Hamilton City Council
Te kaunihera o Kirikiriroa

Otama-ngenge Integrated Catchment Management Plan

FINAL– *September 2015*

View of catchment from Kay Road looking south west over the catchment.

Revision No	Date	Status	Authorised (ICMP)	Approved (Stormwater)
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PGG – Project Governance Group (HCC)
SLT – Senior Leadership Team (HCC)
WRC – Waikato Regional Council

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Hamilton City Council

Otama-ngenge Catchment Management Plan

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ABBREVIATIONS

ARI = Average Recurrence Interval (Rainfall event)

BPO=Best Practicable Option

CSDC = Comprehensive Stormwater Discharge Consent

ICMP = Integrated Catchment Management Plan

LOS = Levels of service

PRPS = Proposed Regional Policy Statement

RPS = Regional Policy Statement

SP = Structure Plan

Executive Summary

The overall purpose of this Integrated Catchment Management Plan (ICMP) is to provide guidance on how stormwater, wastewater and water supply will be managed considering future landuse in the Otama-ngenge catchment. This guidance will be consistent with central and regional government policies, plans and resource consents, and Hamilton City Council policies and plans. Non-statutory policy and planning documents are also considered.

The greater Otama -ngenge catchment covers an area of approximately 822 ha with 89% of the catchment being within the Waikato District Council boundaries and 11% being within Hamilton City Council boundaries. Hamilton City Council is required to control the effects of landuse within its city boundaries and manage any effects of these activities on adjacent territories.

The Otama-ngenge stream is the main conveyance feature in the catchment. The northern branch of the stream has its headwaters in the Horsham Downs area and runs some 3.8 km before it joins with the southern branch 800 m above the confluence with the Waikato River. The southern branch of the Otama-ngenge stream is some 3.2 km long and has its headwaters within the Hamilton City Council boundary.

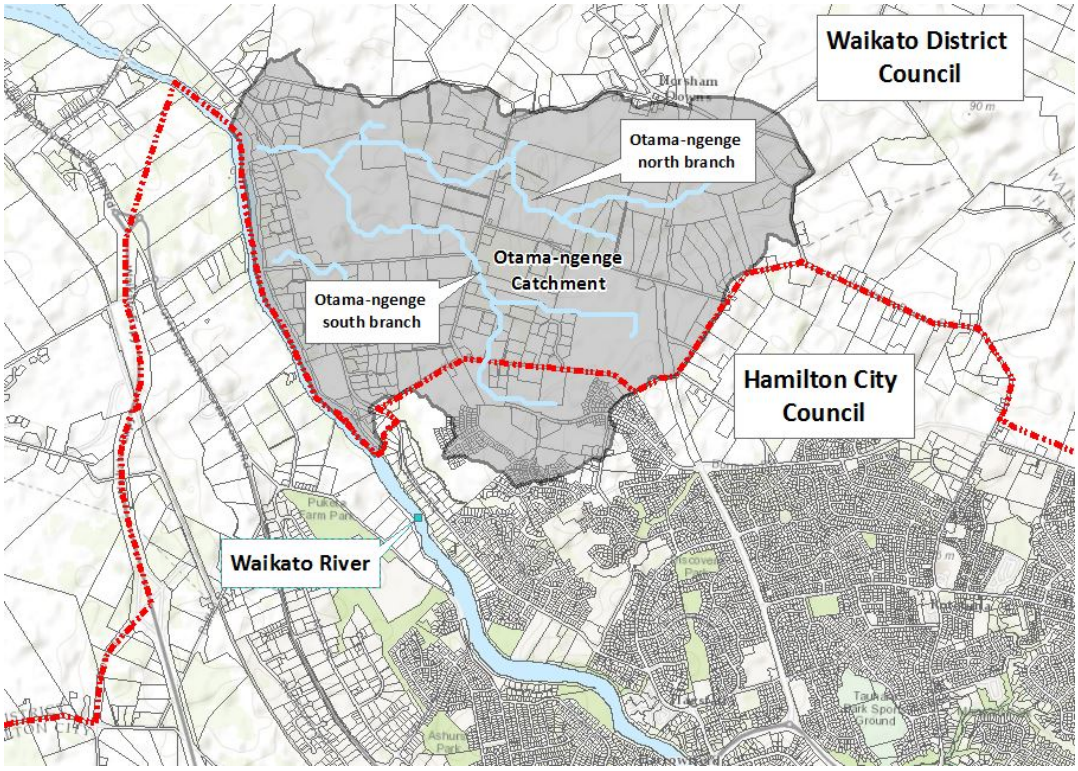

Figure 1 - Otama-ngenge catchment

The Structure Plan land within the Hamilton City area of Otama-ngenge catchment is zoned for urban use. It is made up of two residential areas; General Residential Area and Medium Density Residential Area, with a small community/commercial nod e servicing the local area . A substantial amount of development has already been consented by Hamilton City Council.

The remaining part of the catchment within Waikato district is rural and has no structure plan or significant consented developments. A portion of the proposed Waikato Expressway will pass through the north-east portion of the catchment.

Catchment specific issues and objectives have been identified for the management of stormwater, wastewater and water supply and are provided in Section 3 of this plan. For each of these issues, this ICMP identifies a number of management options. The options are evaluated to identify their suitability and a Best Practicable Option (BPO) is developed. The full list of BPOs is provided in Sections 4 and 5.

The following notable catchment issues and mitigation measures have been identified:

- **Limited stormwater capacity of Otama-ngenge Stream and erosion risk**
  The entire Structure Plan land within Hamilton City discharges into the Otama-ngenge stream at Kay Road. The Stream north of Kay Road is a constructed drain and has a limited flow capacity[1]. Because the stream is small, it will be sensitive to changes in flow regime and there is a risk that stormwater discharges will increase erosion and scour. To ensure that the stream is not overwhelmed by the additional flows associated with development, appropriate stormwater reduction and attenuation measures are required (as well as reuse where possible).

  To manage capacity and erosion risk, two centralised stormwater treatment and attenuation devices are proposed to be located within the city boundary to attenuate flow from future urban development. They will meet identified flood and network mitigation objectives and form part of the BPO.

- **Attenuation and treatment requirements for major roading projects**
  The designated Waikato Expressway proposal cuts through the north eastern area of the Rototuna growth cell and will require appropriate design to manage roading stormwater impacts. It is expected that Kay Road and Horsham Downs Road will continue to provide access to properties to the north east of the Expressway. The Waikato Expressway is expected to be completed early 2020. Resolution Drive is planned to connect to the Expressway and is expected to be constructed at the same time.

  To manage this, swales, wetlands and approved at source devices have been identified as the BPOs for stormwater management for this infrastructure development.

- **Water Quality**
  The Otama-ngenge Stream has water quality and water chemistry which, in ecological terms, is considered to be moderate taking into account the influence of groundwater base flows and plant cover. This is very similar to other open rural waterways around Hamilton.

  Based on the contaminant load assessment [2], stormwater from future urban development within the Hamilton City Council boundary and new roading is unlikely to substantively change either contaminant yields or concentrations discharged down stream. However, there remains a risk of effects from thermal pollution particularly after summer rainfall.

  To manage this, planted wetlands with greater than 80% vegetated cover and/or swales have been identified as the BPO to apply to this future development and roading.

[1] TRIM D-601286: Tonkin and Taylor Ltd 2005: Preliminary Assessment Kay Road Drain, for the Glaisdale Property Partnership May 2005.
[2] Carried out by Morphum Environmental Ltd

- **Ecological quality**
  The Otama-ngenge stream catchment is characteristically intensively grazed, has nutrient enriched landscapes and pollution tolerant species are common. Given the rural nature of the area, ecological values of the catchment are generally not high; however the stream is habitat for native fish species including giant kokopu.

  Water quality, riparian vegetation and in -stream fauna are typical of Waikato rural environments but with the planned development in the Hamilton City Council portion of the catchment there is potential for improvement as nutrient inputs are expected to reduce; livestock will no longer have access to the streambed; and any future riparian planting north of Kay Road will enhance aquatic ecosystems. Because urban stormwater usually has elevated concentration s of contaminants, there is a potential to impact on the aquatic environment.

  To manage this, w etlands are the preferred means of managing water quality for the upper catchment area to be developed south of Kay Road.

  Urbanisation will increase the impervious area over a small proportion of the Otama-ngenge Stream catchment, reducing infiltration to groundwater and increasing the volume and speed of surface runoff. Promotion of soakage where practicable will be important. Flows into down stream waterways will be concentrated at specific discharge points and the increase in flow after rainfall will be rapid. Attenuation devices will be required to mitigate this. Further, any stormwater devices replacing the existing drains must be designed to provide contin ued surface flow to the Otama - ngenge Stream.

  The Waikato Expressway and Resolution Drive road corridors will bisect some headwater drains of the Otama-ngenge Stream potentially affecting fish passage. On that basis, waterway connectivity must be maintained across the proposed road corridors.

- **Water supply capacity**
  Hamilton City Council's Water Master Plan is the overarching plan for the development of major water infrastructure. Water capacity for development of the catchment currently has minor limitations. For The Meadows development, the consent has a condition that restricts the number of lots connected to any single ended principle water main likely until such time connectivity is achieved and the reservoir is in place.[3]

  To manage this, f ull development of the catchment will be further supported by the new Rototuna reservoir and associated bulk mains which are due to be in place by 2018.

- **Water allocation and pressure**
  While Level of Service (LOS) for the water network is not likely to be a problem, water conservation, non-revenue water and demand management measures will always need to be considered and implemented in order to ensure resilient and cost effective network. For the period until 2018, when the Rototuna reservoir and associated bulk ma ins with network connections are anticipated to be operational, there is a predicted drop in water pressure, particularly in the elevated Sections of the developing catchment. However the pressures are still predicted to meet Hamilton City Council LOS requ irements and investigations are underway to confirm this. A small area of

[3] Effectively this limit is in place until the trunk water main in Meadowfield Street connects with the future 250mm water main in Borman Road. The Glaisdale West Devel opment is served by twin 150mm diameter pipes from Cumberland Drive to the eastern edge of the catchment and hence does not have a similar limitation.

properties currently on a restricted supply will not be permitted to have a pressurised water connection until the completion of the Rototuna Reservoir unless it is demonstrated tha t the required LOS can be provided.

To manage this, Water Impact Assessments required by the Proposed District Plan will provide opportunities to assess specific effects from new developments on the water network.

- **Wastewater network constraints**
  Hamilton City Council's Wastewater Master Plan is the overarching plan for the development of major wastewater infrastructure. With the Rototuna West pump station, rising mains and associated trunk gravity mains along Borman Drive, there are no significant wastew ater network constraints.

Parameters have been defined to direct stormwater management requirements during development. These are described in Sections 6.4 (Design Parameters) and 6.5 (Methods to Achieve Compliance).

A description of ICMP Implementation is provided in Section 6 and proposed requirements for catchment monitoring is provided in Section 9. Future actions and opportunities have also been identified in Table 8 and will be assessed for inclusion in ongoing Council programmes and subsequent 10 Year Plans and 30 Year Infrastructure Strategy.

1 Introduction

1.1 Purpose of ICMP

This ICMP covers the Otama-ngenge catchment identified in the grey shaded area of Figure 1 – Otama-ngenge catchment. The 91 ha subcatchment within Hamilton City Council boundaries is subject to intense development as part of the Rototuna Structure Plan Area. The balance of the catchment area outside of Hamilton City and lies within Waikato District Council and the Kirikiriroa Horsham Downs drainage area [4]. Planning is also advanced on the Waikato Expressway in the north east of the catchment. These development areas and their effects are the focus of this ICMP.

This ICMP and its prescribed best practicable options predominantly focuses on managing urbanisation effects of the development area under Hamilton City Council jurisdiction, however, due to the catchment assessment made, and investigations undertaken, some best practicable options also extend into Waikato District territory and should be recognised for development in that area.

The purpose of this ICMP is:

a) To provide an integrated management approach based upon the best practicable option(s) to avoid as far as practicable and otherwise minimise the cumulative adverse effects of all new stormwater diversion and discharge activities in developing catchments.

b) To meet conditions of the comprehensive stormwater discharge consent (CSDC) number 105279 issued by Environment Waikato (now called Waikato Regional Council). Specifically this includes meeting requirements of conditions 3(a) which requires new stormwater activities to be consistent with all conditions of the CSDC as shown in Appendix J.

c) To provide guidance [5] on how water, wastewater and stormwater management in the catchment can accommodate growth in an integrated manner and in accordance with proposed new land uses.

d) To ensure that the LOS of the existing three water networks and the Kirikiriroa Horsham Downs drainage area are not compromised and to provide a platform for considering the implementation of water sensitive devices to reduce demand for water, minimise wastewater generation and minimise need for three water infrastructure where appropriate.

The duration of this ICMP is the "planning horizon" of the Rototuna Structure Plan but will necessarily extend beyond the full development of the Structure Plan area to allow for on-going decision making on management and maintenance of water, wastewater and stormwater infrastructure, and to allow for connectivity to adjoining land and catchments. As discussed in Section 9 this ICMP is to be reviewed periodically to ensure that it remains relevant and considers the results of any ongoing monitoring and changes within the catchment.

[4] Administered by Waikato Regional Council

[5] Guidance from this plan is generally to developers, internal Hamilton City Council Units (City Waters, City Transport, City Planning, Parks and Open spaces, City Development) and regulators (Hamilton City Council Planning Guidance Unit, Waikato Regional Council and Waikato District Council officers).

Development of this ICMP has been led by Hamilton City Council with content contributions from Waikato District Council. The Waikato District Council process for dealing with cross boundary issues is described in the Waikato Operative District Plan Chapter 17[6].

This ICMP has been developed to satisfy Condition 30 of the CSDC 105279. In accordance with Condition 30, Table 1 shows where each requirement is addressed within this document.

Table 1 – Comprehensive Stormwater Discharge Consent Checklist

Condition 30	Status
In accordance with Condition 3(c) of this consent (CSDC), Catchment Management Plans which are prepared to guide new stormwater diversion and discharge activities in developing catchments shall be to a standard acceptable to the Waikato Regional Council, and shall be submitted to the Waikato Regional Council for written approval in a technical certification capacity, prior to the establishment of these activities. Catchment Management Plans shall determine and recommend an integrated catchment management approach which is based upon the Best Practicable Option to avoid as far as practicable and otherwise minimise, the cumulative adverse effects of all new stormwater diversion and discharge activities in developing catchments.	*(General)*
As a minimum, Catchment Management Plans shall include the following information:	
a) Catchment maps/drawings of the catchment delineating the catchment boundary, catchment topography, natural features, surface water bodies, existing drainage systems and infrastructure (if any) and current land uses;	Provided in ICMP Section 2. (Figures 1, 3, 4, 5, 6,7,8)
b) Classification of the surface water bodies within the catchment as detailed in the Waikato Regional Plan;	Provided in ICMP Section 2 (specifically Section 2.3.2 and Figure 7 and 8)
c) A description of the social, economic, ecological, amenity and cultural objectives being sought for the catchment (likely to stem from a concurrent structure planning process);	Provided in ICMP throughout Section 3.
d) A description of proposed urban growth, development and land use intensification within the catchment;	Provided in ICMP Sections 2.2.3 & 2.2.4
e) A list of the key stakeholders associated with the catchment, and details of their respective views on providing for new stormwater diversion and discharge activities within the catchment;	Provided in ICMP Section 8.1. This can also include details of all other internal and external stakeholders.
f) An assessment of the current status of the catchment and its environs, together with a description of the geological, hydrological, ecological and existing infrastructural characteristics of the catchment, including any existing resource use authorisations within the catchment;	Provided in ICMP throughout Section 2.
g) An assessment of the environmental effects of all new stormwater diversion and discharge activities on the catchment, in such detail as corresponds with the scale and significance of the effects that these activities will have on the catchment, including but not limited to, effects on:	The assessment of environmental effects is described for all proposed diversion and discharge activities throughout Section 7 and Appendix G.
i) Natural features, surface water bodies and aquifers,	
ii) Sites of cultural and/or historical significance,	

[6] https://www.waikatodistrict.govt.nz/Documents-Library/Files/Documents/District-Plan/Waikato-District-Plan/Chapters/Chapter17_LocalAuthorityCrossBoundaryIssues.aspx

Condition 30	Status
iii) Public health,	
iv) Flooding hazards,	
v) Receiving water hydrology, including base flows and peak flows in rivers and streams and long-term aquifer levels,	
vi) Receiving water sediment and water quality,	
vii) Receiving water habitat, ecology and ecosystem health,	
viii) Receiving water riparian vegetation,	
ix) The extent and quality of open stream channels,	
x) Fish passage for indigenous and trout fisheries (refer to the Waikato Regional Plan Water Management Classes for applicability),	
xi) Natural and amenity values,	
xii) Existing infrastructure,	
xiii) Existing authorised resource use activities;	
h) An assessment of the cumulative environmental effects of all new stormwater diversion and discharge activities on the catchment over time;	Provided in ICMP Section 7 and Appendix G - Assessment of Environmental Effects.
i) In response to the environmental effects assessment information, an assessment of the available management options (including Low Impact Urban Design measures and stormwater management devices), for all new stormwater diversion and discharge activities within the catchment;	The assessment of environmental effects is described for all proposed diversion and discharge activities throughout Section 7. These proposed diversion activities are based on options assessment of BPOs provided in ICMP Section 4.
j) Recommendations on an integrated catchment management approach which is based upon the Best Practicable Option to avoid as far as practicable and otherwise minimise actual and potential adverse effects of all new stormwater diversion and discharge activities on the catchment;	Provided in ICMP Sections 4, 5 & 6.
k) A description of proposed education and promotion initiatives to be carried out by the Consent Holder to support the integrated catchment management approach recommended by the Catchment Management Plan;	Provided in ICMP Section 6 - ICMP Implementation.
I) A description of key infrastructure works to be carried out by the Consent Holder to support the integrated catchment management approach recommended by the Catchment Management Plan;	Provided in ICMP Section 6.
m) A prioritised infrastructure works schedule for implementing the integrated catchment management approach recommended by the Catchment Management Plan;	Provided in ICMP Section 6 (specifically 6.5). Note that this prioritisation will be on a catchment scale and must be integrated into the citywide programme of works.
n) A list of performance measures by which the implementation of the integrated catchment management approach recommended by the Catchment Management Plan will be gauged.	Provided in Section 9 - Monitoring.
Any approved Catchment Management Plan that needs to be updated following changes to the integrated catchment management approach recommended by the Catchment Management Plan, shall be reviewed, updated and submitted to the Waikato Regional Council for approval in a technical certification capacity, prior to any such changes being	

Condition 30	Status
implemented within the associated catchment.	
Advice Note: It is recognised that Catchment Management Plans may also include information that provides for the integration of municipal water and wastewater services. Such information and the integration of these services are generally encouraged by the Waikato Regional Council, particularly where they result in environmentally sustainable catchment management outcomes.	Three Waters Management is considered throughout the ICMP

1.2 Strategic Context

Key planning documents relationships for catchment management planning are shown below:

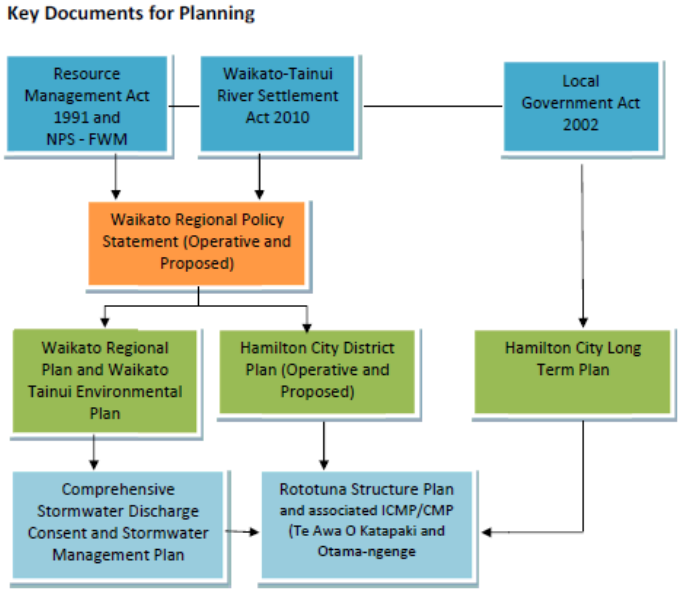

Figure 2 - Planning document heirarchy and linkages

1.3 National Legislation

Resource Management Act 1991

The purpose of the Resource Management Act 1991 is to promote the sustainable management 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 well-being and for their health and safety while:

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) Safeguarding the life-supporting capacity of air, water, soil and ecosystems; and

(c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

Section 15 of the Act includes controls on the discharge of contaminants into the environment, including from stormwater, and states that no person may discharge any water into water or onto land unless the discharge is expressly allowed for in a national environmental standard, regional plan or resource consent.

Waikato-Tainui Raupata Claims (Waikato River) Settlement Act 2010

The Waikato -Tainui Raupata C laims (Waikato River) Settlement Act 2010 relates to Waikato -Tainui's involvement in co -managing the Waikato River from the Karapiro Dam to Te Pauha o Waikato (Port Waikato) as part of their Te Tiriti o Waitangi (Treaty of Waitangi) Settlement. A co -management agreement was signed between Waikato Raupata River Trust (Waikato -Tainui) and Waikato Regional Council. The agreement clarifies a range of factors including relationship, operation and engagement principles and management arrangements. In relation to stormwater planning, the agreement acknowledges that undertaking Integrated Catchment Management will require coordination and collaboration between each Party's respective planning documents and implementation processes.

This Act also provides for the V ision & Strategy for the Waikato River (also incorporated in the Regional Policy Statement). The Waikato Tainui Envir onmental Plan, Tai Tumu Tai Pari Tai Ao is a key document with policies and objectives to enhance Waikato -Tainui participation in resource and environmental management.

1.4 Regional Policy

Waikato Regional Policy Statement (Operative and Proposed)

The Waikato Regional Policy Statement is required by Section 60 of the RMA, and is a document that provides an overview of the resource management i ssues of the region, and the ways in which integrated management of the region 's natural and physical resources will be achieved. The region's Operative RPS (2000) has been reviewed and is subject to appeals; however, most of this Proposed RPS is now beyon d challenge. The effects of urban stormwater runoff on water quality are identified as a significant resource management issue, contributing sediment and potentially toxic contaminants (such as lead and hydrocarbons) to waterways. Classification of waterwa ys and identification of ecologically significant habitat are also notable issues with associated methods in the Proposed RPS . Also of note is the overarching policy direction of the Proposed RPS, in particular the Vision and Strategy for the Waikato River, which seeks the restoration and protection of the health and wellbeing of the Waikato River and its tributaries.

Waikato Regional Plan

The Waikato Regional Plan is required under Section 65 of the RMA. The Waikato Regional Plan contains issues, objec tives, policies and rules, relating to the discharge of stormwater into water and the discharge of stormwater onto or into land. Where permitted activity controls are not complied with, resource consent is required.

1.5 Local Policy

Hamilton City District Plan

The Hamilton City District Plan is a requirement of Section 73 of the RMA. It defines the way in which the city's natural and physical resources will be managed to achieve the purpose and principles of the RMA. It provides a framework of resource manag ement policy and implementation methods to manage the effects of the use, development or protection of land and associated natural and physical resources in the city. The Operative District Plan 2012 is under review and the Proposed District Plan (Appeals Version 2014) is currently in the appeals process.

District Plan provisions generally set maximum levels of building coverage, minimum permeable surface areas, water efficiency measures, and requirements for preparing ICMP's and / or Water Impact Assessments to consider effects on, and integration of, the three waters.

The District Plan, together with the Council's Infrastructure Technical Specifications, are vital tools for managing development within the Otama-ngenge catchment.

Waikato District Plan

Eighty nine percent of the Otama-ngenge catchment is within the Waikato District Council area. Discharges from the Hamilton City Council area of the catchment enter the Waikato District Council area at Kay Road.

Generally the Waikato district growth strategy is that urbanisation will be focused primarily into towns and villages. Most of the Otama-ngenge catchment in the Waikato district area is subject to a Strategic Agreement (2005) that will see a boundary change transferring it into Hamilton City Council's jurisdiction in 2045 unless agreed differently. This land is included within an Urban Expansion Policy Area prohibiting urbanisation to prevent fragmentation that would hinder future urbanisation. Changes to the relevant District Plan would be required in order to provide for changes to the urban development. It is expected that this would need to be informed by an updated ICMP.

A key issue for the Waikato District Council is to avoid compromising the characteristics of rural areas including the productive capacity of the rural resource. Productive rural activities, lawfully established rural-based activities and rural recreational amenities should be protected from reverse sensitivity effects, particularly those associated with rural-residential subdivision and development.

Waikato District Council has commenced a review of the district plan with notification being likely in 2017.

1.6 Waikato Regional Council - Resource consent compliance

The Comprehensive Stormwater Discharge Consent issued and administered by Waikato Regional Council for the urban catchments within Hamilton City authorises the discharge of stormwater from 'existing' developed areas subject to meeting resource consent conditions and for new developments in growth areas, meeting requirements of any approved ICMP. Hamilton City Council's water take consent has requirements for water demand management and Hamilton City Council's wastewater discharge consent requires network management to avoid events such as wastewater overflows.

1.7 Regional Council – Land drainage

The strategic intent of land drainage activity is set out in Waikato Regional Council's Long Term Plan 2012 – 2022 as: "To provide land drainage services to safeguard the economic wellbeing of the region."

The level of service for the land drainage activity is defined as: "To provide reliable water table management on land within drainage [areas] for the purpose of maintaining pastoral production."

Effective land drainage is provided by maintaining a land drainage network that allows landowners the ability to manage water table on their properties, and that reduces surface flooding resulting from significant rainfall events. The land drainage network is established to an agreed standard, and where gravity drainage allows, clears water from the land to avoid damage to pasture.

1.8 Three Waters Management Hierarchy

Application of BPOs must strongly consider Hamilton City Council's established hierarchy for the management of the *three waters* as follows.

Minimise Demand (Water, wast ewater) ➔ Reuse (stormwater) ➔ Treat & Dispose to Ground (stormwater) ➔ Treatment & Detention (stormwater) ➔ Reticulation (stormwater, wastewater)

Hamilton City Council has adopted this best practice hierarchy, based on sustainability, cost and efficiency principles. This is reflected within the Proposed District Plan and Infrastructure Technical Specifications[7].

The ideal stormwater management system for a developed site is one that replicates the undeveloped scenario.

1.9 Three Waters Integration

Three wa ters means the three key areas of strategic water management (including associated infrastructure) within the City. Three Waters comprises:

a) Water supply – including drinking water and other water abstracted from the Waikato River, treated and used within the City, and water for fire fighting purposes.
b) Wastewater – liquid waste (including liquids containing waste solids) from domestic, industrial and commercial premises including toilet wastes, grey water and tradewastes.
c) Stormwater – rainwater that runs off a surface into streams, waterways, underground aquifers, rivers and eventually, far beyond Hamilton's boundaries, ends up in the sea.

The term 'Three waters integration' is recognition that there is a strong interaction between all three types of waters, natural water systems and land and that they need to be managed sustainably and in an integrated way to ensure the availability of services to growth areas and protection of the environment for future generations.

A range of water sensitive te chniques[8] are available to minimise the impact of development and enhance the environment.

As m uch of the Hamilton City Council area of the catchment is consented for development there is limited opportunity to mandate specific water sensitive solutions in those areas. Notwithstanding, future initiatives should focus on water re-use as opposed to network upgrades. For greenfield areas yet to be consented, the opportunity remains to integrate the three waters and use water sensitive techniques.

Integration of the water supply and stormwater system is most easily achieved by rain tanks. Generally the existing city water source and network will be adequate to meet future demand; however, climate change predictions indicate that Hamilton will become drier for extended periods.

It is noted that a ll new urban premises in the Waikato District are no longer required to have a rain tank under the Waikato District Council Water Supply Bylaw 2014. Rural properties are still required to have

[7] Previously referred to as Development Manual
[8] Refer to the definition in Proposed District Plan Vol 2 Appendix 1.1.2 and the Infrastructure Technical Specifications Three Waters Practice Notes for more details

a tank with a minimum size of 22,000 litres or equivalent to at least 48 hours storage, whichever is greater.

Measures that help supplement water sources such as rain tanks are beneficial tools to manage water resources and should be encouraged to help alleviate water scarcity in dry periods. Other benefits include:

- Reduced peak flow impacts due to fast response runoff from impermeable areas
- Reduced water taken from the water source
- Lower treatment and network operational costs
- Maximum use of the existing Water Treatment Plant but with the potential to delay future upgrades
- Emergency supply

The strategic wastewater network and the treatment plant will be under pressure in the future so volume minimisation will also be beneficial. Options to consider wide scale wastewater disposal or grey water re-use at source to manage wastewater volumes in existing interceptor pipelines and the treatment plant may be considered in future, however, due to their complexity, environmental and health concerns, these options are not currently preferred.

1.10 Strategic Objectives

Development within the Otama-ngenge catchment is influenced by central and regional government policies, plans and resource consents, Hamilton City Council policies and plans and Waikato District Council policies and plans. Most policy and rules ultimately flow out of the Proposed Regional Policy Statement (PRPS) which is given effect through planning documents such as District Plans and Regional Plans. The PRPS also reflects iwi aspirations for the region and National Policy Statements.

Relevant chapters in the Hamilton City Council Proposed District Plan that reflect direction coming from the PRPS include Chapter 20 Natural Environments, Chapter 21 Waikato River Corridor and Gully Systems, Chapter 22 Natural Hazards, Chapter 23 Subdivision, Chapter 25.2 Earthworks and Vegetation Removal, Chapter 25.13 Three Waters, Chapter 2 Strategic Framework (see 2.2.7, 2.2.8 and 2.2.9), and Chapter 3 Structure Plans (see 3.3.3 and 3.3.6).

The guidance document 'Integrated Catchment Planning - Planning Guidance and Principles', provides detail on policies to be taken account of when changing land use, and can be requested from Hamilton City Council[9].

[9] TRIM D-928128

Key recognised land use change issues that currently exisit and need to be addressed nationally and regionally, include:

1. Erosion and instability of waterways
2. Water Quality
3. Quality of riparian areas
4. Flooding and natural flow regime
5. Drainage in rural areas
6. Mauri of waterways
7. Water sensitivity
8. Adhoc planning and development
9. Indigenous biodiversity

The following key strategic objectives for this ICMP have been derived from these national and regional planning policies and set the framework for urban development in Otama -ngenge catchment (and all Hamilton City growth cells).

Strategic Objective 1
Where technically possible, development should incorporate a natural environment -based system . Onsite management and disposal of stormwater is preferred. Key elements of this approach include avoiding or minimis ing impervious surfaces, minimising earthworks during construction, and utilising vegetation to assist in trapping sediments and pollutants.

Strategic Objective 2
Stormwater should as far as practicable be used to sustain groundwater levels in peat soils and base flows in freshwater receiving environments and stormwater infrastructure should result in a hydrological cycle as close to the predevelopment hydrological cycle as possible . (Rototuna Structure Plan).

Strategic Objective 3
The quality of stormwa ter (and any wastewater) discharges to the existing stormwater network should not pose a risk to human or ecosystem health and will assist with enhancement of the water quality in the receiving environment

Strategic Objective 4
Stormwater is minimised and stormwater discharges managed so as to avoid adverse effects on channel stability, rural drainage, aquatic life supporting capacity and protect and enhance natural flow regimes in waterways, and maintain and enhance the values of ecologically significant freshwater habitats.

Strategic Objective 5
Manage stormwater discharges to mitigate the effects of flooding on both existing and new urban areas, while avoiding and remedying the adverse effects of channeli sation and channel deepening on ecologically significant freshwater habitats.

Strategic Objective 6
Restore and protect the health and mauri of the catchment waterways and restore and protect the relationship of tangata whenua as Kaitiaki of waterways.

Strategic Objective 7
Wastewater generation is m inimised and w astewater discharges are managed such that no adverse effects are encountered on Hamilton City Council's existing infrastructure network or natural environment.

Strategic Objective 8
Potable water consumption is managed to minimise peak and total demand.

Strategic Objective 9
Infrastructure needs (eg pump stations and stormwater treatment and detention devices) are minimised.

Strategic Objective 10
Water networks accommodate growth in accordance with water conservation and demand management objectives and potable water consumption is managed to minimize peak and total demand.

1.11 Levels of Service

Levels of Service are documented in different levels of detail in various key documents.

Key Levels of Service include:

- Wastewater - no additional overflows due to development (volume and frequency)
- Water pressure – 10m of head at the boundary
- Stormwater – management of 2, 5 and 10 year storm events (in accordance with landuse type)

Refer to the following documents for further level of service and key design standards information:

a) Operative & Proposed District Plan
b) Hamilton City Council Infrastructure Technical Specifications
c) Hamilton City Council Stormwater Modelling methodology
d) Hamilton City Council Standard Assessment Methodology – Water (Model)
e) Hamilton City Council Standard Assessment Methodology – Wastewater (Model)
f) Hamilton City Council 2015-25 10 Year Plan
g) Waikato Regional Council's Long Term Plan 2012 – 2022
h) Hamilton City Council Bylaws (including Water bylaw and Stormwater bylaw)
i) Hamilton City Council Water Master Plan June 2015
j) Hamilton City Council Wastewater Master Plan June 2015
k) Waikato Regional Council Technical Report 2014/13 –Managing land use change and Council's administered drainage area

2 Catchment Description

In accordance with Condition 30 of the CSDC, Section 2 of this ICMP provides a broad range of data and maps to describe the physical, cultural, environmental, infrastructure, economic and future development characterisitics of the hydrological Otama-ngenge catchment. This Section is supported by mapping contained in Appendices B, C & E.

This ICMP also considers water and wastewater network matters which extend beyond the hydrological Otama-ngenge catchment.

2.1 Introduction

The overall Otama-ngenge catchment area encompasses approximately 822 ha of rolling Wai kato lowlands. The Otama-ngenge Stream flows east to west and has 2 main branches (north and south) which ultimately discharge to the Waikato River (Figure 3 – Otama-ngenge catchment).

Approximately 8 9% of the catchment lies within Waikato District Council jurisdiction, with only the upper most headwaters of the south branch of the catchment being within Hamilton City Council.

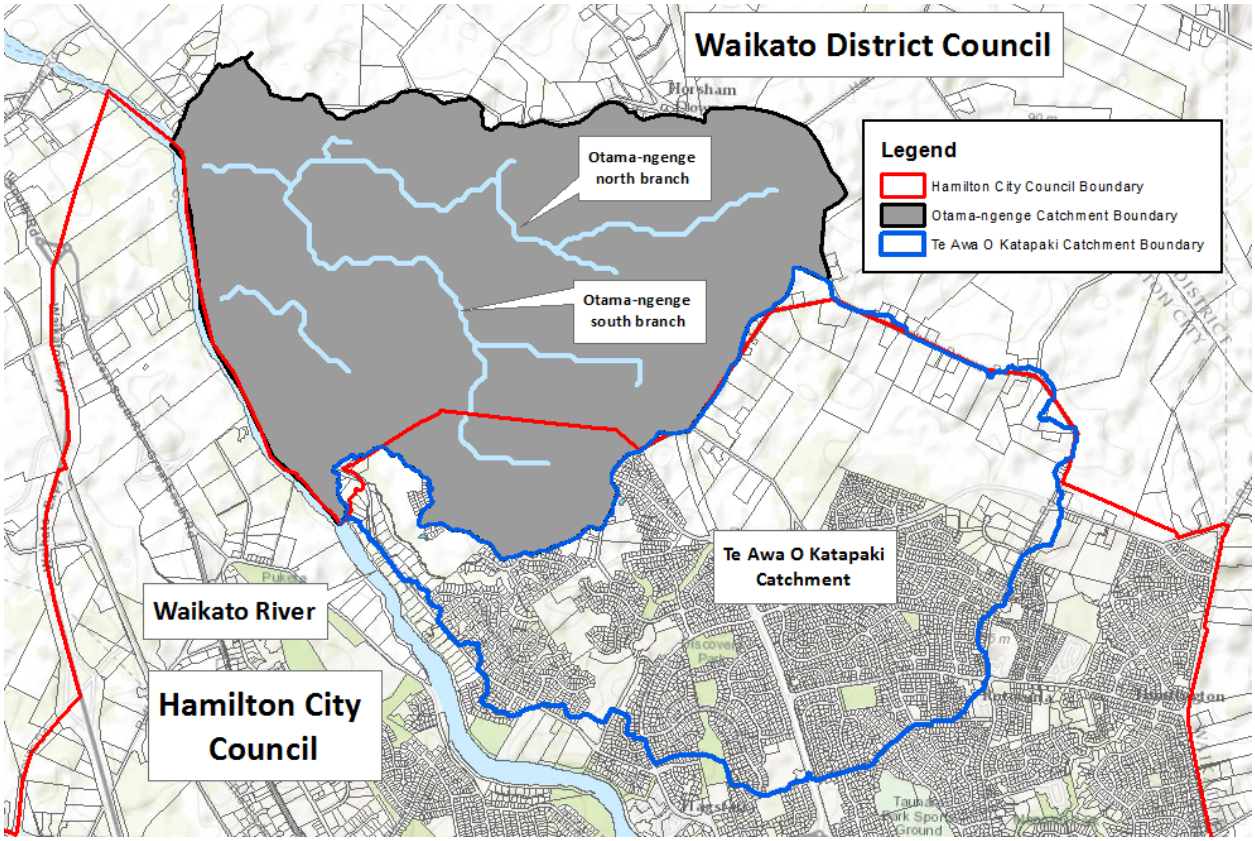

Figure 3 – Otama-ngenge catchment

The north branch has a subcatchment of approximately 430ha (see figures 3 and 8). This branch discharges under Osbourne Road and flows west for around 1.7km to the confluence with the south branch stream. The subcatchment is predominantly rural (dairy farming) with a high proportion of artificial farm drains and negligible riparian vegetation. This branch is unaffected by urbanisation within

Hamilton City Council's boundary but will ultimately be influenced by Waikato Expressway infrastructure proposed in the north east of the catchment. See Figure 5 – Proposed Transport Corridors.

Development within the Hamilton City boundary only influences the south branch subcatchment. The south branch (overall subcatchment size 310ha) has its headwaters south of Kay Road (see Figures 1 and 7). This area of the south branch within Hamilton City Council boundaries is comprised of artificial drains and lies within the Stage 4 boundary of the Rototuna Structure Plan[10]. This area is in the process of being converted from rural to urban landuse.

A further 1.2 km watercourse in the north west of the catchment is independent of the Otama-ngenge stream and drains directly to the Waka to River. No proposed land intensification has been identified within this watercourse's catchment. See Figure 1 - Otama-ngenge catchment.

Within the Hamilton City Council boundary, there are 3 subcatchments that drain to the Otama-ngenge south branch (see Figure 4 – The Otama-ngenge catchment within Hamilton City Council boundary). Additionally there are some areas bordering the southern topographical boundary of the catchment that has a piped stormwater network draining primary stormwater to existing consented stormwater ponds within the Te Awa O Katapaki stream catchment (see Figure 1, Section 2.5 and Appendix B1) A further area on the south-western topographical boundary will drain by soakage. Otama-ngenge Stream catchment and its subcatchments are shown in Figure 4 – The Otama-ngenge catchment within Hamilton City Council boundary and Appendix B (Plan B1).

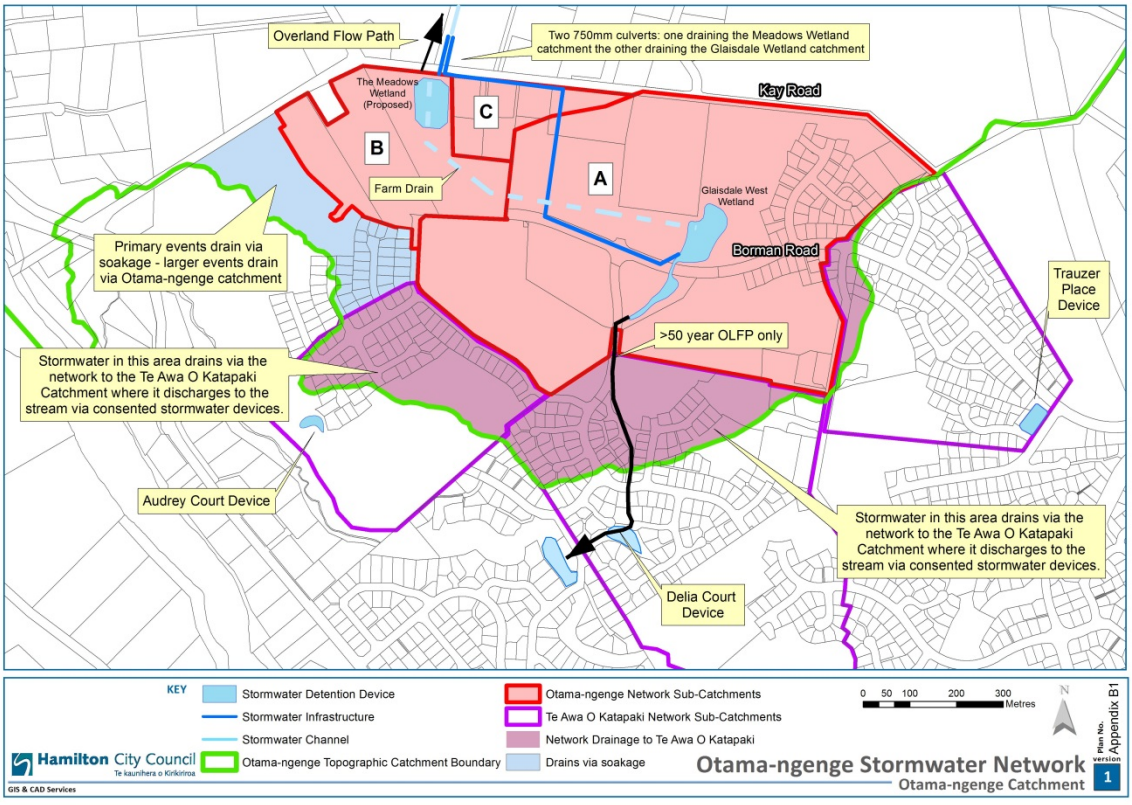

Figure 4 – The Otama-ngenge catchment within Hamilton City Council boundary[11]

[10] See Proposed District Plan, Vol 2, Appendix 2, figure 2-7.

[11] Figure 2 above will be used to identify the land for which this ICMP would represent an 'approved' or 'certified' ICMP in accordance with the Proposed District Plan.

2.2 Landuse

2.2.1 Historic and cultural landuse

The catchment is part of the traditional land holdings of Ngati Wairere. Historically, the area was heavily forested with native trees (Kahikatea, Rewarewa, Tawa, Matai, Rimu and Totara), berries and native birds. Vast and dense swamps were interspersed with the forest (these were likely to have acted as floodwater soakage areas). The area was known at Te Totara, after a Totara tree which was a well-known landmark to pre-European Maori. Te Totara was used for a papakainga (unfortified village) that was located close to the bend in the Waikato River, south west of the inter Section of River Road and Sylvester Road.

Otama-ngenge means "of being tired and sapping the youth of one's st rength", in reference to the very swampy nature of the landscape which made this area very difficult to traverse in pre -European times. There is also a small pa of the same name, on a farm near Lake Road.

As part of background investigations to the Rototuna Structure Plan, a report[12] for Rototuna Stage 4 was prepared by Nga Mana Toopu O Kirikiriroa that researched the historical use of the wider Rototuna area. The area served as:

- Hunting grounds for trapping native birds
- Cultivation areas
- Creeks for gathering tuna (Eels)
- Fresh water mussel beds
- Inanga (white bait) collection points
- Kokowai (ochre) deposits highly prized for adornment for carvings
- Taonga (treasure).

Many of the domestic and ceremonial features that were part of the construction and life of Pa or Papakainga were made of wood – anything buried in the ground may still be there (above ground would have perished). There are a large number of borrow pits (middens) in the area, indicating that in pre-European times there was a significant Maori po pulation living and cultivating crops. Hence it is likely that there are structures and artefacts still buried in the soils of the area.

2.2.2 Current landuse

At present the land is mostly greenfields and in pastures for agricultural grazing or used to grow crops, but there are several pockets of rural residential properties (lifestyle blocks) around the perimeter of the Hamilton City Council portion of the catchment. The Hamilton City Council area is subject to rapid urbanisation with significant earthworks underway.

2.2.3 Proposed Land-Use Changes

The majority of the Rototuna Structure Plan land within the Otama-ngenge catchment is zoned for residential purposes, made up of two zones: the General Residential zone (traditional lower density

[12] Nga Mana Toopu O Kirikiriroa, Tangata Whenua Historical And Cultural Assessment, Rototuna Stages 3 and 4

development) and the Medium Density Residential zone (more compact residential form[13]). A proposed western community/commercial node is to be located at the inter Section of Borman Road and Hare Puke Drive and is expected to provide for a small number of local convenience stores. When developed, the residential area can be expected to have residential imperviousness surfaces of around 60 – 70%. Appendix A shows the Rototuna Structure Plan for the area.

A substantial amount of development in accordance with the Rototuna Structure Plan has been consented by Council. The large majority of this land is owned by two key developers [14,15]. Significant development had already occurred in the catchment at the time of preparing this ICMP [16] and further development is underway with the Glaisdale block well advanced.

Residential development of rural areas is likely to result in a long -term reduction of nutrient and faecal pathogen inputs into surface water with the change from the existing predominant agricultural land use. The new roading network and associated increase in traffic will result in increased heavy metal contaminants and direct discharges of sediment . These combined impacts will be managed predominantly by constructed wetlands discussed later in this ICMP.

2.2.4 Major transport links

The Rototuna Structure Plan indicates the location of the existing and planned arterial road network. See Appendix A and Figure 5[17].

The proposed Waikato Expressway cuts through the north eastern area of the Rototuna growth cell. It is expected that Kay Road and Horsham Downs Road will continue to provide access to properties to the north east of the Expressway. The Waikato Expressway is expected to be completed early 2020. Resolution Drive is planned to connect to the Expressway and be constructed at the same time.

The Proposed RPS, Regional Land Transport Plan, Hamilton City Proposed District Plan and Access Hamilton Strategy also recognise a future arterial link from the central interchange on the Te Rapa Bypass to Resolution Drive. The alignment of this "Northern River Crossing" and its connections to other networks will be determined through a future Notice of Requirement process commencing in 2023 [18]. Any construction staging will be timed and planned to align with growth.

The roading network will be designed to ensure it supports public transport services, cycle and pedestrian facilities. In addition to this, off -road cycle and pedestrian facilities will be integral to the development of the area and a network of off -road facilities as indicated on the Rototuna Structure Plan.

Borman Road will be extended through the centre of the Hamilton City Council portion of the catchment. Several other collector roads and local roads are also indicatively proposed within the

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13 Requirements of Future Proof and to give effect to the Waikato Regional Policy Statement.

14 Glaisdale Property Partnership Ltd/Glaisdale West/Hancock Block. Resource Consent 11.2010.21906(48/1/B358N); 25th August 2011, p. 85-86. Allows subdivision of land into 154 residential lots and three balance lots (in 10 stages)

15 Litt Family Trust. 60ha Resource consent (11.2009.20392(48/1/K197C)) 2nd May 2012, p. 24 -36. Allows subdivision of land into 426 residential lots. Only the north -eastern section of the approved subdiv ision is within the Otama -ngenge catchment, which represents approximately 125 lots – 11.25ha.

16 Other future development includes a 4.1ha property with potential for 45 future lots and another 10 rural residential lots will be urbanized at some point and will deliver another 80-or so residential lots.

17 And Proposed District Plan, Vol 2, Appendix 15, Figure 15-5b, Appendix 2, figure 2-4 and 2-5.

18 Draft 10 Year Plan 2015-2025

catchment. Treatment for stormwater runoff for these roads needs to be appropriate for anticipated traffic loads and associated contaminant loads.

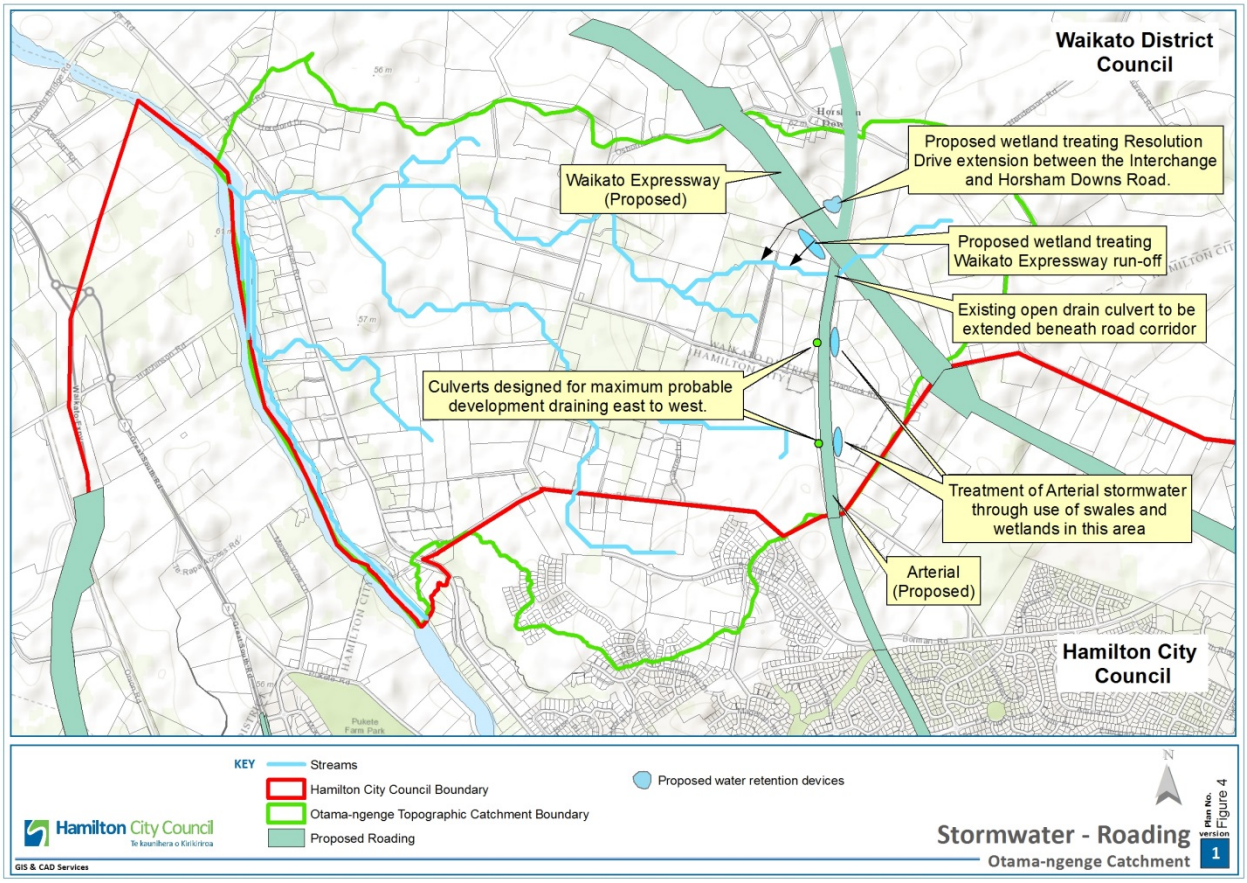

Figure 5 – Proposed Transport Corridors

Note: The alignment of future roads is indica tive only and will be determined thr ough a future designation process.

2.3 Physical Environment

2.3.1 Topography

Figure 6 – Otama-ngenge catchment topography provides contours based on Lidar data 2008. (Note that substantial earthworks have occurred in the catchment since 2008.)

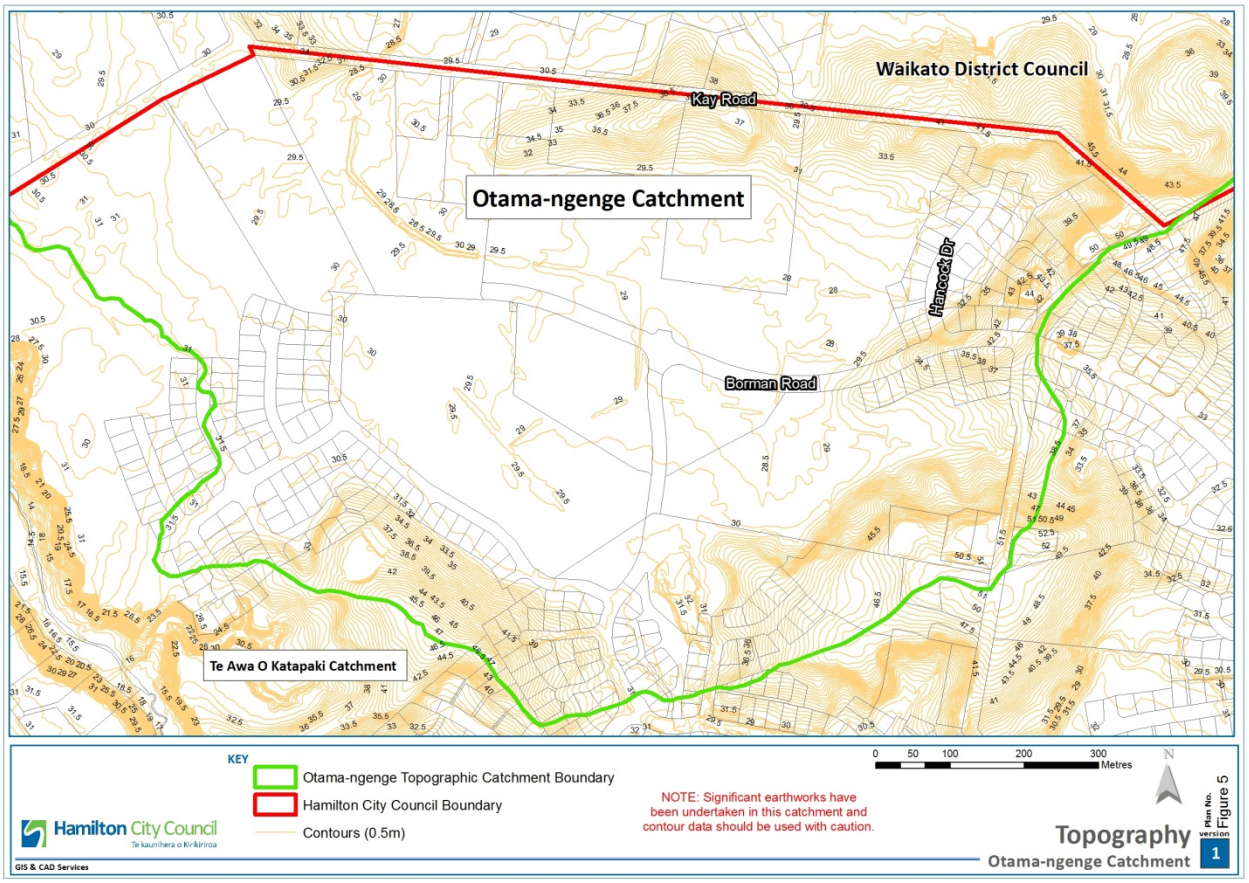

Figure 6 – Otama-ngenge catchment topography

In general, the Hamilton City Council catchment grades towards the approximate centre of the structure plan area where an existing pond area is formed in the natural low point. The pond has been designed to manage the construction phase of subdivision for the Glaisdale West property (subcatchment A) and will ultimately be designed as a wetland. See Figure 4 – The Otama-ngenge catchment within Hamilton City Council boundary for location of key proposed stormwater infrastructure (wetlands and Kay road culvert)

Glaisdale West Wetland (subcatchment A) originally discharged via a farm drain extending to the west and into the adjacent 'The Meadows' block. The drain turns to the north and is conveyed beneath Kay Road and into a farm drain being part of the Otama -ngenge Stream. A piped outlet has been constructed for Glaisdale Wetland that has diverted water from the drain to a piped system including a recently constructed 750mm diameter culvert under Kay Road.

The Meadows land (subcatchment B) is relatively flat. Stormwater run-off currently feeds into the farm drain south of Kay Road and through a recently constructed 750m m diameter culvert under Kay Road (alongside the 750mm culvert servicing the Glaisdale Wetland discharge) and discharges to the Otama-ngenge Stream to the north. Ultimately an additional wetland is planned for stormwater management in this part of the catchment.

2.3.2 Watercourses

The Otama-ngenge Stream has two main branches that meet some 830m upstream of the Waikato River confluence. Most of the catchment is alluvial plains of the Waikato River. The area would have included

wetlands and some of the area is underlain by peat. An ecological assessment of both of these branches has been completed[19]. This assessment identified the following catchment characteristics.

North Branch

The Otama-ngenge Stream north branch (see Figures 1 and Figure 8) consists of a network of farm drains draining historic wetlands and shallow groundwater. This land is predominantly rural with a small pocket of rural-residential development at Osbourne Road, and no short to medium land use change is currently anticipated other than the proposed roads. The drains are mainly poor aquatic and riparian habitat, and many will be dry in summer. However, some drains with shelter belts and permanent water provide moderate aquatic habitat ideal for giant kokopu, shortfin eels and longfin eels.

South Branch

The Otama-ngenge Stream south branch has its headwaters south of Kay Road, comprising artificial drains excavated historically to drain wetlands and shallow groundwater. This land is currently being, or proposed to be, converted from rural to residential land use and stormwater from this area is or will be discharged into the Otama-ngenge Stream south branch via a twin culvert beneath Kay Road (see Figure 7). The installation of the twin culvert resulted in a water course realignment and deepening of the drain at Kay Road. The drains have poor habitat values and may partially dry up in summer. The drain within the Hamilton City Council boundary is typically excavated to 1.5-2.0m deep with channel gradients of 0.4-0.7% or flat.

