporated an intrinsic connection with the 'mauri' (life essence) and sacredness of the waterways including interaction with tribal kaitiaki taniwha (water guardian) whose rangatiratanga (chieftainship) was over the streams and rivers.

4.2 Ngāti Whakaue



C. Lindsay photo.

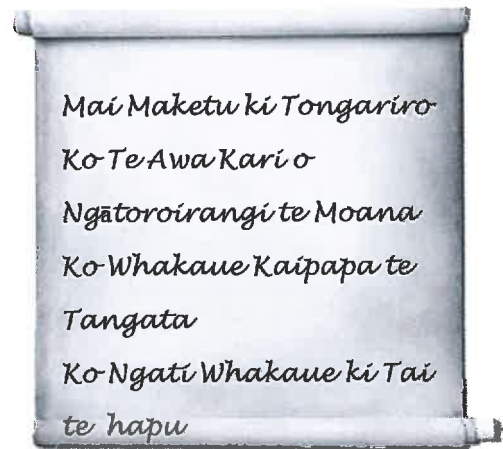
Photo 2 : Whakaue Kaipapa, Maketu.

This photo is of the ancestral house located at Maketu named Whakaue Kaipapa built in 1924 to accommodate the tribe at Maketu.

The people of Ngāti Whakaue take their ancestral name from a past chief named Whakaue Kaipapa who was a well respected leader for this people. The Whakaue families mainly lived at Mokoia Island (a past settlement), along the southern shores of Lake Rotorua and in the Little Waihi Estuary area. An extensive shift of Ngāti Whakaue families to Maketu came extensively in pre-european times around the 1830's when there was a high demand for muskets.

Tribal warfare in the early 19th C saw the introduction of the musket. The strength of the musket was undeniable; the traditional Māori weaponry was no match. So when the Whakaue chiefs heard that a pākeha trader wanted to setup a flax trading post in Maketu and was willing to trade muskets for dressed flax, Te Arawa and in particular Ngāti Whakaue seized the opportunity to not only claim the trader but also to re-new their ancestral links with the coastal areas^{iv}.

The chiefs of those times arranged a marriage between the trader Hans Felk Tapsell to Hineiturama a young woman of high mana (prestige), presence and the bloodline of Ngāti Whakaue chiefs. Tapsell had many friends within the Whakaue chiefly ranks; some of the ancestor names that are still relevant today - Te Haupapa to whom in remembrance the cannon that resides today beside the



Mai Maketu ki Tongariro
Ko Te Awa Kari o
Ngātoroirangi te Moana
Ko Whakaue Kaipapa te
Tangata
Ko Ngāti Whakaue ki Tai
te hapu

Arawa memorial at Maketu. Ngahuru who was killed when Te Waharoa raided Maketu around 1838, Te Amohau who arranged the marriage of Hineiturama to Tapsell and Tohi Te Ururangi a famous Whakaue fighting chief, whose daughter Ngatai married Tapsell's eldest son Retreat.

It is those Ngāti Whakaue chiefs' descendents and the descendents of Hineiturama and Tapsell who have a presence in Maketu today. The kaumatua (elders) refer to this as 'ahi kā roa' (long occupation) a term used to indicate the authority of the people to the land.

4.3 Ngāti Whakahemo



Photo 3: Tawakeheimoetanga Whare, Pukehina.



This photo is of the ancestral house located at Pukehina is named 'Tawakemoetanga who was the grandson of Tamatekapua. The ancient history of Ngāti Whakahemo are they affiliate to three traditional canoes: Takitimu, Mātatua and Te Arawa. Their ancestral lands are located at Pukehina. Their ancestor is Maruahaira who originated from Hakuranui. Maruahaira took the lands at Pukehina by conquest. He was never disputed or challenged by other Iwi (tribes). His descendents during the times of the Māori land courts around the 1860's underwent a number of legal battles over the ownership of Pukehina lands and came out with their 'mana' (prestige) in tact and the recognised owners of those lands. Ngāti Whakahemo whanau (family) own a sizable majority of the farmlands in the Pukehina area.

4.3.A Te Awhe Marae

The other ancestral house that is of Ngāti Whakahemo descent and maybe impacted by the comprehensive stormwater in Maketu is 'Te Awhe' marae. This house has been re-built twice before in the past (lost to fire), the current house was re-built in 1945. This is a house that takes its name a After a Whakahemo chief whose name was "Te Awhe o Te Rangi", which translated means 'The Embrace of Heaven.' This wharenui rests on the Maketu A150 which was gazetted in 1985 through the Maori Land Court as "...for the use and benefit for the purpose of a marae for Ngāti Whakahemo hapu in particular and Te Arawa people in general."

4.4 Waitaha



W.J.P. photo.

Photo 5: Carved house, "Te Hei", Manoeka Pa, Te Puke

This photo is of the ancestral house named 'Hei' belonging to the Waitaha tribe at Manoeka.

Hei was onboard the Arawa canoe that migrated to New Zealand as was his son Waitaha. Onboard the Arawa canoe Hei claimed 'Takapu-o-wai-taha' (the abdomen of Waitaha). Hei also named the highest hill they could see 'Te Puke-o-tawa' (the hill of Tawa) after his wife. He is said to have achieved distinction on the voyage as being the first to realise that it was the plotting of Ngātoroirangi that was responsible for the perilous state of the canoe when it was nearly sunk in a whirlpool of 'te parata' (the demon) and was on his way to negate with the tohunga (priest) when he was hindered by Ihenga⁵.

Waitaha people have two main land areas they have retained which are located at Manoeka and at Te Puke No. 1 Road. There is a mutual consent between Tapuika and Waitaha that they shall work together in carrying out the role of kaitiakitanga (guardianship) for the waterways to which they both have historical accounts recognized and statutory acknowledgements through the Treaty of Waitangi claims process.



4.5 Other Iwi Interests in the Eastern Catchment

- a. Te Arawa Lakes Trust (TALT) own approximately 75% of the lands in Maketu. They are also holders of lands for the Waihi Village. The Trustees comprise of representatives from all the hapu (sub-tribes) within Te Arawa area. The Trustee that represents Maketu / Little Waihi is Tere Tapsell for Governance and Tina Ngātai for the commercial.
- b. Ngawhara Trust – This trust has land ownership on the cliff tops above the Waihi village. In particular WBOPDC and the Ngawhara Trust are in the process of having returned to them a land parcel known as the ‘Quarry.’

5.0 Māori Values & Cultural Connections

The Māori perception of the holistic approach that interconnections the spiritual and physical, realms.



Diagram 1: Pēpeha o Te Ao Māori (Māori World View)

The concept of *Mauri* (life force) is the principle spiritual connection that binds the natural resources to the Gods and the people. There are Māori Atua (*Gods*) that provide the spiritual protection to guard the rivers, the oceans, the mountains and the natural resources. And then there are the people who are the kaitiaki (guardians) charged with the responsibility to uphold and protect those resources in the physical world for the future generations to come.

5.1 *Te Taiao (The Environment)*

The environment and the waterways are connected to the affected tribes and sub-tribes. The Iwi (tribe) that live alongside the primary waterway have their own tribal connection that is revealed through pēpeha (proverbs) and whakapapa (genealogy). This is the customary way in connecting people to their mountain, river, sea, land, ancestral house and people.

Keep in mind most people will have more than one tribal connection and more than one pēpeha (proverb); however what tribes will do is attempt to make a connection through historical accounts and ancestors. The historical accounts that have been gathered for this assessment does not discount other tribal connections but these are the main tribes within the Eastern Catchment that should be consulted.

5.2 *Kaituna River*

“The Kaituna River is the umbilical cord that joins the tribes of the river together. From its commencement at Lake Rotoiti to Okere Falls (Te Wairere o Okere) and onward downstream to the Kaituna plains as it meanders to the outlets at Te Tumu and the Maketu Estuary; the Kaituna River tribes are joined together through whakapapa (genealogy) and are united in their responsibility to ensure the Kaituna River is protected for the generations still to come.” (D. Flavell)



Photo 6: Lower Kaituna River catchment¹

¹ lowerkaituna.co.nz/photogallery

5.2.1 Significance to Tapuika

The relationship of Tapuika with the Kaituna River and the lands adjoining the river lies at the heart of the spiritual and physical wellbeing of the tribe. It is our identity, it is who we are as a river people expressed in the tribal proverb, *'Rangiuru is the mountain, Kaituna is the river, Tapuika is the people.'* The Kaituna River is a taonga kura (highly valued treasure) of immeasurable importance; a gift from the Gods, imbued with great mana (authority). Its waters are as precious as the shimmering greenstone^{vi}.

The traditions and intrinsic connection we have to the Kaituna River and the Mauri (life force) of the Kaituna River are expressed in the oratory, customs, genealogy, sayings, songs and long time occupation of this Iwi (tribe) that have remained permanently beside the waters of the Kaituna River. The mauri (life force) of the Kaituna River is the integral essence that binds together the spiritual and the natural elements.

The belief is that as descendants of 'Puhaorangi' we are the link between the spiritual and the natural world as expressed in the following proverb:



As such Tapuika are responsible for protecting and ensuring respect for the life essence of the Kaituna are expressed through our customs, protocols, laws, and sacred sanctions. Throughout the length of the Kaituna there are tribal taniwha (guardians) named Porohinaki, Pareawheawhe, and Mapu. The guardians of the Kaituna River engendered fear in those who transgress and show disrespect for the river. The taniwha (guardians) are the protectors of this river and of the people; providing warnings for when the tribe were in a crisis. The presence of the taniwha (guardians) represented the power and authority of the spiritual world and their rangatiratanga (chieftainship) over the Kaituna River still remains undisputed.

The waiata tawhito (songs of old)' Tera Koia Ngā Uru Whetu' recounts the numerous Tapuika settlements along the Kaituna River – Te Hape a Tawakepito, Ohautira, Pukemotiti, Paengaroa, Oporouruao, Whirinaki, Te Huruhuru o Topea and others. There are sacred pa sites for Tapuika along the length of the Kaituna River including Oteiere, Otamamarere, Te Ana o Kaiongaonga, and Te Kuaha o Te Urutapu.

The Kaituna River is a provider of food. It sustains and nurtures all who live by its waters. It has been a pataka kai (food store) for generations. Its river banks crowded with watercress, its waters filled with tuna (eel), kakahi (fresh water mussels), koura (freshwater crayfish), inanga (whitebait) and koaro (fish). Its tributaries fed numerous swamps where the flax plantations of many varieties were harvested to make clothes, rope, baskets, bags and building materials. The name Kaituna is derived from the eating of eels which were caught in abundance.

5.2.1 Significance to Waitaha

The significance of the Kaituna is it was a 'pataka kai' for all the Iwi. It also provided medicinal and edible plants such as raupo. The harakeke (flax) was a significant plant to acknowledge it provided for the whanau / hapu / Iwi during the flax trading years. The Kaituna River that ran

from Okere Falls to the coast was called Te Awa Ti-A-Maru, and was then later renamed the 'Kaituna' because of the abundance of tuna.

The Pa sites located on the coast that have an association with Waitaha are Paroa, Te Kopua and Te Karaka. Te Makomako Pa was on the eastern side of the Kaituna. It was heavily contested. After many battles this pa was eventually included in the Te Arawa Toa boundary as set in 1875 by Sir Donald McLean. At the confluence of the Kaituna River and the Waiari Stream was an island on which stood Te Ngaeo Pa which was a pa of Te Rangikiwaho which was destroyed when the Kaituna flood protection scheme was implemented in the 1970's.



Photo : A Typical Māori Settlement (noho nga iwi)

(Image from www.teara.govt.nz)

5.3 Maketu Estuary (Te Awa Kari o Ngātoroirangi)

The Maketu Estuary (food bowl of Te Arawa) is of high significance to Ngāti Whakaue. It has sustained the people since the landing of Te Arawa canoe at Maketu in 1350 AD. A description of the kaimoana (seafood) that could be accessed from the estuary as told by Whakaue elders from past interviews carried out on the estuary before the Kaituna river re-diversion was carried out in 1957.

“From the Maketu estuary we would get pipis, koterotero (sea-anemie), tuangi (cockles), flounder, and titiko. At the mouth of the estuary there is a rock where we got mussels, we could also get paua, pupu, scallops kukuroa (horse mussels) and fish. Outside the estuary we use to haul fish nets from the mouth of the estuary down to Papamoa, we would catch

plenty of snapper, kahawai and trevellie.” The size of the seafood was huge, which was because the water was healthy. The food bowl provided well for the Whakaue marae tables. Because we had seafood in abundance I suppose visitors expected the tables to be filled with all the beautiful seafood (kaimoana) we had in the estuary” (J. Tapsell).



Image 1: Kaimoana no Tangaroa (Food from the Sea)

(Image from www.flickr.com)

“It was beautiful the estuary; all the people would come from all over to get seafood (kaimoana). We would get people from Taupo, Rotorua, Putaruru, Hamilton, not only from Maketu; the estuary could feed everyone. Everyone would gather shellfish pipi, cockles, pupu, and titiko. You could throw a line out and get fish like mullet (kaanai) kahawai, herrings, tamure and trevellie. Grey mullet use to breed in the estuary. In those days our kuia (elderly woman) and koroua (elderly male) were provided for because there was plenty of seafood to go around. As children we would spend most of our time down the estuary having fun collecting seafood building fires and cooking food (kai). I would go home late and miss out on doing my work; it would be dark when I arrived home” (P. Kerr).

The Kaituna Re-diversion work carried out in 1957 has caused the loss of kaimoana (seafood), the continual silt buildup that occurs in the estuary and generally the loss of the Mauri (life essence). After over 50 years of deprivation and the people's battle to have the river returned to the estuary, we are starting to see some movement from Regional Council to right this wrong. The Regional Councils intentions as expressed to Ngāti Whakaue were to return the Kaituna River back to the Maketu Estuary.

"We did not want the Cut or the diversion. Our old people had far reaching visions of what would happen to the Maketu Estuary. Ngati Whakaue was never ever consulted on this matter. In those days council went straight to Government never mind what the people said. Some of our old people were council advisors, they were such eloquent speakers, beautiful speakers who were there to advise council and yet they didn't listen and just went ahead and did it anyway" (TW. Walters).

5.4 Waihi Estuary

The Waihi Estuary historically has been the pataka kai (food store house) for many Iwi (tribes) from Te Arawa waka descent, Ngāti Pukenga, Mātātua and Ngāti Whakahemo. The estuary has a number of canals that feed into it being the Pukehina Canal, Pongakawa River, Kaikokopu and the Wharere stream. The Waihi estuary is just as important as the Maketu estuary it has shellfish of pipi, cockles, oysters, pupu crab, eels and whitebait. This estuary is rich in natural food species. However it suffers extensively from agriculture, dairy, horticulture run-off and from septic tank sewage spills. The pollutants from the farms can be seen floating on the water's surface in the estuary.

"The Pongakawa River and Waihi estuary were subject to re-diversion and now the mouth of what was once a great river is called the Pongakawa Canal. The land was called the Pongakawa Flood Plains or wetlands. It suffered under a county council decision to reclaim swampland in the Pukehina area for dairy farming. The kaikokopu is named after a species of waitbait. There is the kaikokopu short jaw and long jaw. The kaikokopu runs into Royden Downs. There is alot of silt coming down the kaikokopu from Royden Downs the worst thing they could have done is

broken that land in. The Wharere canal is the most productive for rearing ducklings and wild fowl because they are not spraying the sides of the canals and because they have vegetation side cover. The wetlands were drained to allow dairy farming. ^{vii}(R. Bushell)



Map 5: Little Waihi / Pukehina Reclamation Lands

Map 5 shows the Pukehina reclamation of the wetlands around the Waihi estuary which was turned into dairy farming.

5.5 Waiari Stream

5.1 Significance to Tapuika

The Waiari Stream commences at the confluence of the Oturuturu (Te Rerenga) Stream and the Mangatoi Stream. According to the elders, Waiari or Waiariari means clear waters and is a reference to the number of springs and aquifers in the Waiari River which gives the water a crystal clear clarity. There are many pā (communal site), sacred and significant places to Tapuika along the length of the Waiari. A short distance downstream in the vicinity of the Waiari Conservation lands is Purunui pā of Ngāti Totokau. Te Totara is the urupa (cemetery). Continuing downstream is the pā Waiwhero.

Below the pā is the taunga ika (fishing ground) called Pukerimu. This was a special place for the collecting of koura or fresh-water crayfish. The name Pukerimu refers to the placing of rimu branches in the water to form a small mound. The koura (crayfish) would colonize in the branches and after several weeks the branches would be pulled out of the water with large amounts of koura (crayfish) trapped inside.

Travelling further downstream Te Raho o Totokau (the penis of Totokau the eponymous ancestor of Ngāti Totokau) enters the Waiari. The ancient puna (pool) Ngaengaenui is located here. Te Raho o Totokau and Ngaengaenui are two very sacred sites (wāhi tapū).

Like the taumau of Tia, by naming the tributary after his body, Totokau rendered that body of water sacred to him and his descendants. The spring Ngaengaenui is associated with tohi (ritual) or birth-right ceremonies where a child was dedicated to a particular God. The child would be taken to the puna (pool) where the tohunga (priest) would recite incantations over the child using the branch of a karamu tree to sprinkle water over the child during the ceremony. Ngaengaenui is also known as a resting place for spirits upon their final journey. The waiata (song) 'Tenei Te Aroha and Tera Tau Toru' also commemorate the importance of the puna (pool) Ngaengaenui to Ngāti Tuheke and Tapuika.

In the waters of the Waiari below the ancient pā (complex) and cultivation grounds is found the wāhi tapū (sacred site) 'Maioro,' where the bodies of the slain in battle were prepared for burial, by submerging in the icy cold waters in order to preserve the bodies for later burial ceremonies.

Further down the river (on the Te Puke side) is the track Te Arero o Ngakohua named after the matāmua (eldest son) of the Tapuika chief Ruangutu. This was an ancient track used to travel from Te Puke inland towards Te Rerenga.

Moving downstream is Te Kahika the Ngāti Tuheke settlement and pa above the Waiari on the Rangiuuru side of the river. The Waiari provided access via waka (canoe) from

Maketu to Te Puke Township, with the landing place located at the foot of Te Kahika pā. It is here that Ngāti Tuheke brought the first Europeans to Te Puke. This place is of special significance for it represents the gateway through which the Waiari was accessed.

Tawakepito (named for the father of Tuheke) and Makahae are two pā above the Waiari located within the Te Kahika settlement. Tawakepito is the oldest remaining Tapuika pā built during the

late 19th C. The urupa (cemetery) of Tawakepito and Makahae are Taumata and Kahikatea which are located above the Waiari Stream.

Below the two pā on the Waiari is Te Potaka, named because the water at this place churned like a spinning top. Te Potaka was the main water source for Makahae and Tawakepito pā. The elders of Ngāti Tuheke still speak of the times when they would go down to the Waiari to wash clothes, bath and collect water for cooking and drinking. The Waiari was the centre of social activity.

A short distance downstream is the lair Te Kopua a Tamitami. Tamitami is the taniwha kaitiaki (water spirit guardian) of the Waiari. Te Kopua a Tamitami is still able to be located by those of Ngāti Tuheke who were raised by the river. In accordance with Ngāti Tuheke memory there has never been a drowning of any Tapuika in the Waiari because their taniwha Tamitami watches over them.

