REPORT

Tonkin+Taylor

Resource Consent Applications

River Management Activities in the Hutt River / Te Awa Kairangi

Prepared for

Greater Wellington Regional Council (Flood Protection)

Prepared by

Tonkin & Taylor Ltd

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Exceptional thinking together

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Executive summary

River management activities have been undertaken in Te Awa Kairangi / Hutt River for almost 150 years, and today the intensively developed floodplain of the Hutt Valley is protected by flood protection infrastructure that is valued at $66.2 M.

This investment reflects the critical role flood protection plays in managing flood hazards. A large flood over the Te Awa Kairangi / Hutt River floodplain would have wide-ranging social and psychological impacts on the Hutt Valley communities. There would be physical damage and disruption to homes, schools, workplaces, community facilities, and essential and emergency services. Utilities such as water supply, sewerage, electricity and telecommunications could be put out of action for days. The financial cost from such a flood could exceed $1 billion. Recovery would likely be slow, with damage to buildings and roads taking months or even years to repair. This would severely affect the day-to-day functioning of the community, and have an enormous effect on the regional, and possibly national, economy.

The range of river management activities undertaken by GWRC in the Te Awa Kairangi / Hutt River is comprehensive, covering the construction and maintenance of structures, establishment and maintenance of vegetative plantings and river bank protection, and a variety of channel management and maintenance activities including bed recontouring and gravel extraction, and mouth realignment. These activities are undertaken both in the river bed and on public land within the river corridor. Activities in the tributaries are generally limited to the removal of accumulated debris, sediment and aquatic weeds, and maintenance of existing structures. Many of the activities are undertaken on a relatively infrequent basis, but all of the activities identified in the application collectively form a toolbox of river management activities which are available to be used within the application area, subject to the Code of Practice.

GWRC is committed to operating in a manner that reflects good practice and results in the avoidance and minimisation of adverse effects. GWRC also seeks that new methods can be employed if those methods can be approved by an Independent Review Panel. Works with potentially significant effects can only proceed if in accordance with an Operational Management Plan, which takes into account the specific values of the affected reach. Kaitiaki monitoring, the results of which are provided to a Māori Consultative Group, will be conducted in accordance with a Kaitiaki Monitoring Strategy. The results of this monitoring will provide recommendations to the consent holder who must advise the consent authority (after input from the Independent Review Panel) as to how it has incorporated those recommendations into its river management practices.

Given these parameters, a 35 year term is sought.

Not included in the application are specific large capital works (such as the construction of new stopbanks) or application for the use of herbicides for control or removal of vegetation.

The application is one component of a wider GWRC consent renewal project, which covers eight consents for flood protection operations and maintenance activities and three gravel extraction consents. The existing consents cover several rivers in the western and eastern parts of the Wellington Region. Work on re-consenting the western consents started in April 2012, while work on the eastern consents (with the exception of one short-term consent for the Waingawa River) started in late 2014.

A key component of the resource consent project is focused on updating GWRC's existing Code of Practice (COP) for undertaking river management activities. The new COP will be region-wide and will inform all river management activities undertaken by GWRC. A draft of the COP has been prepared and work on COP development will continue throughout the processing of the resource consent applications and beyond, in response to on-going consultation.

The new and comprehensive COP will sit alongside the Te Awa Kairangi / Hutt River Floodplain Management Plan, annual works and maintenance plans and environmental monitoring, to guide and direct GWRC's works and maintenance activities. In particular, the COP will provide specific detail and direction on the methodology to be adopted for individual activities. The resource consents will provide for a review process by which the COP may be updated on an agreed basis, based on the information supplied by on-going monitoring and engagement with iwi and key stakeholders. In that way, the COP will be a living document that drives good practice while also remaining flexible and responsive to the dynamic nature of the river environment.

The effects of the activities individually, and as a whole, have been assessed using existing environmental information, and information made available through the environmental investigation work being undertaken by GWRC.

The positive effects of the works are significant and include the direct reduction of the flood hazard and risks to life, property and the economy of the Hutt Valley and the wider Wellington Region. They are a key component of the continued economic and social well-being of the Hutt Valley in particular and the region as a whole.

The main potential adverse effects can be grouped as follows:

- Water quality;
- Aquatic ecology;
- Birdlife;
- Recreation; and
- Cultural.

They can be summarised as follows.

- **Water quality**. These effects arise from the input of suspended sediments to the water column as a result of the direct disturbance of the bed, or from works on banks or in culverts. The operation of machinery (particularly bulldozers) in the river bed give rise to the greatest effects in this regard. Generally such work will be undertaken for several weeks per annum. Suspended solid concentrations of up to 700 mg/l can be generated for short periods, which is about the same as that arising from a one year return period flood. The aquatic biota are naturally adapted to cope with such variations in turbidity; available information to date suggests that in general the overall effect of increased suspended solids in the water is relatively minor and can be mitigated to a reasonable degree by restrictions of operations to no more than half of every 24 hour period.
- **Aquatic ecology**. These effects arise from direct disturbance of the river bed habitat associated with construction activity, gravel extraction or bed recontouring. Activities such as gravel extraction have a significant impact on the habitat and ecology of the affected reaches, however available information to date suggests that such effects may be relatively short-lived, with the river acting to re-work the bed naturally and the aquatic biota re-colonising impacted areas relatively quickly. Mitigation is currently focused on incorporating final shaping of affected reaches to provide for more complexity of habitat to assist recovery. GWRC is committed to continued investigations into the impacts of in-river works on aquatic ecology which will ultimately help to improve practice and enhance mitigation.
- **Birdlife**. Potential effects arise from disturbance of roosting or nesting birds, or from changes to potential nesting habitats on the river bed. Recent survey work has identified a wide range of bird species along the Te Awa Kairangi / Hutt River and its margins. Particularly sensitive species such as dotterels and pied stilts do not currently nest on the Te Awa Kairangi / Hutt River. Works currently undertaken in the river bed, especially the clearance of vegetation from the beaches within the river, are considered to be positive for the creation of potential nesting

habitats. Proposed mitigation of potential adverse effects is focused on ensuring that if river nesting birds do commence breeding or nesting at some time in the future, this will be detected and there will be opportunity to develop appropriate responses to mitigate any adverse effects.

- **Recreation**. Much of the work that GWRC undertakes in relation to implementation of the Te Awa Kairangi / Hutt River Environmental Strategy has a positive effect on the development of passive recreation opportunities in the Te Awa Kairangi / Hutt River corridor. Adverse effects are generally limited to in-river users (anglers, canoeists and kayakers) and arise from temporary disruption or restriction of access, or creation of hazards. Generally the adverse effects on in-river users from river management activities do not appear to be significant. However it is recognised that GWRC needs to continue to work with user groups to address specific safety issues arising from damaged structures or debris in the river and to ensure that the design of any future grade control structures makes provision for in-river users as far as is practicable.
- **Cultural** (arising from changes to traditional areas of use and disturbance of areas of significance). GWRC has an established relationship with iwi and will continue to work with them to better understand their concerns, share knowledge and make provision for recognition of cultural values within the COP. This consultation is on-going.

Other potential adverse effects of the works on the landscape and visual amenity values of the river corridor are considered to be less than minor, particularly in the context of the other landscape enhancement work associated with implementation of the Te Awa Kairangi / Hutt River Environmental Strategy that GWRC undertakes.

Consultation with affected parties and interested groups has been undertaken in the preparation of this application and the feedback received has been taken into account. GWRC has requested that the application be notified to ensure any other affected or interested parties have the opportunity to have input to the consideration of the application.

The proposed suite of activities has overall status as a discretionary activity under the Operative Regional Plans, and non-complying under the Proposed Natural Resources Plan (PNRP). The proposal is in keeping with the purposes of the RMA and consistent with the objectives and policies of the regional policy statement and plans. It will deliver the anticipated environmental results that the policies of the regional plans are expected to achieve. For this reason we consider that the consents should be granted.

1 Introduction

1.1 The need for river management activities

River management activities have been undertaken in the Te Awa Kairangi / Hutt River for almost 150 years, and today the intensively developed floodplain of the Hutt Valley is protected by flood protection infrastructure that is valued at $66.2 M. The river has been modified and managed since European settlement of the Hutt Valley commenced and, with consents, t will continue to be modified and managed to protect the communities that live adjacent to it, for the foreseeable future.

It is a legislative requirement[1] to address the flood hazard associated with rivers. The Greater Wellington Regional Council (GWRC) assumes responsibility for this function in the Wellington Region. River management activities make up 6% (or nearly $28 M) of the council's expenditure for the current 2015/16 financial year.

The overarching vision and strategy for flood protection work in the Te Awa Kairangi / Hutt River is contained in the Te Awa Kairangi / Hutt River Floodplain Management Plan (HFMP) (Wellington Regional Council, 2001), a document that has been developed through consultation and agreement with the local Hutt Valley communities. This document establishes the level of protection from flooding that has been determined necessary by the community, and it outlines the measures by which it will be achieved. These measures include capital works such as construction of stopbanks, operational works within the river, and other off-river works (such as moving people and infrastructure away from the flood risk). In turn, these requirements are reflected and developed further in the Council's Long Term Plan, Asset Management Plans and annual work programmes. The operations and maintenance works undertaken by GWRC are required to respond to the challenges of a dynamic river system; these include repairing damage caused by periodic flood events, and managing the continuous transport of gravel through the river system and the deposition and build-up of gravel in the lower reaches.

The Te Awa Kairangi / Hutt River Environmental Strategy forms an important part of the HFMP. It provides a vision for development of the Te Awa Kairangi / Hutt River corridor, which further guides GWRC's works and maintenance activities, particularly in respect of the management of vegetation, access, visual amenity and recreational opportunities in the river corridor.

1.2 Te Awa Kairangi / Hutt River Term and scope sought for new consents

Since the introduction of the Resource Management Act (RMA) in 1991, GWRC has been required to undertake its river works and maintenance activities according to resource consents that have been used to prescribe and set the parameters for these activities. To date, the timeframe for these consents has been less than the maximum currently allowed, which has placed additional costs associated with re-consenting/consent renewal unnecessarily on the regional community.

The application which is the subject of this report seeks new resource consents over a 35 year term for GWRC's operations and maintenance activities. In conjunction with this, it proposes an approach whereby much of the detail and prescription for the methods to be employed is to be included in a COP (see Section 2.2.1 below), rather than in the resource consent itself, with the consent providing bottom lines to ensure that the effects of the consented activities are appropriate. The COP will be a living document representing good environmental practice. It will be supported by an on-going programme of investigation and monitoring and review, which provide a process by which it can

[1] GWRC has statutory responsibility for the minimising and preventing of flood and erosion damage under the Soil Conservation and Rivers Control Act 1941 (sections 10 and 126), and avoidance or mitigation of natural hazards under section 30 of the Resource Management Act 1991 (RMA). By definition, 'natural hazards' include flooding.

evolve over time. Such an approach will allow greater flexibility to test and refine methods without the need to vary and/or seek new resource consents.

1.3 Specifics of existing consents held and new consents sought

GWRC currently holds resource consents WGN 980255 (01), (02), (03), (04) & (05) for works and maintenance activities in the bed of the Te Awa Kairangi / Hutt River, which expired on 6 October 2013. GWRC also holds consents WGN 060334 [25362], [25363] & [25364] for gravel extraction between Belmont and the Ava Rail Bridge, which expired on 27 October 2011 but have been afforded continuance pursuant to s 124 of the RMA. Application WGN 110359 for new consents to replace WGN 060334 (lodged 27 April 2011) is currently being processed by the Council's Environmental Regulation Department (Environmental Regulation). A further consent [WGN 060291] to enter the bed of the Stokes Valley Stream for the purposes of mowing the banks is also held by GWRC.

This application is for resource consents to allow continuance of GWRC's operational and maintenance activities in the lower 28 km (approximately) of the Te Awa Kairangi / Hutt River corridor[2]. The end reaches of the following two tributaries: Akatarawa River and Stokes Valley Stream , together with Te Mome Stream and the river bed and banks at the debris arrester in Speedy's Stream, all of which the Council also actively manages, are also included. The application seeks to include all associated activities connected to gravel extraction within these consents, thus superseding current application WGN 110359 (which will be withdrawn once processing of this application is underway). The application also includes the mowing of Stokes Valley Stream banks; the current consent covering this activity will be surrendered once the new consent is granted.

The application does not cover specific large capital works such as the construction of new stopbanks and does not seek consent for the use of herbicides for control or removal of vegetation.

1.4 Applicant and details of area covered by application

The required forms for this application are included in Appendix A.

The application covers publicly owned land[3] in the Te Awa Kairangi / Hutt River corridor as defined by the HFMP and as shown in the aerial photographs provided in Appendix B; it covers the river bed and banks between the upstream side of the Estuary Bridge and the eastern end of Gillespies Rd subdivision, together with short sections of the river beds and adjacent banks in the lowest reaches of four tributaries (Akatarawa River, Stokes Valley Stream, Speedy's Stream and Te Mome Stream), plus the stormwater drainage network on the landward side of the stopbank between Moonshine Bridge and Maoribank Corner. The river bed and the majority of the land lying within the application area is in public ownership, and is administered by either the Crown, Greater Wellington Regional Council, Hutt City Council or Upper Hutt City Council. Details of land ownership are shown on the maps in Appendix B.

Details of the application are shown in Table 1 below.

[2] For a definition of the river corridor see Section 1.6.
[3] This includes land owned by the Crown and by Greater Wellington Regional Council, Upper Hutt City Council and Hutt City Council.

Table 1: Application details

Applicant	Wellington Regional Council[4]
Owner of application site	The Crown, Greater Wellington Regional Council, Upper Hutt City Council and Hutt City Council. Certificates of Title are included in Appendix C[5].
Site address / map reference	Bed and adjacent banks of Te Awa Kairangi / Hutt River within the river corridor (as defined in the Regional Freshwater Plan for the Wellington Region), from the eastern end of Gillespies Road subdivision, Upper Hutt (NZTM grid reference 1777244.28E, 5448911.85N) to the landward side of Estuary Bridge, Lower Hutt (NZTM grid reference 1759244.67E, 5433635.66 N); Bed and adjacent banks of Akatarawa River, from the confluence with the Te Awa Kairangi / Hutt River at or about NZTM grid reference 1776195.77E, 5449115.36 N, to a point approximately 100 metres upstream, at NZTM grid reference 1776186.92E, 5449255.31N; Bed and adjacent banks of Stokes Valley Stream, from the confluence with the Te Awa Kairangi / Hutt River at or about NZTM grid reference 1765989.83E, 5441453.20N upstream to the confluence with Tui Glen Stream, at NZTM grid reference 1766283.49E, 5440806.45 N; Bed and adjacent banks of Speedy's Stream at the debris arrester located approximately at NZTM grid reference 1761616.39E, 5438424.77N; Bed and adjacent banks of Te Mome Stream from the confluence with the Te Awa Kairangi / Hutt River at or about NZTM grid reference 1759070.01E, 5433667.87N upstream to the northern end of the culvert under Bracken St, located approximately at NZTM grid reference 1758769.98E, 5434771.35N. All culverts and outlets managed by GWRC associated with streams and modified watercourses at their confluence with the Te Awa Kairangi / Hutt River, lying between the eastern end of Gillespies Road subdivision and the landward side of the Estuary Bridge; The stormwater drainage network on the landward side of the stopbank between Moonshine Bridge and Maoribank Corner.
Address for service and invoicing	Greater Wellington Regional Council Flood Protection Department Attention: Tracy Berghan

1.5 Summary of regional resource consent requirements

Resource consents are sought to cover all of the operations and maintenance activities undertaken by GWRC whether they currently need consent or are affected by proposed changes in the Proposed Natural Resources Plan. These are summarised in Table 2 below. During the preparation of this AEE Report and supporting documentation, regard has been had to the Proposed Natural Resources Plan being prepared for the Wellington Region.

A variety of consent categories apply across the range of activities. The most onerous is non-complying due to the PNRP requirements detailed in section 10 of this report.

[4] Note that this is the correct legal name for the regional council. Elsewhere in this application document, the council is referred to by its promotional name of 'Greater Wellington Regional Council'.
[5] The official copy of the application includes Schedules of the Certificates of Title and copies of each title; other copies only include the Schedules.

Table 2: Resource consent details

Type of Consent	Relevant Plan & Rule	Activities[6]
Land Use	Regional Freshwater Plan (RFP) Rule 43 – Maintenance, repair, replacement extension, addition to, or alteration of any structure Rule 44 – Removal or demolition of structures Rule 48 – Placement of impermeable erosion protection structures Rule 49 – All Remaining Uses of River Beds	Construction in/on the river beds of: • impermeable erosion protection structures • rock/concrete grade control structures • drainage channels and minor culverts associated with walkway developments Construction in/on the river beds of: • permeable erosion protection structures: • debris fences • debris arresters Planting of willows in the river beds Layering, tethering and cabling of willows in the river beds Recontouring of the river beds Disturbance of river beds by mechanical ripping Cutting of diversion channels Shaping and repair of bank edges Trimming or removal of vegetation from the river beds Clearance of flood debris from the river beds and stream culverts Extraction of gravel from the river beds Maintenance, repair, replacement, extension, addition, alteration of structures on the river beds Demolition and removal of structures from the river beds Dredging of the bed at the "Lower Opahu Stream" (isolated arm) outlet[7] Removal of debris from Stokes Valley Stream stilling basin (immediately upstream of Stokes Valley Rd bridge) Construction of footbridges Operation of machinery in river bed for the purpose of mowing river banks/berms or trimming and mulching vegetation on the banks Entry & passage on river bed for operations & maintenance purposes Maintenance of drains
	Rules 1 - 4 Regional Soil Plan	Repairs etc. of banks, berms and stopbanks Construction of earth training banks, concrete flood walls or retaining walls, drainage channels and minor culverts (not in river bed) Construction of walkways or cycle ways on the river berms Construction of boundary fences Disturbance of vegetation on berms, including mowing.
Water Permit	RFP Rule 16	Diversion of water associated with the above activities as necessary

[6] A full description of activities is included in Section 4.2.
[7] This is located on the true left bank immediately downstream of the Ava rail bridge. "Lower Opahu Stream" is no longer a stream but rather an isolated arm of the Hutt River that receives some stormwater inflow from the land adjacent.

Type of Consent	Relevant Plan & Rule	Activities[6]
Discharge Permit	RFP Rule 5	Discharge to the rivers of silt and sediments associated with: • all construction works • all planting works • all maintenance works • all demolition works • dredging of "Lower Opahu Stream" (isolated arm) outlet • repair of structures on the river berms Discharge of stormwater into surface water associated with works outside the river bed

Consent is sought for GWRC's complete suite of river management activities, as outlined in the table above. It should be noted that some of these activities are classed as permitted activities to a certain threshold. Others are allowed as of right under the provisions of the current plans and rules. For information purposes these are listed in Table 3 below.

Table 3: Permitted activities

Relevant Plan & Rules	Permitted Activities
RFP Rule 1	Discharge of water and minor contaminants from maintenance (e.g. water blasting) of structures.
RFP Rule 2	Discharge of stormwater into surface water (provided it doesn't originate from an area of bulk earthworks greater than 0.3 ha).
RFP Rule 9A	Diversion of water from an artificial watercourse or drain.
RFP Rule 31	The erection and maintenance of any bridge over a river bed (less than 6m in length).
RFP Rule 35	Entry or passage across river bed not covered by any use specified in Rules 22 -48 or s.13 of the Act.
RFP Rule 36	Disturbance of river beds associated with clearance of flood debris.
RFP Rule 37	Recontouring of beaches in the river bed. Removal of vegetation/ 'scalping' of beaches in the river bed.
RFP Rule 39	Maintenance of drains.
RFP Rule 40	Removal of vegetation from river bed (including cutting of stakes and poles for re-planting)
RFP Rule 42	Urgent works within 10 days of a natural hazard event, including: • Repair of any bank protection works • Recontouring of the river beds • Disturbance of the river beds • Deposition on the river beds
Regional Soil Plan Rules 1, 2 & 3	Repairs of stopbanks and berms (outside the river beds). Construction of walkways or cycle ways on the river berms (outside of the river beds). Construction of boundary fences. Disturbance of vegetation on berms, including mowing. Landscaping and/or planting on berms.

1.6 Interpretation

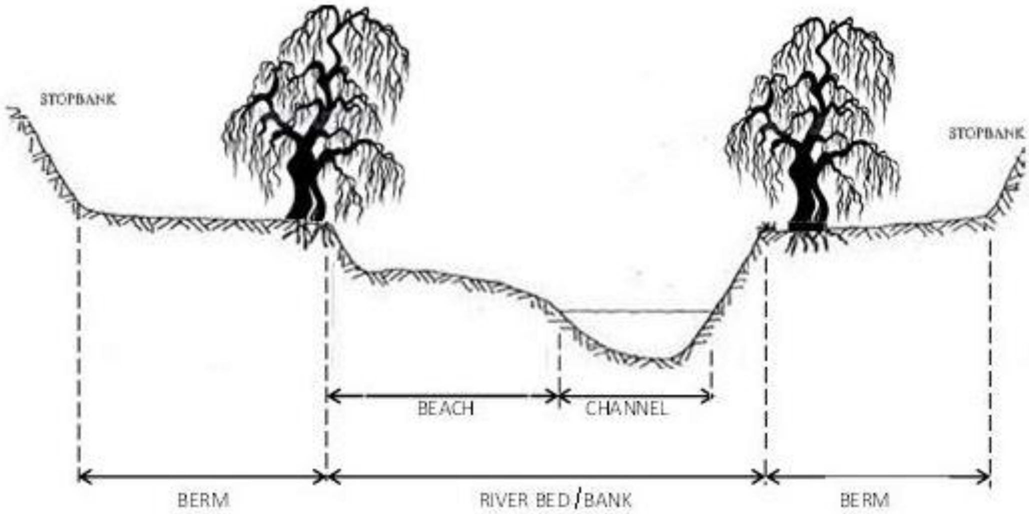

Figure 1: Explanation of terms

Bed	The RMA and the Regional Freshwater Plan for the Wellington Region (RFP) define the bed of a river (for purposes other than esplanade reserves, esplanade strips and subdivision) as: '**the spaces of land which the waters of the river cover at its fullest flow without overtopping its banks.'** See Figure 1 Figure 1 for a visual representation.
Bank	The RMA does not define this; the RFP defines bank in relation to the bed of any river as having **'the same meaning as in the interpretation of "bed" in the Act.'**
Beach	Neither the RMA nor the RFP define 'beach', but based on the definition of 'beach recontouring' in the RFP (see below) it can be assumed to be **'the part of the river bed not covered by water at any particular time**.**'** See Figure 1 for a visual representation.
Berm	Neither the RMA nor the RFP define this. For the purposes of this application it is defined as **'the area of land between the river bed and the inner toe of a stopbank.'** See Figure 1 for a visual representation.
Beach recontouring	**The RMA does not define this; the RFP defines it as** 'disturbance of any river bed by the mechanical movement of sand, shingle, rock, gravel or other natural material, to realign that part of the bed that <u>is not</u> covered by water at the time of disturbance, for the purpose of remedying or mitigating the adverse effects of flooding or erosion.**'**

Bed recontouring	The RMA does not define this; the RFP defines it as **'disturbance of any river bed by the mechanical movement of sand, shingle, rock, gravel or other natural material, to realign that part of the bed that <u>is</u> covered by water at the time of disturbance, for the purpose of remedying or mitigating the adverse effects of flooding or erosion.'** This activity is also referred to as 'cross-blading'. It covers any work that comes in contact with the active channel and results in reshaping of the active channel.
Design Standard	In the context of these applications **"**is the current cumec standard of protection, which is currently a 2300 cumec standard of protection which has been adopted in the Hutt floodplain management plan for all floodplain areas except for small urban areas namely the Belmont and the Bridge Road - Gemstone Drive area of Upper Hutt (which are managed to a 1 in 100 year standard and the Stokes Valley Stream, Speedy Stream and Whakatiki River (which are managed to a 2,800 cumec standard)."
Code	means Wellington Regional Council's Code of Practice for river management activities at the date of consent, or as amended from time to time. The Code also covers activities for which resource consent is not required.
Flooding	The RMA does not define this; the RFP defines it as having **'the same meaning as in the interpretation of 'natural hazard' in the Act. Reference to the flood hazard or flooding in the Plan includes erosion associated with river beds and their banks.'**
Flood Mitigation works	The RMA does not define this; the RFP defines it as **'any structure or work that is used for the purpose of mitigating the adverse effects of flooding. Flood mitigation works include (but are not limited to) any stopbank, bank protection structure, training wall or groyne.'**
Flood debris	The RMA does not define this; the RFP defines it as **'material deposited on the river bed as a result of wreckage or destruction resulting from flooding. Flood debris can include trees, slip debris, collapsed banks, and the remains of structures but does not include the normal fluvial build-up of gravel.'**
Removal of flood debris	is any work where flood debris is required to be cleared to remove or reduce a flood or erosion hazard or to protect structures from damage.
Floodplain	The RMA does not define this; the RFP defines it as **'the flat or gently sloping portion of a river valley that is or has the potential to be covered with flood water when the river overflows during flood events.'**

Gabion	The RMA does not define this; the RFP defines it as **'an erosion or flood mitigation structure that is a wire mesh basket filled with small rocks and extending more or less parallel to, and against, the river or stream bank.'**
Groyne	The RMA does not define this; the RFP defines it as **'an erosion or flood mitigation structure that extends from the bank into the river bed and is designed and constructed to deflect the direction of the flow of water in a river or stream.'**
Natural Hazard	The RMA defines this as **'any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.'**
Rock rip-rap structure	The RMA does not define this; the RFP defines it as **'a structure that is built from large rocks extending more or less parallel to and against the river or stream bank to resist erosion.'**
River management activities	In the context of these applications means 'any activity undertaken for the purposes of flood or erosion control or hazard management to achieve the design standard, and any works undertaken to remedy or mitigate the effects of such activities, but excludes capital works.'
Stopbank	The RMA does not define this; the RFP defines it as **'a structure constructed on a floodplain, or alongside a river, designed to contain flood flows and prevent high river flows flooding onto adjacent land.'**

2 Background

River management activities have been undertaken in the Hutt Valley to address the risks from flooding since the area was first settled by Europeans. The first flood defences were built in 1894 to protect Petone and the first flood protection scheme ('Scheme to Conserve the Te Awa Kairangi / Hutt River') was completed between 1901 and 1906. This involved construction of flood defences (stopbanks and timber groynes) from the mouth to Boulcott, and it replaced the old 1894 Petone stopbank.