Between Kay Road and Osbourne Road, the Otama-ngenge Stream flows north through rural-residential properties at a relatively shallow gradient and, until recently, had a relatively natural stream channel, moderate habitat values, areas of active bank instability, and permanent flows. Recent channel works have largely removed these values over the upstream reach, including habitat for adult shortfin eels.

Middle and Downstream Reaches

From Osbourne Road, both branches flow west and north through a natural gully system that becomes increasingly deep and wide with more extensive floodplains down stream. Down stream of Osbourne Road the land use is rural (dairy farming), and some reaches on both branches have been excavated to create ponds. The down stream reaches flow through deeply incised gullies before reaching the confluence with the Waikato River. A weir at the River Road culvert and the farm ponds upstream provide notable fish passage obstacles. Apart from the ponds, aquatic habitat is moderate and the stream provides habitat for the threatened fish species, giant kokopu.

Drain banks are mostly covered in grass with some shrubs and other weeds. There is limited riparian vegetation. The area has not been noted in a 2012 survey as being a key ecological site.

Northwest drain

The 1.2 km North West artificial watercourse (starting upstream of River road) is partially piped and independent of the south arm. It is managed by Waikato Regional Council and maintained predominantly for weeds. The watercourse is only maintained upstream of River road due to insufficient fall in the system down stream. The partial piping of this watercourse is likely to constrain the amount of any future stormwater discharges to the system; however, at the time of writing this ICMP, there are no plans to direct stormwater to this area.

[19] Boffa Miskell Ltd, 2015. Otama-ngenge Stream: Assessment of Ecological Values to inform an Integrated Catchment Management Plan. Prepared for Hamilton City Council June 2015.

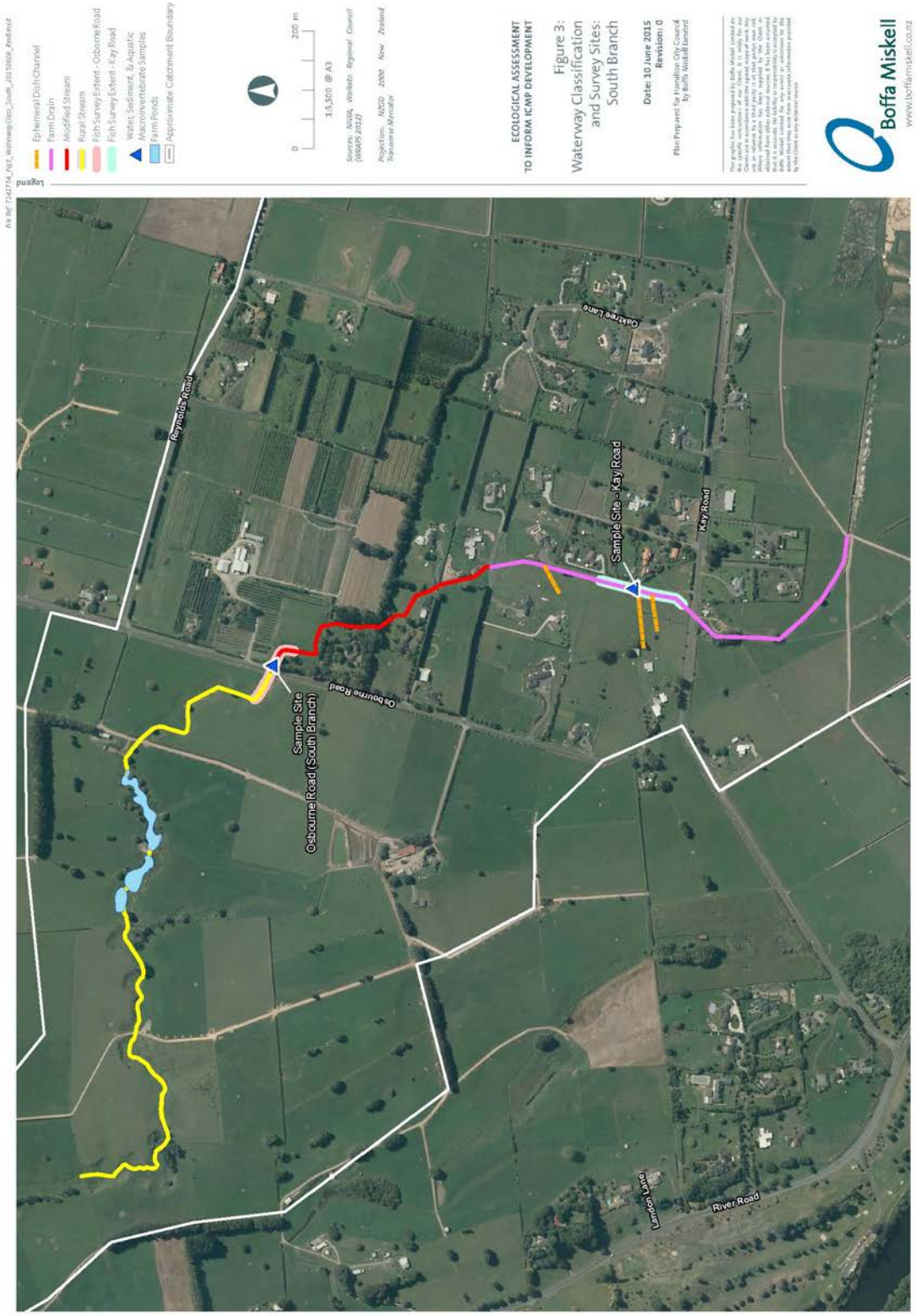

Figure 7 – Waterway Classification of stream reaches - South Branch

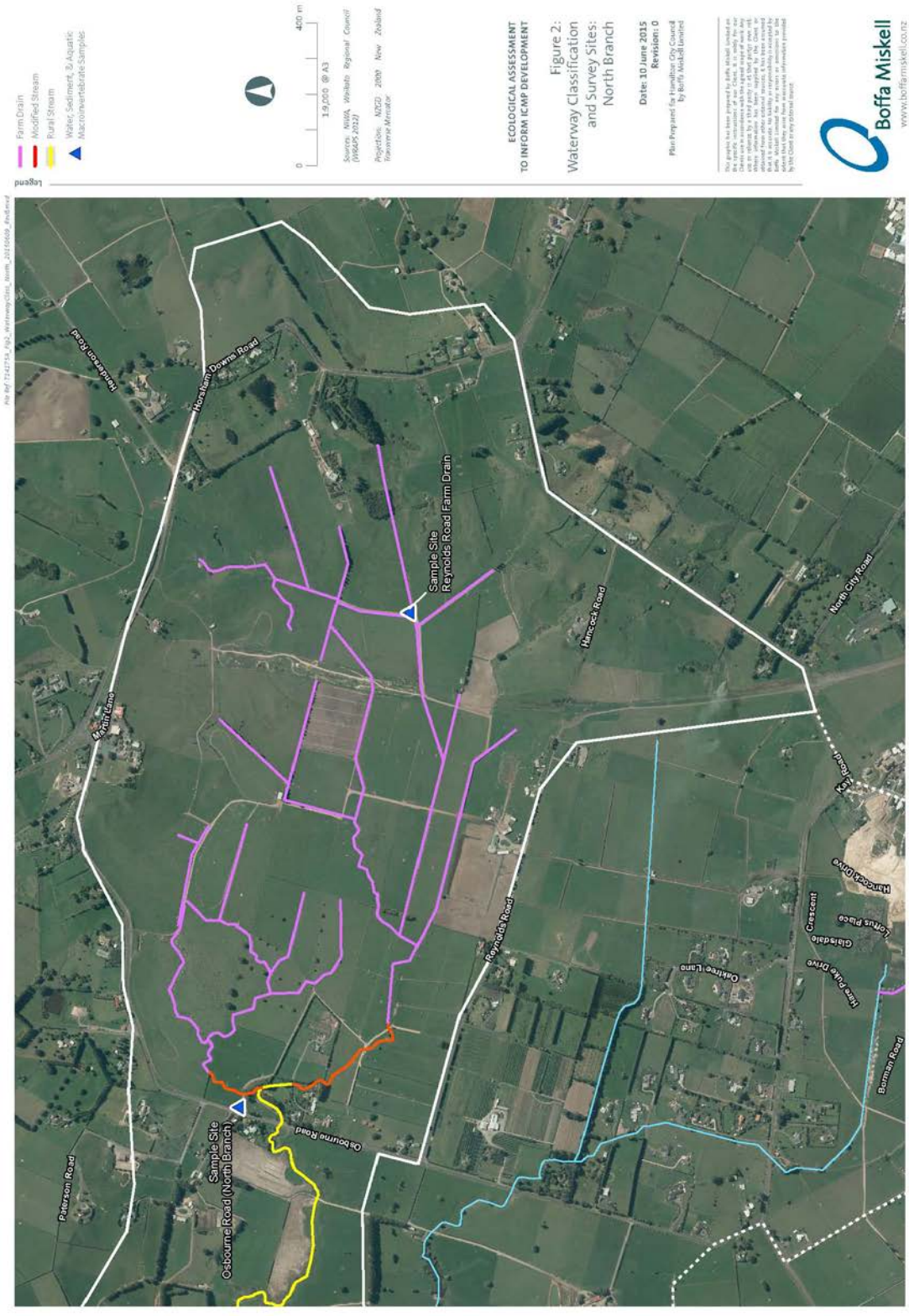

Figure 8 – Waterway classification of stream reaches - North Branch

2.3.2.1 Erosion and Scour

The ecological assessment [20] found active bank failure resulting from channel modification/filling and livestock treading on the south branch between Kay Road and the Osbourne Road right of way, there was active bank erosion occurring in association with channel modification/filling and livestock treading. However the waterway bed appeared stable with abundant aquatic plant growth.

Downstream of the right of way and throughout the north branch drain network, active bank erosion is limited to very small areas, principally localised instances of bank failure associated with riparian springs.. Riparian vegetation, particularly rushes, was observed as providing protection to bank sediments and bank stability on drains with very steep (sometimes vertical) banks.

Downstream of Osbourne Road on both stream branches, the bank height and grade relates to the depth to which the stream is incised into the floodplain, which can be as much as 2m above the waterline in dry conditions. Riparian wetlands are elevated above the banks and seep down over the banks, creating localised instability where bank vegetation is not dense. However, almost all the middle reach of the stream is fenced from livestock access and most has dense grass or sedge growth armouring bank sediment. Active scour of the south branch bed was not observed during low summer flows, and bank instability is generally uncommon throughout the catchment.

Works have been undertaken on the Kay Road drain (2015) and included:

- filling in part of the water course between Kay Road and a new stormwater outlet structure
- fencing to exclude stock;
- excavation below the previous bed

This has resulted in:

- a deeper straightened channel
- removal of structures and aquatic macrophytes providing fish habitat
- exposure of low strength sand bank and bed substrate that is beginning to erode

Riparian planting of vegetation to maintain bank stability on these newly steepened banks is currently absent (2015).

Future stormwater flows from urnbanisation are likely to erode the sandy sediment causing bank slumping and the deepened straightened channel is likely to convey stormwater through the reach faster potentially resulting in erosion effects downstream. Remedial works are required to reverse these effects and reinstate the aquatic habitat. See Table 8 – Future Actions.

Erosion has also been observed near the Otama-ngenge Stream confluence with the Waikato River at River Road. This erosion is part of the existing environment and is not associated with upstream development because the erosion pre-dates development. As such, assessment of this area was not considered necessary for the purposes of waterway management actions, but is listed within the future opportunities.

[20] Boffa Miskell Ltd, 2015. Otama-ngenge Stream: Assessment of Ecological Values to inform an Integrated Catchment Management Plan. Prepared for Hamilton City Council June 2015.

2.3.3 Hydrogeology and groundwater resources

Geological investigations (supporting consent applications for Glaisdale West and The Meadows properties in 2012) identified the subject area as having peaty soils and high water table.

The farm drain south of Kay Road currently drains the Glaisdale West wetland area and drains throughout the catchment are fed predominately by groundwater baseflows.

The high water table is considered to preclude the 'wide' use of soakage as a primary management option on these particular properties. However, on other sites, developers will need to undertake sufficient testing to determine if suitable soakage characteristics are present. Guidelines on requirements for soakage testing and design are provided in the Hamilton City Council Infrastructure Technical Specifications. Geological reports can be requested from Hamilton City Council[21].

The Hamilton City development area is sited at the head of the catchment discharging to existing farm drains, which typically dry up in summer months, then to the perennial reaches of the South Branch of the Otoma-ngenge Stream. There will be significant increases in annual flow volume discharging from this area, as a result of the developable area being up to 60-80% impervious. The effect on baseflows from this change in hydrological regime is considered to be mitigated by the combination, on lot water efficiency measures, wetlands and soakage selected as BPO's and listed in the methods to achieve compliance table. Although the soakage across the catchment will be reduced by the increase in impervious area, the use of unlined wetlands will likely substantially increase baseflows during dry periods and particularly during times when the farm drainage channels typically dry up. Wide shallow wetlands function to recharge down stream subsurface waters through infiltration inflows and during dry periods this acts to provide environmental baseflows mitigating baseflow effects.

There are a number of groundwater takes mapped on Waikato Regional Council website in the Waikato District Council area of the catchment. There are no groundwater takes in the headwaters of the catchment.

2.3.4 Soils

Soil types vary somewhat across the catchment. Towards the Waikato River alluvial, sandy soil is dominant. Within the Hamilton City Council catchment area soils are dominantly peaty and silt loam (Appendix C presents a map of soils for this area). The subsurface materials are considered to have low to moderate soakage characteristics.

Many of the development sites have the potential to provide only a limited amount of soakage to ground. It may be feasible, however, to have road catch pits and lots connected to the pipe network via a soak hole to provide the opportunity to recharge the groundwater table before runoff enters the pipe network. An area adjoining the southwest boundary of the Hamilton City Council portion of the catchment has been identified as being suitable for soakage (shown in Figure 4 and Appendix B1).

[21] TRIM D–719026

2.3.5 Water Quality and Contaminants

2.3.5.1 Contaminated Land

There is potential for the Otama-ngenge dairying and horticultural land types to cause contamination of land. The most likely sources of contamination would be from the use or storage of pesticides , herbicides, and fertilisers, fuel bowsers and oil tanks, and sheep dips. Land Use Information Reports confirm the use or storage of pesticides has occurred across the Hamilton City Council portion of the catchment in various locations.

Such levels of contamination are generally low in terms of risk to people and the environment. However, site specific investigation and potentially testing will need to be undertaken at the subdivision and land use consent stage as required by the District Plan and National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health . Should such testing indicate contamination levels not suitable for residential development, remediation would be required prior to development.

2.3.5.2 Sediment Quality

Sediment quality within the waterways was assessed by Boffa Miskell Ltd [22] at four sites in the catchment. The results showed that the arsenic, cadmium and zinc equaled or slightly exceeded ANZECC 2000 Interim Sediment Quality Guideline (ISQG) values at only one site at Osbourne Road.

Although there is potential for these contaminants to cause adverse effects to benthic fauna and bioaccumulate in aquatic plants (e.g. watercress), the elevated contaminants are very localised to one site and not indicative of a catchment-scale problem.

2.3.5.3 Water Quality

The ecological assessment of water quality and water chemistry shows that the Otama -ngenge stream catchment is typical of rural streams and drains around Hamilton with periodic inputs of suspended sediment, and ongoing inputs of turbidity, nutrients, metals and pathogens.

Faecal pathogens, nutrients, and zinc exceed water quality standards and are a result of the rural land use. Elevated turbidity and aluminium are a result of draining wetland soils, and bo th are ubiquitously high in Hamilton rural drains. Zinc and aluminium are sufficiently elevated to cause harm to aquatic life, but the toxicity of these metals is likely to be moderated by other water quality factors. In general the waterways have moderat e water quality improved by the aquatic and riparian plant cover, and water temperatures are optimal for aquatic fauna.

2.3.5.4 Contaminant Load Modeling

A contaminant load model has been developed for the Otama -ngenge Stream catchment to provide indicative curr ent (existing development situation) and future (fully developed situation) contaminant load and concentration data for a range of contaminants. Model results are compared against means of compliance targets in Section 6.

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[22] Boffa Miskell Ltd, 2015. Otama-ngenge Stream: Assessment of Ecological Values to inform an Integrated Catchment Management Plan. Prepared for Hamilton City Council June 2015.

For the existing scenario, landu se was classified through an analysis of aerial photos. For the future scenario, landuse was classified using existing and structure plan expectations as well as the proposed alignment for the Waikato Expressway.

Treatment devices intended to provide mean s of compliance were determined using information from consents for the various developing areas in the catchment and as included in the Otama-ngenge ICMP. Details of the Contaminant Load Model methodology and results are provided in Appendix D.

2.4 Values

2.4.1 Aquatic, terrestrial and riparian ecology

The ecological assessment for the catchment (Appendix H) concluded that the freshwater receiving environments typically have poor riparian habitat, poor or moderate aquatic habitat values, moderate water quality and good sediment quality with localised contamination. The drains and stream reaches support a moderate diversity of aquatic macroinvertebrates and the fish community is affected by fish passage obstacles and habitat quality[23]. However, the catchment does su pport threatened native fish and therefore has ecological significance under the provision of the RPS.

The diversity of aquatic insects was considered low to moderate, with communities comprised mainly of species tolerant of poor habitats or severe pollution. As for water quality, this is consistent with similar rural waterways around Hamilton and is unlikely to change as a result of urbanisation within the Hamilton City boundary provided that water temperature and contaminant concentrations are managed.

Downstream of River Road, a vertical, undercut weir around 1m high provides a notable fish passage obstacle on the stream's main stem. Any future improvements to fish passage at this location may lead to improved fisheries values in upstream reaches.

The fish survey found only two native species present, being shortfin eel and giant kokopu along with the noxious pest, mosquito fish. This is consistent with previous surveys, and the assessment concluded that the existing fish diversity is unlikely to be a ffected by the proposed urbanisation within Hamilton City provided that stormwater discharges are well managed. However, some of the north branch drains in the proposed road corridors are habitats that may support giant kokopu, shortfin and longfin eel.

Although it is considered unlikely, a small relict population of the non -migratory black mudfish may be present in the north branch drains. Fish surveys of drains along the road alignments are needed confirm this. Road design and construction measures for the Waikato Expressway and Resolution Drive Extension will need to ensure continued fish passage between up stream and downstream fish habitat for all native fish species present, and replacement of removed habitat with equivalent or enhanced habitats. See Means of Compliance Table.

Catchment data from the contaminant load model (contaminant concentration values) was compared to ANZECC guideline values to determine the adequacy of proposed treatment devices in removing contaminants and meeting the required levels of ecological protection for the catchment (see Section 6

[23] Boffa Miskell Ltd, 2015. Otama-ngenge Stream: Assessment of Ecological Values to inform an Integrated Catchment Management Plan. Prepared for Hamilton City Council June 2015.

Methods of Compliance). The model results indicate that the means of compliance measures were met for all catchment areas in the future scenario for cumulative loads and concentration values.

Fish translocation to adjacent habitats and habitat enhancement may be necessary to mitigate the impacts of road construction and stormwater discharges on habitats of ecological significance.

2.4.2 Cultural Value to Iwi and Archeological significance

No cultural or archaeological sites of significance are listed in Hamilton City Council or Waikato District Council District Plan maps but a general background of historic cultural uses and values has been identified. See Section 2.2.1, Historic and Cultural Landuse, for further detail.

2.4.3 Amenity, Recreational and Aesthetic Values

There are no identified significant catchment amenities, recreational and aesthetic values that are thought to be compromised by catchment development within the Hamilton City Council boundary at this time. While the Glaisdale wetland is primarily a treatment and attenuation device, there remains the potential for it to become habitiat for birds and fish.

2.4.4 Economic Values

The Otama-ngenge Stream drains rural farmland with economic valu e to landowners. Management of stream bank stability is important for preservation of land and maintenance of land drainage capacity is vital for pastoral productivity and for delivering the Kirikiriroa Horsham Downs Drainage Area level of service for removing flood waters (see Section 2.6.2 below)

2.5 Existing Utilities and Network

2.5.1 Water Network

Historically, existing dwellings have rainwater tanks and/or a trickle feed system to provide for their water needs. The City water reticulation will be progressively extended by both developers and Council to service growth. Once reticulation is available existing dwellings will be able to connect to the system.

A new 24 mega litre reservoir is planned to be constructed on Kay Road and operational by 2018. See Appendix B for network plans. This will be connected to an extension to the existing bulk water supply network in Resolution Drive. Another bulk connection is envisaged via the Northern River Crossing at a later date. Trunk water networks from the new reservoi r to serve both the new development areas and existing Rototuna trunk networks are planned and will be progressively constructed as development occurs. This will include creation of a 250mm trunk main. This will extend from Kay Road, south through the reserve area resulting from the former Sylvester Road and west along Borman Road to the junction with Hare Puke Drive and then south to connect to the 250mm within the Eton Subdivision. The 250mm trunk will, in the longer term, also be extended down Borman to Kay Road and then south along River Road to join the existing 200mm line.

This water network will improve the security of supply and match the demand for all of the Rototuna Structure Plan area.

The water and wastewater trunk networks will be developed in a staged approach that is timed to meet growth needs by both the private sector and the Hamilton City Council network programmes. Water capacity for development of the upper catchment currently has minor limitations. For The Meadows

development, the consent has a condition "*At no time shall more than 100 lots be served by a single ended principal water main".* Effectively this limit is in place until the water main in Meadowfield Street connects with the future 250mm water main in Borman Road. The Glaisdale West Development is served by twin 150mm diameter pipes from Cumberland Drive to the eastern edge of the catchment and hence does not have a similar limitation.

There are no issues attributed to poor LOS in the catchment.

2.5.2 Wastewater Network

Some dwellings in the catchment are serviced via septic tank systems and these have the opportunity to be replaced as development progresses . Wastewater reticulation in the area is progressing as development occurs. See Appendix B for network plans.

A was tewater pump station, known as the Borman pump station SPS131 is situated in Borman Road/Hare Puke Drive. This pump station serves all of the area within the Hamilton City Council part of the catchment. An assessment based on the installed equipment and con sidering the future catchment area, storage volume and design flows showed that, with the exception of emergency storage, the pump station has sufficient capacity to service anticipated development.

There are no known issues attributed to poor LOS in or adjacent to the catchment.

Hamilton City Council's Wastewater Master Plan is the overarching plan for the development of major wastewater infrastructure. In part, the plan seeks to:

- Minimise whole of life cost of the construction, operation and maintenance of the wastewater network.
- Minimise wet weather overflows of untreated wastewater to the environment.

2.5.3 Stormwater Network

The catchment has historically been served by drains. Two main devices are under development to cater for stormwater management n eeds in the Hamilton City Council portion of the catchment. These devices are:

- Subcatchment A - Glaisdale West Wetland[24], (partially under construction as at 2015, with final engineering plans not yet approved by Hamilton City Council) and
- Subcatchment B - The Meadows Wetland (proposed as at 2015)[25]

At the time of preparing this ICMP (2015) two culverts under Kay Road have been constructed, one to service the discharge from the Glaisdale West Wetland and one other to service the proposed Meadows Wetland.

There is limited soakage potential in the catchment within Hamilton City Council boundary although an area to the south west has been identified as suitable for soakage (see Figure 4 and Appendix B1).

[24] Formally proposed as a lake but to be designed as a wetland to TP10 standards.
[25] Final engineering plans not yet approved by Hamilton City Council

For some areas bordering the southern topographical boundary of the catchment there is a piped stormwater network draining primary stormwater to three existing consented stormwater ponds within the Te Awa O Katapaki stream catchment. Details of these consented ponds are provided in Table 2 below. The catchment area for each device is provided in Appendix A map B1. Each device is capable of serving these catchment areas.

There are no known issues attributed to poor LOS in the catchment. See Appendix B for existing and proposed stormwater network.

Table 2 – Te Awa O Katapaki stormwater devices

Device	Consent	Details
Delila Court	Hamilton City Council consent 2006/5394 Waikato Regional Council consent 119119	- Design catchment 28.8 hectares - Primary treatment of first flush (considered to be 8.9mm of rainfall as described in the Waikato Regional Council evaluation) - Controlled discharge of up to 5 year event. - Emergency overflow of larger >50 year events
Audrey Place (note: not yet vested and name may change)	Hamilton City Council consent 2009/20392 Waikato Regional Council consent 124726	- Water Quality Volume - Extended detention 24mm - Controlled discharge up to 100 year
Trauzer Place	Hamilton City Council consent 2005/5057 Waikato Regional Council consent 114008	- Discharge the 2 year ARI critical duration storm at a rate that does not exceed the peak greenfields discharge. - Water Quality Volume - Extended Detention 34.5mm - Includes sufficient capacity to capture the 5 year ARI critical duration storm. - Includes an emergency spillway that is sufficient to pass the 50 year ARI critical duration storm.

2.6 Surface Water Quantity and Flooding

The planned urban development within the Rototuna Structure Plan will change the predevelopment rainfall runoff characteristics of the catchment. A greater volume of water will flow off the land rather than soaking into the catchment's subsoil as it has previously.

The estimated current impervious area is 5 -10% which includes farm tracks, hardstands, buildings and roads. Under the Proposed District Plan residential urbanisation is expected to create levels of imperviousness of 50-60%. This means that the imperviousness of land draining to the south branch of the stream (i.e. the Structure Plan area) will be approximately 33%. The total imperviousness of the total catchment will double to around 14-16%[26].

[26] Boffa Miskell Ltd, 2015. Otama -ngenge Stream: Assessment of Ecological Values to inform an Integrated Catchment Management Plan. Prepared for Hamilton City Council June 2015.

A network capacity model has been developed for both the north and south branch with the primary objective of quantifying flow changes in the 2 year, 10 year and 100 year 24 hour event due to proposed development. A secondary objective of the model is to assess existing culvert capacity at public road crossings. The results of this model are supplemented with individual stormwater assessments for Glaisdale West and The Meadows subdivisions and Citywide Rapid flood Hazard Mapping . These assessments are generally adopted by the ICMP subject to detailed design and remodeling of the catchment utilising Council's standard modeling protocols (not scheduled until after LiDAR is reflown in 2018).

2.6.1 Flood Risk

There is no detailed flood hazard mapping for this catchment. Post development flood plain extent assessment is limited due to the lack of current LiDAR for the developing areas of the catchment. Hamilton City Council plans to undertake LiDAR survey (LTP programmed for 2018). Once undertaken, Hamilton City Council can program an update to the flood extent modeling.

The existing drains in the Hamilton City Council area of the catchment, including the main outlet drain, are very gently graded and in some cases flat, resulting in slow discharge and frequent flooding of the existing ponding area and adjacent low lying land. Substantial earthworks, either carried out recently or proposed, will have a significant impact on former flooding areas. In the Glaisdale West ponding area risks associated with greater than 1 in 50 year events and potential impacts of blockage of drains have been taken into account in determining flood risk by provision of an overland flo w path discharging to the south of the Glaisdale West Wetland. Provisions for flood risk associated with greater than 1 in 100 year events for the Meadows ponding area will also need to be determined as part of the detailed design.

2.6.1.1 Mitigation measures

The network capacity model does not predict bank overtopping in the predevelopment or postdevelopment scenario, however this assessment should only be considered preliminary in lieu of the detailed flood hazard modelling to be completed. Mitigation measures i n the postdevelopment scenario are attenuation to the 2, 10 and 80% of the 100 year predevelopment flow.

Wetlands

The Glaisdale West Wetland design, park buffer and setting of appropriate minimum floor levels is required to protect surrounding properties and new development from flood risk up to the 100 year ARI event. Figure 9 – Predicted 100 year ARI event flooding extent around the Glaisdale West Wetland/Pond shows the 100 year ARI event flood level with the new Glaisdale We st Wetland and discharge pipe in place. The 100 year flood level has been predicted at 28.7m, (Motoriki Datum) with finished floor levels required at 29.3m during previous Resource Consent applications for this area. These requirements to protect properties from flood risk up to the 100 year event will also be applicable to the Meadows development.

Roading areas

Conceptual flood detention for the motorway and arterial roads was also included in the network capacity model to provide 2 year, 10 year and 80 % of the 100 year predevelopment event detention for these road areas and their up stream catchments (assuming Maximum Probable Development). The model with detention showed peak flows lower than predevelopment conditions, whilst the model scenario without detention show significant flow increases in the 2, 10 and 100 year event. Detention to 2 year, 10 year and 80% of the 100 year predevelopment event is a recommended mitigation measure for these areas to avoid adverse flooding effects.

2.6.2 Erosion Risk

The network capacity model shows that as urbanisation occurs, and without detention, increased flow velocities will occur, with the potential to destabilise stream banks and beds. Attenuation devices will need to detain the additional flows in the developed areas in order to mitigate downstream erosion.

2.6.3 Land Drainage Effects

The Kirikiriroa Horsham Downs drainage area , which was originally established by Waikato District Council and is now administered by Waikato Regional Council, includes most of the rural land within the Waikato District Council area of the Otama-ngenge Stream catchment (See Appendix E) . The primary purpose of the Kirikiriroa Horsham Downs Drainage Area is to manage the water table. The secondary purpose is to drain ponded surface water from the 10 year event within three days[27].

The Waikato Regional Council technical report[27] notes the importance that maintenance of the drainage system results in the same standard right throughout each respective system; as the intention is that ponding is shared equally throughout the system when runoff rates exceed the system capacity. A variation in standard would result in ponding clearing from land with the higher standard and accumulating on land with the lower standard.

Within the wider drainage area there is an area from which Waikato Regional Council collects rates in order to provide maintenance on selected Sections of watercourse. These maintained sections and the rateable area are shown in Appendix E. Due to pockets of running sand and generally less stable material, machine clearing has not been undertaken due to the risk of destabilising the banks leading to slumping and erosion. Current maintenance therefore involves spraying watercourses twice a yea r. All other drains are the responsibility of the landowners to maintain[28].

Potential effects of urbanisation within the catchment that may impact on rural land drainage include capacity issues, ponding after rainfall for longer periods, bank instability in waterways, and increased operation and maintenance requirements. However the mitigation measure previously described (2.6.1.1) is considered the BPO for managing increasing urbanisation in the catchment. Flow volumes are predicted to increase due to urbanisation, therefore it is recommended that the downstream rates collection areas are extended into the areas to be urbanised to ensure funding of the waterways maintenance and management is distributed equitably.

There is t he potential for operations and maintenance costs to increase as a result of this urbanisation such as:

- Increased vegetation management
- Channel enlargement to meet the increases in flow volumes
- Erosion protection works to repair any damage caused by increased flow rates
- Culvert enlargement of existing structures if required

There is potential for road construction to impact land drainage in the north branch by impeding the movement of shallow groundwater and drain flows downstream. Drain bank stability may be affected by increased flow velocity, frequency, and duration. However, the proposed wetland and swale devices are expected to attenuate peak flows. Flow volumes are predicted to increase . Where it is identified that

[27] Waikato Regional Council Technical Report 2014/13 "Managing land use change and Council's administered drainage areas"
28 Waikato Regional Council provides a Best Practice Envirnmental Guideline for Land Drainage. http://www.waikatoregion.govt.nz/PageFiles/9928/TR0606R.pdf

stormwater discharges will have an effect on aquatic habitat and water quality values, then habitat enhancement shall be included as a mitigation measure via riparian planting and/or stream works as appropriate. Flow conveyance beneath the road corridor will be required to maintain land d rainage and fish passage.

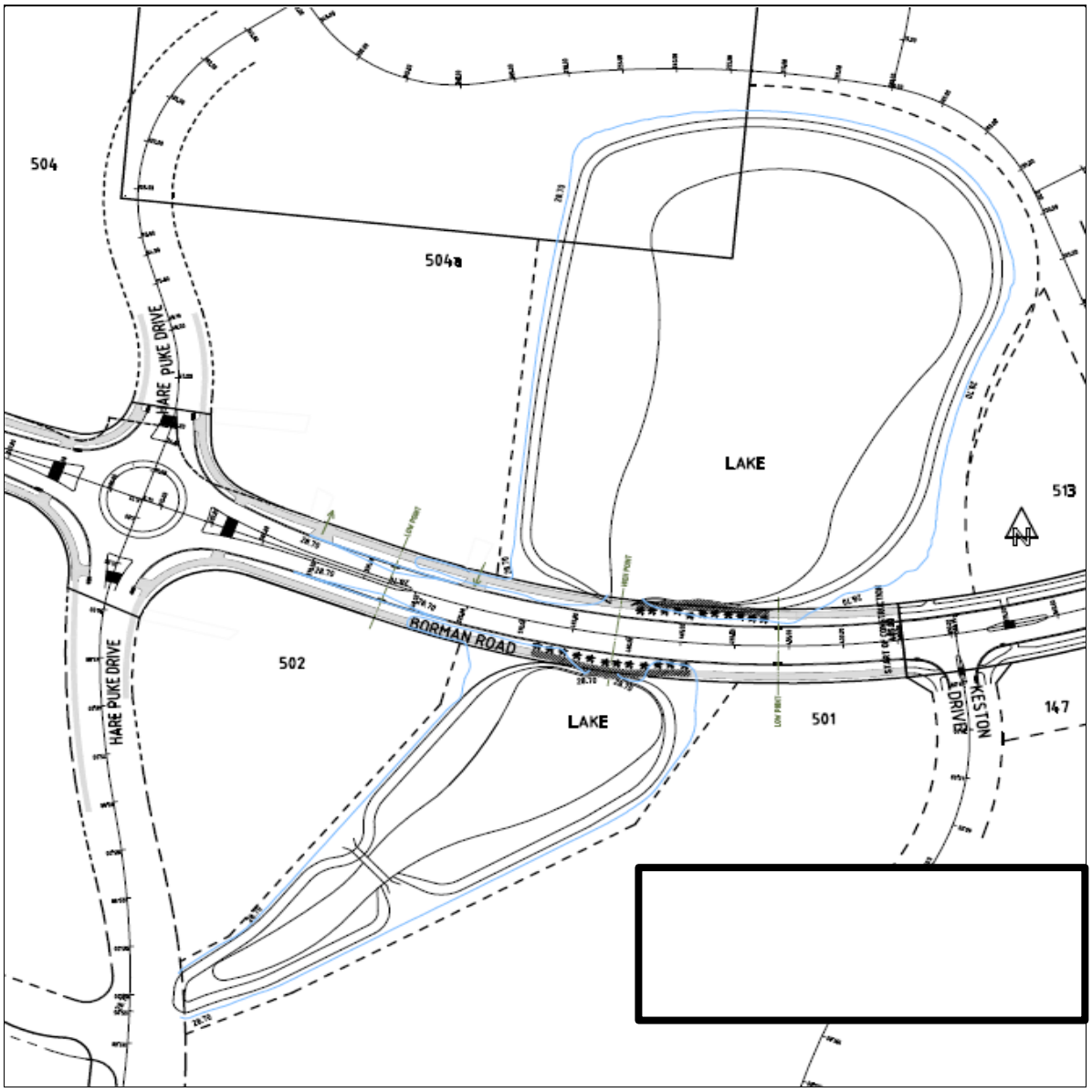


Figure 9 – Predicted 100 year ARI event flooding extent around the Glaisdale West Wetland/Pond.

2.6.4 Hydraulic Analysis

2.6.4.1 Culvert capacity

A Preliminary Assessment [29] of the Kay Road Drain was prepared in 2005 to support the Glaisdale development. The Glaisdale West Wetland has subsequently been consented and is in use initially as a sediment pond. The original report has been superseded by the network capacity model prepared for this ICMP. The network capacity model assessed four culverts.

Kay Road culvert

A 750mm diameter culvert was installed under Kay Road in 2015 to provide a connection for the proposed Meadows device (and hence the north-western catchment) to the Otama-ngenge Stream.

The model results show that Kay road culvert has sufficient capacity to convey the 100 year event without overtopping the road. However with proposed development 2 year, 10 year and 80% of the 100 year event flood detention is still recommended to minimise erosion from changes in landuse and to minimise flood level increases resulting from changes in landuse.

Osbourne Rd South branch culvert

The model results show that the south branch culvert has sufficient capacity to convey the 100 year event without overtopping the road. However with proposed development 2 year, 10 year and 80% of the 100 year event flood detention is still recommended to minimise erosion from changes in landuse and to minimise flood level increases resulting from changes in landuse.

The network capacity assessment also recommends a geotechnical assessment is completed at the Osbourne Road South branch location to determine if the predicted surcharging (but not overtopping) of the culvert at this location will cause land stability issues.

Osbourne Road North branch culvert

The model results show that the north branch culvert has sufficient capacity to convey the 100 year event without overtopping the road. However with proposed development 2 year, 10 year and 80% of the 100 year event flood detention is still recommended to minimise erosion from changes in landuse and to minimise flood level increases resulting from changes in landuse.

River Road culvert

The model results show that the river road culvert has sufficient capacity to convey the 100 year event without overtopping the road. However with proposed development 2 year, 10 year and 80% of the 100 year event flood detention is still recommended to minimise erosion from changes in landuse and to minimise flood level increases resulting from changes in landuse.

The network capacity assessment also recommends a geotechnical assessment is completed at the River Road location to determine if the predicted surcharging (but not overtopping) of the culvert at this location will cause land stability issues.

[29] Tonkin and Taylor Ltd, 'Preliminary Assessment Kay Road Drain', for the Glaisdale Property Partnership May 2005 - TRIM D-601286.

2.6.4.2 Glaisdale subcatchment

For the Glaisdale sub -catchment, a more detailed Stormwater Management Plan [30] was prepared after the initial preliminary assessment in 2005. In summary this report was based on the following stormwater management philosophy:

1. A piped drainage system shall be constructed across the development to provide the specified Council level of service (i.e. 2 year ARI event for residential precincts, 10 year ARI event for commercial precincts). Overland flow paths shall be pro vided to convey flows in excess of the design storm, up to and including the 100 year ARI event. The drainage system shall direct all runoff from the proposed development to the central lake/detention pond.

2. A lake and pond system is proposed in the centre of the site. The lake shall operate as a wet stormwater detention pond, attenuating flows to the Kay Road Drain to an 'acceptable' level, generally equivalent to the existing greenfields peak flows within the drain for a 2 year ARI storm. Flows shall be d ischarged from the pond and conveyed some 840m within a pipe system to discharge to the Kay Road drain.

3. The Lake and pond areas will be constructed to have large areas of open water (generally 2.0m depth), with various marsh and planting zones around its perimeter. The permanent water level has generally been set at RL27.35m.

4. For events exceeding the capacity of the pond/lake and primary outlet system (extreme rainfall events or in the event of pipe outlet blockage), an overflow route is to be provided to the south, discharging to the adjacent Eton Estate via Hare Puke Drive and on into the Te Awa O Katapaki Stream.

Hydraulic modeling of the overflow route via Hare Puke Drive will be required at the detailed design stage of the development to ensure flows can be safely conveyed within the road corridor, providing adequate freeboard to adjacent properties. The analysis will also need to confirm the design for discharge from the road corridor, into the proposed Eton Estate drainage reserve in the Te Awa O Katapaki Catchment and associated channel. This overland flow path should be recognised to ensure it continues to provide this overland flow function.

Note that at the time of preparing this ICMP (2015) the details of the pond were under review for optimisation and therefore may change. The nature of the device is likely to become a 'wetland' as opposed to a pond for water quality purposes.

The stormwater assessment [31] prepared in support of the Meadows subdivision application identified that the subsurface materials are predominantly silts and the results from percolation tests indicate the sub-surface soils have low to moderate soakage characteristics. Therefore the report proposed to provide a stormwater detention structure in the north -east of the site to which stormwater runoff from the 11.15ha sub-area would drain.

[31] Aecom New Zealand Ltd, 'Kay Road, Rototuna North, Hamilton Litt Family Trust Subdivision, Stormwater Management Assessment' May 2009.
[31] Aecom New Zealand Ltd, 'Kay Road, Rototuna North, Hamilton Litt Family Trust Subdivision, Stormwater Management Assessment' May 2009.

HEC-HMS modeling of the catchment and stormwater pond was undertaken by the developer using the following parameters:

- North-eastern catchment area of 11.15ha (of The Meadows property);
- Allowable peak discharge to the Otama -ngenge Stream north of Kay Road equivalent to the 2 -year predevelopment runoff of approximately 0.63m^3/s; and
- Base of pond and outlet pipe invert set at RL 26.72m (Moturiki datum) – i.e. same level as the upstream invert for the existing culvert under Kay Road.

Stormwater runoff from lots is proposed to be piped through a reticulated system to the stormwater device in the north east corner of the sub -area. Overland flows from the lots shall drain, via the road system, to the stormwater pond.

Otama-ngenge catchment will be remodeled as part of the ongoing flood hazard mapping development using URBAN/MIKE 11 software.

2.6.5 Land Drainage

When assessing network capacity stream level estimates were made at seven locations wh ere stream cross Sections were surveyed. The assessment concluded that water levels in the 10 year and 100 year events are not predicted to overtop banks therefore the requirement to avoid more than 3 days ponding in the 10 year event for rural channels is met. See section 2.6.3.

2.6.6 Overland flow

Stormwater runoff that exceeds the reticulation system is required to be safely conveyed by overland flow paths.

To prevent localised flooding as an area is developed, designated ove rland flow paths need to be incorporated into the design and layout of subdivisions. Overland flow paths shall be provided to convey flows in excess of the design storm, up to and including the 100 year ARI event. Roadways will form these secondary flow paths as far as possible. However, where necessary, overland flow paths required over private land will be formally recognized and protected as part of the consenting and construction processes.

For the catchment draining to the Glaisdale West Wetland (subcatchment A), overland flows will drain via the road system to the wetland. If flows/volumes exceed the capacity of the primary outlet pipe from the wetland and available storage of the wetland, or if the primary outlet becomes blocked, flows shall discharge from the wetland via a secondary overland flow path to the Eton Estate development to the south and from there into the Te Awa O Katapaki Stream catchment. Allowance for the flowpath must be reflected in the roads under construction. The two private properties affected have easements on the titles.

For the catchment draining to the Meadows Wetland (subcatchment B) overland flows will drain via the road system to the wetland. If flows/volumes exceed the capacity of the primary outlet pipe from the wetland and available storage in the wetland, or if the primary outlet becomes blocked, flows shall discharge from the wetland via an approved secondary overland flow path. Details of the flow path are yet to be finalised.

3 Catchment Issues and Objectives

Based on information known about the catchment, issues have been identified that require management under this ICMP.

Operational catchment objectives will address the specified issues and align with strategic objectives of this plan.

In some cases there may be a conflict between developmental yield targets and environmental requirements. There is a clear expectation that in meeting development targets permitted by the District Plan, the receiving environment will not be further compromised. Further, given the ecological significance of the catchment as a habitat for threatened native fish species, preference must be given to those methods that enhance water quality and habitat values.

3.1 Key Operational Issues - Stormwater

Urban development within the Hamilton City Council portion of the catchment will increase the amount of impervious surfaces such as roofs and roadways and can lead to increased runoff, increased flow velocities in streams, and potentially destabilisation of the stream banks. The following identified operational issues have the potential to impact on the way stormwater is managed and dealt with within this catchment. These are:

(a) Limited stormwater capacity of Otama-ngenge Stream and erosion risk

The existing waterways north of Kay Road and throughout the north branch drainage network are drains with limited flow capacity. To ensure that the waterways are not overwhelmed by the additional flows associated with development and roading, appropriate stormwater attenuation measures are required as well as reuse in residential areas where possible. Because the waterways are small, they will be sensitive to changes in flow regime and there is a risk that stormwater discharges will increase erosion and scour.

The recent channelisation and deepening of the channel downstream of Kay Road is likely to increase post-development bank instability and channel scour both through the modified reach and downstream. This is likely to require remedial work to address these effects.

(b) Flood risk

Large areas of land within the Hamilton City Council portion of the catchment, particularly the low lying central regions are currently subject to surface flooding following prolonged periods of rainfall. In the central areas especially, the flat terrain limits the ability for stormwater to drain away via overland flow paths and this will continue to lead to localised ponding. It is important that development and stormwater systems be designed to manage this. Urban development will increase the area of impervious surfaces such as roofs and roadways which can exacerbate flood risk. The rate of runoff will be increased, with increased flow velocities and volumes. As flood hazard mapping has not been completed for this area, the risk can not be quantified.

(c) Soakage capacity

The presence of peaty soils and high groundwater tables precludes the use of soakage as a main stormwater management option in significant parts of the catchment. However, there is a subcatchment of the Meadows area (see Appendix B1) where soakage has been determined to be viable and is proposed as the primary stormwater management option.

(d) Ecological values

Given its predominantly rural land use, the ecological values of the catchment are moderate and typical of rural streams around Hamilton . The Otama-ngenge Stream catchment has moderate water quality, moderate aquatic insect community diversity, and low native fish diversity but provides habitat for threatened giant kokopu, longfin and shortfin eel.

The planned development within the Hamilton City portion of the catchment is unlikely to have effects on water chemistry given the proposed methods of compliance. Improvements in water quality due to land use change will be minor due to the small proportion of the catchment being converted from rur al to residential land or roading. However, the diversion of stormwater flows to soakage in part of the catchment has the potential to reduce base flows to the south branch, and continued discharge into the upstream waterways is required to maintain stream base flows.

Urban stormwater often has elevated contaminant concentrations and can have elevated temperature. Small headwater receiving environments like the Otama-ngenge Stream waterways are particularly vulnerable to effects resulting from these disch arges. To minimize the potential for such effects, densely planted wetlands are the preferred means of treating stormwater from roads and land development areas throughout the catchment.

(e) Sediment

Sediment arising from earthworks can have temporary detri mental effects by smothering the stream's aquatic habitat. It is important that development provides appropriate local treatment to minimise any potential effects of sediment before exiting the upper catchment and that earthworks activities ensure adequate sediment and erosion control measures are in pace. Effective monitoring and enforcement of this is required.

(f) Risks to public health and safety

While waterways are viewed as both a stormwater asset as well as an amenity feature to the community, some sto rmwater assets are inherently risky to public safety . The public can access lined channels, deep ponds, inlets and outlets, and on occasions manhole lids can lift. It is important that the stormwater network , especially in urban/future urban environment s, is provided in a manner that minimises the risk to the public health and safety, and adequate consideration is given to the design of such features. Large areas of standing water associated with detention devices that are not shallow wetlands can also be a hazard. Faecal coliform numbers is rural waterways can pose a risk to both the public and livestock. Metal uptake by plants that provide a food source is also a risk.

(g) Maintenance of proposed devices

The nature and frequency of routine maintenance needs to be factored into device selection in conjunction with access and traffic management requirements . An issue for on lot devices is the ownership and maintenance responsibility (including stormwater collection for re -use). The effect of maintenance, plan t control , or lack thereof, on the receiving network, environment or public health must be considered where on lot devices are proposed.

(h) Economic constraints

The stormwater disposal network needs to be provided in a cost effective manner to Council by ma king use of natural land features and existing disposal systems . Land developers must provide an efficient stormwater management asset that take sinto consideration whole of life assets . It is expected th e proposed Meadows and Glaisdale wetlands will provide economies of scale . Collaboration with other developments should be investigated and implemented if feasible.

(i) Land drainage area requirements

The stormwater infrastructure proposed for development must take into account and mitigate potential impacts on rural land and landowners. Potential impacts identified in the Waikato Regional Council Technical Report[27] include:

1. Capacity issues.
2. Areas ponding for longer than 3 days
3. Bank and channel instability
4. Increased inspection and maintenance requirements.

The required Level of Service is to remove ponding from a storm with a 10% probability of occurring in any one year (the 10% Annual Exceedance Probability (AEP) event or '10 year storm') within three days." This level of service will need to be maintained post development using proposed mitigation measures and as shown within the network capacity model.

3.2 Key Operational Issues - Water

(j) Water capacity

Water capacity for development of the catchment currently has minor limitations. For The Meadows development, the consent has a condition restricting connections. Effectively this limit is in place until the trunk water main in Meadowfield Street connects with the future 250mm water main in Borman Road. The Glaisdale West Development is served by twin 150mm diameter pipes from Cumberland Drive to the eastern edge of the catchment and hence does not have a similar limitation.

Full development of the catchment will be further supported by the new Rot otuna reservoir and associated bulk mains due to be in place by 2018.

(k) Water allocation and pressure

While Level of Service for the water network is not likely to be a problem, water conservation , and demand management measures will always need to be cons idered and implemented in order to be resilient and cost effective . For the period until 2018, when the Rototuna reservoir and 250mm trunk mains are anticipated to be in place, there is a predicted drop in water pressure , particularly in the elevated sections of the developing catchment. The pressures are still predicted to meet Hamilton City Council LOS requirements but at the time of preparing this ICMP, this has not been confirmed.

A small area of properties (shown in Appendix B 3 – Water Supply Network) currently on a restricted supply will not be permitted to have a pressurised water connection until the completion of the Rototuna Reservoir unless it is demonstrated that level of service can be provided. Water Impact Assessments required by the Propo sed District Plan can further investigate issues associated with significant new developments.

3.3 Key Operational Issues - Wastewater

With the Rototuna West pump station, rising mains and associated trunk gravity mains along Borman Drive, there are no significant wastewater network constraints.

Collection and distribution networks should generally emulate the existing city network in order to maximise commonality and efficient maintenance (i.e. conventional gravity sewers)[32].

3.4 Operational Objectives

Operational Objective 1 - Maintain or Enhance Otama-ngenge Stream Water and Sediment Quality

a. Contaminants derived from urban or road stormwater are managed through appropriately designed treatment devices, so that any increase in mass contaminant loads and conc entrations in the receiving environment following development, are minimised as much as practicable. For general guidance purposes the following guidelines (or updates thereof) are referred:

   i. For in stream water quality and comparison with baseline contamina nt concentrations: ANZECC, 2000 – 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality'

   ii. For in stream sediment quality and comparison with baseline contaminant concentrations: ANZECC, 2000 – 'Australian and New Zealand Guidelines for Fr esh and Marine Water Quality / Interim Sediment Quality Guidelines (ISQG)'

   iii. For treatment device design and performance efficiencies: Auckland Council, 2003 – 'Stormwater Management Devices: Design Guidelines Manual – Technical Publication 10'

b. Primary storm water treatment devices must achieve at least 75% sediment removal on an average long -term basis . Devices servicing roading should be suitable for the removal of hydrocarbons and heavy metals.

c. To avoid increases in temperature in down stream receiving waterways, open water areas must be avoided in treatment devices and wetland vegetation cover must exceed 80% of the device surface area.

d. Where it is shown that a single device will not address receiving environment sensitivities, that a treatment train approach should be adopted and to minimise temperature effects and maximise contaminant removal.

e. Construction generated sediment shall be controlled to meet Waikato Regional Council standards and shall comply with relevant city bylaws and District Plan requirements.

This objective addresses issues d) ecological quality and e) sediment, and aligns with strategic objectives 3, 4 and 6 (refer to Section 1.10).

Operational Objective 2 – Minimise Alterations to the Natural Flow Regime

a. The erosion and scour of the bed and banks of the Otama -ngenge Stream network is not increased following urbanisation within Hamilton City Council boundary or road construction . Where it is identified that stormwater discharges will have an effect on aqua tic habitat and water quality values, then habitat enhancement shall be included as a mitigation measure via riparian planting and/or stream works as appropriate.

b. Stormwater from within the "Drains via Soakage" Section of The Meadows subcatchment shown in Figure 4 shall be discharged directly to ground via soakage. This will minimise increases in discharge volume, help to recharge groundwater, and mimic the natural water cycle.

[32] This does not preclude the use of alternative technologies provided it is proven in detail that they are more practical and cost effective than Hamilton City Councils preferred option. The application of alternatives on a small scale or for discrete developments is unlikely to be approved.

c. Stormwater from all other subcatchments within the Ha milton City boundary shall continue to provide surface discharges to the Otama-ngenge stream to maintain baseflows into an ecologically significant habitat. This does not remove the requirement for soakage where conditions are considered suitable in accor dance with Hamilton City Council Infrastructure Technical Specifications.

d. Where stormwater discharge to waterways needs to occur, extended detention shall be provided in accordance with TP10 to control flow velocities and erosion.

e. Energy dissipation and er osion protection measures are provided at all discharge locations, and preference is given to green engineering solutions over hard engineering solutions based on rock and concrete.

f. The recent channel modifications to the waterway down stream of Kay Road s hall be reviewed and where necessary remedied to reinstate aquatic habitat, mitigate effects on water quality, and avoid bank instability within the reach and downstream.

g. Stream flooding in a land Kirikiriroa Horsham Downs Drainage Area shall be managed t o the extent that the ponding from a storm with a 10% probability of occurring in any one year (the 10% Annual Exceedance Probability (AEP) event or '10 year storm') shall be removed within three days.

This objective addresses issue s a) drainage capacity a nd erosion, and aligns with strategic objectives 1, 4 and 6 (refer to Section 1.10).

Operational Objective 3 – Utilise Water Sensitive Practices

a. Where site and soil conditions allow, stormwater shall be discharged directly to ground via soakage. This will minimis e increases in discharge volume , help to recharge groundwater, maintain stream base flows, and mimic the natural water cycle.

b. The use of 'water sensitive practices ' shall be incorporated into the stormwater management approach for the catchment.

c. Where it is shown that a single device will not address flood risk or receiving environment sensitivities a treatment train approach shall be adopted.

This objective addresses issue a) drainage capacity and erosion, c) soakage capacity, h) economic constraints and i) land drainage requirements, and aligns with strategic objectives 1, 4, 8, 9 and 10 (refer to Section 1.10).

Operational Objective 4 – Promote Riparian Margin Enhancement and Re-Vegetation

a. Riparian planting shall be undertaken to mitigate effects of urbanisation in potentially effected areas. Riparian planting shall be promoted by Hamilton City Council throughout the catchment in conjunction with developers, landowners, local iwi and oth er interested parties. Planting shall include an appropriate mix of native eco-sourced plant species.

b. Works using natural solutions or green engineering which will enhance habitat and maintain natural stream processes in a soft sediment environment are pr eferred over hard engineering solutions using rock and concrete.

This objective addresses issue d) ecological quality, and aligns with strategic objectives 1, 3, 4 , 5 and 6 (refer to Section 1.10).

Operational Objective 5 – Have Due Regard for Economic Affordability and Safety

a. Proposed stormwater management systems are cost -efficient during long term operation and maintenance.

b. Stormwater and wastewater management systems are designed for public safety.

c. Where it is shown that a single device will not address flood risk or receiving environment sensitivities, a treatment train approach, incorporating an approved at source device upstream of a centralised public device, shall be adopted.

This objective addresses issue g) mainte nance of devices and h) economic constraints, and aligns with strategic objectives 1, 4, 8, 9 and 10 (refer to Section 1.10).

Operational Objective 6 – Protect Cultural Values

a. Stormwater from within the "Drains via Soakage" Section of The Meadows subcatchment shown in Figure 4 shall be discharged directly to ground via soakage, and also in other areas where soil and site conditions are suitable in accordance with Hamilton City Council Infrastructure Technical Specifications.

b. Riparian planting shall be encouraged by Hamilton City Council throughout the catchment in conjunction with developers, landowners, local iwi and other interested parties.

c. Works using natural solutions or green engineering which wil l enhance habitat and maintain natural stream processes in a soft sediment environment are preferred over hard engineering solutions using rock and concrete.

This objective addresses issue c) soakage capacity, d) ecological quality e) sediment and f) pub lic health and safety, and aligns with strategic objectives 1, 2, 3 and 6 (refer to Section 1.10).

Operational Objective 7 - Maintain or Improve Flood Protection Level of Service

a. Where existing flooding is known, or potential flooding is predicted, peak flow management is required with reduction to 80% of predevelopment flow for the 100 year ARI storm event.

b. Overland flow paths shall be provided for all stormwater discharges in accordance with Hamilton City Council standards. Wherever possible, the use of private property for overland flow paths shall be avoided.

c. Sufficient freeboard protection, in accordance with Hamilton City Council standards, shall be provided to building floor levels.

This objective addresses issues a) dr ainage capacity and erosion b) flood risk, f) public health and safety i) land drainage requirements, and aligns with strategic objective 4 (refer to Section 1.10).

Operational Objective 8 – Minimise water consumption and wastewater discharge

a. That water efficient fittings are incorporated into homes and promote sustainable water use practices.

b. That the size of infrastructure is minimised by promoting sustainable water use.

c. That future infrastructure upgrades are avoided or min imised by identifying and managing inefficiencies such as leakage, inflow and infiltration and unauthorised use.

This objective addresses issues h) economic constraints, j) water capacity, k) water allocation and pressure and l) Wastewater network and ali gns with strategic objectives 7, 8, 9 and 10 (refer to Section 1.10).

Operational Objective 9 – Integrated water management

a. Plan and implement three waters networks on a catchment wide basis to minimise the number of public stormwater treatment devices, wastewater pump stations and storage devices.

b. Where it is shown that a single device will not address receiving environment sensitivities, that a treatment train approach, incorporating an approved at source device upstream of a centralised public device, shall be adopted and include minimisation of temperature effects , metals, metalloids and PAHs. Construction generated sediment shall be controlled to Waikato Regional Council standards and relevant city bylaws.

This objective addresses issues a) drain capacity and erosion, g) maintenance of devices and h) economic constraints quality and aligns with strategic objectives 7, 8, 9 and 10 (refer to Section 1.10).

4 Stormwater Management

This Section identifies options that will meet operational objectives and cover the nature of the discharges arising from development in the Hamilton City Council Otama-ngenge catchment. Consistency with Hamilton City Council's stormwater management hierarchy and Stormwater Management Plan is required. Options not considered to be viable are not included in the evaluation. Examples which make an option viable include the following:

- Technical feasibility
- Ability to meet relevant legislative requirements
- Consistent with the principles of the Waikato Tainui Environmental Plan
- Aligned with the catchment specific objectives outlined in this document
- Must have better environmental, social or cultural consequences than doing nothing
- Does not contravene any explicitly stated political objective
- Does not result in an increase in risk
- Does not increase health and safety risks compared with doing nothing.