Just downstream from Te Kopua a Tamitami is the waahi tapū (sacred site) 'Te Pito o Te Whenua.' This is where the afterbirths of Ngāti Tuheke people are buried, the intention being that after death their bodies will return to the awa (river), signaling the intergenerational link between Ngāti Tuheke and the river. Continuing downstream in the middle of the Waiari is the island Taniwhanui the kainga (house) of the tūpuna (ancestors) Te Koata. The island was known for its high quality harakeke (flax) and fertile soils making it easy to grow kumara and other tubers. It was on Taniwhanui that Te Koata died. Ngaeo was a mahinga kai (garden cultivations) of Ngāti Moko in close proximity to Taniwhanui. Te Rahui is a wāhi tapū

pakanga (battle) site at the confluence of the Waiari and Kaituna River. The cause of the pakanga (battle) was the killing of a dog owned by the tūpuna (ancestor) Patuara of Ngati Moko.

5.5.2 Waiari Stream significance to Waitaha

On board the Arawa canoe whilst sailing past the coast areas of Papamoa, Hei (ancestral chief of Waitaha) claimed the lands from the Waiari Stream to Mauao. The Waiari Stream is the recognized boundary to which Waitaha is to the West and Tapuika Iwi is to the East.

The Waiari is the 'soft soothing sounds of the flowing water, where the voices of our tūpuna (ancestors) are heard.' The two taniwha (water spirit) that live in this stream are Te Mangakino and Ngaengaenui. Putu-a-Ruru (nee Putaruru) was a nohonga Iwi (village) along the banks of the Waiari stream where travelers would rest on their way to Rotorua.

The Kaituna River and Waiari meet at a point where Te Ngaero pa site was located. Onwards to Te Pohue (Te Puke) which is a headland jutting out into the wetlands of the Waiari. Te Pohue is bounded by the Waiari and the Ohineangaanga streams.

5.6 Ohineangaanga Stream

5.6.1 Significance to Tapuika

The Ohineangaanga Stream commences in close proximity to Putaruru mountain. Further downstream were the nohonga Iwi (village) of Otaikaka and Ngapāri occupied by the Tapuika hapū (sub tribe) and Ngāti More. According to Ngāti More the name Ohineangaanga refers to the skull of a female child which was used as an omen when fishing.

As the Ohineangaanga reaches the township of Te Puke it flows past the area known today as Donovan Park. This was a highly favoured taunga ika (fishing ground) for catching tuna (eel) and also kokopu (whitebait). The Ohineangaanga flows behind the town into the Raparapahoe Canal where it discharges out into the Kaituna River.

5.6.2 Significance to Waitaha

There are a number of pa sites along the river banks of the Ohineangaanga totaling at least 13 kainga (settlements) for Waitaha. Ohineangaanga was also the name of a pa site located along the banks of this stream. The tribe were instrumental in planting large plantations of mahinga kai (gardens) in this area one garden is recorded as being 200 acres in size.

5.7 Te Raparapa-ā-Hoe Stream



Photo: Te Raparapa-ā-Hoe Stream

(Image from www.waitaha.lwi.nz)

5.7.1 Significance to Tapuika

Raparapahoe Stream refers to the splitting open of the tuna (eel) for drying purposes '*me te whata raparapa tuna e iri mai ana te tuna*'. It is a traditional fishing ground of Ngāti Totokau. Continuing on downstream is the junction of the Waikoki and Raparapahoe Streams where the Pa Waikoki is located along the banks.

The Raparapahoe Stream commences from an underground fissure within the vicinity of Te Riu-o-Hua. The upper reaches of the Raparapahoe Stream is known as having special 'feeder' eels. These were the eels that did not migrate out to sea their purpose was to gather food for the taniwha (guardian).

When the taniwha (guardian) were hungry they would nibble on the tails of the feeder eels that would then go and forage food for the taniwha. The customary rituals and practice is that the eels in this stream could only be taken by certain families at certain times.

5.7.2 Significance to Waitaha

The name for Waitaha refers to 'Te Raparapa-a-hoe' the many waterfalls and rock formations along the water course. This stream can only be navigated by waka (canoe) to a certain point and then the rapids make it impossible to paddle any further. The stream is sacred to Waitaha because they have a number of historical pa sites that were situated along this stream which included Onuku Rangitekapua, Puke Poto, Te Manaroa, Te Kopuru, Hapaitataura, Motungarara and Hei Marae is also located near this stream.

The Raparapahoe Stream commences from an underground fissure within the vicinity of 'Te Riu- o-Hua.' The upper reaches of the Raparapahoe Stream was known to have huge eels with holes in their tails, these were kept as live food for the 'koroua' (male elder) who are the kaitiaki (guardians) of this stream.

5.8 Kirikiri Stream

Further downstream the Kirikiri Stream merges with the Raparapahoe Stream. The Raparapahoe Stream continues on past the settlement of Manoeka. This area is that of Waitaha. The name Manoeka means 1000 acres and is a reference to the setting aside by the Native Land Court of a reserve of land in the sale of the Te Puke Block.



Image : Māori settlements and cultivations.

(Image from www.teara.govt.nz)

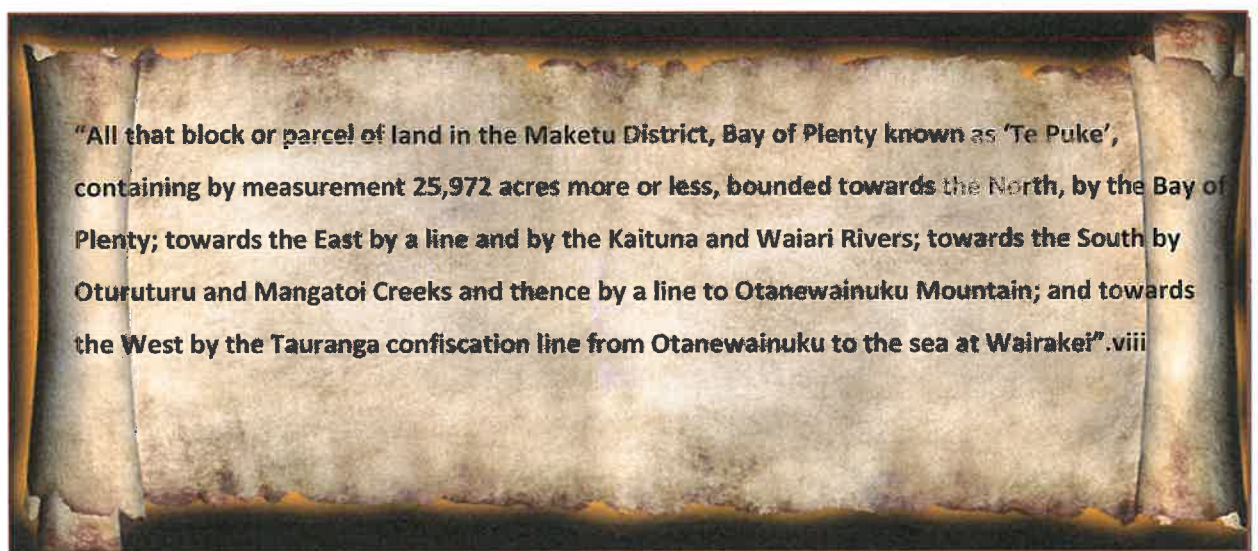
6.0 Historical Accounts of Land Areas

6.1 *Te Puke*

Te Puke Taweare is a significant hill on what is known as the Te Puke block. It is from this hill that Te Puke township takes its name. This township is built on Te Pohue, a pa site which was significant to Waitaha. This pa site had a large number of nohonga lwi (village) and extensive mahinga kai (gardens) that exceeded 200 acres; these gardens were referred to as 'Te Tūnga o Te Pohue.' Te Poto and the pa site Te Tapuae were located at the western side end of Te Pohue and Te Arapaiaka pa site was at the eastern end. Te Pohue lies within the ancestral boundaries called '*Te Korowai o Waiokehu ko Te Iwikoroke.*' Te Pohue provided a tangible link to two settlements in its immediate vicinity which were 'Te Puke Tawaere on the Waiari stream and the Atuaroa which was located on the western side of the Ohineangaanga stream.

In 1867 the Defence Minister Haultain ordered a direct assault upon the Waitaha settlement of Te Puke Taweare. Haltain's reason was that hostile tribes from Tauranga and Rotorua were being housed in this settlement. He also ordered soldiers to destroy the whare (houses) of the Waitaha chief at that time as a special punishment. The loss of houses, crops and domestic animals was detrimental to the well-being of Waitaha. Shortly afterwards a military establishment took occupation on Te Puke block.

In February 1880 the Te Puke Block, Maketu District, Bay of Plenty, Provincial District of Auckland was gazetted as:



6.1.1 Pukehina Peninsula

"The Pukehina peninsula use to be the Ngāti Whakahemo playground. The lands there belonged to our families at one time. Back in the 1940's the peninsula was covered in big sand dunes. To get to the beach area you had to cross over the sand dunes, these are not visible today. Beach Road the current roadway was the trail we blazed with our horses when we were young. As kids we would ride our horses to go and fetch kai (food) from Maramarua (seaside) and Te Ngutuawa o Waihi (Waihi estuary). On early frosty mornings we would get what we called 'frost fish' at Maramarua. The frost fish come up from the deep sea only on really cold mornings; they are long and flat and look like a barracuda fish. We would get there early in the morning, and pick them up off the beach, they were so long we straddled them over our horses. They are beautiful fried. On a Southerly when the weather is stormy there are the kuakua shellfish they look like big white cockles and taste like scallops. We would also get tuatua shellfish and from the estuary we would collect pipi and tuangi (shellfish). We would also hunt, net flounder, spear eels and whitebait at the estuary. The easiest place to gather mussels and kina was at Okurei Point."

"On some occasions we would unearth kolwi (historical bones) which would fall out of the dunes. When we first unearthed bones we got such a fright! We went home and told our parents and they taught us how to rebury the bones and have a karakia (prayer) to return that tūpuna (ancestor) to rest. The sand dunes were one of the places where the old people would bury kolwi (bones), especially along this Peninsula."

I recently re-buried some kolwi (bones) that were unearthed along the dunes at the beach area called Poutuia. There were about nine of them, we lay them to rest again at the Ngāti Whakahemo urupa (cemetery) called Oreiwhata; they are marked with a Pou (pole). I would think that any kolwi (bones) found along the peninsula belong to Ngāti Whakahemo and should go in the same place at Oreiwhata." (W.P Horne)

6.1.2 Historical Account of Tai Rawhiti (East Coast) Expedition

Historically the Pukehina peninsula was part of the highway that connected the East Coast to Maketu, Tauranga and inland areas. The peninsula was home to Ngāti Whakahemo who had kainga (houses) and Pa sites located on the lowlands located alongside the Waeheke, Kaikokopu streams, and Pongakawa River. A desktop study carried out also reveals the details of a well-known battle that took place between the East Coast tribes, the Crown soldiers and the Arawa tribes wanting access through Maketu to Waikato in 1864.

‘The Tai-Rawhiti expedition was reinforced at Otamarakau, on the sea-coast, by a company of sixty from the east coast provinces. The large flotilla of war-canoes was drawn up on the beach at the mouth of the Waitahanui Stream. Towards the end of April they marched on Maketu, and their advance-guard surprised two officers, Major Colville (43rd Regiment) and Ensign Way (3rd Waikato Militia), who were out duck-shooting in a canoe on the Waihi estuary, two miles east of Maketu. The officers had a narrow escape. By this time there was a small body of troops, under Major Colville, in occupation of Maketu, and Pukemaire, an ancient *pa* on the hill above Maketu, was converted into a redoubt, in which two field-guns were mounted. Major Drummond Hay and Captain T. McDonnell had also arrived with a few men of the Forest Rangers and the Colonial Defence Force to organize the Arawa defence. Skirmishing followed for two or three days at Kakiherea and Te Rahuipuharariki, on the high land overlooking the Waihi estuary and the sea. The invaders dug themselves in on the tableland called ‘Te Whare-o-te-Rangi-marere’ (known as Arawa Avenue) about a mile east of the Maketu Village. There the line of rifle-pits is still to be seen. Then two warships appeared, H.M.S. “Falcon” and the colonial gunboat “Sandfly,” and these vessels, and also the guns on Pukemaire, opened fire on the Tai-Rawhiti (East Coast), and soon drove them out of their entrenchments. They re-crossed the Waihi estuary and occupied the sandhills on the opposite side known as the Pukehina peninsula.

They were stormed by Crown soldiers and a small contingent of Arawa. The main body of the Arawa had arrived from the lakes, and some three hundred of their best men pursued the Tai-Rawhiti (East Coast) along the Pukehina beach toward Matata. Meanwhile the “Falcon” and the “Sandfly,” steaming along close to the coast, shelled the retreating force. A heavy shell from the

44

“Falcon” killed several men in a group at the mouth of the Waeheke Stream, near Pukehina. This place the Arawa skirmished with the invaders, and drove them toward Otamarakau.^{ix} The Ngāti Whakahemo families were forced to flee for a short time to avoid being killed in this battle and went to the cliff top of Ohara located at Rahuipuharariki above the Waihi estuary.

Interestingly there are no archeoglocal surveys carried out at the Pukehina peninsula. No recordings of koiwi (bones) or pa sites have been recorded along this peninsula and yet the kaumatua (elders) state that they would re-bury bones in the sand dunes along the peninsula. It is presumed that the reasons for no surveys taking place is so that extensive development of the seashore lands could take place without interference.



Picture 1: Deplction of Battle In 1864

(Image from www.teara.govt.nz)

6.1.3 Paengaroa

There is a traditional reference to the building of the Pa Pakotore by Kahumatamomoe and nothing more until the mention of Rangitihi. It is said Rangitihi was born at Maketu at the Pa Site Te Koari, but died and was buried at Pakotore Pa.

Rangitihi was one of the chiefs of Te Arawa confederation. He left Maketu and settled in the area of Paengaroa at the Pa Site called 'Pakotore' which is located on the river banks of the Kaituna River. Rangitihi was the father to the children who make up 'Ngā pumanawa e waru o Te Arawa' (*The eight beating hearts of Te Arawa*) from these ancestors came the descendents of the Arawa tribes.

Pakotore itself is one of a group of three fairly large fortified Pa and is the largest of these. The other two are known as 'Matapara' and 'Te Hoe a Taunga' and probably at one stage formed with Pakotore three divisions of the one settlement.

When Rangitihi died at least two of his sons continued to live at or in the vicinity of Pakotore and this occupation extended down until the 1820's. So far as we know Pakotore was relatively free from the attacks of other people, probably because of its size and the fact that its defenses were aided by a natural precipitous position^x. The Pa site Pakotore is significant to all of Te Arawa people.

6.1.4 Paengaroa significance to Marukukere Hapu

Marukukere hapu flourished about 10 generations after the arrival of the Arawa canoe. Marukukere was a chief of Tapuika descent, and he was known to have planted vast cultivations of kumara in the lowerlands of Paengaroa. The original name of this area was Te Pae-ngā-roa o Marukukere. Marukukere during his time allowed an alien tribe to live and cultivate on the Paengaroa lands on the agreement that this tribe would harvest the kumara crops each season. To summon this tribe Marukukere would send his dog 'Kauaeranga' to fetch the people. The alien tribe eventually grew weary of taking orders from Marukukere so when his dog arrived they killed him and when Marukukere went searching for his dog he suffered the same fate (Te Arawa, p.125).

6.1.5 Paengaroa signficiance to Ngāti Whakahemo

During the 1860's parts of Paengaroa was used by the Whakahemo / Patuwai tribes to cultivate vast plantations of kumara, potatoes, melons, corn pumpkin and other vegetables growing to satisfy the need for food in Maketu during the flax trading era. It was also a time of great upheaval for our Māori people experiencing land confiscation and alienation. One account is the Crown while looking for hauhau (rebels) deliberately destroyed the cultivations of Whakahemo / Patuwai which left the tribes both destitute. Some years later Ngāti Whakahemo chief Timi Wāta petitioned the Crown and was awarded land shares in Paengaroa for this tribe^{xi}.

6.1.6 Paengaroa Kumara Pa

Recently a Kumara Pa has been located at the Pukehina turn-off, State Highway Two. The *pa* was uncovered during the Tauranga Eastern Link construction. This area during investigative digs was classed as a 'hot spot' where it was likely that historical Māori finds would be located. An extensive Pa where houses were built above ground and kumara store pits were built underneath those kainga (houses). This pa signifies that the Paengaroa area does have cultural heritage still undiscovered and that investigative archeological digs should be carried out and the earthworks are monitored.



Photo 8: Paengaroa Kumara Pa cited 2013. From left: Te Awa Anderson, Ken Phillips (Archeologist), Te Awhi Manahi, and Matire Duncan (TEL Iwi Coordinator).

7.0 Key Issues

Meetings were held with key individuals of each tribe followed by a collective hui (meeting) to determine the key issues expressed by Hapu and Iwi representatives:-

1. A lack of qualitative data and science has not been provided to affected tribes on the current counts of fish, glass eels, birds, and wildlife. There is concern for the well-being of the kaimoana (seafood) and kaiawa (river food), the birdlife that nest along the streams and the overall environment.
2. The Māori Worldview means culturally we are linked inherently to the environment and the waterways. The whakapapa (genealogy) should be included in this report.
3. The role of 'kaitiakitanga' (guardianship) can only be covered by tangata whenua (people of the land).
4. Cultural sites of significance in particular Pa Sites, Urupa (cemetery), traditional fishing spots are avoided from this storm-water consent.
5. Historical koiwi (bones) are treated in accordance with the policies of the affected Iwi (tribe) and the WBOPDC earthworks protocol.
6. The use of natural cleansing resources such as wetlands and roadside swales are put into practice. The minimizing of the effects on the receiving environment is imperative.
7. The need to establish an education program to involve district schools in planting wetlands and to learn from archeological historical finds.
8. The use of cultural monitors during the earthworks.
9. The use of an archeologist to identify 'hot spots' where no archeological surveys have been carried out. The recording of cultural heritage finds by taking photographs, GPS of sites and informing the Iwi / NZHPT.
10. The impacts this consent will have on residential rates to service this catchment and to carry out ongoing maintenance.
11. The direct discharge of storm-water to the waterways.
12. The contamination of fresh water and the lowering of the water quality.

13. The disposal of the sand and dirt that will come from the earthworks.

14. Will the waterways and the tributaries be able to sustain themselves? Consultation is required on the well-being of fresh water.

8.0 Mitigation of Effects

8.1 Wetlands

“Wetlands are important for improving water quality. They are able to directly improve other ecosystems by absorbing many of the impurities that flow into the wetland. Their role is similar to that of our kidneys, they both help control water flow and cleanse the system.

The proposal is to return the waste liquid to land. Wetlands act like giant sponges. They absorb water during heavy rain or snow melt and release the water gradually. This reduces flooding and maintains downstream water flows and ground water levels during periods of low rainfall (p.6)^{xii}.”

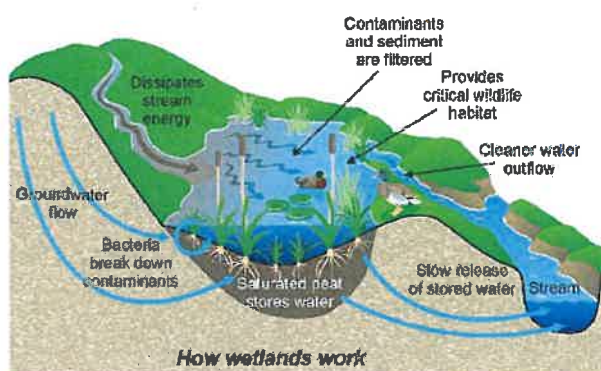


Diagram 1: Wetland Usage

This diagram shows how nature can help cleanse the water naturally and at the same time separating the contaminants from entering into a waterway.