A gravel extraction programme commenced in 1902 and has continued to the present day (apart from a moratorium on extraction from 1991 to 2001). Over time it has been increasingly recognised that gravel extraction needs to be actively managed to preserve the structure of the river bed and reduce the rate of erosion of the river banks while also maintaining the river's flood carrying capacity.

In 1940 stopbanks were extended to Taita Gorge to protect new urban development in that area, and extended further, from Upper Hutt to Maoribank between 1956 and 1972.

By 1972 the extension of the flood protection scheme into Upper Hutt was largely completed, although since this time work has continued on rebuilding and extending isolated sections of the stopbanks. For example, additional stopbanks have been constructed at Parkvale and Totara Park and the Ewen floodway stopbanks have been reconstructed. River alignment and bank edge protection improvements over this time have included works associated with the Upper Te Awa Kairangi / Hutt River Road, Pomare rock groynes, Ewen floodway channel realignment and the Belmont sewer protection works. In addition there has been on-going dredging of the river mouth and an annual maintenance work programme.

Since the development of the HFMP in 2001 (see below), a large capital works programme has been implemented. GWRC is 12 years into this 40 year programme, which has so far included realignment of the river channel, construction of erosion protection works and stopbank upgrades between the Ava and Ewen bridges, Heretaunga, Belmont and Bridge Rd ($16.7M). Current capital work is focusing on construction of the Boulcott Hutt stopbank ($12.6M).

The broader concepts of floodplain management (as opposed to maintenance of the river corridor purely as an efficient floodway) did not begin to emerge until after 1972 when the functions of the Te Awa Kairangi / Hutt River Board (the authority which previously built and maintained the flood defences) were taken over by the Wellington Regional Water Board, and subsequently by the Wellington Regional Council in 1980. From 1972 onwards river management has emphasised the protection and re-establishment of vegetative bank edge protection works and a healthy riparian ecology in addition to structural protection works.

2.1.1 The Te Awa Kairangi / Hutt River Floodplain Management Plan

The need for a review of flood management works in the Te Awa Kairangi / Hutt River was first raised by the National Water and Soil Conservation Authority (NWASCA) in 1977, and the 'Te Awa Kairangi / Hutt River Flood Control Scheme review' was instigated in response to this. In 1986 NWASCA began promoting integrated risk-based floodplain management planning, including the appropriate use of flood-prone areas and flood-proofing of assets to reduce the reliance on stopbanks and other structural works. Following this, the scope of the Te Awa Kairangi / Hutt River Scheme review was extended to include preparation of a comprehensive floodplain management plan.

The HFMP was developed in the following phases, with the assistance of the Te Awa Kairangi / Hutt River Floodplain Management Committee and other Technical and Community Advisory Groups:

- Defining the flood problem;
- Evaluating a broad range of adjustment options (structural, non-structural, river management & environmental strategy);
- Refining preferred options including environmental & economic evaluations;
- Preparing the Plan; and
- Implementing the Plan.

Phase 1 was completed with publication of *'Living with the River'* in November 1996, and the completed Plan was published in October 2001. The Regional Freshwater Plan, made operative in 1999, requires in Method 8.3.1 that the HFMP be prepared to help avoid or mitigate the adverse effects from the flood hazard.

The HFMP is the outcome of a comprehensive planning process, and it defines the strategies and methods that the Hutt and Upper Hutt City Councils, GWRC and the community have agreed to adopt in managing the flood hazard in the Hutt Valley. This encompasses both structural ('keeping the water away from the people') and non-structural ('keeping the people away from the water') measures.

The Te Awa Kairangi / Hutt River Environmental Strategy forms part of the HFMP. It was developed to provide a co-ordinated approach to managing and enhancing the river corridor environment from Kaitoke Regional Park downstream to Seaview Marina, particularly in respect of capital works and developments outside the river bed (including planting). The Strategy sets out the long term vision for this environment as a 'linear park', to provide a 'tranquil environment for people to escape to and enjoy the natural character of the river'.

It was intended that the HFMP would be reviewed every ten years, and GWRC has completed an initial scoping of the content for the first ten year review however works have since been deferred.

2.1.2 Design standard

The HFMP specifies that the agreed design standard for the Te Awa Kairangi / Hutt River is a *risk-based 2300 cumec standard*, which will be achieved by 2041. This provides a 2300 cumec standard of protection to all areas of the floodplain except for 'small urban areas' (such as Belmont and the Bridge Rd – Gemstone Drive area). However, the risk-based approach also applies varying protection standards to different areas in the floodplain, depending on how flood-prone they are. This includes, among other things:

- a requirement to upgrade all major stopbanks (i.e. those protecting the main urban areas of Lower & Upper Hutt cities) to a 2800 cumec capacity with all remaining stopbanks to a 2300 cumec capacity;
- a requirement for bank-edge and berm protection to a 2300 cumec capacity in main urban areas, with a 1900 cumec capacity for isolated and small urban areas; and
- a requirement for all new bridges and their floodways to pass a 2800 cumec flood.

This is the standard to which all new works are constructed and maintained. It is reflected in GWRC's capital works programmes and asset management plan, as well as in the proposed consent conditions.

2.2 Scale and impacts of flood hazard

The HFMP contains maps showing the likely extent of flooding in the Hutt Valley associated with a 2300 cumec flood under various assumptions concerning the performance of the flood protection system.

A large flood over the Te Awa Kairangi / Hutt River floodplain would have wide-ranging social and psychological impacts on the Hutt Valley communities. There would be physical damage and disruption to homes, schools, workplaces, community facilities, and essential and emergency services. Utilities such as water supply, sewerage, electricity and telecommunications could be put out of action for days.

The financial cost from such a flood could exceed $1 billion. Recovery would likely be slow, with damage to buildings and roads taking months or even years to repair. This would severely affect the day-to-day functioning of the community, and have an enormous effect on the regional, and possibly national, economy.

Social and psychological impacts (intangible damages) are likely to cost individuals and the community at least as much again as the physical or tangible damages (Greater Wellington Regional Council, 2011).

GWRC's ongoing operations and maintenance work on the Te Awa Kairangi / Hutt River and its tributaries are essential to address the existing flood hazard and manage its risks, and will continue to be required in perpetuity.

2.2.1 The Code of Practise

The new COP guides all river management activities undertaken by GWRC for the purposes of flood and erosion protection across the Wellington Region, irrespective of funding, location or whether an activity requires resource consent. This means it applies to permitted activities as well as those activities for which resource consent is required under the regional plans.

Rivers are dynamic features which constantly change and evolve according to the influences acting on them. The form and behaviour of the Region's rivers observed today represent a legacy of the complex interactions of past geological, climatic and human influences that have acted on the rivers and their catchments. This legacy, together with the needs of current communities and the choices in the way rivers are to be managed to meet these needs, are key determinants of each river's current character, form, behaviour and ecology. They also determine the way that these river features will develop and evolve into the future.

The COP aims to achieve:

- greater awareness of the effect of river management decisions and activities on river natural character and other significant river values;
- greater consistency of river management practice across the rivers that GWRC administers and manages; and
- good management of the environmental and cultural impacts of river management activities.

The Code applies to work at a number of levels. In the first instance, it provides guidance for the planning of river management activities that occurs in the floodplain management planning process. Floodplain management plans and the processes that are used to develop them, are the places where high level decisions are made about the direction of flood protection services. These decisions in turn are key determinants of the future character of the river, the amount and type of intervention and on-going river maintenance work that is needed to deliver on the agreed services.

At a more detailed level, the Code promotes development of operational plans for every river that provide further guidance on the most appropriate river management methods to be used. This requires division of the river into 'management reaches' based on homogeneity of form and character, and identification of a 'design channel' that allows the river adequate space to move and express its natural form. These factors can then be considered in conjunction with FMP directions and constraints, and the significant values pertaining specifically to those reaches, to develop work practice recommendations and guidelines.

2.3 Current consents and compliance

Resource consents currently held by GWRC for operations and maintenance works in the Te Awa Kairangi / Hutt River and Stokes Valley Stream are listed below.

Consent No		Purpose	Granted	Expiry
WGN 980255	(01) Land Use	To undertake works in the bed of the Te Awa Kairangi / Hutt River, including construction, repair and maintenance of bank protection works (including groynes, rock linings, gabion baskets, driven rail and mesh gabion walls, block linings and debris fences), maintenance and extension of existing structures, cross blading, gravel extraction, dredging Black Creek outlet[8], tree planting, layering and tethering, beach scalping, clearance of flood debris, vegetation removal, beach recontouring and contingency works.	5 October 1998	6 October 2013
	(02) Land Use	To reconstruct and maintain stopbanks and berms (including excavation), and contingency works, outside the bed of the Te Awa Kairangi / Hutt River.		
	(03) Water Permit	To temporarily and permanently divert the normal flow of the Te Awa Kairangi / Hutt River during, and as a result of, activities associated with undertaking river operation and maintenance activities.		
	(04) Discharge Permit	To discharge silt and natural stream sediments into the Te Awa Kairangi / Hutt River during, and as a result of, activities associated with undertaking river operation and maintenance activities.		
	(05) Discharge Permit	To discharge herbicides (Glyphosate and Triclopyr) to air to control noxious weeds and young willow growth on river beaches.		

[8] Black Creek is now referred to as Opahu Stream. As part of the Ava-Ewen flood protection works in 2009, the Stream outlet was re-positioned and now discharges directly to the Hutt River through a floodgate upstream of the Ava rail bridge. The former Black Creek outlet discharged into a channel approximately 500 m long located between a training bank and the true left bank of the river. This channel, now referred to somewhat incorrectly as “Lower Opahu Stream” is no longer a stream but rather an isolated arm of the Hutt River. It is this feature that needs to be periodically cleared of debris, or dredged to maintain habitat.

Consent No		Purpose	Granted	Expiry
WGN 060334	[25362] Land Use	To extract gravel from the bed of the Te Awa Kairangi / Hutt River (between Owen St Belmont, approximately 1.5 km upstream of Kennedy-Good Bridge, downstream to the Ava Rail Bridge), including: • extraction from below water level • temporary stockpiling of gravel on the river bed • disturbance and re-contouring of the river bed following the extraction operation.	27 October 2006	27 October 2011
	[25363] Water Permit	To temporarily and permanently divert the 'normal' flow of the Te Awa Kairangi / Hutt River during and as a result of undertaking gravel extraction operations in the river.		
	[25364] Discharge Permit	To discharge silt and other natural river bed material sediments into the Te Awa Kairangi / Hutt River during and as a result of undertaking gravel extraction operations.		
WGN 060291	[25259] Land Use	To enter and disturb the bed of a section of the Stokes Valley Stream to mow the batter slopes using a tractor mounted reach mower.	11 May 2006	11 May 2016
WGN 110149	[30768] Coastal Permit	To extract sand and shingle from the Te Awa Kairangi / Hutt River mouth for flood mitigation.	6 September 2012	6 September 2047
	[30777] Coastal Permit	To deposit coarse material by-product from the Te Awa Kairangi / Hutt River extraction operation onto the sea floor in Wellington Harbour.		
	[30778] Coastal Permit	To deposit fine by-product material from the Te Awa Kairangi / Hutt River extraction operation on to the easternmost end of Petone foreshore.		

The consents for gravel extraction [WGN 060334] expired on 27 October 2011 but they have been afforded continuance, pursuant to s 124 of the RMA, by lodgement on 27 April 2011 of application [WGN 110359] for new consents. Application [WGN 110359] will be withdrawn in due course once processing of this application (which supersedes it) is underway.

2.3.1 WGN 980255

As a condition of WGN 980255 consents GWRC is required to submit an annual monitoring report (for the period 1 July to 30 June) on or before 1 September each year which includes:

- details of all monitoring undertaken during the preceding year;
- quantities of all the works conducted in the preceding year; and

- details of any significant complaints received and action taken to avoid, remedy, or mitigate any adverse effects.

Based on the available records, the following compliance ratings have been received over the life of the consent (13 records, 1998 – 2013):

- 10 fully complying;
- 2 mainly complying: late submission of reports (i.e. no environmental non-compliance); and
- 1 non-complying: omission of some information (i.e. no environmental non-compliance).

GWRC records also show that no complaints were received in relation to the works undertaken.

2.3.2 WGN 060334

Conditions on the gravel extraction consents require quarterly reporting of the location and description of extraction undertaken, together with volumes extracted and any complaints and issues.

Based on the available records, the following compliance ratings have been received over the life of the consent (6 records, 2006 – 2012):

- 4 fully complying; and
- 2 non-complying – non delivery of report.

GWRC records also show that complaints from one resident were received over two years ago in relation to noise associated with gravel being loaded onto the truck deck; there have been no complaints in the last three years.

2.3.3 WGN 060291

The conditions on the Stokes Valley Stream mowing consent are mostly concerned with managing operation and use of the machinery to minimise adverse impacts on the stream. They also require submission of an annual report that details:

- dates and times the tractor and associated machinery were located in the flowing channel;
- identification of the stream(s) the tractor and associated machinery were previously used within, and details of where and how they were cleaned;
- details of any complaints received and action taken to avoid, remedy, or mitigate any adverse effects.

Based on the available records, the following compliance ratings have been received over the life of the consent:

- 5 fully complying.

GWRC records also show that no complaints were received in relation to the works undertaken.

2.3.4 WGN 110149

These three coastal permits apply to GWRC's gravel extraction operation at the Te Awa Kairangi / Hutt River mouth, within the coastal marine area, which occurs immediately downstream of the area covered by the application which is the subject of this report.

The coastal permits provide for:

- extraction of up to 65,000 m^3 per annum of sand and shingle from the Te Awa Kairangi / Hutt River bed below the Estuary Bridge

- deposition of up to 6,700 m^3 per annum of coarse material by-product (shell, stone etc.) in an area of the sea bed covering approximately 6 ha lying beyond (i.e. southwest of) the river mouth, and
- deposition of up to 11,500 m^3 per annum of fine material by-product (sands and silts) on the eastern end of the Petone foreshore, lying immediately adjacent to the sand processing plant on the true right bank of the river at the mouth.

These consents were granted in September 2012; for a term of 35 years, and information on record shows that the requirements of the consent have been satisfied.

3 Existing Environment

3.1 River character & existing works

Originally known by Maori as Te Awa Kairangi or Te Wai o Orutu, the Te Awa Kairangi / Hutt River was called Heretaunga at the time when European settlers arrived in Wellington. It was re-named in 1839 by William Wakefield after the founding member, director and chairman of the New Zealand Company, Sir William Hutt (Maclean, 2009).

Arising on the steep slopes of the southern Tararua Ranges and surrounding hills, the river has been managed and modified in its lower reaches within the Hutt Valley for over 140 years. The extensive bank protection works undertaken in the river over this time (particularly downstream of Maoribank) have resulted in a well-defined and contained river corridor which is deliberately constrained along a relatively fixed alignment. The 2012 value of infrastructural assets on the Te Awa Kairangi / Hutt River is $66.2 M[9].

The HFMP defines 11 reaches within the river extending from the mouth upstream to the Hutt Gorge. The area covered by this application extends across nine of these reaches, from the Estuary Bridge to the upstream end of Gemstone Drive above the Akatarawa River confluence. River reaches (i.e. the lineal extent of the river in managed portions) are refined on a regular basis, as the river moves. These reaches are captured in the Operational Management Plans described in Section 9.1 of this AEE Report. The river is tidal as far upstream as the Melling Bridge, with few exposed gravel bars. From Melling Bridge upstream to Maoribank, the river is generally characterised by a meandering single channel with alternating gravel beaches. Upstream of Maoribank the channel becomes more confined and uniform and includes more exposed bedrock.

The specific character of the river and adjoining land for each of the individual reaches is described below. Descriptions for the parts of the tributaries covered by this application are also given below.

Aerial photos of each reach are included in Appendix D.

3.1.1 Moera/Petone Reach

Reach Detail	Cross section range10	Reach Description
Estuary Bridge to Ava Rail Bridge	0100 – 0210	The river channel in this reach is bordered on both sides by low-lying floodplains. Shandon Golf Course and Sladden Park lie on the true right bank, while the training bank (downstream of the Opahu Stream floodgates) occupies much of the left bank of this reach. Community assets (industrial and residential) on both sides of the reach are protected by stopbanks. The river was widened under the Ava rail bridge in 2009.

3.1.2 Lower Hutt/CBD/Alicetown Reach

Reach Detail	Cross section range	Reach Description
Ava Rail Bridge to Melling Bridge	0210 – 0440	In this reach the river changes from its alignment along the Wellington Fault and adapts to the sea level control at the mouth. There is intensive residential and commercial development of the floodplain on both sides of the river, and these are protected by stopbanks that are often located very close to the river channel. Extensive river realignment, erosion protection works (groynes and

[9] Source: GWRC Flood Protection.
[10] Cross sections are measured in metres upstream from datum 0000 at the river mouth.

Reach Detail	Cross section range	Reach Description
		riprap) and stopbank upgrades were completed from 2004 to 2009 between Ava and Ewen Bridges. The channel is characterised by 2 significant bends, at Tama St (just south of Ewen Bridge) and Marsden Bend (approximately 500 m north of Ewen Bridge). Channel widths range from 100 m at Ava Bridge to approximately 60 m at Melling Bridge.

3.1.3 Boulcott Reach

Reach Detail	Cross section range	Reach Description
Melling Bridge to Kennedy-Good Bridge	0440 – 0660	This reach follows an alignment along the Wellington Fault. It is bounded by State Highway 2 on the right bank and the Boulcott's Farm Heritage Golf Course on the left. Commercial and residential properties located on the eastern side of the reach are protected by either stopbanks or by high ground, except for the Transpower and Safeway Storage Ltd sites which are located in the floodplain (both have undertaken their own varying mitigation works on their individual sites.) The existing high ground on which SH2 runs along sits above the 2300 cumec event level except at Melling Bridge. The main feature is a decrease in channel gradient in the vicinity of the Kennedy-Good Bridge. This is represented by a decreased channel width and aggrading river bed extending downstream from the change in grade for approximately 2.5 km. The channel is fairly straight and smooth with wide flat berms on right bank and established willow stands on the left bank. Channel widths range from 60 m at Melling Bridge to 100 m at Kennedy-Good Bridge. Speedy's Stream confluence lies on the true right immediately downstream of the Kennedy-Good Bridge.

3.1.4 Belmont/Taita Reach

Reach Detail	Cross section range	Reach Description
Kennedy-Good Bridge to Pomare Rail Bridge	0660 – 1090	Upstream of Kennedy-Good Bridge the river is flanked on the true right by a narrow floodplain in the lower third of this reach (on which the lower Belmont residential area is situated) and by SH 2 further to the north. Approximately 10 properties in the Belmont area are located immediately next to the river channel and while there is no stopbank erosion protection works were constructed in 2005 to a 1900 cumec standard. Some flooding does occur from the 1900 cumec event but generally not from smaller events. The residential suburbs of Taita and Avalon lie on the wide floodplain on the left of the river. These are protected by a stopbank that extends the length of the reach. Other features of this reach are:

Reach Detail	Cross section range	Reach Description
		• The sharp bend in the river below the Pomare Rail Bridge, where the river channel deviates away from the Wellington Fault and across the floodplain to the eastern side of the valley; • Taita Rock at XS 1010 to 1030, which forms a major hydraulic and morphologic control in the river system. Channel widths range from 105 m at Kennedy-Good Bridge to 65 m at Pomare Bridge.

3.1.5 Manor Park Reach

Reach Detail	Cross section range	Reach Description
Pomare Bridge to Silverstream Bridges	1090 – 1395	In this reach the river channel changes to a narrow incised form through Taita Gorge. The river is contained on the left bank by the Eastern Hutt Rd and the Taita stopbank (in the south). The Manor Park Golf Course adjoins the river along most of the right bank in this reach. The residential area of Manor Park (at the southern end of the reach) is protected by a stopbank that extends from the Pomare Bridge to the entrance of the Golf Course. Other features include: • The Stokes Valley Stream confluence on the true left bank approximately 800 m upstream of the Pomare Bridge. • The Hulls Creek confluence on the true left bank immediately below HCC's sewer crossing approximately 400 m below the Silverstream Rail Bridge. As riverbed levels have degraded this structure has formed a grade control structure. The channel is fairly sinuous with high banks, particularly on right bank. The left bank is characterised by rock outcrops and steep cliffs with no berm. Channel widths vary from 70 m at Pomare Bridge, through 55 m adjacent to the golf course to 90 m at Silverstream Rail Bridge. Bedrock is exposed in places.

3.1.6 Heretaunga Reach

Reach Detail	Cross section range	Reach Description
Silverstream Bridges to Moonshine Bridge	1395 – 1775	Above Silverstream Bridges the river follows a course closely aligned along the Wellington Fault on the western side of the valley, and is constrained on the true right bank by SH2. It is flanked by the wide Upper Hutt floodplain on the true left, which includes St Patrick's College, the Silverstream and Royal Wellington Golf Courses, Trentham Memorial Park and the residential areas of Silverstream, Heretaunga and Trentham. The Upper Hutt stopbank extends along the true left bank in the upper third of the reach, and the Whirinaki Crescent

		stopbank protects the much of the Heretaunga residential area adjacent to the Royal Wellington Golf Course. In this reach berms on right bank are narrow and low and merely separate the bank edge from SH2 road embankment, towards which they slope steeply. Berms on the left bank lead to wide, flat open floodplains adjacent to St Patrick's College and Royal Wellington Golf Course, with Barton's Bush in between. Channel widths vary between 60 m and 100 m. Alternating rock riprap is a prominent feature of this reach.

3.1.7 Moonshine Reach

Reach Detail	Cross section range	Reach Description
Moonshine Bridge to the Whakatikei River	1775 – 1900	In this reach the river follows a course on the western side of the valley. The reach is characterised by steep banks covered with undeveloped bush land on the right bank and a wide berm on the left that is bounded by SH2. The residential areas of Trentham and Upper Hutt, lying to the east of the river are protected by the Upper Hutt stopbank that runs adjacent to the eastern side of SH2. The main features of the reach include: • Bedrock outcrops in the channel throughout the reach; • The Whakatikei River confluence at the major bend and rock outcrop on the true right near the top of the reach. The channel is fairly straight downstream of the sharp bend at Whakatikei River confluence. Channel widths are 60 -70 m.

3.1.8 Upper Hutt/Totara Park Reach

Reach Detail	Cross section range	Reach Description
Whakatikei River to Norbert St footbridge	1900 – 2150	The river channel trends across the floodplain in an east-west direction from the Whakatikei River confluence to Maoribank corner. The channel is wide, straight and open with relatively low banks. Widths vary from 60 m at Whakatikei confluence and 75 m at Totara Park Bridge to over 100m along much of reach.
	2150 - 2390	The river makes a 90^{o} turn to a north-south alignment at Maoribank corner; constrained by bedrock and high cliffs on left bank. Bedrock has become exposed as the riverbed has degraded. The river is flanked on the left by the residential areas of Upper Hutt, Maoribank and Brown Owl, and on the right by the residential area of Totara Park. Both of these areas are protected by stopbanks.

Reach Detail	Cross section range	Reach Description
		The upstream end of the reach adjacent to Ngati Tama Park (at Maoribank Corner) is characterised by high gravel and silt banks on both sides of the river. The river is mostly 90 -100 m wide from the Bridge to the corner; 70 m at the corner narrowing to 40 m at the footbridge.

3.1.9 Akatarawa Reach

Reach Detail	Cross section range	Reach Description
Norbert St footbridge to Gemstone Drive	2390 – 2690	In this reach the river channel is narrow and incised, with bedrock outcrops. The Akatarawa River confluence on the true right bank in the middle of the reach marks the point where the channel changes from its upstream east-west alignment to a downstream north – south alignment. The river is flanked by the residential areas of Totara Park and Birchville along much of its length over the reach. Birchville Gorge extending from upstream of footbridge to downstream of Akatarawa River confluence dominates reach. The channel is incised, windy with several areas of exposed bedrock. Fairly constant 40 m width except where it widens below Akatarawa River confluence.

3.1.10 Te Mome Stream

The Te Mome Stream is a tidally influenced former channel of the Te Awa Kairangi / Hutt River that flowed along the western edge of the area known as Gear Island, immediately east of the suburb of Ava. In the early 1900’s the northern connection of this channel to the Te Awa Kairangi / Hutt River was blocked off and the bed filled in, following acquisition of Gear Island by the Te Awa Kairangi / Hutt River Board (Treadwell, 1959). The stream is approximately 1.5 km long, up to 40 m wide and 1.5 m deep, with a tidal range of about 0.5 m. It joins the Te Awa Kairangi / Hutt River on its true right bank via a culvert under Waione Street, approximately 100 m west of the Estuary Bridge. Based on site observations and FENZ predictions, the core fish fauna upstream of the tidal influence is expected to include long and shortfin eel, common bully, banded kokopu and inanga.

The contributing catchment is approximately 110 ha, and includes the suburbs of Ava, Petone and Alicetown. There are eight distinct sub-catchments that discharge into Te Mome Stream via identifiable stormwater outfalls. Catchment land use is primarily residential although there is some industry present; the most significant industrial site being Unilever Australasia (detergent manufacture) (Wellington Regional Council, Pollution Control Team, 2005).

The western arm tidal flat of the Hutt Estuary, including parts of Te Mome Stream is an important roosting, wading and feeding area for a number of birds, including the variable oystercatcher, black shag, little black shag, royal spoonbill, reef heron, mallards and grey ducks, red-billed gulls, and terns (Cameron, 2015).

As this watercourse contains habitat of relatively high value for both fish and waterfowl, the periodic removal of accumulated silt and organic material does present some risks to this habitat which need to be effectively managed. GWRC manages the entire length of the stream, which is included in this application, as shown in Figure 2.