Water sensitive principles are required to be incorporated into all development proposals. Management principles that would apply under a water sensitive 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 planted 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.

4.1 Option Identification- Stormwater

Table 3 provides a list of methods that could be used to potentially address stormwater management issues in the catchment, with commentary regarding how the option could be implemented.

Table 3 – Stormwater Management Options

Management options	Description	Application in the HAMILTON CITY COUNCI L Otama-ngenge catchment
On lot solutions		
Soakage	Soakage minimises the volume of stormwater to be managed by reticulation and provided for groundwater recharge. Soakage systems may need pre -treatment to prevent sediment clogging of the system.	The soil type in the development area generally has limited soakage capability. While soakage is a useful part of the treatment train approach in The Meadows subcatchment, discharges are required to maintain baseflows in south branch waterways.
Sand Filters	Sand Filters are useful where space restrictions apply and they can be designed to take traffic loads. Sand filters often include a settling chamber for removal of coarse material followed by a tank containing the filter media. Finer materials are trapped or adhere to the filter media. Their limitation is that they can generally only service a small area.	Sand filters could be used for treating water from carpark areas and high traffic use areas such as inter Sections, but are not cost effective for residential development.
Rain Gardens/Bioretention devices	Rain gardens are another form of filtration device that use plants and layers of media (e.g. mulch, planting, soils, gravel under drain) for contaminant removal. There may also be treatment through infiltratio n of stormwater to the base of the rain garden, depending on the underlying soils. Rain gardens will be suitable for treating runoff from small areas.	Bioretention devices are generally used for treating water from industrial sites and carpark areas , but are unlikely to be applicable within this catchment.
Oil separation	Tanks and/or filters used to segregate oils from stormwater. Several products are available that specifically target oils and greases. Devices are most applicable to areas where this is the contaminant of concern e.g. garages.	Useful for industrial areas, but not considered relevant for residential development or roading. This may be needed for High Risk activities (refer Stormwater Bylaw)
Rainwater reuse tanks	Rainwater tanks are a bove or below ground tanks which are used to store rainfall collected from roof areas for non -potable use inside and outside the building. These tanks have two functions. They reduce the total volume of stormwater which runs off your site, especially from the frequent small rainfall events, and they reduce the demand for potable water from the council water supply system	Suitable for residential homes and can be used for non-potable water use, including toilet flushing, laundry use and garden watering

Management options	Description	Application in the HAMILTON CITY COUNCIL Otama-ngenge catchment
On lot solutions		
Detention	Detention tanks work by temporarily storing the rainwater runoff during a rainfall event and then slowly releasing the water through a controlled small diameter orifice. This storage and slow release of the rainwater reduces the peak stormwater flows during a rainfall event and which in turn reduces the impacts on downstream infrastructure and/or streams.	Detention may be suitable where on site soakage is not available and where there is no down stream centralised wetland or pond available within the immediate catchment.
Permeable surfaces	Permeable surfaces are surfaces which absorb and detain stormwater reducing runoff to stormwater in frastructure. Natural permeable surfaces include grass and landscape and planted areas. Constructed permeable surfaces generally consist of a layered construction to enable rainwater filtration to either ground soakage or an underdrain connected to an approved stormwater outlet.	The first preference is to retain existing natural permeable surfaces, including grass and planted areas. Where hardstand areas are necessary for the development proposal, constructed permeable surfaces can be used that still achiev e infiltration of the stormwater runoff to ground. Constructed permeable surfaces may be required where there is no down stream centralised wetland or pond available within the immediate catchment.
Building and landscape design	Set floor levels above floo d levels and away from overland flow paths. Ensure landscaping (including driveways, walls and structures) does not block, divert or convey overland flow in a way that causes ponding or potential flooding of buildings.	Required either specifically under th e District Plan or generally under the RMA and/or Building Act
Centralised Devices and Practices (Community based)		
Soakage	Refer to discussion under 'on lot'	Catchpits could incorporate soakage sumps for limited soakage but would still require reticulation.
Rain gardens/ Bioretention devices	Refer to discussion under 'on lot'	Rain gardens could also be used to target interSections for improved water quality should monitoring indicate the proposed wetland devices do not remove sufficient contaminant load.
Reticulation	Reticulation will manage the increased stormwater runoff from impervious areas in a controlled manner and control runoff and nuisance flooding to LOS.	Some form of servicing required as part of development proposal.
Subdivision design for secondary overflow	Secondary overland flow paths are necessary to manage runoff that exceeds reticulation LOS (e.g. 2 year ARI flows) residential Standard.	Required as part of development proposal.

Management options	Description	Application in the HAMILTON CITY COUNCIL Otama-ngenge catchment
On lot solutions		
Wetlands	Constructed wetlands consist of shallow vegetated pond areas. Wetlands are only practicable where space is available for construction. Wetlands remove contaminants through physical and biological processes. Extended detention can be incorporated to moderate storm flows.	Wetlands are an appropriate form of treatment within the Hamilton City Council Otama-ngenge Stream catchment for effective contaminant removal, maintaining low down stream temperatures, and attenuating stormwater flows. Wetlands may also provide or enhance indigenous biodiversity particularly where the historic environments were wetlands as is the case in the Otama -ngenge Stream catchment. Two wetland devices have a lready been consented for the catchment, with the detailed engineering plans yet to be approved.
Water quality ponds	Where space is available, ponds can provide flood mitigation and improve water quality by settling suspended sediment. Potential for adverse temperature effects.	Effective at removal of some contaminants but can contribute to reduced water quality for other parameters such as temperature (too high for fish and plants) and dissolved oxygen. Therefore, wetlands are preferred due to enhanced contaminant removal , maintained water quality, and potential for biodiversity enhancement.
Swales	Swales use a combination of slow, shallow flow and vegetation to remove contaminants from stormwater. Swales can be used in place of drainage pipes and to co nvey flood flows. Swales are most effective on gently sloping sites (1% -5%). In general a width of 3-7m is required to accommodate design requirements (maximum side slope 3H:1V).	In general, Hamilton City Council prefers that swales are used only on limite d access roads due to public safety and maintenance requirements. However, in the following circumstances, swales may be considered for local roads and residential areas: • Flat land with high groundwater where the fall required for reticulated stormwater is impractical. • Sensitive receiving environments or sensitive indigenous aquatic species located down stream of discharge points requiring high standards of stormwater treatment. • Constrained space or distance within which to achieve stormwater treatment to a sufficient standard using conventional single device-methods.

Management options	Description	Application in the Hamilton City Council Otama-ngenge catchment
On lot solutions		
Filter strips/riparian planting	Filter strips are used to intercept stormwater before it becomes concentrated. The effect of stormwater travelling through the vegetation is to slow down the stormwater allowing some infiltration and removal of contaminants. Riparian planting is a form of filter strip.	Suitable for treatment of diffuse sources of runoff along lengths of a waterway where there is overland flow or shallow sub -surface flow into t he waterway, but only in specific circumstances. Riparian planting or filter strips can also contribute widespread habitat, water quality, and bank stability enhancements. Specific methods and plant selection are site specific but applicable to all rural Otama-ngenge Stream waterways downstream of stormwater discharge points where there is potential for effects.
Gross Pollutant Traps and Litter Traps	Devices in this category include floating booms, gratings and mesh inserts installed within ponds, culverts and catch pits. Proprietary products are available that use a combination of hydraulic motion and sedimentation to remove contaminants.	The suitability of devices needs to be reviewed on a case by case basis. Application for runoff from industrial/commercial areas with high risk activities may be appropriate but are generally considered unnecessary for the proposed residential areas and roading.
Permeable pavements for car parks and footpaths	Special concrete and aggregate mixes allow water to pass through reducing catchment imperviousness, promoting soakage. There may be a need pre -treatment so permeable matrix does not clog.	Application for treatment of runoff from high traffic or industrial/commercial areas may be appropriate but soils in the catchment are generally unsuitable for soakage from permeable paving.

4.2 Option Evaluation - Stormwater

Once the options are identified, they nee d to be evaluated for effectiveness in addressing the Otama-ngenge Stream catchment risks and sensitivities and meeting the catchment objectives for stormwater management. To facilitate the option evaluation , assessment components are grouped under the framework of economic, environmental, and social and cultural effectiveness. Those options that rank highest in terms of environmental, economic and social/ cultural benefit will form the basis for the Best Practicable Option (BPO) for the catchment.

The qualitative assessment below shows which options are most likely to address catchment issues and meet objectives in accordance with the requirements of the CSDC Condition 30 . Relative life cycle costs are considered for those options delivering similar outcomes. Multiple options may be suitable in each situation, and multiple options will be needed to provide full servicing and a treatment train for the developing areas of the catchment.

The effectiveness of a method with respect to each criterion is indica ted by ticks (✓) 0-4; the more ticks listed, the more effective the method in addressingthe criterion.

Table 4 – Stormwater Management Option Evaluation

Management option	Environmental	Economic	Social, Cultural and Community	Overall assessment and applicability
On lot				
Soakage	Stream channel protection Ground water recharge	Low cost option if soils permit Minimises infrastructure	Very minor flood risk mitigation Reduce discharges at source	Cost effective and provides limited environmental benefits.
	√√	√√√√	√	Good where soakage is viable. Contributes to meeting operational objectives 2, 3, 6 and 8.
Sand Filters	Contaminant management for carparks and high traffic	High cost and maintenance		Does not provide sufficient benefits to be widely implemented.
	√√	√		
Rain Gardens/Bioretention devices	Contaminant management Reduced discharge if infiltration capability included	Moderate cost and maintenance	Amenity value if well planted	Provides some benefits in specific situations
	√√	√√	√	Possible limited applicability
Oil separation	Contaminant management for carparks and some industry	Moderate cost and maintenance		Does not provide sufficient benefits to be widely implemented.
	√√	√		
Rainwater reuse tanks	Mimics natural flow regime	Moderate cost and maintenance	Can be used for non-potable water supply including garden watering An option to support resiliency and security of water supply	Cost effective and provides environmental benefits.
	√√	√√√√	√	Good as part of treatment train. Contributes to meeting operational objectives 2, 3, 5, 8 and 9.

Management option	Environmental	Economic	Social, Cultural and Community	Overall assessment and applicability
On lot				
Detention	Capture first flush runoff Reduce peak flows for up to 10 year events	Relatively low cost	Can be used garden watering	Cost effective and provides environmental benefits.
	√√	√√√√	√	Good as part of treatment train. Contributes to meeting operational objectives 2, 3, 5, 8 and 9.
Permeable Surfaces	Mimics natural flow regime	Moderate cost and maintenance	Can provide functional and aesthetic value	Provides some benefits in specific situations
	√√	√√	√√	Possible limited applicability
Building and landscape design		Relatively low cost as part of overall design	Mitigates flood risk associated with overland flow and ponding	High social and economic benefits.
		√√√	√√√√	Essential to meet objectives. Contributes to meeting operational objectives 5 and 7.
Centralised Devices and Practices (community based)				
Soakage	Stream channel protection Ground water recharge	Low cost option if soils permit Minimises infrastructure	Minor flood risk mitigation Reduce discharges at source	Cost effective and provides limited environmental benefits. Good where soakage is viable.
	√√	√√√	√	Contributes to meeting operational objectives 2, 3, 6, 8 and 9.
Rain gardens/ Bioretention devices	Stream channel protection Contaminant management Reduced discharge if infiltration capability included	Moderate cost and maintenance	Minor amenity provided	Provides some benefits, but other options have scored higher
	√√	√√	√	Possible limited applicability

Management option	Environmental	Economic	Social, Cultural and Community	Overall assessment and applicability
On lot				
Reticulation		Moderate to High cost, relatively low cost maintenance	Mitigates nuisance and flood risk for frequent flows Maintains LOS	Provides high degree of social benefits
		√√	√√√√	Applicable
Subdivision design for secondary overflow	Can incorporate bioretention features	Relatively low cost as part of overall design	Mitigates flood risk Minimises infrastructure	
	√	√√√	√√√√	Essential to meet objectives. Contributes to meeting operational objectives 5, 7 and 9.
Wetlands (with extended detention)	Stream channel protection Contaminant management Habitat enhancement Some soakage provided	Economy of scale Less maintenance than pond	Mitigates Flood risk Provides amenity Wetland planting supports mauri Shallowness and planting bench make safer than deep pond	High benefits and already consented in catchment
	√√√√	√√√	√√√√	Applicable

Management option	Environmental	Economic	Social, Cultural and Community	Overall assessment and applicability
On lot				
Ponds	Stream channel protection from flow attenuation Can elevate discharge temperature, reduce dissolved oxygen, affect fish passage, and replace stream habitat if online Contaminant management (principally sediment) Some soakage provided unless pond is lined	Economy of scale	Mitigates flood risk Can provide amenity	Provides some benefits, but wetlands with detention score higher and alleviate temperature concerns in this catchment.
	√√	√√	√√	
Swales	Stream channel protection from flow attenuation Contaminant management if densely planted Potential for enhanced indigenous biodiversity if planted	Can reduce reticulation Provide overland flow path	May mitigate flood risk	Cost effective and provides environmental benefits. Good as part of treatment train.
	√√√	√√√	√√	Only preferred by Hamilton City Council for limited access roads due to operations and maintenance considerations, access complications and conflicts with other services. May be applicable for proposed Waikato Expressway and Arterial

Management option	Environmental	Economic	Social, Cultural and Community	Overall assessment and applicability
On lot				
Filter strips/riparian planting	Contaminant management Stream protection Riparian planting enhances habitat	Very cost effective if space available	Can provide amenity Riparian planting supports mauri	Provides environmental benefits.
	√√√√	√√	√√	Applicable in suitable situations.
Instream channel or riparian modifications	Potential to enhance bank instability Potential to improve aquatic habitat Potential for increased capacity Potential for effects on aquatic life during construction	Can be cost effective if carefully managed	Can be effective in improving cultural and community values on degraded waterways if carefully managed	Must incorporate multidisciplinary approach to design and implementation not limited to a single outcome (e.g. capacity).
	√√√√	√√	√√√	Applicable in suitable situations.
Gross Pollutant Traps and Litter Traps	Contaminant management	Moderate cost, maintenance required	Improves visual appearance	Does not provide sufficient benefits to be widely implemented.
	√	√	√	
Permeable pavements for car parks and footpaths	Soakage	Minimise infrastructure	Reduce discharges at source	Does not provide sufficient benefits to be widely implemented.
	√	√	√	

The above evaluation demonstrates that wetlands and riparian planting provides the highest environmental benefits followed by swales. The options with the most economic advantages includes soakage, proper building and landscape design, subdivision overland flow paths, swales and rainwater reuse tanks. Options with good social and commu nity benefits include wetlands, reticulation, overland flow paths and proper building and landscape design. Additionally, wetlands and riparian planting supports the mauri of water.

Based on this evaluation the following stormwater management methods a re considered suitable to form the BPO:

<u>On Lot Devices and Practices:</u>

The preferred on lot stormwater effeciency measure for this catchment:

1. Rainwater reuse tanks (where this is used it shall be plumbed back into the toilet and laundry with an option for garden use).

Other equivalent features suitable for this catchment:

2. Soakage (which must be used for the entire lot if deemed suitable during the subdivision).
3. Permeable Surfaces
4. Bioretention/raingardens
5. Detention

Other on lot practices that are encouraged:

- Proper building and landscape design

<u>Centralised Devices and Practices</u>

1. Wetlands with extended detention and attenuation
2. Soakage (where feasible)
3. Bioretention/raingardens (limited applicability)
4. Subdivision overland flow paths with erosion protection
5. Swales (in limited access roads)
6. Reticulation (treatment required before or after)
7. Riparian Planting

4.2.1 Ownership Considerations

Assets that are required to meet a level of service for public good are generally owned and operated by Hamilton City Council, however some categories of private on-lot devices will need to be owned and maintained by the on-lot owner.

Where assets are to be vested to Hamilton City Council, these must meet Hamilton City Council requirements of meeting levels of service, safety, access, flood risk protection, treatment performance, asset life cycle, operations and maintenance and renewals cost (and meet certification requirements of CSDC).

Where assets are to be privately owned, consideration shall be made for how the asset is to b e operated and maintained and the risk of asset failure or poor performance accounted for. Private asset ownership is normally limited to on lot assets. Any communal devices are normally vested, and whether public or private must be at the standard of Hamilton City Council Infrastructure Technical Specifications.

Developers must discuss with Hamilton City Council the intent and options of vestment and private ownership prior to approval of development proposals.

The drains in the Otama -ngenge Stream catchment are managed by the Kirikiriroa Horsham Downs drainage board who manages the expenditure on drain maintenance from land drainage rates (refer Appendix E) . Collaboration and agreement is required between Hamilton City Council and the drainage board regarding drain performance and future maintenance near the road corridors and downstream of Kay Road Funding of waterways maintenance through extention of the down stream rates collection areas into the areas to be urbanised would ensure the cost of management is distributed equitably. This option will be explored in detail with Wa ikato Regional Council. See Section 6.6 Future Actions.

4.3 Best Practicable Options (BPO) - Stormwater

This Section presents the BPO for the stormwater catchment. It includes criteria for managing the discharges that are expected to occur with development in the Hamilton City Council Otama-ngenge catchment. The BPO organizes and integrates the management options, existing stand ards and consented devices into a servicing approach that addresses issues and objectives in the catchment. This integrated approach to managing stormwater diversion and discharge activites is a key requirement of the CSDC Condition 30.

4.3.1 Flood management

At thetime of writing this ICMP (2015), t wo centralised stormwater treatment and attenuation devices are already consented within Hamilton City Council's jurisdiction to manage stormwater from development in the catchment , and are currently undergoing the d etailed engineering phase . As these are already consented, at least partially implemented, and meet identified flood and network mitigation objectives , they will necessarily form part of the BPO and be reflected in the Means of Compliance table[33]. Major roading projects are identi fied in the catchment and have devices currently in various stages of design.

> **Glaisdale West Wetland:** The proposed Wetland (in the vicinity of the western community/commercial node) is shown on Figure 4 and is included in the Rototuna Structure Plan. The device is considered a cost effective way to facilitate development of the wider area as it will somewhat replicate the historical peat wetland features and provide an amenity function for the adjacent medium-density housing. The wetland is proposed to detain and attenuate all flows to the 2 year pre development flow up to and including the 100 year ARI post development event from the majority of the upper Otama -ngenge Stream catchment. Attenuated flows will then enter the stream on the northern side of Kay Road and ensure the stream is protected [34]. Normal discharge of stormwater from the wetland will be via a pipe system to the stream on the northern side of Kay Road. An overflow system to the Te Awa O Katapaki is provided for the 50 year event and above, or if the primary outlet is blocked.

33 At the time of preparing this ICMP Waikato Regional Council has consented the G laisdale stormwater management approach but not the Meadows. Glaisdale device will need to comply with conditions set by Waikato Regional Council and engineering plans.

34 This has come forward through the Glaisdale West subdivision proposal. Extensive details of the design are contained within the references;

In the Medium Density Residential area, Comprehensive Development Plans (CDPs) must be approved prior to development. Application of permeability restrictions and water sensitive techniques in accordance with the District Plan will also minimise impacts of stormwater flow and volume.

Meadows Wetland: A second stormwater management device is proposed in the north-east of the site (Figure 4 and Appendix B1). Peak 2 and 50 year flows are proposed to be limited to the existing runoff of approximately 0.63m ^{3}/s (e.g. the 2yr ARI greenfield flow component to the Kay Road Drain from the Meadows subcatchment area)[35].

Waikato Expressway and Arterial roads : Stormwater management devices have been identified in preliminary design stages to manage water quality and quantity issues relating to the construction of the Waikato Expressway and the Resolution Drive extension. As shown in Figure 5, a large wetland is proposed to manage the Waikato Expressway and there are three smaller wetlands for the arterial road. In addition, proposals also indicate the use of swales within the road corridor. Locations and sizes of wetlands are yet to be confirmed.

Therefore the first BPO for the catchment is:

Stormwater BPO 1 – Maintain or Improve Flood Protection Level of Service

a. Due to flood risk, topography and downstream capacity of the Otama-ngenge Stream, the Glaisdale West Wetland and the Meadows Wetland shall be installed so that the 100 year ARI post development peak flows are attenuated to 80% of pre-development 100 year ARI peak flows.

b. Each sub-catchment in the Otama-ngenge Stream catchment shall be designed with suitable overland flow paths. Where feasible, overland flow should occur within the roading network or through designated paths in public reserve. If needed, suitable energy dissipation and/or erosion protection measures shall be provided.

c. Sufficient freeboard protection, in accordance with Hamilton City Council standards, shall be provided to building floor levels.

d. The reticulation system shall drain to downstream centralised device/s (with a maximum of one centralised device per subcatchment)[36] except where the required level of treatment and attenuation has been achieved in preceding devices. Refer to Appendix B1 for existing and indicative location of devices in the development areas.

e. Soakage and attenuation solutions must be designed in order to maintain Land Kirikiriroa Horsham Downs Drainage Area Levels of Service requirements. (The level of service for flooding in the agricultural areas of the Kirikiriroa Horsham Downs Drainage area is to be maintained, that is: remove ponding from a storm with a 10% probability of occurring in any one year (the 10% Annual Exceedance Probability (AEP) event or '10 year storm') within three days.")

[35] TRIM D -856142: Maunsell/AECOM 2009: Kay Road, Rototuna North, Hamilton Litt Family Trust Subdivision - Stormwater Management Assessment, dated 1 May 2009. Engineering approval has not yet been applied for nor granted.

[36] Developers may need to work together to achieve this.

4.3.2 Water sensitive design

Water sensitive works include multiple site -specific stormwater controls that work with the natural landscape and are relatively cost effective. Water sensitive principles must be a part of the design philosophy. Most water sensitive methods assist in controlling runoff at the source in order to replicate the predevelopment hydrology. Controlling water at the source reduces the stormwater network requirements and may lower costs for developer and the Council. As shown in the option evaluation, options that meet a number of stormwater objectives , are cost effective and that can form part of a treatment train are ranked high and considered suitable for the Otama -ngenge catchment. Therefore the next two BPOs for the catchment are:

Stormwater BPO 2 – Water Sensitive Techniques

a. Low Flow Fixtures shall be incorporated as part of any new development. Refer to Table 7 (Methods to achieve compliance) for details.

b. Developers are to consider opportunities to implement water sensitive urban design approaches such as on site devices, permeable paving, minimising impervious areas and clustering development to retain larger natural spaces within the built form.

c. A water efficiency measure shall be incorporated as part of any new development within the Hamilton City Council boundary, in accordance with Proposed District Plan 25.13.4.5a and 25.13.4.6. For developments that fall under rule 25.13.4.5a, all measures within the supporting practice notes are considered suitable for the developable area. In accordance with Hamilton City Council's drainage hierarchy, (Proposed District Plan and Infrastructure Technical Specifications) the highest priority for stormwater management from domestic roofs is to capture and re-use rainwater for non-potable uses (e.g. washing machines, toilets and watering gardens), followed by soakage and then detention. Therefore, whilst the developer can determine the measure they use, the measure most encouraged is a rain tank, and where this is used it will need to be plumbed back into the toilet and laundry.

Stormwater BPO 3 – Minimise alterations to the flow regime

a. Developers shall undertake sufficient testing to determine if suitable soakage characteristics are present before a piped network is approved. Where soakage is suitable, on-lot soakage shall be the water efficiency measure at the time of Building Consent. See Table 7 – Methods to achieve compliance. In areas with sloping topography, ground stability shall be considered when designing for soakage systems. This will require specific geotechnical investigations to be undertaken. Guidelines on requirements for soakage testing and design are provided in Hamilton City Council Infrastructure Technical Specifications. Requirements for pre-treatment prior to soakage discharge will need to be considered to prevent sediment clogging of the system.

b. Centralised stormwater devices that can include a soakage component shall be preferred.

c. A development shall attenuat e the 2 and 10 year, 24 hour post development events to pre-development levels and attenuat e the 100 year, 24 hour post development event to 80% of the predevelopment level. These calculations should be carried out following the guidance in Section 4 of the Hamilton City Council Infrastructure Technical Specifications.

d. Stormwater devices shall continue to discharge surface waters to the Otama -ngenge Stream catchment waterways to maintain base flows in downstream ecologically significant habitats.

e. Suitable energy dissipation and erosion protection measures shall be provided at all discharge locations, with preference for natural solutions or green engineering appropriate to the soft sediment environment over hard engineering solutions (eg using rock and concrete).

4.3.3 Environmental protection

The environmental state of the Otama-ngenge catchment and down stream areas has already been modified through long term agricultural activities and land drainage . With the change in land use from rural uses to urban development further environmental damage could occur but there is also the opportunity for environmental enhancement values . The following BPOs are intend ed to allow development to proceed while maintaining and enhancing environmental values where practicable.

Stormwater BPO 4 – To Maintain or Enhance Otama-ngenge Stream Water Quality

a. Soakage, treatment and attenuation solutions shall be provided for on lo t to avoid direct pipe connections to a receivng water body. (Direct pipe connections from lots to a receiving water body will not be acceptable.)

b. Treatment through a single device shall be adopted for all developments and new roading within the Otama-ngenge Stream catchment area. Such treatment shall specifically consider minimisation of temperature effects , and removal of sediment, nutrients, metals, metalloids, PAHs and gross pollutants. Where this cannot be achieved with centrali sed devices (such as wetlands) or in advance of a centralised device being installed, there shall be appropriate at source devices (using a treatment train approach). Within wetlands, the management of gross pollutants can be achieved through the installation o f inlet or outlet screening, such as floating litter traps or net technologies.

c. Devices servicing high traffic roading and upgraded roads shall be suitable for the removal of hydrocarbons. If the main central device is not suitable to remove hydrocarbons , additional devices shall be implemented within a treatment train.

d. High risk sites (i.e. those with the potential for the discharge of unusual or high concentration contaminant runoff (as defined in Waikato Regional Plan and Hamilton City Council Stormwater Bylaw) shall have their own comprehensive treatment system prior to discharge from the site.

e. Unless a community stormwater device provides the required catchment parameters individual lots will need to provide a n on lot stormwater management system that meets the catchment parameters.[37]

f. Where it is identified that stormwater discharges will have an effect on aquatic habitat and water quality values, then habitat enhancement shall be included as a mitigation measure via riparian planting and/or stream works as appropriate.

g. All stormwater devices holding permanent static or flowing water shall have >80% wetland plant cover to provide habitat for indigenous fish where appropriate and reduce the effects of temperature increases and contaminant loads on receiving waters.

Note: For installation of such devices and any in stream or riparian works in urban streams it is highly recommended that a qualified river geomorphologist and aquatic ecologist participate in the design and implementation of engineering solutions to ensure l ong term performance and

[37] Refer to the Hamilton City Council Infrastructure Technical Specifications for design storms for residential, industrial and commercial. Refer to Hamilton City Council Three Waters Management Practice Notes for guidance on private systems.

effectiveness. Instream and riparian works on any waterway may require regional council resource consents.

Stormwater BPO 5 – Retention and enhancement of existing riparian areas and vegetation

a. Review and remedy where necessary the recent channelization of ecologically significant habitat downstream of Kay Road, through options including battering back oversteep banks, reinstating channel features, riparian planting for bank stability and armouring as far downstream as required. (Works on private property or within the Waikato District Council area will be subject to agreement of affected parties and may require regional council resource consent.)

b. Energy dissipation devices shall be provided at all discharge locations to prevent bed scour and bank instability, with preference for natural solutions or green engineering appropriate to the soft sediment environment over hard engineering solutions using rock and concrete.

c. Modified and natural stream channels and their riparian margins shall not to be used to locate stormwater treatment devices. However, in the upper catchment, the modification of artificial drains to create stormwater treatment wetlands and detention basins is encouraged rather than device creation in farmland, provided that flood flows and fish passage are incorporated into the design as appropriate.

d. Hamilton City Council shall encourage landowners within the Otama-ngenge Stream catchment to retain existing riparian vegetation, and undertake riparian planting with indigenous eco-sourced vegetation selected from the Plant Selection Tool for Waikato Waterways, Waikato River Authority (and/or using the advice of a suitably qualified ecologist). A minimum of 5m wide riparian planting either side of all waterbodies, streams and drains shall be encouraged.

e. Any restoration planting will require stock proof fencing and on-going weed control, ideally through hand releasing rather than spraying or machinery to avoid bank intability and by-kill of desirable species

Stormwater BPO 6 – Construction Controls

a. Sediment control measures shall be in accordance with Waikato Regional Council requirements and Hamilton City Council stormwater bylaw and District Plan and must protect the Otama-ngenge Stream and its tributary drains, plus any existing stormwater network or devices (such as catchpits, swales and wetlands). These requirements are aimed at reducing the amount of sediment leaving construction sites, as the construction period is when significant sediment runoff can occur.

b. Controls on stormwater runoff from lots during development will be required to keep sediment out of the stormwater system and receiving environment in accordance with Waikato Regional Council requirements and Hamilton City Council stormwater bylaws. This will protect the catchment waterways and the integrity of stormwater management devices.

c. The presence of native fish in catchment waterways (including drains) affected by proposed construction must be established prior to construction commencing. If native fish are present, they must be translocated to an appropriate habitat [38] and/or fish passage must be

[38] Required under the Conservation Act 1987 section 26ZM(2) and Freshwater Fisheries Regulations 1983 section 70. Persons undertaking fish translocation are required to obtain permits from Ministry for Primary Industries and may also require authorisation from the Department of Conservation.

provided to up stream habitats where native fish are present . Removed habitiat must be authorized and by replaced with equivalent or enhanced habitats.

Note: Specific guidelines for erosion and sediment controls required for earthworks in the ICMP area will be provided by Waikato Regional Council.

4.3.4 Other BPOs

Several other BPOs have been identified that are intended to help communicate the stormwater management philosophy for the catchment and meet cultural and legislative requirements.

Stormwater BPO 7 – Education

a. The ICMP shall be listed within the Hamilton City Council Education Strategy for further assessment on appropriate public communications plan. As a minimum, the ICMP shall be placed on the Hamilton City Council website and documented in planning documents.

b. As a minimum the finalisation or major update of the ICMP shall be communicated externally and internally with key stakeholders.

Stormwater BPO 8 – Application of RMA, LGA, DP and Bylaws and City wide Comprehensive Stormwater Discharge Consent

a. Appropriate legislation and regulation measures such as bylaw [39] enforcement, legislation relating to fauna management [40], and district plan rules shall be applied to main tain and protect the Otama-ngenge Stream receiving waters and indigenous aquatic fauna.

b. Management of catchment stormwater shall align with requirements of the CSDC and associated Hamilton City Council Stormwater Management Plan.

c. Operations and maintenanc e plans shall be provided to ensure that stormwater management devices provide best practicable stormwater management efficiency at all times and meet parameters of Table 6.

d. In the event of any discovery of artefacts in watercourses that may have potential cultural or historical significance, the appropriate iwi representatives and authorities shall be notified.

e. Connections to the network must not increase the scale or intensity of the actual and potential effects o f the stormwater diversion and discharge. Connection must not be inconsistent with conditions of the Hamilton City Council CSDC, and must not increase peak discharges rates to or flow volumes in stormwater receiving bodies unless it is demonstrated that there are no additional adverse effects on the environment or down stream properties as a result of such increase. Technical certification from Waikato Regional Council may be required.

[39] Stormwater bylaw has been adopted by Council and comes into force 28 September 2015.

[40] Required under the Conservation Act 1987 section 26ZM(2) and Freshwater Fisheries Regulations 1983 section 70. Persons undertaking fish translocation are required to obtain permits from Ministry for Primary Indus tries and may also require authorisation from the Department of Conservation.

5 Water and Wastewater Management

5.1 Wastewater

The entire Otama -ngenge Stream catchment can be served by the new wastewater pump (see Appendix B2). The gravity mains to access the pump will be extended as development occurs in accordance with Hamilton City Council's Infrastructure Technical Specifications and assessed during the engineering phase for suitability to serve the surrounding areas draining to the pump.

The size of infrastructure should be minimized by promoting sustainable water use and where possible, three waters networks are integrated within the catchment prior to discharge to the wider city networks. Future infrastructure upgrades shall be minimised by preventing, identifying and managing inefficiencies such as leakage, inflow and infiltration, and unauthorised use.

5.2 Best Practicable Options (BPO) - Wastewater

There are no Best Practicable Options for this catchment that are not standardised city wide measures as described in Hamilton City Council Infrastructure Technical Specifications and Proposed District Plan.

Wastewater BPO 1 – General requirements

a. Acceptable means of compliance for the provision, design and construction of wastewater infrastructure is contained in the Hamilton City Council Infrastructure Technical Specifications and Proposed District Plan.

b. Low flow fixtures shall be incorporated in accordance with the Proposed District Plan requirements. Refer to Methods to achieve compliance for details (Table 7).

5.3 Water Supply and Demand Management

Residential premises will dominate the water demand within the Otama-ngenge catchment. Undeveloped areas of the Otama-ngenge catchment will be serviced by the existing water system. In future, the entire Otama -ngenge catchment will be serviced by the new water supply network located within Borman Road which will also be reticulate d throughout the local roading network. Existing rural residential dwellings however, will continue with their individual rain tank supply or trickle feed supply, until urban services are practically available for connection.

Notwithstanding the above, vi able water sensitive options exist for a more sustainable and integrated approach and will need to be applied in accordance with provisions of the Hamilton Proposed District Plan.

In addition, Hamilton City Council has the following initiatives planned t o ensure that water demand is met in the Otama-ngenge catchment as well as other catchments within the city:

- New reservoir in Rototuna and associated bulk mains;
- City wide reticulation upgrades to support infill and intensification;
- Water demand and loss management programme to effectively manage water in the network and reduce loss;

- Continuation of the water model to forecast water demand out to 2061 and beyond;
- Enforcement of Water bylaw which requires water conservation in accordance with trigger levels;
- Education initiatives on water demand management;
- Reducing water demand through universal metering or meet increased growth demand through the construction of additional treatment capacity;
- Continue to work with Waipa and Waikato District Councils to pro vide a Sub -Regional solution to water as per the Sub-Regional 3 Waters Strategy;
- Implementation of Public Health Risk Management Plan (Water Safety Plan) and

5.4 Best Practicable Options (BPO) - Water

The following Section provides details of the selected Water BPO measures and how they will achieve the objectives for the Otama-ngenge catchment.

Best practicable options are standardised city wide measures as described in Hamilton City Council Infrastructure Technical Specifications and Proposed District Plan , however, investigations are in progress (as at 2015) to determine options for managing potential pressure issues until the Rototuna reservoir is commissioned. Any development proposal will need to take into account the outcomes of this investigation.

Water supply infrastructure shall be designed and constructed to meet consumption, hygiene, water-sensitive design and firefighting requirements. Undeveloped areas of the catchment will be serviced by the existing water system. New distribution networks s hall be compatible with the existing system in accordance with the Hamilton City Council Infrastructure Technical Specifications.

A list of suitable BPO s for water supply and conservation for the catchment has been developed as discussed below. The BPOs listed below provide for specific requirements . F or items not discussed in this Section, refer to the design requirements provided within the Hamilton City Council Infrastructure Technical Specifications.

Water BPO 1 – General requirements

a. Acceptable mean s of compliance for the provision, design and construction of water infrastructure is contained within the Hamilton City Council Infrastructure Technical Specifications.

b. Continuation of trickle feed supply until connections to new water infrastructure are approved.

Water BPO 2 – Water use reduction

a. Low flow fixtures shall be incorporated into all new buildings in accordance with the Proposed District Plan, refer to (Methods to achieve compliance Table 7) for details.

b. If stormwater reuse tank s (raintanks) are installed, the permanent storage shall be used for toilet flushing and laundry , by plumbing the tank into the house. The tank may be plumbed into the mains supplied potable water system via an approved backflow prevention device. See Hamilton City Council Three Waters Management Practice Note available online[41].

[41] http://www.hamilton.govt.nz/our-council/council-publications/manuals/Pages/Three-Waters-Management-Practice-Notes.aspx

6 ICMP Implementation

6.1 Implementation methods[42]

Most of the mitigation measures set out in this ICMP and selected in the planning and design process will be required to be implemented as subdivision proceeds and as individual lot development progresses. In some cases Council may elect to install major infrastructure in advance of private development.

Funding decisions of Council are made via the Long Term Plan process in accordance with the LGA which is informed by Councils 30 Year Infrastructure Plan and planning documents (e.g. District Plan, Hamilton Urban Growth Strategy).

Developer led provision of key infrastructure is done in accordance with resource and/or building consents.

As required by the CSDC, key infrastructure is provided for in concept network plans with an implementation timeline shown in Table 8 – Future Actions

All BPOs identified in Sections 4 and 5 have been translated into a range of actions, projects and compliance requirements that is given in:

- Options Hierarchy (Table 5)
- Discharge Parameters (Table 6)
- Means of Compliance (Table 7)
- Future Actions (Table 8)

4[42] CSDC / Condition 30(k)

6.2 Hamilton City Council Preferred Options Hierarchy

The following table shows the hierarchy of stormwater solutions acceptable to Hamilton City Council (also refer to Section 1.2.3.1). This reflects the overall Infrastructure Technical Specifications and Proposed District Plan hierarchy of reuse, soak, detain. Although there is a preferred order to the devices, in this catchment, it is up to the individual at the time of Building Conse nt to select the option they implement.

Table 5 – Options for new development

Option Hierarchy	Primary driver
On lot (refer to Hamilton City Council's Three Waters Practice Notes)	
	The prefered on lot stormwater efficiency measure for this catchment: 1. Rainwater reuse tanks (where this is used it shall be plumbed back into the toilet and laundry with an option for garden use). Overflow and hardstand areas to be directed to soakage where soakage is suitable. Other equivalent features suitable for this catchment: 2. Soakage (which must be used for the entire lot if deemed suitable during the subdivision). 3. Permeable Surfaces 4. Bioretention/raingardens 5. Detention (the least preferred option in general, and particularly in sub-catchment a because the centralised device provides significant attenuation) Other on lot practices that are encouraged: • Proper building and landscape design
Centralised devices and practices	
All contributing area (including on lot, new roads and reserves)	1. Wetlands with extended detention and attenuation 2. Soakage (where feasible) 3. Bioretention/raingardens (limited applicability) 4. Subdivision overland flow paths with erosion control 5. Swales (in limited access roads) 6. Reticulation (treatment required before or after) 7. Riparian Planting

6.3 Catchment specific requirements

The CSDC [43] requires an integrated catchment management approach based upon the Best Practicable Option. BPO requirements are to be implemented as part of development and ongoing management in the Otama-ngenge Stream catchment. The BPO must be appropriate for site conditions such as contours , ecology and geotechnical characteristics. If a developer proposes an option not listed in the ICMP, then the developer must prove the option is the most appropriate and will meet the ICMP objectives. The development's design report should include , but not necessarily be limited to Information Requirements provided in Appendix F. (This may form the basis of a Water Impact Assessment as required under the District Plan.)

[43] Condition 30(j)

Key points are listed below:

- The BPO to be implemented must ensure management of stormwater quality and quantity;
- Unless specifically superseded by the requirements of this ICMP, all development design is to be in accordance with the Hamilton City Council Infrastructure Technical Specifications;
- Development design must specifically consider cumulative environmental and infrastructure effects; and
- Development design must provide for long-term management of effects that encompasses the entire area over which potential effects may occur.

6.4 Design Parameters

The following table outlines the parameters to be achieved for all discharges within the Otama-ngenge Stream catchment. Refer to Appendix B1 for subcatchment areas.

These parameters have been selected to address catchment risks and sensitivities set out in the ecological assessment, and to meet the operational objectives. The parameters shall be used in the design of stormwater treatment and flow attenuation devices within catchment where applicable. Some parameters are specific to a particular sub-catchment and based on investigations such as flooding, modelling, geotechnical and ecological studies. For further information in regard to the design of specific solutions, refer to Hamilton City Council Infrastructure Technical Specifications and Auckland Council Technical Publication 10 (TP10).

Table 6 – Otama-ngenge ICMP discharge parameters

	Parameter	Requirement	BPO Reference
	All sub catchments except for catchments covered by item 6 below.		
1	Extended detention	24mm, 24 hours for greenfields development	SW BPO8b,c,e
2	Contaminants	Treatment Device Performance (contaminant removal on a long term average basis): a) Suspended solids: > 75% b) Other contaminants (metals, TPH/PAH, TN and TP): to achieve maximum potential removal rates Receiving Environment (after reasonable mixing) c) Dissolved oxygen: > 80% saturation d) Turbidity: < 25 NTU e) Colour/visual clarity: no conspicuous change in colour or visual clarity	SW BPO4a-g SW BPO8b,c,e
3	Temperature	<23° Celsius at the point of discharge to a waterway and water temperature increase of no more than 3° Celsius	SW BPO8b,c,e
4	Attenuation and Flood Control	a) 2 and 10 year post-development flow attenuated to respective 2 and 10 year pre-development flow. b) 100 year post development flow attenuated to 80% of pre-development flow.	SW BPO1a SW BPO1e SW BPO3c
5	Land drainage Level Of Service	a) In a 10 year storm, ponding of stormwater on adjacent farmland shall not exceed 3 days on farmland serviced by a Waikato Regional Council land drainage network.	SW BPO1e

	Parameter	Requirement	BPO Reference
		b) The mean depth of shallow groundwater on farmland serviced by a Waikato Regional Council land drainage network shall not be increased as a result of increased stormwater discharge volumes.	
	Sub catchments in Otama-ngenge hydrological catchment with piped drainage and/or overland flows to Te Awa O Katapaki Stream		
6	All parameters	Several subcatchments (as shown on Appendix B – Map B1 – Stormwater Network) drain to existing consented stormwater devices within the Te Awa O Katipaki catchment. Refer to Hamilton city Council for expected or preferred parameters, BPOs and Compliance methods to apply in Te Awa O Katapaki catchment.	

6.5 Methods to Achieve Compliance

The following table outlines methods to achieve compliance with the discharge requirements and this ICMP. Where there is an approved Water Impact Assessment (WIA) [44] that recommends specific on-lot water efficiency measures, the methods prescribed in the WIA shall be used as the relevant methods to be implemented to achieve compliance with the Proposed District Plan and CSDC.

Where the methods listed below are not practical for a given site, reference should be made to the relevant authority, including Hamilton City Council Infrastructure Technical Specifications for alternative solutions which are acceptable to Hamilton City Council . It will be important for Developers to have joint preapplication meetings with Hamilton City Council and Waikato Regional Council and if required Waikato District Council to facilitiate alignment with ICMP requirements and approval processes.

Table 7 – Methods to achieve compliance

Ref	Solution / Requirement	Reason	BPO Reference	Assessment Timing
	ON LOT REQUIREMENTS			
	WATER EFFICIENCY MEASURES (on lot within Hamilton City boundary)			
1	Low flow fixtures are installed in accordance with Rule 25.13.4.5a and c of the Proposed District Plan.	Water conservation, non-revenue water and demand management.	WW BPO1b W BPO2a SW BPO2a	Building Consent
2	On lot water efficiency measures are incorporated, connected to, achieved or maintained in accordance with Rule 25.13.4.5a of the Proposed District Plan, and as detailed within Three Waters Management Practice Notes[45] To comply with this rule select at least one of the following options. The prefered option for this catchment to meet water efficiency measures for water type Stormwater is:	Meets requirements of Proposed District Plan Rule 25.13.4.5a and in accordance with Hamilton City Council's drainage hierarchy (Proposed District Plan and Infrastructure Technical Specifications).	W BPO1 W BPO2b SW BPO2c SW BPO3a	Building Consent

[44] prepared in accordance with Proposed District Plan 25.13.4.6

Ref	Solution / Requirement	Reason	BPO Reference	Assessment Timing
	1. Rainwater reuse tanks (where this is used it shall be plumbed back into the toilet and laundry with an option for garden use). However other equivalent features that may be selected that are suitable for this catchment are: 1. Soakage (which must be used for the entire lot if deemed suitable during the subdivision). 2. Permeable Surfaces 3. Bioretention/raingardens 4. Detention (note that this is the least preferred option in general, and particularly in sub-catchment A because the centralised device provides significant attenuation) Other on lot practices that are encouraged: • Proper building and landscape design **Note 1:** A Water Impact Assessment (Refer Proposed District Plan Rule 25.13.4.6) as part of a granted resource consent may specify an option, or identify other options, for a specific development proposal. **Note 2:** Three Waters Management Practice Notes may be updated from time to time and include other equivalent features suitable for this catchment.			
	STORMWATER ON LOT – All Sub Catchments in Hamilton City			
3	On lot soakage if feasible as per the requirements of Stormwater BPO 3 and the Hamilton City Council Infrastructure Technical Specifications.	Groundwater recharge and volume reduction to help to maintain predevelopment runoff character. Maintains Land Drainage area Levels of Service requirements.	SW BPO3a SW BPO4a	At time of Hamilton City Council Resource Consent (a piped connection will not be provided if adequate soakage is available).
4	Site specific comprehensive treatment systems will be required for high risk sites as per Stormwater BPO 4.	Management of high concentration contaminant runoff.	SW BPO4 d	Building and/or Hamilton City Council Resource Consent

Ref	Solution / Requirement	Reason	BPO Reference	Assessment Timing
				(Pollution Plans required in accordance with Hamilton City Council Stormwater Bylaw)
	STORMWATER ON LOT – All Sub Catchments			
5	If certain areas of a development cannot discharge to a centralised device, at-source devices will be required to meet the discharge parameters[45]. Strong justification as to why a centralised device cannot serve the lot will be required. Within Hamilton City Boundary, this applies to subcatcment C. Technical certification from Waikato Regional Council may be required in accordance with condition 3 of the CSDC.	Application of RMA, LGA, DP and Bylaws and City wide Comprehensive Stormwater Discharge Consent.	SW BPO1d SW BPO 4a,e SW BPO8a-d	At time of Resource Consent (a piped connection will not be provided if adequate soakage is available). Assessment may be provided to Waikato Regional Council in accordance with Hamilton City Council CSDC.
	STORMWATER CENTRALISED DEVICES AND PRACTICES – all subcatchments			

6	Centralised devices to be located and sized to ensure suitable flows and minimised operation and maintenance costs (Hamilton City boundary centralised devices to be in accordance with Appendix B1–Stormwater Network).
	
	Wetlands to be densely planted with >80% plant cover. Open water areas are to be avoided. Each specific development will need to provide robust justification of why proposed devices cannot be used before proposing alternatives.
	
	Operations and maintenance plans shall be provided to:
	• ensure that stormwater management devices provide best practicable stormwater management efficiency at all times
		Minimise number of devices for operation and maintenance purposes.
		
		Ensures drainage board area levels of service are not compromised.
		
		Contaminant removal (all), extended detention and attenuation for environmental, erosion, stability and temperature.
		
		Management of gross pollutants required for
			SWBPO1a,d,e
			SW BPO8
			SW BPO3b,d
			SW BPO4b,g
				At time of Resource Consent
				
				Resource Consent (Waikato District Council, Hamilton City Council and Waikato Regional Council)

[45] http://www.hamilton.govt.nz/our-council/council-publications/manuals/Pages/Three-Waters-Management-Practice-Notes.aspx

Ref	Solution / Requirement	Reason	BPO Reference	Assessment Timing
	• show how the developer will undertake the monitoring plan components relevant to dev ice performance (to be compliant before vesting to Hamilton City Council and during defects liaibilty) • Within wetlands, the management of gross pollutants can be achieved through the installation of inlet or outlet screening	stream environment.		
7	Overland flow path to be provided for 100 year ARI event in road or reserve and secured by an appropriate legal mechanism to the satisfaction of the regulatory authority. For Hamilton City Council, adequate freeboard to be provided to all buildings as detailed in the Infrastructure Technical Specifications. (Note: Glaisdale West Wetland within sub-catchment A has an overland flowpath to the Te Awa O Katapaki catchment as shown on the Stormwater Network Map. 2 private properties are affected and they have easements on their Certificate of Titles: 131 Cumberland Drive & 5 Everleigh Court.)	Flood control.	SW BPO1b,c	At time of Resource Consent
8	Suitable energy dissipation and erosion protection measures shall be provided at all discharge locations, with preference for natural solutions or green engineering appropriate to the soft sediment environment over hard engineering solutions using rock and concrete.	Erosion protection	SW BPO1b SW BPO3e SW BPO5b	At time of Resource Consent
9	Modified and natural stream channels and their riparian margins shall not to be used as locations for stormwater treatment devices. However, in the upper catchment, the modification of artificial drains to create stormwater treatment wetlands and detention basins is encouraged rather than device creation in farmland, provided that flood flows and fish passage are incorporated into the design as appropriate.	Retention and enhancement of existing riparian areas and vegetation.	SW BPO 5c	At time of Resource Consent
10	Existing riparian vegetation should be retained and any new riparian planting done with indigenous eco-sourced vegetation selected from the Plant Selection Tool for Waikato Waterways, Waikato River Authority. A minimum of 5m wide riparian planting either side of all waterbodies, streams and drains with stock proofing is	Retention and enhancement of existing riparian areas and vegetation.	SW BPO5d-e	At time of Resource Consent

Ref	Solution / Requirement	Reason	BPO Reference	Assessment Timing
	encouraged.			
11	a. Construction controls: Application of sediment control measures to protect stormwater devices, Otama-ngenge stream and its tributaries.Translocation and/or fish passage to upstream habitats where native fish are present. Developers may be asked to establish presence of native fish that could potentially be affected by proposed construction. b. In the event of any discovery of artefacts in watercourses that may have potential cultural or historical significance, the appropriate iwi representatives and authorities shall be notified.	Construction controls required for: - Sediment management. - Aquatic habitat - Device maintenance and performance - Culrtural and historical significance.	SW BPO6 SWBPO8d	At time of Resource Consent
12	Where it is identified that stormwater discharges will have an effect on aquatic habitat and water quality values, then habitat enhancement shall be included as a mitigation measure via riparian planting and/or stream works as appropriate. This is particularly relevant to Major Roading Projects, which will require downstream investigation and potential mitigation works.	Erosion protection, aquatic habitat and water quality.	SW BPO4f	At time of Resource Consent
	STORMWATER – Sub Catchments with piped network to Te Awa O Katapaki			
13	Some areas (as identified on stormwater network map) drain to consented devices within Te Awa O Katapaki. Refer to Hamilton City Council for expected or preferred parameters, BPOs and Compliance methods to apply in Te Awa O Katapaki catchment.	Sections of Otama-ngenge near the southern catchment boundary have a primary piped system to the Te Awa O Katipaki Stream but predicted overland flow to Otama-ngenge.		At time of Resource Consent
	STORMWATER – Otama-ngenge: Major Roading Projects see Figure 5 **(these measures are in addition to the other measures in this table)**			
14	Swales, wetlands and approved at source devices capable of removal of hydrocarbons. Swales and wetlands to be densely planted with >80% plant cover and open water areas are to be avoided. Road corridor projects shall be designed to ensure drain replacement devices maintain waterway connectivity and provide surface flow to maintain base flows in the Otoma - ngenge Stream.	Contaminant removal, extended detention and attenuation for environmental, erosion, stability and temperature. Ecological habitat	SW BPO4a-g SWBPO3d	At time of Resource Consent

Ref	Solution / Requirement	Reason	BPO Reference	Assessment Timing
15	Fish surveys shall be carried out in waterways potentially affected by construction and operation of the Waikato Expressway and Resolution Drive Extension. Measures shall be included in these construction works to avoid, remedy or mitigate adverse effects on these fish habitat, including by providing for fish passage between habitat up stream and downstream of the road corridors and by replacing removed habitat with equivalent or enhanced habitats.	aquatic habitat	SW BPO6c	At time of Resource Consent
	WASTEWATER (within Hamilton City boundary)			
16	Wastewater in all subcatchments shall be served by the wastewater pump (in the vicinity of Borman Rd/Hare Puke Drive). Gravity mains to access the pump shall be extended as development occurs and capacity shall be assessed during the engineering phase for suitability to serve the surrounding areas draining to the pump. Levels of service to be achieved in accordance with Hamilton City Council's requirements. Best practice design, construction and inspection are required to ensure that inflow and infiltration is minimised.	Minimum levels of service achieved.	WW BPO 1	Resource Consent
	WATER (within Hamilton City boundary)			
17	Strategic 250mm water mains shall be required in specified locations as per Water Master Plan and indicated on shown in Appendix B Water Supply Network Map B3 (or any updates). Levels of service to be achieved in accordance with Hamilton City Council's requirements. Minimum pressure and flows to be achieved, including consideration of adverse effects on the existing built and consented environment. Water Impact Assessments for elevated sites shall specifically address predicted Level Of Service prior to Rototuna Reservoir being operational, Those sites shown on the appendix B water network map predicted to fall below Hamilton City Council Level of Service shall not be permitted to have a pressurised water connection until the completion of the Rototuna Reservoir unless it is demonstrated that Level Of Service can be provided.	Minimum levels of service achieved.	W BPO1	Resource Consent

6.6 Future Actions

The following are recognised future actions considered important to meet the outcomes of the Otama-ngenge ICMP. These will need to be addressed by developers at the time of their proposals or subsequently by Hamilton City Council and reflected in future revisions of the ICMP. Opportunities that should be sought by parties in the hydrological catchment are also listed.

Table 8 – Future Actions

	Future action	Anticipated timeline (responsibility)
	Flood Hazard Assessment	
1	LiDAR survey extent assessment and implementation	2018 – programmed work with current LTP funding. (Hamilton City Council)
2	Detailed flood hazard modeling in accordance with extent assessment using MIKE 11 (or similar) and following Hamilton City Council's Stormwater Modelling Methodology	To be undertaken after new LiDAR is flown of the city, and in line with funding prioritisation. (Hamilton City Council)
	Water	
3	Investigate predicted water pressure issues in the elevated area of the Hamilton City Council area of the catchment	2015 – committed work being undertaken by Mott MacDonald. (Hamilton City Council)
4	Rototuna Reservoir – Kay Road for water service level and storage	2015-2018 (Hamilton City Council)
5	Bulk water mains - 550/700mm bulk pipelines for water service level	2015-2018 (Hamilton City Council)
	Aquatic Habitat and Erosion	
6	Hamilton City Council to collaborate with Waikato District Council and Waikato Regional Council for Osbourne and River Road culverts to determine if the predicted surcharging (but not overtopping) of the culvert at these locations will cause localised land stability issues.	2016-2019 (Hamilton City Council to lead)
7	**Downstream of Kay Rd (see Figure 8 for approximate location):** Hamilton City Council to collaborate with Waikato Regional Council, Waikato District Council, the consent holder and landowners to agree on and programme an appropriate plan to mitigate existing and potential effects of upper catchment development on the ecologically significant habitat downstream of Kay Road. Investigations may require geotechnical assessment of strength of bank and bed material, culvert embankments and geomorphology study of the response of the stream to the altered flow regime to establish the nature and extent of impacts and mitigation options. Remedial works may include battering back over steep banks, reinstating channel features, riparian planting for bank stability and armouring. Figure 10 – Future Works indicates the areas of concern. An allowance of	2016-2019 (Hamilton City Council to lead)

	$200,000 has been set aside for the investigation and indicative physical works.	
	Future action	**Anticipated timeline (responsibility)**
	Monitoring	
8	The Tonkin & Taylor Stormwater Monitoring Plan (SMP) 2012 is due to be updated every 3 years (as per CDSC condition 37), an up-dated version is due in December 2015. At this point, monitoring of Otama-ngenge Stream should be considered for inclusion in the SMP and any required modifications to the plan made at this time. This update will also include consideration of methodology updates, including erosion.	Dec 2015 (Hamilton City Council)
	Land Drainage	
9	Investigate potential extention of the land drainage rateable area and operations and maintenance costs attributed to urbanisation (including Hamilton City Council development area) The ICMP recognises that flow volumes are predicted to increase due to urbanisation, therefore it is recommended that the downstream rates collection areas are extended into the areas to be urbanised to ensure funding of the waterways maintenance and management is distributed equitably. There is the potential for O&M costs to increase as a result of this urbanisation such as: · Increased vegetation management · Channel enlargement to meet the increases in flow volumes · Erosion protection works to repair any damage caused by increased flow rates · Culvert enlargement of existing structures if required	2016/17 –(Waikato Regional Council and Hamilton City Council)
	Maintenance	
10	Review Stormwater Device Operations & Maintenance template and Infrastructure Technical Specifications checklist to ensure it refers to ICMP parameters, and to ensure stormwater devices have proven history at time of ownership transfer.	2016 (Hamilton City Council)
	Opportunities	
11	If and when opportunities arise, measures should be implemented to eliminate the barrier effect of existing obstacles to fish passage, especially, but not exclusively, at the River Road culvert, either by providing fish passage beyond the obstacles or removal of the obstacles	Opportunity to remediate when carrying out large projects or done as a special community project (opportunity for all)
12	Erosion of banks at the Waikato River confluence has been observed. Any party undertaking development or works upstream should consider opportunities to manage and	Opportunity to remediate when carrying out large projects or done as a special community project

	mitigate erosion, for example through channel strengthening,	(opportunity for all)
	Future action	**Anticipated timeline (responsibility)**
	Education	
13	Once the ICMP is finalised and approved by the Hamilton City Council Project Governance Group , key stakeholders will be informed. The ICMP will be placed on the Hamilton City Council website, added to the agenda of the Developers Forum quarterly meeting, and passed to the Hamilton City Council Compliance team for Educatio n purposes under the CSDC requirements.	2015 (Hamilton City Council)
14	Implementation meetings with Hamilton City Council Development Engineers, City Planning, Planning Guidance Unit and Building Unit to ensure requirements within the ICMP (specifically Parameters and Methods to Achieve Compliance Table) are implemented through Resource Consents and Building Consents as required.	2015 (Hamilton City Council)

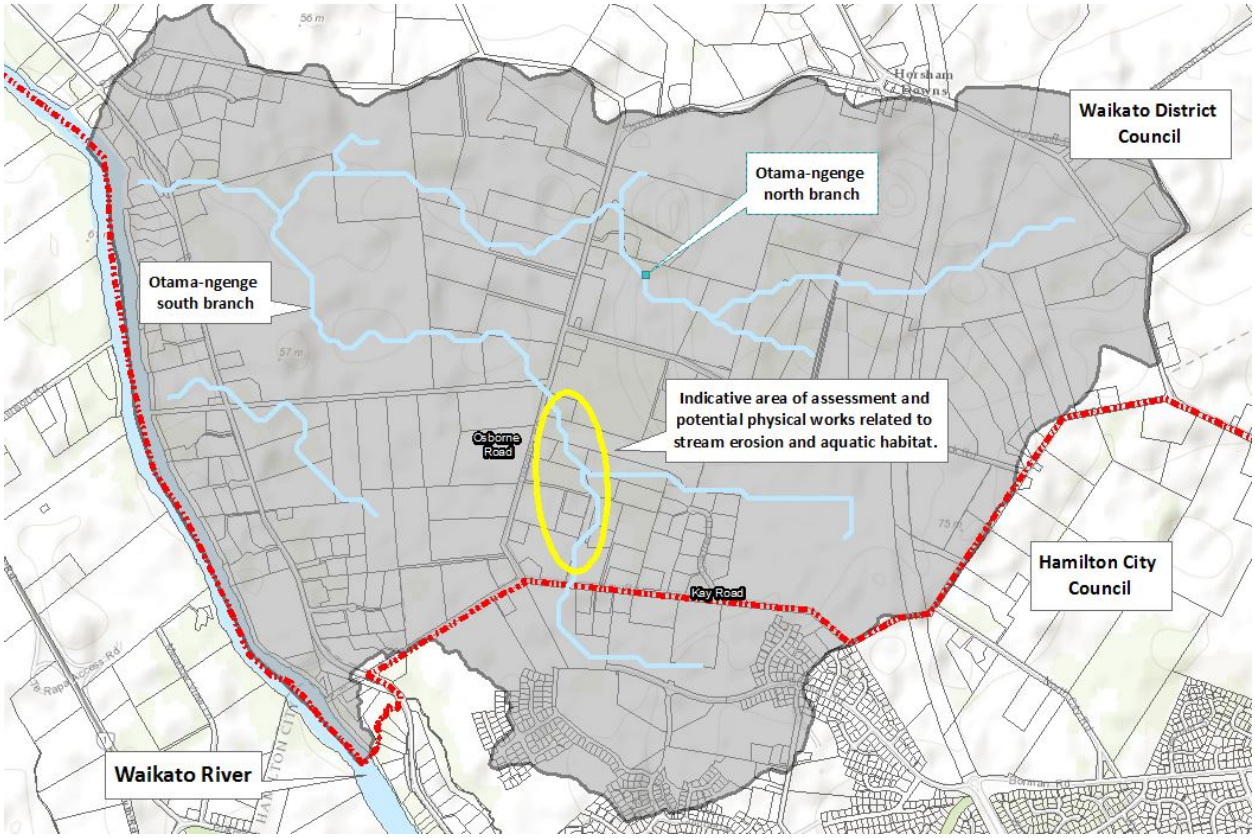


Figure 10 – Future Works

6.7 Mechanisms for Implementing Measures

Mechanisms for implementing measures include:

- **Development applications** – Developments will be assessed against each of these documents at the time of resource consent and/or building consent application. Resource consent conditions will be written and enforced accordingly.