Swamps are fed by streams or lakes as well as rain water and ground water. Streams carry nutrients and sediments and the current means these nutrients are distributed around the swamp. The water level in swamps fluctuates but swamps are usually permanently wet (p.19). Swamps in this area were drained to reclaim lands for agricultural purposes. Lands in the vicinity of Waitangi, Rangiuru, Te Tumu, Maketu and Pukehina and the Waihi estuary were at one time vast areas of swampland, which have since been preceded by wetland managed reserves.

"If the Eastern Catchment comprehensive storm-water consent is going to make any difference at all to the environment then it should not be discharging directly into the waterways. The WBOPDC should be working with Regional Council to carry out monitoring and inspections of the discharges from all the waterways connected to the Waihi estuary. The more use of wetlands and swales along the road edges the better off the waterways, environment and wildlife will be." (R. Bushell)

9.0 Consultation

9.1 Iwi Authorities

Consultation with Iwi / hapu may be best carried out using the following processes:

1. A letter notifying the consent application is sent to all affected Iwi Authorities.
2. This is followed up by an email with the resource consent attached to the affected Iwi Authorities.
3. An invitation to carry out a site visit that will be resourced by WBOPDC.
4. Ask each Iwi Authority how they wish to proceed, whether they would like to meet (kanohi ki te kanohi) face to face in the future with council staff.
5. If the Te Puke Library meeting rooms are available and convenient for the Iwi Authority to meet with Council then that should be a suggested place to meet.
6. Have a cultural advisor on hand who is able to perform cultural rituals for the meeting.
7. Invite the Iwi (tribes) to perform a blessing in the various areas to 'break the dirt.' Also when the works are concluded they may want to carry out a blessing to bring closure to the works.
8. A note when meeting with tangata whenua and it comes to introducing yourself acknowledge those who are before you and thank the person who performed the karakia. Give your own personal genealogy and a brief background.
9. Open with a presentation of the proposed works; provide some information that they can take away. Have on hand the appropriate staff that can answer questions concerning the environment, the science, the engineering, rates, and the project archeologist. These people should be prepared to answer questions.
10. If there are issues then open and honest communication is recommended. Or make a note of the issue and get back to the Iwi concerned.
11. Always have a minute taker present who can carry out actions from each meeting.
12. Carry out bi-monthly newsletters to be sent out to Iwi (tribes) and the general public.

9.2 Joint Consultation

1. Tapuika and Waitaha have expressed that they can be consulted jointly on rivers and streams where they have a joint relationship. Both these Iwi have Statutory Acknowledgements over waterways that are part of the Eastern Catchment.
2. Whakaue and Whakahemo have expressed that they can be consulted jointly due mainly to the limited personnel resources. There may be an opportunity for consultation to also add Ngawhara Trust with Whakahemo as these trustees are of Whakahemo descent.
3. Te Arawa Lakes Trust can be consulted through the Arawa representative for Maketu (refer contacts) who also attends Maketu Project Team meetings to advance the Maketu Community Plan. The governance representative is Terry Tapsell and the commercial representative is Tina Ngatai.

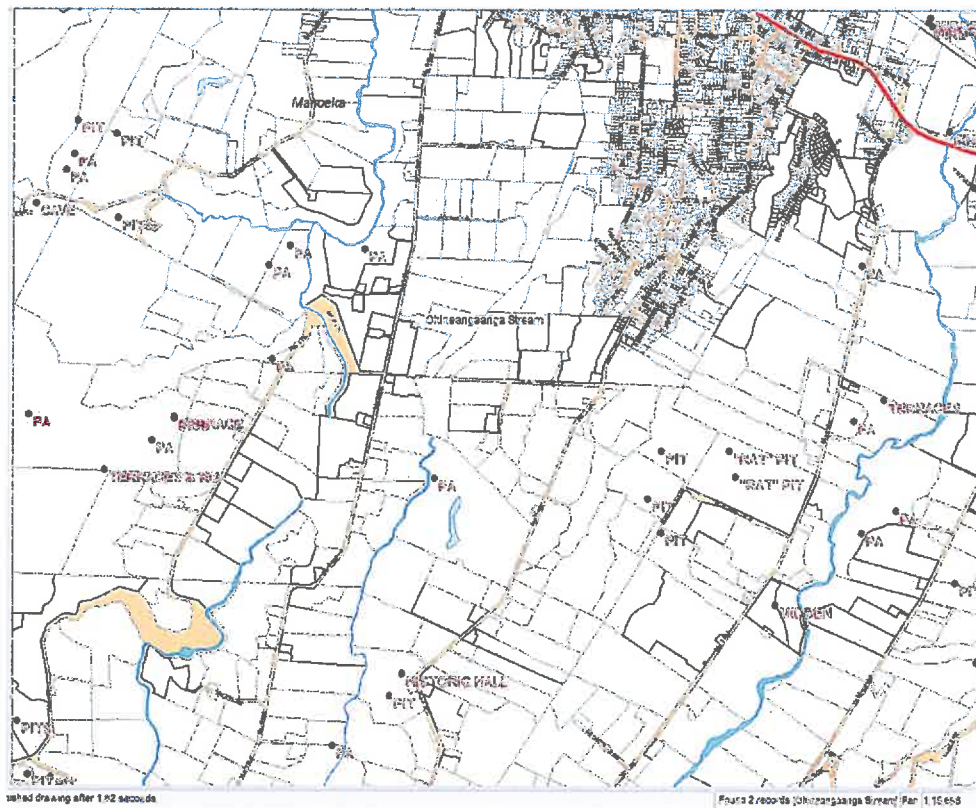
10.1 Cultural Heritage

“The cultural heritage of these lands must be preserved and recorded for future generations. In our day Māori heritage sites were given no recognition. Today and under the RMA 1991 we have a different mindset to preserve such sites for the future generation, which pleases me.” (T. Walters)

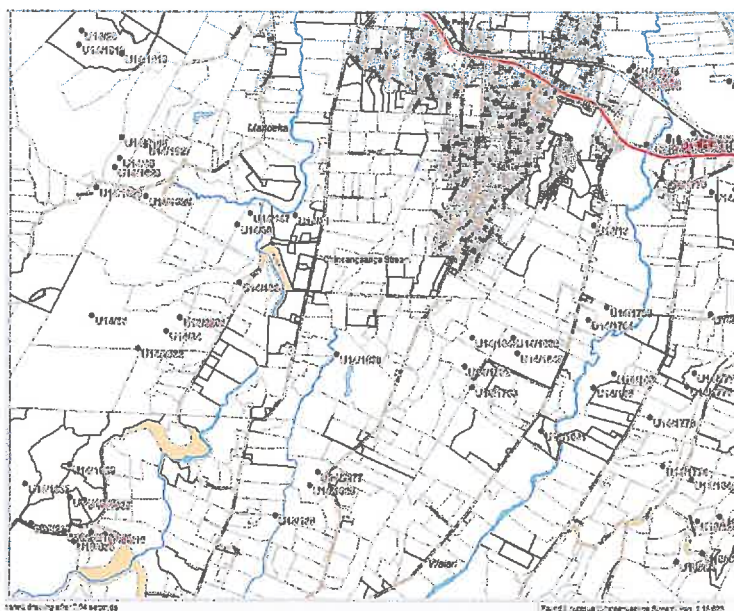
10.2 Te Puke Township - Manoeaka



10.3 Ohineangaanga Stream - Manoeka

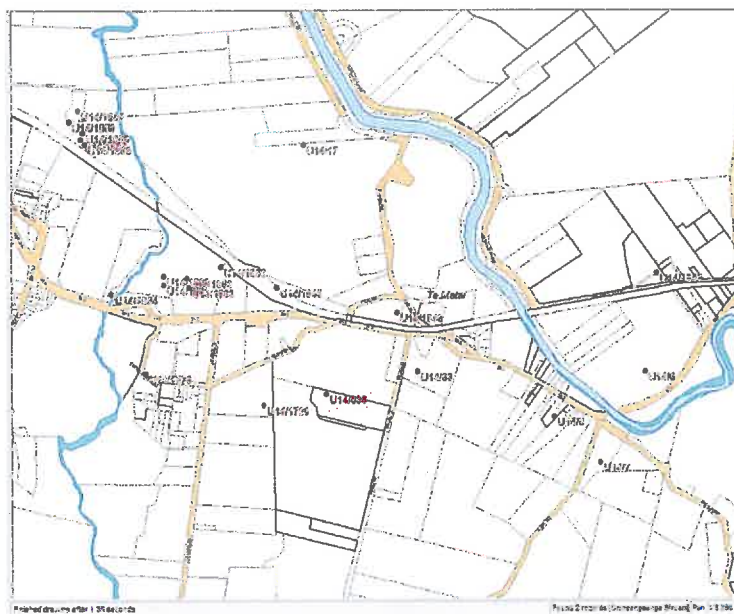
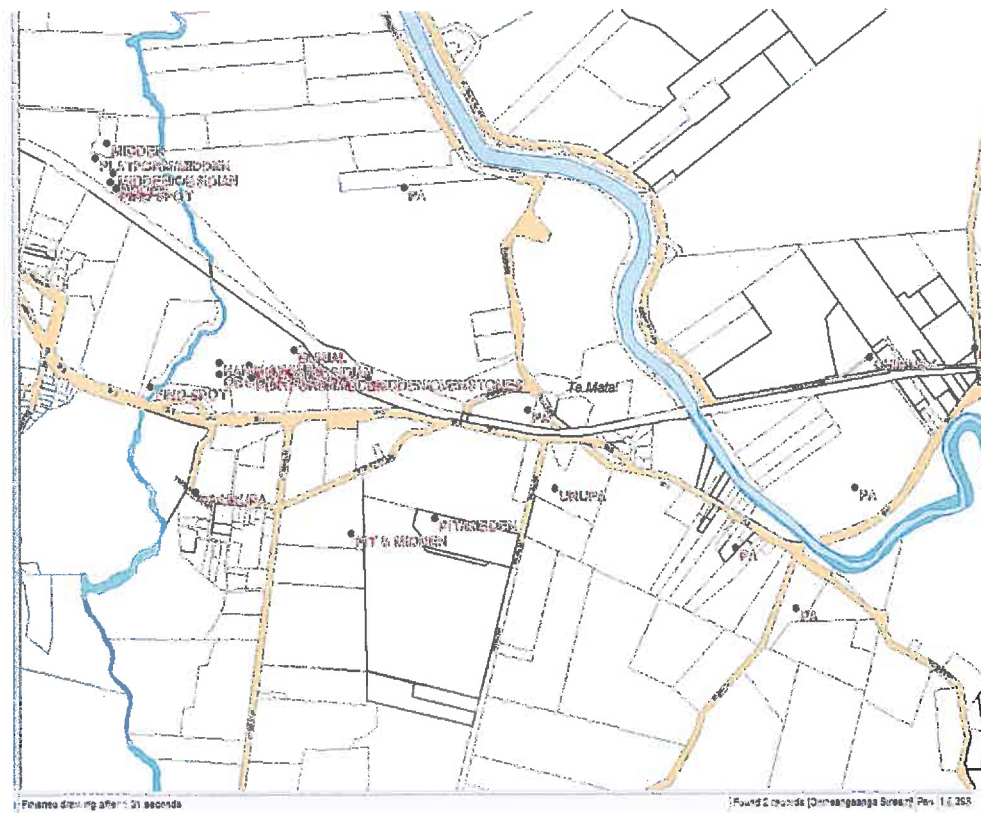


Te Puke - Manoeka



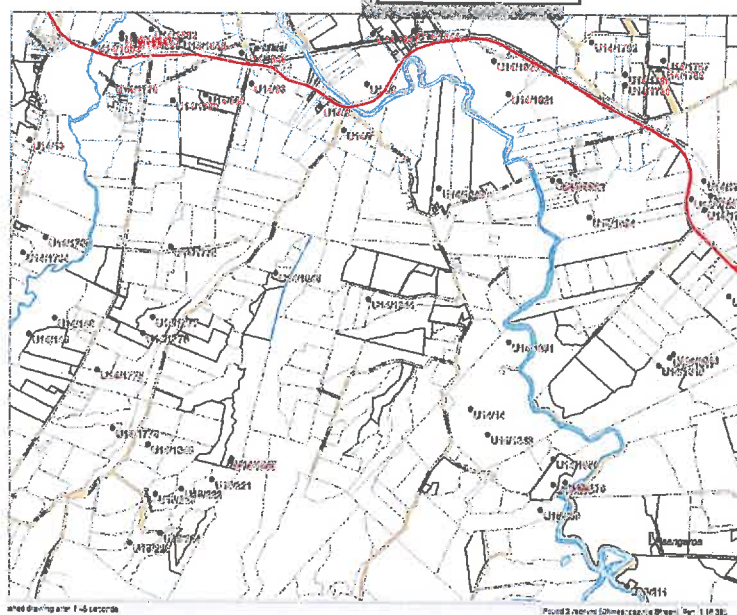
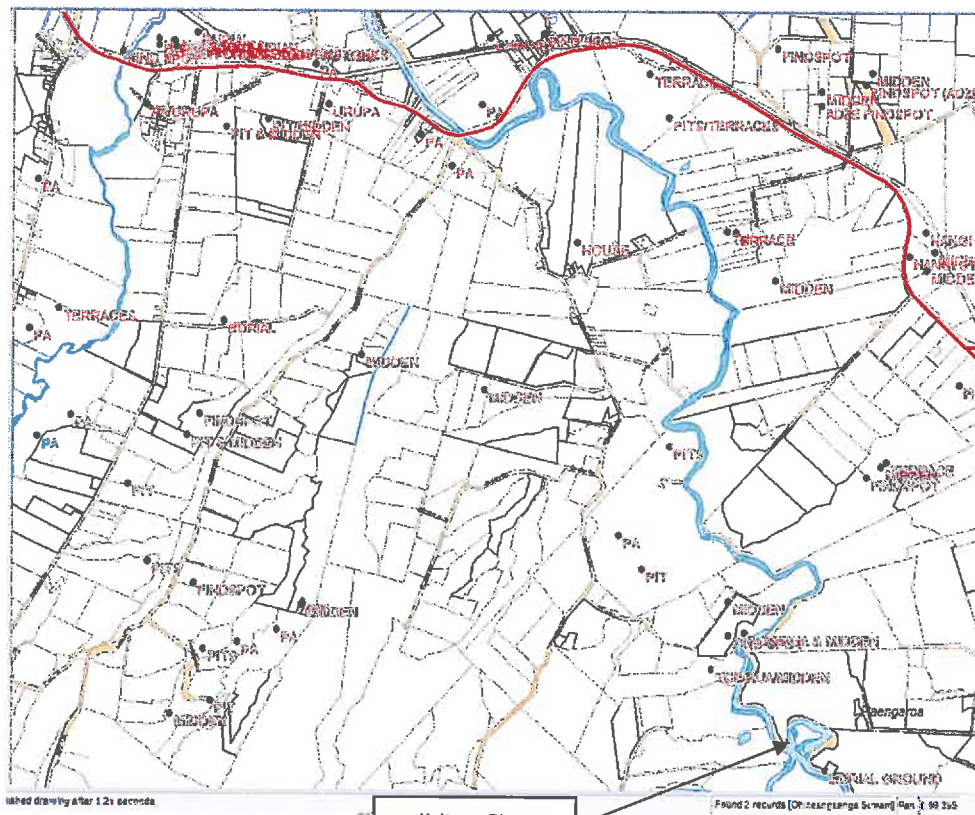
Arch Site 1A-B: Te Puke and Manoeka archeological sites

10.4 East of Te Puke – Te Matai



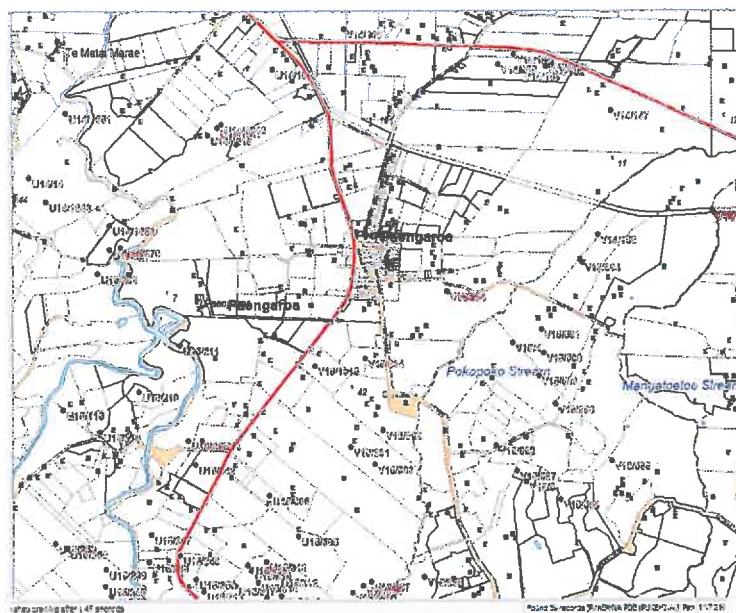
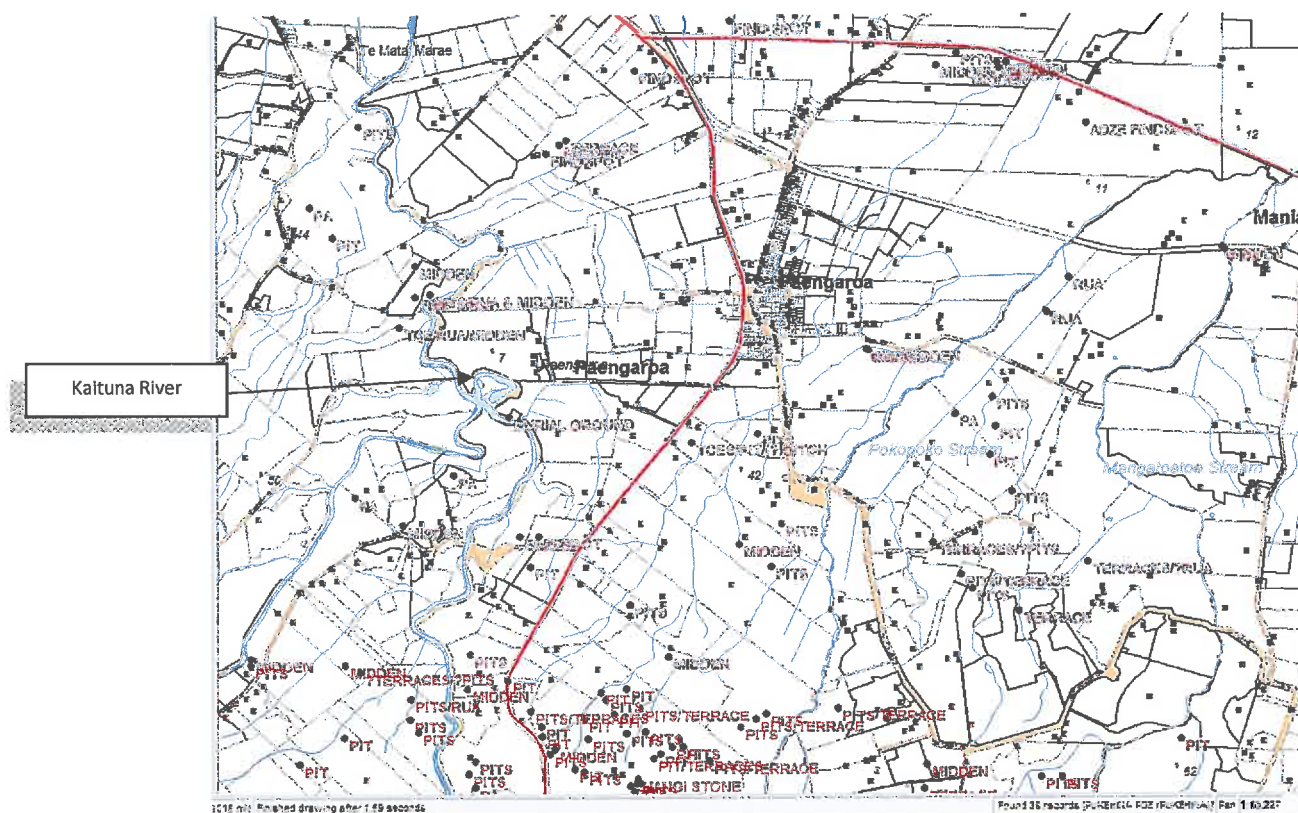
Arch Site 3: East of Te Puke – Te Matai