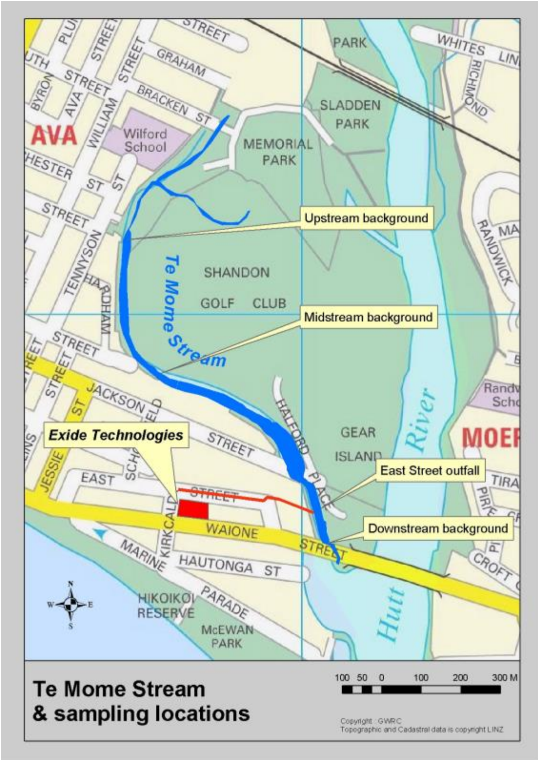

Figure 2: Te Mome Stream. Source: (Wellington Regional Council, Pollution Control Team, 2005)

3.1.11 Speedy's Stream

Speedy's Stream drains a small, steep, forested catchment on the western side of the suburb of Kelson. The only work GWRC undertakes in this stream is to maintain the debris arrester which is located approximately 400 m upstream of the confluence with the Te Awa Kairangi / Hutt River, as shown in Figure 3.

Upstream of State Highway 2 the stream has retained much of its natural character; it supports regenerating indigenous vegetation at the riparian margins, and provides good quality habitat for benthic macroinvertebrates and fish. Site observations together with FENZ predictions indicate that it supports a moderately diverse macroinvertebrate fauna including mayflies (Deleatidium and Coloburiscus) caddisflies (Aoteapsyche and Olinga), freshwater snails (Potamopyrgus) and beetles (Elmidae). The fish community comprises shortfin eel, longfin eel, redfin bully, and banded kokopu. (Cameron, 2015) considers this stream to be of relatively high value due its diversity of invertebrates and fish.

No river nesting bird species have been found on Speedy's Stream. Those birds that are found adjacent to the stream are terrestrial species that are common and widespread in the surrounding landscape and are unlikely to be affected by the very limited flood protection activities that occur in this watercourse.

Figure 3: Speedy's Stream, showing the debris arrester that is included in this application. Source: Google Earth

3.1.12 Stokes Valley Stream

Stokes Valley Stream arises at the southeast corner of the sports field (Delany Park) on George St in central Stokes Valley in a concrete-lined channel. It flows in a generally northerly direction along the eastern boundary of the sports fields before being piped under the Stokes Valley shopping centre at Evans St, and re-emerging in a concrete-lined channel at Bowers St. It proceeds through the residential and commercial areas bounded by George St (to the west) and Stokes Valley Road (to the east) for approximately 1.4 km. It then trends in a north-easterly direction for a further 300 m approximately to Stokes Valley Road, where it transitions from a concrete-lined channel to a natural stream bed by dropping over a weir and into a stilling basin. The Stream passes under Stokes Valley Road and flows for a further 40 m before making a 90^{o} turn, after which it flows for approximately 600m in a north-easterly direction through the residential areas bounded by Thomas St (to the east) and Stokes Valley Rd (to the west). Once the Stream passes under Eastern Hutt Rd, it makes another 90^{o} turn and flows for approximately 300m parallel to the true left bank of the Te Awa Kairangi / Hutt River before reaching its confluence.

The lower reach, from Stokes Valley Road to the Te Awa Kairangi / Hutt River has a more natural bed substrate consisting of gravel, silt and sand, however the channel retains the straightened and simplified character and has generally degraded habitat quality, particularly in respect of bank vegetation, riparian width and fish cover. FENZ predictions of macroinvertebrate distribution indicate a moderately degraded fauna which might include the mayfly *Deleatidium*, but is likely to be dominated by more tolerant taxa such as freshwater snails and Orthoclad midges (Table 3-14). A single fish record within the application area, together with FENZ predictions indicates that the core fish fauna of the lower stream is likely to consist of shortfin eel, longfin eel, redfin bully, common bully, juvenile trout and inanga. However, due to limited habitat availability the abundance of fish may be low.

Given the highly modified condition of the lower stream, neither the macroinvertebrate nor fish fauna are likely to be sensitive to the type of disturbance caused by the occasional passing of a tractor along the channel or the operation of a digger bucket to remove debris. It is noted however, that the practice of mowing right down to the waters' edge has reduced the quality and quantity of habitat for invertebrates and fish. Habitat could be improved by restoring stands of native vegetation at selected locations along either bank so as to increase the amount of shade and cover over the stream bed and to provide refuges for fish.

No river nesting bird species have been found on Stokes Valley Stream. Those birds that are found adjacent to the stream are terrestrial species that are common and widespread in the surrounding landscape and are unlikely to be affected by the very limited flood protection activities that occur in this watercourse.

GWRC maintains approximately 1.6 km of the stream from the confluence of the Te Awa Kairangi / Hutt River to the confluence with Tui Glen Stream (which lies approximately 350 m upstream of the Stokes Valley Rd bridge), as shown in Figure 4.

3.1.13 Opahu Stream

GWRC maintains the outlet from Opahu Stream, which is tidally influenced arm of Te Awa Kairangi / Hutt River opposite Sladden Park, and which is separated from the main flow of the Te Awa Kairangi / Hutt River by a long training bank. The river management activities undertaken here include the occasional dredging of the outlet reach, maintenance of plantings, and periodically undertaking additional planting and landscaping.

The reach of the Te Awa Kairangi / Hutt River beside the training bank has been identified by Taylor and Kelly (2001) as potential inanga spawning habitat. GWRC have undertaken works to enhance this habitat as part of flood protection upgrade works in the Ava to Ewen reach.

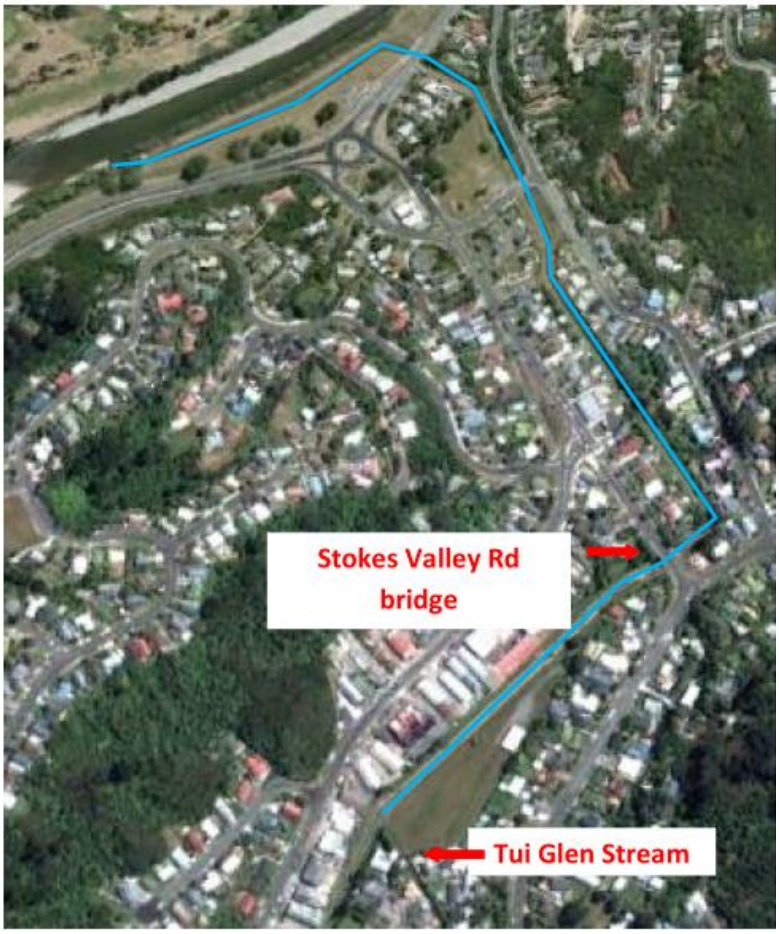

Figure 4: Stokes Valley Stream, blue line showing the reach included in this application. Source: Google Earth

3.1.14 Akatarawa River

The Akatarawa catchment, with a total area of 116 km², is situated in the northern part of the Hutt catchment, between the Whakatikei and Waikanae catchments. A major fork in the river occurs at Karapoti Road. The rainfall monitoring station at Warwicks is located at the top of the east branch, which is the larger of the two branches.

Most of the catchment is covered in indigenous forest, although there is some pine plantation forestry at the lower end of the catchment. Historically, land situated close to the river was cleared for pasture, but much of this land has now either reverted to scrub, or been planted in pine forest.

Approximately 100 m of the lower-most reach above the Te Awa Kairangi / Hutt River confluence is maintained by GWRC and included in this application as shown in Figure 5.

Figure 5: Akatarawa River, blue line showing the reach included in this application. Source: Google Earth

3.2 Hutt Estuary

The Hutt Estuary is a moderate sized (3km long) "tidal river mouth" type estuary which drains into Wellington Harbour at Petone. It has been extensively reclaimed and modified, and the banks clad with large rip-rap boulders (Robertson & Stevens, 2007). Saltwater extends up to 3km, nearly as far as Ewen Bridge (and well upstream of the Estuary Bridge). The estuary is highly modified from its original state. In 1909 it was much larger and included several large lagoon arms and extensive intertidal flats and saltmarsh vegetation. Over the next 50 years, most of the intertidal flats and lagoon areas were re-claimed and the estuary was trained to flow in one channel between rock rip-rap lined banks. The terrestrial margin, which was originally vegetated with coastal shrub and forest species, was replaced with urban and industrial land-use (Robertson & Stevens, 2011).

The application area extends downstream to the Estuary Bridge, well into the upper part of the estuary. The river mouth downstream of the Estuary Bridge which is not within the application area is regularly dredged (under a separate consent) to maintain flood capacity.

3.3 Geology

3.3.1 General

The basement rocks of the Hutt Valley and surrounding hills are comprised of greywacke formed between 350 and 140 million years ago. These rocks have been repeatedly covered by water, twisted and thrust up by earth movements, weathered and eroded. At times they have been covered by ash layers derived from the Central North Island volcanoes.

The landscape has also been shaped by faults of different ages: an older northerly-trending set of faults that created valleys such as the one in which the Korokoro Stream flows, and a younger series of more north-easterly trending faults including the Wellington Fault.

The Hutt Valley is a fault-controlled feature lying adjacent to the Wellington Fault. It has been created over the past two million years by a combination of a general westwards tilting of all land in the Wellington Region, together with simultaneous uplift of the western hills along the Wellington Fault relative to the west coast, and downward tilting of the eastern hills relative to the rising Rimutaka Range (Wellington Regional Council, 1990). This movement created a subsiding basin bounded on the western side by the Wellington Fault, into which the Te Awa Kairangi / Hutt River has deposited up to several hundred metres of sediment, creating broad floodplains and a prograding delta where the river flows into Wellington Harbour.

Upwards warping of the land in the areas around the Taita Gorge and Te Marua has raised the basement rocks and narrowed the floodplain between Upper and Lower Hutt, and at the northern end of the Upper Hutt floodplain respectively, and in the process separated the valley into a series of depositional basins.

The tectonic and sedimentation processes that have contributed to the development of the Hutt Valley are still currently active and on-going. The most recent geological event to have a significant effect on the Te Awa Kairangi / Hutt River catchment was the 1855 magnitude 8.1 earthquake on the West Wairarapa Fault. This uplifted and tilted an area approximately 5000 km^2 lying west of the fault, with the southern end of the Rimutaka Range rising more than 6 metres. Up to 18 m lateral movement along the fault was also recorded (McSaveney, E, 2009).

Among other things, this event:

- Lifted the Petone shore so that the shoreline moved 100 -150 m seawards
- Raised the Hutt Valley bottom so that swamps and wetlands in the lower reaches were drained
- Reduced the navigability of the Te Awa Kairangi / Hutt River and Waiwhetu Streams
- Caused the Te Awa Kairangi / Hutt River to change its primary course from the western to the eastern side of Gear Island, (Begg, 1996), (Boffa Miskell, 2012).

3.3.2 Lower Hutt basin

The Lower Hutt depositional basin (and its continuation southwards into the Port Nicholson basin) is deepest on its north-western side, closest to the Wellington Fault, and it thins to both the north and the east. A large quantity of subsurface information based on drill hole logs exists for the Lower Hutt area. The maximum drilled thickness is 299 m (at the Gear Meat: Petone Drill hole site (Begg, 1996)).

Sediments of the Lower Hutt basin are formally known as the Hutt Formation, and consist of both alluvium and also marine sediments that have been deposited during periods of high sea level. The Hutt Formation has been separated into 6 member units – Moera Basal Gravels, Wilford Shell Bed, Waiwhetu Artesian Gravels, Petone Marine Beds, Melling Peat and Taita Alluvium.

The Waiwhetu Artesian Gravels form the principal aquifer of the Lower Hutt valley, and are known to extend up valley at least as far as Taita.

3.3.3 Upper Hutt basin

Like the Lower Hutt basin, the Upper Hutt depositional basin is also deepest on its north-west side, adjacent to the Wellington Fault. (Begg, 1996) states that based on seismic survey these sediments are estimated to be between 360 -460 m thick against the Fault. The basement rises rapidly towards the surface towards both the south-western and north-eastern ends of the basin; at the Silverstream bridges the sediments are less than 10 m thick.

Seismic survey indicates that the sediments of the Upper Hutt basin can be divided into two main units: an upper unit (A) over 200 m thick, overlying an older unit (B) that is up to 180 m thick.

There are few outcrops of the sediments in the Upper Hutt basin on which to base description of these sedimentary units, and the most complete data on the basin’s stratigraphic sequence comes from a deep drill hole at Trentham Memorial Park. This drill hole showed that the sediments correlated with seismic unit A consist of alternating layers of river (gravels) and swamp sediments (carbonaceous silts and clays) from 5 – 50 m thick. Unit B sediments are not present in the drill hole, however it has been surmised that this unit can be correlated with gravels and sands of alluvial origin that outcrop further to the north.

3.4 Hydrology

3.4.1 Te Awa Kairangi / Hutt River catchment

The Te Awa Kairangi / Hutt River is approximately 54 km long. It has a mountainous source in the southern Tararua Ranges, with the highest point in the catchment being Mt Hector (1529 m above sea level). The floodplain at Te Marua is approximately 110 m above sea level, falling relatively rapidly to 70 m above sea level at Totara Park, before sloping more gradually towards the mouth. The Te Awa Kairangi / Hutt River catchment covers a total area of 655 km^2.

The main tributaries are the Pakuratahi, Mangaroa, Akatarawa and Whakatikei Rivers, and the Waiwhetu and Korokoro Streams. Details for these waterways are included in Table 4. Minor tributaries include Collins Creek, Hulls Creek and Pinehaven Stream, and Stokes Valley, Speedy’s, Waiwhetu and Te Mome Streams.

Table 4: Te Awa Kairangi / Hutt River & catchment information

Catchment Name	Area (km^2)	Length (km)
Te Awa Kairangi / Hutt River	655.0	54.0
Hutt headwaters	88.6	15.6
Pakuratahi River	81.4	25.3
Mangaroa River	104.1	21.6

Catchment Name	Area (km²)	Length (km)
Akatarawa River	116.4	24.4
Whakatikei River	81.8	18.4
Waiwhetu Stream	18.1	8.1
Korokoro Stream	15.7	7.2

Source: Te Awa Kairangi / Hutt River Floodplain Management Plan 2001

Flow in the upper part of the Te Awa Kairangi / Hutt River is fed by two main (East and West) branches. Concurrent stream gauging carried out at the Hutt Forks indicate that baseflow in the East branch is around 70-80% of the West branch (Wilson, 2006).

The first major change in river discharge occurs at the Kaitoke Weir, located 3.8 km below the Hutt Forks. During summer months, more than 50% of the flow is typically abstracted from the river at this point for public water supply. Inflow from the Pakuratahi River supplements the flow in the river about 750 m downstream of the weir. Approximately 8.5 km further downstream, the river enters the Te Marua basin, which is the first major groundwater reservoir on the Te Awa Kairangi / Hutt River. (For much of the upper reaches of the Hutt catchment, the river substrate is bedrock).

At Te Marua the flow is supplemented by inputs from Benge Stream and the Mangaroa River, before reaching the Akatarawa River confluence (near the upper end of the application area). The Akatarawa is a major tributary of the Te Awa Kairangi / Hutt River, which has an equivalent discharge to the Te Awa Kairangi / Hutt River during times of low flow (owing to the flow reduction in the Te Awa Kairangi / Hutt River caused by the Kaitoke Weir abstraction).

Downstream of the Akatarawa River confluence, the Te Awa Kairangi / Hutt River flows over a Torlesse basement high between Birchville and Maoribank before entering the Upper Hutt alluvial basin. The river crosses the Wellington Fault approximately halfway between the Birchville and Maoribank and it loses water to the Upper Hutt Aquifer on the southern side of the Wellington Fault. It stops losing flow when it again crosses the fault at McLeod Park, 750m upstream of the Whakatikei River confluence. The river gains return flow from the Upper Hutt Aquifer when it crosses the fault again at Moonshine Bridge. This gaining reach continues until the river reaches Taita Gorge, where greywacke bedrock is exposed.

Downstream of Taita Gorge, the river loses flow to the Lower Hutt alluvial basin. At Kennedy Good Bridge, the river crosses the Petone Marine Bed aquitard, which confines the Waiwhetu aquifer. From this point onwards, about 10% return flow occurs from the shallow gravels of Taita Alluvium. The volume of return flow downstream of Kennedy Good Bridge is largely determined by water demand, and available storage in the Waiwhetu Aquifer.

The river discharges into Wellington Harbour and the lower reaches as far up river as the Melling Bridge are tidally influenced. However saline conditions seldom penetrate further upstream than the Ewen Bridge (Montgomery Watson, 1998).

3.4.2 Flow statistics

GWRC monitors the Te Awa Kairangi / Hutt River level and flow at five permanent gauging stations: Kaitoke, Kaitoke West, Te Marua, Birchville and Taita. The most recent available summary flow data are given in Table 5.

Table 5: Te Awa Kairangi / Hutt River flow statistics

Station	Catchment Area (km²)	Lowest (l/s)	Mean (l/s)	Median (l/s)	Max[11] (l/s)	7 day MALF (l/s)
Kaitoke	89	800 (1973)	7840	4297	393481	1458
Te Marua	191	397 (2001)	10822	5841	358263	1173
Birchville	427	1090 (1971)	22117	12420	1227185	2669
Taita	556	1628 (1989)	24514	14243	1298468	3744

Source: (Wilson, 2006)

The Te Awa Kairangi / Hutt River displays a highly variable flow regime that is typical of a river draining a mountainous catchment, in that there are long periods of relatively low flow interspersed with occasional large floods. As a consequence, the median flow is significantly less than the mean (Opus International Consultants Ltd, 2010), see Figure 6.

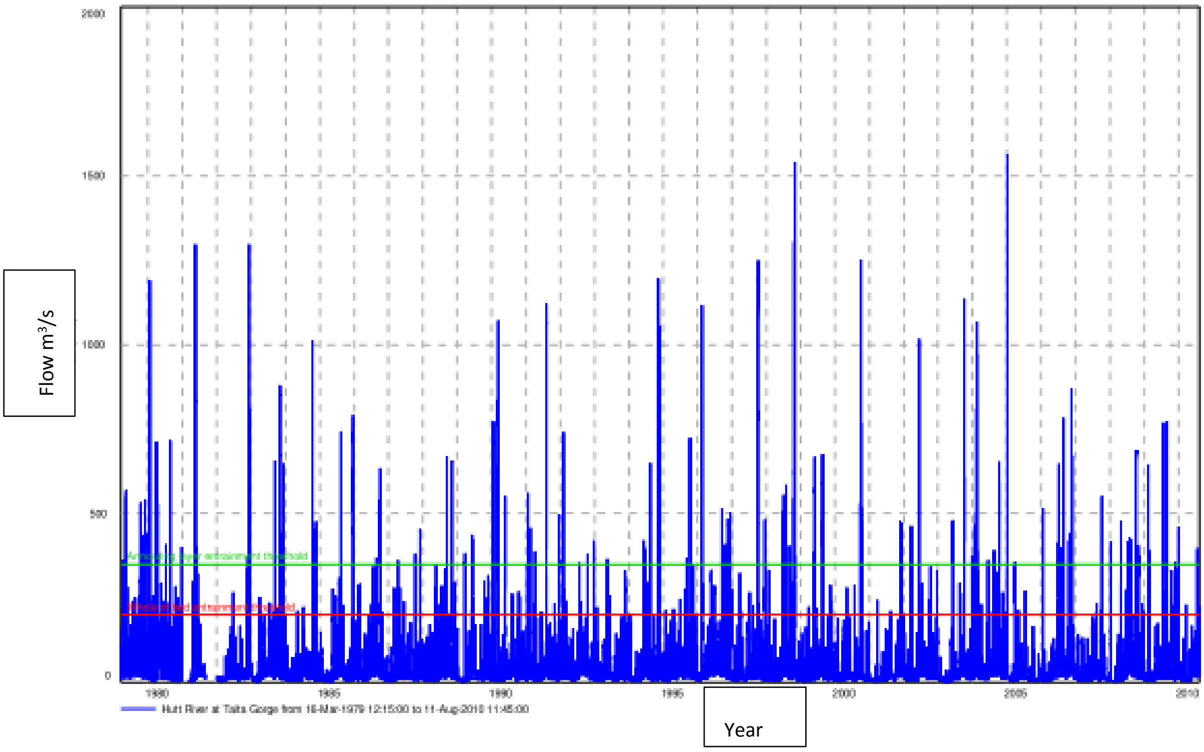

Figure 6: Flow record for Te Awa Kairangi / Hutt River at Taita Gorge (1979 -2010). Source: (Opus International Consultants Ltd, 2010)

The flow gauging site at Taita Gorge is the most downstream on the river. The site lies below the last tributary providing significant inputs of water and sediment to the river, and lies at the upstream limit of influence of Wellington Harbour in extreme flood events. Flows have been monitored at this site since 1979, and are therefore a reliable basis on which to assess the flow regime of the lower Te Awa Kairangi / Hutt River (Opus International Consultants Ltd, 2010). Analysis of the flow record over the past 33 years shows the flow at Taita Gorge has varied from as low as 2 m³/s to a maximum of 1562 m³/s.

[11] These figures are taken from (Montgomery Watson, 1998)

3.4.3 Flood flows

Flood flow return periods, based on flow data for Taita Gorge are given in Table 6.

Table 6: Te Awa Kairangi / Hutt River flood flows for Taita Gorge gauging station

Flow (cumecs)	Return period
1900	1 in 100 years
2300	1 in 440 years
2800	1 in 1000 years
7000 (Probable Maximum Flood)	thousands of years

Source: Te Awa Kairangi / Hutt River Floodplain Management Plan 2001

3.5 Sediment Transport

3.5.1 Features and controls

(Opus International Consultants Ltd, 2010) reports that the Te Awa Kairangi / Hutt River displays a pattern typical of most rivers: erosion and transport of sediment in the upper catchment, conveyance through the mid reaches, and deposition in the lower reaches and at the mouth. The sediment load is comprised of all the inorganic material (including gravel, sand silt and clay) that is eroded from the upper catchment and the floodplain, and transported by the flowing water. It can be divided into three principal fractions depending on the primary mode of sediment transport, and includes:

- dissolved load – comprised of inorganic ions derived from rocks, soil, atmosphere and human activity in the catchment
- suspended load – comprising fine silts and clays that stay in suspension and also larger material that is held in the flowing water by turbulence
- bed load – the fraction that is hydraulically “pushed” by the flowing water, and rolls, saltates or slides along the bed.

From the perspective of channel stability and the impacts of gravel extraction, it is the suspended and bed load components that are most relevant.

Key controls on sediment transport are the availability of material to be transported, particle size (which is used as a measure of entrainment threshold) and the energy of the river.

In relation to the availability of material, the extensive floodplains and terraces of the Hutt Valley were deposited during former glacial periods during which time erosion rates in the upper catchment were much greater than at present. Following the end of the last glacial period, increased forest cover in the upper catchment has led to a reduction in the rate of upper catchment erosion. In response to the reduced sediment supply the river has become incised into its earlier alluvial deposits, and now flows largely within sediments that it eroded and transported previously. This means that the bed material of the river is supplied by re-working of available deposits along the river channels, rather than directly from erosion in the upper parts of the catchment.

(Williams, 2013) – see Appendix F - reports that the gravel bed material is relatively coarse, particularly above the Taita gorge, with the medium size for the whole of the bed material generally reducing downstream, from around 100 mm at the top end of the Upper Hutt basin (see Section 3.3.3), to around 50 mm at the top end of the Lower Hutt basin (see Section 3.3.2). At the major grade change in the river (that extends from just upstream of Melling Bridge through to Kennedy-Good Bridge) the medium size is around 20 mm. There is a similar reduction in the armour layer size from over 200 mm in the Upper Hutt basin down to 30 to 40 mm at the major grade change, and then finer along the flat graded reach to the river mouth.

The Opus report notes that a flow of 350 m³/s is an upper threshold for bed load movement in the river, based on consideration of the median (or D_{50}) particle size. If the characteristics of the entire bed sediment envelope are taken into account the threshold reduces to 200 m³/s. This means that there should be no bed load movement below this flow rate, although material will still be moved in suspension. Analysis of the flow record for Taita Gorge (see Figure 6) shows that the upper bed load entrainment threshold of 350 m³/s has been exceeded only 0.3% of the time in the last 31 years (this is still the case taking into account records for 2011 and 2012), while the lower threshold of 200 m³/s has been exceeded 0.8% of the time. It should be noted however that even though bed load transport is infrequent and limited to times of flood flow, significant volumes of sediment can be eroded and transported due to the high energy levels associated with these flows.