  See Appendix B for network service plans to assist in development proposals. Developers will need to check with Hamilton City Council on the status of the plans in this ICMP, catchment performance and where resource consent i s required, should participate in preapplication meetings to understand requirements prior to development of proposals.

- **Enforcement – Proposed District Plan and Bylaws** – Council has adopted a stormwater bylaw[46] which sets out Councils powers under the Local Government Act to manage, regulate and protect, and to prevent the misuse of Council's land, structures or infrastructure associated with stormwater drainage. This will be supported by an Education Strategy.

- **Waikato Regional Council Drainage Networks** – Waikato Regional Council has powers relating to the maintenance of land drainage networks to maintain groundwater levels, manage surface ponding after rainfall, and prevent flooding. Hamilton City Council's Education Strategy will include information relevant to ensuring Waikato Regional Council's land drainage requirements are met.

[46] To come into force 28th September 2015.

- **Councils Long Term Plan** – The LTP is used as a funding mechanism for infrastructure required for the Otama-ngenge catchment. ICMP's will contribute to funding decisions on infrastructure projects in the LTP.

- **Existing programmes** such as:
    - Planned maintenance[47] and operational improvements
    - Asset renewal programmes
    - Design and development in accordance with Infrastructure Technical Specifications
    - Customer service level (satisfaction surveys, complaints, monitoring)

- **Education strategy – this requires effective internal and external communication**

Incorporate into City Waters education strategy and assess appropriate communications plan within one month ICMP approval. The strategy needs to ensure that a ffected Units understand and apply ICMP content and implement though mechanisms such as consent approval processes and conditions. The external communication strategy needs to ensure that the ICMP is understood, referenced in consent application documents and by key stakeholders, BPOs are adopted and there are no buildings exposed to unacceptable levels of risk from flood hazards. Measures will include: Roadshow, Intranet , Website – ICMP, Website – FAQ, Territoral authority websi tes where appropriate.

[47] For example road catchpits and sumps are currently cleaned out on an annual cyclic basis. However, streets with known leaf fall problems which are swept up to three times a week to forestall blockages.

- **Collaboration with other agencies**

Collaboration with other agencies on ICMP's, District Plan changes and Resource consent approvals and bylaw reviews to ensure appropriate quality and quantity requirements are met.

7 Assessment of Environmental Effects - Executive Summary

The conditions for the CSDC provided by Waikato Regional Council requires that the ICMP include an assessment of the potential effects on the Otama-ngenge catchment and receiving environment. An assessment has been provided in Appendix G, and is based on considering the impacts 'after' the BPO measures are implemented and considers the following effects:

- Impact on Cultural & historical values;
- Public health and safety;
- Stormwater Quantity;
- Flooding hazards;
- Stream Baseflow;
- Stormwater Quality;
- Effects of Urban Development On Streams;
- Ecology (including in-stream and riparian);
- Aesthetics; and
- Effect on existing infrastructure.

This Assessment of Environmental Effects ("AEE") assesses the effects on Otama -ngenge Stream Catchment ("the Catchment") of proposed new stormwater diversion and discharge activities undertaken in accordance with the *Otama-ngenge Integrated Catchment Management Plan: Draft for Consultation – July 2015* ("the ICMP").

The Catchment lies mostly within Waikato District, but straddles Hamilton City's northern boundary just east of the Waikato River. The land use within the Catchment is mainly dairy farming, but there are pockets of rural residential development. The part of the Catchment within Hamilton City is Stage 4 of the Rototuna Structure Plan Area and has begun to be urbanised. The entire catchment is highly modified. The vegetation is mainly pasture, and there is very little other riparian vegetation.

The ICMP is a comprehensive plan for managing the three waters (stormwater, water supply, and wastewater) and its infrastructure within Otama-ngenge Catchment in an integrated way. It identifies Best Practicable Options, Means of Compliance, Future Actions and a Monitoring Programme. It aims to avoid as far as practicable, and otherwise minimise, the cumulative adverse effects of all new stormwater diversion and discharge activities within the Catchment.

This AEE is intended to satisfy the requirements of conditions 30(g) and 30(h) of Hamilton City Council's Comprehensive Stormwater Discharge Consent.

It is based on assessments undertaken by environmental specialists: assessments of contaminant load and waterway capacity by Morphum Environmental Limited, an ecological assessm ent by Boffa Miskell Limited, and a Tangata Whenua Cultural Assessment Report by Nga Mana Toopu o Kirikiriroa.

The assessment concludes that any adverse effects of new stormwater diversion and discharge activities undertaken in accordance with the ICMP will be no more than minor. Implementation of the ICMP is expected to have positive effects on the Catchment, including, in particular, the

provision of wetlands with 80% vegetation cover, a reduction in peak flows in Otama-ngenge stream, and the provision of riparian planting.

A high level assessment of the draft plan against the CSDC conditions is shown in Table 9. This assessment has been carried to ensure that appropriate BPOs have been considered. Reference should be made to Appendix G for a detailed assessment of effects and how they have been addressed.

Table 9 – Assessment of ICMP against CSDC Conditions

Condition	Criteria	ICMP assessment against condition requirement
6	Increasing the scale or intensity of adverse effects on the network	This ICMP lists quality and quantity parameters to be met and requires that any discharges to Te Awa O Katapaki must be to consented devices which can manage the inputs. See Means of Compliance table.
7	Implementation of BPO to mitigate actual and potential effects	See means of compliance Section (aligned to BPO s) which requires treatment and attenuation to parameter deemed appropriate to protect the catchment. See also Future Actions Section.
8	Activities managed to meet conditions	Key stakeholder engagement, BPO s and means of compliance Section
9	Avoid as far as practicable, minimise quantity effects of scour, erosion, sediment deposition, flooding and adverse effects on aquatic ecosystems.	Assessment has been carried out to determine stream condition and ecological value. A capacity assessment has been done and contaminant loading has been carried out. BPOs which address protection of ecological value, drainage area LOS, potential flooding in Hami lton boundary include: · 2 and 10 year post-development flow attenuated to respective 2 and 10 year pre-development flow. · 100 year post development flow attenuated to 80% of pre-development flow. · 24mm, 24 hours for greenfields development
10	Addressing adverse stormwater quantity effects - Procedure	Procedure has been referenced in Section 9
11	Fish passage review	Assessment of fish passage constraints has been carried out. Fish passage requirements has been included in BPOs and existing issues note d as an opportunity for improvement.
12	Devices operated and maintained	BPO adopted that make reference to requirement for O&M plans.

Condition	Criteria	ICMP assessment against condition requirement
14	Avoid as far as practicable, minimise discharges of oil, grease, scums or foams and suspended solids in water bodies after mixing	BPOs reference requirement for appropriate treatment device and for roading, devices that will remove hydrocarbons.
15	Avoid as far as practicable, minimise discharges of suspended solids	BPOs and means of compliance require treatment device to remove 75% TSS, and require construction controls.
16	Avoid as far as practicable, minimise discharges of hazardous substances	BPO adopted that requires comprehensive treatment system such as interception devices. (The Hamilton City Council stormwater bylaw also requires a Pollution Control Plan).
17	Avoid as far as practicable, minimise discharges of micro-organisms	The means of compliance table requires the use of a wastewater pump station that has adequate capacity to serve the whole subcatchment within the city boundary and requires compliance design to minimise inflow and infiltration of stormwater to the wastewater system.
18	Avoid as far as practicable, minimise discharges that will adversely affect aquatic ecosystems in terms of oxygen, pH, suspended solids, biological growths, water temperature, turbidity, ammoniacal nitrogen and other contaminants concentrations that exceed USEPA max concentration.	Ecological assessme nt and contaminant loading was carried out and it was determined that BPO's that required treatment devices was necessary. This included centralised wetlands with >80% wetland plant cover, a treatment train if the centralised device was not adequate, c atchpits that could remove hydrocarbons and a treatment train for highly trafficked roads. The means of compliance requirements are in line with CSDC requirements and has the addition of a water temperature requirement of <23° Celsius at the point of discharge to a waterway and water temperature increase of no more than 3° Celsius BPOs require high risk facilities to have treatment systems and requirement for construction controls via Waikato Regional Council and Hamilton City Council stormwater bylaw to manage these effects.
20	Stormwater catchpits to be capable of capturing majority of gross pollutants	BPO has been adopted which requires this capability.
21	Stormwater devices are to provide best practicable treatment efficiency at all times.	A B PO has been adopted requiring O&M plans for new treatment devices.
23	Avoid as far as practicable, minimise discharges of routine contaminants from high risk catchments	A BPO requires comprehensive treatment system such as interception devices. (The Hamilton City Council stormwater bylaw also requires a Pollution Control Plan).
32 and 33	Promotion of Sustainable Subdivision development and LIUD measures	BPOs provide for water sensitive design, wetlands vs ponds, Infrastructure Technical Specification s and TP10 implementation.

8 Consultation

8.1 Key Stakeholders

Parties identified as requiring consultation and information are:

- Waikato Regional Council as the Regional authority for the Otama-ngenge catchment area, Technical assessor for CSDC alignment and Drainage area administrators
- Waikato District Council – territorial authority for large part of catchment
- Waikato-Tainui Raupatu River Trust (in accordance with the Waikato River Settlement Act)
- Department of Conservation, Centre for Biodiversity and Ecological Research and Waikato District Health Board (parties interested in citywide stormwater management)
- Developers (as landowners) in headwater of catchment and within city boundary
- Landowners outside city boundary adjacent to Otama-ngenge Stream (up to Osbourne Road)
- Land drainage scheme parties, specifically the Kirikiriroa Horsham Downs Drainage Board
- NZ Transport Agency (NZTA)
- Internal Council stakeholders City Planning, City Waters, City Development, City Transportation and Parks & Open Spaces, asset owners, Operations and Maintenance and Regulators.

A Consultation Plan has the following key actions:

- Key stakeholder presentation and targeted consultation for a period of 3 weeks
- 'Drop in' sessions where the ICMP can be further explained and feedback provided and individual/group meetings as required [48]
- Follow up letter on outcome and ICMP outcomes and implementation presentation (invite to PCG reps, Unit Managers, Building Unit, PG Unit, DE's, City Waters reps and Compliance team)
- Invite to external parties on finalised ICMP (presentation format)

8.2 Key Issues Raised

Responses were received from Waikato Regional Council , Waikato District Council, NZTA, Tainui, THAWKE, Waikato District Health Board , developers , a down stream landowner and internal Hamilton City Council stakeholders. A summary of key issues raised through the consultation period and how they have been addressed is provided in the table below.

[48] Where possible, opportunities for information dissemination, such as Waikato District Council District Plan review sessions will be sought.

Table 10 - Consultation - key issues

	Item	Addressed
1	Network capaci ty identification and attenuation requirements	ICMP has been updated to reflect pre and post development attenuation requirements for all subcatchments based on Network Modelling carried out by Morphum (July 2015) and concluded that capacity was adequate but that bank stability needed further assessment.
2	Effect on land drainage system and erosion mitigation and scour potential	The ICMP has been updated to acknowledge land drainage LOS requirements as a driver for mitigation methods and future investigation into targeted rates to contribute to operations and maintenance of the drainage area due to stormwater discharges. A revised monitoring plan ensures that erosion is appropriately reported on. Erosion mitigation works also programmed and there is a stronger recognition of need for enhancement.
3	Impact of overland flow on Te Awa O Katapaki catchment	More detail provided on overland flow paths and ability of devices to manage Otama-ngenge flows.
4	Network plan accuracy and signficance of drainage systems. Earthworks minimisation, drain filling and impact on future ability to develop.	Networks have been updated for accuracy. Stream classification differences between Waikato Regional Council and Ecological assessment clarified. Ecological sign ificance classification under Regional Policy Statement retained due to presence of threatened fish species.
5	Soakage as an option, clarity on soakage requirements, groundwater recharge and base flow impacts	ICMP has been updated to reflect Hamilton City Council's consistent preference for soakage where feasible but that any stormwater that can not be soaked needs to be directed to Otama -ngenge stream to maintain stream base flows. Need for connectivity also required.
6	Consistency with the Hamilton City Council CSDC monitoring plan	The ICMP has a revised monitoring plan that has more consistency with the CSDC monitoring plan where appropriate for the catchment.
7	Stream maintenance risk	Updated ICMP references existing maintenance and the undesirab le method machine cleaning.
8	Clarity on means of compliance for the catchment including parameters, on lot water sensitive and centralised devices	ICMP has been updated with a Methods of Compliance table that is more detailed on preferred water sensitive measures and options (as required by the Hamilton City Council Proposed District Plan).
9	Assessment of Effects to show that the ICMP meets the requirements of the CSDC with exisiting BPO's and means of compliance.	ICMP updated to include a more comprehensive AEE.
10	Contaminant management and treatment	ICMP updated to reflect requirements for contaminant management including interceptors , construction controls and temperature requirements.
11	Ecological assessment methodology and acknowledgement of po tential for long and short fin eels and mudfish	ICMP updated to reflect methods, potential for short finn eels and mudfish and require fish surveys.

9 Monitoring

9.1 Catchment monitoring

Development in the Otama-ngenge catchment will be monitored under the requirements of:

a) Subdivision discharge consent monitoring conditions prior to being transferred to Hamilton City Council under the City wide consent number 105279
b) Extended CSDC monitoring plan required under consent number 105279

9.1.1 Hamilton City Council responsibility

Hamilton City Council holds Waikato Regional Council resource consents for stormwater discharges, water take, and wastewater discharges. Hamilton City Council's citywide stormwater discharge consent 105279 covers existing urban development. Hamilton City Council was required to prepare a monitoring plan to assess the adverse effects of municipal stormwater diversion and discharge activities on the environment. The monitoring plan was approved by Waikato Regional Council in 2013 (hereafter referred to as the Tonkin and Taylor Stormwater Monitoring Plan (SMP), December 2012), but it does not include the Otama -ngenge Stream catchment. Hamilton City Council will carry out monitoring in the catchment guided by the methods outlined in the monitoring plan. In addition where the monitoring plan does not provide fit for purpose method, e.g. Erosion monitoring, other existing methods will be followed , as agreed with Waikato Regional Council through the updated SMP due in December 2015.

As the monitoring for ICMP in Hamilton is in its inceptive stages its recommended that the next version of the SMP, The Tonkin and Taylor SMP (Dec, 2012), is amended to include the Otama -ngenge catchment and catchment specific monitoring requirements so that representative data can be collected to support future planning and management. This is included in Table 8 – Future Actions.

The effects from up stream discharges could potentially occur along the entire open channel length to the confluence of the Waikato River, outside of the ICMP area and Hamilton City boundaries in to Waikato District. Consequently the extent of physical habitat and channel condition assessment has been defined to be from Kay Road to River Road (this is further detailed in Table 10).

9.1.2 Development community responsibility

Developers require stormwater consents to allow discharge to the receiving environment in accordance with the requirements of the Regional Plan. The ICMP will help developer s in the preparation of these co nsents and assist the Waikato Regional Council in determining what monitoring of discharge quality and quantity is required. In particular the ICMP will help ensure consents are issued which address cumulative effects. In general, discharge consent condit ions need to be consistent with the Hamilton City Council CSDC to provide certainty that the consents can be transferred to Hamilton City Council . A fuller description of the administrative process for incorporating new diversion and discharge activities in to the CSDC is contained within Appendix 2 of the Stormwater Management Plan (Hamilton City Council, December 2012)

Any stormwater discharge consent held by a developer must have its specific consent monitoring requirements carried out by the developer until the consent is transferred to Hamilton City Council.

Performance assessment of stormwater treatment systems that are in private ownership are to be carried out by the owner/operator.

9.2 Proposal

A catchment specific monitoring plan is provided in Figure 11 - Monitoring Plan - sampling locations and Table 11 – Monitoring Plan. This plan has been developed based on assessment and technical review recommendations. The proposal is designed to take into a ccount the Ecologic Report recommendations (As per Appendix H), to tie in with the citywide stormwater monitoring plan previously developed by Tonkin &Taylor (Dec, 2012) and for Hamilton City Council to satisfy the monitoring requirements of Consent 105279, Condition 37.

Where a method has not been predetermined or is not considered fit for purpose, suitable methods will be agreed with Waikato Regional Council.

At agreed points on the Otama -ngenge Stream, and at pre -determined intervals, the following monitoring program is proposed and will be used for baseline data, remedial actions and monitoring for change over time.

Figure 11 - Monitoring Plan - sampling locations

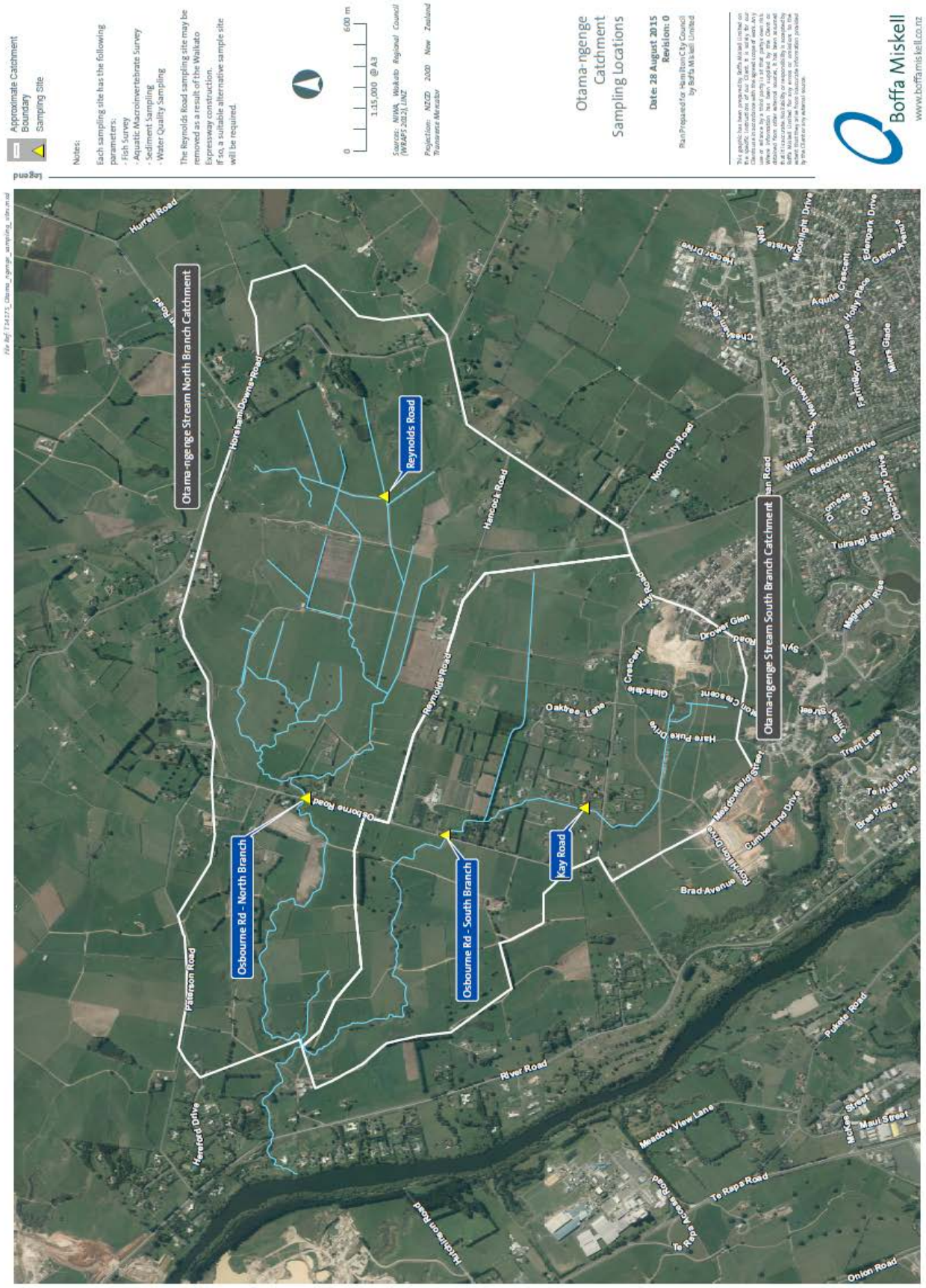


Table 11 – Monitoring Plan

ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
1	**Receiving Environment**				
1a	Visual semi-quantitative, assessment of bank and bed stability	Riparian margins, vegetation type and density, bank stability, sediment deposition, channel width and depth	Site walkover, GIS mapping and photo points between Kay road, transport corridor and Osbourne Road on the South and North Branch. The monitoring and inspection should follow T&T SMP 2012 Report including: • Stream morphology and characteristics related to flow • Bank and channel erosion (slumps and slips) • Sedimentation [fn 45]) • Debris accumulation • Channel or culvert blockages, stormwater outlets, weirs and channel works • Channel and hotspot erosion • End of pipe scour and erosion • Map stormwater outlets, culverts, weirs and channel works • Change in vegetation type and cover (%) in riparian margins, floodplains and seepages • Fish passage barriers • Presence of undesirable bacterial growths, litter, foams, scums, conspicuous oil or grease films • Aesthetic issues related to drainage structures.	Riparian margins remain stable, channel width and depth stable. Change in the extent and severity of scour and erosion downstream of discharge points compared with baseline erosion survey.	Monitoring to be undertaken 2 yearly during low base flows following commencement of discharges until development is complete, 4 yearly thereafter, and following any significant (> 10yr) storm events. The T&T SMP 2012 Report separates Hamilton City Council streams into 5 Rounds for inspection to ensure each stream is inspected and monitored five times over the duration of consent 105279. The monitoring of Otama-Ngenge Stream shall be coordinated into the CSDC SMP and be allocated to a "Round" to facilitate the monitoring programme as per with Table 6 of the SMP.
1b	Semi-quantitative	Aquatic and	Habitat quality will be assessed in accordance	Results from the visual	Monitoring will be repeated 2 yearly

ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
	assessment of aquatic fauna presence and/or diversity	riparian habitat quality	with Waikato Regional Council's Regional Guidelines for Ecological Assessment of Freshwater Environments the T&T SMP 2012 Report methods. Results can be compared with results from similar HAMILTON CITY COUNCIL Stream catchments in addition to providing year-on-year comparison to assess changes in habitat values.	semi-quantitative assessment provide context in the event of unexpected fish diversity, macroinvertebrate metrics or sediment quality results.	following commencement of discharges until development is complete and 4 yearly thereafter. Monitoring will be conducted alongside fish and macroinvertebrate surveys.
		Aquatic macroinvertebrate community composition and diversity	Aquatic habitat quality will be assessed in accordance with relevant Waikato Regional Council 's Regional Guidelines for Ecological Assessment of Freshwater Environments relating to aquatic macroinvertebrates and/or the T&T SMP 2012 Report methods.	Macro invertebrate metric values unchanged or improved compared with baseline survey and compared with Waikato Regional Council reference sites as per TR2012/27 The Ecological Condition of Waikato wadeable streams based on the REMS Programme, in addition to a year-on-year comparison of metrics to assess changes in aquatic habitat values.	Macroinvertebrate sampling will be repeated 2 yearly following commencement of discharges until development is complete and 4 yearly thereafter. Monitoring will coincide with that proposed for "Visual semi-quantitative, assessment of bank and bed stability" and fish survey.
		Native fish presence and diversity	Aquatic habitat quality will be assessed in accordance with relevant Waikato Regional Council Regional Guidelines for Ecological Assessment of Freshwater Environments	Native fish diversity in the catchment remains similar or better than baseline results when assessed in	A baseline fish survey was carried out in December 2014 using methodologies appropriate to the aquatic environment[49] Monitoring will be

[49] The baseline survey confirmed the same species as listed in the FFDB, and previous ecological assessments using the same meth ods that have historically been applied by other ecologists. In this catchment, e lectric fishing and spotlighting was not considered effective or appropriate due to constraints such as (1) high turbidity, c onductivity, and colour such as are present in

ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
			relating to native fish and/or the T&T SMP 2012 Report methods.	the context of the catchment values.	repeated 2 yearly following commencement of discharges until development is complete and 4 yearly thereafter. Monitoring will be conducted alongside macroinvertebrate survey and habitat assessment.
		Sediment Quality Sample	Composite sediment samples will be collected from surface sediments at habitat quality monitoring sites: • Reynolds Road Farm Drain • Osbourne Road (North Branch) • Osbourne Road (South Branch) • Kay Road and tested for total organic carbon, polynuclear aromatic hydrocarbons and total recoverable copper and zinc. Laboratory analysis of samples would follow the same protocol as used in NIWAs 2012 study of contaminants in Hamilton's urban stream sediments.	Sediment quality data presented in NIWAs 2012 report will be used as a baseline for the CSDS consent monitoring. Sediment quality data should be unchanged or improved compared to the baseline survey.	Sediment quality monitoring will be carried out 2 yearly following commencement of discharges until development is complete and 4 yearly thereafter. Monitoring will be conducted alongside fish and macroinvertebrate sampling and habitat assessment.
1c	Quantitative assessment of stream water quality	In-stream water quality variables to be assessed.	Water samples to be taken at both Osbourne Road culverts following the Waikato Regional Council Water Quality Monitoring Protocol to assess:	Results meet ANZECC 2000 guidelines for freshwater aquatic ecosystems to 90% protection of species and MfE 1992 Water Quality Guidelines No. 1.	Baseline water quality assessment carried out December 2014 (south branch) and June 2015 (north branch). Monitoring to be undertaken 2 yearly following commencement of discharges until development is complete and 4

Otama-ngenge Stream (2) Waikato -Tainui preference for not using electric fishing bec ause of potential effects on fish health. A net survey was considered adequate for determining fish diversity in Otama-ngenge catchment. Establishing fish abundance, population structure, or distribution is not considered necessary so more intensive sampling effort is not required.

ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
			• pH • Temperature • Dissolved Oxygen • Conductivity (required?) • Turbidity • Suspended sediment[50] • Total and dissolved copper, lead and zinc • Total and ammoniacal nitrogen • Total and dissolved reactive phosphorus • Faecal Coliforms and analysed according to ANZECC 2000 guidelines.	Results should be compared to Waikato Regional Councils water quality standards (satisfactory or excellent).	yearly thereafter.
	Device performance and discharge quality				
1d	Stormwater treatment device performance (by consent owner/operator via consent conditions)	Criteria per Otama-ngenge ICMP discharge parameters set out in Table 6 – Otama-ngenge ICMP discharge parameters Table 6 above, using methods specified in developer consent	To test performance of large treatment devices in situ is both technically challenging and cost prohibitive. If the treatment devices being wetlands in the majority are monitored to ensure they are built and maintained as per design, the efficiency can be considered to be achieved. This will require moni toring of wetland vegetation cover which must be above 80% of the total wet area of any wetland and hydraulic function to ensure short circuiting is not occurring the device functions as per design as per inspection sheets in TP 10.	Assets meet design 80% vegetated and functions as per design to meet criteria being 75% TSS removal and passes inspection checks as per TP10.	Operational Monitoring to be undertake n annually following commencement of discharges until development is complete, including defects liability. Waikato Regional Council consent conditions remain the responsibility of the consent holder until it is transferred to the local Regulatory authority.

[50] Otama-ngenge watercourses are a soft sediment environment, so accumulation of sedimentation is difficult to determine accurately. Some sedimentation is likely to come from internal water chemistry/microbiology processes unrelated to stormwater.

ID	Parameter	Criteria	Program/Method	Performance measure	Frequency
		conditions or, if not specified, methods specified in CSDC.	Water temperature disc harge to be monitored using insitu monitor at discharge point with 5 minute time stamp. This should be done in the summer months from 1 December to March 30. If up stream input flows, particularly from open channels, can be monitored then they should be included in sample design.	Have discharge temperatures below 23 degrees.	Temperature monitoring to be conducted in the following years 2015, 2016, 2017 as specified and if Hamilton City Council considers adverse temperature effects are likely.
1e	Visual contaminants	Oil, grease, scum, foam, colour, and litter.	Site walkovers from Osbourne Road to Kay Road	Absence of oil, grease, scum and foam. Less than minor litter. No conspicuous changes in colour down stream of discharge points.	Monitoring to be undertaken annually following commencement of discharges until devel opment is complete, and 4 yearly thereafter following any significant (> 10yr) storm events.
1f	Sediment control of building construction and earthworks	Audit by both Hamilton City Council and Waikato Regional Council	Earthworks, building and construction sites inspected for appropriate use of on -site management controls, including correct design, installation, operation and maintenance. Water samples may be taken down stream of the site to determine overall management performance and to ensure compliance w ith relevant regulatory provisions, including building permits and/or resource consents where applicable.	Onsite management controls are correctly designed, installed, operated and maintained. All relevant regulatory provisions are met[51] (fn)	During construction.

[51] Waikato Regional Plan Permitted Activity standard = 100 gm per m3 after reasonable mixing. CSDC turbidity criteria = 25 NTU

At the time when assets and discharge consents are transferred to Hamilton City Council, responsibility for maintaining and monitoring those assets and discharges also transfer to Hamilton City Council. It is important to note that Hamilton City Council will only allow transfer of assets and discharge consents if:

a) Assets have been designed to meet required performance standards
b) Assets have been appropriately maintained and are fit for purpose at the time of transfer
c) Compliance with resource consent conditions has been achieved;
d) Monitoring of device performance and discharge effects has been carried out in accordance with the conditions of the consent; and
e) Appropriate legal protections have been established (e.g. easements)

For detailed monitoring methodologies and scheduling see the Hamilton City Council Stormwater Monitoring Plan, December 2012 (TRIM link D-724659) and protocols 1, 2, 7, 8, 9 and 10 form the Auckland Council Watercourse Assessment Methodology: Infrastructure and Ecology (Version 2.0), Lowe and Young 2015.

9.3 Reporting and Review Process

Monitoring of individual discharge consents will be reported to Waikato Regional Council in accordance with consent conditions, and copies of the reports and monitoring results will also be provided to Hamilton City Council.

Monitoring of discharges required under the CSDC (including where this has been extended to include Otama-ngenge Stream catchment) will be presented as part of the Municipal Stormwater Network Operation Annual Report (as required by Condition 38 and 39 of the CSDC).

The report will contain recommendations on any changes that may be needed to the monitoring plan.

Waikato Regional Council and Hamilton City Council will liaise in order to review and, where necessary, alter the CSDC monitoring plan in scale and/or method and/or location after having regard to the consistency and significance of the monitoring data collected, or any other information relating to the stormwater diversion and discharge activities authorised by this consent.

Hamilton City Council will be responsible, on an ongoing basis, for the review of guidelines and procedures for the implementation, performance evaluation, operation and maintenance of Otama-ngenge Stream catchment and site practices consistent with the approved ICMP.

Hamilton City Council will also be responsible for reviewing the level of subdivision and development occurring in the Otama-ngenge Stream catchment relative to the land use assumptions underlying the ICMP, with particular emphasis on:

- Monitoring on-site stormwater management;
- Restoration and management of riparian and aquatic habitat downstream of discharge points; and
- Compliance with (and performance of) erosion and sediment controls implemented in the Otama-ngenge catchment for residential building sites.

Hamilton City Council may direct immediate intervention where significant effects are identified. This may include, but is not limited to:

a) Building site management enforcement
b) Remedial stream and riparian works for scour and erosion
c) Additional auditing
d) Riparian vegetation management
e) Maintenance or retrofitting of stormwater devices.

9.4 Asset Monitoring

Asset monitoring is carried out on all three networks including condition assessment and capacity reviews. A list of this type of monitoring is provided in respective Activity Management Plans.

9.5 ICMP Review

This document will be reviewed every five to seven years [52]. However, should there be demonstrable adverse effects identified through monitoring, or significant changes in policies and structure plans, the ICMP will be reviewed earlier. For demonstrable adverse effects, the Waikato Regional Council report procedure (as required by condition 10 of the CSDC) shall be carried out. Developers should be aware that changes to ICMP objectives may mean that different BPOs will be required. Such changes will be subject to consultation processes.

Hamilton City Council will monitor designs and construction as development progresses. Where approved designs or as built construction changes the outcome, the application of BPOs or the nature of the BPOs in the ICMP may need to be changed. These could differ from those already implemented by earlier developments in the catchment. Changes will only generally be made if a more practicable option is identified. The exception to this is where implementation results in the identification of an environmental shortcoming which requires a more effective BPO.

A reduction in requirements will not be made for minor improvements against the objectives. For a fundamental change to the ICMP objectives to be made, the positive impact of actual development will need to be significant and measurable. The same approach will generally apply to the application of more stringent requirements, but it is acknowledged that adverse effects and degradation can be a slow and cumulative process. A more proactive approach to managing the effects of stormwater discharges will be undertaken where a minor but consistently measurable reduction in water and/or habitat quality and/or bank stability is observed

Significant ICMP changes will require an internal Hamilton City Council Group review process, stakeholder consultation and approval by Waikato Regional Council. Minor changes will be discussed and agreed with Waikato Regional Council where this is relevant to the Hamilton City Council CSDC.

[52] This term is considered appropriate on the basis of development which is estimated to be complete in the HAMILTON CITY COUNCIL development area in 4 years time, sufficient monitoring data, flood hazard assessment, ability to review critical requirements through other mechanisms such as SMP reviews and the ability to amend the ICMP at any time if adverse effects are identified.

Potential amendments may also be required to any of the following:

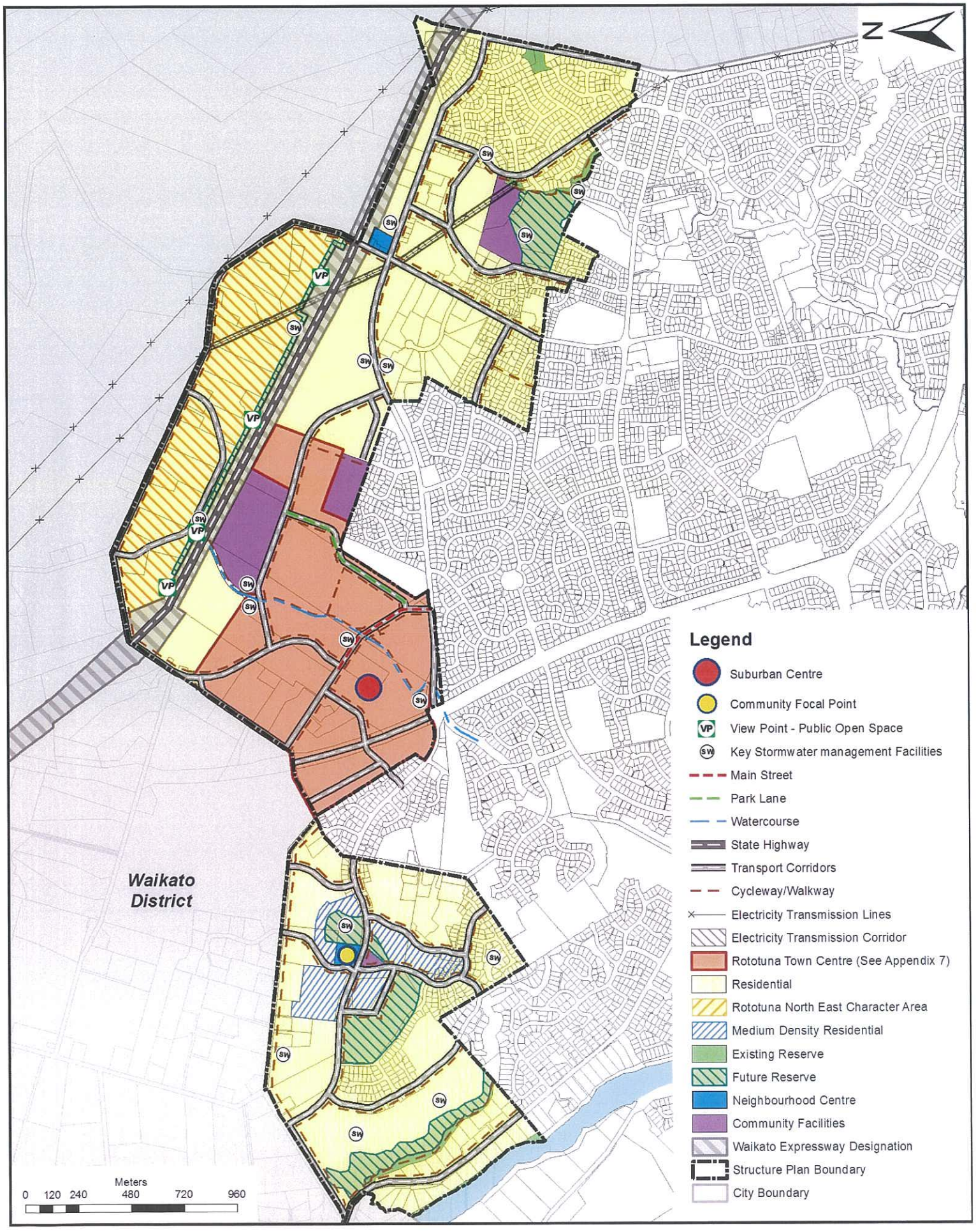
a) Associated Structure Plan/District Plan
b) Hamilton City Council Stormwater Management Plan
c) Relevant bylaw or policy
d) The relevant activity management plan.
e) CSDC Monitoring Programme

10 References

- Hamilton City Council, Subdivision Resource Consent 11.2010.21906(48/1/B358N); 25th August 2011, p. 85-86 and associated engineering design plans.
- Hamilton City Council, Subdivision Resource Consent 11.2009.20392(48/1/K197C); 2nd May 2012, p. 24-36.
- Hamilton City Council, Comprehensive Stormwater Discharge Consent 105279, (granted by Waikato Regional Council – expires 30th June 2036).
- Tonkin & Taylor Ltd 2012: Stormwater Monitoring Plan – Waikato Regional Council Consent 105279.
- TRIM D –719026: Howes and Vink Consulting : Otama-ngenge catchment - Glaisdale West Stormwater Management Plan Revision 2 - 2012/10/18
- TRIM D –719035: McPherson Goodwin Surveyors: Otama-ngenge catchment - Glaisdale West Stormwater Management Plan Indicative 100 Year Flooding Level - 2012/10/18
- TRIM D -856142: Maunsell/AECOM 2009: Kay Road, Rototuna North, Hamilton Litt Family Trust Subdivision - Stormwater Management Assessment, dated 1 May 2009
- TRIM D -728128: AECOM 2011: Glaisdale West (Hancock) Block, Kay Road – Stormwater Management Concept Report, dated 20 May 2011.
- TRIM D -601286: Tonkin and Taylor Ltd 2005: Preliminary Assessment Kay Road Drain , for the Glaisdale Property Partnership May 2005.
- TRIM D-928128: Integrated catchment Planning - Planning Guidance and Principles (Draft)
- TRIM D-1825095: Waikato Regional Council Technical Report 2014 - Managing Landuse Change and Councils Administered Areas
- TRIM D-1069627: Stormwater Management Plan, Hamilton City Council, December 2012 (Resource Consent 105279)
- D-1168323 NIWA - Streams and lakes in and near Hamilton and the issues for stormwater disposal - HCC00213 -March 2001
- D-1168330 NIWA - Hamilton City stormwater - assessment of contaminant loads & impacts on Waikato River - HCC00210- January 2001
- Hamilton City Council Water Master Plan June 2015
- Hamilton City Council Wastewater Master Plan June 2015
- TRIM D–719026 Geological reports
- D-1049842 Hamilton City Council – Streams and lakes in and near Hamilton and the issues for stormwater disposal, NIWA, March 2001
- Integrated catchment Management Principles D-928128
- Incidence of catchment and corridor impervious Collier/clements, 2010
- D-1484111 Soil Map Aecom
- Kay Road subdivision, Preliminary Geotechnical Assessment Aecom, 29 July 2014
- Resolution Drive Extension: Resource Consent Applications, Assessment of Environmental Effects Bloxam, Burnett & Olliver Limited. October 2004
- CDL Land NZ Ltd, Subdivision Cumberland Drive, rototuna – Cumberland Drive Overland flow Path Modelling – Revision 0213 March 2013
- D-1863233 Ecological assessment Boffa Miskell, 6 July 2015
- D-1643362 Engineering Design Plans & Application - Kay Road Drain & SW Outlet - Glaisdale West Subdivision - 2014-12-08
- D-1883535 Network Capacity Model Morphum – Appendix I of this document.
- D-1873728 –Assessment of Environmental Effects

Appendix A	**HCC Structure Plan**
Appendix B	**Network Plans**
	B1 – Stormwater Network **B2 – Wastewater Network** **B3 – Water Supply Network**
Appendix C	**Soil Map**
Appendix D	**Contaminant Load Model**
Appendix E	**Kirikiriroa Horsham Downs Drainage Area**
Appendix F	**Water Impact Assessment – Information Requirements**
Appendix G	**Assessment of Environmental Effects**
Appendix H	**Ecological Report**
Appendix I	**Network Capacity**
Appendix J	**Comprehensive Stormwater Discharge Consent 105279 (Conditions)**

Appendix A – HCC Structure Plan

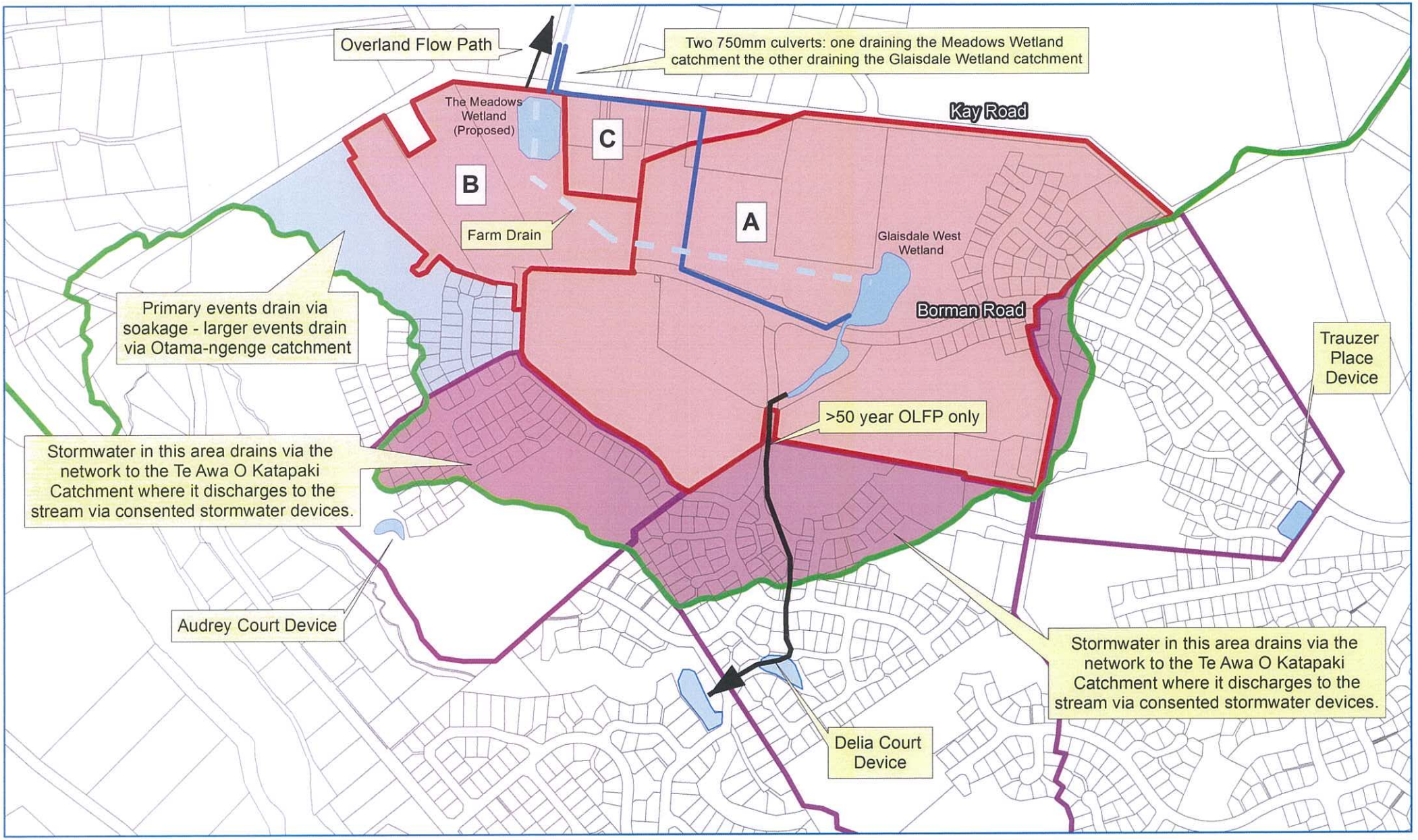

N
Waikato
District
Legend
Suburban Centre
Community Focal Point
View Point - Public Open Space
Key Stormwater management Facilities
Main Street
Park Lane
Watercourse
State Highway
Transport Corridors
Cycleway/Walkway
Electricity Transmission Lines
Electricity Transmission Corridor
Rototuna Town Centre (See Appendix 7)
Residential
Rototuna North East Character Area
Medium Density Residential
Existing Reserve
Future Reserve
Neighbourhood Centre
Community Facilities
Waikato Expressway Designation
Structure Plan Boundary
City Boundary
Meters
0 120 240 480 720 960

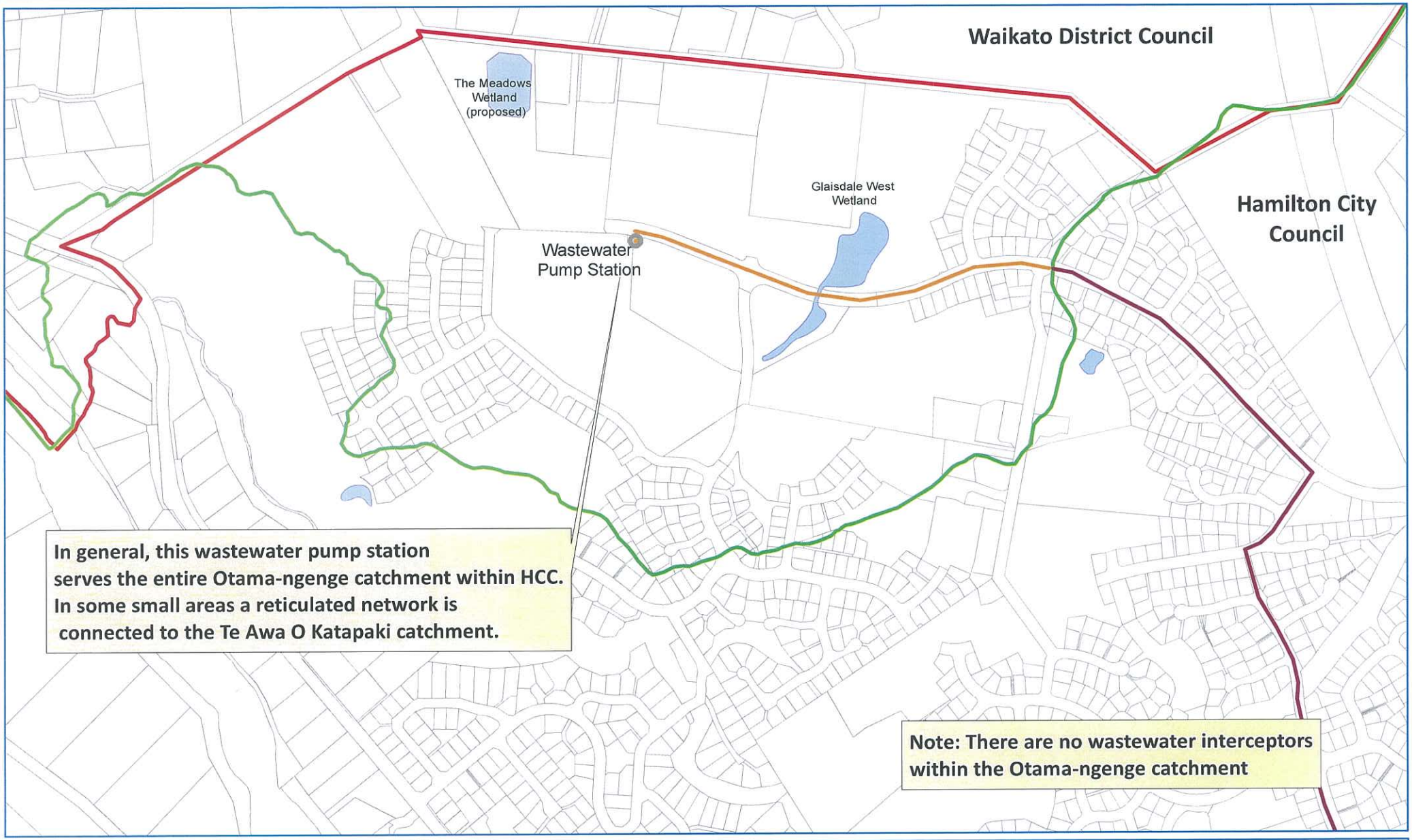
Appendix B – Network Plans

B1 – Stormwater Network

B2 – Wastewater Network

B3 – Water Supply Network


Overland Flow Path
Two 750mm culverts: one draining the Meadows Wetland catchment the other draining the Glaisdale Wetland catchment
The Meadows Wetland (Proposed)
Kay Road
C
B
A
Farm Drain
Glaisdale West Wetland
Borman Road
Primary events drain via soakage - larger events drain via Otama-ngenge catchment
Trauzer Place Device
>50 year OLFP only
Stormwater in this area drains via the network to the Te Awa O Katapaki Catchment where it discharges to the stream via consented stormwater devices.
Audrey Court Device
Stormwater in this area drains via the network to the Te Awa O Katapaki Catchment where it discharges to the stream via consented stormwater devices.
Delia Court Device
KEY
Stormwater Detention Device
Stormwater Infrastructure
Stormwater Channel
Otama-ngenge Topographic Catchment Boundary
Otama-ngenge Network Sub-Catchments
Te Awa O Katapaki Network Sub-Catchments
Network Drainage to Te Awa O Katapaki
Drains via soakage
0 50 100 200 300
Metres
N
Hamilton City Council
Te kaunihera o Kirikiriroa
GIS & CAD Services
Otama-ngenge Stormwater Network
Otama-ngenge Catchment
Plan No. Appendix B1
version 1



KEY

- Hamilton City Council Boundary
- Otama-ngenge Topographic Catchment Boundary
- Wastewater Mains = 300mm
- Rising Main = 225mm

0 75 150 300 Metres

N

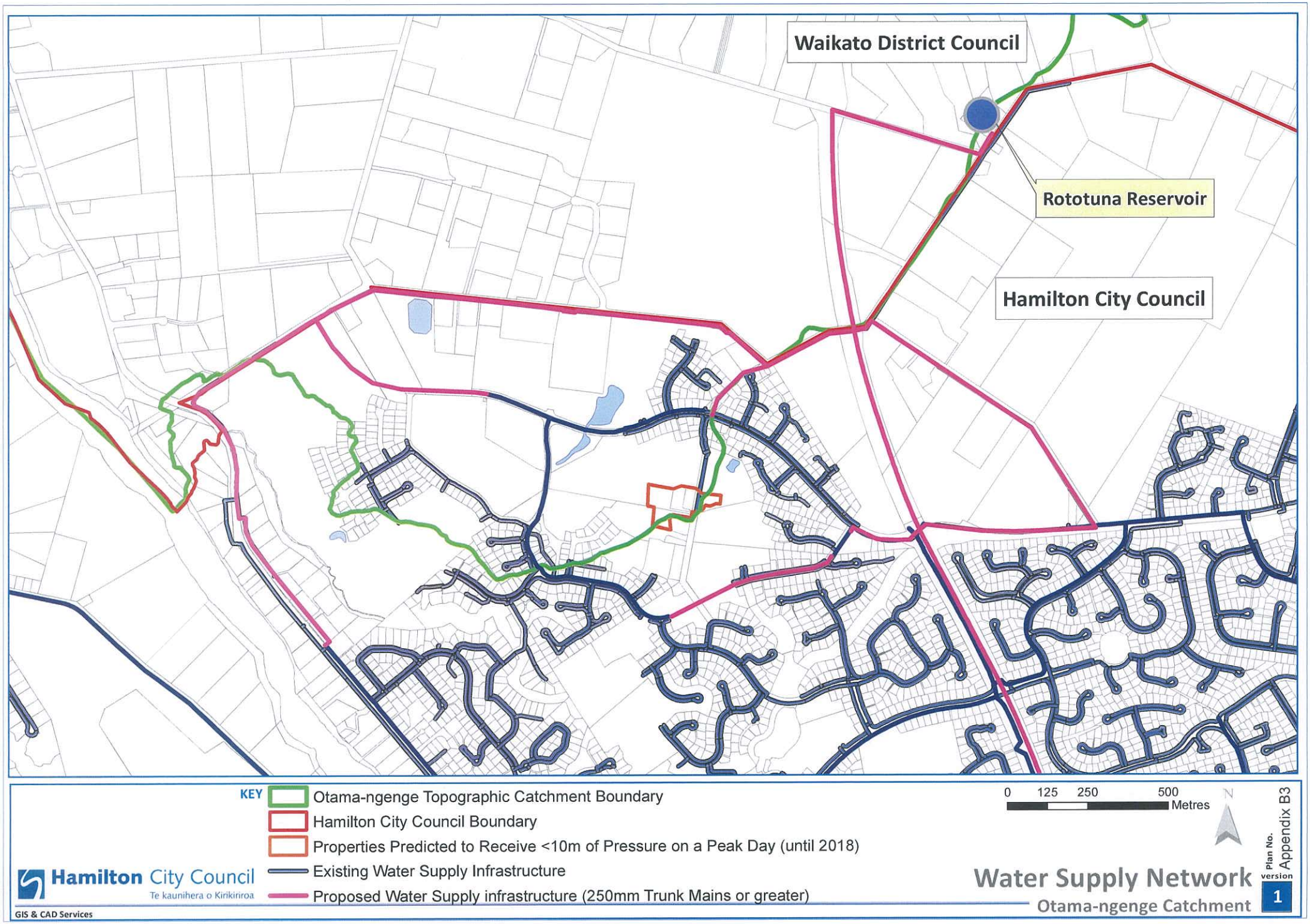
Hamilton City Council
Te kaunihera o Kirikiriroa

GIS & CAD Services

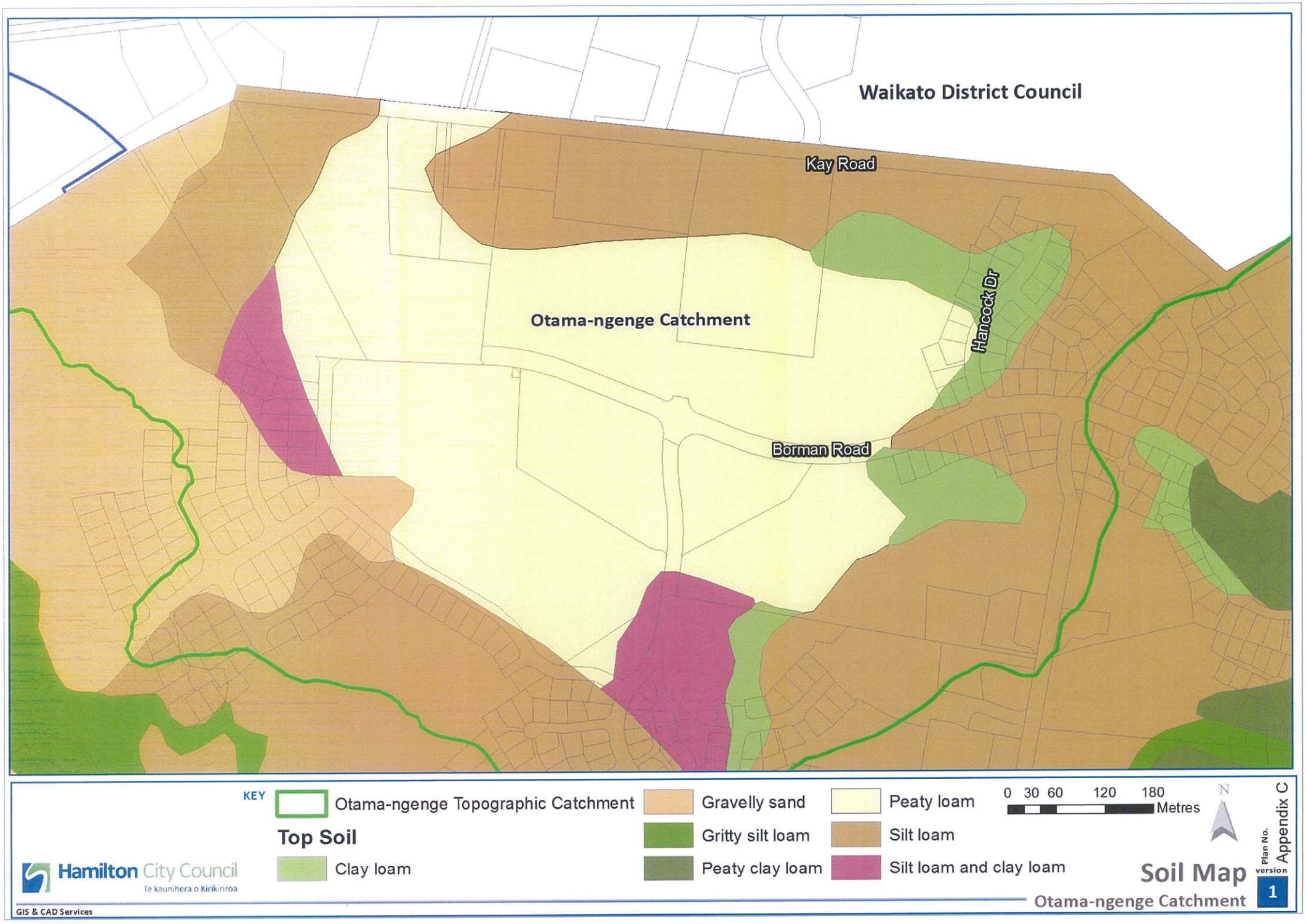
Wastewater Network

Otama-ngenge Catchment

Plan No. Appendix B2
version 1


Waikato District Council
Rototuna Reservoir
Hamilton City Council
KEY
Otama-ngenge Topographic Catchment Boundary
Hamilton City Council Boundary
Properties Predicted to Receive <10m of Pressure on a Peak Day (until 2018)
Existing Water Supply Infrastructure
Proposed Water Supply infrastructure (250mm Trunk Mains or greater)
0 125 250 500
Metres
N
Hamilton City Council
Te kaunihera o Kirikiriroa
GIS & CAD Services
Water Supply Network
Otama-ngenge Catchment
Plan No. Appendix B3
version 1

Appendix C – Soil Map


Waikato District Council
Kay Road
Hancock Dr
Otama-ngenge Catchment
Borman Road
KEY
Otama-ngenge Topographic Catchment
Top Soil
Clay loam
Gravelly sand
Gritty silt loam
Peaty clay loam
Peaty loam
Silt loam
Silt loam and clay loam
0 30 60 120 180
Metres
N
Hamilton City Council
Te kaunihera o Kirikiriroa
GIS & CAD Services
Soil Map
Otama-ngenge Catchment
Appendix C
Plan No.
version
1

Appendix D – Contaminant Load Model

MORPHUM ENVIRONMENTAL LTD

Engineers & Consultants

PO Box 99642
Newmarket
Auckland
Ph 09 377 9779

3rd of July, 2015

Andrea Phillips
Hamilton City Council

Subject: Otama-ngenge Contaminant Load Model

Dear Andrea,

Thank you for the opportunity for Morphum Environmental Ltd (Morphum) to complete a Contaminant Load Model (CLM) for the Otama-ngenge (OGG) Integrated Catchment Management Plan (ICMP). This report discusses the method and results of the OGG CLM.