10.5 Paengaroa



Arch Site 4: Kaituna river and Ohineangaanga Stream

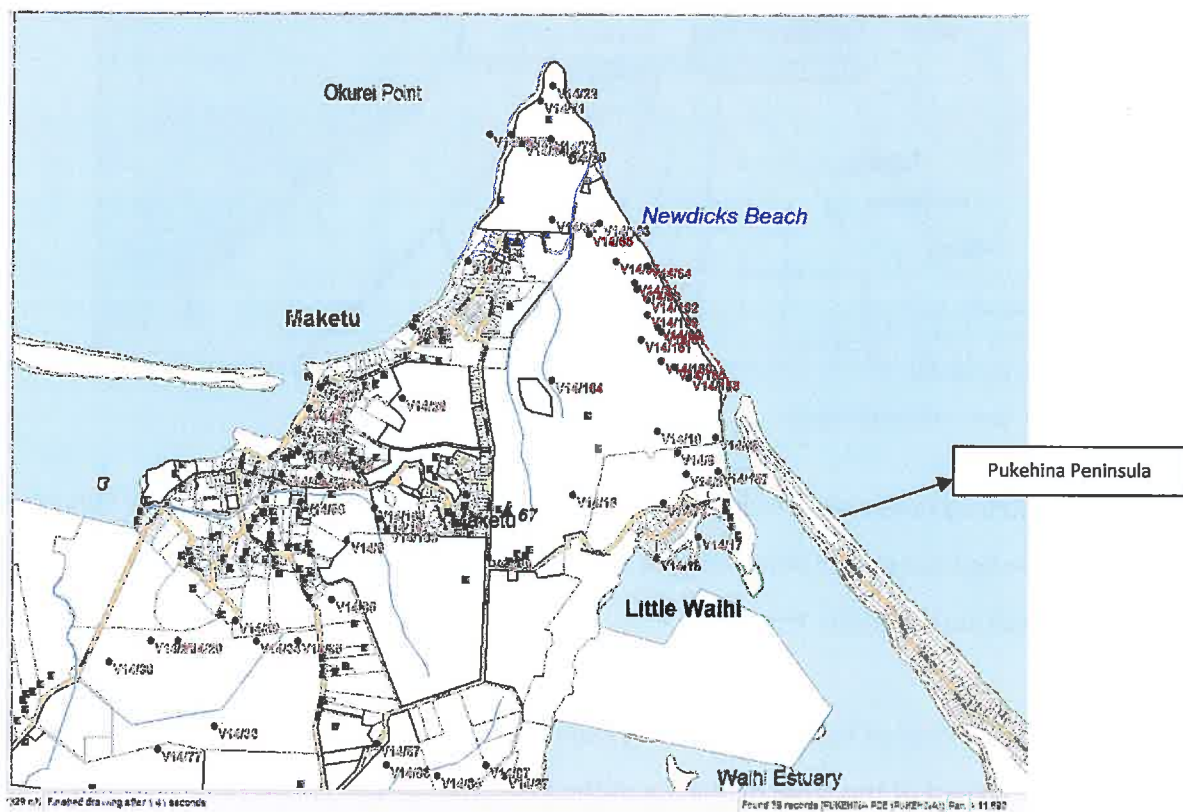
10.6 Paengaroa



Arch Site 5: Paengaroa and Kaituna River

10.7 Maketu

Maketu is possibly the last bastion within the Western Bay of Plenty that is rich in Māori history. A comprehensive archeological survey is required in order to have a true record of the archeological sites. There have been some recorded finds at Maketu however there are still artefacts and historical bones that are being unearthed. For example the Maketu Wastewater Scheme there were two historical koiwi (bones) that were uncovered along Townpoint and Beach Road.

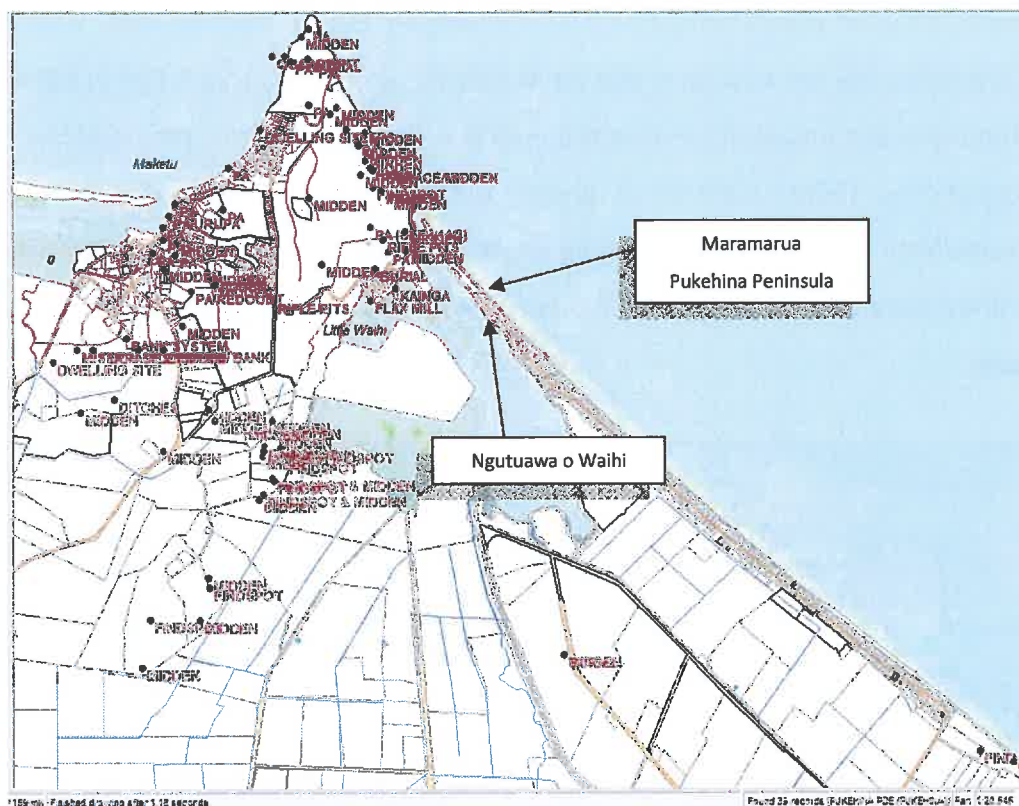


Arch Site 6: Maketu – Waihi – Pukehina Peninsula

10.8 Waihi

There are some recorded archeological sites located in the Waihi village area. However in the 19C this area was heavily populated by various tribes who lived in unison at Waihi. It is also an area that is rich in historical accounts of land ownership challenges and Māori battles fought.

10.9 Maketu – Waihi - Pukehina Peninsula



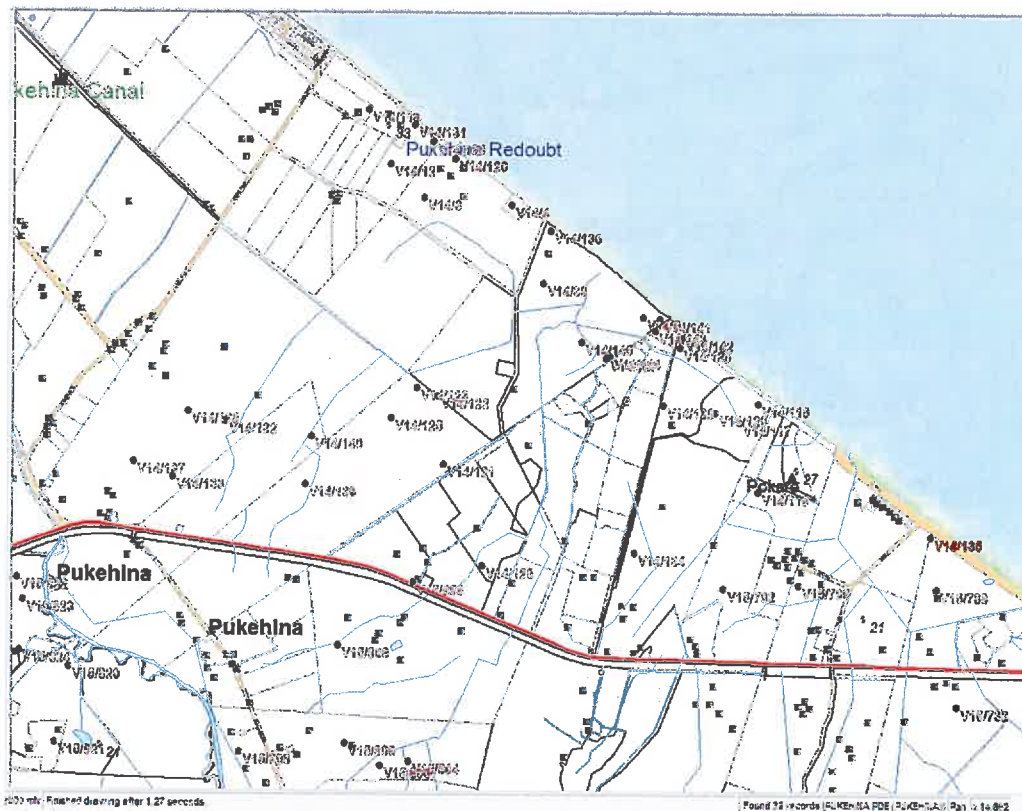
Arch Site 7: Waihi - Pukehina Peninsula

The Pukehina Peninsula which is of particular concern given no archeological surveys have been carried out on the Peninsula yet there has been vast archeological surveys carried out on lands that surround the Peninsula.

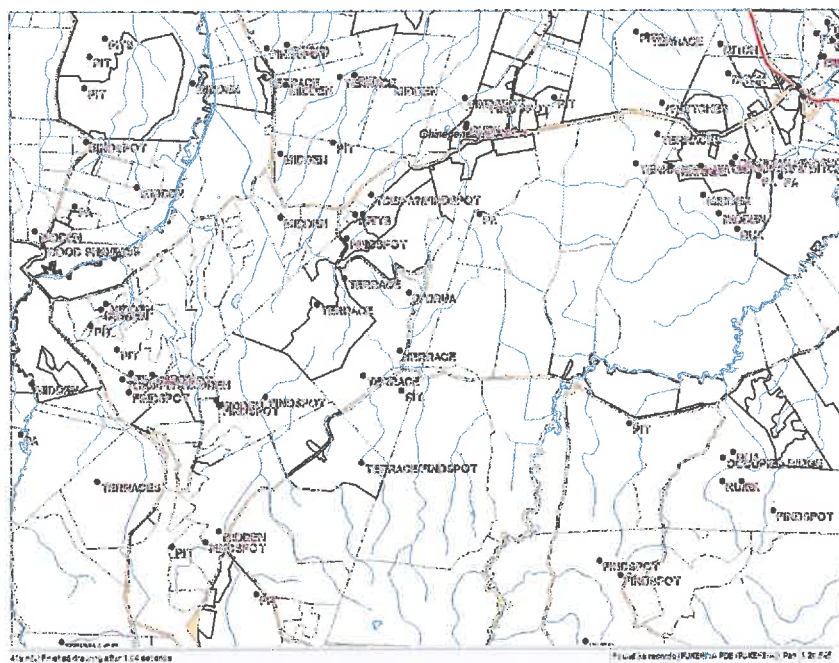
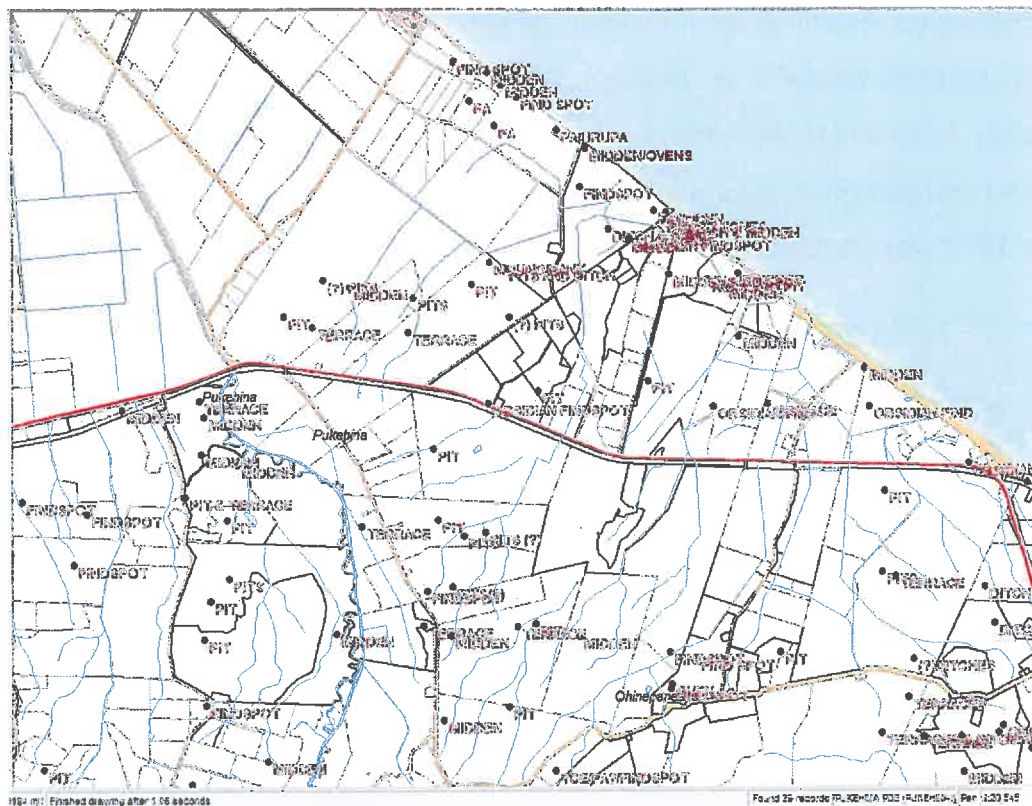
The recollections of Ngāti Whakahemo kaumatua are the sand dunes on the peninsula reached around 60 feet at the initial beginning of the Peninsula and then flattened out. Those sand dunes were used as urupa (cemetery) where the ancestors were buried. There have also been cultural heritage finds of kainga, middens and Māori artefacts that have recently been unearthed by the locals but not recorded.

10.10 Pukehina Inland

The archeological recordings are from Poutuia Beach area back to Oreiwhata which is the tribal cemetery for Ngāti Whakahemo. Most of these archeological finds are located on private land ownership. According to locals they continue to uncover finds of midden, artefacts, kainga and historical koiwi (bones) in and around the Pukehina peninsula. The Pukehina Redoubt during the late 19th C was established on a Pa site along the Pukehina coast.



Arch Site 7: Pukehina coastal and Inland Sites



Arch Site 7: Pukehina Inland

11.0 Recommendations

11.1 Recommendations to Consenting Authority (Council / HPT)

The recommendation from affected tangata whenua (people of the land) is that the Eastern Catchment comprehensive storm-water consent has conditions to the consent:

- i. Formation of a 'kaitiakitanga komiti' (guardianship committee).
- ii. Discharge of storm-water is to wetlands / swales as a first point of contact.
- iii. Earthworks cultural monitoring is initiated in accordance with Iwi Authority and WBOPDC earthworks monitoring protocols.
- iv. A riparian management strategy is recommended in consultation with affected Iwi / Hapu.
- v. An ecology report providing qualitative data is carried out on the waterways affected.
- vi. A site visit is resourced by WBOPDC for affected Iwi / Hapu alongside the technical staff.

11.2 Recommendations to the Applicant

- a) Consultation carried out with the first point of call being the Iwi Authority for each of the affected Iwi / hapu.
- b) A 'Kaitiakitanga Komiti' is formed and resourced by WBOPDC to form protocols. Links to the Regional Policy Statement is recommended.
- c) A site visit is resourced by WBOPDC for affected Iwi / hapu.
- d) A schedule of the planned consent works is provided to the wider Iwi / hapu groups.
- e) Earthwork cultural monitors are employed as part of the project in accordance with the WBOPDC earthworks monitoring protocol.
- f) An archeologist is contracted to carry out investigative digs prior to the project commencing to identify archeological 'hot spots.'
- g) A riparian management strategy is initiated with the affected Iwi / hapu.

- h) The use of wetlands, roadside swales are the first point of contact for discharging of storm-water. Direct discharges are opposed.
- i) Monitoring of samples taken from the waterways. Must show pristine and low quality water sampling.
- j) Education providers within the district are visited and the students informed of what a wastewater system in their district will provide for the environment, waterways and community.
- k) An ecology report with qualitative data on the eels, fish, bird, plant, and wild life is required before the project resumes and at intermittent periods during the consent period. This report should also cover the storm-water effects.
- l) The disposal of sand and dirt from the earthworks requires tangata whenua (people of the land) consultation.
- m) A review process is carried out after the first year.

12.0 Contacts List

The following list of Iwi Authorities and the contact person is provided for the purpose of the Eastern Catchment comprehensive storm-water consent.

Iwi Authority	Names	Contacts	Area of Interest
Kaituna River Authority	Pim DeMonchi Regional Council	Mobile: 021 649818 Email: pim.demonchi@envbop.govt.nz	Kaituna River.
Ngawhara Trust	Shane Swales Trustee	Mobile: 022 6076278 Email: swales@clear.net.nz	Landowner Trust Waihi Estuary.
Ngāti Pukenga	Rehua Smallman Chairperson	Phone: 0800-895-212 Email: reception@teaumaaro.co.nz	Te Tumu to Waihi Estuary Coastal.
Tapuika Iwi Authority	Dean Flavell Resource Management Unit	Phone: 07 5735351 Email: info@tapuika.iwi.nz	Te Puke / Paengaroa Wairakei to Kaikokpu Stream.
Te Arawa Lakes Trust	Terry Tapsell Governance Trustee	Mobile: 0272244702 Email: trtapsell@hotmail.com	Landowner Trust Maketu / Waihi Village.
Te Rūnanga o Ngāti Whakahemo	James (Mal) Anderson Resource Management Unit	Mobile: 0211255289 Email: rmu.whakahemo@gmail.com	Pukehina / Waihi Estuary.
Te Rūnanga o Ngāti Whakaue ki Maketu	Maria Horne Manager	Mobile: 0272910737 Email: runanga@actrix.co.nz	Maketu / Waihi Estuary.
Waitaha Raupatu Trust	Maru Tapsell Resource Management Unit	Phone: 07 5737483 Email: veroni@starltd.co.nz	Te Puke / Mauao to Maketu Coastal.