3.5.2 Volumes passing Taita Gorge

Bed load and suspended sediment transported past Taita Gorge was modelled and used to develop a net sediment balance for four five-year periods from 1987 to 2009. These results are shown in Figure 7 and compare favourably to GWRC estimates based on bed level survey and extraction volumes.

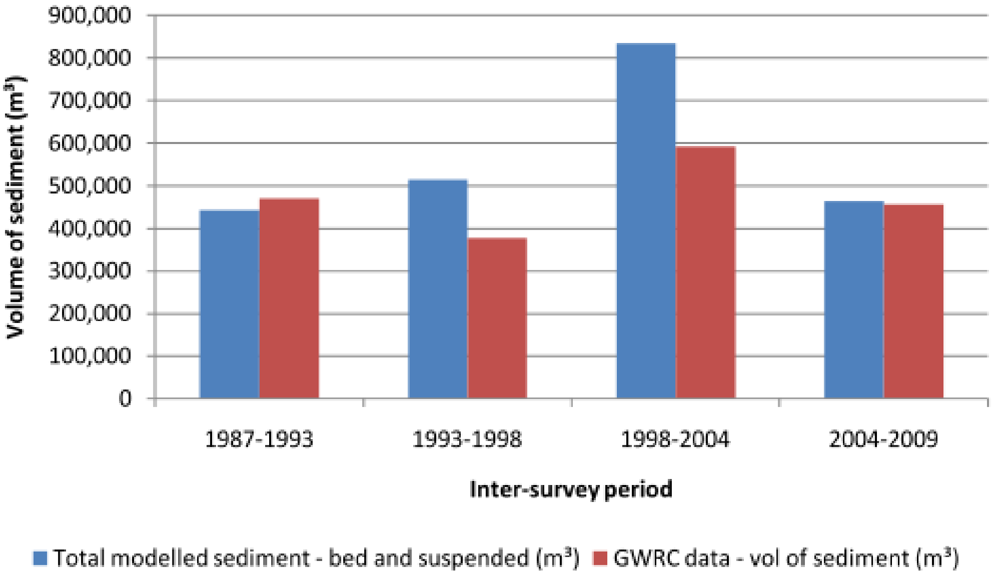

Figure 7: Comparison of total sediment volumes estimated from both modelling and measurement. Source: (Opus International Consultants Ltd, 2010)

The study also showed that only 8% of the total sediment load is bed load, with the remaining 82% being suspended load. This is consistent with other New Zealand data. Annual average sediment loads were derived from the data shown above, and are given in Table 7.

Table 7: Annual average sediment transport volumes passing through Taita Gorge

Period	Annual average suspended sediment volume (m³)	Annual average bed load sediment volume (m³)	Annual average total sediment load (m³)	Annual average GWRC estimated total volume (m³)
1987 – 1993	69,200	5,780	75,000	79,600
1993 – 1998	102,000	8,050	110,000	80,800

1998 – 2004	129,000	10,500	139,000	98,700
2004 - 2009	83,900	8,860	92,700	91,200
1987 -2009	**96,300**	**8,280**	**105,000**	**87,800**

In summary, the Opus report concluded that:

- There is a high degree of variability in sediment transport, and this reflects the variability in flows within the river, with sediment transport being largely controlled by the number, magnitude and duration of flood events
- The annual rate of sediment transport since 1987 has ranged from 75,000 m³ to 139,000 m³
- Average annual sediment load past Taita Gorge is approximately 105,000 m³, which is predominantly suspended sediment load
- The average annual total sediment volume of approximately 88,000 m³ (estimated by GWRC) is likely to be more indicative of the long term sediment transport regime.

3.5.3 Gravel transport rates

(Williams Consultants Ltd, 2006) reports that gravel bed material will pass down any reach to downstream reaches, with additions or subtractions from channel storage (which may be either natural or man-induced) until the material enters a natural deposition reach, where the river's overall transporting power declines. The Te Awa Kairangi / Hutt River's natural depositional reach lies downstream of Belmont. In summary; the net transport balance calculation for any reach is:

Net Supply = Upstream Supply – Downstream Supply

= Extraction +/- Channel Bed Changes –Bank Losses

Changes in the channel are derived from changes in the levels of the bed and in the position of the banks that have been measured at a series of channel cross sections along a reach.

Pre 1987/88 transport calculations estimated an average net supply of up to 100,000 m³ per year, with about 50,000m³ depositing in the river channel mostly between the mouth and Belmont, and 50,000 m³ depositing in the harbour beyond the mouth. However, these estimates were based on incomplete survey data.

More detailed cross sectional surveys of the Te Awa Kairangi / Hutt River (with sections every 100 m) were carried out in 1987 (mouth to Taita Gorge), 1988 (upper valley to Birchville Gorge) and 1989/90 (Birchville to Hutt Gorge upstream of Te Marua). Repeat surveys of the full set of cross sections were carried out in 1993, 1998, 2004, and 2009. Partial river bed surveys were also carried out in 2005 and 2012. This has enabled a much more accurate assessment of channel changes over time.

Transport balance calculations derived from the survey data indicate:

- an overall average annual supply of bed material to the lower depositional reaches of the river of approximately 60,000 – 70,000 m³
- of this, 30,000 – 45,000 m³ is deposited between Ava Bridge and Belmont, with the remainder (presumably) depositing in the harbour beyond the river mouth.

3.5.4 Optimum river bed levels

As reflected in the consent conditions and the Operational Management Plans for each reach, GWRC's aim is to maintain mean bed levels (MBLs) for the managed section of the Te Awa Kairangi / Hutt River to a design profile (at or about the 1998 MBLs) within an envelope of minimum and maximum bed levels (Optimum Bed Levels [OBLs]).

The purpose of the OBLs, which vary from reach to reach, is to maintain a balance between:

- Flood capacity: If riverbed levels increase, the capacity of the channel is reduced and the chance of overtopping or breaching of the stopbanks is increased. Consequently the risk of significant floodplain damages is also increased.
- Channel asymmetry: If the asymmetry of the channel increases, the degree of berm damage and maintenance required to protect bank edges increases.
- Erosion potential: If riverbed levels drop, the risk of damage to rock protection and berms is increased, leading to greater maintenance and repair costs and erosion risk to stopbanks.

3.6 Vegetation

Prior to human habitation, it is likely that the whole of the Te Awa Kairangi / Hutt River catchment was forested. This would have included:

- raupo (Typha angustifolia) and flax (Phormium tenax) marshes in the lower tidal reaches of the river;
- kahikatea (Dacrycarpus dacrydioides) dominated forest on the valley floor, with totara (Podocarpus totara) on the fringes of wetlands;
- beech (Nothofagus sp.) forest on the surrounding hills with rimu (Dacrydium cupressinum), pukatea (Laurelia novae-zelandiae) and matai (Prumnopitys taxifolia) in gullies; and
- flax (Phormium tenax) and toetoe (Austroderia sp.) on river banks and in open patches.

Over 40% of the Hutt catchment is still covered by indigenous forest; this is mainly confined to upper parts of the catchments of the Whakatikei, Akatarawa, Hutt and Pakuratahi Rivers.

Much of the Hutt catchment south of the Akatarawa River confluence was stripped of timber by the early settlers. Low forest or shrubland dominated by plants such as tawa *(Beilschmiedia tawa)*, mahoe (*Melicytus ramiflorus*), tree ferns (*Dicksonia squarrosa*), titoki (*Alectryon excelsus*), rangiora (*Brachyglottis repanda*), hange (*Geniostoma ligustrifolium*) and kawakawa (*Macropiper excelsum*) remained.

As the hill country could not be used for intensive farming, re-growth and regeneration of cleared areas took place. However in the mid-20th century highly competitive weed shrubs including gorse gained the advantage and grew to cover large areas of both the eastern and western hills (Montgomery Watson, 1998). Much of the low lying terrain in the Upper and Lower Hutt basins is urban residential land (about 10% of the catchment).

The present day riverbank vegetation is now dominated by willows (now largely sterile hybrids) that have been planted for flood protection. In 1998 it was estimated that willows lined approximately 64% of the left bank and 51% of the right bank downstream of Birchville.

Other species such as karamu (*Coprosma robusta*), flax (*Phormium tenax*), toetoe (*Austroderia sp.*), tree lucerne (*Chamaecytisus palmensis*) and a range of weeds including gorse, old man's beard and blackberry also occur wherever conditions are suitable.

Beech forest remnants occur down to the water's edge in the upper reaches of the Te Awa Kairangi / Hutt River, such as at Birchville.

GWRC has also planted a large number of native plants in the river corridor over the past 15 years. For example, in the 2011/2012 financial year 4200 assorted natives were planted in the river corridor (in comparison to 740 willows).

3.7 Water quality

Surface water quality has been routinely monitored in the western half of the Wellington Region by GWRC since 1987. There are three RSoE[12] monitoring sites on the main stem of the Te Awa Kairangi / Hutt River and one on the Akatarawa River see Table 8 for details.

Water quality at each site is assessed monthly from a range of physico-chemical and microbiological variables measured at each site. These include:

- Temperature;
- Dissolved oxygen (DO);
- pH;
- Conductivity;
- Visual clarity, turbidity and suspended solids;
- Total organic carbon;
- Nitrogen (total ammoniacal nitrogen, nitrite, nitrate, nitrate+nitrite, total Kjeldahl nitrogen, total nitrogen);
- Phosphorus (Total phosphorus, dissolved reactive phosphorus);
- Faecal coliforms and E coli; and
- Heavy metals (dissolved copper, lead, zinc).

The National Institute of Water Atmospheric Research (NIWA) also operates two sites on the Te Awa Kairangi / Hutt River – at Kaitoke and Boulcott, as part of the National River Water Quality Network (NRWQN) programme. The latter site at Boulcott lies within the application area. NIWA tests samples from these sites for a range of physical and chemical variables on a monthly basis, and also undertakes monthly periphyton assessments. Benthic invertebrate samples are collected on an annual basis. (This is in addition to the GWRC monitoring).

The annual monitoring report for the year to June 2014 (Heath, Perrie, & Morar, 2014) graded the Te Awa Kairangi / Hutt River sites at Te Marua as "good", while Manor Park and Boulcott were both rated as having "fair" water quality. All three sites had less than optimal visual clarity while the Manor Park and Boulcott sites also had elevated *E. coli* values. The low water clarity recorded during much of 2014 is attributed to a major slip in the Te Awa Kairangi / Hutt River headwaters upstream of the Kaitoke Weir (John Duggan, Wellington Water, pers. com.). There has been evidence from time to time that river management activities may occasionally contribute to reduced water clarity (i.e., Perrie *et al* 2012). It is noted also that water quality within the application area is influenced by multiple factors associated with a variety land-uses. The Akatarawa River near the Te Awa Kairangi / Hutt River confluence was rated as "Excellent" and was ranked 10th out of 55 RSoE sites. Of the other major tributaries to the Hutt included in the RSoE programme, the Whakatikei River (RS26) was rated as having "excellent" water quality, while the Pakuratahi (RS23) and the Mangaroa (RS24) rivers were "fair".

In general, the upper parts of the Te Awa Kairangi / Hutt River, and the Akatarawa and Whakatikei Rivers show consistently high water quality with high visual clarity, low turbidity, faecal coliforms and nutrient levels. Water quality is less in the lower river, with some of the increases in turbidity and nutrient concentrations attributable to inflows from agricultural and urban catchments.

Overall, the Te Awa Kairangi / Hutt River is considered suitable for general use. Weekly summer water quality monitoring between 2005/06 and 2010/11 has shown popular swimming spots mostly comply with national guidelines for contact recreation, except when it rains. The exceptions are sites

[12] "Rivers State of the Environment"

at Silverstream and Boulcott. Toxic algae (cyanobacteria) is often a problem in the Te Awa Kairangi / Hutt River in summer; since 2005, 11 dogs have died after coming in contact with this algae (Greater Wellington Regional Council, 2012).

Table 8: Water Quality Index grades for RSoE sites in the application from monthly samples collected from July 2013 to June 2014 (Heath, Perrie, & Morar, 2014)

Site	Site name	Water quality grade	Rank (of 55)	Guideline compliance (median values)					
				DO	Clarity	E. coli	NNN	Amm. N	DRP
RS20	Hutt R. at Te Marua intake	Good	22	✓	✗	✓	✓	✓	✓
RS21	Hutt R. at Manor Park G.C.	Fair	28	✓	✗	✗	✓	✓	✓
RS22	Hutt R. at Boulcott	Fair	26	✓	✗	✗	✓	✓	✓
RS25	Akatarawa R. @Hutt R. con.	Excellent	10	✓	✓	✓	✓	✓	✓

Table 9: Summary of water quality data at Te Awa Kairangi / Hutt River and Akatarawa River sites sampled monthly between Jan 2010 and March 2015.

Determinand	*Te Awa Kairangi / Hutt River at Te Marua (RS20)*			*Te Awa Kairangi / Hutt River at Manor Park (RS21)*			*Te Awa Kairangi / Hutt River at Boulcott (RS22)*			*Akatarawa R at Hutt R confluence (RS25)*			*Guideline value**
	median	*min*	*max*	median	min	max	*median*	*min*	*max*	*median*	*min*	*max*	
Water temp. (°C)	11.1	7	17.35	13.8	8.5	21.4	14.2	8.27	21.52	11.6	6.8	17.49	≤19
DO (%saturation)	101	92	110	105	96	127	103	96	126	102	95	114	≥80
pH	7.27	6.51	7.79	7.29	6.58	8.51	7.26	6.57	8.23	7.33	6.65	7.87	6.5-9.0
Visual clarity (m)	3.23	0.31	7.73	1.75	0.05	6.83	1.59	0.04	7.5	3.66	0.07	7.97	≥1.6
Turbidity (NTU)	0.8	0.3	23	1.8	0.3	220	2.1	0.3	230	0.6	0.2	191	≤5.6
Suspended solids (mg/L)	<1	<1	33	<1	<1	440	<1	<1	470	<1	<1	370	--
Conductivity (µS/cm)	70	46	87	97	71	136	91	67	116	84	54	102	--
TOC (mg/L)	2.4	0.8	11.4	2.7	0.3	16.2	2.7	0.8	9.8	1.8	0.8	13.9	--
NNN (mg/L)	0.074	0.026	0.167	0.191	0.050	0.890	0.172	0.044	0.560	0.079	0.001	0.620	≤0.444
Ammoniacal N (mg/L)	0.005	0.003	0.005	0.005	0.003	0.045	0.005	0.003	0.01	0.005	0.003	0.033	≤0.021
Total N (mg/L)	0.162	0.055	0.420	0.330	0.140	1.96	0.310	0.120	1.83	0.160	0.055	1.38	≤0.614
DRP (mg/L)	0.002	0.002	0.007	0.005	0.001	0.011	0.004	0.001	0.011	0.002	0.002	0.008	≤0.010
Total P (mg/L)	0.006	0.002	0.032	0.01	0.002	0.38	0.009	0.002	0.39	0.006	0.002	0.3	≤0.033
E. coli (cfu/100ml)	20	1	300	100	4	4000	80	10	3600	42	11	2600	≤550

3.8 Aquatic ecology

Ecosystem health is assessed at each of GWRC's 55 RSoE sites through biological monitoring. This includes:

- Annual monitoring of periphyton biomass and macroinvertebrate communities during stable/low flows in summer/autumn;
- Monthly assessment of Periphyton cover in conjunction with the water quality sampling programme (see Section 3.7); and
- Monitoring of aquatic macrophyte cover at selected sites with soft sediment substrates (this does not apply to the application area).

Biological assessment methods have remained largely unchanged since 2003, except that the number of invertebrate samples at each site was reduced from three to one in 2010. Formal monitoring of aquatic macrophyte cover at selected sites has been undertaken only since July 2011; prior to this only general observations of nuisance growth were recorded during monthly water sampling.

3.8.1 Aquatic Plants

Periphyton

Periphyton assessments are only undertaken at sites with hard substrates (gravel and cobbles), including the four sites of relevance to this application. Summary data for these sites are given in Table 10. For a detailed analysis of the results, refer to the source report.

Table 10: Summary of monthly observations of visible streambed filamentous and mat-forming periphyton [13]

Year	Site no.	Site name	*n*	Streambed cover (%)			
				Filamentous (>2 cm long)		Mats (>0.3 cm thick)	
				Max	n>30% cover	Max	n>60% cover
2010	RS20	Te Awa Kairangi / Hutt River at Te Marua intake	8	0	0	0	0
	RS21	Te Awa Kairangi / Hutt River at Manor Park Golf Club	10	7	0	58	0
	RS22	Te Awa Kairangi / Hutt River at Boulcott	7	2	0	51	0
	RS25	Akatarawa River at Hutt R. confluence	11	0	0	0	0
2011	RS20	Te Awa Kairangi / Hutt River at Te Marua intake	10	0	0	0	0
	RS21	Te Awa Kairangi / Hutt River at Manor Park Golf Club	9	15.5	0	**88**	**1**
	RS22	Te Awa Kairangi / Hutt River at Boulcott	8	8	0	**100**	**1**
	RS25	Akatarawa River at Hutt R. confluence	10	0	0	9	0

[13] Cover in relation to exceedances of the MfE (2000) guidelines at RSoE sites within the application area (grey) and upstream (unshaded) for the years to June 2010, 2011, 2012, 2013 and 2014 (after Perrie and Conwell, 2013; Morar & Perrie, 2013; Heath, Perrie, & Morar, 2014)).

2012	RS20	Te Awa Kairangi / Hutt River at Te Marua intake	11	0	0	12	0
	RS21	Te Awa Kairangi / Hutt River at Manor Park Golf Club	11	20	0	38	0
	RS22	Te Awa Kairangi / Hutt River at Boulcott	11	17	0	**82**	**1**
	RS25	Akatarawa River at Hutt R. confluence	11	0	0	21	0
2013	RS20	Te Awa Kairangi / Hutt River at Te Marua intake	11	0	0	4	0
	RS21	Te Awa Kairangi / Hutt River at Manor Park Golf Club	10	7	0	15	0
	RS22	Te Awa Kairangi / Hutt River at Boulcott	8	**60**	**1**	52	0
	RS25	Akatarawa River at Hutt R. confluence	11	0	0	17	0
2014	RS20	Te Awa Kairangi / Hutt River at Te Marua intake	4	0	0	0	0
	RS21	Te Awa Kairangi / Hutt River at Manor Park Golf Club	3	1	0	0	0
	RS22	Te Awa Kairangi / Hutt River at Boulcott	3	22	0	16	0
	RS25	Akatarawa River at Hutt R. confluence	10	8	0	8	0

Over the five year period from 2010 to 2014 inclusive, the Te Awa Kairangi / Hutt River at Te Marua (upstream of the application area) and the Akatarawa River site at the confluence complied with the MfE guidelines for periphyton cover and biomass on all sampling occasions. Over the same five year period the Te Awa Kairangi / Hutt River at Manor Park exceeded the periphyton cover guidelines on one monthly sampling occasion, and twice exceeded the periphyton biomass guideline (in 2010 and 2012). The Te Awa Kairangi / Hutt River at Boulcott exceeded the periphyton cover guidelines on two monthly sampling occasions, and twice exceeded the periphyton biomass guideline (in 2010 and 2012).

At both the Manor Park and Boulcott monitoring sites the periphyton cover is typically dominated by mat-forming cyanobacteria of the genus *Phormidium* which blooms annually along the middle and lower reach of the Te Awa Kairangi / Hutt River.

Some very high biomass values have been recorded at sites RS21 and RS22 in recent years, but not especially during the period analysed in the report (although note the chlorophyll a value of 119.3 at Site RS22 for 2010) (Perrie, *pers. comm.).* Cameron, 2015 notes that an increasing trend in mean mat periphyton streambed cover at these sites was detected. It suggested that this could be more attributable to flow conditions over the monitoring period than a decreasing trend in water quality.

<u>Other Aquatic Plants</u>

According to GWRC records, no nationally threatened aquatic or semi-aquatic indigenous plant species have been located in the Te Awa Kairangi / Hutt River within the application area to date.

3.8.2 Macroinvertebrates

Fine scale monitoring reported by Robertson & Stevens (2012) includes survey of infauna from sediment core samples collected at two Hutt Estuary sites (A & B) in 2010, 2011 and 2012. In all three years the macroinvertebrate community was found to have low-moderate numbers of species at both sites. In terms of abundance, the results show a large reduction at both sites between 2010 and 2012. Compared with other NZ tidal river estuaries the abundances were relatively low.

The mud tolerance of the Hutt Estuary macroinvertebrate community was in the “moderate-high” category in 2012, a slight improvement from the previous two years (see Appendix E, (Cameron, 2015) for further detail). The results show that the community was dominated by species that prefer mud rather than those that prefer sand.

Tributaries

Water quality and ecological data for the tributaries included in the application is limited. The only routine monitoring is undertaken at RSoE Site RS25 (Akatarawa River at Hutt confluence).

(Wellington Regional Council, Pollution Control Team, 2005) reported that Te Mome Stream sediments are highly organic and in excess of 0.5 m deep in places, ranging from silt to sandy mud. Biodiversity of the stream is limited, with predominant biota being algae, reeds and eels.

3.8.3 Fish

In total 12 New Zealand Freshwater Fish Database (NZFFD) sites are located within the application area and a further 18 sites are located on affected watercourses outside (upstream) of the application area. The tributary stream reaches included in the application area are relatively short stream lengths for which very limited fish data is available. The number of survey sites within and upstream of the application area is listed in the Table below.

Table 11: Number of NZFED fish survey sites in each river sampled for freshwater fish (1960-2015)

Watercourse	Number of sites/records within application area	Number of sites/records upstream of application area	Sampling period
Te Awa Kairangi / Hutt River	9	10	1962 to 2005
Akatarawa River	0	6	1968 to 2005
Stokes Valley Stream	1	2	1997 to 2004
Speedy’s Stream	2	0	1961 to 1962
Opahu Stream	0	0	none
Te Mome Stream	0	0	none

Te Awa Kairangi / Hutt River

Targeted investigations of Te Awa Kairangi / Hutt River habitats affected by flood protection activities have recently been undertaken by Perrie (2013) and Cameron (2016). The 2013 study is comprehensive, covering deep pools, deep runs, shallow runs and riffle habitats in a reach affected by gravel extraction, and further detail is provided in Appendix E of this report.

Table 12: Summary of NZFFD records for the Te Awa Kairangi / Hutt River

Scientific name	Common name	%Occurrence			Migratory species	Threat status (Goodman *et al* 2014)
		Recorded within application area (n=9)	Recorded outside applicatio n area (n=10)	Predicted within/ upstream (FENZ)		
Anguilla australis	Shortfin eel	44	0	100/10	yes	Not threatened
Anguilla dieffenbachii	Longfin eel	33	40	100/100	yes	At risk (declining)
Galaxias argenteus	Giant kokopu	22	0	30/0	yes	At risk (declining)
Galaxias brevipinnis	Koaro	22	30	10/30	yes	At risk (declining)
Galaxias divergens	Dwarf galaxias	0	30	10/10	no	At risk (declining)
Galaxias maculatus	Inanga	22	0	100/10	yes	At risk (declining)
Galaxias fasciatus	Banded kokopu	0	0	30/10	yes	Not threatened
Geotria australis	Lamprey	33	0	20/10	yes	Threatened (Nationally Vulnerable)
Gobiomorphus basalis	Crans bully	11	40	10/50	No	Not threatened
Gobiomorphus cotidianus	Common bully	11	0	100/20	yes	Not threatened
Gobiomorphus gobioides	Giant bully	11	0	40/0	yes	Not threatened
Gobiomorphus hubbsi	Bluegill bully	44	30	50/60	yes	At risk (declining)
Gobiomorphus huttoni	Redfin bully	55	80	100/100	yes	At risk (declining)
Retropinna	Common smelt	*	0	80/0	yes	Not threatened
Salmo trutta	Brown trout	44	70	50/90	yes	Introduced/naturalised

Source: (Cameron, D, 2015)

The most commonly recorded fish in the Te Awa Kairangi / Hutt River are longfin eel, redfin bully and brown trout. One of the fish in Table 11 is listed as “Nationally vulnerable”, seven are listed as “At risk (declining)”, while the remaining nine species are “Not Threatened” according to the threat classification system in Goodman et al (2014).

The report by Cameron, included in Appendix E, notes that over 70% of the 111 Hutt catchment surveys in the NZFFD were undertaken using electric fishing methods, indicating that primarily only shallower water habitats in the Hutt catchment have been adequately surveyed. To assess the fish communities in deeper water habitats in the Te Awa Kairangi / Hutt River GWRC undertook fish surveys upstream of Kennedy-Good Bridge at two sites associated with rock groynes, and lying upstream of an area of gravel extraction activities. The results are shown in Table 13.

Table 13: Overnight fishing survey at two deep-water sites in the Te Awa Kairangi / Hutt River

	Site 1		Site 2
	Fyke nets & Gee-minnow traps	**Spotlighting (indicative only)**	**Fyke nets & Gee-minnow traps**
Common bully	16	“heaps”	10 (70 – 114 mm)
Cran’s bully	7	“a few”	

	Site 1		Site 2
	Fyke nets & Gee-minnow traps	Spotlighting (indicative only)	Fyke nets & Gee-minnow traps
Unidentified bully (very small)	8	2	?
Giant bully			
Shortfin eel	11 (350 – 600 mm)		
Longfin eel	2 (450 – 550 mm)	"A few"	3 (400 – 800 mm)
Inanga	28 (50 – 80 mm)		
Whitebait	1 (47 mm)	"a few"	
Koaro	1 (51 mm)	"possibly"	2 (51 – 56 mm)
Shrimp	17	"heaps"	16
Brown trout		4 (400 - 500 mm)	2 (50 – 52 mm)

Source: (Perrie, A, 2013a)

GWRC also undertook an electric fishing survey at three sites (downstream of, within, and upstream of) the proposed gravel extraction area, prior to the works commencing. These results are shown in Table 14.