Methodology

The OGG CLM was developed in four stages:

1. Landuse definition
2. Proposed means of compliance measures
3. Landuse Contaminant Load definition
4. Contaminant Load modelling

The following sections outline each of the four stages. The model covered the entire OGG hydrologic catchment.

Landuse Definition

Existing and future landuse was determined using Aerials photos and structure plan information. Landuse classifications used were:

- Rural
- Urban Grass
- Residential
- Large Lot Residential
- Commercial
- Local Road
- Arterial Road
- Motorway

For the existing scenario, landuse was classified through an analysis of aerial photos. For the future scenario landuse was classified using existing and structure plan zonings as well as the proposed alignment for the Waikato Expressway. Paper roads were assumed to be constructed in the future scenario. No rezoning or rural land to residential is included in the future scenario other than what is shown in Structure Plans. Landuse classifications in the existing and future scenario are shown in the Otama-ngenge Landuse map.

Proposed means of compliance

Treatment devices intended to provide means of compliance were determined using information from consents for the various developing areas in the catchment and as included in the Otama-ngenge ICMP. Catchment concentrations were compared to ecological requirements, to determine the adequacy of these devices for the catchment.

Landuse Contaminant Load Definition

Landuse Contaminant Loads were defined using three documents:

- Hamilton City Stormwater: assessment of contaminant loads and impacts on the Waikato River prepared for HCC by NIWA in 2001
- Development of the Contaminant Load Model prepared by the Auckland Regional Council in 2010
- Stormwater Quality – An analysis of Runoff from Modern Subdivisions and the Impactions for Stormwater Treatment, Brough et. al 2012

Landuse concentrations used in the model are given below in Table 1.

Table 1 Landuse Contaminant Concentrations

Landuse	TSS $mg.L^{-1}$	T Cu $\mu g.L^{-1}$	T Zn $\mu g.L^{-1}$
Rural	127	1.1	5
Urban Grass	38	0.3	1.6
Residential	25	3.3	50
Large Lot Residential	30	10.0	60
Commercial	26	26.5	100
Local Road	23	3.5	22
Arterial Road	44	14.6	92
Motorway	80	33.9	214

Concentrations were derived based on comparing the different landuses in each of the studies against the landuse type being classified. Where suitable, Hamilton data was used in preference to the Christchurch or Auckland studies.

Contaminant Load Modelling

The Contaminant Load Modelling was carried out using the above concentrations. Modelling analysis is attached for the existing and future scenarios.

All catchments were modelled with treatment devices in place. Existing treatment devices were included in the existing model and all devices shown on the means of compliance map were included in the future model. Linear relationships between inflow and outflow for treatment devices based on the information in the International Stormwater BMP database were used to estimate outflow concentrations from devices. These relationships are shown below in Figure 1, Figure 2 and Figure 3.

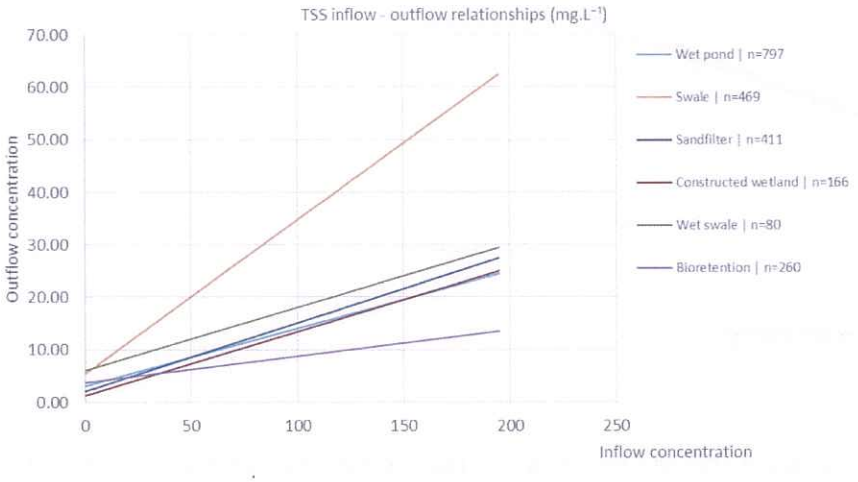


Figure 1 Total Suspended Solids removal relationships

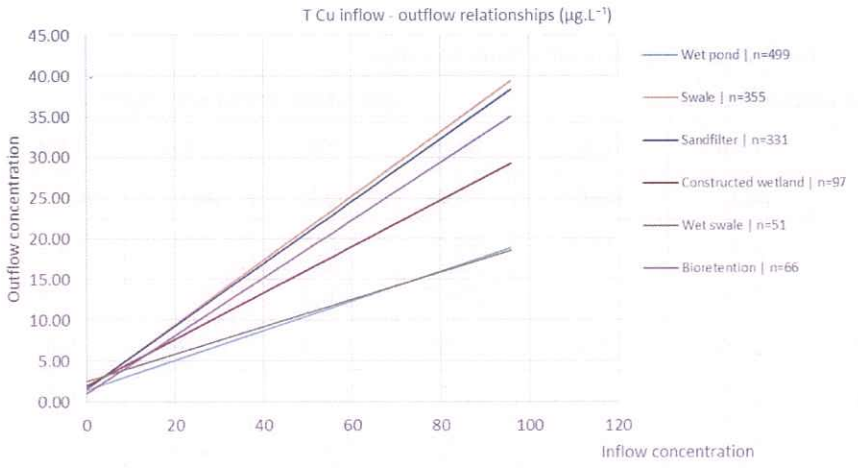


Figure 2 Total Copper removal relationships

Figure 3 Total Zinc removal relationships

Results

CLM modelling results for the future scenario are shown in Table 2. Full results for the existing and future scenarios are attached as an appendix to this report. Catchment O1 discharges to soakage, however concentrations from this catchment were still included in the model to show the predicted annual concentrations to groundwater. Results are shown in the Otama-ngenge Cumulative Contaminant Load Model results map.

Table 2 CLM Future results (Concentration)

	Incremental catchment results				Cumulative catchment results			
	Area	**TSS**	**T Cu**	**T Zn**	**Area**	**TSS**	**T Cu**	**T Zn**
	Ha	**$mg.L^{-1}$**	**$\mu g.L^{-1}$**	**$\mu g.L^{-1}$**	**Ha**	**$mg.L^{-1}$**	**$\mu g.L^{-1}$**	**$\mu g.L^{-1}$**
S1	65.3	4.7	2.95	15.2	65.3	4.7	2.95	15.2
S2	144.3	94.1	1.74	8.2	209.7	66.2	2.12	10.4
S3	110.9	123.0	1.29	5.9	320.6	85.9	1.83	8.8
N1	168.9	113.1	1.43	6.4	168.9	113.1	1.43	6.4
N2	149.3	124.2	1.17	5.4	318.2	118.3	1.31	5.9
J1	34.9	76.8	5.10	20.7	673.7	100.7	1.75	8.1
O1	24.9	8.1	2.51	15.7	24.9	8.1	2.51	15.7
O2	108.3	81.2	4.64	19.6	108.3	81.2	4.64	19.6

Table A-1 Otama-ngenge Contaminant Load model results

					Units	S1	S2	S3	N1	N2	J1	O1	O2
Incremental	Area				Ha	65.3	144.3	110.9	168.9	149.3	34.9	24.9	108.3
	Concentration	Existing	No treat	TSS	$mg.L^{-1}$	106.4	107.9	123.0	119.0	125.5	78.1	64.4	84.1
				T Cu	$ug.L^{-1}$	1.43	2.45	1.29	1.03	1.13	5.14	2.48	4.58
				T Zn	$ug.L^{-1}$	10.6	10.7	5.9	4.7	5.2	21.4	27.9	19.2
			Treat.	TSS	$mg.L^{-1}$	14.2	107.9	123.0	119.0	125.5	78.1	15.5	84.1
				T Cu	$ug.L^{-1}$	2.41	2.45	1.29	1.03	1.13	5.14	2.25	4.58
				T Zn	$ug.L^{-1}$	11.4	10.7	5.9	4.7	5.2	21.4	11.5	19.2
		Future	No treat	TSS	$mg.L^{-1}$	27.8	99.2	123.0	118.3	125.0	78.1	27.8	81.2
				T Cu	$ug.L^{-1}$	3.36	3.03	1.29	3.19	1.48	5.14	3.27	4.64
				T Zn	$ug.L^{-1}$	40.3	14.5	5.9	18.4	7.4	21.4	43.6	19.6
			Treat.	TSS	$mg.L^{-1}$	4.7	94.1	123.0	113.1	124.2	76.8	8.1	81.2
				T Cu	$ug.L^{-1}$	2.95	1.74	1.29	1.43	1.17	5.10	2.51	4.64
				T Zn	$ug.L^{-1}$	15.2	8.2	5.9	6.4	5.4	20.7	15.7	19.6
	Yield	Existing	No treat	TSS	$g.m^{-1}.a^{-1}$	66.2	68.0	74.4	71.4	75.5	55.6	47.6	58.1
				T Cu	$mg.m^{-1}.a^{-1}$	1.19	2.41	0.91	0.62	0.71	5.84	2.72	5.12
				T Zn	$mg.m^{-1}.a^{-1}$	10.3	10.5	4.2	2.8	3.3	24.1	32.4	21.3
			Treat.	TSS	$g.m^{-1}.a^{-1}$	8.9	68.0	74.4	71.4	75.5	55.6	9.5	58.1
				T Cu	$mg.m^{-1}.a^{-1}$	1.73	2.41	0.91	0.62	0.71	5.84	1.92	5.12
				T Zn	$mg.m^{-1}.a^{-1}$	8.3	10.5	4.2	2.8	3.3	24.1	10.1	21.3
		Future	No treat	TSS	$g.m^{-1}.a^{-1}$	28.9	64.4	74.4	74.6	75.7	55.6	31.0	56.7
				T Cu	$mg.m^{-1}.a^{-1}$	4.00	3.16	0.91	3.24	1.13	5.84	3.90	5.22
				T Zn	$mg.m^{-1}.a^{-1}$	48.1	15.3	4.2	19.4	6.0	24.1	52.2	21.9
			Treat.	TSS	$g.m^{-1}.a^{-1}$	4.9	58.3	74.4	68.4	74.7	54.0	7.7	56.7
				T Cu	$mg.m^{-1}.a^{-1}$	3.32	1.62	0.91	1.13	0.76	5.79	2.49	5.22
				T Zn	$mg.m^{-1}.a^{-1}$	17.1	7.7	4.2	5.0	3.5	23.4	15.0	21.9
Cumulative	Area				Ha	65.3	209.7	320.6	168.9	318.2	673.7	24.9	108.3
	Concentration	Existing	No treat	TSS	$mg.L^{-1}$	106.4	107.5	112.9	119.0	122.0	115.4	64.4	84.1
				T Cu	$ug.L^{-1}$	1.43	2.13	1.84	1.03	1.08	1.65	2.48	4.58
				T Zn	$ug.L^{-1}$	10.6	10.7	9.0	4.7	5.0	7.8	27.9	19.2
			Treat.	TSS	$mg.L^{-1}$	14.2	78.7	94.1	119.0	122.0	106.4	15.5	84.1
				T Cu	$ug.L^{-1}$	2.41	2.44	2.04	1.03	1.08	1.75	2.25	4.58
				T Zn	$ug.L^{-1}$	11.4	10.9	9.2	4.7	5.0	7.8	11.5	19.2
		Future	No treat	TSS	$mg.L^{-1}$	27.8	77.0	92.9	118.3	121.4	105.6	27.8	81.2
				T Cu	$ug.L^{-1}$	3.36	3.13	2.49	3.19	2.39	2.58	3.27	4.64
				T Zn	$ug.L^{-1}$	40.3	22.6	16.8	18.4	13.3	15.4	43.6	19.6
			Treat.	TSS	$mg.L^{-1}$	4.7	66.2	85.9	113.1	118.3	100.7	8.1	81.2
				T Cu	$ug.L^{-1}$	2.95	2.12	1.83	1.43	1.31	1.75	2.51	4.64
				T Zn	$ug.L^{-1}$	15.2	10.4	8.8	6.4	5.9	8.1	15.7	19.6
	Yield	Existing	No treat	TSS	$g.m^{-1}.a^{-1}$	66.2	67.4	69.9	71.4	73.3	70.8	47.6	58.1
				T Cu	$mg.m^{-1}.a^{-1}$	1.19	2.03	1.64	0.62	0.66	1.40	2.72	5.12
				T Zn	$mg.m^{-1}.a^{-1}$	10.3	10.4	8.3	2.8	3.1	6.6	32.4	21.3
			Treat.	TSS	$g.m^{-1}.a^{-1}$	8.9	49.6	58.2	71.4	73.3	65.2	9.5	58.1
				T Cu	$mg.m^{-1}.a^{-1}$	1.73	2.20	1.75	0.62	0.66	1.45	1.92	5.12
				T Zn	$mg.m^{-1}.a^{-1}$	8.3	9.8	7.9	2.8	3.1	6.4	10.1	21.3
		Future	No treat	TSS	$g.m^{-1}.a^{-1}$	28.9	53.3	60.6	74.6	75.1	67.2	31.0	56.7
				T Cu	$mg.m^{-1}.a^{-1}$	4.00	3.42	2.55	3.24	2.25	2.58	3.90	5.22
				T Zn	$mg.m^{-1}.a^{-1}$	48.1	25.5	18.2	19.4	13.1	16.1	52.2	21.9
			Treat.	TSS	$g.m^{-1}.a^{-1}$	4.9	41.7	53.0	68.4	71.4	61.7	7.7	56.7
				T Cu	$mg.m^{-1}.a^{-1}$	3.32	2.15	1.72	1.13	0.96	1.57	2.49	5.22
				T Zn	$mg.m^{-1}.a^{-1}$	17.1	10.6	8.4	5.0	4.3	7.2	15.0	21.9

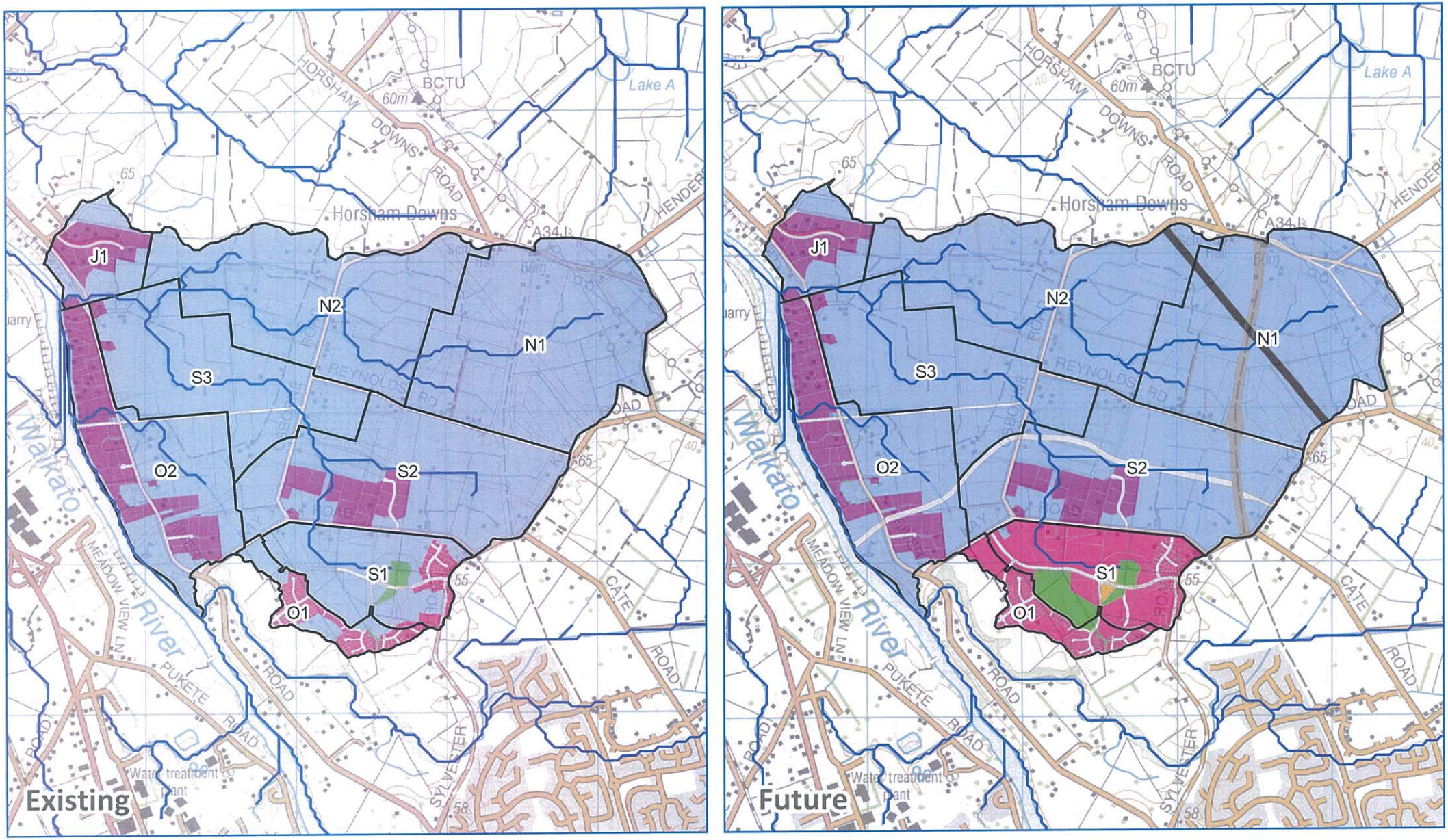


Figure B-1 Otama-ngenge Landuse

Otama-ngenge Catchment

version 1

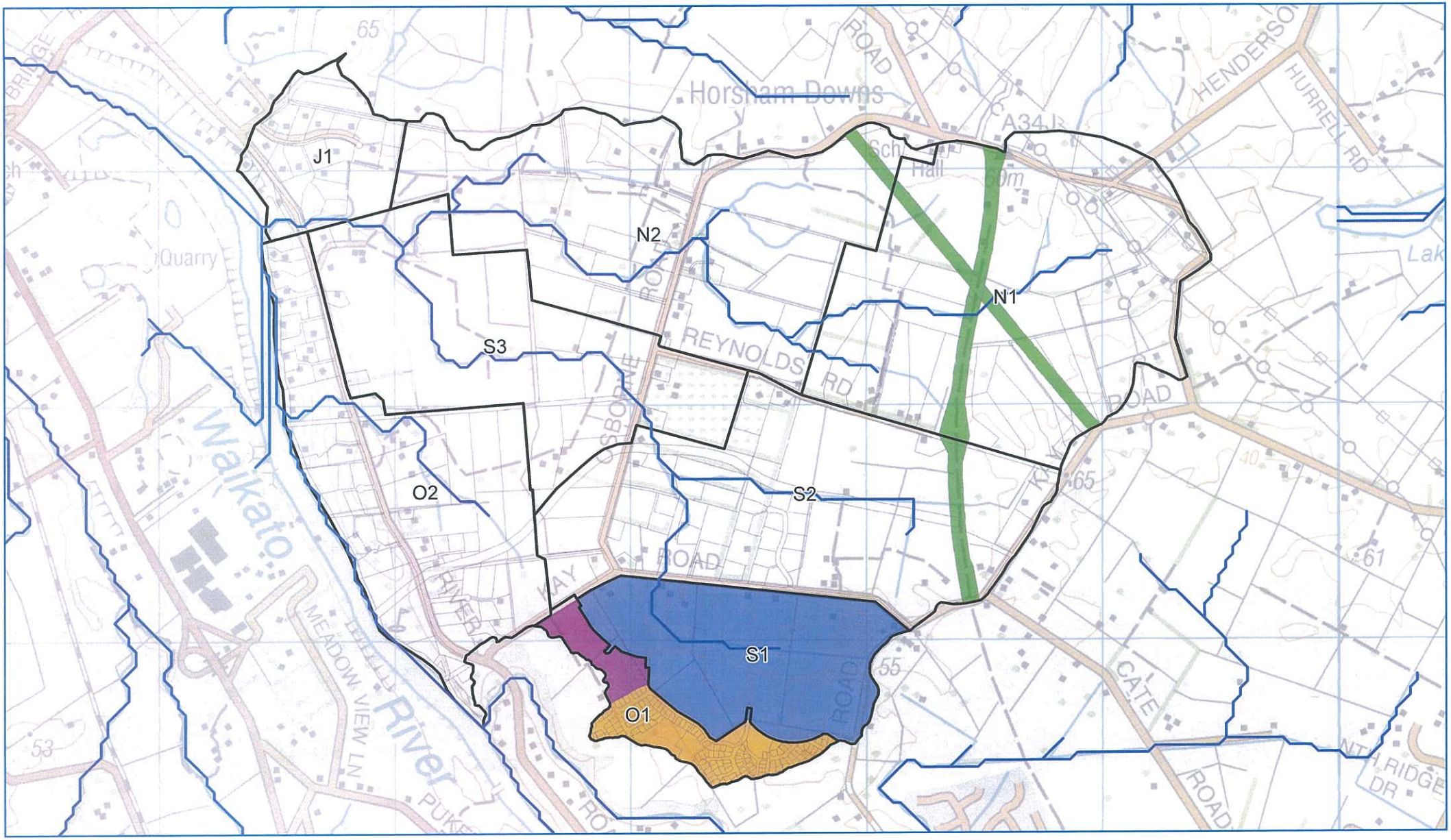
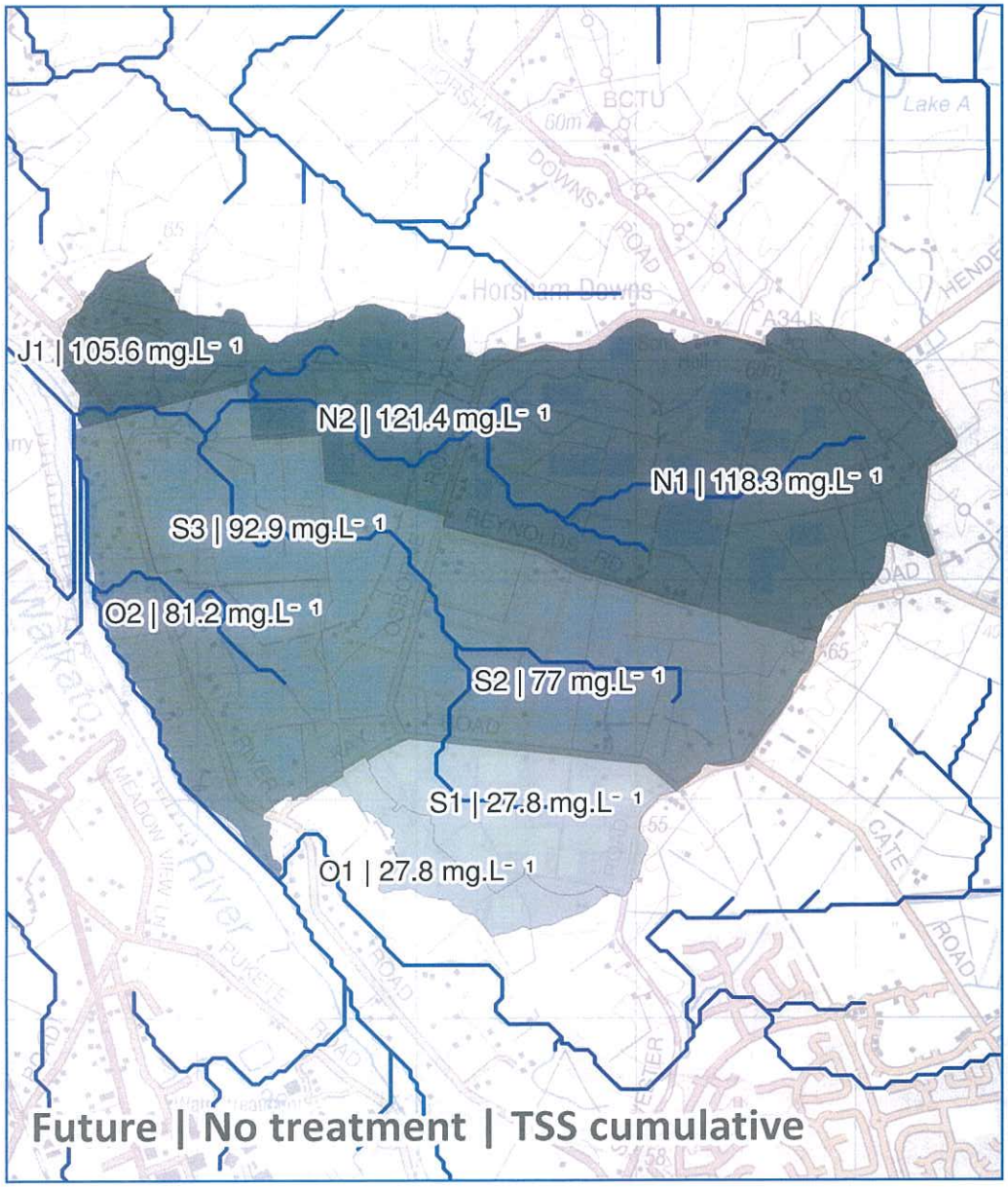
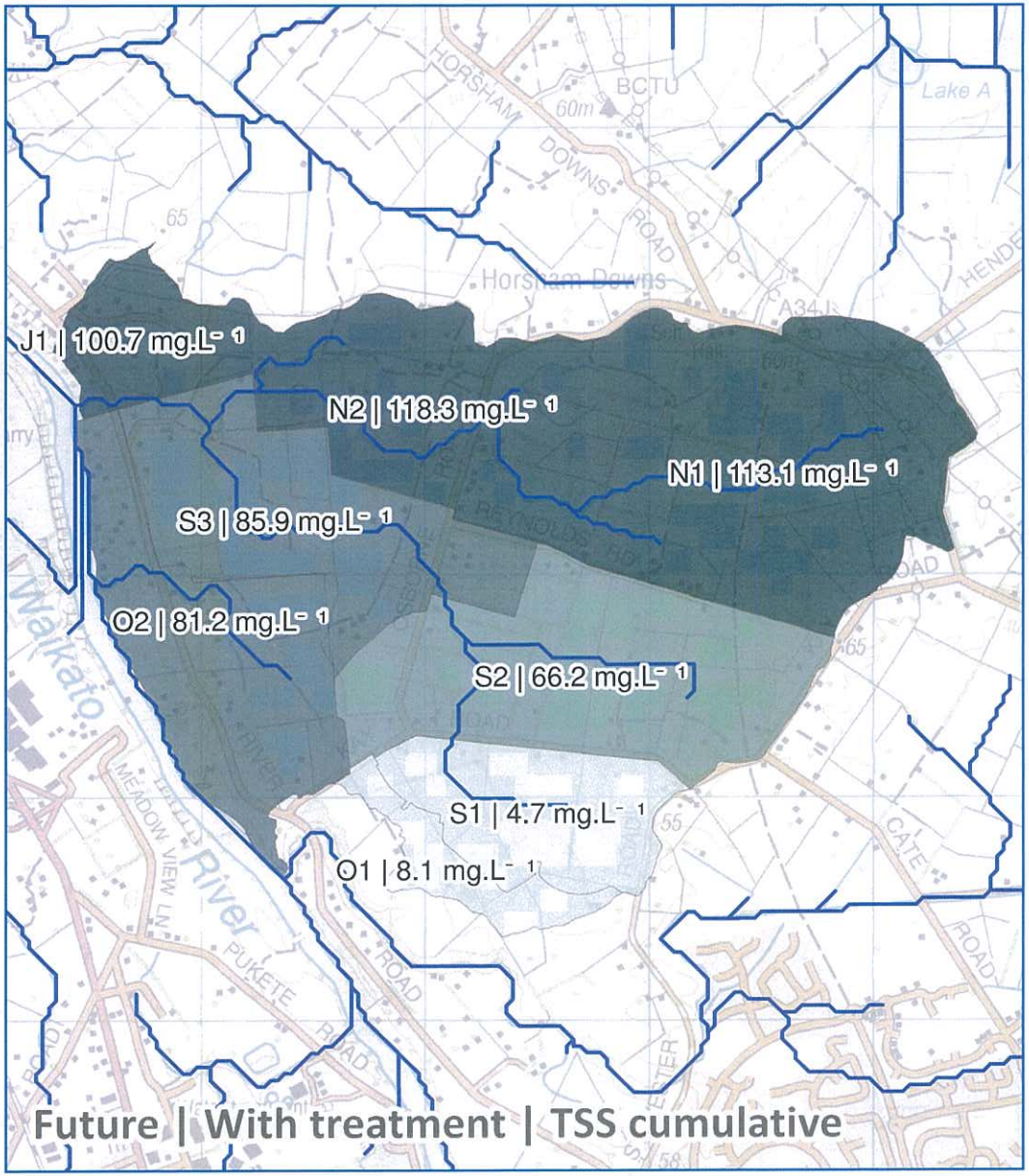


Figure B-2 Otama-ngenge Treatment Means of Compliance

version 1

Otama-ngenge Catchment





KEY

REC Streams layer

< 25 mg.L⁻ ¹

< 50 mg.L⁻ ¹

< 75 mg.L⁻ ¹

< 100 mg.L⁻ ¹

> 100 mg.L⁻ ¹

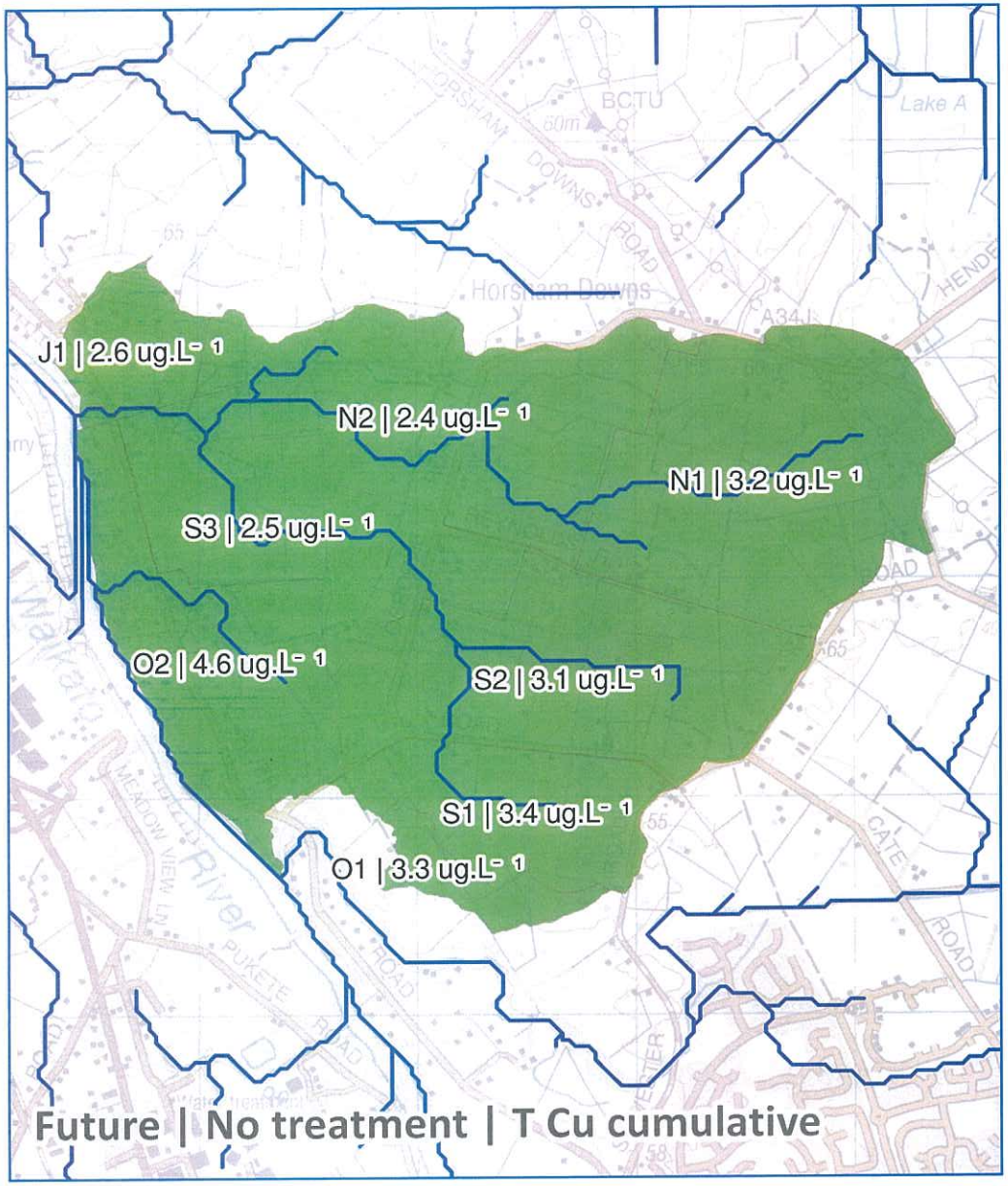
0 290 580 1,160 1,740 Metres

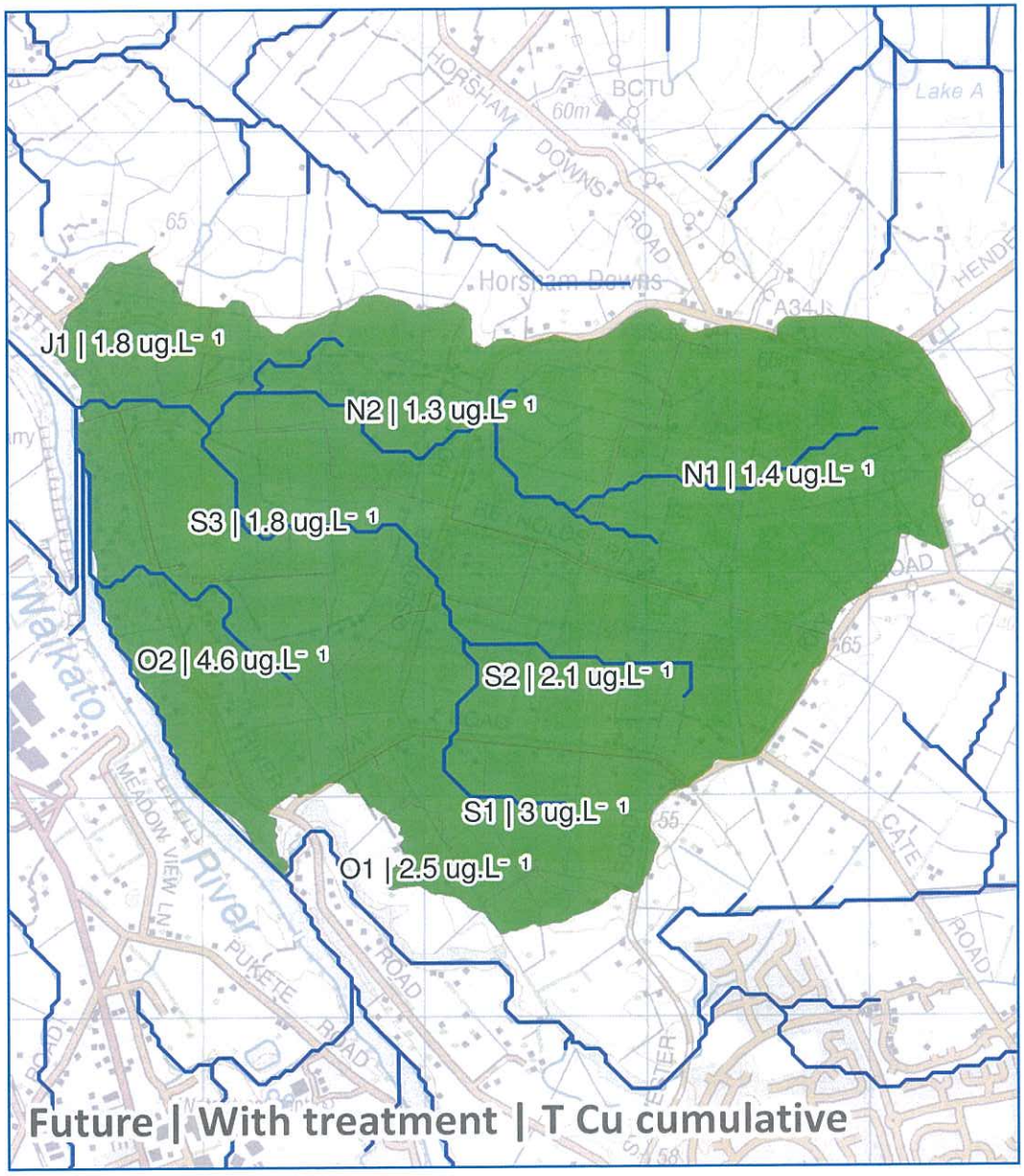
N

Figure B-3 Otama-ngenge Contaminant Load results | Total Suspended Solids

Otama-ngenge Catchment

version 1





KEY
REC Streams layer
< 15 ug.L- 1
< 30 ug.L- 1
> 30 ug.L- 1

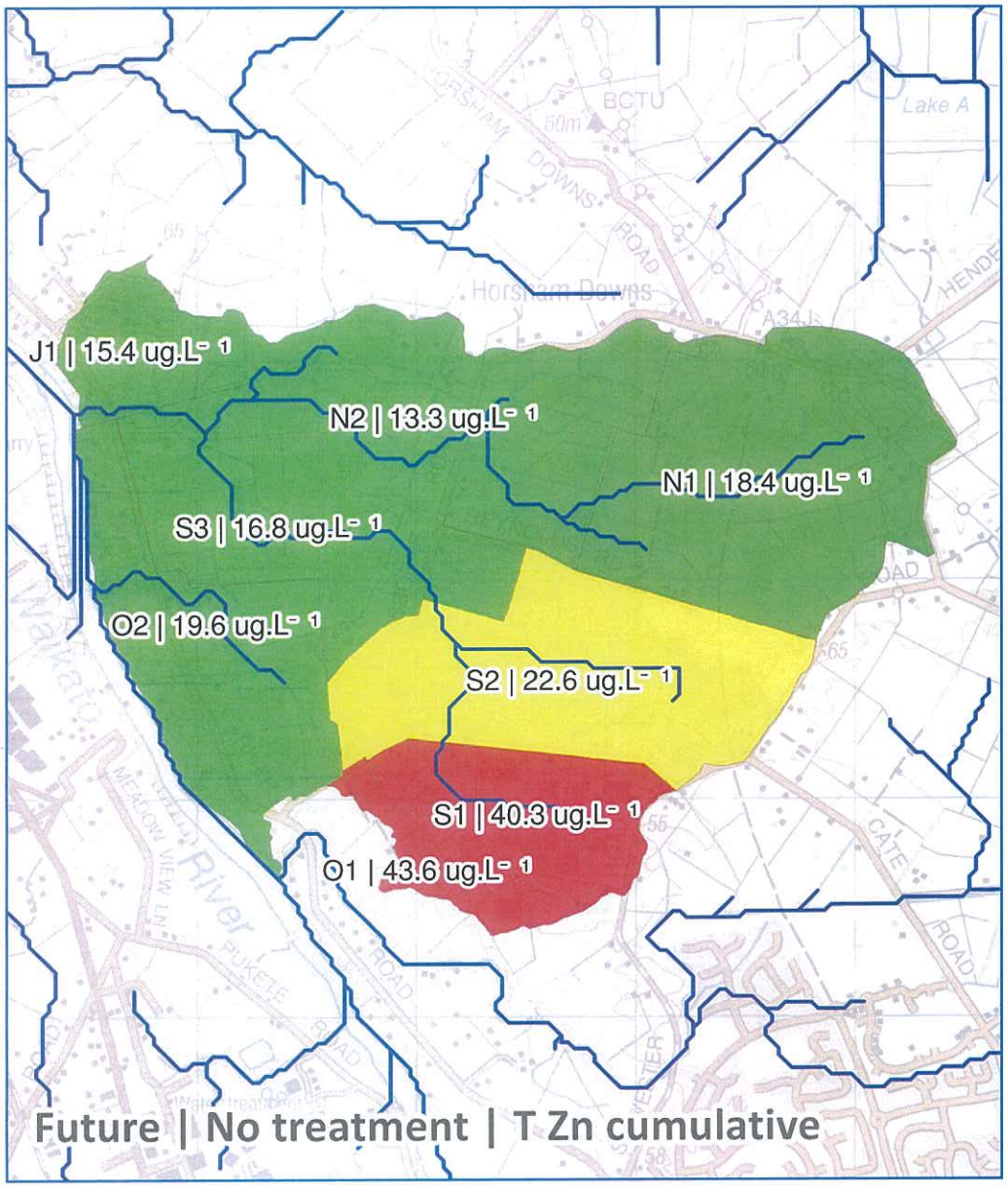
0 310 620 1,240 1,860 Metres

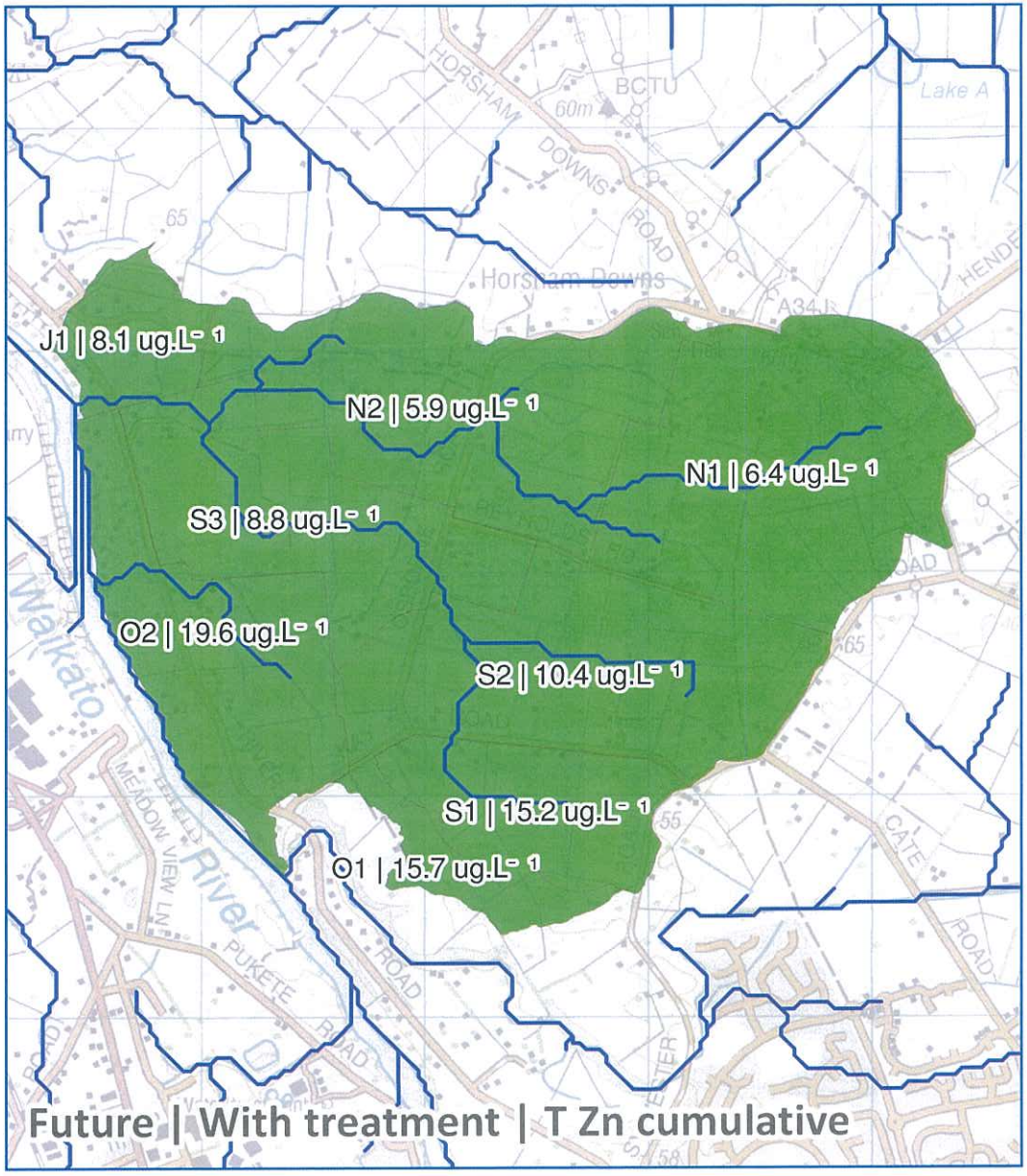
N

Figure B-4 Otama-ngenge Contaminant Load results | Total Copper

version 1

Otama-ngenge Catchment





KEY
REC Streams layer
< 20 ug.L⁻ ¹
< 40 ug.L⁻ ¹
> 40 ug.L⁻ ¹

0 287.5 575 1,150 1,725 Metres

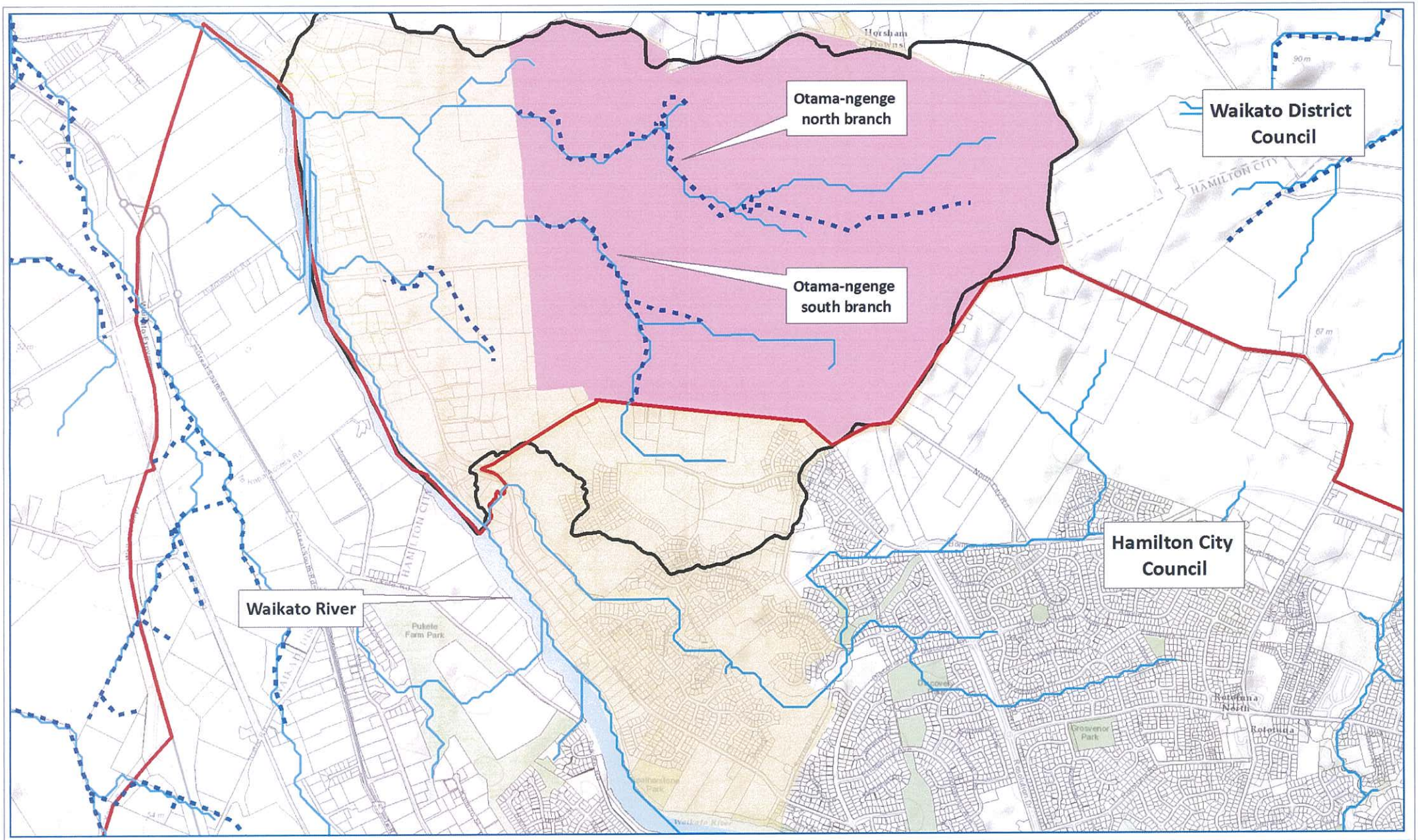
N

Figure B-5 Otama-ngenge Contaminant Load results | Total Zinc

Otama-ngenge Catchment

version 1

Appendix E
Kirikiriroa Horsham Downs Drainage Area



KEY

- Kirikiriroa Horsham Downs Drainage Area
- Land Drainage Area - Rateable
- Maintained Streams and Drains
- Natural Streams
- Hamilton City Council Boundary
- Otama-ngenge Topographic Catchment

N

Hamilton City Council
Te kaunihera o Kirikiriroa

GIS & CAD Services

Kirikiriroa-Horsham Downs Land Drainage Area

Otama-ngenge Catchment

Plan No. 1 version

Appendix F – Water Impact Assessment – Information Requirements

Appendix F – Water Impact Assessment Information Requirements

1.1.1 Nature of water use and discharges

Describe the nature of water use and discharge in relation to:

- The quantity of runoff from the existing catchment and how this will change with development;
- The quality of runoff from the existing catchment (using either information on contaminant concentrations and loads from the literature or from assessments/monitoring information, if available).
- Wastewater discharges taking into account special measures for reuse, reduction or disposal
- Water use taking into account measures to reduce consumption

Use the above information to predict the contaminant loads that are likely to be generated from the Otama-ngenge catchments under the proposed development scenarios.

1.1.2 Stormwater Mitigation Measures – Stream Protection

Describe the measures and stormwater management options that were considered to achieve the objectives set for the Otama-ngenge catchment and to mitigate the impacts of stormwater runoff on the receiving environment. This includes cumulative effects on existing and future development.

A description of how these options and measures were evaluated should also be included along with details on how these measures will be implemented. This might include riparian margin work, fencing, bank stabilization, hydrological controls, and water sensitive techniques.

1.1.3 Stormwater Mitigation Measures – Contaminant Management

Describe treatment device options, and/or water sensitive techniques considered, in a similar manner as above.

1.1.4 Water demand and discharge measures (water and wastewater)

Describe the measures and options that were considered to achieve the objectives set for the Otama-ngenge catchment and to minimise water use and discharge. This includes cumulative effects on existing and future development.

1.1.5 Three waters integration

Describe how the measures considered can be integrated for overall effect and efficiency.

1.1.6 Option Evaluation

Summarise the mitigation measures considered to achieve each operational objective. The process carried out to evaluate these measures should be described and the reasons provided why certain measures were selected or discounted.

1.1.7 Infrastructure Plans

Provide network service plans which have been developed to address network requirements.

Describe the key aspects of 3 waters network management including:

- Staging
- Alignment with growth and impacts on HCC's existing key infrastructure (e.g.) treatment plans, trunk lines etc.
- Proposed key infrastructure

Appendix G – Assessment of Environmental Effects

Hamilton City Council
Te kaunihera o Kirikiriroa

17/08/15 15:56
D-1873728

Otamangenge Integrated Catchment Management Plan

Appendix G:

Assessment of Environmental Effects

Status: *FINAL*

View of Catchment from Kay Road looking south west over the Catchment.

Revision No	Date	Status	Authorised (ICMP)	Approved (Stormwater)	TRIM link to authorisations
0-1					

This finalised document has been reviewed by Hamilton City Council's Projects Governance Group for Integrated Catchment Management Plans:

Approved for release by:

.....

Hamilton City Council

Otamangenge Catchment Management Plan

Appendix G: Assessment of Environmental Effects

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Appendix

Tables

Figures

Abbreviations

AEE = Assessment of Environmental Effects

BML = Boffa Miskell Limited

BPO = Best Practicable Option

CSDC = Comprehensive Stormwater Discharge Consent

ICMP = the *Otamangenge Integrated Catchment Management Plan: Draft for Consultation – July 2015*

MCI = Macroinvertebrate Community Index for soft-bottomed streams

NaMTOK = Nga Mana Toopu o Kirikiriroa

SQMCI = Semi Quantitative macroinvertebrate metrics for soft-bottomed streams

Terms Used in this Report

Appendix = an Appendix to the ICMP, unless specified otherwise

Development Area = the part of Otamangenge Catchment which lies within Hamilton City

Morphum = Morphum Environmental Limited

The Catchment = Otamangenge Catchment

Executive Summary

This Assessment of Environmental Effects ("AEE") assesses the effects on Otamangenge Stream Catchment ("the Catchment") of proposed new stormwater diversion and discharge activities undertaken in accordance with the *Otamangenge Integrated Catchment Management Plan: Draft for Consultation – July 2015* ("the ICMP").