Table 3: Contact Details

References & Resources

- ⁱ The University of Auckland (2012). Making Good Decisions Workbook 6th Edition.
- ⁱⁱ Regional Council Bay of Plenty (2013). Using Iwi and Hapu Resource Management Plans in our work. Published by Maori Policy.
- ⁱⁱⁱ Tapuika Iwi Authority (2012). Tapuika Deed of Settlement. Cited 17 Sept 2013 www.tapuika.iwi.nz.
- ^{iv} Treaty Of Waitangi Office (2005). Ngā tangata whenua of the Central North Island. Cited 04 October 2013 www.waitangi-tribunal.govt.nz.
- ^v Phillios, W.J. & McEwan, J.M. (1948). Carved Houses of Te Arawa. Cited on 28 September 2013 www.knowledge-basket.co.nz.
- ^{vi} Flavell, D. (2013). Tapuika a Historical Account.
- ^{vii} Horne. M. (2009). Maketu Wastewater Scheme Cultural Impacts Assessment.
- ^{viii} Te Puke Environmental Forum (2012). Te Puke Kahikatea Historical Information. Cited 1 October 2013 www.tepukeenvironmentalforum.co.nz.
- ^{ix} Victoria University of Wellington (2013). The NZ Wars. A history of the Maori campaigns and the Pioneering Period: VOL 1 (1845 – 1864). Cited www.nzetc.victoria.ac.nz 26 September 2013.
- ^x Stafford D. (1967). Te Arawa: A History of the Arawa People. Published by Reed House in 1967.
- ^{xi} Jaram, B.K. (1999). The Life and Times of Timi Waata. Te Puea Maori News.
- ^{xii} Department of Conservation (2005).

Appendix One

Glossary of Maori Words and Abbreviations

Maori	English
Ahi kā roa	Origin continuous long occupation
Hapu	Sub Tribe
Hui	Meeting
Iwi	Main Tribe
Kai	Food
Kaimoana	Seafood
Kaitiaki Taniwha	Spiritual water guardian
Kaitiakitanga	exercise of guardianship by tangata whenua
Kaumatua	Elder
Koha	Gift
Koiwi	Bones
Mana	Authority or prestige
Mahinga Kai	Traditional food sources
Manāki	Hospitality
Mana Whenua	customary authority exercised by an Iwi / hapu
Manuhiri / Manuwhiri	Visitors
Marae	Courtyard
Mihi	Greeting
Ngutuawa o Waihi	Waihi Estuary
Nohonga Iwi	Village
Pa	The marae and tribes area of residence
Paepae	Speaking Platform
Pakeke	Adults
Pataka Kai	Food store or larder
Pēpeha	Ancestral genealogy to the natural resources
Puhaorangi	Spiritual being of Tapuika
Raupatu	Confiscation of land
Tapu	Sacred
Tangata Whenua	people of the land
Taonga Kura	Highly prized treasure
Taniwha	Monster, spiritual water creature
Te Parata	The demon
Tikanga	Maori customary values and practices

Tohu	Sign
Tohunga	High Priest—Expert in a given field
Tūpuna	Ancestor
Urupa	Cemetery
Wāhi Tapu	a place sacred to Maori
Wahi Whakahirahira	Place of Importance
Wai	Water
Waka	Canoe
Waharoa	Gateway
Whanau	Family
Whakapapa	Family Tree/Lineage
Whaikorero	Oratory
Whakatauaki	Proverb

Appendix Two

Abbreviations

CIA	Cultural Impact Assessment
TCC	Tauranga City Council
GIS	Geographical Information System
GST	Good and Services Tax
MVA	Maori Values Assessment
NZHPT	New Zealand Historic Places Trust
RMU	Resource Management Unit
TKNoNW	Te Komiti Nui o Ngāti Whakaue
WBOPDC	Western Bay of Plenty District Council

Appendix Three

Te Awhe Marae Gazette Notice

T.N. 1642

Extract from N.Z. Gazette, 21 August 1986, No. 130, page 3537

Setting Apart Maori Freehold Land as a Maori Reservation

PURSUANT to section 439 of the Maori Affairs Act 1953, the Maori freehold land described in the Schedule hereto is hereby set apart as a Maori reservation for the purpose of a marae for the common use and benefit of Ngati Whakahemo Hapu in particular and Te Arawa people in general.

SCHEDULE

SOUTH AUCKLAND LAND DISTRICT

ALL that piece of land situated in Block VI, Te Tumu Survey District and described as follows:

Area m ²	Being
5826	Maketu A 150 and being all of the land on partition order of the Maori Land Court dated 13 November 1985.

Dated at Wellington this 17th day of June 1986.

B. S. ROBINSON,
Deputy Secretary for Maori Affairs.

(M.A. H.O. 21/3/5; D.O. Appln. 27805)

Appendix I

Eastern Catchments
Flooding maps

Figure F-1 Te Puke Flood extent for the 50-year ARI, 24-hr duration design nested storm rainfall event (from Opus 2015)

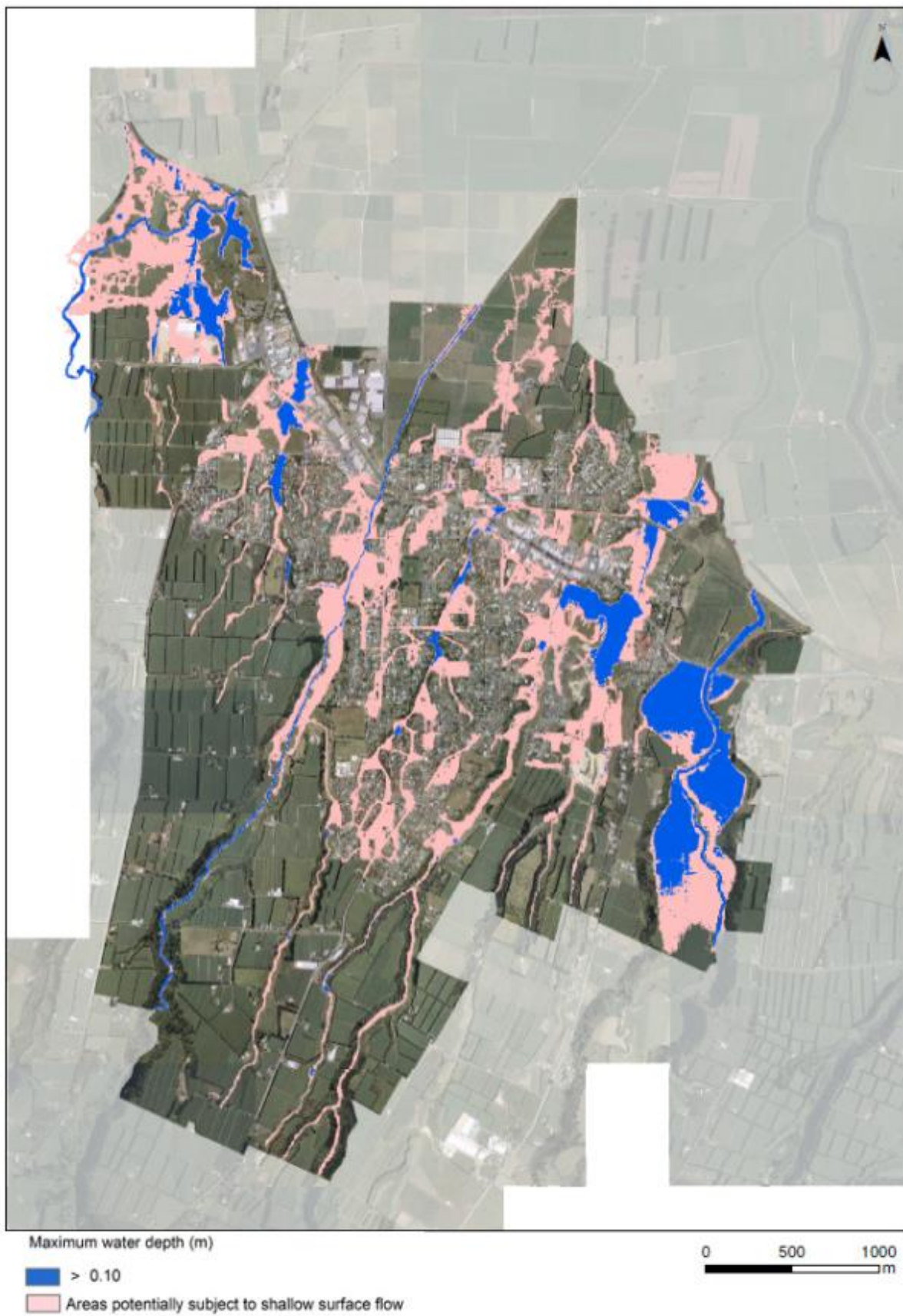


Figure F-2 Te Puke Flood depth for the 50-year ARI, 30-min duration design nested storm rainfall event (from Opus 2014)

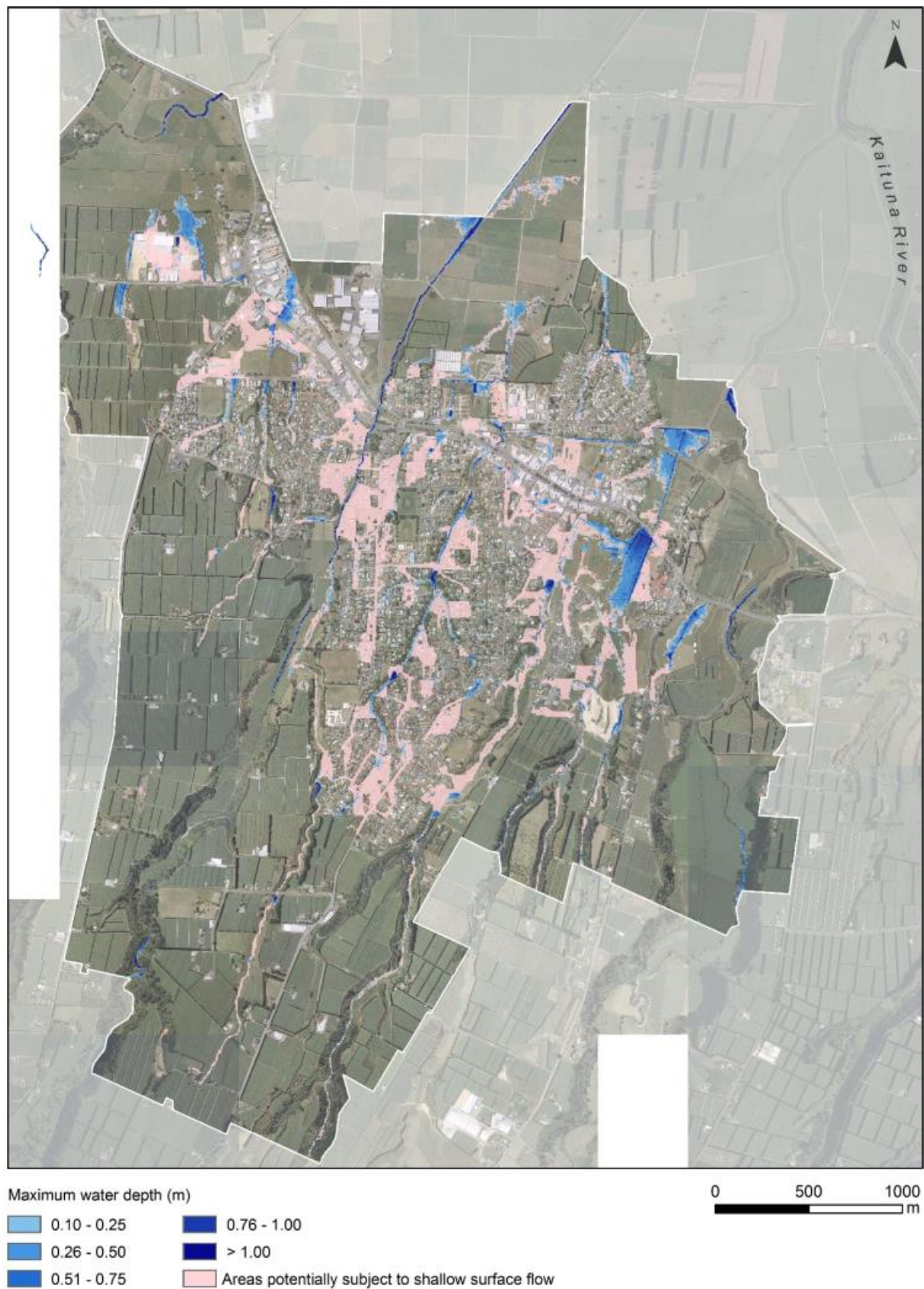


Figure F-3 Flood map of Paengaroa Catchment (50-year ARI storm event, figure taken from Duffill Watts 2005)

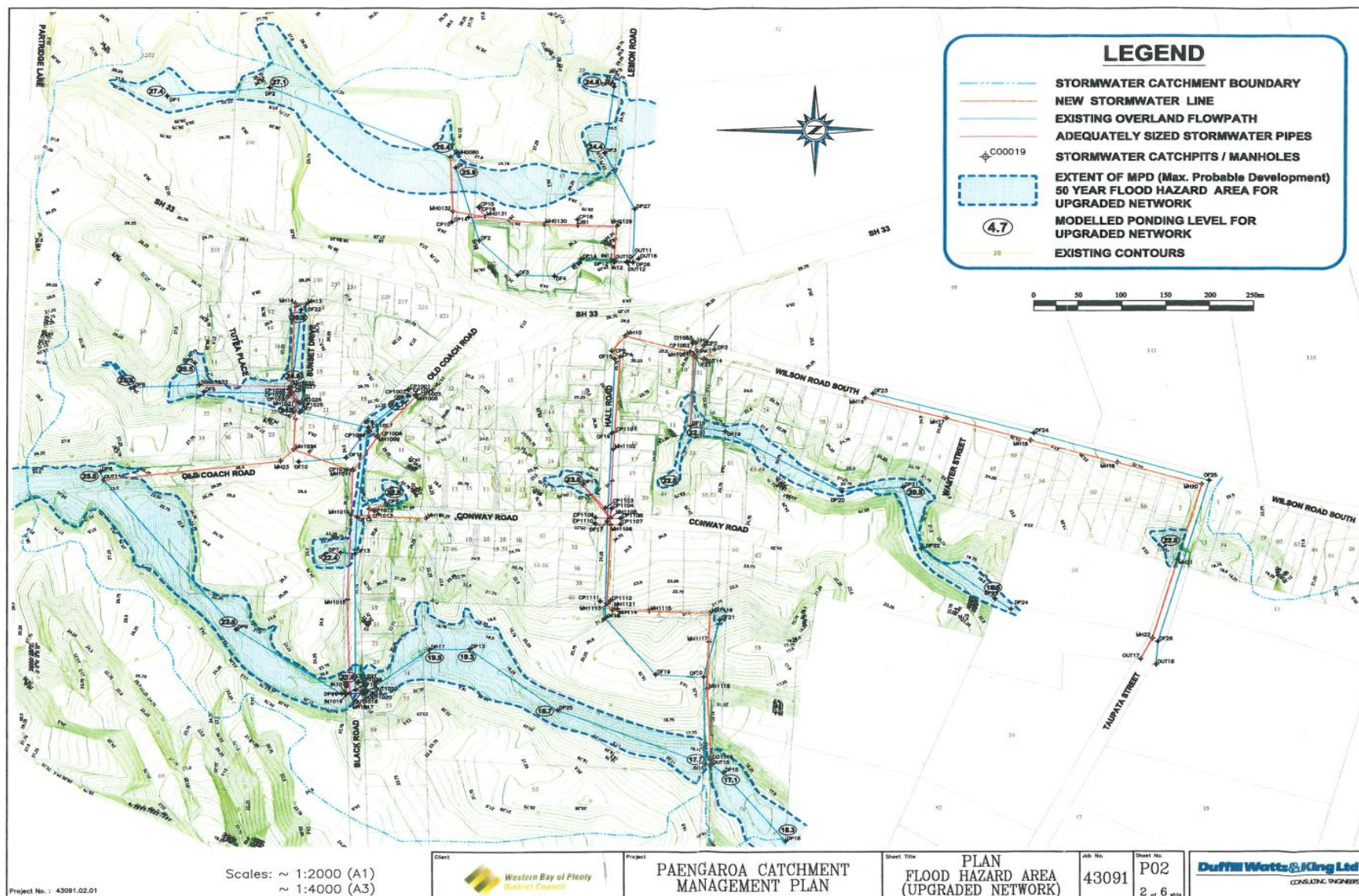


Figure F-4 Location of stormwater network upgrade projects within Paengaroa Catchment (Duffill Watts 2005)

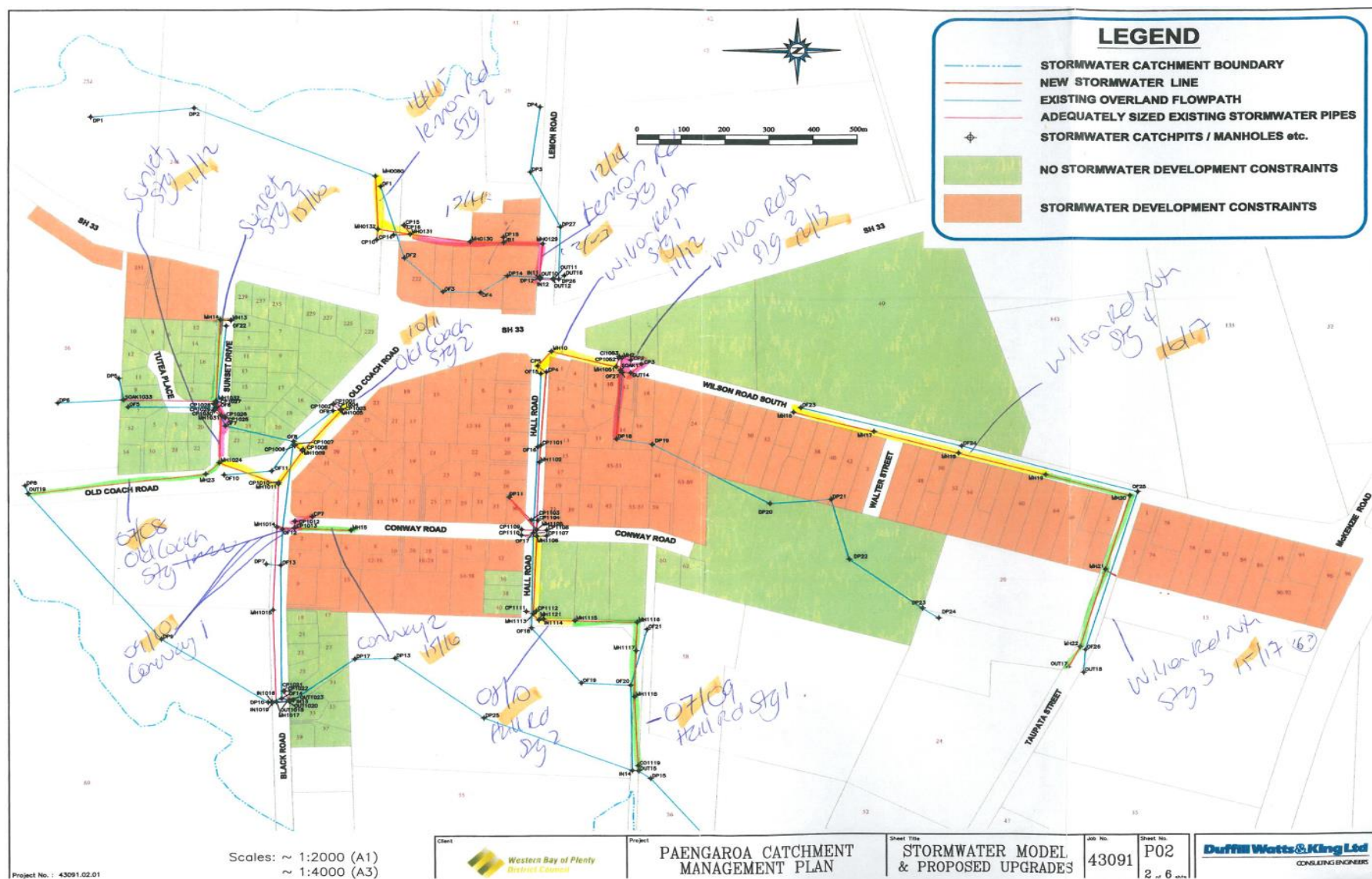


Figure F-5 Flood map (1) of Maketu Catchment (50-year ARI storm event, figure taken from Maketu ICMP (PMS 2013))