Table 14: Electric fishing survey at three sites in the Te Awa Kairangi / Hutt River

Variable/species	Downstream Site	Proposed Impact Site	Upstream site
Flow (m^3/s)	6.1	8.7	8.7
Area fished (m^2)	330.75	360	342
Shock time (s)		18	9
Bluegill bully	48	77	52
Redfin bully	5		1
Cran's bully			
Common bully			1
Unidentified bully			3
Smelt	1	3	
Koaro	89	41	48
Whitebait			
Shortfin eel		1	
Longfin eel			
Elver (unidentified)			
Koura			
Brown trout			3
Fish per m^2	0.435	0.339	0.316
Fish per m^2 (excluding koaro)	0.166	0.225	0.175

Variable/species	Downstream Site	Proposed Impact Site	Upstream site
Bluegill bullies per m²	0.145	0.214	0.152

Source: (Perrie, A, 2013a)

Overall, the results of these fishing surveys indicated the presence of a relatively diverse fish fauna in a Te Awa Kairangi / Hutt River reach that is affected by a variety of existing flood protection structures including rock groynes and rip-rap lining.

Diadromous fish (which include bullies, eels, lampreys, kokopu, koaro, torrentfish, smelt, inanga) migrate to and from the sea, at well-defined life stages. For native species, most migration from the sea into the river occurs during late winter and spring, with the main period for species found in the Te Awa Kairangi / Hutt River extending from August to November (McDowall 1995).

Sea-run brown trout migrate from the sea into the river during autumn, moving upstream and into the headwaters to spawn in winter. Since trout are not obliged to spend time in the sea, many trout may simply move from the main stem of the river to a headwater tributary to spawn.

Migration from the river into the sea occurs for most migratory species during summer to mid-winter, but this migratory activity is less intense.

Species that could potentially seek spawning habitat in the reaches affected by gravel extraction in particular include:

- Common smelt (Retropinna retropinna);
- Common bully (Gobiomorphus cotidianus);
- Inanga (whitebait species) (Galaxias maculatus); and
- Bluegill Bully (G. hubbsi).

It has been reported that historically the Te Awa Kairangi / Hutt River supported a productive whitebait (inanga) fishery, and while it is still fished, this fishery has undoubtedly declined because of river engineering works (Hudson, 2008). Inanga normally spawn on spring-tide events during late summer and autumn, amongst tidally inundated riparian vegetation near the top of the saltwater wedge. In the Te Awa Kairangi / Hutt River this corresponds to the Ava to Ewen reach. River engineering works have resulted in losses of such habitat, but some is still known to exist in Sladden Park (on the true left bank) and further downstream in the vicinity of the Ava Rail Bridge.

As part of the Ava to Ewen works extensive off-setting was undertaken to recreate habitat (whitebait in particular) in the lower Opahu Stream (which is now an isolated arm of the Te Awa Kairangi / Hutt River. This work is now maintained as part of the operations and maintenance works undertaken on the river.

Trout

Brown trout were originally introduced into the Te Awa Kairangi / Hutt River in 1874 by the Wellington Acclimatisation Society and until 1941 tens of thousands of trout were liberated annually. After 1941, artificial stocking became irregular until it ceased altogether in 1976 (Fish & Game NZ, 2011).

Trout abundance has been monitored annually (via drift dives) by Fish & Game NZ since 1999, principally for the purpose of assessing the impacts of river works. In 1998 GWRC was granted resource consent [WGN 980255] to carry out various works in the bed of the Te Awa Kairangi / Hutt River (and also in the Waikanae River [WGN 980256]). In response to the concerns of Fish & Game NZ that one activity, ‘cross blading’[14], was particularly harmful to the preferred habitat

[14] This activity is now referred to as “bed recontouring”.

requirements of trout, GWRC agreed (via a Memorandum of Understanding) to fund the monitoring of trout abundance over the 15 year term of these consents.

The primary objective of this MoU is:

> *"to explore the relationship between trout abundance and the frequency and extent of river control works, in particular cross-blading".*

Trout are found from the Melling Bridge up to the Pakuratahi River confluence, with the main fishery located between the Melling Bridge and Birchville. Overall, the highest numbers of trout are generally recorded at Melling. Trout numbers are low in the upper reaches of the Te Awa Kairangi / Hutt River, and the lowest numbers are consistently recorded at Kaitoke.

The results from (Pilkington, S, 2014) note the following:

- The mean number of trout per km was 118.65 (with a standard error of 31), compared with 155.28 (*s.e.* 45.55) in 2013. This change was not considered to be statistically significant.
- The number of large brown trout (>400mm long) per km for the 16 years between 1999 and 2014 increased, on average, by 3% per year
- The number of medium brown trout (200 -400 mm) per km has increased on average by 5% per year over the same period
- Trout numbers show significant annual variation from year to year, both for the river overall, and from reach to reach. However, the numbers of large and medium brown trout per km over the past 16 years has remained the same overall.

In the 2012 report (Pilkington S. , 2012) an observation was made that where 'cross blading' (i.e. bed recontouring) had been undertaken recently at the Melling site, there were virtually no invertebrate life visible, and no trout of any size observed.

Declines in trout numbers have been attributed by Fish & Game NZ to the effects of bed recontouring (cross blading), however it should be noted that monitoring data for trout larger than 200mm showed a significant decline between 1997-2001 compared with a previous period from 1983 -1989, at a time when the extent of bed recontouring (cross blading) varied little. This, together with the results noted above, suggests that while bed recontouring may be a contributing factor, it is not the only factor that may be causing trout numbers to fluctuate, and its effects may be more likely to be short term, rather than long term.

Another important influence on trout numbers is the severity of spring floods between August and November, which is believed to reduce trout recruitment. (Pilkington, 2012) noted that correlating flood data against the medium trout counted per km 1.5 years later showed a reasonably strong negative relationship (-0.89) and this was strengthened if the flood data was weighted to account for the relative severity of the flood. The report also stated that the increased number of medium size fish counted in the 2012 annual drift dive was indicative of good recruitment and survival over the previous two year period, which was a period in which no major floods were recorded.

Fish & Game NZ have also noted that angler harvest, particularly in years when weak year classes are present may also contribute to a decline in fish >200mm.

3.9 Birdlife

McArthur et al (2015) recorded a total of 44 bird species during the 2012-15 bird surveys, including 26 native species and 18 introduced species. Of the native species, seven were ranked as Nationally Threatened or 'At Risk' under the New Zealand Threat Classification System (Robertson, et al., 2012). The authors note that in addition to the 44 birds species observed during the 2012-15 surveys, a further 18 species (all native) have been recorded on the Te Awa Kairangi / Hutt River since 1997, bringing the total number of bird species recorded on the Te Awa Kairangi / Hutt River to 62.

Both the total number of species and the ratio of native to introduced species encountered within each 1km survey section varied little along the 31.5 km of the Te Awa Kairangi / Hutt River that was surveyed (Figure 3 30). A slightly higher proportion of 'Threatened' or 'At Risk' species were recorded between XS1310 and XS2270 (within the application area, from the Silverstream Weir to the eastern end of Awa Kairangi Park) and between XS2730 and XS2900 (upstream of the application area, alongside the Te Marua Golf Course), due to the presence of both pied stilts and black shags on the riverbed in these reaches. The total number of species recorded, the ratio of native to introduced species and the proportion of 'threatened' and 'at risk' species all increased with increasing distance downstream of XS540. McArthur et al (2015) concluded that this change was due to the presence of greater numbers of predominantly coastal bird species such as red-billed gulls (Larus novaehollandiae), royal spoonbills (Platalea regia), pied shags and variable oystercatchers in this lower reach of the Te Awa Kairangi / Hutt River. The Ornithological Society's Bird Distribution Atlas (Robertson et al) notes a total of 45 bird species within the Hutt upper catchment.

- GWRC staff have also carried out annual bird counts on the Te Awa Kairangi / Hutt River, which has provided useful information (unpublished) on the diversity and relative abundance of bird species using the parkland habitats either side of the river. While bird surveys have been undertaken for several of the Wairarapa rivers in recent years, (e.g. Sim (1998), Rebergen (2011, 2012)), the Te Awa Kairangi / Hutt River and other large rivers in the western part of the Wellington Region (Waikanae and Otaki Rivers) appear to have never been systematically surveyed for birds prior to 2012.
- During 2012, GWRC commissioned a comprehensive bird survey in the Hutt and other rivers, to provide information to inform the preparation of resource consent applications for these rivers. This involved development of a standardised, repeatable survey method, which involved carrying out surveys on fine, calm days during 'normal' river flows. One or two observers walked slowly downstream recording the identity and numbers of all birds seen or heard in the river bed, and any species obviously associated with the riverbed habitat that were seen flying upstream along the river. The Te Awa Kairangi / Hutt River was surveyed along the 31.5 km reach between Te Marua water treatment plant and the Hutt Estuary. The results of this work to date are contained in (McArthur, 2013) and summarised in Table 15.

Table 15: Bird species recorded in the 2012 Te Awa Kairangi / Hutt River survey, and NZ Threat Classification System category

Common Name	Scientific Name	Threat ranking (as per Miskelly et al (2008)
Pied shag	*Phalacrocorax varius*	Nationally vulnerable
Red-billed gull	*Larus novaehollandiae*	Nationally vulnerable
Pied stilt	*Himantopus*	At Risk - Declining
Variable oystercatcher	*Haematopus unicolor*	At Risk - Recovering
Little shag	*Phalacrocorax melanoleucos*	At Risk – Naturally uncommon
Black shag	*Phalacrocorax carbo*	At Risk – Naturally uncommon
Little black shag	*Phalacrocorax sulcirostris*	At Risk – Naturally uncommon
Royal spoonbill	*Platalea regia*	At Risk – Naturally uncommon

Common Name	Scientific Name	Threat ranking (as per Miskelly et al (2008)
Black swan	*Cygnus atratus*	Not threatened
Paradise shelduck	*Tadorna variegata*	Not threatened
White-faced heron	*Egretta novaehollandiae*	Not threatened
Pukeko	*Porphyrio*	Not threatened
Spur-winged plover	*Vanellus miles*	Not threatened
Black-backed gull	*Larus dominicanus*	Not threatened
New Zealand kingfisher	*Todiramphus sanctus*	Not threatened
Welcome swallow	*Hirundo neoxena*	Not threatened
California quail	*Callipepla californica*	Introduced and Naturalised
Canada Goose	*Branta canadensis*	Introduced and Naturalised
Mallard	*Anas platyrhynchos*	Introduced and Naturalised
Rock pigeon	*Columba livia*	Introduced and Naturalised
Eastern rosella	*Platycercus eximius*	Introduced and Naturalised
Blackbird	*Turdus merula*	Introduced and Naturalised
Song thrush	*Turdus philomelus*	Introduced and Naturalised
Starling	*Sturnus vulgaris*	Introduced and Naturalised
House sparrow	*Passer domesticus*	Introduced and Naturalised
Chaffinch	*Fringilla coelebs*	Introduced and Naturalised
Greenfinch	*Carduelis chloris*	Introduced and Naturalised
Goldfinch	*Carduelis*	Introduced and Naturalised
Yellowhammer	*Emberiza citrinella*	Introduced and Naturalised
Muscovy duck	*Cairina moschata*	No ranking

Source: (McArthur, 2013)

The results show that no Nationally Endangered species were recorded in the Te Awa Kairangi / Hutt River, and neither were species that nest in the river bed, including banded dotterels (Nationally Vulnerable) or black-fronted dotterels (At Risk –Declining). Pied shags and red-billed gulls, both of which are nationally vulnerable, are present, as are six other ‘at risk’ species.

3.10 Natural character

The natural character of a river reach is a reflection of the river’s physical morphology, hydrological regime, riparian and in stream ecology and the complex interactions among these parameters over time.

As part of investigations for this application for resource consent, a basic assessment of natural character has been undertaken. A Natural Character Index (NCI) has been determined for defined reaches identified in the application area using a combination of individual indices that have been determined for a number of physical features of the channel including:

- the width of the actively worked channel;
- the bankfull width before the river overflows to the floodplain;
- the width of floodplain available to floodwater (permitted floodplain width);
- channel sinuosity, from flow length and direct valley length; and

- the number of pools per km.

These features were determined from aerial photography and contour information produced from LiDAR imagery surveying. The latest and earliest available (complete) aerial photography was used, to set up a baseline index.

The results of the NCI determination for the Te Awa Kairangi / Hutt River are given in Table 16.

Table 16: Natural Character Index for the Te Awa Kairangi / Hutt River

REACH (Cross Sections)	OVERALL NCI
XS 2780 –XS 2560	0.73
XS 2540 – XS 2410	1.04
XS 2400 – XS 2270	0.83
XS 2260 – XS 1920	0.54
XS 1910 – XS 1780	0.71
XS 1770 – XS 1350	0.70
XS 1340 – XS 1090	0.55
XS 1080 – XS 850	0.68
XS 840 – XS 510	0.72
XS 500 – XS 370	1.14
XS 360 – XS 210	0.97
XS 200 – XS 100	1.11
Average	**0.81**

Source: (Williams, 2013)

The values are the ratios of the present to historic measurements, where a value of 1 means no change over the assessment time period. The lower the ratio value the greater the change away from natural character. The NCI index varies from 0.54 to 1.14 for the twelve individual reaches, reflecting the fact that there has been varying degrees of modification over time. Where the index is greater than 1, there has been an improvement over the baseline condition – this has occurred in three of the reaches. The overall averaged index for the Te Awa Kairangi / Hutt River reaches is 0.81.

Since determination of the NCI for a reach can be repeated from updated aerial photography/LiDAR survey data over time, it provides a potentially useful tool for monitoring trends in river condition over time.

3.11 Landscape and landscape character

3.11.1 Landscape

Five landscape areas are identified in The Te Awa Kairangi / Hutt River Environmental Strategy:

- Te Marua Basin (predominantly rural with the river corridor having steep banks and willow plantings;
- Birchville Gorge (narrow valley running through an urban area with native vegetation on the surrounding hills);

- Upper Hutt Basin (urban, with some farming and forestry, dense secondary and regenerating native bush on the surrounding hills);
- Taita Gorge (narrow valley with tree-lined gorge); and
- Lower Hutt Basin (low lying urban area dominated by the State Highway and becoming more industrial towards the mouth).

The last four of these areas lie within the application area. The Environmental Strategy notes that the local community places a high value on the 'natural' character of the river and its margins. It also notes that while the river and its banks provide a series of linked open spaces, the quality of this space could be improved, principally by provision of topographic variation and enhancement of plantings on the river berms, and also by variation in the levels of maintenance of riverside vegetation.

3.11.2 Landscape character

Landscape character describes the unique features of an area deriving from the combination of the land form, cover and land use of that area. A landscape character area can be defined as having a distinct combination of biophysical and cultural factors that distinguish it from other areas.

The Hutt Landscape Study has been initiated by GWRC to assist in the long-term development of planning measures for managing landscape change in the Hutt, in response to new requirements in the proposed Regional Policy Statement. Stage Two of that study, the Landscape Character Description, was completed in 2012. This provides a comprehensive landscape assessment of the Lower and Upper Hutt districts (Boffa Miskell, 2012).

It is intended that Upper Hutt City and Hutt City councils will use this work as a basis for assessment and identification of proposed outstanding natural features and landscapes, and significant amenity landscapes within their respective districts. Eventually this process is to lead to development of appropriate objectives, policies and rules in the district plans.

(Boffa Miskell, 2012) identifies the Hutt Valley Landscape Character Area as covering the Hutt Valley floor and the lower parts of the hill slopes to the east, and stretching from Emerald Hill to the Petone foreshore. Within this area, the river corridor (which corresponds to the area covered by this application) is identified as a dominant feature, and one of the largest areas of flat land remaining undeveloped for urban and residential use. As such, it provides an important open space and recreational resource.

The report does not assign values to the character area or features identified in it, and nor does it prescribe any actions as to how such areas should be managed.

3.12 Recreation

The Te Awa Kairangi / Hutt River is a major recreational resource for both the Hutt Valley and Wellington Region; uses include fishing, paddling, swimming and river-bank activities such as walking and cycling. Several golf courses, parks and sports fields also lie adjacent to the river. A brief summary is included below. Much of the information is drawn from the Te Awa Kairangi / Hutt River Environmental Strategy and a review of recreation and tourism on the Hutt, Wainuiomata, Otaki and Waikanae Rivers commissioned by GWRC and undertaken by TRC Tourism (TRC Tourism, 2013) in conjunction with the preparation of GWRC's resource consent applications for these rivers. This report is attached in Appendix J.

3.12.1 Fishing

The Te Awa Kairangi / Hutt River is a popular (brown) trout fishery and offers good fishing opportunities throughout its length. The Wellington Branch of Fish & Game NZ describe the Te Awa Kairangi / Hutt River on their website as follows:

"The Hutt, largest of the Wellington rivers, dominates angling interest. Access is easy with riverside parks or access tracks along most of its length. In general anglers fish "blind" and cover the water rather than fish to sighted fish. Spinning or wet fly fishing is also popular. The time for spinning is either early season (particularly if the water is slightly discoloured) or late in the season when trout become aggressive leading up to spawning. Alternatively, try a large weighted nymph such as a size 10 or 12 hare and copper. As water temperatures rise, fish smaller patterns. A small wet fly drifted across the tail of the pool is a favoured method during summer. Mornings or evenings are prime times in the summer. After dark, try a sinking line, Taupo style lure and search the depths."

The most popular fishing reaches within the application area lie between Melling Bridge and Birchwood. Survey data indicates that trout fishing on the Te Awa Kairangi / Hutt River has experienced a significant decline over the last 15 years, from nearly 20,000 visits (angler-days) in 1994/5, to just over 6,000 in 2001/2, to 3,800 in 2007/8. (In comparison, angler-days for the whole Wellington Fish & Game Region for the same periods were 68,000 in 1994/5, and 45,000 for both 2001/2 and 2007/08) (Unwin, 2009). Much of the decline in the Te Awa Kairangi / Hutt River has been attributed to the effects of floods in the late 1990's that led to a decline in fish numbers. The most recent drift dive survey of January 2012 indicated that the fishery is recovering. Current fishing visits to the Te Awa Kairangi / Hutt River are estimated at 3,000 – 4,000 per year (TRC Tourism, 2013)[15].

Saltwater fishing occurs at the river mouth, and particularly from the Hutt Estuary Bridge, where there is a small group who fish most days, for kahawai and mullet.

Whitebaiting is also undertaken by a relatively small group (< 50 people) in the reaches downstream of Melling Bridge, during the season (August – November). GWRC issues approximately 20 gate keys, enabling whitebaiters better access to the river (TRC Tourism, 2013).

3.12.2 Paddling

(TRC Tourism, 2013) reports that paddling (kayaking, canoeing and rafting) are popular on the Te Awa Kairangi / Hutt River, with kayaking being the most popular. Most whitewater kayaking and rafting occurs in the upper reaches of the application area and beyond, from Poets Corner upstream to Pakuratahi Forks in Kaitoke Regional Park. An estimated 500 kayakers per year paddle the Hutt Gorge section of the river, which is classified by Whitewater NZ as a grade III – IV with a 5 star rating. It is estimated that rafting is undertaken by a small number of people; less than 100 per annum.

The Hutt Valley Canoe Club, with a membership of approximately 50, has an informal slalom course adjacent to their clubrooms at Hoggart Park, Birchville. (TRC Tourism, 2013) reports that the course is used regularly on Saturday mornings. Inexperienced paddlers from the club make use of the reach from Birchville downstream to Poets Corner. The 4 km trip from Karapoti Rd down the Akatarawa River to the clubrooms is also reported to be popular with club members.

The sewer crossing downstream of the Silverstream Bridges presents a barrier to paddlers that is difficult to negotiate. The reaches downstream of the sewer crossing are used by novice paddlers,

[15] Based on an estimated mean effort of 15 days fishing per licence noted in (Unwin, 2009) this is likely to represent between 200 -300 fishing licence holders.

and also by some multisport enthusiasts for training. The lower reaches of the river are also used for fun events such as building and paddling rafts by schools and corporate groups.

3.12.3 Swimming

There are numerous locations for swimming along the length of the Te Awa Kairangi / Hutt River within the application area, including:

- Near Whakatikei River, just north of Moonshine Bridge (widely regarded as the best spot);
- Gemstone Drive;
- Te Haukaretu Park (Brown Owl);
- Trentham Memorial Park;
- Silverstream bridges;
- Taita Park;
- Melling; and
- Strand Park.

Detailed figures for swimming use are not available, although 11% of respondents to a survey of Te Awa Kairangi / Hutt River Trail Users undertaken by TRC Tourism in March 2010[16] indicated that swimming in the river was an activity that they also undertook.

3.12.4 Walking and cycling

The Te Awa Kairangi / Hutt River Trail runs alongside the river (on both sides, in many reaches) from the Petone foreshore to Te Marua. It is used extensively for walking, dog exercise, cycling, running, picnicking, and also by people commuting to and from work.

GWRC pedestrian trail counters at Block Rd/Melling and County Lane/Silverstream each recorded between 70,000 and 83,000 visits per annum over the last 3 years. A survey of trail users between Kennedy Good and Ewen bridges, conducted by TRC Tourism in March 2010, indicated that use of the trail is dominated by Hutt Valley residents, and is focused largely on reaches closest to their place of residence. The survey showed that walking on the trail was the predominant use (33 % of users), followed by dog walking (26%) and cycling (23%).

(TRC Tourism, 2013) reports that overall annual cycling use of the Te Awa Kairangi / Hutt River Trail is estimated at approximately 100,000 cycle visits, or approximately 20% of all users. Events such as the annual GWRC Bike the Trail, which attracts over 1000 participants, have acted as a catalyst for increasing cycle use of the trail. In addition, sealing of the trail between Ewen and Kennedy Good bridges by Hutt City Council and development of new sections of track continue to attract new users.

The Te Awa Kairangi / Hutt River trail is also an integral component of the New Zealand Cycle Trail route. The proposed route links the trail with the Rimutaka Incline Trail to the Wairarapa, and thence via a coastal route back to Wainuiomata and possibly on to Eastbourne (www.nzcycletrail.com).

3.12.5 Golf

There are five 18-hole golf courses along the length of the Te Awa Kairangi / Hutt River, four of which lie adjacent to the area covered by this application:

- Royal Wellington Golf Club, Heretaunga;

[16] The total number of people surveyed was 638 (Jimmy Young, TRC *pers.comm.*)

- Manor Park Golf Club;
- Boulcott's Farm Heritage Golf Club, Lower Hutt;
- Shandon Golf Club, Petone; and
- There is also a driving range with a 9-hole course at County Lane, Silverstream.

(TRC Tourism, 2013) reports that the five courses have a total of 4,100 members and approximately 190,000 rounds are played annually. Membership levels are either stable or declining, reflecting the national trend (although it should be noted that only about 25% of all golf players belong to a club). Both the Royal Wellington Golf Club and Boulcott's Farm Heritage Golf Club are currently upgrading their infrastructure and facilities.

3.12.6 Parks and sport fields

The key local parks along the Te Awa Kairangi / Hutt River include: Harcourt, Trentham Memorial, Fraser, Avalon, Strand and Hikoikoi Reserve. These cater for a wide variety of sports including football, rugby, touch rugby, cricket, harriers/running, softball and hockey.

3.12.7 Recreational use of tributaries

- Te Mome Stream – flows around the western side of Shandon Golf Course; there are no recreational activities directly associated with this stream.
- Speedy's Stream – walking on the track alongside the stream is the main recreational activity.
- Stokes Valley Stream – there are no known recreational activities directly associated with this stream (TRC Tourism, 2013).
- Akatarawa River – (TRC Tourism, 2013) reports that the confluence of the Akatarawa and Te Awa Kairangi / Hutt Rivers is a popular swimming and picnic site. The river is also popular with kayakers and rafters (as noted in Section 3.12.2). Fly fishing is undertaken on the Akatarawa River, with the best sites in open areas at Karapoti and Cloustonville, although the activity is relatively minor in comparison to the Hutt and Wainuiomata Rivers. Survey data recorded 320 fishing visits in 2001/2 and 220 in 2007/08.

3.13 Tourism

- (TRC Tourism, 2013) reports that tourism in or immediately adjacent to the Te Awa Kairangi / Hutt River is fairly limited, and there do not appear to be any commercially guided fishing or paddling operations on the river.

The most significant tourism activity is likely to be associated with the Lord of the Rings Tours and their visits to the Rivendell site, located in Kaitoke Regional Park which is upstream of the application area.

3.14 Neighbouring community

3.14.1 Population

The application area lies within the territorial jurisdiction of both Upper Hutt City and Hutt City Councils. The boundary between these two cities crosses the Te Awa Kairangi / Hutt River in the vicinity of the Silverstream road and rail bridges[17]. A breakdown of population for Lower and Upper Hutt is given in Table 17.

[17] The boundary crosses the river in a zig-zag fashion to the north and south of the bridges at Silverstream, and runs longitudinally down the middle of the river for approximately 800 m.

Table 17: Population figures for Lower and Upper Hutt

City	Suburb	Population (2006)
Lower Hutt		97,701
	Petone, Gracefield	6,666
	Alicetown, Moera, Waiwhetu	7,413
	Hutt Central, Woburn, Waterloo	11,229
	Boulcott, Avalon	7,110
	Epuni, Naenae, Taita	20, 415
	Korokoro, Maungaraki, Normandale, Kelson	13,689
	Stokes Valley	9,228
	Eastbourne, Wainuiomata & other areas	21,951
Upper Hutt		38,415

Source: (Maclean, 2009)

3.14.2 Infrastructure and services

In addition to residential areas, the Hutt Valley also accommodates a range of retail, light industrial and manufacturing activities, research and educational facilities, a major hospital, and cultural facilities such as the Dowse Museum.

State Highway 2 and the Hutt Rail Line form major arterial routes through the Hutt Valley, lying adjacent to the river corridor in many places. Many residents use these routes to commute daily to and from Wellington and the Wairarapa.