The Catchment lies mostly within Waikato District, but straddles Hamilton City's northern boundary just east of the Waikato River. The land use within the Catchment is mainly dairy farming, but there are pockets of rural residential development. The part of the Catchment within Hamilton City is Stage 4 of the Rototuna Structure Plan Area and has begun to be urbanised. The entire catchment is highly modified. The vegetation is mainly pasture, and there is very little other riparian vegetation.

The ICMP is a comprehensive plan for managing the three waters (stormwater, water supply, and wastewater) and its infrastructure within Otamangenge Catchment in an integrated way. It identifies Best Practicable Options, Means of Compliance, Future Actions and a Monitoring Programme. It aims to avoid as far as practicable, and otherwise minimise, the cumulative adverse effects of all new stormwater diversion and discharge activities within the Catchment.

This AEE is intended to satisfy the requirements of conditions 30(g) and 30(h) of Hamilton City Council's Comprehensive Stormwater Discharge Consent.

It is based on assessments undertaken by environmental specialists: assessments of contaminant load and waterway capacity by Morphum Environmental Limited, an ecological assessment by Boffa Miskell Limited, and a Tangata Whenua Cultural Assessment Report by Nga Mana Toopu o Kirikiriroa.

The assessment concludes that any adverse effects of new stormwater diversion and discharge activities undertaken in accordance with the ICMP will be no more than minor. Implementation of the ICMP is expected to have positive effects on the Catchment, including, in particular, the provision of wetlands with 80% vegetation cover, a reduction in peak flows in Otamangenge Stream, and the provision of riparian planting.

1 Introduction

This Assessment of Environmental Effects ("AEE") assesses the effects on Otamangenge Steam Catchment, including the cumulative effects in particular, of proposed new stormwater diversion and discharge activities undertaken in accordance with the *Otamangenge Integrated Catchment Management Plan: Draft for Consultation – July 2015*.

This AEE is intended to satisfy the requirements of conditions 30(g) and 30(h) of Hamilton City Council's Comprehensive Stormwater Discharge Consent (Number 105279) ("the CSDC"). The section headings used below in this AEE (other than "Conclusions" and "References") are the matters set out in condition 30(g) of the CSDC on which the effects of the activities are to be assessed.

The stormwater diversion and discharge activities, whose effects are assessed, are the best practicable options, methods of compliance, future actions and monitoring identified in the ICMP and listed in Appendix A to this AEE.

A reference in this report to an Appendix is a reference to an Appendix to the ICMP, unless specified otherwise.

In this AEE the part of Hamilton City within the Catchment is referred to as "the Development Area".

1.1 Specialists reports

This AEE draws upon environmental specialists' assessments which are documented in the following reports:

- *Otamangenge Stream: Assessment of Ecological Values to inform an Integrated Catchment Management Plan* (6 July 2015) prepared by Boffa Miskell Limited ("BML") – see Appendix H.
- *Otama-ngenge Contaminant Load Model* (27 May 2015) prepared by Morphum Environmental Limited ("Morphum") – see Appendix D.
- *Otama-ngenge Capacity Model* (July 2015) prepared by Morphum - – see Appendix I.
- *Rototuna Stages 3 & 4 Tangata Whenua Cultural Assessment Report: November* 2005 prepared by Nga Mana Toopu o Kirikiriroa.

2 Natural features, surface water bodies and aquifers

2.1 Natural features and water bodies

The Catchment lies within the rolling Waikato lowlands, and most is part of the alluvial plains of the Waikato River. The Otamangenge Stream splits into a northern branch and a southern branch some 830m upstream of its confluence with the Waikato River (see Figure 1 in Appendix 1 of Appendix H).

The land use within the Catchment is predominantly rural and dairy farming, but there are pockets of Rural Residential development. The vegetation is predominantly pasture with some shelter belts and shade trees on the farm land and some planting around dwellings. There is very little riparian vegetation throughout the Catchment, other than grass.

The entire Catchment is highly modified. There are few natural features other than ground water, the landform itself, the surface water that drains from it, and the life within that water. Much of the Otamangenge Stream comprises artificial drains, or modified stream channel (see Plates 1 to 9 in Appendix H). Downstream of Osbourne Road both the north and south branches of Otamangenge Stream flow through a gully system that becomes increasingly deep and wide with more extensive floodplains in the lower reaches (see Plate 10 on p.17 of Appendix H).

On the South Branch downstream of Osbourne Road, the stream has been dammed and modified to form ponds for the purposes of recreational waterfowl hunting (see in Appendix H: Plate 11 (p.29) and Figure 3 in Appendix 1). Also, there is an undercut weir about 1m high immediately downstream of the River Road culvert (see Plate 12 on p.29 of Appendix H). This weir and the dams are barriers to fish passage and exclude non-climbing species.

Despite these barriers, a fish survey undertaken by BML in 2015 identified the presence of the threatened species giant kokopu in the South Branch of Otamangenge Stream (pp23-24 in Appendix H). Its presence means the Otamangenge Stream has ecological significance under the provisions of the Waikato Regional Policy Statement.

The Development Area lies to the south of Kay Road in the headwaters of the south branch of Otamangenge Stream. Here the waterways are artificial drains. Urbanisation of the Development Area has already begun. At the time of writing this AEE, Waikato Regional Council had already consented earthworks in this area (see Figure 1, below). It had also issued Resource Consent 121687 for stormwater diversion and discharge activities in relation to the Glaisdale West Block Subdivision, including a stormwater detention pond, stormwater inlet and outlet structures, pipe reticulation and overland flow paths[1].

BML provides a more detailed description of the Catchment (see section 1.1 on pp3-4 of Appendix H).

The proposed drainage concept for the Development Area is shown on Plan B1 in Appendix B and described in Section 2.5.2 of the ICMP. A stormwater network for part of the Development Area has already been consented to discharge to Te Awa o Katapaki. Within the south-western part of the Development Area primary rainfall events will be discharged to ground via soakage, and larger events will discharge to the Otamangenge Stream at the Kay Road culverts. The remainder of the Development Area will discharge via stormwater pipeline networks to a wetland, then to the Otamangenge Stream via a further pipeline and a culvert under Kay Road. Replacing the open drains with pipeline networks is expected to enhance the economic efficiency of subdivision and urbanisation of the Development Area.

Currently, the part of the Development Area for which development has yet to be consented is drained by means of artificial surface channels that discharge to Otamangenge Stream via a culvert under Kay Road. These channels are 1.5 to 2.0m deep with no or slight gradients (0.4 - 0.7%). The drains were originally excavated to drain wetlands and shallow groundwater and may dry up in summer (p.13 of Appendix H).

The stormwater diversion and discharge activities provided for in the ICMP will have the following actual or potential effects on natural features and water bodies:

1. Filling of shallow artificial drains and their replacement by a piped stormwater network;

[1] Resource Consent 121687 is not shown on Figure 1.

2. Discharge of sediments and contaminants to the Otamangenge Stream or Te Awa o Katapaki during and post construction;
3. Scour and erosion of the receiving waters as a result of sustained higher flows from detention devices;
4. The development of two wetlands for the purpose of treating and attenuating the stormwater prior to discharge to the Otamangenge Stream.

The wetlands will be intensively planted and will replicate the appearance and stormwater treatment function of natural wetlands. In time, once the vegetation matures, they will look like natural features in the landscape. They can be considered environmental enhancement.

The filling of artificial drains with low ecological value is considered a minor adverse environmental effect.

2.1.1 Management of effects

Appendix A to the AEE identifies the ICMP provisions that will avoid, remedy or mitigate the adverse effects of new stormwater diversion and discharge activities within the Catchment on landform and surface water. These methods provide for:

1. Sediment controls on earthworks construction works;
2. Stormwater soakage, which recharges ground water resources;
3. Treatment and attenuation of stormwater prior to discharge to Otamangenge Stream, including by means of intensely planted wetlands to maintain surface water at suitable temperatures for aquatic life;
4. Gross pollutant and litter traps;
5. Stormwater treatment devices are not constructed within natural or modified stream channels, other than in the upper catchment;
6. Stream works to protect against scour and erosion;
7. Retention and provision of riparian planting;
8. Translocation of fish to upstream habitats prior to commencing construction;
9. Enhancement of aquatic habitat through riparian planting and/or stream works;
10. Compliance with Te Awa o Katapaki ICMP;
11. Culverts to be provided under the Waikato Expressway and Resolution Drive Extension in order to ensure the headwaters to the north and east of these corridors remain connected to the rest of Otamangenge Stream.
12. Fish surveys, fish passage between habitat upstream and downstream of road corridors, and by replacing removed habitat with equivalent or enhanced habitat.
13. Removal of barriers to fish passage;
14. Careful management of wastewater to minimise the risk of discharges to stormwater;
15. More efficient use of water, which minimises the volume of water that needs to be extracted from the Waikato River and thereby minimises effects on that significant natural feature;
16. Monitoring of effects on the receiving environment.

Overall, it is considered the stormwater diversion and discharge activities undertaken in accordance with the ICMP will have a positive effect on natural features – particularly the development and intensive planting of the wetlands. Also, based on the Contaminant Load Modeling undertaken by Morphum, provided the various means of compliance perform to expectations, contaminant concentrations and yield will generally be lower than the existing environment (p.21 in Appendix H). Furthermore, any fish barrier removal or new riparian planting achieved through implementation of the ICMP will further enhance the aquatic habitat values and naturalness of Otamangenge Stream.

2.2 Aquifers

Urbanisation of the Development Area and construction of the Waikato Expressway and Resolution Drive Extensions will reduce the total area of permeable surfaces in the Catchment, reduce the volume of recharge to ground-water, and increase the volume of water that is to be discharged to the Waikato River via the Otamangenge Stream or Te Awa o Katapaki.

Based on the figures in Table 2 of Appendix I, the Development Area (catchments S6 and S7) covers an area of 65.9ha, which represents just 9.6% of the total Catchment. Following development, 28.3ha, or 42.9%, of the Development Area is predicted to remain as permeable surface. This will continue to provide recharge to groundwater aquifers, including through the beds of the detention wetlands and Otamangenge Stream itself.

A specific assessment of the effects of the proposed development within the Catchment on groundwater has not been undertaken for this ICMP. Given the small percentage of the Catchment that is to be converted to impermeable surface, an adverse effect on aquifers is not expected.

2.2.1 Management of effects

ICMP provisions that promote disposal of the stormwater by soakage and require provision of wetlands will mitigate the reduction in the volume of water recharging aquifers. Furthermore, the ICMP provisions that require treatment of stormwater and careful management of wastewater will avoid or mitigate the risk of contaminating aquifers. These provisions are identified in Appendix A to the AEE.

The effects of the reduction in ground water recharge on aquifers has not been assessed, but based on the percentage of the Catchment that will be converted to impermeable surface, any adverse effect is expected to be no more than minor. The requirement for treatment of stormwater runoff prior to discharge to receiving water will ensure the effects of the diversion and discharge of stormwater on the quality of groundwater is no more than minor.

3 Sites of cultural and/or historical significance

The following documents were reviewed in order to identify whether the proposed stormwater diversion and discharge activities provided for in the ICMP would affect any known sites of cultural or historical significance:

- *Rototuna Stages 3 & 4 Tangata Whenua Cultural Assessment Report: November* 2005 prepared by Nga Mana Toopu o Kirikiriroa ("NaMTOK");
- *Waikato District Plan*; and
- *Hamilton City Proposed District Plan (Appeals Version).*

Hamilton City Council commissioned the 2005 NaMTOK report to inform the preparation of Variation 14 to the then Hamilton City Proposed District Plan to rezone for development areas known as Stages 3 and 4 of the Rototuna Structure Plan. The Development Area lies within Stage 4. The report outlines the history of Maori occupation of a wide area, including, but extending far beyond the Catchment. It includes accounts of significant historic events and people and the various kin groups associated with the area. It describes the significance of the general area to the Maori who lived there and relied on the forests, waterways, wetlands and cultivations for food and materials to support everyday life.

The NaMTOK report identifies no specific known heritage sites within the Development Area. However, it identifies the possibility of finding timber carvings and human remains when excavating in former peat

swamps and artefacts and buried human remains near springs. It also identifies that earthworks within this area could potentially uncover the following types of artefacts:

- Hangi stones;
- Midden;
- Bones of humans or dogs;
- Carved stones used as talisman ;
- Evidence of posts embedded in the ground, which could have supported elevated food drying platforms, or been parts of houses or palisades, or ceremonial posts; and
- Discarded domestic items, such as chards of obsidian flakes, broken or discarded stone tools such as adzes or stone fern root pounders, pumice carvings, kokowai (iron oxide), bone bird-snaring points, greenstone ornaments, and broken clay tobacco pipes.

The Hamilton City Proposed District Plan and the Waikato District Plan identify no archaeological or cultural sites within the Catchment.

The CSDC is not a consent to carry out earthworks, and there are no conditions on it referencing procedures to be followed in the event of discovery of any artefact or human remains. Waikato Regional Council usually imposes such conditions on the earthworks consents developers obtain for the development of subdivisions.

However, the exercise of the stormwater diversion and discharge activities covered by the ICMP could give rise to the discovery of artefacts or human remains, if the discharge were to result in the erosion or scour of a stream bed and that exposed such items.

3.1 Management of effects

Effects on sites of cultural or historic significance will be minimised by the ICMP requirements (Stormwater BPO 8 (d) and Method 11 in Table 7) for notification of the appropriate iwi representatives and authorities if any artefacts or human remains are discovered.

The diversion and discharge of stormwater in accordance with the ICMP will have no adverse effects on known sites of cultural or historical significance. Any artifacts discovered in the area could potentially provide an opportunity to add to the knowledge of pre-European material culture and occupation in this area, and this would be a positive effect.

4 Public health

4.1 Domestic water supplies

There is potential for any significant contaminant discharged to the stormwater network in the Catchment, during or post construction, to adversely affect the quality of the water at the abstraction points of human drinking water systems downstream. Normal earthworks construction activities and urban stormwater discharge post-construction are not expected to have such an effect. But spillage of a significant quantity of a significant contaminant might, although the probability of this occurring is considered very low. Nevertheless, the ICMP requirement that stormwater is discharged via ground soakage or treated in wetlands prior to discharge to the Otamangenge Stream will minimise the potential for such effects to occur.

The ICMP also requires that treatment devices are maintained so that the devices provide best practicable stormwater management efficiency at all times (see Method 6 in Table 7 of the ICMP). The

ICMP's monitoring requirements will also focus on ensuring devices are being maintained and continuing to function as required (see Table 10 of the ICMP).

The wetlands might provide an opportunity for any toxic spill to be contained, isolated and treated.

In addition, conditions 26 and 27 of the CSDC provide further protection in the event of a significant spillage and will help ensure its adverse effects are avoided, remedied or mitigated so that they would be no more than minor. It is understood these conditions, were included on the CSDC to satisfy the requirements of the *National Environmental Standard for Sources of Human Drinking Water*. They are as follows:

> 26) *The consent holder shall manage the stormwater network to avoid as far as practicable and otherwise minimise, the discharge of any contaminant that may affect the suitability of water for human consumption after treatment.*
>
> 27) *The Consent Holder shall as soon as practicable but no longer than 3 hours after it comes to its attention, notify the Waikato District Council, Watercare Services Ltd and the Waikato Regional Council of an event that may in itself, or as a consequence of the event, have a significant adverse effect on the quality of water at any downstream drinking water supply abstraction point. The Consent Holder shall record the reasons for the event, the actions taken by the Consent Holder to avoid and/or mitigate issues relating to the event, and undertake an assessment of what measures can be adopted in the future to minimise such events. Upon the written request of the Waikato Regional Council, the Consent Holder shall report this information to the Waikato Regional Council and the Medical Officer of Health.*

4.2 Other health risks

BML concluded:

- *"The microbial pathogen load* [in the Otamangenge Stream] *makes the water unsuitable for human contact or livestock consumption throughout the catchment, but it is unlikely water from this water way would be used for these purposes"* (p.26 in Appendix H);

- *"... the concentrations* [in Otamangenge Stream sediments at Osbourne Road] *of arsenic, cadmium, and zinc (and potentially chromium, lead, and nickel) may present a risk for people collecting watercress for human consumption. Watercress was observed in the stream downstream of Osbourne Road and is known to bioaccumulate metals, particularly arsenic (Edmonds, 2001)"* (p.27 in Appendix H); and

- *"Table A1* [in the Contaminant Load Model (Morphum, 2015) – see Appendix D] *shows that contaminant concentrations and yield will generally be lower than the existing environment. Some zinc and copper loads and concentrations show small increases compared to the existing environment, but these are considered to be within both the margin of error of the contaminant load model and the typical variation of these contaminants occurring as a result of agricultural land use"* (p.22 in Appendix H).

The ICMP includes the preparation and implementation of an education strategy. This will include a collaborative approach with Waikato Regional Council, Waikato District Council and tangata whenua to ensure that appropriate messages to the public are provided to discourage them from having contact with water in, or consuming watercress gathered from, Otamangenge Stream and to advise the public that water in the stream is unsuitable for consumption by livestock.

4.3 Management of effects

Public health will be protected by the particular ICMP provisions identified in Appendix A to the AEE. These provisions require:

- Treatment of stormwater prior to discharge to surface water;
- Disposal of stormwater runoff by means of ground soakage;
- Careful management of wastewater so as to avoid contaminating stormwater;
- Management of flooding so as to minimise the risk of dwellings being inundated or people drowning during flood events;
- Compliance with Te Awa o Katapaki ICMP;
- Assessment of the stability and safety of the River Road and Osbourne Road culvert embankments during flood conditions; and
- Monitoring of stream water quality and stormwater treatment device performance and for visual contaminants.

In addition, the following will also protect public health:

- Notification and reporting in accordance with CSDC Condition 27; and
- Application of appropriate bylaws (including the Hamilton Stormwater Bylaw 2015).

Overall, any adverse effects on public health of activities carried out in accordance with the ICMP will be no more than minor.

5 Flooding hazards

The criteria to be met relating to the attenuation of 2, 10 and 100 year events, post-development, are set out in Table 6 of the ICMP.

Morphum has developed a stormwater capacity model for the Catchment (see Appendix I) and used it to assess the effects of proposed development on flow in the Catchment's watercourses. 24 hour storm events with 2 year, 10 year and 100 year recurrence interval probability were assessed. The model was also used to assess the capacity of existing culverts on public roads within the Catchment in the 2, 10 and 100 year events. The culverts are described in Table 4 on page 5 of Appendix I. Effects on any culverts on private roads or access within the Catchment will be assessed in the future as part of the proposed Flood Hazard Mapping where this falls within the modelling extent.

The capacity model assumed the same existing and future land use that was used for development of the Contaminant Load Model (see s.7 below) with one exception. In addition, it assumed residential development of the land within the Catchment lying north and east of the Waikato Expressway and the area south and west of the Expressway that lies east of Resolution Drive Extension and north of a line defined by a projection of Reynolds Road eastward to Kay Road. Residential development of this area is not currently envisioned by the Waikato Proposed Regional Policy Statement, but has been provided for in the capacity model for the purposes of sizing and future-proofing the culverts to be provided under Resolution Drive Extension and the Waikato Expressway. The design of these culverts will be confirmed during the detailed design phase of each respective project and may change.

The model assumes seven stormwater detention devices within the Catchment located where indicated on Figure 1 in Appendix I. These include two devices proposed in relation to the proposed expressway, three in relation to the proposed Resolution Drive Extension, and one each proposed for The Meadows and Glaisdale West developments. Actual design information was used in the model for Glaisdale

wetland; the other detention areas were sized to meet the 2 year, 10 year and 80% of the 100 year predevelopment flows (without climate change) (p.6 of Appendix I).

5.1 Peak flows

The capacity model predicts the means of compliance measures set out in section 6.4 of the ICMP will reduce post development peak flows in the 2, 10 and 100 year events with climate change below those predicted for existing land use with climate change, except for the Northern Arm, 2 year event for which flows are predicted to increase from 1.6 to 1.7 m^3/s (Appendix I, p.7). On that basis, stormwater diversion and discharge activities undertaken in accordance with the ICMP will generally have a positive effect on peak flows, except for the 2 year event in the Northern Arm for which the adverse effect will be no more than a minor adverse effect.

However, the capacity model predicts longer periods of elevated flow after the storm peak, post development. These flows have the potential to increase erosion and scour of downstream watercourses. In order to ensure this adverse effect will be no more than minor, the ICMP requires the following measures to be implemented:

- Suitable energy dissipation and erosion protection measures provided at all discharge locations (Means of Compliance 8);
- Otamangenge Stream downstream of new development will be monitored for evidence of scour or erosion (see Action 1a in ICMP Table 10) and any eroding sections will be treated to stabilise them (see Action 7 in ICMP Table 8). This has been assessed as the Best Practicable Option for managing scour and erosion; and
- Extended detention in accordance with TP10 is proposed as a Best Practicable Option to mitigate potential erosion and scour downstream (see in the ICMP: section 4.2, Parameter 1 in Table 6, and Stormwater BPO 8c in section 4.3.4).

Morphum recommends (Appendix I, p.1) site-specific design be undertaken for the attenuation devices proposed and their effects on flood flows modelled in order to ensure the site specific device design satisfies the flood peak attenuation performance criteria outlined in Table 6 of the ICMP. This requirement is reflected in Method 6 in ICMP Table 7.

5.2 Stream levels

The capacity model predicts the stream level at seven locations in the Catchment where stream cross-sections were surveyed (see Table 7 in Appendix I). It predicts that the water levels within the 10 and 100 year events are not predicted to overtop the banks. Therefore, the requirement to avoid more than 3 days ponding in the 10 year event for rural channels is met (Appendix I, p.10)

5.3 Culvert capacity

Morphum's review of culvert capacity concluded (see Table 6 in Appendix I):

- The head water at the existing culvert at River Road will be level with the culvert's soffit during the 100 year event;
- The existing culvert at Osbourne Road South will surcharge during floods equivalent to, or greater than, the 10 year event;
- None of the existing public roads in the Catchment will be overtopped during the 100 year event.

Morphum recommended the stability of these River Road and Osbourne Road South culvert embankments be assessed to determine whether any measures are necessary to address any

deficiencies (Appendix I, p.10). This measure has been included in the ICMP as Future Action 6 in Table 8.

5.4 Overland flow

The ICMP requires stormwater runoff that exceeds the reticulation system capacity to be safely conveyed by overland flow paths (Method 7 in Table 7 of the ICMP). To prevent localised flooding as an area is developed, designated overland flow paths will be incorporated into the design and layout of subdivisions. Overland flow paths will be provided to convey flows in excess of the design storm, up to and including the 100 year Average Recurrence Interval rainfall event. Roadways will form these secondary flow paths as far as possible. However, where necessary, overland flow paths required over private land will be formally recognized and protected as part of the consenting and construction processes.

For the catchment draining to the Glaisdale West Wetland, overland flows will drain via the road system to the wetland. If flows and volumes exceed the capacity of the primary outlet pipe from the wetland and available storage of the wetland, or if the primary outlet becomes blocked, flows will discharge from the wetland via a secondary overland flow path to the Eton Estate development to the south and from there into Te Awa o Katapaki Stream catchment. Road design is required to allow for these flow paths. The two private properties affected have easements on the titles. Waikato Regional Council has already consented these diversion and discharge activities.

For the catchment draining to the Meadows Wetland overland flows will drain via the road system to the wetland. If flows or volumes exceed the capacity of the primary outlet pipe from the wetland and available storage in the wetland, or if the primary outlet becomes blocked, then flows will discharge from the wetland via a yet to be approved secondary overland flow path. Details of the flow path have yet to be finalised.

5.5 Flood hazard modelling

Morphum's capacity model is of insufficient detail for flood hazard modelling (s.1.1 in Appendix I), so at least part of the Catchment will be remodeled as part of Hamilton City Council's 3 Waters Modeling project. This project uses URBAN/MIKE 11 software and produces flood hazard maps that will identify the location of overland flow paths and high, medium and low flood hazard areas. The extent of the area to be modelled will be determined in the future.

It is proposed to complete the flood hazard modeling after the next LiDAR flight for the city, which is programmed for the 2017/2018 year. However, the actual timing of modeling has yet to be determined. It is likely to be undertaken as part of a future revision of the ICMP, which is currently planned every 5 to 7 years, but will be influenced by available funding and ICMP priorities.

The Flood Hazard Maps will be incorporated into the Hamilton City Proposed District Plan. The provisions of the District Plan will ensure that new activities are not established within Hamilton City where they will be prone to, or cause, unacceptable risk of loss of human life or property as a result of a flood hazard.

5.6 Management of effects

Potential adverse effects of flooding caused by the diversion and discharge of stormwater within the Catchment will be managed by the ICMP provisions identified in Appendix A to the AEE that require:

- Disposal of stormwater runoff by means of ground soakage;

- Re-use of rainwater for non-potable purposes;
- Attenuation of stormwater in wetlands prior to discharge to Otamangenge Stream;
- Site-specific design of attenuation devices to ensure they satisfy the flood peak attenuation criteria;
- Provision of overland flow paths for stormwater runoff that exceeds the reticulation system's capacity;
- Stormwater treatment devices are not constructed within natural or modified stream channels, other than in the upper catchment;
- Sediment controls on earthworks construction works;
- Compliance with Te Awa o Katapaki ICMP;
- Flood hazard modelling and mapping, incorporation of the maps in the Hamilton City District Plan, and provisions of the District Plan that manage activities within Flood Hazard Areas;
- Assessment of the stability and safety of the River Road and Osbourne Road culvert embankments during flood conditions;
- Investigation of the potential extension of the land drainage rateable area; and
- Monitoring of stream bed and bank condition and the sediment control of building construction and earthworks.

These ICMP provisions will ensure that any adverse effects of the diversion and discharge of stormwater in the Catchment on flooding will be no more than minor.

6 Receiving water hydrology

6.1 Base flows

Base flow is generated when rain or stormwater soaks into the ground and migrates as groundwater towards streams and rivers.

The Development Area is sited at the head of the catchment discharging to existing artificial farm drains, which typically dry up in summer months, then to the perennial reaches of the South Branch of the Otomangenge Stream.

Waikato Regional Council has already consented[2] to a stormwater detention pond, stormwater inlet and outlet structures, pipe reticulation and overland flow paths for the Glaisdale West Block Subdivision. The detention pond will discharge via a pipeline to Otamangenge Stream at Kay Road. The pipeline will not drain shallow groundwater from the terrain it passes through. The contribution of this groundwater to sustaining flow in the Stream may be lost.

In addition, Waikato Regional Council has already authorised the diversion of stormwater from the south-western part of the Development Area to Te Awa o Katapaki. Furthermore, the increase in impermeable surfaces within the Development Area will reduce direct infiltration of rainwater into the ground, and there will be a significant increase in the annual stormwater flow volume discharging from the Development Area.

However, the effect on baseflows from these changes in hydrological regime is considered to be significantly mitigated by the combination of on-lot water efficiency measures, wetlands and soakage selected as BPOs and listed in ICMP Table 7 (Methods to Achieve Compliance). Although the soakage

[2] Resource Consent 121687.

area across the catchment will be reduced by the increase in impermeable surfaces, the wide, shallow, unlined wetlands will recharge downstream subsurface waters through infiltration inflows and likely substantially increase baseflows during dry periods, when the farm drainage channels typically dry up (Damian Young, pers com, 30 July 2015).

BML notes (p.27 in Appendix H):

> *"Increased impervious surfaces combined with removal of the drains south of Kay Road to facilitate development will reduce the volume of water flowing into the Otamangenge Stream south branch. Because the stream has ecological significance as giant kokopu habitat, stream base flows must be maintained".*
>
> *Provided that the drains south of Kay Road are replaced post-development with stormwater devices that discharge into the stream's south branch, the increased stormwater volume generated as a result of increased impermeable surfaces is likely to offset the reduced base flows from stormwater diverted to the Te Awa O Katapaki Stream catchment via soakage. On that basis, stormwater devices replacing the existing drains must continue to provide surface flow to the Otamangenge Stream south branch to maintain stream base flows.*

This has been adopted as a requirement of this ICMP, but is subject to a requirement for stormwater to be discharged to ground soakage where conditions are considered suitable, in accordance with Hamilton City Council's Infrastructure Technical Specifications. See "c" under Operational Objective 2 in section 3.4 of the ICMP.

BML also notes (p.27 in Appendix H):

> *Baseflow in the north branch drains will be sourced from shallow groundwater within the basin defined by Kay Road, Horsham Downs Road, and the eastern end of Osbourne Road. Those flows combine through the drainage network to provide the permanent flows in the two main drains and the natural stream at and downstream of Osbourne Road. On that basis, waterway connectivity must be maintained across the proposed road corridors and stormwater devices replacing the existing drains must continue to provide surface flow to the Otamangenge Stream north branch to maintain stream base flows.*

These have also been adopted as requirements of this ICMP – see Method 14 in ICMP Table 7.

6.2 Management of effects on base flows

Potential adverse effects on Otamangenge Stream base flows will be managed by the ICMP provisions identified in Appendix A to the AEE, which require:

- Stormwater runoff from the Development Area to be discharged, with attenuation, via wetlands to the South Branch of Otamangenge Stream (except for those discharges Waikato Regional Council has already authorised to be diverted to Te Awa o Katapaki);
- Disposal of stormwater via ground soakage; and
- Culverts to be provided under the Waikato Expressway and Resolution Drive Extension in order to ensure the headwaters to the north and east of these corridors remain connected to the rest of Otamangenge Stream.

6.3 Peak flows in streams

The effects of the proposed stormwater diversion and discharge activities provided for in the ICMP on Otamangenge Stream peak flows are discussed in section 5.1 above.

6.4 Long-term aquifer levels

The effects of the proposed stormwater diversion and discharge activities on aquifer levels is addressed in section 2.2 above

7 Receiving water sediment and water quality

The minimum contaminant removal performance criteria for stormwater treatment devices are set out in Table 6 of the ICMP.

Morphum undertook a Contaminant Load Assessment ("CLA") for the Catchment (see Appendix D) and modelled existing and proposed future contaminant loads discharged in stormwater to natural waterways in the Catchment.

The land use assumed for each model is depicted in Figure B-1 in Appendix D.

The model of the future scenario assumes:

- the proposed Resolution Drive Extension, Waikato Expressway and other roading shown on Figure B-1 have been constructed;
- land use within the Development Area will be as specified in the Rototuna Structure Plan;
- land use within the remainder of the Catchment will remain Rural or Large Lot Residential as currently zoned in the Waikato District Plan; and
- The stormwater treatment devices as shown on Figure B-2, the Means of Compliance Map, in Appendix D will be in place. These devices include swales and wetlands for the Waikato Expressway and Resolution Drive Extensions and soakage and wetlands elsewhere.

The modelling concluded (Appendix I, p.4):

1. The proposed stormwater treatment methods will achieve the target performance of at least 75% removal of Total Suspended Solids removal for all developed areas;
2. Total copper and total zinc concentrations will be within the ANZECC guidelines; and
3. The rural areas, which are not developed, generally do not provide 75% Total Suspended Solids removal.

The Monitoring Programme provided for in the ICMP will ensure compliance with the other contaminant requirements of Table 6 in the ICMP, namely:

1. *Turbidity: no greater than 25NTU in stormwater discharge measured after reasonable mixing.*
2. *Colour: no conspicuous changes in colour downstream of the discharge point after reasonable mixing.*
3. *Other stormwater contaminants appropriate to the Catchment to be managed to avoid adverse effects on the environment.*
4. *Livestock watering: no discharge of any contaminant that would make the downstream waterways unsuitable for livestock watering after treatment.*

BML concluded (p.22 in Appendix H) the following about the CLA:

> *"... assuming the means of compliance perform to expectations following development, Table A1* [of the CLA] *shows that contaminant concentrations and yield will generally be lower than the existing environment. Some zinc and copper loads and concentrations show small increases compared to the existing environment, but these are considered to be within both the margin of*

error of the contaminant load model and the typical variation of these contaminants occurring as a result of agricultural land use.

However most of the Catchment within Waikato District will be unmodified by development and will continue to discharge sediments and contaminants to Otamangenge Stream, as at present. Consequently, BML also concluded (p.26 in Appendix H):

Based on the CLA ..., stormwater from urbanisation within the HCC boundary and roading is unlikely to substantively change either contaminant yields or concentrations discharged downstream

7.1 Management of effects

Potential adverse effects on receiving water sediment and water quality will be managed by the ICMP provisions identified in Appendix A to the AEE. These provisions require:

- Disposal of stormwater by means of ground soakage;
- Treatment and attenuation of stormwater in wetlands prior to discharge to Otamangenge Stream;
- Provision of gross pollutant and litter traps;
- Stream works to protect against scour and erosion;
- Stormwater treatment devices are not constructed within natural or modified stream channels, other than in the upper catchment;
- Retention and provision of riparian planting;
- Sediment controls on earthworks construction works;
- Enhancement of aquatic habitat through riparian planting and/or stream works;
- Compliance with Te Awa o Katapaki ICMP;
- Careful management of wastewater to minimise the risk of discharges to stormwater;
- Review of Stormwater Device Operations & Maintenance template and ITS checklist; and
- The Monitoring Plan activities.

Stormwater discharged from the Development Area in accordance with the ICMP will generally have contaminant concentrations and yields that are lower than the existing environment. Any adverse effects of the diversion and discharge of stormwater on water quality and sediment will be no more than minor.

8 Receiving water habitat, ecology and ecosystem health

BML has evaluated Otamangenge Stream's existing aquatic ecological values and water and sediment quality and identified the potential effects on, risks to, and sensitivities of, the stream's ecology to stormwater discharges from proposed development in the Catchment - see Appendix H.

The assessment is based on existing information, field surveys of riparian and aquatic habitat, on-site measurements of water quality, contaminant analysis of water and sediment samples, analysis of aquatic macro-invertebrate samples, evaluation of Freshwater Fish Database records and a fish survey (see Appendix H, p.7, Table 1).

BML identifies the Catchment has the following characteristics (p.1 in Appendix H):

- *The stream headwaters are artificial drains, which convert to modified stream channels within a surface flow path, before becoming a natural stream channel.*

- *In general, aquatic habitat quality provides moderate conditions for biota, but indigenous fish diversity is limited by fish passage obstacles and lack of riparian cover.*
- *Water quality is typical of groundwater-fed rural Hamilton streams with some water quality parameters exceeding the tolerances of aquatic species. Concentrations of copper, zinc and aluminium exceed ANZECC guidelines, and nutrients are elevated. The toxicity of metals is likely to be limited by formation of mineral complexes with phosphorus and organic material, meaning the bioavailability in the water column is low.*
- *Benthic sediment has elevated contaminant concentrations at Osbourne Road but this is likely to be a localised issue*[3]*.*
- *As well as shortfin eels, the stream provides habitat for giant kokopu which confers ecological significance on the catchment. Longfin eels, also threatened, may also be present.*

BML's assessment assumes urban and road stormwater discharges are treated and attenuated to TP10 standards and takes into account the CLA (Appendix D).

8.1 Water quality

The effects stormwater diversion and discharge in accordance with the ICMP will have on water quality are discussed in Section 7 above. BML has assessed the particular effects of these activities on aquatic habitat as follows.

BML concluded (p.22 in Appendix H) the following about the CLA:

> *The results of the CLA indicate that use of the various means of compliance as set out in Figure B2* [of the CLA] *to treat stormwater will maintain concentrations of metals and sediment below ANZECC guideline values for biological harm.*

BML also concluded (p.26 in Appendix H):

> *... there remains a risk of effects from thermal pollution particularly after summer rainfall and particularly if ponds are used rather than planted wetlands or swales. On that basis, stormwater devices throughout the catchment must use planted swales and wetlands with >80% cover to maintain cool stormwater discharge temperatures.*

In order to help ensure the Catchment's surface waters remain at temperatures that will sustain aquatic life, the requirement that stormwater attenuation and treatment devices comprise planted swales and wetlands with greater than 80% cover has been adopted as a requirement of the ICMP – see Methods 6 and 14 in Table 7 of the ICMP.

Proposed stormwater diversion activities in the Development Area will replace artificial surface drains with piped stormwater networks. However, these drains provide *"poor habitat for fish and macro-invertebrates, shallow water depths, poor habitat diversity, poor water clarity, and minimal stable habitat, shade or riparian vegetation"* (p13 in Appendix H). Waikato Regional Council has already authorised the loss of these artificial drains. Any adverse effect of this loss is no more than minor.

[3] BML discusses this in detail on pages 22-23 in Appendix H.

8.2 Aquatic macro-invertebrates

BML (pp27-28 in Appendix H) assesses the effects of the proposed development on aquatic macro-invertebrates as follows:

> *"The MCI /SQMCI[4] scores* [for the benthic macro-invertebrate samples collected from Otamangenge Stream] *are consistent with those measured in similar open rural streams with permanent water flow, groundwater-derived base flows, abundant aquatic macrophyte cover, and water with elevated nutrient and metal concentrations. This reflects the catchment's rural and rural-residential land use.*
>
> *On balance, no change in the MCI/SQMCI scores can be expected as a result of urbanisation and road construction provided that suspended sediment discharges from construction do not cause smothering of benthic and aquatic macrophyte habitat downstream.*

The means of compliance measures will ensure this proviso is met. BML also concluded (p.28 in Appendix H):

> *The aquatic macroinvertebrate community diversity on the Otamangenge Stream could be improved with changed land use that improves shallow groundwater quality, enhancement or replanting of riparian vegetation, and treatment of diffuse stormwater runoff as could occur with conversion from rural to residential land use. However, given the small proportion of the catchment being converted within Hamilton City, such a change is likely to be very limited and aquatic macroinvertebrate community composition downstream of the site is likely to remain unchanged. As a result, the MCI and SQMCI scores at the survey sites are likely to remain similar over time because habitat values and water quality influenced by* [sic] *predominantly by rural land use are unlikely to change.*
>
> *However, should riparian restoration be advocated to offset a different effect (for instance potential for increased stream bed or bank erosion), then a small localised improvement in MCI/SQMCI scores might be expected".*

Riparian restoration is discussed in section 9 below.

8.3 Management of effects

Potential adverse effects on aquatic habitat, ecology and ecosystem health will be managed by the particular ICMP provisions identified in Appendix A to the AEE. These provisions require:

- Treatment and attenuation of stormwater prior to discharge to Otamangenge Stream;
- Stormwater treatment wetlands to be densely planted with greater than 80% plant cover to maintain surface water at suitable temperatures for aquatic life;
- Provision of gross pollutant and litter traps;
- Stream works to protect against scour and erosion;
- Stormwater treatment devices are not constructed within natural or modified stream channels, other than in the upper catchment;
- Retention and provision of riparian planting;

[4] In this context "MCI" means "Macroinvertebrate Community Index for soft-bottomed streams", and "SQMCI" means "Semi Quantitative MCI for soft-bottomed streams". These indices are discussed in Appendix 3 to the BML report and can be interpreted as indicators of water quality.

- Sediment controls on earthworks construction works;
- Translocation of fish to upstream habitats prior to commencing construction;
- Enhancement of aquatic habitat through riparian planting and/or stream works;
- Compliance with Te Awa o Katapaki ICMP;
- Culverts to be provided under the Waikato Expressway and Resolution Drive Extension in order to ensure the headwaters to the north and east of these corridors remain connected to the rest of Otamangenge Stream;
- Fish surveys, fish passage between habitat upstream and downstream of road corridors, and replacement of removed habitat with equivalent or enhanced habitat;
- Careful management of wastewater to minimise the risk of discharges to stormwater;
- Review of Stormwater Device Operations & Maintenance template and ITS checklist;
- Removal of barriers to fish passage; and
- Monitoring Plan activities.

The stormwater treatment and any enhancement of riparian planting required by the ICMP have the potential to improve aquatic macroinvertebrate community diversity. However, the Development Area and the area of the new roading corridors represent only a small proportion of the total Catchment. The effects of existing stormwater discharges to Otamangenge Stream from the rural areas will predominate. Consequently, any improvement to aquatic habitat resulting from these ICMP measures is likely to be localised. Some existing artificial drains within the Development Area will be filled in, and stormwater conveyance provided by pipeline networks. However, these drains provide poor quality aquatic habitat. Overall, any adverse effects on aquatic habitat, ecology and ecosystem health of the diversion and discharge activities provided for in the ICMP will be no more than minor.

9 Receiving water riparian vegetation

No significant riparian vegetation will be destroyed by urbanisation of the Development Area.

BML has recommended the intensive planting of 80% of the surface area of The Meadows and Glaisdale West wetlands in order to maintain the water in the wetlands at a cool temperature that will not stress aquatic life when discharged to Otamangenge Stream (p.26 in Appendix H).

BML has also recommended (p.31 in Appendix H):

- *Planting indigenous riparian plants specially chosen to improve bank stability and protect the channel bed (see Plant Selection Tool for Waikato Waterways).*

The ICMP includes the following measure that seeks to enhance the riparian vegetation of the receiving waters downstream of the discharge point at Kay Road (Method 18 in Table 7 of the ICMP):

- *Where it is identified that stormwater discharges may be having an effect on aquatic habitat and water quality values, then habitat enhancement shall be included as a mitigation measure via riparian planting and/or stream works as appropriate*.

As there will be no fish habitat in the Development Area, then habitat enhancement included as a mitigation measure via riparian planting will need to be undertaken outside of the Development Area, that is, outside of the area within the control of the developer or Hamilton City Council. The ICMP includes as a Future Action the development and implementation of a programme of mitigation works to be undertaken downstream of Kay Road in the area shown on Figure 8 of the ICMP (Action 4 in Table 12 of the ICMP). This programme of works will inform Hamilton City Council's LTP.

9.1 Management of effects

Potential adverse effects on riparian vegetation will be managed by the particular ICMP provisions identified in Appendix A to the AEE. These provisions require:

- Stormwater treatment wetlands to be densely planted to achieve greater than 80% plant cover;
- Stream works to protect against scour and erosion;
- Stormwater treatment devices are not constructed within natural or modified stream channels, other than in the upper catchment;
- Retention and provision of existing riparian planting; and
- Replacement of aquatic habitat lost through road corridor construction by equivalent or enhanced habitat.

Implementation of the ICMP could increase the total extent of riparian planting in the Catchment, which would be an environmental enhancement. Otherwise, any adverse effects on riparian vegetation will be no more than minor.

10 The extent and quality of open stream channels

Existing open channels upstream of Kay Road will be lost as a result of urbanisation of the Development Area. BML has assessed these waterways as low quality (p.13 in Appendix H):

> *The first approximately 400m of drain is a habitat consistent with the assessment of Kessels (2013) i.e. poor habitat for fish and aquatic macroinvertebrates, shallow water depths, poor habitat diversity, poor water clarity, and minimal stable habitat, shade or riparian vegetation ... The drain has no natural surface drainage and is likely to be fed predominantly by groundwater. The shallow depth indicates that it may dry up in summer when groundwater levels drop, leaving the occasional deeper pools as habitat refuges.*

The loss of low quality water channels in the Development Area will be offset by any channel enhancement work undertaken downstream (Method 10 in Table 7 of the ICMP). Enhancement works are planned to be implemented on the Stream between Kay Road and Osbourne Road (Future Action 7 in Table 8 of the ICMP). A purpose of these enhancement works will be to prevent stream bed scour and bank erosion that might otherwise result from sustained high flows from the stormwater wetlands, which are a consequence of the increase in impermeable surfaces in the Development Area. The riparian planting will also improve the habitat quality of the stream for fish and aquatic macroinvertebrates. The channel enhancement works and riparian planting will enhance the quality of any open stream channels treated in this way.

10.1 Management of effects

Potential adverse effects on the extent and quality of open stream channels will be managed by the particular ICMP provisions identified in Appendix A to the AEE. These provisions require:

- Treatment and attenuation of stormwater prior to discharge to Otamangenge Stream;
- Stormwater treatment wetlands with greater than 80% plant cover;
- Provision of gross pollutant and litter traps;
- Stream works to protect against scour and erosion;
- Suitable energy dissipation and erosion protection measures at all discharge locations;
- Stormwater treatment devices are not constructed within natural or modified stream channels, other than in the upper catchment;
- Retention of existing riparian vegetation or provision of new riparian planting;

- Sediment controls on earthworks;
- Compliance with Te Awa o Katapaki ICMP;
- Enhancement of aquatic habitat through riparian planting and/or stream works;
- Fish surveys, fish passage between habitat upstream and downstream of road corridors, and by replacing removed habitat with equivalent or enhanced habitat;
- Careful management of wastewater to minimise the risk of discharges to stormwater;
- Review of Stormwater Device Operations & Maintenance template and ITS checklist;
- Removal of barriers to fish passage; and
- Monitoring Plan activities.

The loss of the low quality water channels upstream of Kay Road is considered no more than a minor adverse effect. It is likely the quality of the open stream channels immediately downstream of Kay Road will be enhanced as a result of the stormwater diversion and discharge activities provided for in the ICMP on account of the improved quality of the stormwater discharge, and particularly if any new riparian planting is undertaken.

11 Fish passage for indigenous and trout fisheries

Fish surveys BML conducted in the Catchment identified no trout, but did identify the presence of threatened giant kokopu (pp24-25 in Appendix H). The latter means the stream has ecological significance under the provisions of the Waikato Proposed Regional Policy Statement.

Fish passage in the Catchment is already compromised by a weir downstream of the River Road culvert and by farm ponds constructed on the stream (p.28 in Appendix H). These features are barriers to all non-climbing fish species and are considered by BML to be one of several factors that contribute to the recorded fish diversity in the Catchment being *"substantially less than would be expected in natural conditions"* (p.28 in Appendix H). Furthermore, climbing species can only gain access beyond these obstacles if vegetation, debris or water flow are conducive to climbing.

BML concluded: *"Although the low recorded fish diversity is unlikely to be affected as a result of urbanisation and roading with stormwater management to TP10 standards, it could be improved if fish passage obstacles were remedied for climbing species"* (p.29 in Appendix H).

BML considers it is unlikely that giant kokopu occupy the drain habitats that will be modified or removed by urbanisation of the Development Area or stormwater discharges (p.30 in Appendix H). BML assumed fish passage upstream of Kay Road will not be provided since there is no upstream aquatic habitat, except the detention basins associated with The Meadows and Glaisdale West wetlands (p.5 in Appendix H).

11.1 Management of effects

The particular ICMP provisions that will manage adverse effects on fish passage are identified in Appendix A to the AEE.

The ICMP includes Future Action 11 in Table 8 of the ICMP to improve fish passage at existing barriers to fish passage:

> *If and when opportunities arise, measures should be implemented to eliminate the barrier effect of existing obstacles to fish passage, especially, but not exclusively, at the River Road culvert, either by providing fish passage beyond the obstacles or removal of the obstacles.*

BML considers fish passage upstream of the Waikato Expressway and Resolution Drive Extension may be required, depending on the presence of fish in drain habitat upstream of these road alignments (pp2, 5, 30 and 38 in Appendix H). Waikato Regional Council has already issued consents for the construction of the Waikato Expressway. Nevertheless, to ensure fish passage is provided for appropriately in the design of the Resolution Drive Extension or any future variation of the relevant Expressway consents, the ICMP includes the following requirement (Method 15 in ICMP Table 7):

> *Fish surveys shall be carried out in waterways within the Otamangenge catchment potentially affected by construction and operation of the Waikato Expressway and Resolution Drive Extension. Measures shall be included in these construction works to avoid, remedy or mitigate adverse effects on these fish habitat, including by providing for fish passage between habitat upstream and downstream of the road corridors and by replacing removed habitat with equivalent or enhanced habitats.*

In addition, Method of Compliance 9 in Table 7 of the ICMP will avoid adverse effects on fish passage. It requires that stormwater treatment devices are not constructed within natural or modified stream channels, other than in the upper catchment.

The provision of no fish passage upstream of Kay Road is no more than a minor adverse effect, as there is no upstream aquatic habitat other than the detention basins associated with The Meadows and Glaisdale West wetlands. Any works undertaken in the future to bypass or remove the existing barriers to fish passage at the River Road culvert and the in-stream ponds would be a significant environmental enhancement.

12 Natural and amenity values

As discussed in section 2.1 above, the entire Catchment is highly modified; the landform, ground water, surface water and aquatic life are the main natural features of relevance to the CSDC. Within both the rural and the proposed future urban landscapes, the stormwater diversion and discharge activities provided for in the ICMP have the potential to affect the appearance and visual amenity of the channels and the water within them, and their natural habitat values.

12.1 Management of effects

The ICMP requires measures to be implemented in relation to construction, and post-construction, that will protect natural and amenity values. These are identified in Appendix A to the AEE.

Such measures required in relation to construction include:

- Sediment controls during earthworks; and
- Translocation of fish, or fish passage provided, to upstream habitats prior to construction.

Once any part of the Development Area has been urbanised, or new road corridors have been constructed, potential adverse effects on natural and amenity values will be managed by ICMP provisions requiring:

- Re-use of rainwater and other water efficiency measures, which will minimise water consumption and contribute in a small way to protecting natural and amenity values of the Waikato River from which the City's water supply is extracted;
- On-lot soakage;
- Stormwater treatment devices;

- Stormwater treatment wetlands with greater than 80% plant cover;
- Provision of gross pollutant and litter traps;
- Stream works to protect against scour and erosion, including energy dissipation and erosion protection measures at stormwater discharge locations;
- Other than in the Catchment headwaters, stormwater treatment devices are required to be located away from modified or natural stream channels;
- Retention of existing riparian vegetation or provision of new riparian planting;
- Enhancement of aquatic habitat through riparian planting and/or stream works;
- Compliance with Te Awa o Katapaki ICMP;
- Measures to mitigate the effects of the Waikato Expressway and Resolution Drive Extension on fish habitat;
- Careful management of wastewater to minimise the risk of discharges to stormwater;
- Removal of barriers to fish passage; and
- Monitoring Plan activities.

Initially, urbanisation of the Development Area, construction of road corridors and implementation of mitigation measures will have localised effects on the appearance of those sections of waterway which will be filled or altered to accommodate these works. As previously discussed, the loss of the waterways within the Development Area, which have low ecological value, is a minor adverse effect. Construction of stormwater pipeline outfalls to the Otamangenge Stream will affect the appearance of the waterway and its amenity, but this will be a temporary and minor effect.

Sediment controls required during construction will ensure that any sediment discharged to the stormwater will be within allowable limits. The treatment, by wetlands and/or other devices, of stormwater runoff from urbanised areas will ensure adverse effects on the appearance and visual amenity and natural values of the water itself are no more than minor downstream of the point it is discharged to Otamangenge Stream.

As wetland and riparian planting grows and matures, the visual amenity of the wetlands and the planted waterways will be enhanced. This planting will help ensure stream temperature remains within a suitable range for aquatic life and this will enhance the stream's natural habitat values. Any measures implemented in the future to remove barriers to fish passage in the Catchment will also enhance the Stream's natural values. (See s.11 above).

As discussed in section 8.3 above, the stormwater treatment that is required, and any riparian planting provided, have the potential to improve aquatic macroinvertebrate community diversity and the stream's natural values. However, this improvement will be diminished by the effects of the poor quality stormwater runoff from existing activities in the rural part of the Catchment. Any adverse effects of the stormwater diversion and discharge activities provided for in the ICMP on natural values will be no more than minor.

13 Existing infrastructure

The Catchment is mostly a green-fields rural area, with roading, isolated farm buildings, pockets of rural residential development and some initial urbanisation within the Development Area. The majority of the Catchment is a green-fields area. The existing infrastructure relevant to stormwater management is as follows:

1. Public roads and their associated culverts;
2. Private roads or access and their associated culverts;
3. Dwellings and other buildings; and

4. The dams constructed on the north and south branches of the Otamangenge Stream to form a series of ponds for recreational waterfowl hunting (see s.4.15 on p.16 of Appendix H);
5. Existing stormwater infrastructure within the Development Area, including that connected to Te Awa o Katapaki catchment.

Morphum has assessed the effects on peak stormwater discharges of the proposed stormwater diversion and discharge activities provided for in the ICMP for the Development Area (see Appendix I). This assessment and related mitigation measures are discussed in s.5 above.

Using its capacity model, Morphum has predicted that the stormwater attenuation proposed in the ICMP will reduce peak flow in the 2, 10 and 100 year events to below those predicted for existing land use with climate change, except for the Northern Arm 2 year event where flows are predicted to increase from 1.6 to 1.7 m3/s (see Appendix I, p.7). Furthermore, as discussed in s.5.2 above, Morphum also predicted the Otamangenge Stream will not overtop its banks during the 10 and 100 year events.

It is concluded, therefore, that developments implemented in accordance with the ICMP will not cause flooding of any existing buildings, or other infrastructure in the Catchment that would not already flood with existing land use and climate change in the same recurrence interval storm, being 10 years or greater. If any existing buildings or infrastructure in the Catchment is prone to flooding with existing land use and climate change, the activities proposed in the ICMP will not increase the depth to which they are flooded, but may affect the duration of any such flooding.

13.1 Management of effects

The ICMP provisions that manage potential adverse effects on flooding will also manage effects on infrastructure. Those provisions are listed in s.5.6 above and identified in Appendix A to the AEE. They will ensure that any adverse effects on existing infrastructure will be no more than minor.

14 Existing authorised resource use activities

Authorised resource use activities include permitted activities allowed under the Waikato Regional Plan and activities for which resource consents have been granted. Waikato Regional Council has issued resource consents for activities of the type and at the locations indicated on Figure 1 and summarized in Table 1. In addition, it is known that Waikato Regional Council has also issued the consents listed in Table 2 in relation to the Waikato Expressway – Hamilton Section and Table 3 in relation to the Glaisdale West Block Subdivision, which are for activities within the Catchment but which are not indicated on Figure 1. The Resolution Drive Interchange will be located within the Catchment.

Table 1 – Summary of resource consents issued by Waikato Regional Council and shown on Figure 1

Type of Activity Consented	Number of Consents in Otamangenge Catchment	Colour of dot on Figure 1
Ground water take	9	Blue
Discharge of farm animal effluent onto land	4	Yellow
Earthworks	3	Olive

Note: The location of the consented activities is shown on Figure 1.

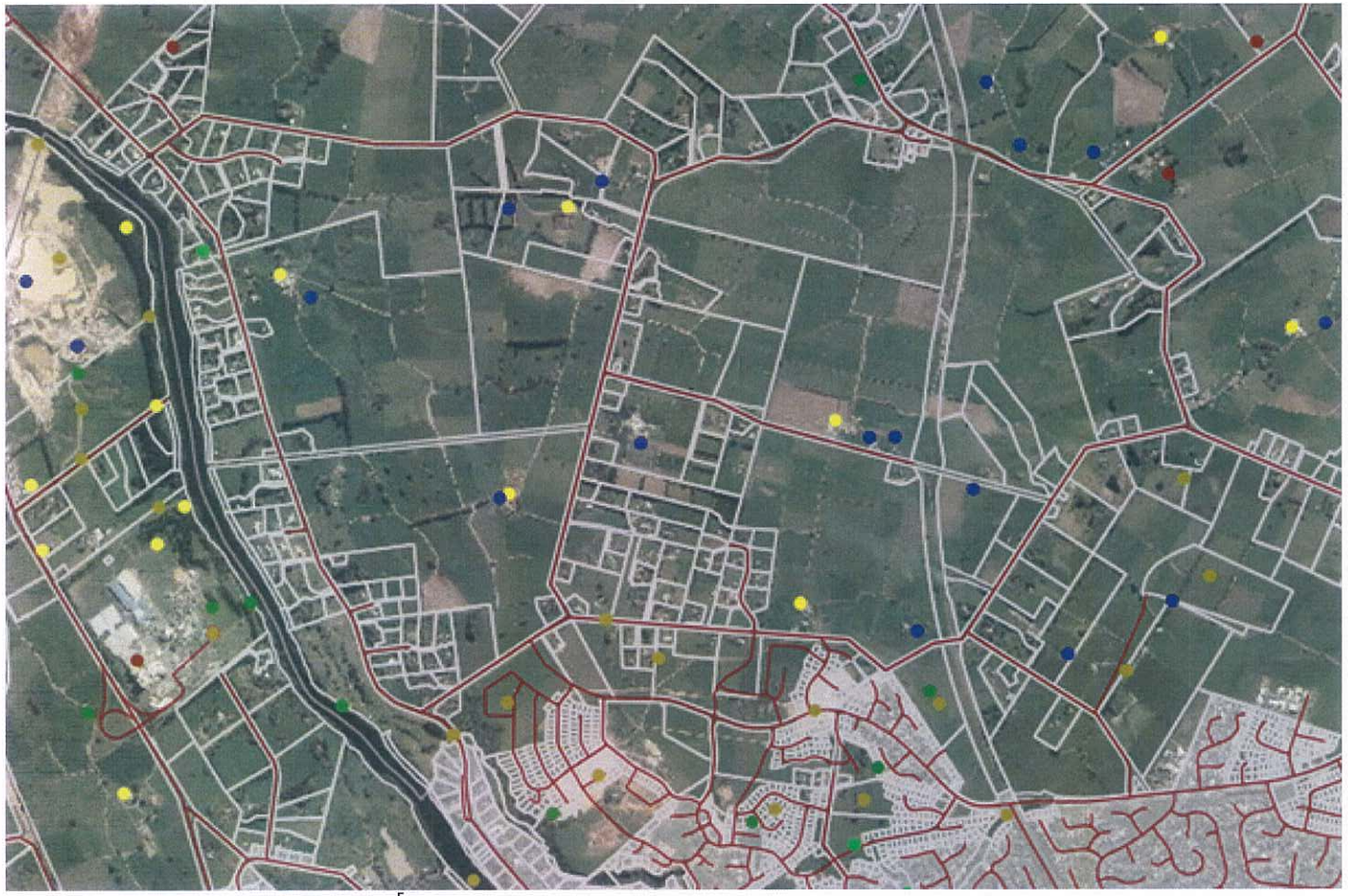

Figure 1 – Existing Resource Consents[5]

See Table 12 above for an explanation of the coloured dots.