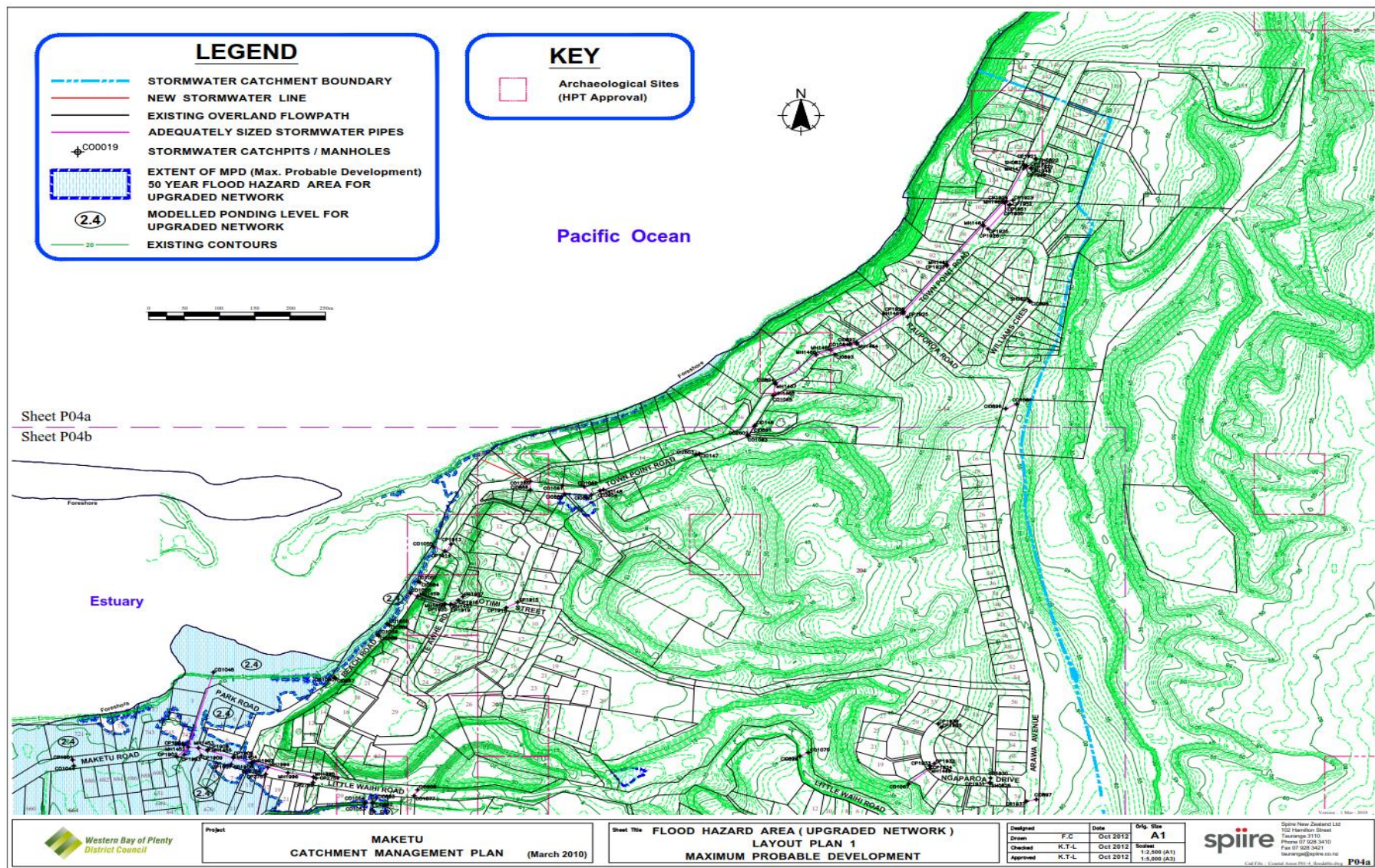


Figure F-6 Flood map (2) of Maketu Catchment (50-year ARI storm event, figure taken from PMS 2013)

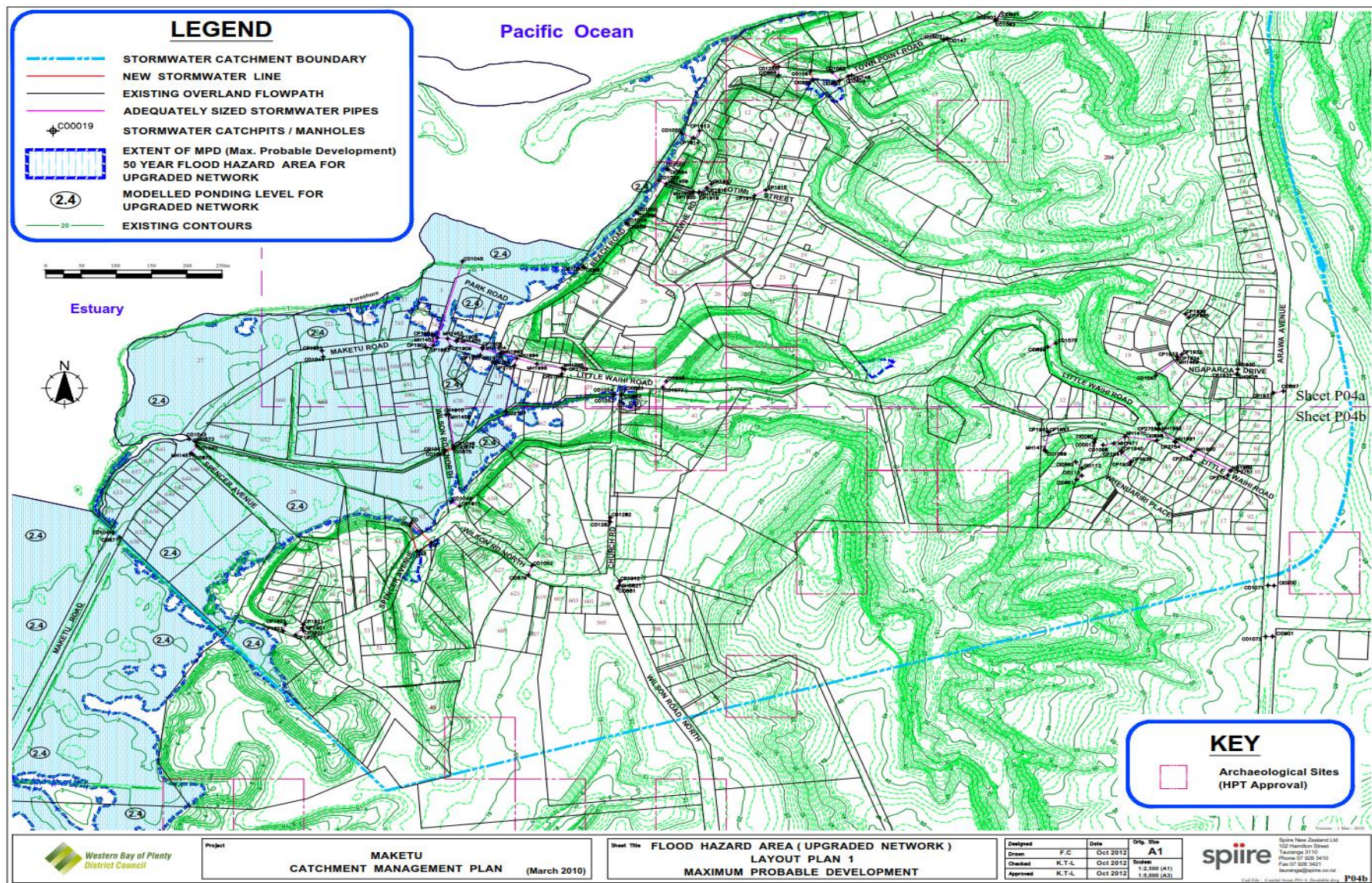


Figure F-7 Flood map (1) of Pukehina Catchment (50-year ARI storm event, figure taken from PMS 2013)

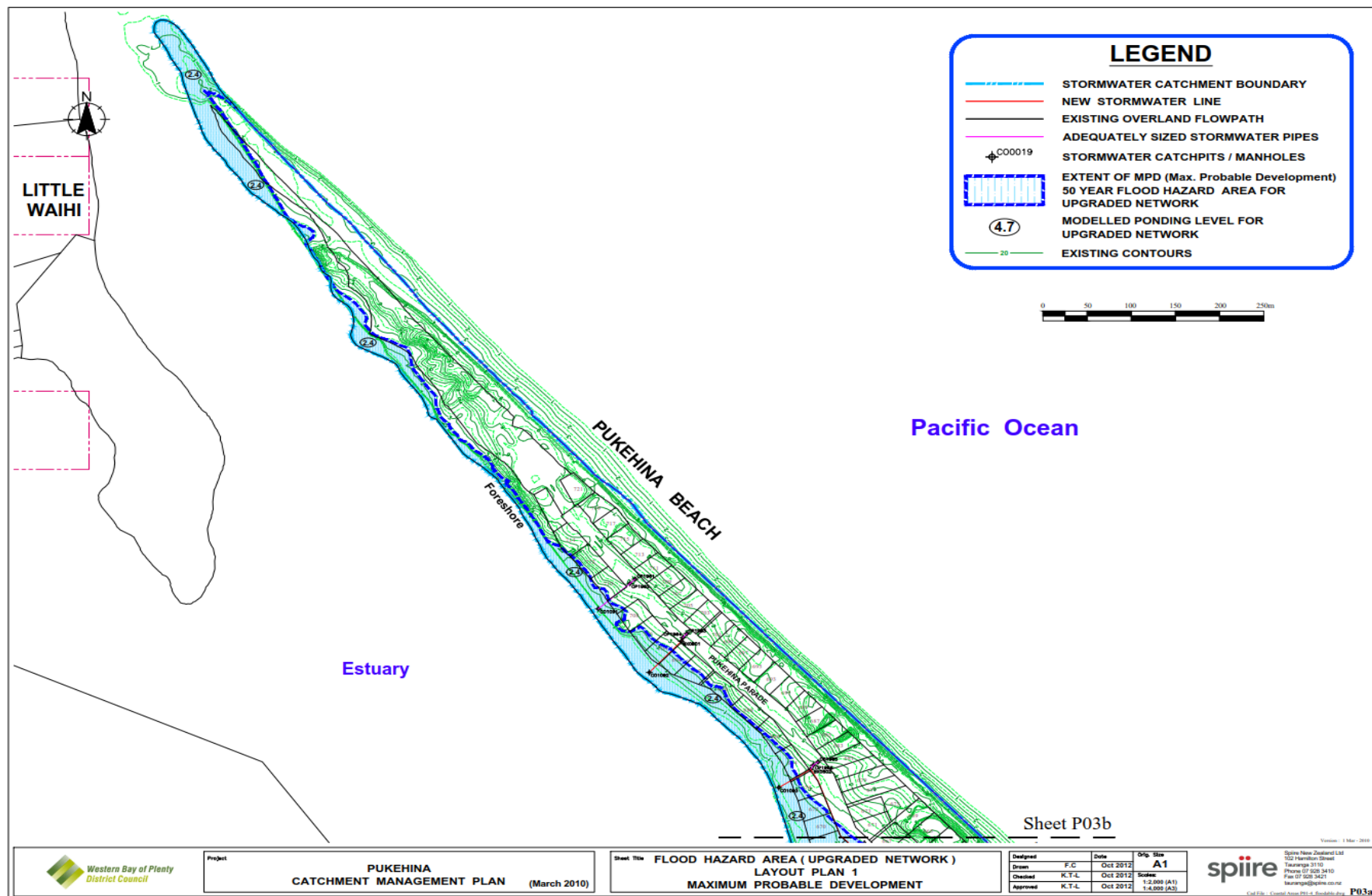


Figure F-8 Flood map (2) of Pukehina Catchment (50-year ARI storm event, figure taken from PMS 2013)

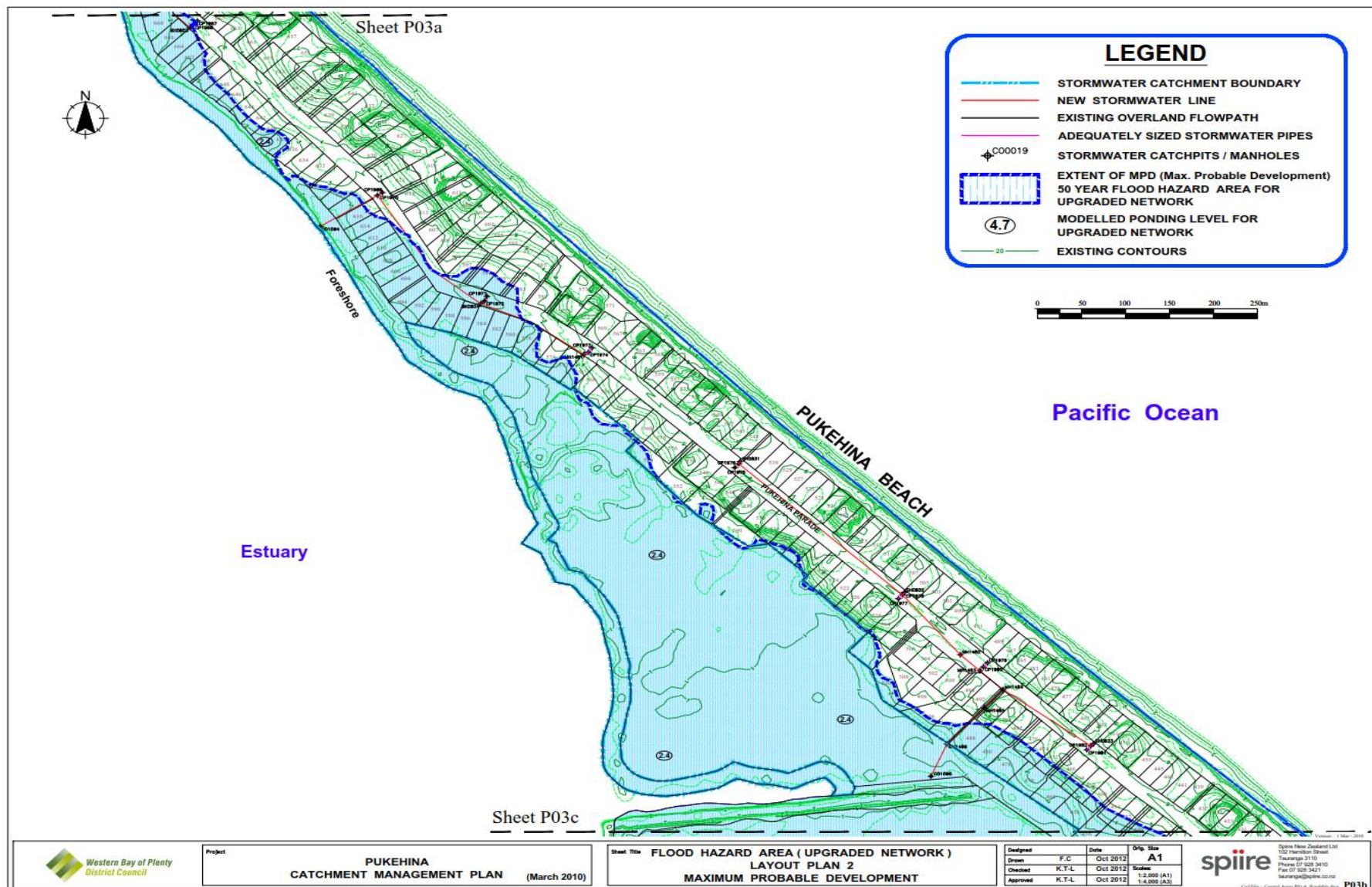
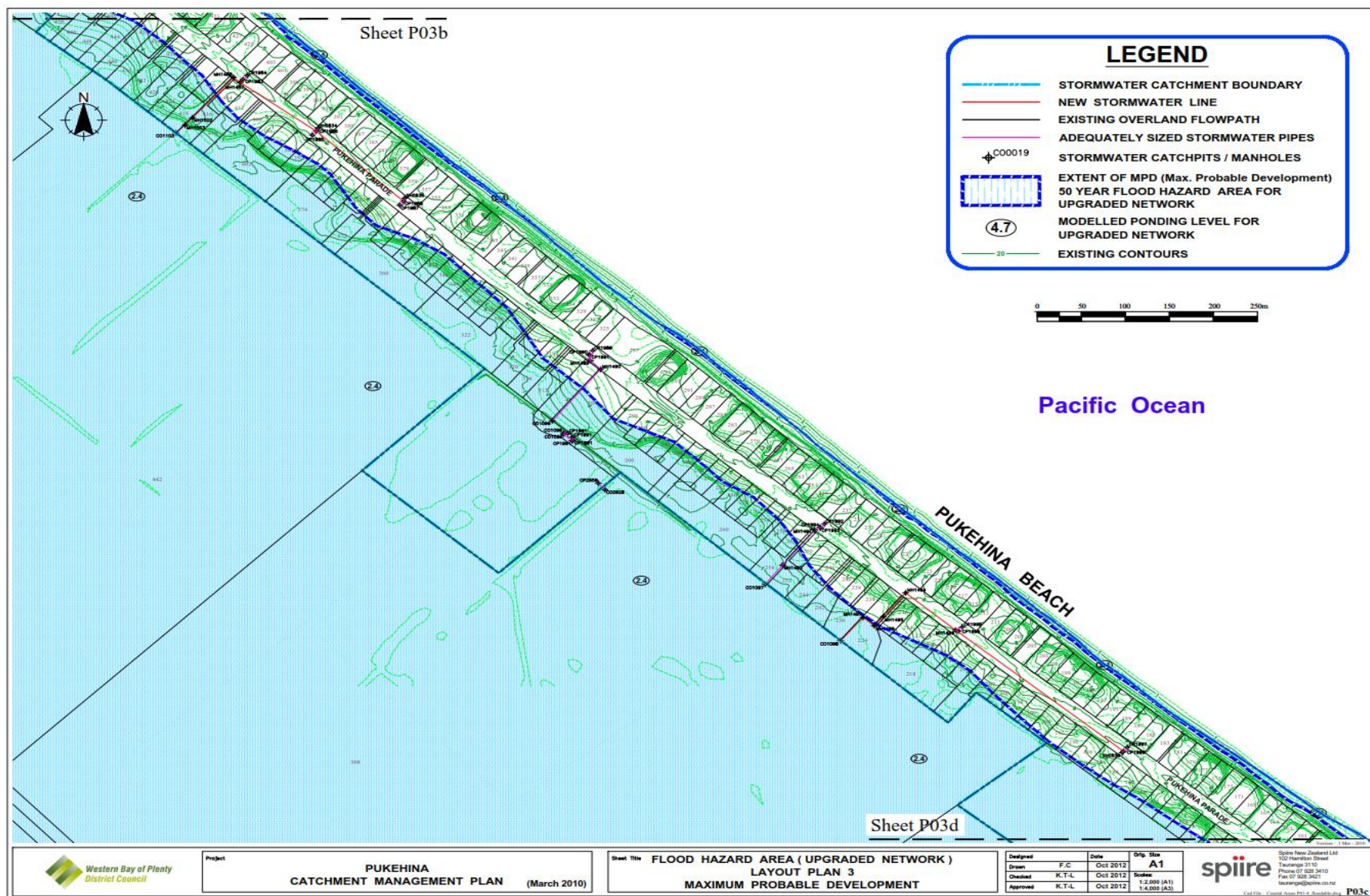