There are twelve bridges across the Te Awa Kairangi / Hutt River within the application area:

- Akatarawa Road bridge (carries electricity lines and gas pipes)
- Norbert St footbridge (carries a gas pipe)
- Totara Park Road bridge (carries electricity, telecommunication lines and sewer)
- Moonshine Bridge (SH2) (carries telecommunication lines)
- Silverstream road bridge (Western Hutt Rd/Fergusson Drive) (carries electricity and telecommunications lines)
- Silverstream Rail Bridge
- Pomare Rail Bridge (carries gas, telecommunications lines and sewer)
- Kennedy-Good road bridge (Fairway Drive)
- Melling road bridge (Melling Link) (carries electricity, gas, and telecommunications lines
- Ewen road bridge (carries gas, telecommunications lines and stormwater)
- Ava Rail Bridge (carries electricity and telecommunications lines and gas)
- Estuary road bridge (carries a pipe supplying water to Wellington City)

Transpower high voltage power lines cross the river at:

- Gemstone Drive (opposite Jasper Grove intersection)
- Maoribank (at the end of Black Beech St)
- Haywards and Connolly St (just upstream of Melling Bridge)

Lower voltage power lines also cross the river at several locations, including:

- At the Akatarawa Rd bridge
- Akatarawa Rd (just south of Birch St intersection)
- Immediately downstream of Norbert St footbridge
- River Rd at Maoribank corner
- Eastern Hutt Rd, just upstream of Stokes Valley Stream outlet
- Taita Rail Bridge – immediately downstream and 350 m downstream
- Connolly St
- between Wakefield St and Whites Line West, just upstream of the Ava Rail Bridge

There are also underground crossings at:

- XS 0110 for electricity
- XS 0670 for electricity, gas and bulk water supply to Belmont
- XS 0980 for gas
- XS 1180 for electricity and telecommunications lines
- XS 1780 for electricity and gas

A sewer main which forms part of the Hutt Valley Trunk Wastewater System crosses the river approximately 300 m downstream of the Silverstream Rail Bridge. This line carries waste water to the Seaview Treatment Plant and is operated by Upper Hutt City and Hutt City Councils. As the river bed has degraded over time, the sewer crossing has formed a grade control structure. HCC has placed some rock downstream of the crossing to prevent further scouring.

3.15 Tangata whenua

The area covered by the application lies within the takiwa (or tribal area) of Taranaki Whanui ki Te Upoko o Te Ika. The takiwa has been known as the 'Port Nicholson Block' since the negotiation of the "Port Nicholson Deed" by the New Zealand Company in 1839; see Figure 8.

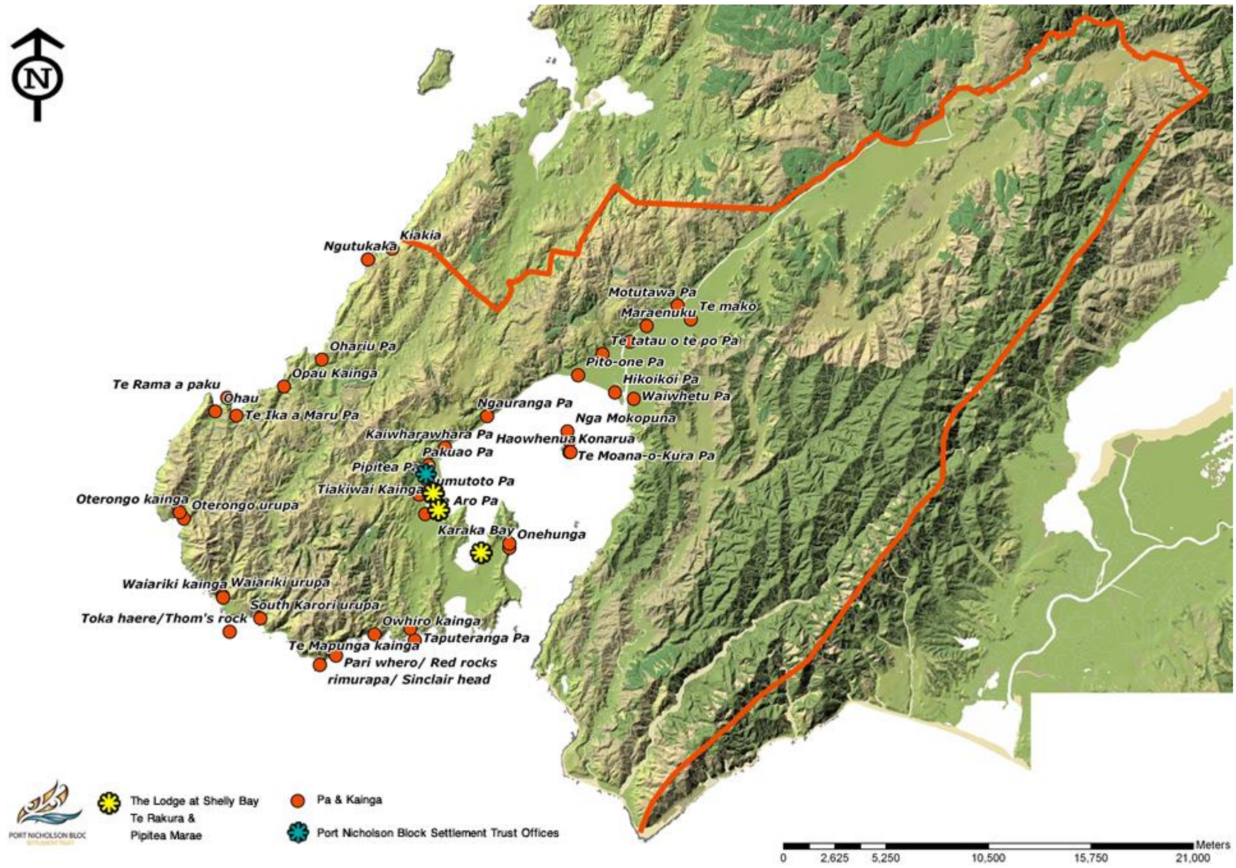

Figure 8: The Port Nicholson Block (Source: Port Nicholson Block Settlement Trust website)

Taranaki Whanui is a collective group of individuals who descend from:

- Te Atiawa;
- Ngati Tama;
- Taranaki;
- Ngati Ruanui;
- Other iwi from the Taranaki area, e.g. Ngati Mutunga; and
- Other individuals identified in the Port Nicholson Block Deed of Settlement (2008)

Taranaki Whanui's assertion of mana whenua over the Port Nicholson Block area is based on rights of take raupatu (conquest) arising from conquest by taua (war parties) in the early 19th century, and ahi ka roa (continuous occupation) as a result of subsequent heke (migrations). A deed of settlement for Taranaki iwi was signed in the 5th September 2015.

The Port Nicholson Block Settlement Trust (PNBST) is an organisation that was established in August 2008 to receive and manage the Treaty settlement package for Taranaki Whanui ki Te Upoko o Te Ika. The Port Nicholson Block (Taranaki Whanui Ki Te Upoko o Te Ika) Deed of Settlement was signed on 19 August 2008 and the Port Nicholson Block (Taranaki Whanui ki Te Upoko o Te Ika) Claims Settlement Act 2009 came into force on 2 September 2009.

The Deed of Settlement and the subsequent Act include a statutory acknowledgement by the Crown of the statements of association made by Taranaki Whanui of their particular cultural, spiritual, historical and traditional association with the areas included in Schedule 1 of the Act. The Te Awa Kairangi / Hutt River (as shown on SO 408071) is included in this Schedule.

The effect of this acknowledgement is that Taranaki Whanui ki Te Upoko o Te Ika (as represented by the PNBST) must be regarded as a stakeholder in matters concerning the Te Awa Kairangi / Hutt River and its management. The PNBST represents Taranaki Whanui as an iwi authority for the purposes of the RMA[18].

Another organisation that also represents tangata whenua (and is an iwi authority) is the Wellington Tenths Trust, which was established to administer Maori Reserve lands largely in urban Wellington, although it also administers a rural block in Kaitoke, Upper Hutt. According to its website, the beneficial owners of this Trust are descendants of hapu of Te Atiawa, Ngati Tama, Taranaki and Ngati Ruanui who were living in the rohe (tribal area) in 1839. Many of the registered members of the Tenths Trust are also beneficiaries of the PNBST (and vice versa).

Te Atiawa (Wellington) is also represented by the Te Atiawa ki te Upoko o Te Ika a Maui Potiki Trust and is also an iwi authority for the purposes of the RMA.

The Statements of Association in the Port Nicholson Block (Taranaki Whanui Ki Te Upoko o Te Ika) Deed of Settlement (Documents Schedule) include the following in relation to the Te Awa Kairangi / Hutt River:

'Prior to the 1855 uplift, Te Awaikairangi was navigable by waka up to Pakuratahi and the river was navigable by European ships almost to Whirinaki (Silverstream).

Taranaki Whanui ki Te Upoko o Te Ika travelled in the Hutt Valley largely by waka. There were few trails through the heavy forest of the valley. Many Taranaki Whanui ki Te Upoko o Te Ika kainga and pa were close to the river including Haukaretu (Maoribank), Whakataka Pa (which is across the bank from what is now Te Marua), Mawaihakona (Wallaceville), Whirinaki, Motutawa Pa (Avalon), Maraenuku Pa (Boulcott), Paetutu Pa and at the mouth of the river, Hikoikoi Pa to the west and Waiwhetu Pa (Owhiti) to the east.

Te Awaikairangi linked the settlements as well as being a food supply for the pa and kainga along the river. Mahinga kai were found along the river such as Te Momi (Petone) which was a wetland that held abundant resources of birds, tuna and other food sources. The river ranged across the valley floor and changed course several times leaving rich garden sites. Waka were carved from forest trees felled for that purpose close to the river.'

The rohe of Ngati Toa Rangatira extends over the lower western parts of the North Island, including the Hutt Valley. Ngati Toa Rangatira is represented by Te Runanga o Toa Rangatira, which is an iwi authority for the purposes of the RMA. A Deed of Settlement between the Crown and Te Runanga o Toa Rangitira (in relation to Treaty claims) was signed on 7 December 2012, and the Ngati Toa Rangatira Claims Settlement Act 2014 came into effect on 23 April 2014. This legislation gives effect to certain provisions of the Deed of Settlement that settles the historical claims of Ngati Toa Rangatira. The Deed includes a Statutory Acknowledgement and Deed of Recognition in relation to specific areas (including the Te Awa Kairangi / Hutt River and its tributaries) within Ngati Toa's area of interest. This obliges the Crown to consult with Ngati Toa Rangatira on specified matters and have regard to their views regarding their special associations with these areas.

Rangitane (North Island) is represented by six organisations, most of which are iwi authorities for the purposes of the RMA.

[18] Te Puni Kokiri website: http://www.tkm.govt.nz/iwi/taranaki-whanui-ki-whanganui-a-tara/#. Iwi authorities are also noted in Section 2.2 of the Proposed Regional Policy Statement for the Wellington Region.

3.16 Archaeological sites

The New Zealand Archaeological Association online database does not record any archaeological sites within the application area.

4 Proposed Activities

4.1 Purpose and intended outcomes

The main aims of the river operation and maintenance work programme are to:

- establish and maintain the Te Awa Kairangi / Hutt River channel on its design channel alignment as defined in the HFMP;
- maintain the flood capacity of the existing channel by removal of obstructions and gravel build-ups as necessary; and
- maintain the integrity and security of the existing flood defences (including stopbanks and bank protection works).

In addition, the work programme also aims to “maintain, or (where possible) improve, the in-river and adjacent riparian environment” on a reach-by-reach basis.

4.1.1 Maintenance of channel alignment

Without active management the river would erode its berms and develop meanders in a similar way to that which existed in pre-European times. However the need to protect the private properties, urban infrastructure, utility services, bridges and floodway assets that are located adjacent to the river today means that the river must be actively managed within its existing alignment.

Channel alignment is maintained using a combination of:

- Hard edge protection works such as rock rip-rap linings or groynes;
- Soft edge protection such as planted, or layered, and/or tethered, willows;
- Mechanical shaping of the beaches and channel – either by ‘ripping’ (i.e. dragging a tine through the gravels), or by recontouring (more extensive movement and redistribution of the gravels); and
- Channel diversion cuts.

Hard edge protection works provide a high degree of bank protection but are expensive and can only be justified at points on the river which are particularly vulnerable to erosion and/or where strategic assets are at an unacceptable level of risk.

In contrast, soft edge protection works are less expensive and provide a moderate degree of berm security during flood events. They are suitable where there is a wide berm and they contribute to the relatively ‘natural’ appearance of the river. Often soft edge protection will need to be supported by channel shaping (e.g. beach and bed recontouring) particularly if they are located on the outside of a bend or other vulnerable points.

Diversion cuts are a means of realigning the low flow channel where it has moved too far from its design alignment, or a means of deflecting the channel where it is creating a bank erosion problem. Typically diversion cuts are more likely to be used in braided rivers, and would only be used in single thread rivers if a significant channel diversion occurred as a result of a flood event.

In the Te Awa Kairangi / Hutt River soft edge protection works predominate below the Silverstream Bridges where the channel gradient is less steep, the berms are wider and the river is relatively less aggressive. Rock rip-rap is still used in key locations, for example where stopbanks are located close to the bank edge, but the presence of large lengths of soft edge protection means that the requirement for channel shaping is greatest over this part of the river.

The section of the river from Silverstream to Maoribank has extensive lengths of rip-rap linings that were constructed as part of the SH2 development in 1985 – 88. Further rock edge lining and riverbed stabilisation works are planned over this reach in the next few years. Channel shaping work is more limited over this reach but is necessary from time to time.

Between Maoribank and Gemstone Drive the river is mostly confined within natural rock gorges or existing bank edge protection (soft edge protection combined with rail-iron fences or rock lines). There has been a very limited need for further bank edge protection or channel shaping, although some bank edge protection may require renewal in the near future (e.g. failing rail iron fences).

The river channel is not actively managed upstream of Gemstone Drive.

4.1.2 Maintenance of channel capacity

The tools used to maintain channel capacity may include:

- Clearance of vegetation from gravel beaches (‘scalping’);
- Removal of unwanted willows;
- Clearance of flood debris;
- Removal of weed and sediment; and
- Gravel extraction from aggradation zones.

Gravel extraction is the most important of these tools, although removal of beach vegetation and unwanted willows are also important because of their tendency to encourage gravel aggradation and debris accumulation.

In the Te Awa Kairangi / Hutt River gravel most commonly tends to build up in the channel in the vicinity of Kennedy-Good Bridge, but large accumulations of gravel also occasionally occur upstream of this bridge in response to changes in channel configuration and flood events. Current management policy is to try to maintain river bed levels to a design profile within a target bed level envelope determined in 2001 (Optimx Ltd, 2001). (The upper level of this envelope is the maximum mean bed level that can be reached before channel capacity is adversely affected; the lower is the level below which erosion becomes a problem.) This is achieved principally by extraction of gravel from beaches (i.e. above water level) and also from areas of the channel (‘wet extraction’) where necessary.

The recent approach (since 2006) applies the wet extraction method between the Ava and Kennedy-Good Bridges and is focused on lowering the active riverbed. This involves extracting gravel to a design meander pattern and longitudinal profile, rather than the traditional approach of dry extraction. It necessitates the use of machinery within the active channel to shape the river channel to the required pattern. Once the riverbed has been lowered, a combination of dry and wet extraction is used to manage riverbed levels.

Extraction at the Te Awa Kairangi / Hutt River mouth is undertaken under a separate consent and does not form part of this application.

4.1.3 Maintenance of existing flood defences

This includes all of the works necessary to maintain the existing in-river structures, and repairs to flood defence structures outside the river bed – principally the stopbanks. It also includes the clearance of debris from stormwater culverts through the stopbanks and drains.

4.1.4 Environmental improvement

Environmental improvement within the river corridor is on-going, and includes development of the pathways and trails, footbridges and other community infrastructure, as well as restoration and planting of selected sites. This work is undertaken by GWRC in conjunction with Hutt City and Upper Hutt City Councils and community groups.

GWRC has programmed $1,276,000 of works related specifically to implementation of the Te Awa Kairangi / Hutt River Environmental Strategy between 2012 and 2022 (see Table 26).

Improvement of the in-river environment is also achieved by the on-going development of good practice by GWRC through better understanding of the effects of works and maintenance activities. In Section 3.10 it is noted that river works and maintenance activities have led to an overall measured increase in the natural character of three reaches of the Te Awa Kairangi / Hutt River channel over time.

4.2 Description of activities

4.2.1 Overview

The operations and maintenance activities identified in Section 4.1 above are summarised in:

- Table 18: Summary of operations and maintenance activities
- Table 19: Description of construction activities
- Table 20: Description of activities involving demolition or maintenance of structures
- Table 21: Description of other works

Photographs are included in Appendix G. Further details are also discussed in:

- Section 4.2.2 Diversion of water
- Section 4.2.3 Gravel extraction

The activities have been assessed overall as having non-complying activity status due to the requirements under the PNRP. It is important to note however that some elements of the activities for which consent are sought are provided for as permitted or controlled activities (either in whole or in part, depending on the scale of the activity) within the regional plans, for example:

- Maintenance and repair of structures;
- Extensions of rock rip-rap;
- Disturbance of a river bed associated with clearance of flood debris;
- Beach recontouring; and
- Trimming and removal of vegetation including any associated disturbance of the river bed or temporary diversion.

While these methods form the current ‘tool box’ for GWRC’s operations and maintenance works at present, it may be that different, more suitable methods are developed in the future. Accordingly, GWRC is seeking to ensure that the new consents that are granted do not restrict the methods to those listed here, but allow for new methods to be used provided that they are first incorporated into the COP via the agreed process. This may include an initial trial period in selected areas.

Table 18: Summary of operations and maintenance activities

Type of Activity	General Description	Typical Individual Components
Construction of "Impermeable" Erosion Protection Structures on & in the river bed	Erosion protection structures are classified as both 'impermeable' and 'permeable' because of the way current rules in the Regional Freshwater Plan (RFP) are written, but this is largely arbitrary because some so-called "impermeable" structures are not impermeable in the true sense of the word. 'Impermeable' structures are constructed of hard materials and are generally designed to give long-term protection to the river banks. Structural works involve activities that disturb the river bed and may involve removal of vegetation – which require approval under s 13 of the RMA. They may also involve disturbance of the bank edges and berms, which requires approval under s 9 RMA. Structural works may also involve temporary diversion of the river channel, and this requires approval under s 14 RMA. Any discharges of sediment from disturbed areas or discharges of water from temporarily bunded zones back to the river require approval under s 15 RMA. Details of structural works in or on the river bed, including the specific activities that are included in this application are given in Table 19.	Groynes constructed of rock and/or concrete block and/or gravel Rock linings (rip-rap and toe rock) Gabion baskets Driven rail and mesh gabion walls Reno mattresses Rock or concrete grade control structures
Construction of "Permeable" Erosion Protection Structures on & in the river bed	Permeable structures are of lower structural strength than the 'impermeable' works, and can be semi-permanent in nature or designed as temporary measures giving protection to willow plantings while they are established.	Debris fences Debris arrester Permeable groynes
Construction of other works outside the river bed (on berms and stopbanks within the river corridor)	The construction of new stopbanks or the driving of new culverts under the stopbanks are not included in this application. Works outside the river bed are mostly associated with the development of the Te Awa Kairangi / Hutt River Trail within the river corridor. New structural works outside the river bed may include new stormwater culverts under trails, small floodwalls, and drainage channels constructed across the river berms to carry stormwater to the river. Minor works associated with management or improvement of the riparian margins are also included, e.g. erection of footbridges and boundary fences. All these activities involve uses of land that require approval under s 9 RMA.	Cycleway/walkway construction and associated new stormwater drainage, culverts ,footbridges and access ways Fences Floodwalls Shaping of river banks and berms

Type of Activity	General Description	Typical Individual Components
	Works involving diversion and discharge of water may also require approval under s 14 and s 15 RMA respectively. Details of structural works outside the river bed, including the specific activities that are included in this application are given in Table 19.	
Demolition and removal of existing structures on & in the river bed	This refers to the permanent removal of erosion protection structures that have served their purpose. The partial demolition of a structure in order to effect its repair or upgrade is covered under maintenance, which is discussed below. Demolition work assumes removal of all material (other than that derived from bed material) from the river bed. Demolition works involve disturbance of the river bed, which requires approval under s 13 of the RMA. If temporary diversion of the river channel is necessary then approval under s 14 RMA is also required. Any discharges of sediment from disturbed areas or discharges of water from temporarily bunded zones back to the river require approval under s 15 RMA. Details of demolition works in or on the river bed, including the specific activities that are included in this application are given in Table 20.	Demolition by mechanical and/or hand methods Removal of material from river bed
Maintenance of existing structures on & in the river bed	This includes the maintenance, repair, replacement, extension, addition to, or alteration of, any existing bank protection structures and outlet structures associated with some of the Te Awa Kairangi / Hutt River tributaries. Such activities, that disturb the river bed and may involve removal of vegetation, require approval under s 13 of the RMA. Any temporary diversion of the river channel requires approval under s 14 RMA. Any discharges of sediment from disturbed areas or discharges of water from temporarily bunded zones back to the river require approval under s 15 RMA. The specific activities included in this application are given in Table 20. (Note that the control of vegetation associated with any structure by the application of herbicide is not included in this application).	Structural repairs and maintenance to: • Existing erosion protection structures in the river bed • Existing culverts and outlet structures that discharge directly to the Te Awa Kairangi / Hutt River (including clearance of debris)
Structural maintenance work outside the river bed	This may include intermittent repairs of damage to structural works such as stopbanks that has been caused by flood events, stormwater runoff or vandalism. It also may include repairs, enhancements or extensions to walking tracks and cycle ways, and upgrade or repair of any stormwater culverts and drainage channels on the berm.	Structural repairs and maintenance to: • Stopbanks & training banks • Flood walls • Stormwater culverts (including clearance of debris)

Type of Activity	General Description	Typical Individual Components
	These activities are uses of land requiring approval under s 9 RMA. The specific activities covered by this application, are given in Table 20.	• Stormwater drainage channels • Footbridges located on the river berms • Fences located on the river berms • Banks and berms
Development of vegetative bank protection	Willows are used extensively on the banks alongside the Te Awa Kairangi / Hutt River to stabilise and bind the banks and also afford additional protection to structural works. The introduction of any plant material onto a river bed, together with the disturbance of the bed associated with planting works requires approval under s 13 RMA. Works may also involve temporary diversion of the river channel, and this requires approval under s 14 RMA. Any discharges of sediment from disturbed areas or discharges of water from temporarily bunded zones back to the river require approval under s 15 RMA. The specific activities included in this application are given in Table 21.	Tree Planting Willow layering, cabling & tethering
Maintenance of vegetative works	This may include trimming, removal, repair and re-cabling of layered or tethered willows, or trimming and additional planting to establish willow stands. As noted above, the introduction of any plant material onto a river bed, together with the disturbance of the bed associated with planting works requires approval under s 13 RMA. Any temporary diversion of the river channel requires approval under s 14 RMA. Any discharges of sediment from disturbed areas or discharges of water from temporarily bunded zones back to the river require approval under s 15 RMA. The specific activities included in this application are given in Table 21. (Note that the control of vegetation by the application of herbicide is not included in this application).	Trimming and mulching of trees Removal of old trees Removal of damaged structures Additional planting New layering of trees Re-cabling of tethered willows
Channel shaping or realignment	This includes movement of the bed material by mechanical means – both beach recontouring and bed recontouring (which used to be referred to as “cross-blading”). Machinery used in these operations can include bulldozers, excavators, tractors and dump trucks. It also includes shaping or contouring banks to improve channel profile (as opposed to shaping work associated with construction of specific	Mechanical: • Beach ripping • Beach recontouring • Channel diversion cut • Ripping of the bed in the wet channel • Bed recontouring • Shaping/recontouring of bank edges

Type of Activity	General Description	Typical Individual Components
	structures) and reshaping/re-filling of bank edges that have been eroded or damaged. These works involve disturbance of the river bed and possibly removal of vegetation and disturbance of plant and animal habitat, all of which require approval under s 13 RMA. In addition, any temporary diversion of the river channel requires approval under s 14 RMA, and any discharges of sediment from disturbed areas or discharges of water from temporarily bunded zones back to the river require approval under s 15 RMA. The specific activities included in this application are given in Table 21.	
Channel maintenance	This covers activities that remove obstructions (such as vegetation or flood debris) from the channel and bank edges, as well as periodic removal of gravel from the bed. Dredging of the Lower Opahu Stream outlet, now an isolated arm of the Te Awa Kairangi / Hutt River, approximately 530 m long, and clearance of the Stokes Valley Stream stilling basin are specifically included. These works involve disturbance of the river bed and possibly removal of vegetation and disturbance of plant and animal habitat, all of which require approval under s 13 RMA. In addition, any discharges of sediment from disturbed areas require approval under s 15 RMA. The specific activities included in this application are given in Table 21.	Removal of vegetation & sediment Beach scalping Clearance of flood debris Gravel extraction Dredging of Lower Opahu Stream isolated arm
Non-structural maintenance works outside the river bed	This includes regular maintenance works on berms or stopbanks such as mowing, and other activities such as riparian planting (with willows or native vegetation). The control of vegetation by the application of herbicide is not included in this application. These activities are uses of land requiring approval under s 9 RMA. The specific activities covered by this application, and the regional rules that apply to them, are given in Table 21. Mowing of the berms of the Stokes Valley Stream in the area downstream of the Stokes Valley Rd bridge is undertaken from the river bed. In addition to the s 9 RMA approvals noted above, the operation of machinery in the river bed may involve some disturbance of the river bed and aquatic habitat, which requires approval under s 13 RMA. In addition, any discharges of sediment from disturbed areas require approval under s 15 RMA. The specific activities included in this application are given in Table 21.	Mowing stopbanks & berms (not involving machinery in river bed) Mowing stopbanks & berms – Stokes Valley Stream (machinery in river bed) Drain maintenance Water blasting Trimming and mulching of vegetation Planting & landscaping

Type of Activity	General Description	Typical Individual Components
Urgent works	Any of the above activities that are undertaken in response to a flood or emergency situation and may need to be undertaken under regular methodologies or operating conditions.	