[5] Sourced on 29 July 2015 from: http://giswrcmaps.waikatoregion.govt.nz/wrcmaps/?variant=Resource-Consents

Table 2 –Resource consents for Waikato Expressway Hamilton Section within Otamangenge Catchment

Resource Consent	Consent Subtype	Activity authorised
AUTH130361.01.01	Land disturbance	Earthworks
AUTH130361.05.01	Land - well	To drill below the water table to install bridge piles
AUTH130361.06.01	Groundwater take	To take and divert groundwater and discharge groundwater to water
AUTH130361.07.01	Water – stormwater	To divert and discharge stormwater
AUTH130361.08.01	Bed - structure	Construction, operation and maintenance of culverts
AUTH130361.09.01	Dam	To dam and divert surface water in association with culvert construction, operation and maintenance

Table 3 –Resource consent for Glaisdale West Block Subdivision within Otamangenge Catchment

Resource Consent	Consent Subtype	Activity authorised
121687	Discharge to Water	To divert and discharge urban stormwater runoff and associated contaminants to Otamangenge Stream

14.1 Authorised diversion and discharge

As discussed in section 5.1 above, methods of compliance included within the ICMP that require attenuation of stormwater discharges from the Development Area or roading projects will reduce peak flow in the 2, 10 and 100 year events to below those predicted for existing land use with climate change, except for the Northern Arm 2 year event where flows are predicted to increase from 1.6 to 1.7 m3/s (see p.7 in Appendix I). This means that implementation of the ICMP will generally ensure that sufficient capacity remains within the Catchment's waterways to convey any stormwater discharges authorised at other locations within the Catchment.

14.2 Consents to discharge farm effluent onto land

Stormwater diversion and discharge activities provided for in the ICMP will not affect the exercise of consents to discharge effluent onto land. As the former activities will not affect base flows (see s.6.1 above) or increase contaminant concentrations or yields in Otamangenge Stream, they will not affect the waste-assimilating capacity of the Stream either.

14.3 Authorised surface water takes

It is not expected that the Otamangenge Stream is being relied upon as a water supply source, including for stock watering purposes, on account of its poor water quality (see s.5.1 in Appendix H). Figure 1 shows no consented surface water takes within the Catchment, and no water extraction pipelines or pump houses were observed during the ecological survey of the Catchment (Louise Saunders, pers com, 30 July 2015). It is expected that the farms will be operating reticulated water supplies using consented ground water takes. If there were any permitted surface water takes, the proposed stormwater treatment the ICMP requires to be provided is not expected to adversely affect the stream's water quality downstream of Kay Road (see s.7 above) or its base flow (see s.6.1 above). Consequently, activities provided for under the ICMP will not affect any authorised surface water takes.

14.4 Authorised ground water takes

There are 9 consented ground water takes in the Catchment. As discussed in s.2.2, any adverse effects of the stormwater diversion and discharge activities provided for in the ICMP on aquifers is expected to be no more than minor. Consequently, no more than minor effects on the authorized ground water takes are expected.

14.5 Earthworks

The ICMP is not expected to have any adverse effect on existing consented earthworks activities. These consents will require these activities to manage sediment discharged from the earthworks sites, and this is consistent with the requirements of the ICMP.

14.6 Works over, on, in, or under the bed of a stream

There are no known consents for works in the bed of a stream in the Catchment downstream of Kay Road.

At present, any existing authorised works over, on, in, or under, the bed of the Otamangenge Stream downstream of the Development Area or the proposed road corridors will be subject to the peak flows and associated water forces that result from existing land use and climate change. As discussed in section 13 above, the peak flows resulting from implementation of the ICMP will generally be less than those resulting from existing development with climate change. Consequently any such authorised works will not be subject to higher peak flows, or greater peak discharge depths of flow as a result of the diversion and discharge of stormwater in accordance with the ICMP.

However, these diversions and discharges will result in higher sustained stormwater flows downstream of the Development Area and the points of discharge from the proposed road corridors. These higher sustained flows could cause scouring of the affected stream bed and erosion of its banks. Such scour or erosion could expose or undermine any existing authorised works over, on, in, or under the bed of the stream. However, the ICMP provides for stream beds and banks to be protected to prevent scour and erosion and this will protect any existing consented works in, on, or under the stream bed.

The implementation of any bank or stream bed armouring works will themselves be subject to the requirements of the Waikato Regional Plan, which will ensure that any adverse effects of the armouring works are appropriately avoided, remedied or mitigated.

14.7 Management of effects

Potential adverse effects of stormwater diversion and discharge on existing authorised resource use will be managed by the particular ICMP provisions identified in Appendix A to the AEE. These provisions require:

- Disposal of stormwater to ground soakage;
- Reuse of rainwater for non-potable purposes;
- Treatment and attenuation of stormwater prior to discharge to Otamangenge Stream;
- Stormwater treatment wetlands to be densely planted with greater than 80% plant cover;
- Provision of gross pollutant and litter traps;
- Stream works to protect against scour and erosion;
- Suitable energy dissipation and erosion protection measures at all discharge locations;

- Stormwater treatment devices are not constructed within natural or modified stream channels, other than in the upper catchment;
- Sediment controls on earthworks;
- Enhancement of aquatic habitat through riparian planting and/or stream works;
- Compliance with Te Awa o Katapaki ICMP;
- Culverts to be provided under the Waikato Expressway and Resolution Drive Extension in order to ensure the headwaters to the north and east of these corridors remain connected to the rest of Otamangenge Stream;
- Careful management of wastewater to minimise the risk of discharges to stormwater;
- Flood hazard modelling and mapping, incorporation of the maps in the Hamilton City District Plan, and provisions of the District Plan that manage activities within Flood Hazard Areas;
- Assessment of the stability and safety of the River Road and Osbourne Road culvert embankments during flood conditions; and
- Monitoring Plan activities.

The ICMP provisions that manage the effects of stormwater diversion and discharge activities on peak flows, base flows, water quality, scour and erosion will ensure that any adverse effects of these activities on existing authorized resource use in the Catchment will be no more than minor.

15 Conclusions

Stormwater diversion and discharge activities undertaken in accordance with the Otamangenge ICMP will have the following environmental effects:

Adverse effects considered no more than minor:

- Effects on aquifers;
- Effects on public health;
- Longer periods of elevated flow after a storm, which have the potential to increase scour and erosion of Otamangenge Stream bed and banks;
- Effects on flooding;
- Effects on base flows;
- Effects on water quality and sediments;
- Loss of artificial drains upstream of Kay Road, which are of low ecological value;
- Effects on aquatic habitat, ecology and ecosystem health;
- Effects on riparian vegetation;
- Effects on Otamangenge Stream's visual and natural amenity values;
- Effects on existing infrastructure; and
- Existing authorised resource use activities; and

Positive effects:

- Provision of wetlands with 80% vegetation cover;
- A general reduction in contaminant concentrations and yield discharged to Otamangenge Stream from the areas to be urbanised;
- Reduction in peak flows in Otamangenge Stream;
- Possible removal of existing barriers to fish passage;
- Any discovery of Maori artefacts;

- Dissemination of public health advice regarding contact with and use of Otamangenge Stream; and
- Riparian planting proposed along Otamangenge Stream between Kay Road and Osbourne Road; and

No effects:

- No known sites of cultural or historical significance will be affected.

16 References

Boffa Miskell Limited. (6 July 2015). *Otamangenge Stream: Assessment of Ecological Values to inform an Integrated Catchment Management Plan*[6].

Hamilton City Council. (July 2015). *Otamangenge Integrated Catchment Management Plan: Draft for Consultation.*

Morphum Environmental Limited. (27 May 2015). *Otama-ngenge Contaminant Load Model.* [7]

Morphum Environmental Limited. (July 2015). *Otama-ngenge Capacity Model.* [8]

Nga Mana Toopu o Kirikiriroa. (November 2005). *Rototuna Stages 3 & 4 Tangata Whenua Cultural Assessment Report.*

16.1 Personal Communications

Damian Young (Morphum Environmental Limited). Meeting with Paul Ryan et al on 30 July 2015.

Louise Saunders (Boffa Miskell Limited). Telephone Conference call with Paul Ryan et al on 30 July 2015.

[6] Appendix H
[7] Appendix D
[8] Appendix I

Assessment of Environmental Effects

Appendix A

ICMP provisions that will manage adverse effects of stormwater diversion and discharge activities

Appendix A: ICMP provisions that will manage adverse effects of stormwater diversion and discharge activities

Note: A tick indicates the ICMP provision will avoid, remedy or mitigate one or more adverse effect of stormwater diversion and discharge on the relevant receiving environment feature.

	Relevant subclause of HCC's Comprehensive Stormwater Discharge Consent clause 30(g) →	Features of the receiving environment on which the ICMP provisions will manage the adverse effects of stormwater diversion and discharge													
		(i)	(i) & (v)	(ii)	(iii)	(iv) & (v)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)
No.	ICMP Provision	Natural features, surface water bodies	Aquifers	Sites of cultural and/or historical significance	Public health	Flooding Hazards	Receiving water hydrology - base flows	Receiving water sediment and water quality	Receiving water habitat, ecology and ecosystem health	Receiving water riparian vegetation	The extent and quality of open stream channels	Fish passage for indigenous and trout fisheries	Natural and amenity values	Existing infrastructure	Existing authorised resource use activities
	TABLE 7: METHODS TO ACHIEVE COMPLIANCE														
	ON LOT REQUIREMENTS														
	WATER EFFICIENCY MEASURES (on lot within Hamilton City boundary)														
1	Low flow fixtures are installed as per the requirements of Waste water BPO 1 and Water BPO 2.	✓											✓		
2	On lot water efficiency measures are incorporated, connected to, achieved or maintained in accordance with Rule 25.13.4.5a of the PDP, and as detailed within Three Waters Management Practice[41] To comply with this rule select at least one of the following options.	✓	✓			✓	✓	✓	✓				✓	✓	✓
	The prefered option for this catchment:														
	1. Raintank (where this is used it shall be plumbed back into the toilet and laundry with an option for garden use).														
	Other equivalent features suitable for this catchment:														
	2. Soakage (which must be used for the entire lot if deemed suitable during the subdivision).														
	3. Permeable Surfaces														
	4. Bioretention														
	5. Detention														
	STORMWATER ON LOT – All Sub Catchments in Hamilton City														
3	On lot soakage if feasible as per the requirements of Stormwater BPO 3 and the HCC ITS.	✓	✓		✓	✓	✓	✓					✓	✓	✓
4	Site specific comprehensive treatment systems will be required for high risk sites as per Stormwater BPO 4.	✓			✓			✓	✓				✓		✓
	STORMWATER ON LOT – All Sub Catchments														
5	If certain areas of a development cannot discharge to a centralised device, at-source devices will be required to meet the discharge parameters. Strong justification as to why a centralised device cannot serve the lot will be required.	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓
	Within Hamilton City Boundary, this applies to subcatcment C. Technical certification from WRC may be required in accordance with condition 3 of the CSDC.														

Note: A tick indicates the ICMP provision will avoid, remedy or mitigate one or more adverse effect of stormwater diversion and discharge on the relevant receiving environment feature.

Relevant subclause of HCC's Comprehensive Stormwater Discharge Consent clause 30(g) →		Features of the receiving environment on which the ICMP provisions will manage the adverse effects of stormwater diversion and discharge													
		(i)	(i) & (v)	(ii)	(iii)	(iv) & (v)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)
No.	**ICMP Provision**	**Natural features, surface water bodies**	**Aquifers**	**Sites of cultural and/or historical significance**	**Public health**	**Flooding Hazards**	**Receiving water hydrology - base flows**	**Receiving water sediment and water quality**	**Receiving water habitat, ecology and ecosystem health**	**Receiving water riparian vegetation**	**The extent and quality of open stream channels**	**Fish passage for indigenous and trout fisheries**	**Natural and amenity values**	**Existing infrastructure**	**Existing authorised resource use activities**
	STORMWATER — all subcatchments														
6	Centralised devices to be located and sized to ensure suitable flows and minimised operation and maintenance costs (Hamilton City boundary centralised devices to be in accordance with Appendix B1–Stormwater Network).	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	Wetlands to be densely planted with >80% plant cover. Open water areas are to be avoided. Each specific development will need to provide robust justification of why proposed devices cannot be used before proposing alternatives.														
	Operations and maintenance plans shall be provided to: · ensure that stormwater management devices provide best practicable stormwater management efficiency at all times · show how the developer will undertake the monitoring plan components relevant to device performance (to be compliant before vesting to HCC and during defects liaibilty)														
	Treatment of contaminants greater than 2mm shall be achieved through the use of gross pollutant traps and litter traps. Within wetlands, the management of gross pollutants can be achieved through the installation of inlet or outlet screening, such as floating litter traps or net tech technologies. In addition to contaminant removal from the central devices, suitable management solutions include hydrodynamic separators or filters, catch pit inserts and litter traps.														
7	Overland flow path to be provided for 100 year ARI event in road or reserve and secured by an appropriate legal mechanism to the satisfaction of the regulatory authority.				✓	✓								✓	
	For HCC, adequate freeboard to be provided to all buildings as detailed in the ITS.														
	(Note: Glaisdale West Wetland has an overland flowpath to the Te Awa O Katapaki catchment as shown on the Stormwater Network Map. 2 private properties are affected and they have easements on their Certificate of Titles: 131 Cumberland Drive & 5 Everleigh Court.)														
8	Suitable energy dissipation and erosion protection measures shall be provided at all discharge locations, with preference for natural solutions or green engineering appropriate to the soft sediment environment over hard engineering solutions using rock and concrete.	✓						✓	✓	✓	✓		✓		✓

Note: A tick indicates the ICMP provision will avoid, remedy or mitigate one or more adverse effect of stormwater diversion and discharge on the relevant receiving environment feature.

	Relevant subclause of HCC's Comprehensive Stormwater Discharge Consent clause 30(g) →	Features of the receiving environment on which the ICMP provisions will manage the adverse effects of stormwater diversion and discharge													
		(i)	(i) & (v)	(ii)	(iii)	(iv) & (v)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)
No.	ICMP Provision	Natural features, surface water bodies	Aquifers	Sites of cultural and/or historical significance	Public health	Flooding Hazards	Receiving water hydrology - base flows	Receiving water sediment and water quality	Receiving water habitat, ecology and ecosystem health	Receiving water riparian vegetation	The extent and quality of open stream channels	Fish passage for indigenous and trout fisheries	Natural and amenity values	Existing infrastructure	Existing authorised resource use activities
9	Modified and natural stream channels and their riparian margins shall not to be used as locations for stormwater treatment devices. However, in the upper catchment, the modification of artificial drains to create stormwater treatment wetlands and detention basins is encouraged rather than device creation in farmland, provided that flood flows and fish passage are incorporated into the design as appropriate.	✓				✓		✓	✓	✓	✓		✓	✓	✓
10	Existing riparian vegetation should be retained and any new riparian planting done with indigenous eco-sourced vegetation selected from the Plant Selection Tool for Waikato Waterways, Waikato River Authority. A minimum of 5m wide riparian planting either side of all waterbodies, streams and drains with stock proofing is encouraged.	✓						✓	✓	✓	✓		✓		
11	Construction controls: Application of sediment control measures to protect stormwater devices, Otama-ngenge stream and its tributaries.	✓				✓		✓	✓		✓		✓	✓	✓
	Translocation and/or fish passage to upstream habitats where native fish are present. Developers may be asked to establish presence of native fish that could potentially be affected by proposed construction.	✓							✓						
	In the event of any discovery of artefacts in watercourses that may have potential cultural or historical significance, the appropriate iwi representatives and authorities shall be notified.			✓											
12	Where it is identified that stormwater discharges will have an effect on aquatic habitat and water quality values, then habitat enhancement shall be included as a mitigation measure via riparian planting and/or stream works as appropriate.	✓						✓	✓	✓	✓		✓		✓
	STORMWATER – Sub Catchments with piped network to Te Awa O Katapaki														
13	Some areas (as identified on stormwater network map) drain to consented devices within TOAK Te Awa O Katapaki ICMP Stormwater BPOs and means of compliance are to be referred to for solutions.	✓			✓	✓		✓	✓		✓		✓	✓	✓
	STORMWATER – Otama-ngenge (northern branch) Major Roading Projects see Figure 3														
14	Swales, wetlands and approved at source devices capable of removal of hydrocarbons.	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓

Note: A tick indicates the ICMP provision will avoid, remedy or mitigate one or more adverse effect of stormwater diversion and discharge on the relevant receiving environment feature.

	Relevant subclause of HCC's Comprehensive Stormwater Discharge Consent clause 30(g) →	Features of the receiving environment on which the ICMP provisions will manage the adverse effects of stormwater diversion and discharge													
		(i)	(i) & (v)	(ii)	(iii)	(iv) & (v)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)
No.	ICMP Provision	Natural features, surface water bodies	Aquifers	Sites of cultural and/or historical significance	Public health	Flooding Hazards	Receiving water hydrology - base flows	Receiving water sediment and water quality	Receiving water habitat, ecology and ecosystem health	Receiving water riparian vegetation	The extent and quality of open stream channels	Fish passage for indigenous and trout fisheries	Natural and amenity values	Existing infrastructure	Existing authorised resource use activities
	Swales and wetlands to be densely planted with >80% plant cover and open water areas are to be avoided.														
	Road corridors and drain replacement devices designed to maintain waterway connectivity and provide surface flow to north branch to maintain base flows.														
15	Fish surveys shall be carried out in waterways potentially affected by construction and operation of the Waikato Expressway and Resolution Drive Extension. Measures shall be included in these construction works to avoid, remedy or mitigate adverse effects on these fish habitat, including by providing for fish passage between habitat upstream and downstream of the road corridors and by replacing removed habitat with equivalent or enhanced habitats.	✓							✓	✓	✓	✓	✓		
	WASTEWATER (within Hamilton City boundary)														
16	Wastewater in all subcatchments shall be served by the wastewater pump (in the vicinity of Borman Rd/Hare Puke Drive).	✓	✓		✓			✓	✓		✓		✓		✓
	Gravity mains to access the pump shall be extended as development occurs and capacity shall be assessed during the engineering phase for suitability to serve the surrounding areas draining to the pump.														
	Levels of service to be achieved in accordance with HCC's ITS requirements.														
	Best practice design, construction and inspection are required to ensure that inflow and infiltration is minimised.														
	WATER (within Hamilton City boundary)														
17	Strategic 250mm water mains shall be required in specified locations as per Water Master Plan and indicated on shown in Appendix B Water Supply Network Map B3 (or any updates).														
	Levels of service to be achieved in accordance with HCC's ITS requirements.														
	Minimum pressure and flows to be achieved, including consideration of adverse effects on the existing built and consented environment. Water Impact Assessments for elevated sites shall specifically address predicted Level Of Service prior to Rototuna Reservoir,														

Note: A tick indicates the ICMP provision will avoid, remedy or mitigate one or more adverse effect of stormwater diversion and discharge on the relevant receiving environment feature.

	Relevant subclause of HCC's Comprehensive Stormwater Discharge Consent clause 30(g) →	Features of the receiving environment on which the ICMP provisions will manage the adverse effects of stormwater diversion and discharge													
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No.	**ICMP Provision**	**Natural features, surface water bodies**	**Aquifers**	**Sites of cultural and/or historical significance**	**Public health**	**Flooding Hazards**	**Receiving water hydrology - base flows**	**Receiving water sediment and water quality**	**Receiving water habitat, ecology and ecosystem health**	**Receiving water riparian vegetation**	**The extent and quality of open stream channels**	**Fish passage for indigenous and trout fisheries**	**Natural and amenity values**	**Existing infrastructure**	**Existing authorised resource use activities**
	Those sites shown on the appendix B water network map predicted to fall below HCC Level of Service shall not be permitted to have a pressurised water connection until the completion of the Rototuna Reservoir unless it is demonstrated that LOS can be provided.														
	TABLE 8: FUTURE ACTIONS														
	Flood Hazard Assessment														
1	LiDAR survey extent assessment and implementation				✓	✓								✓	✓
2	Detailed flood hazard modeling in accordance with extent assessment using MIKE 11 (or similar) and following HCC's Stormwater Modelling Methodology				✓	✓								✓	✓
	Water														
3	Investigate predicted water pressure issues in the elevated area of the HCC area of the catchment														
4	Rototuna Reservoir – Kay road for water service level and storage														
5	Bulk water mains - 550/700mm bulk pipelines for water service level														
	Aquatic Habitat and Erosion														
6	HCC to collaborate with WDC and WRC for Osbourne and River road culverts to determine if the predicted surcharging (but not overtopping) of the culvert at these locations will cause localized land stability issues				✓	✓								✓	✓
	Downstream of Kay Rd (see Figure 8 for approximate location):														
7	HCC to collaborate with WRC, the consent holder and landowner to agree on and program an appropriate plan to mitigate existing and potential effects of upper catchment development on the ecologically significant habitat downstream of Kay Road.	✓						✓	✓	✓	✓		✓		

Note: A tick indicates the ICMP provision will avoid, remedy or mitigate one or more adverse effect of stormwater diversion and discharge on the relevant receiving environment feature.

	Relevant subclause of HCC's Comprehensive Stormwater Discharge Consent clause 30(g) →	Features of the receiving environment on which the ICMP provisions will manage the adverse effects of stormwater diversion and discharge													
		(i)	(i) & (v)	(ii)	(iii)	(iv) & (v)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)
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	Investigations may require geotechnical assessment of strength of bank and bed material, culvert embankments and geomorphology study of the response of the stream to the altered flow regime to establish the nature and extent of impacts and mitigation options. Remedial works may include battering back over steep banks, reinstating channel features, riparian planting for bank stability and armouring. Figure 8 indicates the areas of concern. An allowance of $200,000 has been set aside for the investigation and indicative physical works.														
	Monitoring														
8	The Tonkin and Taylor SMP Report 2012 is due to be updated every 3 years (as per CDSC condition 37), An up-dated version is due in December of this year. At this point, monitoring of Otama-ngenge Stream should be considered for inclusion in the SMP and any required modifications to the plan made at this time.														
	Land Drainage														
9	Investigate potential extention of the land drainage rateable area and operations and maintenance costs attributed to urbanization (including HCC development area and Major Roading Projects.)					✓								✓	
	The ICMP recognises that flow volumes are predicted to increase due to urbanisation, therefore it is recommended that the downstream rates collection areas are extended into the areas to be urbanised to ensure funding of the waterways maintenance and management is distributed equitably. There is the potential for O&M costs such as vegetation management to increase as a result of this urbanisation														
	Maintenance														
10	Review Stormwater Device Operations & Maintenance template and ITS checklist to ensure it refers to ICMP parameters, and to ensure stormwater devices have proven history at time of ownership transfer.							✓	✓		✓				

Note: A tick indicates the ICMP provision will avoid, remedy or mitigate one or more adverse effect of stormwater diversion and discharge on the relevant receiving environment feature.

	Relevant subclause of HCC's Comprehensive Stormwater Discharge Consent clause 30(g) →	Features of the receiving environment on which the ICMP provisions will manage the adverse effects of stormwater diversion and discharge													
		(i)	(i) & (v)	(ii)	(iii)	(iv) & (v)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)
No.	ICMP Provision	Natural features, surface water bodies	Aquifers	Sites of cultural and/or historical significance	Public health	Flooding Hazards	Receiving water hydrology - base flows	Receiving water sediment and water quality	Receiving water habitat, ecology and ecosystem health	Receiving water riparian vegetation	The extent and quality of open stream channels	Fish passage for indigenous and trout fisheries	Natural and amenity values	Existing infrastructure	Existing authorised resource use activities
	Opportunities														
11	If and when opportunities arise, measures should be implemented to eliminate the barrier effect of existing obstacles to fish passage, especially, but not exclusively, at the River Road culvert, either by providing fish passage beyond the obstacles or removal of the obstacles	✓							✓		✓	✓	✓		
12	Erosion of banks at the Waikato River confluence has been observed. Any party undertaking development or works upstream should consider opportunities to manage and mitigate erosion, for example through channel strengthening,	✓						✓	✓	✓	✓		✓		
	TABLE 10: MONITORING PLAN														
1	Receiving Environment														
1a	Visual semi-quantitative, assessment of bank and bed stability	✓				✓		✓	✓		✓		✓	✓	✓
1b	Semi-quantitative assessment of aquatic fauna presence and/or diversity	✓						✓	✓		✓		✓		✓
1c	Quantitative assessment of stream water quality	✓			✓			✓	✓		✓		✓		✓
1d	Device performance and discharge quality. Stormwater treatment device performance (by consent owner/operator via consent conditions).	✓			✓			✓	✓		✓		✓		✓
1e	Visual contaminants	✓			✓			✓	✓		✓		✓		✓
1f	Sediment control of building construction and earthworks	✓				✓		✓	✓		✓		✓	✓	✓
	BEST PRACTICABLE OPTIONS														
BPO 8 (d)	Stormwater BPO 8 – Application of RMA, LGA, DP and Bylaws and City wide Comprehensive Stormwater Discharge Consent: (d). In the event of any discovery of artefacts in watercourses that may have potential cultural or historical significance, the appropriate iwi representatives and authorities shall be notified.			✓											

Appendix I – Network Capacity

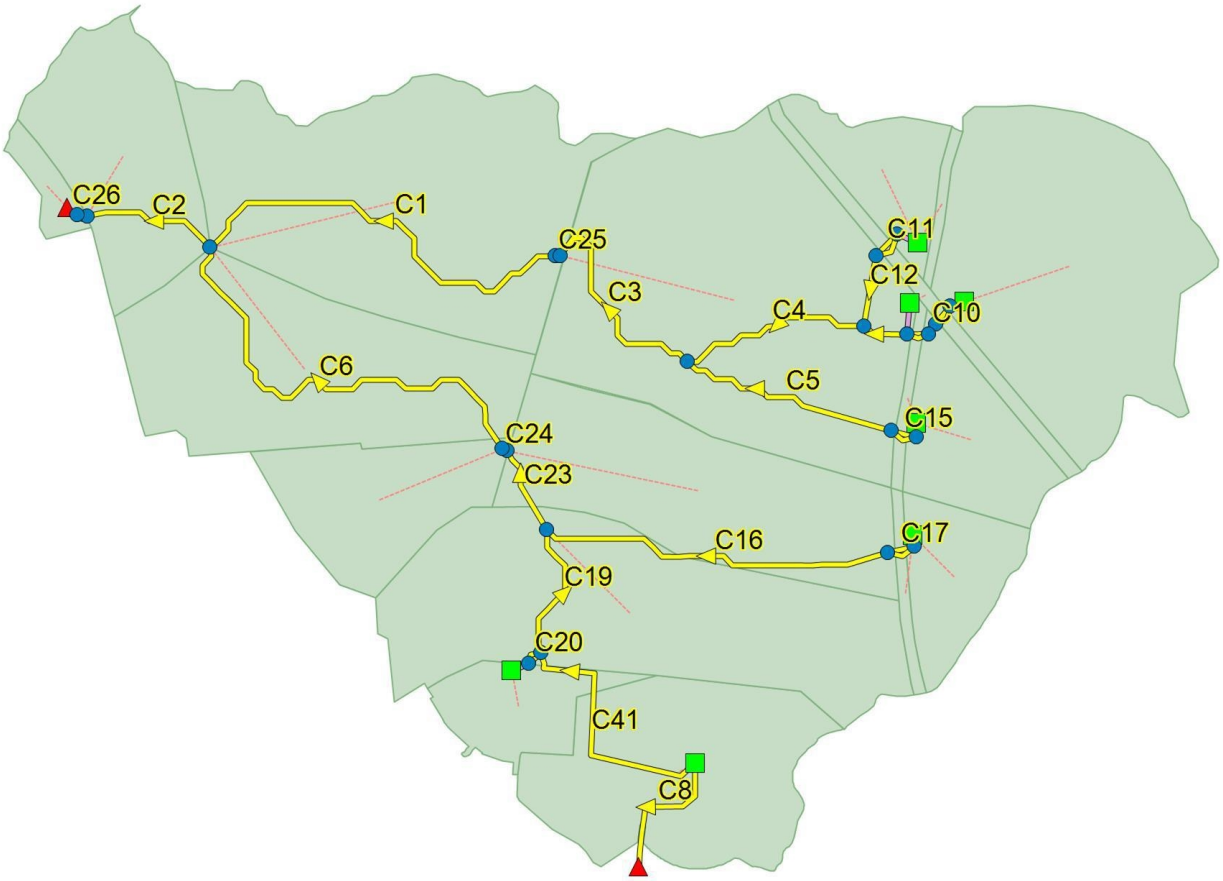
Engineers & Consultants

Otama-ngenge Integrated Catchment Management Plan

Otama-ngenge Capacity Model

Final

Prepared for Hamilton City Council by Morphum Environmental Ltd
August, 2015



Engineers & Consultants

Document Control

Client Name: Hamilton City Council

Project Name: Otama-ngenge Integrated Catchment Management Plan

Project Number: HCC003

Document: Otama-ngenge Capacity Model

Revision History

Status	Date Issued	Author	Reviewed By	Released By
Draft for comment	26/6/15	Sam Blackbourn	Caleb Clarke	Damian Young
Final Draft	10/7/15	Sam Blackbourn	Caleb Clarke	Damian Young
Final	24/8/15	Sam Blackbourn	Caleb Clarke	Damian Young

Reviewed by:

Caleb Clarke **Signature:** 

Released by:

Damian Young **Signature:** 

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Executive Summary

Morphum Environmental Ltd was engaged by Hamilton City Council to produce a capacity model to support the Otama-ngenge Integrated Catchment Management Plan. The primary objective of the capacity model is to quantify flow changes in the Otama-ngenge watercourses in the 2 year, 10 year and 100 year, 24 hour event due to proposed development. A secondary objective of the model is to assess existing culvert capacity at public road crossings.

The model was constructed in PC-SWMM and includes 18 subcatchments. Existing and future landuse was based on the landuse model prepared for the Otama-ngenge Contaminant Load Model with adjustments made for future residential development east of the new arterial road, outside of the current Hamilton City Council boundary.

The Otama-ngenge capacity model estimates that the means of compliance measures recommended in the Otama-ngenge ICMP will reduce post development peak flows in the 2, 10 and 100 year event below predevelopment levels in both the Northern and Southern arms. Post development model results for no mitigation in place show a significant increase in flow, therefore the means of compliance measures are required to avoid increased flows downstream.

The hydrographs also show longer periods of elevated flow after the storm peak in the post development scenario. This longer flow is likely to increase erosion in downstream watercourses, therefore an erosion management scheme is recommended for downstream watercourses to manage this issue.

Existing culvert surcharging (but not road overtopping) is predicted at the River Rd and Osbourne Rd South culverts. It is recommended that a stability assessment is carried out at these culvert crossing points to determine the risk of failure during the 100 year event and to determine any remedial actions required.

Contents

Figures

Tables

1.0 Scope

A capacity model has been developed to support the assessment of stormwater management issues within the Otama-ngenge Integrated Catchment Management Plan (ICMP). The purpose of this modelling is to provide a high level comparison of predevelopment and post development flows based on the means of compliance outlined in the Otama-ngenge ICMP. An assessment of existing road culvert capacity if also included.

The means of compliance assessed in the model are detention of the 2 and 10 year post development flows to predevelopment levels and the detention of the 100 year post development flow to 80% of the predevelopment level.

For a detailed description of the 686 Ha Otama-ngenge catchment, please refer to the Otama-ngenge ICMP main document.

1.1 Limitations

This model has been developed to assess the proposed means of compliance in the Otama-ngenge ICMP against required outcomes. The model is not of sufficient detail for flood hazard modelling and does not take into account any blockage of the drainage network. Future mitigation has been sized to meet the means of compliance in the Otama-ngenge ICMP, however site specific constraints have not been taken into account. Site specific device design must be undertaken and modelling updates and/or separate modelling completed to ensure that the site specific device design provides the means of compliance outlined in the ICMP.

2.0 Model development

The Otama-ngenge capacity model was developed using the PC-SWMM stormwater modelling package based on the US EPA SWMM 5.0 engine. Model files can be provided on request, PCSWMM stores modelling information in ESRI shapefiles and the model files can be read using standard GIS applications.

2.1 Rainfall

Rainfall hyetographs provided in section 4.2.4.4 of the HCC Infrastructure and Technical Standards (ITS) were used with and without climate change for the predevelopment landuse scenario and with climate change for the post development landuse scenario. For an explanation of why predevelopment rainfall was included with and without climate change, please refer to section 2.4.

2.2 Catchments

Table 2 gives the catchment parameters for the 18 subcatchments used in the model for the existing and future landuse scenarios. The landuse model used the Otama-ngenge Contaminant Load Model (CLM) as a starting point, with residential development east of the new arterial added to account for potential redevelopment of this land. Landuse impervious rates used for different landuse types are given in Table 1. Impervious percentages were based on existing aerials and future drawings for the arterial road and motorway landuse.

Table 1 Landuse impervious percentages

Landuse	Impervious %
Urban Grass	5
Rural	5
Large lot residential	30
Residential	70
Commercial	90
Local Road	50
Arterial Road	60
Motorway	60

Mannings N was set to 0.026 for pervious areas and 0.015 for impervious areas. Storage for pervious areas was set to 5 mm and the curve number for pervious areas was set to 61 based on a SCS Group B soil. Catchment slopes were determined using the equal area method. Catchment parameters used in the model are given in Table 2. Catchment locations are shown in Figure 1.

Table 2 Catchment parameters used in the model

ID	Area (Ha)	Length (m)	Slope	Impervious area	
				Existing	Future
S1	17.0	428	6.3%	7.4%	13.2%
S2	78.5	865	1.3%	5.0%	68.7%
S3	16.0	436	6.0%	5.0%	69.4%
S4	21.9	541	3.2%	5.0%	69.1%
S5	108.9	1,603	0.3%	5.2%	5.8%
S6	51.0	988	0.5%	17.6%	54.4%
S7	14.9	359	0.0%	5.5%	66.3%
S8	80.4	1,445	0.5%	13.6%	14.2%
S9	54.9	1,418	0.4%	6.8%	7.0%
S10	27.7	1,264	0.4%	7.0%	7.0%
S11	37.8	695	2.7%	16.7%	16.7%
S12	92.7	1,689	0.5%	6.2%	6.2%
S13	65.1	1,677	0.5%	6.2%	6.2%
S14	7.9	628	1.8%	5.0%	60.6%
S15	4.5	410	3.2%	14.8%	14.8%

ID	Area (Ha)	Length (m)	Slope	Impervious area	
				Existing	Future
S16	1.9	523	5.2%	5.0%	60.0%
S17	2.7	492	0.6%	6.4%	60.0%
S18	2.4	263	0.4%	5.0%	60.0%

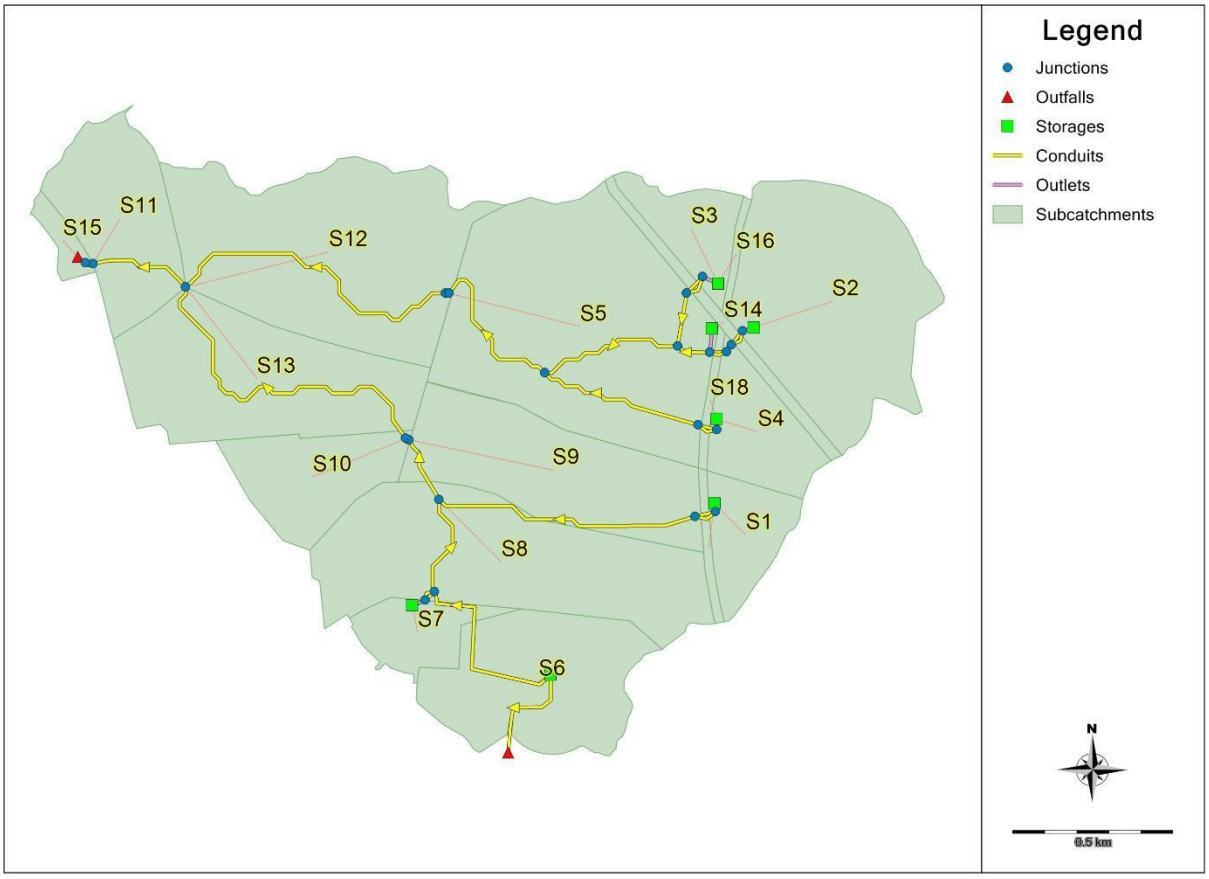

Figure 1 PC SWMM model catchments

2.2.1 Catchment runoff calibration

As the PC-SWMM modelling package utilises the new SWMM 5.0 engine, runoff results can vary from those predicted using the SCS Curve Number methodology recommended in the ITS. To ensure results are consistent with typical runoff values for Hamilton, the catchment runoff was calibrated for the 100 year, 24 hr post development event to be within 10% of those predicted using a TP108 calculation. The time of concentration was calculated using the method in section E1.2.3.6 of the NZ building code. The width value was adjusted until the catchment runoff values were within 10% of those predicted in TP108. The table below gives the results of the calibration and the resulting catchment widths. Note that this calibration method is the recommended method in the SWMM documentation. TP108 calculations are provided in Appendix 1 of this document.

Table 3 PC-SWMM model calibration results

ID	Width (m)	Estimated 100 yr ARI peak flow ($m^3 s^{-1}$)		
		TP108	PC SWMM	% difference
S1	106	2.79	2.55	-8.7%
S2	500	15.83	17.32	9.4%
S3	56	3.89	3.78	-2.8%
S4	89	5.30	4.82	-9.0%
S5	1,011	8.72	7.87	-9.8%
S6	293	7.53	7.99	6.1%
S7	256	2.07	2.20	6.5%
S8	500	7.66	7.18	-6.2%
S9	500	4.90	5.11	4.4%
S10	321	2.61	2.85	9.1%
S11	447	6.04	6.52	7.9%
S12	823	7.91	7.35	-7.0%
S13	280	6.80	7.21	6.0%
S14	62	1.28	1.20	-5.9%
S15	26	1.04	1.08	4.1%
S16	8	0.43	0.44	3.4%
S17	24	0.54	0.55	2.8%
S18	35	0.52	0.55	5.2%

2.3 Pipes and Channels

The model extent of pipes and channels extended upstream to existing or known future locations of detention devices as indicated in Figure 2. Existing road culverts were surveyed and included; culverts outside of the road network were not included in the model.

Culvert sizes used in the model are given in Table 4. Culvert sizes were determined from survey for the existing model and set from drawings where available for future networks. Future culverts with no design available were sized to provide the required detention for the 2, 10 and 80% of the 100 year event. The entry loss coefficient for culverts was set to 0.2 and the mannings N value was set to 0.015 for culverts and 0.035 for open channels.

Table 4 Culvert sizes in model

ID	Description	Number of barrels	Barrel diameter (m)
C27	River Rd	1	2.32
C25	Osbourne Rd North	1	1.80
C24	Osbourne Rd South	1	1.20
C20	Kay Rd[1]	1	0.75
C14	New Arterial North	1	1.05
C15	New Arterial Mid	1	1.05
C17	New Arterial South	1	1.05
C11	New Motorway North	1	0.90
C13	New Motorway South	2	1.05

[1]Kay Rd culvert drains the "Meadows" catchment. The 750 mm Glaisdale pipe is not included in this table.

Overland flow paths over roads were provided for existing roads and set at the height of the road over the culvert estimated from LIDAR and checked against nearby survey cross sections for accuracy.

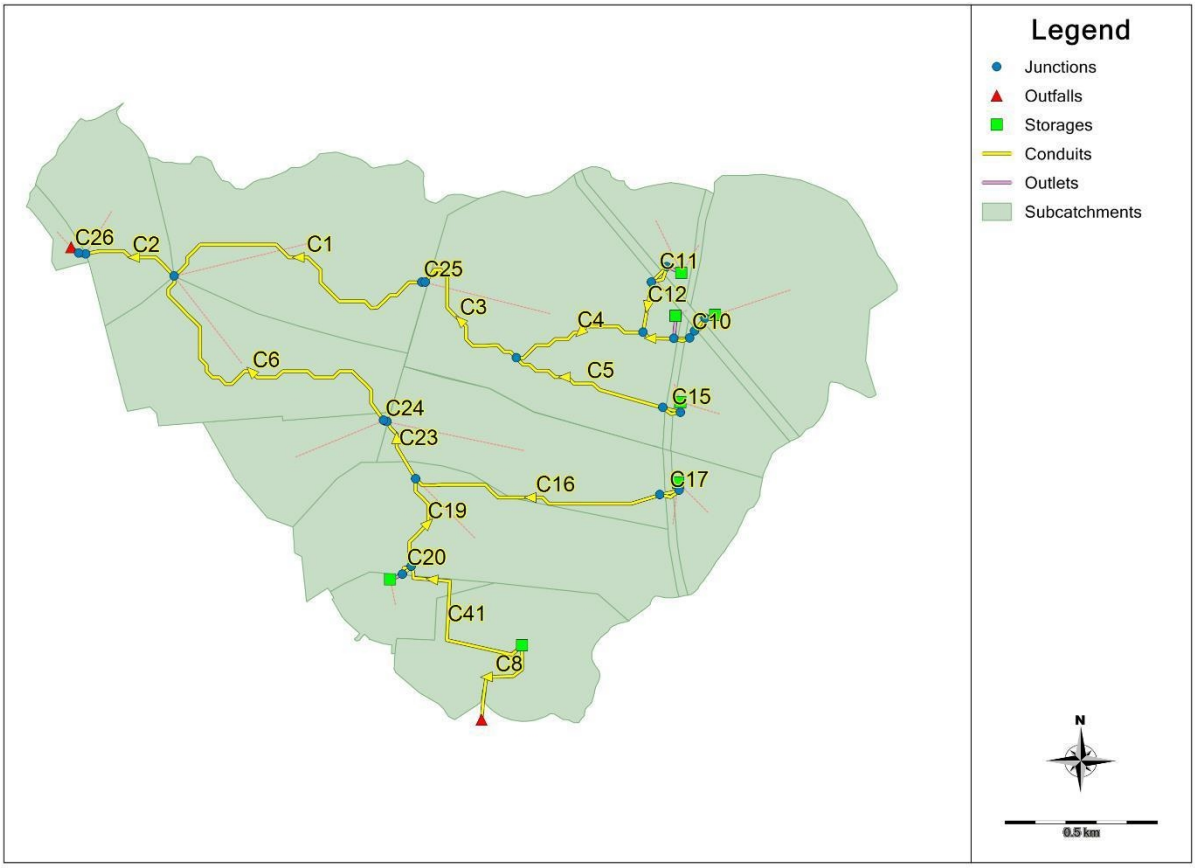

Figure 2: PC-SWMM future model schematic

2.4 Scenarios

Four different scenarios were modelled, these are shown in

Scenario	Landuse	Climate Change	Mitigation	Description
NoCC_Ex	Existing	No	-	Existing landuse with no climate changes, used to assess current flows and to determine flow targets for means of compliance.
CC_Ex	Existing	Yes	-	Existing landuse with climate change, used to show future runoff if no further development occurred in the catchment
CC_Fut_Mit	Future	Yes	Yes	Future landuse with climate change and mitigation follow the means of compliance in the ICMP. Used to show effect of means of compliance on runoff.
CC_Fut_NoMit	Future	Yes	No	Future landuse with climate change and no mitigation. Used to show effects of development if no means of compliance are implemented.

The existing scenario was modelled with and without climate change. The scenario without climate change was used to assess current flow levels and to determine flow targets for means of compliance. The existing scenario with climate change was included to compare with the future landuse scenario. As large areas remain undeveloped in the future landuse scenario, these areas will not have any means of compliance added to them. However runoff from these areas will increase due to climate change.

In the CC_Fut_Mit scenario, the means of compliance for developed areas will reduce flows to below existing levels without climate change. However the remaining areas with no change in landuse will show increased runoff, which may increase flows in the overall catchment to above existing flow rates. Therefore an existing scenario with climate change is provided for comparison purposes.

Where future locations for detention devices are proposed, these devices were included in the capacity model (shown in Figure 2). Only the Glaisdale wetland had design information available. This information was inputted into the model and assessed. All other detention areas were sized to meet the 2 year, 10 year and 80% of the 100 year predevelopment flows (without climate change) using a stage discharge relationship for the device outlet and a stage area relationship for the device storage. For further information on the storage devices and their parameters, please request the model files.

3.0 Results

Predevelopment and post-development hydrographs are provided for stream reaches to show the change in runoff in the existing landuse without climate change, existing landuse with climate change, post-development and post-development with no mitigation scenarios. Existing culvert flow and level tables are also provided to show culvert capacity in the 2, 10 and 100 year events. Stream level estimates are also provided for surveyed locations.

3.1 Hydrographs

Table 5gives the estimated peak flows for the three design events (2, 10 and 100 year) at four locations within the catchment, Figure 3 to Figure 5show the hydrographs for these events.

Table 5 Estimated Peak flows ($m^3.s^{-1}$)

	Conduit ID	**C19**	**C6**	**C1**	**C2**
	Scenario	**Southern Arm Upstream of Osbourne Rd Culvert**	**Southern Arm**	**Northern Arm**	**Full catchment**
2yr	**NoCC_Ex**	0.8	2.0	1.1	3.7
	CC_Ex	1.0	2.6	1.6	5.1
	CC_Fut_Mit	0.6	2.0	1.7	4.4
	CC_Fut_NoMit	2.2	4.3	7.3	12.3
10yr	**NoCC_Ex**	1.9	5.5	4.5	12.5
	CC_Ex	2.2	6.5	6.5	16.3
	CC_Fut_Mit	0.9	5.6	5.0	13.4
	CC_Fut_NoMit	4.8	7.5	15.2	25.5
100yr	**NoCC_Ex**	2.7	8.7	11.6	25.3
	CC_Ex	3.1	10.5	16.2	33.6
	CC_Fut_Mit	1.1	9.5	10.8	28.0
	CC_Fut_NoMit	8.5	11.4	24.4	39.9

The results show that the proposed mitigation reduces peak flow in the 2, 10 and 100 year events to below those predicted for existing landuse with climate change, except for the Northern Arm 2 yr event where flows are predicted to increase from 1.6 to 1.7 $m^3.s^{-1}$.

Peaks flows are predicted to increase in the post development scenario compared to existing landuse without climate change. This increase in flow can be largely attributed to the increased runoff from non-developed areas due to climate change.

Post development results without mitigation are also included. These results show peak flows to increase significantly without mitigation, reinforcing that the flow control means of compliance are required to avoid significant downstream effects from increased flows.

The hydrographs also show longer periods of elevated flow after the storm peak in the post development scenario. This longer flow is likely to increase erosion in downstream watercourses, therefore an erosion management scheme is recommended for downstream watercourses to manage this issue.

For the southern arm, the 10 year and 100 year event hydrographs show significant detention from the Osbourne Rd South culvert. For this reason, a forth hydrograph above this culvert was included to illustrate the peak runoff reduction achieved in the southern branch upstream of this culvert.

C = Full catchment (C2), NA = Northern Arm (C1), SA = Southern Arm (C6) SO = Southern Arm upstream of Osbourne Rd Culvert (C19). X axis = model time in hours, Y axis = flow in $m^3 s^{-1}$.

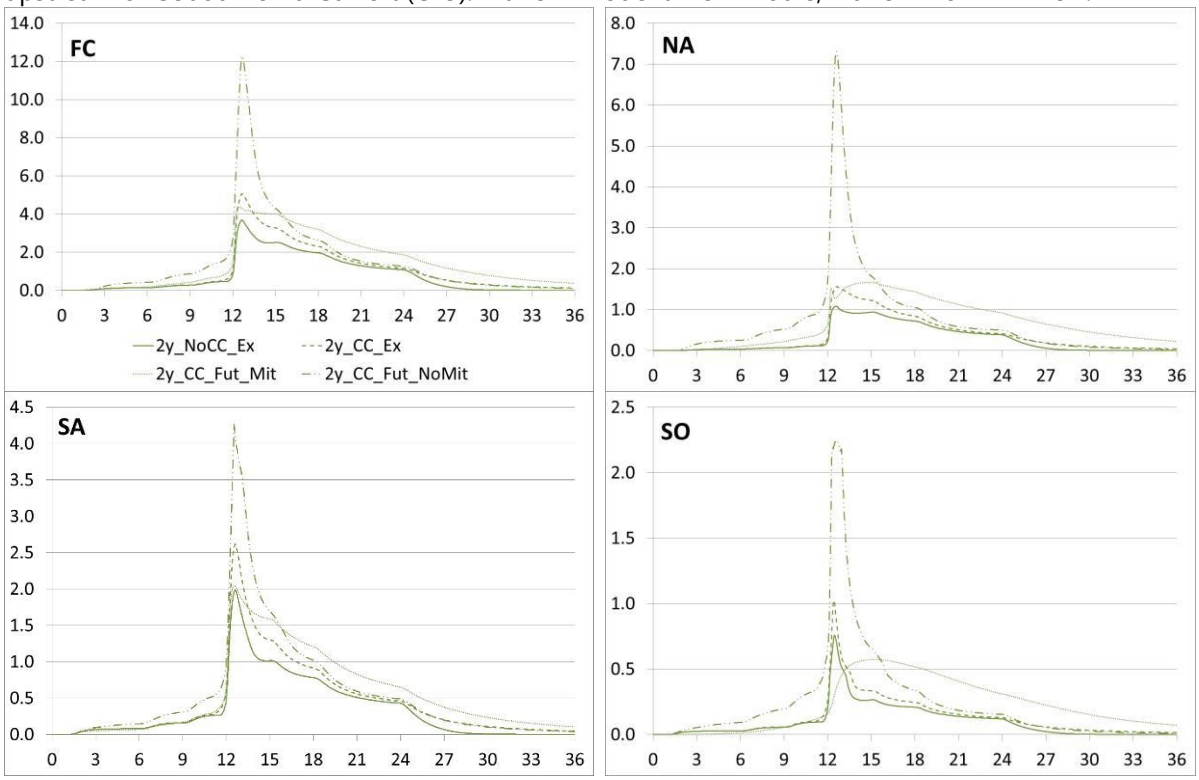

Figure 3: 2 yr event results

FC = Full catchment (C2), NA = Northern Arm (C1), SA = Southern Arm (C6) SO = Southern Arm upstream of Osbourne Rd Culvert (C19). X axis = model time in hours, Y axis = flow in $m^3 s^{-1}$.

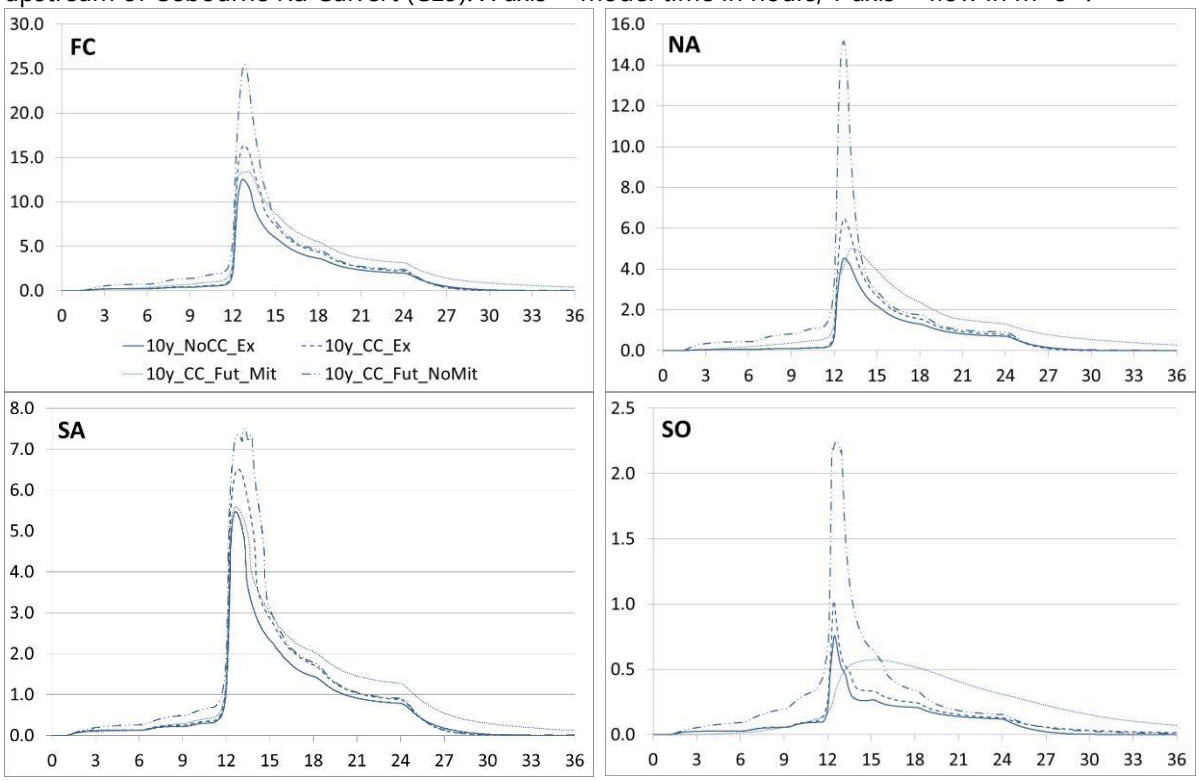

Figure 4: 10 yr event results

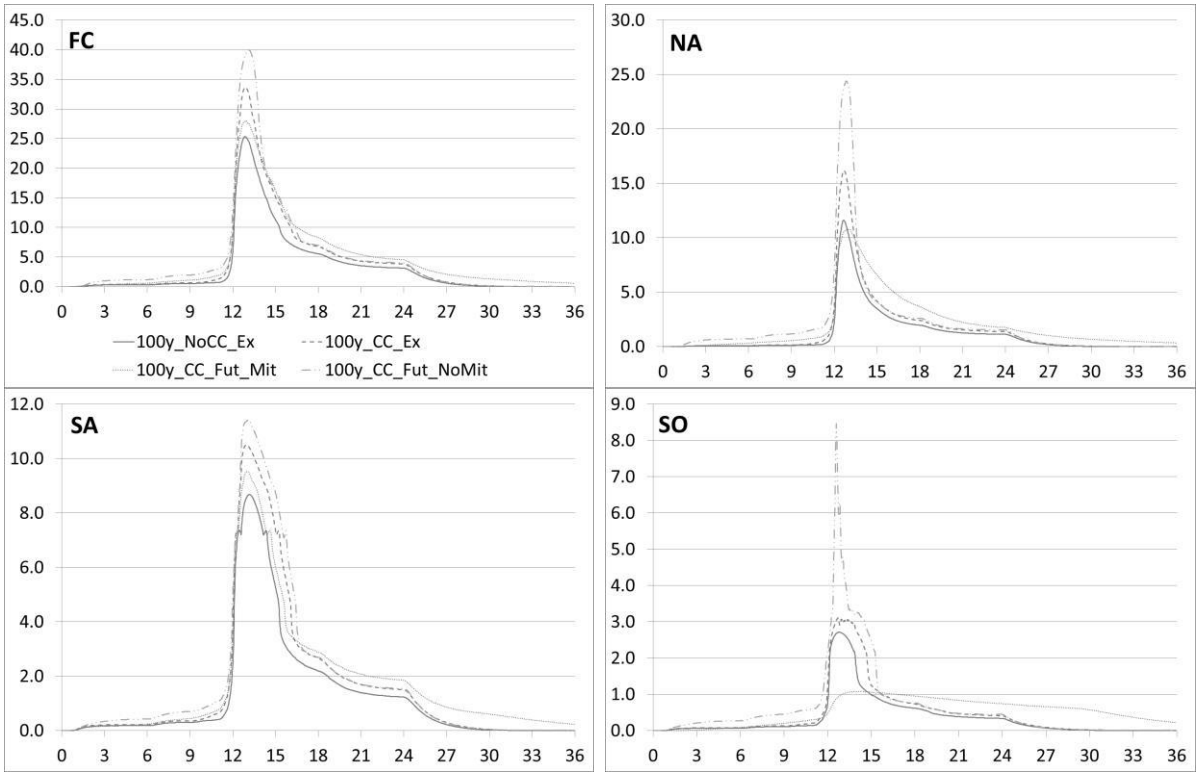

Figure 5 100 yr event results

Model results for the existing culverts in the post development with mitigation scenario are shown in Table 6. The model predicts the culverts will surcharge in the 100 year event, but not overtop the roads they pass under.