Figure F-9 Flood map (3) of Pukehina Catchment (50-year ARI storm event, figure taken from PMS 2013)



Sheet P03c

LEGEND

- STORMWATER CATCHMENT BOUNDARY
- NEW STORMWATER LINE
- EXISTING OVERLAND FLOWPATH
- ADEQUATELY SIZED STORMWATER PIPES
- + CO0019 STORMWATER CATCHPITS / MANHOLES
- EXTENT OF MPD (Max. Probable Development)
- 4.7 50 YEAR FLOOD HAZARD AREA FOR UPGRADED NETWORK
- 20 EXISTING CONTOURS

0 50 100 150 200 250m

Pacific Ocean

PUKEHINA BEACH

Project		Design		Date		Dwg. Size	
PUKEHINA CATCHMENT MANAGEMENT PLAN (March 2010)		Drawn	F.C.	Oct 2012	A1 Scale: 1:2,000 (A1) 1:4,000 (A3)		
		Checked	K.T.L.	Oct 2012			
		Approved	K.T.L.	Oct 2012			

spire

Spire New Zealand Ltd
 122 Taranaki Street
 Tauranga 3110
 Phone 07 528 3410
 Fax 07 528 3421
taurang@spire.co.nz

Western Bay of Plenty District Council
Private Bag 1283
Tauranga

Attention: Coral-Lee Ertel

Dear Coral-Lee

Te Puke Structure Plan Stormwater Review

1 Introduction

This letter report has been prepared in accordance with the Letter of Engagement dated 14 December 2015, and in it the conceptual design of the stormwater system to serve the Te Puke Area 3 Structure Plan is described.

1.1 Background

T+T was engaged by Western Bay of Plenty District Council to undertake a review of the stormwater requirements currently in the Te Puke Structure Plan, focussed on Area 3 (the area south of Macloughlin Drive). The subject area is shown in the Te Puke Long Term Plan 2012-2022 Structure Plan maps, sheet 1 of 2, dated 02/03/2012 and is shown indicatively in Figure 1 below. This review was conducted as an investigation into an updated structure plan to facilitate staged urban growth within the subject area. The base underlying philosophy applied was that future development of this area would not cause any increase to peak flood discharge downstream.

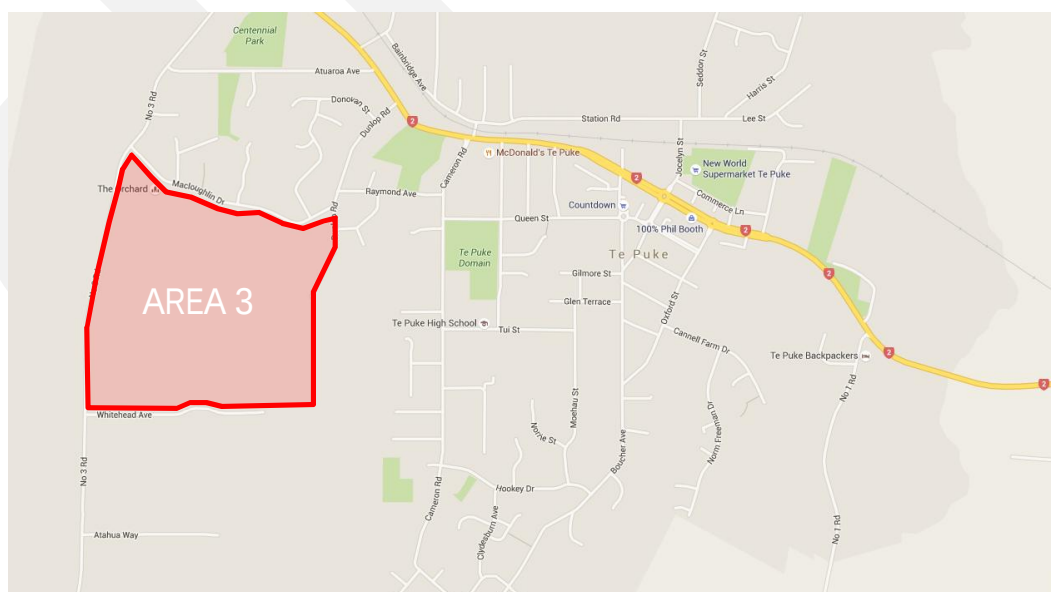


Figure 1: Location of Area 3, Te Puke Structure Plan (image courtesy of Google Maps)

1.2 Proposed future development

Area 3 of the Te Puke Structure Plan covers an area of 71.4 Ha bound by MacLoughlin Drive to the north, No 3 Road to the West, Whitehead Avenue to the South and Dunlop Road to the East as shown in Figure 2 below). Potential future development is divided into three phases with a total of 521 potential residential lots, consisting of a mixture of Residential and Medium Density Residential Zones (both zones have a maximum allowable imperviousness of 50%). Through discussions with Western Bay of Plenty District Council it is our understanding that phase 1 and phase 2 would occur before phase 3, but that either phase 1 or phase 2 may be developed first.

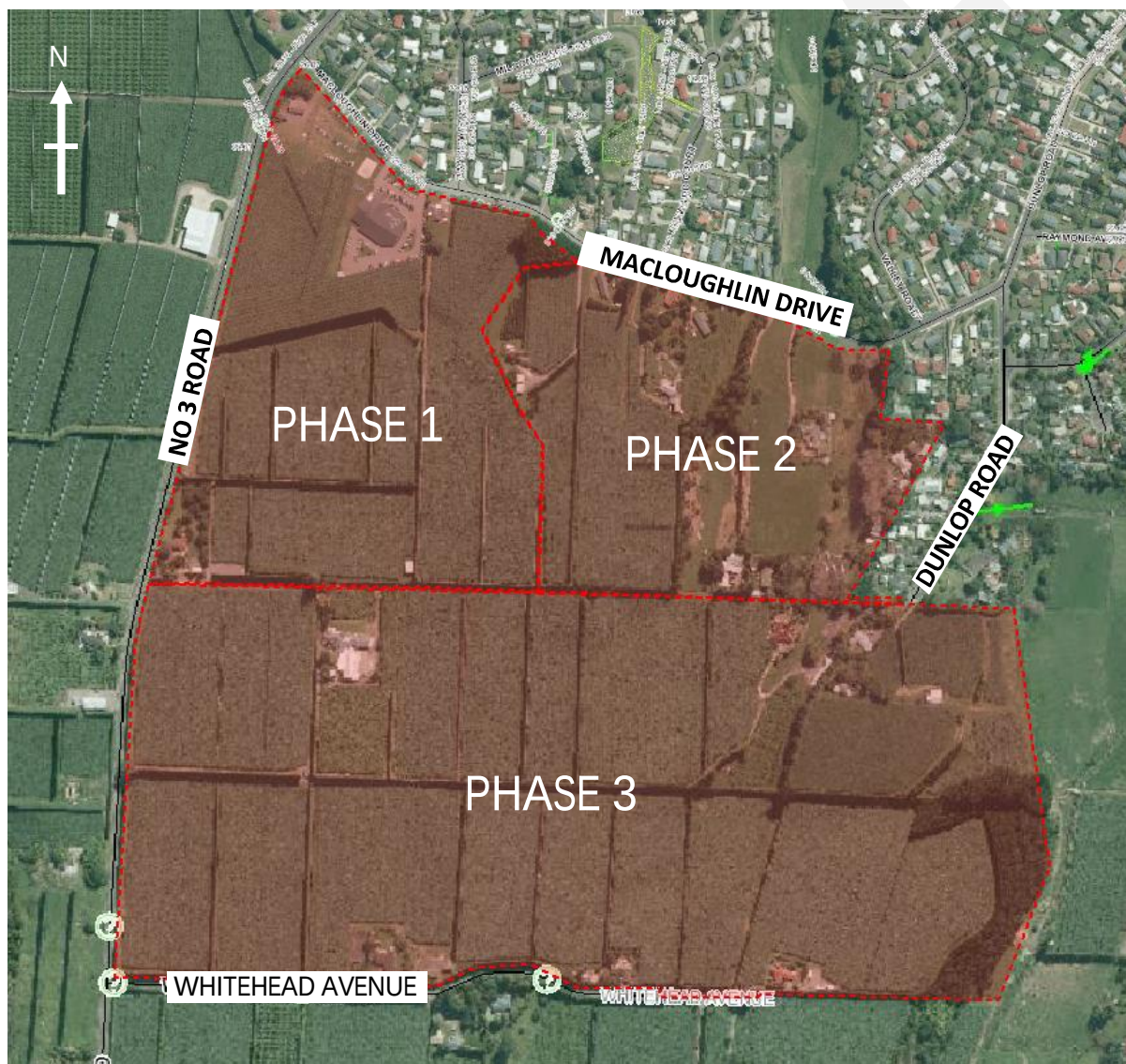


Figure 2: Development phase boundaries for Area 3 of the Te Puke Structure Plan

1.3 Previous work

T+T has previously undertaken flood modelling to verify the flood hazard mapping for Te Puke. The model results show flooding downstream of MacLoughlin Drive in Centennial Park and the industrial complex on the northern side of Jellicoe St/SH2. Any increase in impervious area in the upstream catchment where future development is proposed may result in increased flood impacts on downstream properties if not adequately mitigated.

2 Hydrological Assessment

A hydrological assessment was carried out to understand stormwater flows originating from the wider Macloughlin Drive catchment, of which Area 3 is a portion. The details of the assessment are given in the following sections.

2.1 Rainfall

A frequency analysis of rainfall depths for the site was produced using NIWA's HIRDS V3 software with a temperature increase of 2.1°C used in the generation of the rainfall depths to account for climate change (projected 2090 levels from MfE Guidelines 2008). The 24 hour design hyetograph was derived using the Chicago method for the 2% annual exceedance probability (AEP) event (refer Figure 3). This is in accordance with the Bay of Plenty Regional Council (BoPRC) method.

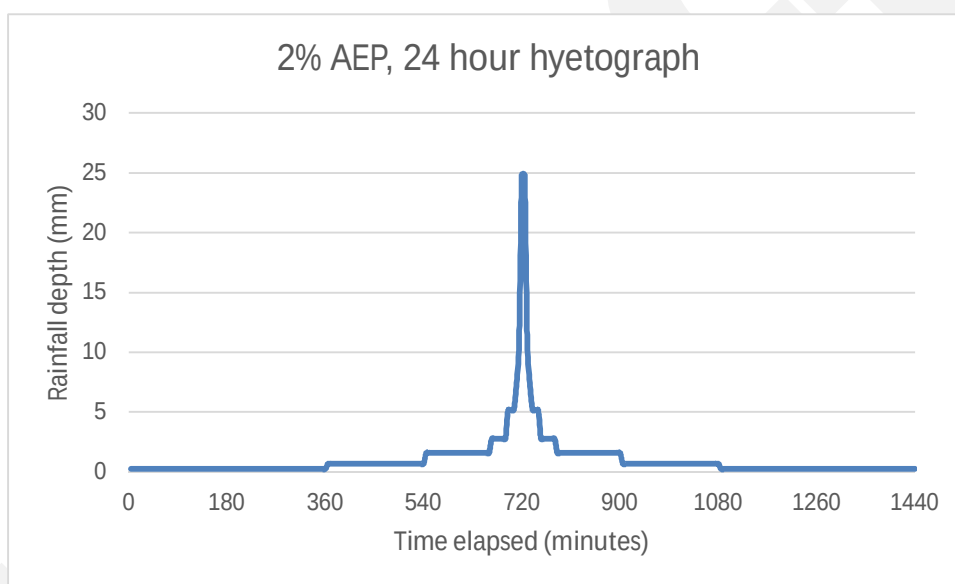


Figure 3: Design hyetograph

2.2 Catchment properties

The catchment draining to Macloughlin Drive, within the proposed development area, has been split into six sub-catchments. Catchment boundaries were delineated based on 2012 LiDAR data provided by Western Bay of Plenty District Council. The sub-catchments have been labelled A through F and their boundaries are shown in Figure 4 below.

The catchment topography is mildly sloping from south to north. Towards the top of the catchment the catchment is fairly flat becoming more hilly, with incised channels forming toward the bottom of the catchment near Macloughlin Drive. Aerial photography shows the current landuse is agricultural with the entire catchment consisting of kiwifruit orchard interspersed with a few rural dwellings and access ways.

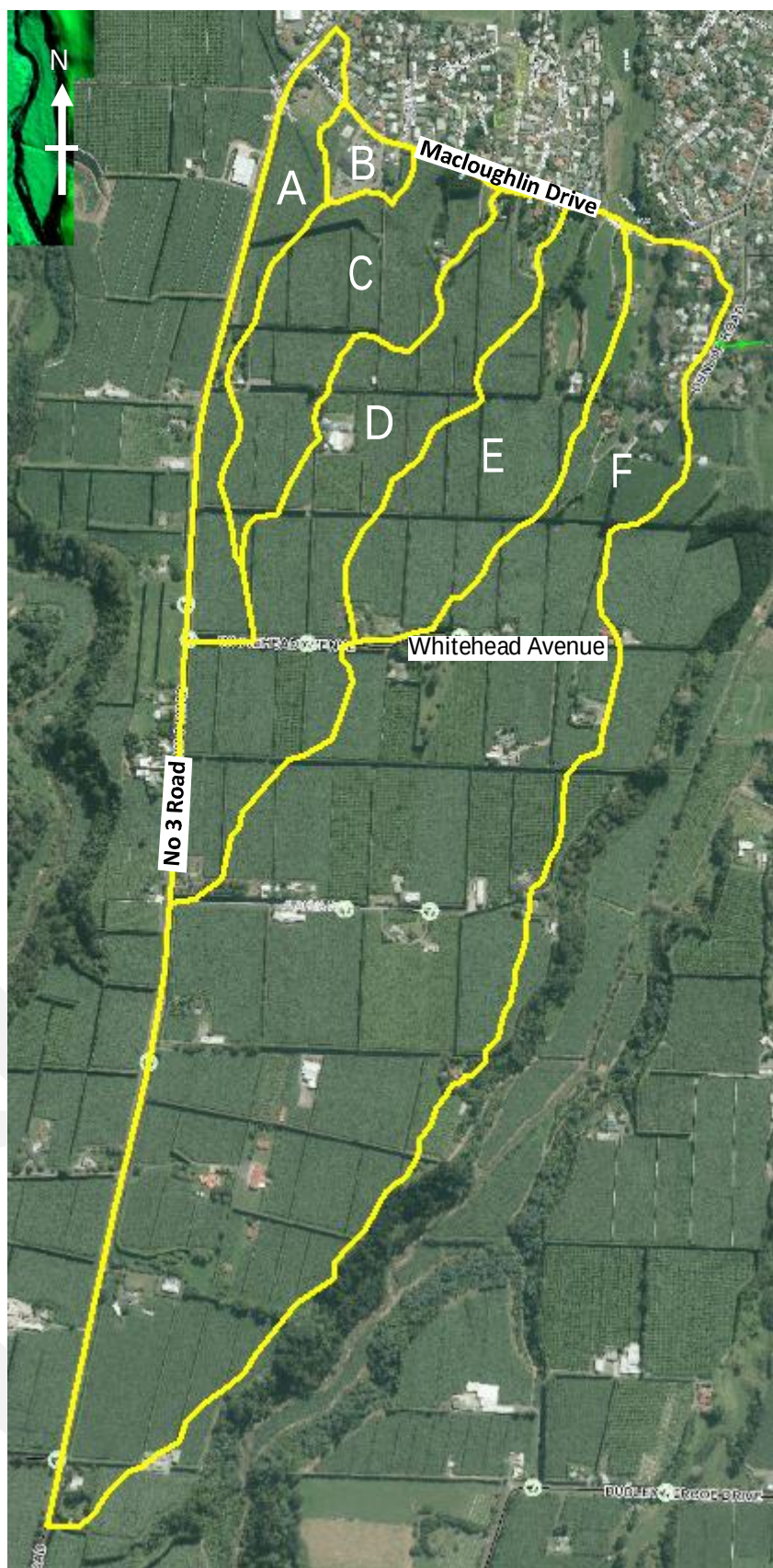


Figure 4: Sub-catchment boundaries

2.3 Site assessment

A site assessment was undertaken by T+T stormwater engineers on 13 January 2016 to examine the existing stormwater infrastructure (including natural storage areas) and the drainage regime in the catchment. The observations made are summarised below and shown on Figure 5 below.

Sub-catchment A drains to a 450 mm diameter culvert located under No 3 Road near the intersection of MacLoughlin Drive and No 3 Road. There is a low point in the road at this point but no depression allowing natural storage was observed on the upstream side of the road on site or in the digital elevation data. Flow from sub-catchment A heads north-west and drains into the Raparapahoe Stream where the stream crosses Jellicoe St/State Highway 2.

Sub-catchment B is a predominantly impervious subcatchment which enters the piped network via a catchpit on the southern side of MacLoughlin Drive. Subcatchment C drains to the wooded area on the upstream side of MacLoughlin Drive, opposite Rimu Lane. The wooded area is a natural depression and drains under MacLoughlin Drive via a 900 mm diameter culvert with a manhole riser inlet. Flow from both sub-catchments B and C converges in the pipe network near the Te Puke Sports and Recreation Club.