Table 19: Description of construction activities

Activity	Description	Historical and Likely Quantum	Typical Activity Components
Impermeable Groyne Construction	Groynes are structures that extend from the bank into the river bed and deflect the direction of the flow of water- see Appendix G. They are designed to slow flow velocities and gravel bed movement in the immediate vicinity of the river bank and hence prevent bank erosion. Impermeable groynes are constructed from impermeable material, such as rock or concrete blocks and/or gravel. On the Te Awa Kairangi / Hutt River groynes are most likely to be used to reinforce bank edges and hence reduce or eliminate the need for bed recontouring, or as an alternative to rock lining. To be effective groynes must be well-keyed into a stable bank edge. Groynes vary in size, from a minimum of approximately 300 tonnes of rock, but more typically between 600 – 900 tonnes. The largest groynes on the river are those constructed at Pomare Rail Bridge in 1990. These have a gravel core and a rock capping of approx. 3,000 tonnes. Size is dependent on situation, but a typical groyne has dimensions 10 -15 m long by 6 -8 m wide at the nose, tapering to 4 m wide at tail. Normally the structure would not project more than 10m perpendicular to the bank edge into the channel. An impermeable groyne may be constructed entirely from rock boulders, or have a gravel or concrete block core. Concrete blocks are typically 1.6 x 0.8 x 1 m and weigh approximately 3 tonnes each. They have no exposed reinforcing steel and have a cast-in lifting eye to allow them to be cabled together. Groynes are typically constructed using a hydraulic excavator to excavate a trench typically 1.0 -3.0 m	Rock groynes have been used within the whole 28 km length of the Te Awa Kairangi / Hutt River lying within the current application area. Some, such as the four large groynes at Pomare Rail Bridge are permanent features, others may be constructed as a temporary bank stabilisation measure. For example, smaller (200 – 300 tonne) groynes constructed at Ewen/Marsden Bend in 1989 have subsequently been replaced with rock linings. Mass concrete block groynes were once used quite extensively on the Te Awa Kairangi / Hutt River, typically consisting of strings of blocks layered over the bank edge into the channel perpendicular to the bank; e.g. Belmont motorway works in 1960's and Stokes Valley training bank works in 1980's (both now largely replaced with rip-rap linings). Today concrete blocks tend to be used in conjunction with rock in groyne construction, rather than on their own – principally for aesthetic reasons. However, stockpiles of concrete blocks are held adjacent to the river at a number of sites for urgent works during or after a major flood event. In this case they could be used *en masse* by tipping over a bank edge to prevent failure during a flood or as a temporary protection measure immediately after an event in areas where there was an immediate risk to community assets. GWRC records show that 45 groynes have been constructed on the Te Awa Kairangi / Hutt River	Remove vegetation if required Formation of access onto river bed (if required). Use excavator to batter bank to specified slope, prepare/contour bed or construct trench. Bulldozer may also be used to form a building platform. Excavate to foundation level Place hard material & filter cloth if required Rock stockpiling on bed River crossings Diversion of water Discharge of sediment

Activity	Description	Historical and Likely Quantum	Typical Activity Components
	deep. Rocks (and/or concrete blocks) are placed in the trench and keyed into the adjacent bank to form the base of the groyne. Additional rock is then placed as a capping to shape the groyne. Generally an area of less than 100 m² of river bed would be disturbed in the construction of a groyne.	since 1999. This equates to an average of three per year, although the actual amount constructed in any one year might vary from none through to several. The maximum constructed in any one year was 11 (in 1999/2000); since then the most constructed in any one year has been 6 (in 2011/12). See Appendix H for further details.	
Rock Rip-rap Lining Construction	Rock rip-rap consists of rock boulders placed against a section of river bank to form a longitudinal wall - see Appendix G. Constructed using hydraulic excavators shaping a section of river bank to a specified slope and excavating a trench in the river bed to a design scour depth. (This may necessitate temporary diversion of the river away from the works area by forming a low bund in front of the work area and dewatering the working area with a pump). Filter cloth or a filter material (usually gravel sourced in-situ) can be placed on the prepared slope prior to placement of the rock in the trench and up the slope batter. A full rock wall typically extends up to a height equivalent to a 2 year return period flood. Toe rock linings are constructed in a similar way but generally are not as deeply founded in the river bed and do not extend higher than approximately 1 m above low flow water levels.	GW records show that to date approximately 7.9 km of the true left bank and 5.9 km along the right bank is rock-lined; this represents just under 25% of the total length of river bank actively managed by GWRC. See Appendix H for further details. GW records also show that since 1999 a total of 1.7 km of new rock lining (rip-rap or toe rock) has been constructed; this has ranged in length from 10 m to 255 m. This equates to an average of 122 m per year (or 0.2% of the total length of managed river bank per year) although no new rock lining work has been undertaken in the last two years. See Appendix H for further details.	Extension of rock rip-rap (and associated disturbance, deposition on bed, diversion of water) – applies to small works.
			Remove vegetation if required
			Formation of access onto river bed (if required). Use machine to batter bank to specified slope, prepare/contour bed or construct trench. Bulldozer may also be used to form a building platform.
			Excavate to foundation level
			Place rock & filter cloth/gravel if required
			Rock stockpiling

Activity	Description	Historical and Likely Quantum	Typical Activity Components
			River crossings
			Diversion of water
			Discharge of water and/or sediment
Gabion basket/ Reno mattress Construction	Gabions are wire mesh baskets (typically 2m x 1m x 1m) filled with rock (either quarry rock or locally sourced riverbed material). They are generally used to provide isolated protection for banks and services such as stormwater outlets, service crossings, bridge abutments or access tracks. Reno mattresses are wire mesh baskets that have wider and thinner dimensions than the more blocky gabions. They are filled with stones or pebbles generally derived from the in-situ bed material but quarry rock may also be used; they can be used for both bank protection and channel linings. Construction involves excavation of a trench at the toe of the bank to a depth of one basket. Baskets are lowered into the trench, and filled with rock, then empty baskets are placed on top laced together and filled to form the required protection structure. Sometimes the baskets are anchored to driven railway irons concealed in the bank. Construction is undertaken in the dry and may thus require temporary diversion of the river away from the works area by forming a low bund in front of the work area; generally dewatering of the working area (with a pump) is not required.	Gabions and Reno mattresses are constructed infrequently in the Te Awa Kairangi / Hutt River, and this is likely to continue. They are most likely to be used where access for heavy machinery is constrained, which makes placement of rock lining difficult. Gabions have been used, for example in the Taita Gorge to protect the river trail and bridge abutments. Reno mattresses have been used at Belmont to afford additional protection on the banks above rock groynes. **On average, GWRC might expect to construct short lengths of gabions or Reno mattresses (<10 m) once in every 5 years.**	Remove vegetation if required
			Formation of access onto river bed (if required). Use machine to contour bank to specified slope, prepare/contour bed or construct trench. Bulldozer may also be used to form a building platform.
			Place baskets and fill with rock and lace together
			Diversion of water
			Discharge of water and/or sediment

Activity	Description	Historical and Likely Quantum	Typical Activity Components
Driven Rail & Mesh Gabion Walls Construction	This is a continuous rail-iron founded gabion structure used to protect and stabilise bank edges. Willows are normally planted behind the back irons and over time the willow roots extend through the structure and assist in binding it together, while the willows grow over the works and hide the irons and basket work. Construction involves driving of railway iron piles at 1 m spacings along the inner (river-side) edge of the structure, and typically an iron is also driven 1 – 1.5 m behind these irons at 3 m spacings (to provide a back anchor). Piles normally only extend 1 -1.5 m above low flow level. Longitudinal cables are strung along the piles to create a 'fence'. Gabion or chain link mesh is then laid behind the irons and wired to the longitudinal cables. A flap is left at the base to form the bottom of the basket work. Gravels are then placed in the baskets and mesh is usually placed to cap the structure. The main limitation of the work is the difficulty in founding to an adequate depth to avoid scour.	Since 1984 this type of work was used over 1 km sections on the left and right banks immediately upstream of the Maoribank corner. It has proved to require relatively high maintenance, and for this reason much of the original gabion work has now been replaced with rock lining behind the cables. If this type of work were to be required, it is unlikely that more than 100 m would be constructed in an annual programme.	Remove vegetation if required
			Formation of access onto river bed (if required). Prepare/contour bed Form building platform if required
			Drive piles/posts
			Place mesh & fill with gravel
			Plant willows
			Diversion of water
			Discharge of water and/or sediment
Grade control structure Construction	Grade control structures (either rock or concrete block) are constructed across the width of a watercourse to control gravel deposition with the goal of maintain the river bed level or to protect bridge piles.	Grade control structures are used on some of the smaller tributary stream outlets (e.g. Stokes Valley Stream) and could possibly be used on the main river stem (e.g. at Maoribank).	As for Impermeable Groynes
Debris Fence Construction	Debris fences are iron and cable fences that extend from the bank into the river channel. They are used to create or re-establish a willow buffer zone along the edge of the river channel, and so maintain channel alignment.	Debris fences have been used in two principal reaches: • 800 m section near Kennedy-Good Bridge, • River Road reach from Silverstream Bridges to Maoribank corner.	Remove vegetation if required
			Prepare/contour bed Form building platform if required

Activity	Description	Historical and Likely Quantum	Typical Activity Components
	They are interplanted with willows and afford protection to these by trapping flood debris and slowing flows (and gravel movement). Willows planted in a river bed without debris fences are very vulnerable to flood damage and are much less likely to establish than those planted with fences. Fences are constructed by driving railway iron posts (or similar) 3 -5 metres apart into the river bed in a series of discrete lines generally at a 45^{o} angle from the channel alignment. The posts stand approximately 1.2 m above the bed. Three to four steel cables are strung through the posts to form the fence - see Appendix G. It is usually necessary to contour the site with a bulldozer to create a smooth construction platform and also to divert the flowing channel away from the works site. The irons are driven with a hydraulic hammer mounted on a large excavator.	The Kennedy-Good Bridge fences are largely intact with willows well established, but since completion of the river works associated with the River Road section of SH2 in the 1980's over half of the permeable groynes and fence work failed and has been removed. GW records show that over the life of consent [WGN 980255] 13 debris fences were constructed between 1998 and 2005 (see Appendix H for details). No new debris fences have been built for several years, but they remain a useful tool in the right situation and their suitability for future erosion control is considered on a case-by-case basis. Debris fences (and permeable groynes) would only be considered for use downstream of the Silverstream Rail Bridge (as the technique has proved to be largely unsuccessful further upstream).	Drive piles/posts into riverbed String cables Diversion of water Discharge of water and/or sediment
Debris Arrester Construction	A debris arrester is generally constructed from railway irons, steel beams or pipe that is driven into the bed and tied together with horizontal irons. More robust than a debris fence, it is designed to catch flood debris and prevent it from travelling downstream where it may cause damage to bridges or other structures.	Currently there are currently debris arresters located at: • Speedy's Stream • Maoribank The large (16 m approximately) arrester at Maoribank is located on the true left bank of the river adjacent to SH 2. This functions effectively in large flood events, by picking up logs and other debris being carried in the floodwaters, and training the river away from the bank No new debris arresters have been built for several years, but they remain a useful tool in the right	Remove vegetation if required Prepare/contour bed Drive steel/timber piles into riverbed Attach horizontal iron rails Diversion of water Discharge of water and/or sediment

Activity	Description	Historical and Likely Quantum	Typical Activity Components
		situation and their suitability for future erosion control will be considered on a case-by-case basis.	
Permeable Groyne Construction	Permeable groynes act in a similar way to debris fences but are more robust and give greater control of flow direction. They are used to establish or maintain willow buffer zones. A variety of construction methods have been used in the past: Downstream of Ewen Bridge groynes tended to have been round hardwood timber piles with two horizontal hardwood pole cross members (constructed in 1990 as part of the Ewen temporary works). Upstream of Pomare Bridge, piles were generally railway irons at 2 -3 m centres with large timber horizontal members. Many of these groynes have now failed and have been removed.	Timber groynes are located in the lower reaches of the river, generally below the Ava Bridge and at the river mouth. No new timber groynes have been built over the past 15 years, but they remain a useful tool in the right situation and their suitability for future erosion control will be considered on a case-by-case basis.	As for Debris Fence
Construction works outside of the river bed	These works are mostly associated with development of the Te Awa Kairangi / Hutt River Trail and implementation of the Te Awa Kairangi / Hutt River Environmental Strategy. Minor works associated with management or improvement of the riparian margins are also included, e.g. erection of footbridges and boundary fences. All these activities involve uses of land that require approval under s 9 RMA. Associated with this work there may be a requirement for new stormwater culverts under trails, and drainage channels constructed across the river berms to carry stormwater to the river. These works also involve diversion and discharge of water requiring approval under s 14 and s 15 RMA respectively.		Formation of new drainage channels Construction of cycle ways or walkways, and access ways. Construction of flood walls Erection of boundary fences Removal of vegetation Diversion of stormwater drains Discharge of stormwater

Table 20: Description of activities involving demolition or maintenance of structures

Activity	General Description	Historical and Likely Quantum	Typical Activity Components
Demolition & Removal of Structures	Structures on the Te Awa Kairangi / Hutt River are most likely to be removed following partial or total failure, and a decision being taken not to reconstruct. Removal is necessary to prevent creation or aggravation of erosion of the adjacent river banks, to remove danger to river users, and for visual reasons.	Removal or demolition of structures is not a major activity on the Te Awa Kairangi / Hutt River. It is undertaken on an as-required basis. Typically, it might involve one excavator for a few days per year. GWRC records show that since 1998 debris fences were removed on six occasions, and one timber groyne was removed from the river bed. See Appendix H.	Machinery on bed; bed disturbance; demolition & removal of structure from river bed; deposition of material on river bed; disturbance of plant & animal habitat.
Maintenance of 'impermeable' structures (in the river bed)	This work includes repair and maintenance of all existing 'impermeable' erosion protection structures in the river bed noted above. It also includes repair and maintenance of existing head walls, wingwalls, culverts, and steel grilles, flap gates etc. associated with outlet structures (e.g. at Opahu Stream, Te Mome Stream and Trentham Memorial Park as well as maintenance of any other outlets or culverts associated with minor watercourses flowing through the stopbanks to the Te Awa Kairangi / Hutt River that GWRC manages. The maintenance of 'demolition lines' (i.e. historic protection structures formed from demolition rubble) lying downstream of Estuary Bridge is also included. Maintenance of these structures is limited to pulling material that is dislodged back into the bank edge, with an excavator.	GW records show that since 1999 approximately 6,000 tonnes of rock has been used in maintaining groynes (either in repairing flood damage, or in topping up the rock in the structure); this equates to an average of 430 tonnes of rock utilised in groyne maintenance per year. Over the same time, a total of 8,000 tonnes of rock has been used to maintain 980 m of rock lining; this equates to an average of 571 tonnes per year and 70 m per year of rock lining maintenance. See Appendix H for further details.	Remove vegetation if required Add rock/concrete Rebuild River crossings Diversion of water Discharge of water and/or sediment Water blasting

Activity	General Description	Historical and Likely Quantum	Typical Activity Components
Maintenance of debris fence/ debris arrester/permeable groynes	This includes repairs to any damage, and clearance of flood debris build-up as required.	GWRC records for the period 1998 to 2013 show that this is not a major activity – see Appendix H.	Remove debris
			Disturbance of bed associated with removal of debris
			Rebuild
Maintenance of structural works outside the bed	This covers repair and maintenance of all structures within the river corridor that lie outside the river bed, including stopbanks, cycle ways, fences, floodwalls etc. It may include intermittent repairs to structural works (stopbanks, floodwalls, culverts, drainage channels, cycle ways) caused by floods, stormwater runoff or vandalism and enhancements or extensions to such structures. Also included is the clearance of silt and debris from culverts through the stopbanks[19] and from stormwater drains – including those located behind the stopbanks in the Moonshine to Maoribank area (see Appendix G –drain clearing).		Repair of stopbanks and berms, floodwalls etc. – recontouring, re-establishment of vegetation.
			Repair of stormwater drainage channels and culverts,
			Repair/upgrade of cycle ways or walkways
			Repair of boundary fences
			Removal of vegetation (i.e. outside of the river bed)
			Diversion of stormwater drains
			Discharge of stormwater

[19] Many of these culverts are associated with the drainage system that sits behind the stopbanks, and originate from underground pipes. However, those that are known to be associated with streams include the outlets for Te Mome Stream, Opahu Stream (above the Ava rail bridge) and Moehau Stream (Trentham Memorial Park).

Table 21: Description of other works

Activity	General Description	Historical and Likely Quantum	Typical Activity Components
Establishment bank protection plantings	This involves planting vegetation along the edges of river banks generally within the design buffer zone, in order to bind and support the bank edge and so maintain a stable river alignment. Branch growth also reduces water velocities at the bank edge which assists in erosion protection. Trees may be used to further reinforce structural works. Willow trees are the species considered most suitable for front-line flood protection (i.e. in the design alignment buffer zone). Native species are more suited for planting outside of the buffer zone. Planting is generally carried out between June and September. Four planting methods are used: By hand, using a crow bar. Willow stakes are cuttings 1 – 1.5 m long and approximately 2.5 cm in diameter. Stakes or poles (i.e. large cuttings more than 3 m long) are usually cut from existing stands. 'Rip planting' using an excavator or planting tine. The tine is dragged through the soil at up to 1 m depth and the stakes/poles or rooted stock planted behind the moving tine. The movable arm of the excavator allows planting to be undertaken on quite steep banks and amongst established trees. This is most commonly used where large areas of planting are required. 'Trench planting' using a digger. Willow poles are planted in a trench dug and backfilled by the excavator. This method is used where willows are planted in very dry areas or immediately adjacent to fast flowing water. Planting using a mechanical auger to prepare holes for stakes or poles. See Appendix G for photographs of these activities.	Willows are an important and necessary tool for stabilisation and protection of banks will need to continue to be used on the Te Awa Kairangi / Hutt River until such time as a more suitable alternative method is developed. Currently approximately 17 km on the left bank and 15 km of the right bank within the application is willow-lined; this equates to approximately 57% of the banks. Much of the anticipated future willow planting work will be in maintaining (renewing and replanting) these established willow plantings. Only minor additional willow planting is anticipated, although continued planting of native trees in the river corridor in accordance with the Te Awa Kairangi / Hutt River Environmental Strategy will continue.	Cut stakes or poles from existing willows as required. Remove vegetation if required Prepare/contour bed Hand planted poles Rip planted using an excavator Trench planted Re-tethering, cabling, layering Re-planting of willows

Activity	General Description	Historical and Likely Quantum	Typical Activity Components
	Tethering (or cabling) involves cutting large willow or poplar trees and laying them in a shallow trench excavated along the bank to be protected. The trees are bundled with wire rope and securely fixed to driven railway irons and/or buried concrete block weights. The base of the trees are covered with gravel to encourage root growth, and willow poles are planted behind the tethered layer. The structure has sometimes been referred to as fascine. Layering is similar, except that in-situ willows are partially cut through and felled obliquely, generally towards the river in a downstream direction. The intent is to allow the willows to sucker from branches on the ground once they are covered in silt and gravel. The tree is wired to its stump to prevent it breaking off in a flood. Layering is normally completed in the August – September period following completion of planting work.	GWRC records show that 22 tree groynes were established since 2010 (see Appendix H for details).	Tethered, cabled, layered
Maintenance of vegetative plantings & structures	Maintenance of willow plantings on the river edge would generally involve removal of unstable trees, replanting with new poles, or layering and tethering of mature trees. Mulching is used to rejuvenate old trees; preventing them from getting too large or unstable while maintaining bank stability. Maintenance of existing layered and tethered trees usually involves strengthening by cabling-in additional tree material, and inter-planting with additional poles. If existing vegetative structures (cabled willows & tree groynes) start to show signs of failure a decision may be made to remove them to reduce the potential for them to create a hazard during future floods. This would involve excavation using a hydraulic excavator, and removal from the river bed. Periodic trimming of willows is also required to clear survey sight lines and to maintain access to the river. Clearance may be done by excavator and/or by hand.	GWRC records show that since 1999 a total of 11,600 willow poles and 40,000 willow plants (approximately) have been planted along the banks of the Te Awa Kairangi / Hutt River. This equates to an average of nearly 900 poles and 3,000 plants per year (see Appendix H for details).	Remove, thin, mulch trees using excavator. Re-tethering, cabling, layering Re-planting of willows

Activity	General Description	Historical and Likely Quantum	Typical Activity Components
Channel shaping or realignment	Beach recontouring is undertaken in the dry bed, away from the flowing channel. Carried out as a discrete activity, its purpose is to streamline the beaches to avoid any future obstructions to flow. It can also be undertaken as part of site preparation associated with establishment of structures, or in conjunction with bed recontouring. Beach ripping involves dragging a tine behind a bulldozer to loosen the upper surface layer (armour) of the beach; this encourages gravel movement and thus helps to prevent channel distortions and bank erosion.	Beach recontouring and ripping is typically undertaken at the same time as removal of vegetation off beaches (scalping) – see below.	Beach recontouring Beach ripping
	Channel diversion cuts are typically undertaken through beach areas, away from flowing water, to create a new low flow channel within the design alignment. Undertaken either as a discrete activity or in conjunction with other works, a diversion cut assists in the establishment and maintenance of a more uniform and better aligned channel form.	Diversion cuts would only be undertaken very occasionally in the Te Awa Kairangi / Hutt River. However it is a useful tool in the right situation, as it potentially offers a lower impact alternative to bed recontouring.	Excavation of new channel across beach
	Ripping in the wet channel involves dragging a tine mounted on a bulldozer through riffle sections of the low flow channel, in order to encourage mobility of the gravels and thus encourage a more uniform channel form.	This activity is a new method that in the right circumstances may offer an alternative to, or reduce the need for, more extensive and invasive bed recontouring.	Ripping with a tine in the flowing channel
	Bed recontouring (formerly referred to as 'cross-blading') is mechanical shaping of the active channel to realign the low flow channel so as to reduce erosion (typically at the outside of a bend) or to prepare the bed for construction or planting works. Straightening of the channels increases the hydraulic efficiency of a reach and thereby reduces flood levels. Bed recontouring is done by cutting a new channel through the dry beach on the inside of a bend, leaving a bund at both ends to minimise silt discharges. Excavated material is placed at the outside edge of the new channel. When the new channel is completed, the end bunds are removed, and the excavated material pushed across the old channel alignment to the required finished profile.	The channel alignment created by bed recontouring will often remain effective for up to 2 years; however a large flood can reduce the effectiveness at any stage. Hence the quantity of bed recontouring undertaken in any year is very dependent on the occurrence of flood events and the effectiveness of other control measures such as gravel extraction. Over the past six years most bed recontouring has been undertaken in	Bed recontouring

Activity	General Description	Historical and Likely Quantum	Typical Activity Components
		conjunction with gravel extraction, although some has been undertaken in the upper reaches of the application area (Whakatikei to Maoribank) for bank protection purposes. The largest requirement for bed recontouring will be after flood events. The ability to undertake up to 800m of such 'reactive maintenance' work, or for preparation of sections of bed for structural works is required. GWRC records show that a total of 7050 m of bed recontouring (cross-blading) has been undertaken in the Te Awa Kairangi / Hutt River since 1998. This equates to an average amount of 542 lineal metres per year, although the actual amount has varied between 210 m and 800 m (i.e. the maximum allowed under consent WGN 980255). See Appendix H for further details.	
	Shaping or reconstruction of berm edges will normally occur following flood damage. The river is diverted away from the affected bank, and the bank edge is then rebuilt by placing fill in layers. Fill is generally sourced from a suitable adjacent beach where available; otherwise weathered overburden sourced from a quarry would be used. The intention is to reconstruct the berm to a similar height and alignment prior to erosion. Following reconstruction, the new bank edge will be stabilised by construction of one or more appropriate bank protection works.		Batter/shape banks Repair scalloped areas
Channel Maintenance	Removal of vegetation involves removal of excessive or unwanted willows or other tree species from the channel, so as to minimise potential for	Removal of willows is not a major activity on the Te Awa Kairangi / Hutt River, and is usually done when machines are present for	Removal of vegetation

Activity	General Description	Historical and Likely Quantum	Typical Activity Components
	blockages during floods, or to prevent dislodged willows re-growing in the channel. Trimming of willows is also required to clear survey sight lines and to maintain recreational access to the river. Clearance may be done by excavator and/or by hand.	other works. Typically may involve a machine for a few days once or twice a year.	
	Beach scalping involves mechanical clearance of woody and herbaceous weeds and grasses from gravel beaches. This is necessary to prevent reduction in flood flow velocities and gravel aggradation. Mechanical clearance is typically performed using a bulldozer, large excavator or front end loader to strip the vegetation and loosen the armouring layer. The vegetation is crushed and left to break down or become light flood debris. The activity involves excavation or disturbance of bed material but does not typically result in a discharge of sediment to the flowing channel.	Removal of vegetation from beaches is done throughout the application area every year, on an as-required basis, and usually in conjunction with beach ripping. Typically this would involve the use of a machine for 3 to 5 days. Other minor areas of vegetation build-up would be removed using an excavator while other work was taking place, e.g. willow planting.	Beach scalping (clearance of vegetation)
	Flood debris is defined in the RFP as 'material deposited on the river bed as a result of wreckage or destruction resulting from flooding', and it can include trees, slip debris, collapsed banks, the remains of structures, and other foreign material including abandoned vehicles, but does not include the normal fluvial build-up of gravel. Removal of flood debris is necessary because blockages reduce channel cross-sectional area which result in higher flood levels. In addition, if allowed to occur, build-up of obstacles may deflect flood flows into banks, causing lateral erosion. Removal of flood debris covers only the minimal amount of work needed to clear the bed or structures within the bed of flood debris; any beach or bed contouring completed at a location where debris removal occurs is accounted for as beach or bed recontouring.	Uprooted trees, large logs and car bodies etc. are removed using an excavator. Smaller debris items and general rubbish are often removed by hand or with the assistance of a 4WD utility vehicle or tractor. This activity is normally undertaken after each significant flood event.	Clearance of flood debris
			Gravel extraction

Activity	General Description	Historical and Likely Quantum	Typical Activity Components
	Gravel bed material is currently extracted from the Te Awa Kairangi / Hutt River to maintain bed levels to a design profile within an envelope of maximum and minimum levels. The aim is to maintain a balance between flood capacity (reduced by higher bed levels) and the threat of undermining bank protection works (increased by lower bed levels). Material is excavated from the beaches (i.e. above the active channel) where possible, and from the active channel using the methods discussed in Section 4.2.3.4.	The amount of gravel to be extracted will be determined in response to the movements in bed material throughout the river system; in particular gravel extraction policy will be determined principally by bed survey data which is collected on a regular basis, as discussed more fully in Section 4.2.3.	Temporary stockpiling of excavated material on river bed
	The Lower Opahu Stream channel forms an isolated arm of the Te Awa Kairangi / Hutt River, into which silt and tidal debris gets washed. This debris needs to be periodically removed, principally for aesthetic reasons. This work is undertaken by a long reach excavator from the river banks. The excavated silts and organic debris are loaded onto trucks for disposal off site.	The channel adjacent to the training bank would require maintenance dredging over the full 750 m length approximately every 5 years.	Dredging of Lower Opahu Stream channel (Te Awa Kairangi / Hutt River bed – isolated arm)
Maintenance of non-structural works outside the bed	This may include any works required to maintain the stability of the river berms, and general maintenance such as mowing of the river berms (see Appendix G). Non-structural maintenance works such as cleaning /water-blasting of any concrete flood protection structures are also included.	Generally GWRC would undertake nine mowing rounds per year.	Repair of berms Mowing of berms Water blasting
Urgent Works	This covers repair of any non-structural bank protection works and any bed recontouring after a major flood event where immediate action is required to protect existing permanent dwellings, network utility structures or flood mitigation structures from imminent threat of erosion. Such work may necessitate working outside normal operating conditions, such as outside usual hours of operation, working in the channel during fish spawning periods etc.	Varies in response to need; driven by flood occurrences, level of damage and the level of risk posed to adjacent assets.	