Table 6 Existing culvert post development flow and level

ID	Description	Culvert	Road	2 yr		10 yr		100 yr	
		Invert	Level	Flow	Water Level	Flow	Water level	Flow	Water level
		RL	RL	(m^3 s^{-1})	RL	(m^3 s^{-1})	RL	(m^3 s^{-1})	RL
C27	River Rd	13.17	21.00	5.14	14.12	16.22	15.05	29.98	15.49
C25	Osbourne Rd North	22.51	26.00	1.67	23.14	5.01	23.53	10.77	24.02
C24	Osbourne Rd South	23.24	27.27	1.83	23.99	4.81	24.58	8.20	25.92
C20	Kay Rd	26.57	29.58	0.12	26.72	0.27	26.8	0.44	26.87

Whilst road overtopping in the 100 year event is avoided, there is surcharging at the Osbourne Rd South and River Rd locations. This means the road crossings at these points are functioning as dams. It is recommended that a stability assessment is carried out at these culvert crossing points to determine the risk of failure of the road embankment during the 100 year event and to determine any remedial actions required.

3.2 Stream level estimates

Table 7 shows stream level estimates at seven locations where stream cross sections were surveyed. The table shows that water levels in the 10 year and 100 year events for the post development with mitigation scenario are not predicted to overtop banks. Therefore the requirement to avoid more than 3 days ponding in the 10 year event for rural channels is met.

Table 7 Stream level estimates

		Approx. Top of Bank RL	Channel Invert RL	Water Level RL		
				2yr	10yr	100yr
C19	Downstream of Kay Rd	28	25.51	25.91	25.98	25.98
C23	Upstream of Osbourne Rd South	27	23.24	23.99	24.58	25.92
C6	Downstream of Osbourne Rd South	27	23.14	23.68	24.01	24.35
C3	Upstream of Osbourne Rd North	24.5	22.51	23.14	23.53	24.02
C1	Downstream of Osbourne Rd North	24.5	22.55	22.9	23.14	23.42
C2	Upstream of River Rd	18	13.17	14.12	15.05	15.49

4.0 Conclusion and Recommendations

The results show that the proposed mitigation reduces peak flow in the 2, 10 and 100 year events to below those predicted for existing landuse with climate change, except for the Northern Arm 2 yr event where flows are predicted to increase from 1.6 to 1.7 $m^3.s^{-1}$.

Peaks flows are predicted to increase in the post development scenario compared to existing landuse without climate change. This increase in flow can be largely attributed to the increased runoff from non-developed areas due to climate change.

The hydrographs also show longer periods of elevated flow after the storm peak in the post development scenario. This longer flow is likely to increase erosion in downstream watercourses, therefore an erosion management scheme is recommended for downstream watercourses to manage this issue.

Existing culvert surcharging (but not road overtopping) is predicted at the River Rd and Osbourne Rd South culverts. It is recommended that a stability assessment is carried out at these culvert crossing points to determine the risk of failure of the road embankment during the 100 year event and to determine any remedial actions required.

Stream water levels in the 10 year and 100 year events are not predicted to overtop stream banks at seven surveyed locations. Therefore the requirement to avoid more than 3 days ponding in the 10 year event for rural channels is predicted to be met.

Catchment ID		**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
Storm ID		**Post 100 yr**	**Post 100 yr**	**Post 100 yr**	**Post 100 yr**	**Post 100 yr**	**Post 100 yr**	**Post 100 yr**
Permeable area	m^2	147,690	245,391	49,028	67,599	1,025,920	232,368	50,207
Impermeable area	m^2	22,580	539,658	111,308	151,234	63,562	277,612	98,861
Total area	m^2	170,270	785,049	160,336	218,832	1,089,482	509,980	149,068
Event depth	mm	163	163	163	163	163	163	163
Initial abstraction	mm	4.3	1.6	1.5	1.5	4.7	2.3	1.7
Permeable area curve number		61	61	61	61	61	61	61
Impermeable area curve number		98	98	98	98	98	98	98
Site curve number		66	86	87	87	63	81	86
Potential maximum retention	mm	131.4	39.9	39.0	39.4	148.2	59.0	42.9
Runoff depth	mm	86.7	129.4	130.0	129.7	81.7	117.5	127.3
Volume	**m^3**	**14,769.1**	**101,590.0**	**20,841.9**	**28,387.2**	**89,024.8**	**59,915.9**	**18,982.3**
Channelisation factor		1.00	0.60	0.60	0.60	1.00	0.60	0.60
Catchment length	km	0.428	0.865	0.436	0.541	1.603	0.988	0.359
Catchment slope	m/m	6.3%	1.3%	6.0%	3.2%	0.3%	0.5%	0.0%
Time of concentration	hr	0.17	0.32	0.17	0.17	0.85	0.53	0.70
Runoff index		0.37	0.67	0.67	0.67	0.34	0.57	0.65
Specific peak flow rate		0.10	0.12	0.15	0.15	0.05	0.09	0.09
Peak flow	**m^3/s**	**2.794**	**15.835**	**3.890**	**5.299**	**8.724**	**7.532**	**2.066**

Catchment ID		**S8**	**S9**	**S10**	**S11**	**S12**	**S13**	**S14**
Storm ID		**Post 100 yr**	**Post 100 yr**	**Post 100 yr**	**Post 100 yr**	**Post 100 yr**	**Post 100 yr**	**Post 100 yr**
Permeable area	m^2	690,166	484,209	245,404	318,395	873,189	441,906	63,163
Impermeable area	m^2	114,025	65,015	31,647	59,574	54,036	208,931	15,401
Total area	m^2	804,191	549,224	277,051	377,969	927,226	650,836	78,564
Event depth	mm	163	163	163	163	163	163	163
Initial abstraction	mm	4.3	4.4	4.4	4.2	4.7	3.4	4.0
Permeable area curve number		61	61	61	61	61	61	61
Impermeable area curve number		98	98	98	98	98	98	98
Site curve number		66	65	65	67	63	73	68
Potential maximum retention	mm	129.4	134.5	135.4	126.1	148.2	94.5	118.1
Runoff depth	mm	87.4	85.8	85.5	88.5	81.7	100.2	91.2
Volume	**m^3**	**70,262.5**	**47,103.6**	**23,682.6**	**33,437.1**	**75,762.4**	**65,202.3**	**7,161.2**
Channelisation factor		1.00	1.00	1.00	1.00	1.00	0.80	1.00
Catchment length	km	1.445	1.418	1.264	0.695	1.689	1.677	0.628
Catchment slope	m/m	0.5%	0.4%	0.4%	2.7%	0.5%	0.5%	1.8%
Time of concentration	hr	0.69	0.76	0.67	0.20	0.75	0.77	0.22
Runoff index		0.37	0.36	0.36	0.38	0.34	0.45	0.40
Specific peak flow rate		0.06	0.05	0.06	0.10	0.05	0.06	0.10
Peak flow	**m^3/s**	**7.657**	**4.896**	**2.613**	**6.043**	**7.907**	**6.801**	**1.275**

Catchment ID		**S15**	**S16**	**S17**	**S18**
Storm ID		**Post 100 yr**	**Post 100 yr**	**Post 100 yr**	**Post 100 yr**
Permeable area	m^2	18,073	7,407	10,571	9,493
Impermeable area	m^2	27,077	11,111	15,998	14,337
Total area	m^2	45,150	18,518	26,569	23,830
Event depth	mm	163	163	163	163
Initial abstraction	mm	2.0	2.0	2.0	2.0
Permeable area curve number		61	61	61	61
Impermeable area curve number		98	98	98	98
Site curve number		83	83	83	83
Potential maximum retention	mm	51.3	51.3	51.0	51.1
Runoff depth	mm	122.0	122.0	122.2	122.2
Volume	**m^3**	**5,509.2**	**2,260.0**	**3,247.2**	**2,911.5**
Channelisation factor		0.60	0.60	0.60	0.60
Catchment length	km	0.410	0.523	0.492	0.263
Catchment slope	m/m	3.2%	5.2%	0.6%	0.4%
Time of concentration	hr	0.17	0.17	0.27	0.20
Runoff index		0.61	0.61	0.61	0.61
Specific peak flow rate		0.14	0.14	0.12	0.13
Peak flow	**m^3/s**	**1.038**	**0.426**	**0.535**	**0.523**

Appendix J
Comprehensive Stormwater Discharge Consent 105279 (Conditions)

Resource Consent Schedule

Resource Consent: 105279

Consent Type: Discharge permit

Consent Subtype: Discharge to water

Pursuant to the Resource Management Act 1991, the Waikato Regional Council hereby grants consent to:

Hamilton City Council (Water & Waste Services)
Private Bag 3010
Waikato Mail Centre
Hamilton 3240

(hereinafter referred to as the Consent Holder)

Activity authorised: Divert and discharge urban stormwater runoff and associated contaminants at multiple locations to land, the Waikato River, Lake Rotoroa, Lake Rotokaeo, Lake Waiwhakareke, Lake Rotokauri, Mangaonua Stream, Mangakotukutuku Stream, Waitawhiriwhiri Stream, Kirikiriroa Stream, Te Awa o Katapaki Stream, other unspecified tributaries of the Waikato River and such other locations as may be covered by this consent in the future in accordance with the conditions of this consent, and use discharge structures within the general vicinity of Hamilton Urban Area which is reticulated by the Hamilton City Council municipal stormwater network

Location: Hamilton Urban Area

Map Reference: NZTopo50 BD33:007:154

Consent Duration: This consent will commence on the date of decision notification and expire on 30th June 2036

Subject to the conditions overleaf:

Glossary of terms

Act:	Resource Management Act 1991
Best Practicable Option:	(Refer to RMA, Part 1 – Interpretation and application)
Catchment Management Plan:	Pertains to all new stormwater diversion and discharge activities in developing catchments. Catchment Management Plans are pre-development planning tools which determine and adopt an integrated catchment management approach based upon the BPO, to avoid as far as practicable and otherwise minimise the cumulative adverse effects of new stormwater diversion and discharge activities in developing catchments. A Catchment Management Plan may apply to a developing catchment or to a number of developing catchments in a Growth Cell
Consent Holder:	The Hamilton City Council
Contaminant:	As defined in section 2 (1) of the RMA
Developing catchment:	A catchment or part of a catchment which is either undergoing urban development, identified for urban development or may in the future be identified for urban development. At the time of consent decision, developing catchments in Hamilton City include catchments, and parts of catchments, within the Rotokauri, Rototuna, Ruakura and Peacock Growth Cells
Gross pollutants:	Litter items such as plastic bottles, bags, takeaway wrappers and leaves
Hazardous substance:	As defined in section 2 (1) of the RMA
High Risk Catchments:	Urbanised catchments which are exposed to high concentrations of routine contaminants, or which are deemed to be more at risk to non-routine contaminant discharge incidents
Illicit wastewater connections:	Wastewater connections to the stormwater network which should be connected to the wastewater network. These primarily relate to private wastewater connections and do not include HCC wastewater network emergency overflow connections
Integrated catchment management approach:	In respect to Catchment Management Plans, an 'integrated catchment management approach' is derived from assessments of available stormwater management options and their associated environmental impacts. An integrated catchment management approach will likely combine several stormwater management options and be based upon the Best Practicable Option
Low Impact Urban Design:	LIUD comprises design and development practices that utilise natural systems and low-impact technologies. Key elements include working with natural site features, avoiding or minimising impervious surfaces, minimising earthworks in construction, and utilising vegetation to assist in trapping sediment and pollutants
Non-routine contaminant discharge:	An unauthorised discharge (accidental or deliberate) of contaminants directly to the stormwater network or to land where it may then enter the municipal stormwater network
Routine contaminant discharge:	The discharge of stormwater containing contaminants that run off impervious surfaces and enter the stormwater network during rain events, where the types and concentrations of the contaminants are consistent with the contributing catchment
Stormwater management devices:	Structural stormwater management devices which are applied in

	stormwater quantity and quality management. These generally include water quantity and water quality ponds, wetlands, filtration practices, infiltration practices, biofiltration practices and various proprietary devices
Stormwater Management Plan:	Pertains to existing stormwater diversion and discharge activities in urbanised catchments. The Stormwater Management Plan records the way in which the stormwater network is operated and includes various management measures to avoid, remedy or mitigate the adverse effects of stormwater diversion and discharge activities on the environment
Stormwater network:	The Hamilton City Council's municipal stormwater network, including all structural management components associated with the conveyance, soakage, detention storage and contaminant treatment of stormwater
Urbanised catchment:	A catchment which is predominantly urbanised and has limited scope or opportunity for further development

General

Stormwater diversion and discharge activities

1) The stormwater diversion and discharge activities authorised by this consent shall be designed, operated and maintained in general accordance with the application for this consent and the Stormwater Management Plan required by Condition 35 of this consent, except where otherwise required in the resource consent conditions below. Where there is any discrepancy between the application documents, the Stormwater Management Plan and the resource consent conditions, then the conditions below shall prevail.

Scope of the stormwater diversion and discharge activities authorised

2) Except as provided for by Condition 3 of this consent, the stormwater diversion and discharge activities authorised by this consent relate to the Hamilton City Council municipal stormwater network ("stormwater network") as constructed at the commencement of this consent, and as generally shown on the Hamilton City Council Drawing MW/MAP-014. All new stormwater diversion and discharge activities which are established after the commencement of this consent shall meet the technical certification requirements of Condition 3 of this consent, and be shown on an updated version of the Hamilton City Council Drawing MW/MAP-014. This drawing shall be provided to the Waikato Regional Council in accordance with the Municipal Stormwater Network Operation Annual Report, required by Condition 39 of this consent.

Technical certification requirements for new stormwater diversion and discharge activities

3) All new stormwater diversion and discharge activities which are established after the commencement of this consent shall be authorised by this consent when this is confirmed in writing by the Waikato Regional Council in a technical certification capacity. This shall occur on receipt of information from the Consent Holder, showing to the satisfaction of the Waikato Regional Council that:

   a) The new stormwater diversion and discharge activities are consistent with the conditions of this consent; and

   b) For new stormwater diversion and discharge activities established in urbanised catchments - the new activities do not increase peak discharge rates to, or flow volumes in, stormwater receiving water bodies above those that would occur at the time of granting this consent, unless it is demonstrated that there are no additional adverse effects on the environment or downstream properties as a result of such increase; or

   c) For new stormwater diversion and discharge activities established in developing catchments - the new activities are consistent with Catchment Management Plans which

have been prepared in accordance with Condition 30 of this consent, prior to the establishment of new activities within these catchments.

Advice Note: Condition 3(c) requires Catchment Management Plans as a prerequisite to new stormwater diversion and discharge activities established in developing catchments. For new activities established in catchments which are not guided by Catchment Management Plans, these activities will not be authorised by the CSDC and will retain respective single site resource consents.

Exemption to Condition 3(c) requirements

4) All new stormwater diversion and discharge activities which are established after the commencement of this consent and located within the Rotokauri, Rototuna, Ruakura and Peacockes Growth Cells as shown on the Hamilton City Council Drawing MW/MAP-020, shall be authorised by this consent if:

   a) The Consent Holder has completed or adopted Catchment Management Plans for the developing catchments within these Growth Cells and submitted them to the Waikato Regional Council for approval in a technical certification capacity by 1 December 2012 (Rotokauri and Rototuna), 1 December 2014 (Ruakura and Peacock), or such later date that may be approved in writing by the Waikato Regional Council in a technical certification capacity;

   b) The Catchment Management Plans include all of the information required by Condition 30 of this consent;

   c) The Waikato Regional Council has approved the Catchment Management Plans and confirmed in writing that the new stormwater diversion and discharge activities are consistent with the Catchment Management Plans and the conditions of this consent; and

   d) Any single site resource consents which are associated with the new stormwater diversion and discharge activities and held by the Consent Holder, shall be surrendered by the Consent Holder in accordance with section 138 of the RMA or amendments thereof.

   The Catchment Management Plans for these catchments shall determine and adopt integrated catchment management approaches which are based upon achieving at least an equivalent outcome (in terms of avoiding as far as practicable and otherwise minimising cumulative adverse effects) to what could have been achieved by the Best Practicable Option for these catchments prior to any development.

Design, structural integrity and maintenance of the stormwater network

5) The Consent Holder shall be responsible for the design, structural integrity and maintenance of the stormwater network, and shall operate and maintain the stormwater network to avoid, remedy or mitigate the actual and potential adverse effects of the stormwater diversion and discharge activities authorised by this consent on the environment.

Changes to the stormwater network

6) The Consent Holder shall not undertake any changes to the stormwater network which would increase the scale or intensity of the actual and potential adverse effects of the stormwater diversion and discharge activities authorised by this consent on the environment.

Best Practicable Option

7) The Consent Holder shall seek to implement the Best Practicable Option to avoid, remedy or mitigate the actual and potential adverse effects of the stormwater diversion and discharge activities authorised by this consent on the environment. To this end, the Best Practicable Option shall be informed by the Stormwater Management Review Report required by Condition 40 of this consent, and implemented through the Stormwater Management Plan required by Condition 35 of this consent.

Consent Holder asset management activities

8) All Consent Holder asset management activities, including those relating to:

   a) Stormwater network activities;

   b) Water and wastewater network activities;

   c) Roading and footpath activities;

   d) Parks and gardens activities;

   e) Refuse collection activities; and

   f) Building maintenance activities

   shall, as far as practicable, be managed to assist the Consent Holder in meeting the conditions of this consent. In this regard the Consent Holder shall provide a copy of this consent to all units of the Hamilton City Council that undertake activities which are relevant to compliance with the consent conditions, and take all reasonable steps to ensure that the appropriate personnel within those units are familiar with the consent conditions to manage activities accordingly. In addition, the Consent Holder shall provide copies of the Stormwater Management Plan (Condition 35), Municipal Stormwater Network Operation Annual Report (Condition 39) and the Stormwater Management Review Report (Condition 40) to these same units of the Hamilton City Council.

Stormwater Quantity & Receiving Environment

Adverse stormwater quantity effects

9) The Consent Holder shall manage the stormwater network to avoid as far as practicable and otherwise minimise, the following stormwater quantity effects:

   a) Adverse scour, erosion and sediment deposition on land, property and the beds of stormwater receiving water bodies;

   b) Adverse flooding of land, property and stormwater receiving water bodies;

   c) Adverse effects on aquatic ecosystems.

   All such adverse effects that are more than minor shall be addressed in the manner provided for in Condition 10 hereof, where they have been caused by the stormwater diversion and discharge activities authorised by this consent.

   Advice Note: *Municipal stormwater diversion and discharge activities in conjunction with urban land-use, can adversely affect flood potential by either limiting the rate at which stormwater drains from a catchment, or by increasing the rate and volume of discharge to downstream catchments. Whilst such effects are the subject of this consent, it is also recognised that 'levels of service' for flood alleviation in existing urban catchments are established by the Consent Holder through separate statutory procedures and community consultation. The 'levels of service' that are established between the Consent Holder and the community are not the subject of this consent.*

Procedure for addressing adverse stormwater quantity effects

10) As soon as practicable after becoming aware of any of the adverse effects of the nature specified in Condition 9 that are more than minor, the Consent Holder shall submit a report to the Waikato Regional Council in relation to the adverse effects. As a minimum, the report shall include:

   a) A description of the adverse effects;

b) A description of the cause of the adverse effects;

c) An explanation of any measures taken to remedy or mitigate the adverse effects, the outcome of those measures, and whether further measures are necessary and reasonably practicable;

d) If no measures have been taken in accordance with (c), a description of any reasonably practicable measures that could be taken to remedy or mitigate the adverse effects and a recommendation as to whether those measures are necessary.

The Consent Holder shall liaise with the Waikato Regional Council with a view to determining any reasonably practicable measures which should be taken to remedy or mitigate the adverse effects.

Advice Note: *Separate resource consents may be required to undertake remedial or mitigation works. The Consent Holder is advised to obtain all such consents at its sole expense, prior to any works being undertaken.*

Fish passage

11) The Consent Holder shall undertake a review of municipal stormwater management structures that have been placed in, on, under or over the beds of receiving water bodies to enable the stormwater diversion and discharge activities authorised by this consent. The purpose of the review will be to assess the extent to which stormwater management structures impede or facilitate the upstream and downstream movement of fish with a view to:

a) Assessing whether measures to remedy or mitigate the effects of stormwater management structures on fish movement are warranted having regard to all relevant factors, including engineering difficulties, costs and environmental benefits; and

b) Liaising with the Waikato Regional Council to determine any reasonably practicable measures which should be taken to remedy or mitigate the effects of stormwater management structures on fish movement, where these are considered necessary or desirable by the Waikato Regional Council after having had regard to all relevant factors.

The remedial and mitigation measures which are determined through the review process shall be designed and constructed by the Consent Holder to the satisfaction of the Waikato Regional Council acting in a technical certification capacity, and shall be implemented through the Stormwater Management Plan required by Condition 35 of this consent.

Advice Note: *When acting on this condition the Consent Holder is advised to consult with the Department of Conservation, in accordance with Part VI of the Freshwater Fisheries Regulations 1983.*

Stormwater management devices

12) All stormwater management devices which connect to the stormwater network and are designed to control stormwater volumes and/or peak rates of discharge, shall be operated and maintained by the Consent Holder to provide best practicable stormwater management efficiency at all times.

Stream channel works

13) When carrying out stream channel works for the purpose of maintaining stormwater flows in stormwater receiving water bodies, the Consent Holder shall have due regard to the ecosystem and habitat values that these receiving water bodies support. To this end the Consent Holder shall develop its own activity specific guidelines for stream channel works, and shall implement these guidelines through the Stormwater Management Plan required by Condition 35 of this consent.

Advice Note: *Separate resource consents may be required to undertake stream channel works for the purpose of maintaining stormwater flows in receiving water stream channels. The Consent Holder is advised to obtain all such consents at its sole expense, prior to any works being undertaken.*

Stormwater Quality & Receiving Environment

Floatable contaminants

14) The Consent Holder shall manage the stormwater network to avoid as far as practicable and otherwise minimise, the discharge of any substance that is likely to cause the production of conspicuous oil, or grease films, scums or foams, or floatable suspended materials in stormwater receiving water bodies after reasonable mixing.

Suspended solids

15) The Consent Holder shall manage the stormwater network to avoid as far as practicable and otherwise minimise, the discharge of suspended solids and any other substances that are likely to cause the following effects in stormwater receiving water bodies after reasonable mixing:

a) Conspicuous changes in colour or visual clarity;

b) Smothering of benthic organisms by sediment;

c) Make the water in the Waikato River unsuitable for contact recreation.

Hazardous substances

16) The Consent Holder shall manage the stormwater network to avoid as far as practicable and otherwise minimise, the discharge of hazardous substances in concentrations that are likely to adversely affect aquatic life, or the suitability of water for human consumption after treatment. Where a question arises as to whether the concentration of any particular hazardous substance is causing these effects, it shall be determined through the application of the United States Environmental Protection Agency National Recommended Water Quality Criteria (USEPA, 2009) – Criteria Maximum Concentration, or any other technical publication approved in advance by the Waikato Regional Council in a technical certification capacity.

Micro-organisms

17) The Consent Holder shall manage the stormwater network to avoid as far as practicable and otherwise minimise, the discharge of micro-organisms in concentrations that are likely to adversely affect human health. Where a question arises as to whether the concentration of micro-organisms is adversely affecting human health, it shall be determined through the application of the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (MfE, 2003), or any other technical publication approved in advance by the Waikato Regional Council in a technical certification capacity.

Adverse effects on aquatic ecosystems

18) The Consent Holder shall manage the stormwater network to avoid as far as practicable and otherwise minimise, discharges that are likely to adversely affect aquatic ecosystems and cause the following effects in stormwater receiving water bodies after reasonable mixing:

a) Dissolved oxygen levels to fall below 80% of saturation;

b) pH to fall below 6 or exceed 9;

c) Suspended sediments to smother benthic organisms;

d) Undesirable biological growths;

e) Water temperature to change by more than 3°C or exceed 25°C;

f) Turbidity levels to exceed 25 NTU between the months of August and December;

g) Ammoniacal nitrogen concentrations to exceed 0.88 grams of nitrogen per cubic metre; and

h) Other contaminant concentrations to exceed the United States Environmental Protection Agency National Recommended Water Quality Criteria (USEPA, 2009) – Criteria Maximum Concentration.

Advice Note: *Conditions 9, 14, 15, 16, 17 and 18 identify various adverse effects that this consent is seeking to avoid or minimise through improvements in the management of the stormwater network and the stormwater diversion and discharge activities authorised by this consent. Compliance with these conditions will therefore be determined through the establishment and implementation of best practicable stormwater management measures that are adopted by, and implemented through, the Stormwater Management Plan required by Condition 35 of this consent.*

Street and stormwater catchpit cleaning operations

19) The Consent Holder shall carry out regular street and stormwater catchpit cleaning operations to minimise the volume of stormwater contaminants entering the stormwater network and discharging to the receiving environment. When considering the frequency of street and stormwater catchpit cleaning operations, the Consent Holder shall take account of the land use characteristics within respective stormwater sub-catchments, the intensity of the various land use activities taking place, and any means other than street and stormwater catchpit cleaning operations that are being utilised to control and/or treat contaminated stormwater.

Stormwater catchpits

20) All stormwater catchpits which connect to the stormwater network shall be capable of capturing and retaining the majority of gross pollutants. New, replacement and/or upgraded stormwater catchpits shall, when constructed, be further capable of capturing and retaining the majority of floatable contaminants such as oil and grease, unless any discharges of floatable contaminants from the catchpits to the receiving environment would have no more than negligible adverse effects.

Advice Note: *It may not be necessary for all new, replacement and/or upgraded stormwater catchpits to be capable of retaining the majority of floatable contaminants. Whether this is necessary or not depends on whether floatable contaminants such as oil and grease are being discharged into catchpits and, if they are, in what concentrations. The concentrations, the nature of the receiving environment, and any dilution available in receiving water bodies are all factors that should be taken into account on a case by case basis.*

Stormwater management devices

21) All stormwater management devices which connect to the stormwater network and are designed to treat contaminated stormwater, shall be operated and maintained by the Consent Holder to provide best practicable stormwater treatment efficiency at all times.

Illicit wastewater connections to the stormwater network

22) The Consent Holder shall manage the stormwater network to avoid as far as practicable and otherwise minimise, illicit wastewater connections to the stormwater network. On becoming aware of such connections the Consent Holder shall instigate remedial works to remove these connections as soon as practicable.

Advice Note: *This resource consent does not authorise any wastewater connections, illicit or otherwise, to the stormwater network.*

Routine contaminant discharges into the stormwater network

23) The Consent Holder shall manage the stormwater network to avoid as far as practicable and otherwise minimise, routine contaminant discharges into the stormwater network, particularly in High Risk Catchments where there is greater potential for stormwater to become contaminated.

Non-routine contaminant discharges to/from the stormwater network

24) On becoming aware of a non-routine contaminant discharge incident, the Consent Holder shall make all reasonable endeavours to avoid contaminants entering the stormwater network, or discharging from the stormwater network to the environment. Standard Operating Procedures to achieve compliance with this condition shall be included in the Stormwater Management

Plan required by Condition 35 of this consent and, as a minimum, those procedures shall address the following matters:

a) The Consent Holders response to non-routine contaminant discharge incidents, including the availability of spill response equipment and HCC staff to assist with such incidents;

b) Notifying the Waikato Regional Council of non-routine contaminant discharge incidents;

c) The assistance to be provided by the Consent Holder to the Waikato Regional Council and other emergency response agencies in undertaking their respective response roles.

Advice Note: *Requirements of the Fire Service Act and other legislative requirements may override the requirements of this condition in certain circumstances.*

New or replacement connections to the stormwater network

25) When assessing applications and engineering approvals for new or replacement connections to the stormwater network, the Consent Holder shall, to the extent that it lawfully can, ensure that stormwater management devices are required and/or in place to avoid as far as practicable and otherwise minimise routine contaminant discharges to the stormwater network.

Domestic water supplies

26) The consent holder shall manage the stormwater network to avoid as far as practicable and otherwise minimise, the discharge of any contaminant that may affect the suitability of water for human consumption after treatment.

27) The Consent Holder shall as soon as practicable but no longer than 3 hours after it comes to its attention, notify the Waikato District Council, Watercare Services Ltd and the Waikato Regional Council of an event that may in itself, or as a consequence of the event, have a significant adverse effect on the quality of water at any downstream drinking water supply abstraction point. The Consent Holder shall record the reasons for the event, the actions taken by the Consent Holder to avoid and/or mitigate issues relating to the event, and undertake an assessment of what measures can be adopted in the future to minimise such events. Upon the written request of the Waikato Regional Council, the Consent Holder shall report this information to the Waikato Regional Council and the Medical Officer of Health.

Stormwater Quality Improvement Programme

28) The Consent Holder shall prepare a Stormwater Quality Improvement Programme, designed to improve the quality of stormwater network discharges and assist the Consent Holder in meeting the conditions of this consent. The Stormwater Quality Improvement Programme shall form part of the Stormwater Management Plan required by Condition 35 of this consent, and be implemented by the Consent Holder progressively over the duration of this consent. As a minimum, the Stormwater Quality Improvement Programme shall include the following:

a) Education programmes which raise the general public's awareness of stormwater quality issues and the ways in which individuals can avoid as far as practicable and otherwise minimise the contamination of stormwater;

b) To the extent that the Consent Holder is authorised to do so, proposed site inspections and stormwater contamination audits of industrial and commercial properties that connect to the stormwater network in High Risk Catchments, along with education and promotion of at-source stormwater management measures to the owners/operators of these properties;

c) Investigative and remedial works programmes to remove illicit wastewater connections to the stormwater network;

d) Stormwater catchpit upgrade programmes which retrofit best practicable outlet devices (for example baffles, siphons, filter bags) to stormwater catchpits in existing urban catchments;

e) Stormwater network upgrade programmes which retrofit best practicable stormwater management devices to the stormwater network in High Risk Catchments.

f) How the Consent Holder proposes to use its regulatory powers and exercise its functions through, for example, consent requirements, engineering approvals, design specifications and guidelines and the introduction of a Stormwater Bylaw to avoid, remedy, and mitigate the adverse effects of stormwater discharges.

Complaints Register

29) The Consent Holder shall keep a Complaints Register for all formal complaints received about the stormwater diversion and discharge activities authorised by this consent. The Complaints Register shall record:

a) The date, time and duration of any alleged event/incident that has resulted in the complaint;

b) The location of the complainant when the alleged event/incident was detected;

c) The possible cause of the alleged event/incident;

d) Any corrective action taken by the Consent Holder in response to the complaint.

The Complaints Register shall be available to the Waikato Regional Council at all reasonable times. Details of complaints about significant events/incidents shall be forwarded to the Waikato Regional Council in writing within 5 working days of such complaints being received, unless otherwise authorised by the Waikato Regional Council.

Urban Growth and Development

Catchment Management Plans

30) In accordance with Condition 3(c) of this consent, Catchment Management Plans which are prepared to guide new stormwater diversion and discharge activities in developing catchments shall be to a standard acceptable to the Waikato Regional Council, and shall be submitted to the Waikato Regional Council for written approval in a technical certification capacity, prior to the establishment of these activities.

Catchment Management Plans shall determine and recommend an integrated catchment management approach which is based upon the Best Practicable Option to avoid as far as practicable and otherwise minimise, the cumulative adverse effects of all new stormwater diversion and discharge activities in developing catchments.

As a minimum, Catchment Management Plans shall include the following information:

a) Catchment maps/drawings of the catchment delineating the catchment boundary, catchment topography, natural features, surface water bodies, existing drainage systems and infrastructure (if any) and current land uses;

b) Classification of the surface water bodies within the catchment as detailed in the Waikato Regional Plan;

c) A description of the social, economic, ecological, amenity and cultural objectives being sought for the catchment (likely to stem from a concurrent structure planning process);

d) A description of proposed urban growth, development and land use intensification within the catchment;

e) A list of the key stakeholders associated with the catchment, and details of their respective views on providing for new stormwater diversion and discharge activities within the catchment;

f) An assessment of the current status of the catchment and its environs, together with a description of the geological, hydrological, ecological and existing infrastructural characteristics of the catchment, including any existing resource use authorisations within the catchment;

g) An assessment of the environmental effects of all new stormwater diversion and discharge activities on the catchment, in such detail as corresponds with the scale and significance of the effects that these activities will have on the catchment, including but not limited to, effects on:
   i) Natural features, surface water bodies and aquifers,
   ii) Sites of cultural and/or historical significance,
   iii) Public health,
   iv) Flooding hazards,
   v) Receiving water hydrology, including base flows and peak flows in rivers and streams and long-term aquifer levels,
   vi) Receiving water sediment and water quality,
   vii) Receiving water habitat, ecology and ecosystem health,
   viii) Receiving water riparian vegetation,
   ix) The extent and quality of open stream channels,
   x) Fish passage for indigenous and trout fisheries (refer to the Waikato Regional Plan Water Management Classes for applicability),
   xi) Natural and amenity values,
   xii) Existing infrastructure,
   xiii) Existing authorised resource use activities;

h) An assessment of the cumulative environmental effects of all new stormwater diversion and discharge activities on the catchment over time;

i) In response to the environmental effects assessment information, an assessment of the available management options (including Low Impact Urban Design measures and stormwater management devices), for all new stormwater diversion and discharge activities within the catchment; followed by

j) Recommendations on an integrated catchment management approach which is based upon the Best Practicable Option to avoid as far as practicable and otherwise minimise actual and potential adverse effects of all new stormwater diversion and discharge activities on the catchment;

k) A description of proposed education and promotion initiatives to be carried out by the Consent Holder to support the integrated catchment management approach recommended by the Catchment Management Plan;

l) A description of key infrastructure works to be carried out by the Consent Holder to support the integrated catchment management approach recommended by the Catchment Management Plan;

m) A prioritised infrastructure works schedule for implementing the integrated catchment management approach recommended by the Catchment Management Plan;

n) A list of performance measures by which the implementation of the integrated catchment management approach recommended by the Catchment Management Plan will be gauged.

Any approved Catchment Management Plan that needs to be updated following changes to the integrated catchment management approach recommended by the Catchment Management Plan, shall be reviewed, updated and submitted to the Waikato Regional Council for approval in a technical certification capacity, prior to any such changes being implemented within the associated catchment.

Advice Note: *It is recognised that Catchment Management Plans may also include information that provides for the integration of municipal water and wastewater services. Such information and the integration of these services are generally encouraged by the Waikato Regional Council, particularly where they result in environmentally sustainable catchment management outcomes.*

Implementation of Catchment Management Plans

31) The Consent Holder shall coordinate and oversee the implementation of approved Catchment Management Plans as required by Condition 3(c) of this consent, and shall ensure as far as practicable, that all relevant stormwater management devices are constructed and operational prior to the development of impervious surfaces within developing catchments.

Waikato Regional Council guidelines for sustainable subdivision development

32) For all new stormwater diversion and discharge activities in developing catchments, the Consent Holder shall promote consideration of the Waikato Regional Council publication titled "Sustainable Subdivision Development – An Environment Waikato Perspective" (WRC, 2006), or any other technical publication approved in advance by the Waikato Regional Council in a technical certification capacity.

Low Impact Urban Design measures and stormwater management devices

33) In addition to the requirements of Conditions 30 - 32 of this consent, the Consent Holder shall promote the implementation of Low Impact Urban Design measures and stormwater management devices in all reticulated catchments, to avoid as far as practicable and otherwise minimise the actual and potential adverse effects of the stormwater diversion and discharge activities authorised by this consent on the environment.

Register of stormwater management devices

34) As the Consent Holder and/or private developers progressively construct new stormwater management devices that become part of the stormwater network, the Consent Holder shall maintain a register of these devices in the Stormwater Management Plan required by Condition 35 of this consent, including details of their location, catchment area, operational procedures and maintenance requirements.

Stormwater Management Planning

Stormwater Management Plan

35) The Consent Holder shall prepare a Stormwater Management Plan for its stormwater network and the existing stormwater diversion and discharge activities that are authorised by this consent. The Stormwater Management Plan shall record the way in which the stormwater network is operated, and shall include best practicable stormwater measures to avoid, remedy or mitigate adverse effects on the environment.

The operational procedures, management initiatives and implementation methods that are adopted by, and implemented through, the Stormwater Management Plan shall assist the Consent Holder in meeting the conditions of this consent.

As a minimum, the Stormwater Management Plan shall include the following information:

a) A plan or drawing or series thereof which shows the Hamilton City Council administrative area, main hydrological catchments, main stormwater network (including sites of key stormwater management devices), major secondary overland flow-paths and stormwater receiving water bodies;

b) A description of the relationship and integration of the Stormwater Management Plan with other key planning instruments and regulatory/non-regulatory processes, including all those utilised in the management of the stormwater network;

c) A description of the stormwater network in relation to the contributing catchments, existing land uses within these catchments, Low Impact Urban Design measures, stormwater management devices and main pipe reticulation;

d) A description of all stormwater receiving water bodies, including their locations, key characteristics (for example water quality, ecological and hydrological characteristics), existing uses and values;

e) A list of the key stakeholders who have an interest in the stormwater diversion and discharge activities authorised by this consent, and their respective views on managing these activities;

f) A description of all stormwater network operation and maintenance procedures, including those associated with land use (for example street and catchpit cleaning), stormwater management devices, pipe reticulation and stormwater receiving water bodies;

g) A description of other Consent Holder asset management activity initiatives that will assist the Consent Holder in meeting the conditions of this consent, or are otherwise complimentary to stormwater management;

h) A description of the management initiatives and implementation methods to avoid as far as practicable and otherwise minimise:
   i) Adverse scour, erosion and sedimentation deposition on land, property and the beds of stormwater receiving water bodies,
   ii) Adverse flooding of land, property and stormwater receiving water bodies,
   iii) Adverse effects on aquatic ecosystems;

i) A list of the municipal stormwater management structures that require reasonably practicable measures to be undertaken to remedy or mitigate the effects of these structures on fish movement, in accordance with Condition 11. Also a description of the specific measures to be undertaken and a programme of works to implement these measures.

j) A set of guidelines for undertaking stream channel works in stormwater receiving water bodies;

k) A description of all potential sources of stormwater contaminants within reticulated catchments (including all potential sources of routine and non-routine contaminant discharges to the stormwater network);

l) Standard Operating Procedures for managing non-routine contaminant discharge events, including the notification procedures described in Condition 27 of this consent;

m) A Stormwater Quality Improvement Programme which, as a minimum includes:
   i) All of the activities listed in the Stormwater Quality Improvement Programme required under Condition 28; and
   ii) A prioritised schedule for implementing the Stormwater Quality Improvement Programme progressively over the duration of this consent;

n) A description of the management initiatives to promote developer consideration of the Waikato Regional Council publication titled "Sustainable Subdivision Development – An Environment Waikato Perspective" (WRC, 2006), or any other technical publication approved in advance by the Waikato Regional Council in a technical certification capacity;

o) A description of the management initiatives to promote the implementation of Low Impact Urban Design measures and stormwater management devices in reticulated catchments;

p) A register of all stormwater management devices associated with the stormwater network, including their location, catchment area, operational procedures and maintenance requirements;

q) A prioritised works schedule for implementing the operational procedures, management initiatives and implementation methods that are adopted by, and implemented through, the Stormwater Management Plan;

r) A list of performance measures by which the implementation of the operational procedures, management initiatives and implementation methods adopted by the Stormwater Management Plan will be gauged.

The Stormwater Management Plan shall be to a standard acceptable to the Waikato Regional Council and shall be submitted to the Waikato Regional Council for written approval in a technical certification capacity, by 30th September 2011 or such later date that may be approved in writing by the Waikato Regional Council in a technical certification capacity. Thereafter, the Stormwater Management Plan shall be reviewed, updated and submitted to the Waikato Regional Council for approval in a technical certification capacity, by 30th September every third year.

(The Consent Holder may update the Stormwater Management Plan at other times and submit it to the Waikato Regional Council in a technical certification capacity. The Waikato Regional Council may waive the requirement for the Stormwater Management Plan update in any three year period if it has been updated and approved before that three year period expires, in which case it shall be updated and submitted to the Waikato Regional Council for approval in a certification capacity, by 30th September in the next three year period.)

Implementation of the Stormwater Management Plan

36) The Consent Holder shall implement the operational procedures, management initiatives and implementation methods adopted by the Stormwater Management Plan, in accordance with that plan as required by Condition 35 of this consent.

Monitoring

Monitoring Programme

37) The Consent Holder shall retain appropriately qualified and experienced persons to prepare a Monitoring Programme. The objectives of the Monitoring Programme are to:

- Investigate the actual and potential adverse effects of municipal stormwater diversion and discharge activities on the environment;
- Provide information to refine Best Practicable Option stormwater management measures that assist the Consent Holder in avoiding, remedying or mitigating actual and potential adverse effects on the environment;
- Assess the performance of utilised stormwater management devices to determine their overall effectiveness in managing and/or treating stormwater, and to guide the best practicable application of these devices in respective catchments;
- Provide guidance on the ongoing and necessary changes to the Stormwater Management Plan to address any shortcomings with the operational procedures, management initiatives and implementation measures adopted by the Stormwater Management Plan;
- Review the level of subdivision and development that is occurring in developing catchments, relative to the land use assumptions underlying the integrated catchment management approaches recommended by approved Catchment Management Plans;
- Determine overall compliance with the conditions of this consent.

As a minimum, the Monitoring Programme shall include:

a) Monitoring to identify any adverse stormwater quantity and quality effects on aquatic ecosystems. This shall include stormwater receiving water body monitoring at targeted stream, lake and river locations, and comprise combinations of the following activities:

   i) Visual assessments of general habitat quality and sensitivity to stormwater inputs,
   ii) Stormwater quality sampling and analyses of key stormwater contaminants and physio-chemical parameters that aid data interpretation,
   iii) Sediment quality sampling and analyses of key stormwater contaminants and sediment characteristics that aid data interpretation, and
   iv) Biological sampling and analyses of macroinvertebrate communities and fish populations;

b) Monitoring to identify any visual signs of contaminants in stormwater (conspicuous oil or grease films, scums or foams, floatable suspended materials, conspicuous change in colour or visual clarity);

c) Monitoring to identify any adverse scour, erosion and sediment deposition on land, property and the beds of stormwater receiving water bodies;

d) Monitoring to identify any adverse flooding of land, property and stormwater receiving water bodies;

e) Monitoring to identify any stormwater management structures that are impeding the upstream and downstream movement of fish;

f) Monitoring to determine the performance of utilised stormwater management devices in managing and/or treating stormwater;

g) Monitoring to gauge the level of subdivision and development that is occurring in developing catchments, relative to the land use assumptions underlying the integrated catchment management approaches recommended by approved Catchment Management Plans;

h) Monitoring to ensure that all stormwater management devices are maintained in good working order, and providing best practicable stormwater management and/or treatment efficiency at all times;

i) Monitoring to determine best practicable street and stormwater catchpit cleaning operations to minimise the volume of stormwater contaminants entering the stormwater network and discharging to the receiving environment;

The Monitoring Programme shall be to a standard acceptable to the Waikato Regional Council and shall be submitted to the Waikato Regional Council for written approval in a technical certification capacity, by 30th September 2011 or such later date that may be approved in writing by the Waikato Regional Council in a technical certification capacity. Thereafter, the Monitoring Programme shall be reviewed, updated and submitted to the Waikato Regional Council for approval in a technical certification capacity, by 30th September every third year. The Waikato Regional Council will review and may alter the Monitoring Programme (in scale and/or method and/or location) after having had regard to the consistency and significance of the monitoring data collected, or any other information relating to the stormwater diversion and discharge activities authorised by this consent.

38) The Consent Holder shall undertake all monitoring in accordance with the Monitoring Programme required by Condition 37 of this consent, and the results of the monitoring shall, as a minimum, be summarised in the Municipal Stormwater Network Operation Annual Report required by Condition 39 of this consent.

Reporting

Municipal Stormwater Network Operation Annual Report

39) The Consent Holder shall compile an annual report entitled "Municipal Stormwater Network Operation Annual Report", for the year ending 31st March each year, and shall submit this report to the Waikato Regional Council by 1st July each year or such later date that may be approved in writing by the Waikato Regional Council in a technical certification capacity. As a minimum the report shall contain:

a) A summary of the operational procedures, management initiatives and implementation methods adopted by the Stormwater Management Plan which have been implemented during the year, along with the results of these initiatives (where relevant). Also a summary of the operational procedures, management initiatives and implementation methods which are proposed to be implemented over the coming year, along with any proposed changes or review updates to the Stormwater Management Plan that provide for the ongoing implementation of best practicable stormwater management measures;

b) A summary of the main stormwater infrastructure works undertaken during the year, particularly the works undertaken in developing catchments in accordance with approved Catchment Management Plans. Also a summary of the main stormwater infrastructure works proposed for the coming year, along with any proposed changes to approved Catchment Management Plans (where deemed by the Consent Holder to be necessary);

c) A summary of other Consent Holder asset management activity initiatives which are complimentary to stormwater management and have been undertaken during the year, along with a summary of similar type initiatives proposed for the coming year;

d) A summary of the information gathered and analysed through the Monitoring Programme required by Condition 37 of this consent. Any proposed refinements to the Monitoring Programme in response to the monitoring information gathered, or particular issues arising, should also be provided;

e) Details of all non-routine contaminant discharge incidents which have been responded to by the Consent Holder, along with a summary of the outcomes of these incidents. Any proposed changes to the Standard Operating Procedures for non-routine contaminant discharge incidents, should also be provided;

f) A summary of the level of compliance achieved with the conditions of this consent, including any reasons for non-compliance or difficulties in achieving compliance;

g) A summary of all formal complaints received in regard to the stormwater diversion and discharge activities authorised by this consent, as recorded in the Complaints Register required by Condition 29 of this consent;

h) An updated version of the Hamilton City Council Drawing MW/MAP-014, showing all new stormwater diversion and discharge activities which have been certified as authorised by the Waikato Regional Council in accordance with Condition 3 of this consent;

i) General comment on the functioning of the Hamilton City – Waikato-Tainui Stormwater Steering Group;

j) A summary of the actions and/or stormwater management measures to be implemented over the coming year to remedy any non-compliance with the conditions of this consent;

k) Details of any other matters considered relevant to this consent.

Stormwater Management Review Report

40) By 30th September 2012 and every third year thereafter, the Consent Holder shall submit a report to the Waikato Regional Council entitled "Stormwater Management Review Report". The report shall address issues relevant to the adoption by the Consent Holder of best practicable measures for avoiding, remedying or mitigating actual and potential adverse effects on the environment as a result of the stormwater diversion and discharge activities authorised by this consent. As a minimum the report shall contain:

a) A literature review of the latest developments in stormwater management best practice with particular emphasis on:
   i. Catchment management planning;
   ii. Application of Low Impact Urban Design measures in developing catchments;
   iii. At source stormwater management practices including regulatory, educational, specific trade and industry, and general land-use management practices,
   iv. Advancements in stormwater treatment technologies and management devices,
   v. Contingency planning for non-routine contaminant discharge incidents,
   vi. Remedial and mitigation measures available to stormwater network operators;

b) An assessment of the extent to which the Consent Holder is implementing the Best Practicable Option to avoid, remedy or mitigate the actual and potential adverse effects of the stormwater diversion and discharge activities authorised by this consent on the environment in accordance with Condition 7 of this consent;

c) In the event that the Consent Holder is not implementing the Best Practicable Option to avoid, remedy or mitigate the actual and potential adverse effects of the stormwater diversion and discharge activities authorised by this consent on the environment, recommendations on the measures to be adopted by the Consent Holder to achieve the Best Practicable Option. These measures shall be adopted by, and implemented through, the Stormwater Management Plan required by Condition 35 of this consent;

d) An assessment of the effectiveness of the District Plan provisions, along with other planning provisions (such as those within the Hamilton City Council Development Manual), to implement the integrated catchment management approach recommended by Catchment Management Plans; and

e) If considered necessary by the Consent Holder, suggestions on changes to the District Plan provisions, and/or other Consent Holder planning document provisions where appropriate, that will assist in achieving the integrated catchment management approach recommended by Catchment Management Plans;

f) A review of any stakeholder concerns raised during the period covered by the Stormwater Management Review Report, and any measures taken or proposed to be taken to address those concerns.

Hamilton City – Waikato-Tainui Stormwater Steering Group

41) The Consent Holder shall invite the Waikato Tainui Te Kauhanganui Inc (or replacement body) to establish in association with the Consent Holder a group to be entitled the Hamilton City Council - Waikato-Tainui Stormwater Steering Group. If established, the Consent Holder shall provide organisation and administrative support to facilitate the development and ongoing role of the Steering Group for the duration of this consent. If established, membership of the Steering Group shall comprise an equal number of Waikato Tainui Te Kauhanganui Inc (or replacement body) and Hamilton City Council representatives appointed respectively by each of those parties. As a minimum:

a) The Steering Group shall be invited to meet at least annually to exercise the functions set out in sub-condition (c) of this condition;

b) The Steering Group shall establish its own meeting protocols having regard to the customary practices of Waikato-Tainui, and shall operate in accordance with the principles

of the Treaty of Waitangi, especially the principles of consultation, active participation and partnership;

c) The functions of the Steering Group shall include, but not be limited to, the following activities:
   i. Identify ways to improve stormwater quality, receiving environs and fish passage,

   ii. Receipt of and comments on, the Municipal Stormwater Network Operation Annual Report as required by Condition 39 of this consent,

   iii. Receipt of and comments on, the Stormwater Management Plan and review updates to this plan as required by Condition 35 of this consent,

   iv. Receipt of and comments on, the Stormwater Management Review Report as required by Condition 40 of this consent,

   v. Based on the information in the Municipal Stormwater Network Operation Annual Report, the Stormwater Management Plan, the Stormwater Management Review Report and other relevant information, review the effects of municipal stormwater diversion and discharge activities on stormwater receiving water bodies, and make recommendations to the Consent Holder and/or the Waikato Regional Council as to any management measures and initiatives further needed to address actual and/or potential effects of these activities,

   vi. Recommend to the Consent Holder the commissioning of research and technical reports to assist the Steering Group with its functions,

   vii. At least one month prior to the opportunities for review provided for in Condition 44 of this consent, to make recommendations to the Waikato Regional Council on issues raised by the Steering Group in relation to, amongst other matters, the Stormwater Management Plan, the Municipal Stormwater Network Operation Annual Report, the Stormwater Management Review Report, and how such issues were addressed by the Consent Holder; and

   viii. Consideration of other matters raised by the Steering Group.

This condition shall cease to have any effect if the Consent Holder and the duly authorised representative(s) of Waikato-Tainui advise the Waikato Regional Council in writing that the functions of any Steering Group that is established are to be exercised in accordance with a joint management agreement prepared pursuant to section 41 of the Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010.

Advice Note: *Subject to agreement between the Consent Holder and the Waikato Tainui Te Kauhanganui Inc (or replacement body), the Hamilton City – Waikato Tainui Stormwater Steering Group may establish itself as a broad based steering group, focussed on the management of Hamilton's municipal water, wastewater and stormwater activities.*

Administrative

Consent Holder's representative

42) The Consent Holder shall appoint a representative who shall be the Waikato Regional Council's principal contact person in regard to matters relating to this consent. The Consent Holder shall forward contact details of its representative to the Waikato Regional Council. The Consent Holder shall inform the Waikato Regional Council in writing of any change in its representative as soon as practicable.

Waikato-Tainui Raupatu Claims Waikato River Settlement Act

43) Within 12 months of all of the provisions of the Waikato-Tainui Raupatu Claims Waikato River Settlement Act 2010 commencing the Waikato Regional Council may, following service of

notice on the consent holder, commence a review of the conditions of this consent pursuant to section 128(1) of the Resource Management Act 1991, for the purpose of ensuring that the conditions of this consent are not inconsistent with the provisions of the Act; and

Within the six month period following 1st December 2012 and the six month period following the 1st December every five years thereafter, the Waikato Regional Council may, following service of notice on the consent holder, commence a review of the conditions of this consent pursuant to section 128(1) of the Resource Management Act 1991, for the purpose of ensuring that the conditions of this consent are not inconsistent with the Vision and Strategy of the Waikato-Tainui Raupatu Claims Waikato River Settlement Act 2010 (Schedule 2 – Vision and Strategy for Waikato River), and if necessary to address any such inconsistencies by way of further or amended conditions.

Review clause

44) The Waikato Regional Council may within the six month period following 1st July 2014 and the six month period following 1st July every three years thereafter, serve notice on the Consent Holder under section 128(1) of the Resource Management Act 1991, and commence a review of the conditions of this consent for the following purposes:

a) To review the effectiveness of the conditions of this consent in avoiding, remedying or mitigating any adverse effects on the environment from the exercise of this consent, and if necessary to avoid, remedy or mitigate such effects by way of further or amended conditions;

b) In view of the findings of the Stormwater Management Review Report required by Condition 40, or the Monitoring Programme required by Condition 37 of this consent, to require the Consent Holder to adopt the Best Practicable Option or other specific measures to avoid, remedy or mitigate any adverse effects on the environment that result from the exercise of this consent;

c) To review the adequacy of and necessity for the monitoring undertaken by the Consent Holder, and, if necessary, to amend and/or introduce new conditions to monitor any adverse effects on the environment that result from the exercise of this consent;

d) To respond to concerns raised by the Hamilton City Council – Waikato-Tainui Stormwater Steering Group;

e) To achieve consistency with any future changes to the Waikato Regional Council's Regional Plans or policies in regard to catchment management planning and stormwater management.

Costs associated with any review of the conditions of this consent will be recovered from the Consent Holder in accordance with the provisions of section 36 of the Resource Management Act 1991.

Administrative charges

45) The Consent Holder shall pay to the Waikato Regional Council any administrative charge fixed in accordance with section 36 of the Resource Management Act 1991, or any charge prescribed in accordance with regulations made under section 360 of the Resource Management Act.

For and on behalf of the
Waikato Regional Council

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General Advice Notes

1) *This resource consent does not give any right of access over private or public property. Arrangements for access must be made between the Consent Holder and the property owner.*

2) *The reasonable costs incurred by the Waikato Regional Council arising from supervision and monitoring of this consent will be charged to the Consent Holder. This may include but not be limited to routine inspection of the site by Waikato Regional Council officers or agents, liaison with the Consent Holder, responding to complaints or enquiries relating to the site, and review and assessment of compliance with the conditions of consent.*

3) *This consent does not authorise any stormwater diversion or discharge activities derived from privately owned stormwater networks, nor any other stormwater diversion or discharge activities that do not result from the operation of the Hamilton City Council's municipal stormwater network.*

4) *This consent does not authorise any works in a watercourse, nor any other activity for which further consents may be required under sections 13, 14 and 15 of the RMA, or the provisions of the Waikato Regional Plan.*

5) *The Consent Holder is responsible for compliance with the conditions of this consent, except where statutory defences pursuant to section 341 of the RMA apply.*

6) *Pursuant to section 332 of the RMA 1991, enforcement officers may at all reasonable times go onto the property that is the subject of this consent, for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.*

Appendix to Resource Consent Schedule - 105279

Condition 30 (Catchment Management Plans) and Condition 35 (Stormwater Management Plan) refer to 'key stakeholders'. In this regard 'key stakeholders' include but are not limited to, the following parties and/or their successors:

1. Waikato Regional Council – P O Box 4010, Hamilton East
2. Waikato Tainui Te Kauhanganui Inc / Waikato Raupatu River Trust – Private Bag 3344, Hamilton
3. Waikato District Council – Private Bag 544, Ngaruawahia
4. Waikato District Health Board – Public Health Unit, P O Box 505, Hamilton
5. Department of Conservation – Private Bag 3072, Hamilton
6. Watercare Services Limited – Private Bag 92521, Wellesley Street, Auckland
7. Te Kotuku Whenua Consultants – C/- Maree Pene, 96 Insol Avenue, Hamilton
8. Tui 2000 – C/- Mairi Jay, 43 MacFarlane Street, Hamilton
9. Lake Rotokauri Management Committee – C/- 17 Wynvale Lane, RD9, Hamilton
10. The University of Waikato - Centre for Biodiversity & Ecology Research – Private Bag 3105, Hamilton
11. Mangaiti Gully Restoration Group – C/- Mr Robin Holdsworth, 13 Sexton Road, Rototuna Park, Hamilton
12. Mr Bruce MacKay 1A Wymer Terrace, Hamilton
13. CDL Lands New Zealand Ltd – C/- McPherson Goodwin Surveyors Ltd, P O Box 9379, Hamilton

In terms of Condition 30 (Catchment Management Plans), 'key stakeholders' shall be limited to those parties who are associated with a particular catchment, not the wider Hamilton Urban Area.

In terms of Condition 35 (Stormwater Management Plan), all parties shall be consulted in the development of the Stormwater Management Plan before the Stormwater Management Plan is submitted to the Waikato Regional Council for approval. Thereafter the appropriate party/s shall be consulted as relevant to the stormwater management activity under review.