Sub-catchment D drains to a grated pipe inlet located in a natural depression upstream side of MacLoughlin Drive, opposite Hayward Court. Flow continues eastward in the piped network underneath MacLoughlin Drive. Sub-catchment E enters the piped network via a catchpit on the southern side of MacLoughlin Drive. No natural storage was observed on the upstream side of MacLoughlin Drive and information provided by Western Bay of Plenty District Council suggests that the natural depression may have been filled in as a historical rubbish tip. Sub-catchment F drains to a 900 mm diameter culvert located under MacLoughlin Drive. Upstream of the culvert there is an incised gully that provides some natural storage. Information provided by Western Bay of Plenty District Council suggests that there may also be a historic rubbish tip located in the gully. Flow from sub-catchments D, E and F discharges into the open channel at 67 MacLoughlin Drive



Figure 5: Existing stormwater infrastructure

2.4 Modelling approach

The effects of the proposed development were analysed by grouping the sub-catchments based on common downstream discharge locations. This approach allowed for over-attenuation in one catchment to compensate for no attenuation in another without exacerbating flooding effects on downstream properties. This approach yields three analysis locations:

- downstream of sub-catchment A;
- downstream of sub-catchments B and C and;
- downstream of sub-catchments D, E and F.

Hydrological modelling was undertaken using the SCS Curve Number Method with a specified hyetograph using HEC-HMS v4.0 software. Lag time was calculated using the SCS method. A curve number of 57 was adopted for kiwifruit orchards. This is consistent with the guidance given in the United States Department of Agriculture's (USDA) Technical Report 55 (TR55) for orchards with good hydrologic condition and soil group B soils. A low curve number is a conservative approach to runoff losses in this context as it produces the greatest difference in peak flows when considering the hydrologic effect of developing the catchment.

SWMM v5.1 was used to hydraulically model the natural storage areas and stormwater infrastructure described in Section 2.3. The hydraulic modelling was undertaken to determine the pre-development flow being discharged to the downstream side of Macloughlin Drive, accounting for the attenuation effects from the existing natural storage. Pipe locations, sizes and invert levels were taken from Western Bay of Plenty District Council GIS data. The results from the SWMM model are presented in Section 2.5 below.

2.5 Unmitigated peak flow results

Table 1 below compares the pre-development peak flow rate against the unmitigated post development peak flow rate. The unmitigated case assumes that all three development phases have been implemented (the worst case scenario in terms of hydrologic impact) with no change to the existing stormwater infrastructure or natural storage areas. The results show an increase in peak flow rates generated from the catchment at all three analysis locations.

Table 1: Unmitigated peak flow results

Analysis location	Pre-development 2% AEP peak flow (m ³ /s)	Post-development (Phase 1, 2 & 3) 2% AEP peak flow – Unmitigated (m ³ /s)	% increase in peak flow
Sub-catchment A	3.78	4.76	25.9%
Sub-catchment B+C	4.85	5.93	22.3%
Sub-catchment D+E+F	38.3	43.59	13.8%

Table 2 below shows the increase in total runoff volume generated over the duration in the storm as a result of development. The results compare the pre-development case with three post-developed cases that assume the phases are constructed sequentially.

Table 2: Additional runoff volume from development (m³)

Analysis location	Phases completed		
	1	1 & 2	1, 2 & 3
Sub-catchment A	2,922	2,922	5,179
Sub-catchment B+C	8,123	9,022	11,326
Sub-catchment D+E+F	1,949	12,339	35,478

3 Proposed Peak Flow Mitigation

3.1 Design philosophy

We understand that the principal design constraint for stormwater management is that future development of Area 3 should cause no increase in post-development peak runoff rate (compared against pre-development rate) in response to a climate adjusted (2090) rainfall event of 2% AEP. All calculations have been based on this.

3.2 Proposed mitigation option

The proposed option to mitigate increases in peak flow as a result of development consists of enlarging the existing storage areas to provide increased attenuation capacity. This is considered to be a lower cost option than traditional “hard” stormwater infrastructure currently proposed for managing stormwater for Area 3 in the Te Puke Structure Plan. In the cases of sub-catchment B and sub-catchment E, no natural storage area currently exists and it is proposed that the increased flow from these two sub-catchments is mitigated by over-attenuating other sub-catchments that drain to the same analysis location. Sub-catchment A also has no existing natural storage by cannot be mitigated in this way so a new storage area will need to be constructed. The location and approximate extent of the storage areas required and indicatively shown in Figure 6 below.

The approximate extent of the proposed storage facilities is based on an average ponding depth taken to be 60% of the maximum ponding depth available before overtopping of MacLoughlin Road occurs. Detailed design is required to confirm the exact size and extent of the required ponding areas to mitigate increases in peak flowrates as a result of future development.

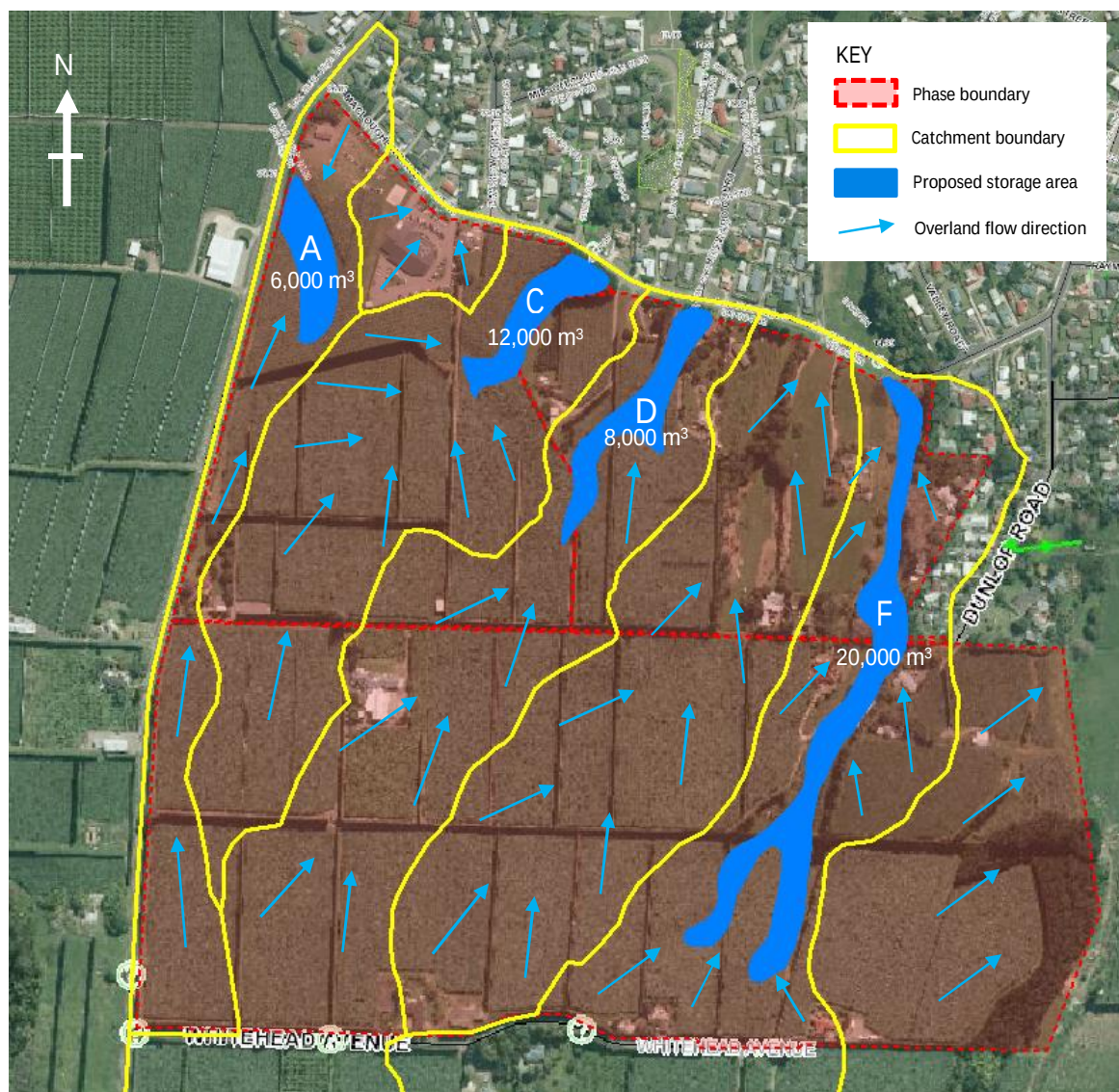


Figure 6: Proposed storage area location and extents

Enlarged storage areas were sized by using cumulative inflow curves from pre- and post-development. The volumes found to be required were checked using a revised SWMM model to ensure peak flows were attenuated to pre-development rates. It was assumed for conceptual design that the existing stormwater infrastructure under Macloughlin Drive will remain unchanged. The approximate required sizes for the proposed storage facilities are presented in Table 3 below. These volumes are taken to road level with some overtopping of Macloughlin Road predicted in the model.

Table 3: Required storage volumes

Storage area	Storage volume (m³)
Storage area A	6,000
Storage area C	12,000
Storage area D	8,000
Storage area F	20,000

While the storages volumes presented provide peak flow mitigation for the development of all three phases they can also be implemented in a staged approach. The proposed solution for staging of the development and storage areas is as follows:

- Phase 1 – construct storage area A and storage area C
- Phase 2 – construct storage area D
- Phase 3 – construct storage area F

The catchment area served by storage areas A and C is almost exclusively contained within Phase 1 while the catchment area served by storage area D is almost exclusively contained within Phase 2. Therefore these two development phases could be completed in any order with their corresponding storage areas able to mitigate increases in peak flow. However Phase 3 spans all six sub-catchments and construction of storage area F will not provide mitigation for the resulting increase in flows in sub-catchments A, B and C unless other ponding areas are also constructed.

3.3 Mitigated peak flow results

Table 4 below compares the pre-development peak flowrate against the mitigated post development peak flowrate assuming the development staging as described in Section 3.2. The results show that the proposed mitigation option can attenuate the increase in peak flows from development of Area 3 to pre-development rates. The pre-development and post-development mitigated hydrographs are shown in Appendix A.

Table 4: Mitigated peak flow results

Analysis location	Pre-development 2% AEP peak flow (m ³ /s)	Phase 1, 2% AEP peak flow – Mitigated (m ³ /s)	Phase 1 & 2, 2% AEP peak flow – Mitigated (m ³ /s)	Phase 1, 2 & 3, 2% AEP peak flow – Mitigated (m ³ /s)
Subcatchment A	3.79	2.35	2.35	3.84
Subcatchment B+C	4.85	4.28	4.48	4.93
Subcatchment D+E+F	38.3	38.54	37.9	37.78

4 Conclusion

Hydrological analysis shows that proposed future development of Area 3 could result in an increase of peak flow rates between 14% and 26% downstream of the development. To mitigate any increase in peak flow we propose enlarging the existing natural storage areas identified in our site assessment to provide a greater degree of attenuation. The proposed staged mitigation is as follows:

First:

- Phase 1 – construct storage area A (6,000 m³) and storage area C (12,000 m³) and/or
- Phase 2 – construct storage area D (8,000 m³)

Then:

- Phase 3 – construct storage area F (20,000 m³)

Phase 1 and Phase 2 could be completed in any order with their corresponding storage areas able to mitigate increases in peak flow. However Phase 3 spans all six sub-catchments and construction of storage area F will not provide mitigation for the resulting increase in flows in sub-catchments A, B and C unless other ponding areas are also constructed.

This conceptual design is intended to understand the approximate volumes and extent of land required to provide attenuation of stormwater runoff for proposed future development of Area 3. Detailed design will be required to confirm the exact size of the required storage areas and the how they will be constructed.

5 Applicability

This report has been prepared for the exclusive use of our client Western Bay of Plenty District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:

Authorised for Tonkin & Taylor Ltd by:

.....
Joshua Hodson

Stormwater Engineer

.....
Glen Nicholson

Project Director

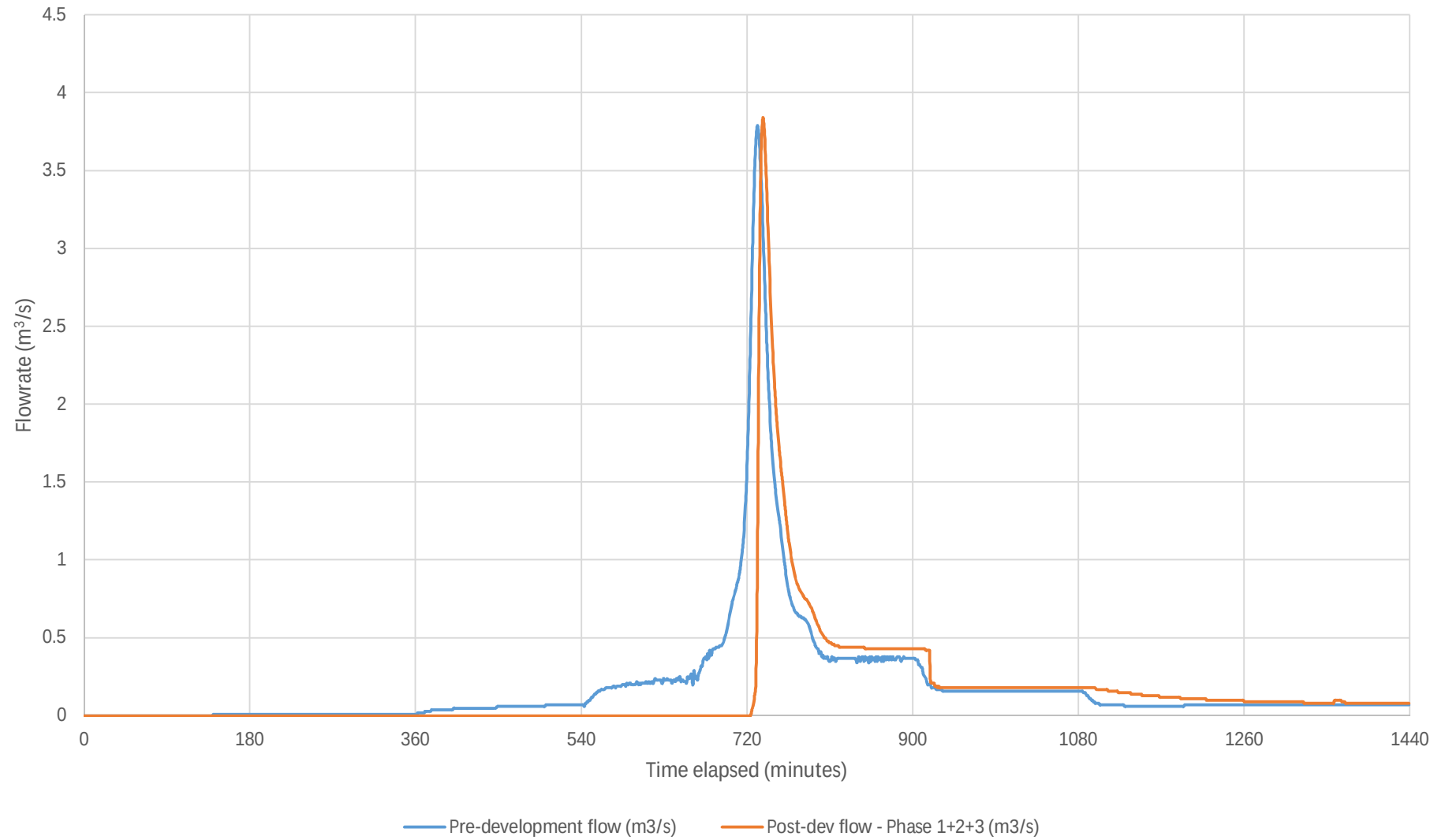
JTIH

\\tgadc\data\rep\live\tp\projects\851969\851969.4000\workingmaterial\structure plan\5.0 reporting\20160203 te puke structure plan area 3 stormwater report mcp review.docx

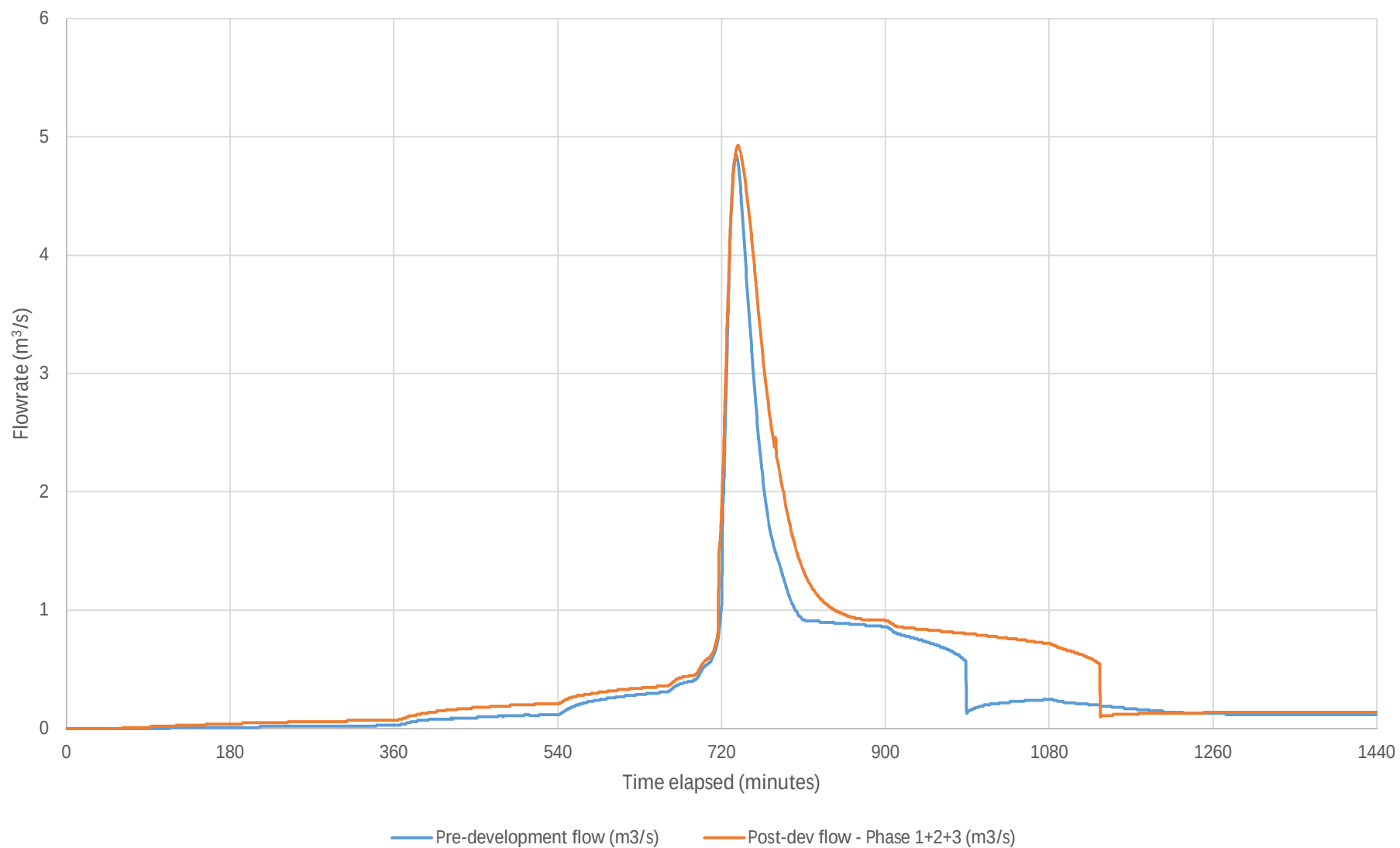
Appendix A: Hydrographs

draft

Sub-catchment A



Sub-catchment B + Sub-catchment C



Sub-catchment D + Sub-catchment E + Sub-catchment F