4.2.2 Diversion of water

Several of the activities noted in Table 19, Table 20 and Table 21 require diversion of part of the Te Awa Kairangi / Hutt River flow. This includes permanent diversion of normal low flows as a result of:

- Bed recontouring;
- Gravel extraction; and
- Construction of new structural works or bank reconstruction.

It also may include temporary or permanent diversion of normal low flows to allow construction of new works, demolition of obsolete or damaged works and repairs to banks.

4.2.3 Gravel extraction

4.2.3.1 Background

Historically, the Te Awa Kairangi / Hutt River Board actively promoted and assisted the development of a gravel extraction industry on the Te Awa Kairangi / Hutt River, with the dual purpose of undertaking improvement works and generating income. This led to large amounts of gravel being removed from the river, with significant lowering of the river bed levels. Annual extraction rates peaked at 300,000 m^3 in the mid 1960's. This steadily declined over the next 20 years and by 1990/91 had reduced to a rate of 3,500 m^3/yr.

By the late 1980's it was recognised that over-extraction was leading to increased lateral erosion and damage to banks and riparian ecology. In response, GWRC adopted a 'no extraction policy' in 1991, and this remained in place until 2001. In 2001 gravel extraction re-commenced at a rate of 10,000 m^3/yr.

As a result of the 2003/04 river bed survey, the gravel extraction rate was increased to 30,000 m^3/yr. In response to a 2005/06 (after the January 2005 flood) partial re-survey of the deposition reach, which confirmed a continuing general trend of increasing volumes of gravel deposition in the reach from Ewen Bridge to Belmont, the annual extraction rate was increased to 80,000 m^3.

In 2006, GWRC was granted consent [WGN 060334] to extract 320,000 m^3 of gravel from the Te Awa Kairangi / Hutt River between the Ava Rail Bridge and Owen St over a five year period. The purpose was to enable lowering of the mean river bed over the entire extraction reach by approximately 400mm.

The 320,000 m^3 was to be achieved by extracting gravel above the water level ('dry extraction') where possible (under consent [WGN 980255]) with the balance achieved by extraction below the water level (under consent [WGN 060334]). In practice, the amount extracted below the water level could vary between 30,000 and 60,000 m^3 in any one year.

In 2011, GWRC applied for a short term extension to [WGN 060334] to allow continuance of wet extraction until new consents (which are the subject of the current application) were granted.

4.2.3.2 Current GWRC gravel management policy

The gravel management envelope is described fully in the "Te Awa Kairangi / Hutt River Floodplain Management Plan: Optimum Bed Levels Guidelines and 1998 River bed assessment" (Optimx Ltd, 2001). The key factors that were considered in the development of the OBLs are outlined below:

- Thalweg levels;

- Stopbank capacity (determined by the HFMP);
- Rock [riprap/groyne] toe levels;
- Existing berm levels (maintenance and frequency of inundation);
- Visual consideration;
- Ecological effects;
- Lateral bank edge erosion;
- Service crossings; and
- Geomorphology.

The OBLs are the management tool GWRC uses to manage the risk to the flood protection scheme taking into account a balance of the above factors (flood capacity, channel asymmetry and erosion potential). In practice this means managing patterns of deposition and degradation in the riverbed, which may result in a different management response depending on the risk and management objectives for each reach of the river.

The management of the riverbed is dynamic and requires regular review as environmental conditions and management priorities change. Given this, it is expected that the design profile and OBLs may be adjusted to take into account new information on riverbed behaviour, especially after a significant flood event.

Following each five year riverbed survey, a detailed gravel analysis report is produced that makes recommendations for:

- Management objectives specific to each river reach
- Extraction methodology
- Available volumes, which are determined by comparing the actual MBL with the design profile
- Priority reaches

Both dry and wet gravel extraction are management tools will be used, as appropriate, for the reach in question.

4.2.3.3 Works undertaken since 2006

Wet extraction has been undertaken systematically through the main deposition/extraction reach (XS 0420 to 0840), from upstream to downstream.

The first cut commenced in November 2006 at Owen St (XS 0790) and finished in April 2011 at Harcourt Werry Drive (XS 0570). The second cut commenced in June 2012 and is now complete; this latter extraction operation has focused between XS 0750 to 0620. Extraction volumes from 2006 to date are shown in Table 22.

Table 22: Gravel volumes extracted since November 2006

Financial Year	Volumes Extracted (m^3)
2006/07	60,680
2007/08	66,201
2008/09	30,343
2009/10	7,981
2010/11	5,660
2011/12	49,358

2012/13	46,642* (as at 31 Dec 2012)
Total	**266,865**

4.2.3.4 Dry extraction methodology

'Dry extraction' involves extraction of gravel from beaches above the normal low flow water level. All works are undertaken out of running water, except for any river crossings for access or for transport of extracted gravel that may be necessary.

Extraction is usually carried out using either hydraulic excavators or front end loaders which load onto trucks (either road trucks or off road dumpers). Extraction is undertaken in uniform strips parallel to the river channel, to a depth no lower than 0.2 m above the normal level of the adjacent flow (Figure 9).

Figure 9: 'Dry' gravel extraction

Small stockpiles of the extracted gravel may be formed on a daily basis, but would not normally be left in the floodway for longer than the working day. The extracted gravel is transported to the processing plant using existing access tracks and/or public roads wherever possible. For remote beaches trucks may need to travel along the dry river bed, and may need to cross the river. Such crossings will be kept to a minimum, and restricted to a single point of entry and exit.

At the end of extraction, beaches are left with an even surface to ensure that there are no major discontinuities that could divert future floodwaters. The next fresh or flood will re-work the bed to a more natural form.

4.2.3.5 Wet extraction methodology

The current extraction methodology has been used in the river since 2006, following consultation and agreement with key stakeholders (Fish & Game NZ, DOC and some iwi representatives). Its purpose is to minimise the disruption to the meander pattern of the river channel and to maintain a well-defined low flow channel with a 'natural' slope up to the beach. It was also agreed that in the upper part of the extraction reach (XS 0570 to 0790) a design meander pattern to restore in-stream habitat would be implemented as described above; this is reflected in Condition 18 of consent [WGN 060334].

Preparatory works

- The most recent cross section surveys are compared with the design profile and cross sections (see Section 3.5.4) to determine cut and fill depths and calculate available gravel volumes.
- Construction plans are prepared, which detail the active channel centre line (thalweg), active channel width and beach offsets, and finished beach and river bed levels. An example of these plans is included in Appendix I.
- The beach edge and active channel centre line are set out from reference points on the bank, and are marked with either a green waratah (beach edge) or red waratah (thalweg).

In-channel works

- The low flow channel is deepened by pushing gravel material up onto the existing beach to form a temporary stockpile (Figure 10). Over most of the extraction reach this work is carried out by one, or sometimes two, D9 bulldozers, with the machines working in the low flow channel. At some smaller beaches where the low flow channel is relatively deeper and well-defined (generally in the downstream end of the reach), an excavator is generally used. There may be times when this excavator may also need to work in the low flow channel. In some instances it may be necessary to cut a new channel through an existing beach to achieve the design meander pattern.
- Work commences at the downstream end of each beach with a lowering and re-shaping of the riffle; the machine will then continue shaping the low flow channel, moving in an upstream direction to create a lowered pool.
- Upon completion of the pool deepening some re-shaping of the riffle may be required to ensure the desired cross-over has been achieved.
- As the river reworks the altered meander pattern and lowered riverbed, the adjoining willow stands and bank edges may become exposed and vulnerable to erosion. This may require further re-shaping of riffles and re-establishment of the beach shape to maintain the design meander, which in turn protects the willows and bank edge. This additional channel shaping is most likely to happen after a flood. It may also be necessary to use additional vegetative protection measures (e.g. willow layering, tree groynes and tethered willows) to protect the most vulnerable willow stands and bank edges.

Figure 10: 'Wet' gravel extraction: bulldozer forming low flow channel

<u>Gravel removal</u>

- The temporary gravel stockpiles are allowed to drain sufficiently (for at least 1 day) before gravel removal commences. The raised beach can then be lowered progressively by the contractor.
- Work commences at the downstream end of the beach and proceeds upstream. Gravel is extracted in strips parallel to the river flow, working from the front of the beach to the rear. This stage of the operation takes place above normal water levels, and no further re-working of the low flow channel is required. The raised beach also remains largely intact during flood events.
- A front end loader is used to load the gravel onto either road trucks or off-road dumpers, which then transport it offsite via existing haul roads for processing (Figure 11). In places where direct access to the working area from the bank edge is not available, there may be a requirement for new access points to be formed from the bank edge; or if no access is possible from the bank edge, there may be a requirement for river crossing points to be formed, and for trucks to track within the river bed (Figure 12).

Figure 11: Gravel extraction: front-end loader loading an off-road dumper truck

Figure 12: Gravel extraction: off-road dumper truck crossing river

<u>Beach re-contouring</u>

- At the completion of the gravel extraction operation the remaining beach is re-contoured to give a smooth profile, with a central rise, downward slope to the low flow channel, and a well-defined water edge (where possible). Where the low flow channel is shaped with a bulldozer, there may be the need to further shape the beach edge with an excavator to achieve this. The purpose of this is to ensure a minimum of re-working by the river is required to re-establish a 'natural' channel form and shape.

Timing of works

Generally the majority of in stream channel works have occurred between 10 November and 22 December, to comply with the following two restrictions (conditions 23 and 24 of WGN 060334):

- 1 September – 9 November (inclusive) to avoid upstream migration of native fish, and
- 23 December to 15 February (inclusive) to avoid peak angler use and recreational users.

Reshaping or finishing work is generally undertaken in February, while removal of stockpiled gravel is undertaken throughout the year.

Profile management

As part of the determinations associated with consent [WGN 060334], independent consultant Gary Williams was engaged to provide advice related to the impacts of wet extraction on river systems and processes. He proposed that the gravel extraction gave an opportunity for improvement of the overall meander pattern and an enhancement of the pool and riffle sequence within the river. As a result, a requirement to increase the number of pools and riffles in the river was included as a consent condition when the wet extraction consent was granted. Gary Williams provided a design meander pattern and adjusted cross-section shapes for cross sections between XS320 and XS780. The adjusted cross-sections were intended to provide a channel capacity of around the 1998 level while creating the new meander pattern and reinstating riffles and pools within the river channel. These adjusted cross-section profiles were then used as the basis for gravel management within the river to create the new meander pattern.

- Following the 2012 partial river bed survey and resulting check of mean bed levels through the surveyed reach, GWRC again engaged Gary Williams to further refine and improve the design meander pattern and section profiles. This refinement used data from the survey and information from GWRC staff on the behaviour of the river since the initial wet extraction took place.
- The refinement has given rise to a more consistent and stable meander shape and length throughout the study reach, and was adopted as the basis of gravel management practices in the Te Awa Kairangi / Hutt River from 2012 onwards. The 2012 revised design profile gives the most up to date information for determination of the gravel extraction rate currently required to meet the prescribed design profile.

4.3 Design of annual work programmes

4.3.1 Gravel extraction

Gravel extraction is generally undertaken by contractors. In recent times, GWRC has extracted gravel for its own purposes where there is a defined need (e.g. construction of new stopbanks), however Council relies heavily on gravel contractors to extract material from the river in order to minimise costs. The availability of contractors wishing to remove and process the gravel material is the main limiting factor in terms of the volume of material actually extracted for flood management purposes at present.

Contractors who have undertaken extraction in the past, and are likely to continue to do so in future include Winstone Aggregates and Horokiwi Quarries Ltd. In recent years the demand for gravel has slowed dramatically; this has occurred for a number of reasons, including:

- Reduced demand for sand and aggregate from the concrete industry as a result of the economic downturn
- Increased costs associated with the greater cartage distance following the closure of the Horokiwi Road intersection on State Highway 2
- Higher unprocessed costs of landing the gravel at the quarry compared with land based extraction

4.3.2 Other works

The specific type of work chosen will depend on the nature of the problem at a site and river engineering design criteria such as channel width, flow velocities and channel alignment, the width of berm to critical assets including stopbanks and services, cost versus benefit, available budget and environmental considerations.

Soft-edge works are cheaper than hard-edge works but afford a lower level of protection and require time to establish before being effective. Construction of structural works at an early stage may avoid the necessity of more extensive works at a later stage, or reduce the requirement for repeat in-channel works with consequential reductions in overall cost and environmental impact.

Costs of permanent works can vary from \$5/m^2 for willows, \$7,000 to \$11,000 for a typical debris fence[20] and from \$1,500 to \$3,000 for rip-rap lining[21]. New structural works will typically be constructed where existing willow protection is repeatedly failing, or where existing structural works have failed and repair is neither adequate nor appropriate.

A range of structural options is required to ensure the optimal option (based on consideration of the factors above) is used at each particular site.

GWRC undertakes a formal annual inspection of all infrastructural assets and assign a condition rating of 1 to 5 to each asset (1 being highest). From this inspection, the annual work programme is derived; the work programme notes ongoing maintenance activities (mowing etc.) and the work required to improve those assets with low condition ratings.

[20] Based on 2013 GW rates of \$366/m and a typical length of 20-30 m.
[21] Based on 2013 GW rates of \$123/tonne and a volume of between 12 - 25t/m.

5 Consideration of Alternatives

5.1 General

Alternatives to the proposed activities can be considered at a number of levels. On a broad scale, the consequences and unacceptability of doing nothing, and the consideration of the extent and type of flood protection works that should be adopted in the Te Awa Kairangi / Hutt River are issues that have already been addressed by the community through the development of the HFMP.

In addressing the more specific issue of alternatives to the individual activities that are proposed, it is relevant to note that the types of activities undertaken in the river have changed, and will continue to change, over time in response to different management philosophies, available technology, experience of what does and does not work at a practical level, and increasing understanding of the river system and the effects of activities. The evolution of the current flood protection scheme as a whole also influences the types and the relative amounts of works that are required on an on-going basis.

The works and activities proposed in this application form a suite, or 'tool-box' of techniques to address and implement the objectives of the HFMP, and are based on current good engineering and environmental practice. This has been formalised into updated new COP. The COP provides specific details of the methods of undertaking each of the identified activities, together with agreed restrictions around their use.

The availability of a 'toolbox' of methods provides flexibility for river managers to select the most suitable method or methods to address a particular issue, taking into account:

- the urgency of the work and consequences of not undertaking it;
- the degree of digression of the channel from its design alignment and/or desired plan form;
- the values associated with the specific site and the river as a whole; and
- the environmental effects of the work and available alternatives to achieving the desired outcomes.

River managers undertake such assessment, and consideration of alternative methods, in the development of all work plans.

As explained further in Section **Error! Reference source not found.**, this application proposes a structured mechanism for the consideration of new techniques or alternative methods. Once an alternative has been fully evaluated through a process of analysis and review and confirmed as providing a better alternative to current practice, the COP would be then be updated to reflect this.

5.2 Willow planting

Willow planting forms an essential part of current river protection work nationwide. Willows are easy to establish, grow rapidly and form an intricate root system that is ideal for binding and strengthening river banks and structural measures such as permeable groynes and debris fences. Generally, the same results cannot be achieved using native species. This means the most realistic alternatives to willows are likely to be structural works (e.g. rock lining), which involves higher costs and arguably increased environmental impact.

It should be noted that GWRC uses sterile cultivars in all willow planting so that the issue of wilding plants becoming established in the river bed is minimised (although willow debris is still able to re-establish vegetatively on exposed beaches if left unchecked).

Once established, the presence of willows along a river bank contributes to the available aquatic habitat, by the provision of sheltered habitat within the tangle of roots binding the banks, the provision of shade by overhanging branches and by the input of leaf matter into the water.

This report has noted that the willow plantings along the Te Awa Kairangi / Hutt River are now relatively well established, and work involving willows by GWRC into the future is expected to be largely focused on maintenance and renewal of these plantings. In addition, on-going plantings of native trees and other restoration of ecological areas within the river corridor will add to and enhance the natural biodiversity of the area over time.

6 Assessment of Effects on the Environment

6.1 Positive effects

The principal positive effects of the proposed works as a whole include increased security from the risks of flooding and flood damage for the Hutt Valley communities. This includes increased personal safety, lowered risk of property damage or loss, lowered risk of insurance claims and costs and lowered risk of disruption to lives and economic activity. This is a very significant and important positive effect and without it the long term economic well-being of the Hutt Valley communities would be seriously jeopardised.

As noted above, a large flood over the Te Awa Kairangi / Hutt River floodplain would have wide-ranging social and psychological impacts on the Hutt Valley communities. There would be physical damage and disruption to homes, schools, workplaces, community facilities, and essential and emergency services. Utilities such as water supply, sewerage, electricity and telecommunications could be put out of action for days. The financial cost from such a flood could exceed $1 billion. Recovery would likely be slow, with damage to buildings and roads taking months or even years to repair. This would severely affect the day-to-day functioning of the community, and have an enormous effect on the regional, and possibly national, economy.

In addition, the on-going works and maintenance activities undertaken by GWRC within the river corridor on behalf of the community lead to development of an increasingly robust system of river management works.

Actual and potential adverse effects of the proposed works are generally associated with impacts (both positive and negative) on the established natural ecology within the modified and managed river environment. These are identified and summarised with reference to individual activities in Sections 6.3 to **Error! Reference source not found.** and potential cumulative effects are discussed in Section 6.20.

6.2 Discharge of sediment

<u>In-river works</u>

Activities that involve the movement or excavation of river bed material within flowing water (including, but not limited to, bed recontouring and wet gravel extraction) will cause discharge of natural fine bed sediments into the water column. The sediments are the same or very similar to those that occur naturally in the water column during natural flood events. The main difference is that the discharge from works activities is likely to occur at times of low flow when the suspended solid load of the water is also low.

The nature of the sediment discharge will depend on whether the sediment is derived from recently reworked gravels (i.e. gravels that have been disturbed and re-deposited by flood events in the channel), or from disturbance of older alluvial bank materials comprising gravels with a silt/clay matrix.

Most in-channel works in the lower river (from Taita Rock downstream) are within re-worked gravels, and discharges show as a light-coloured silt discharge.

Clayey gravels are likely to be encountered anywhere where channel degradation is occurring (i.e. the reach from Taita Rock upstream to Maoribank corner), or where channel shaping involving excavation of existing banks is required. Discharges from these areas will contain a highly visible orange/brown stain which reflects the higher clay content of the entrained sediments.

Measurements of turbidity and suspended solids were taken recently in association with the 2012 Te Awa Kairangi / Hutt River gravel extraction programme upstream of Kennedy-Good Bridge (which was undertaken from 26 November 2012 to 19 December 2012). Approximately 16,000m^3 of gravel was extracted from a river length of approximately 300m (XS 0720 – 0750), (not the 1400 m river length between XS 0720 and 0860 as originally planned). The activity was undertaken by two bulldozers which pushed the gravel up onto a beach for later removal by off road dumper or road truck. The truck crossed the river at several locations. The results are summarised in Table 23.

They show that maximum turbidity and suspended solids values of 306 NTU and 207 mg/L respectively, were recorded in the river during bulldozer operation.

Table 23: Turbidity and suspended solids (SS) monitoring results for the Te Awa Kairangi / Hutt River during gravel excavation by bulldozer in flowing water 500m Upstream of Kennedy Good Bridge on 28 November 2012

Time*	Bulldozer activity	Upstream		100m Downstream		500m Downstream	
		Turbidity (NTU)	SS (mg/L)	Turbidity (NTU)	SS (mg/L)	Turbidity (NTU)	SS (mg/L)
16:10	Excavating gravel from river	6	1	175	90	47	29
16:35	Excavating gravel from river	5	2	306	207	102	51
17:00	No activity (work ceased at 17:00)	6	1	52	180	84	100
17:35	No activity	4	1	13	72	64	17
18:00	No activity	5	1	7	1	8	1

*Sampling commenced at the upstream site followed by 100m and 500m downstream over a 15 minute period.

Source data from Geotechnics Ltd

Table 24 summarises the results of turbidity and suspended solids monitoring undertaken during repeated truck crossings of the Te Awa Kairangi / Hutt River at the same location. Truck crossing activity was shown to cause turbidity and suspended solids increases of up to 16 NTU and 2 mg/L respectively.

Table 24: Turbidity and suspended solids monitoring results for the Te Awa Kairangi / Hutt River during truck crossings of the river 500m Upstream of Kennedy Good Bridge on 28 November 2012

Time	Truck activity	Upstream		100m Downstream	
		Turbidity (NTU)	Suspended solids (mg/L)	Turbidity (NTU)	Suspended solids (mg/L)
15:40	Prior to crossing river	1	1	6	2
15:48	Truck crossing river (1)	-	-	17	4
15:52	Truck crossing river (2)	-	-	5	2
15:54	Truck crossing river (3)	-	-	8	3
15:56	Truck crossing river (4)	-	-	12	2
15:58	Truck crossing river (5)	-	-	4	2
16:00	Truck crossing river (6)	-	-	7	2
16:02	Post crossing river	1	1	7	3

Source data from Geotechnics Ltd

The results confirm earlier observations that water clarity returns to near ambient levels rapidly, often within 1 hour of the activity ceasing. This is an important result because it indicates that even during an intense period of in-stream channel works the aquatic biota downstream would have the benefit of normal water quality for at least half of each 24 hour period.

These latest results indicate lower values than those previously recorded by GWRC for the Hutt and Waikanae Rivers (see Table 25), which indicated that bulldozer channel shaping could generate suspended solids concentrations as high as 690 mg/L. (Cameron, D, 2015) notes that suspended solids concentrations as high as 780 mg/l also occur during a one year return period flood. For smaller more frequent flood events, i.e., those occurring three to four times each year, suspended solids concentrations typically fall in the range 100 to 400 mg/l.

Table 25: Suspended solids concentrations in Waikanae River below works

River	Activity	Suspended solids concentration in river (mg/L)		
		Background	Downstream (100m)	Downstream (300m)
Hutt	Channel shaping	2	480	-
	Bulldozer crossing river	2	130	-
	High river flow event (410m^3/s @ Birchville on 19/11/96)	-	780	-
	High river flow event (160m^3/s @ Birchville on 8/10/2007)	-	397	-
	High river flow event (80m^3/s @ Birchville on 5/2/2013)		65	
Waikanae	Placement of rip-rap	<2	98	68
	Truck crossing	<2	<2	11
	Thalweg cutting by bulldozer	<2	690	160

Source: GWRC 1998 data

In summary, the available data indicate that:

- River crossings by dumper trucks generate relatively low suspended solids concentrations, from 2 to 10 mg/l above background; this would apply to all machinery (other than bulldozers) required to do river crossings;
- River crossings by bulldozer can increase river suspended solids concentrations by 130 mg/l;
- Channel shaping by bulldozer can increase suspended solids concentrations by nearly 700 mg/l;
- Channel shaping may result in a temporary increase in fine sediment deposition on the riverbed downstream of the works;
- Suspended solids and turbidity levels return close to ambient levels rapidly, typically within 1 hour of the activity ceasing;
- Typically a major gravel extraction operation has been undertaken for a number of weeks, for up to eight hours a day, five days a week. The presence of elevated suspended solids concentrations have therefore occurred over the same timeframes;
- The discharge plume may also contain elevated levels of total nitrogen and total phosphorus, but monitoring undertaken in the Te Awa Kairangi / Hutt River indicates that these nutrients are bound to particulate material and that there is no associated increase in water column concentrations of dissolved nutrients (and therefore little risk of stimulating excessive algae growth);
- A larger flood event (annual and above) in the river can increase river suspended solids by over 700 mg/L, but more common smaller events typically increase river concentrations in the range 100 to 400 mg/L.

Drain Clearance

The clearance of silt and debris from drains and culverts has the potential to generate minor amounts of suspended sediments. This is expected to occur over a relatively short period of time.

Earthworks outside the river bed

Earthworks undertaken on the banks and berms also have the potential to generate stormwater runoff containing suspended sediment.

6.3 Construction of impermeable erosion protection structures

6.3.1 Groynes

Historic records for the Te Awa Kairangi / Hutt River from 1999 to 2013 show 45 rock groynes have been constructed within the current application area, at an average of 3 per year. On this basis approximately 30m lineal length of river bank would be affected annually by new groyne construction, which is approximately 0.05% of the total length of river banks within the application area. In total approximately 0.8% of the lineal length of river bank within the application area has been affected by rock groyne construction over the 14 year period. If this level of activity were to be maintained then it could be expected that an additional 1.8% of the total river length of the river banks in the application area might be affected by groyne construction over the next 35 years.

Generally less than 100 m² of river bed (or less than 0.01% of the total river bed area in the application area) is disturbed by groyne construction. If the existing level of activity were to continue at about the same rate over the next 35 years, then this would equate to an additional 1% of the river bed area being affected by groyne construction in that time.

Short term effects

Construction requires excavation and disturbance of the bed material and creates a localised temporary increase in suspended solids concentrations, possibly by as much as 100 mg/L immediately downstream of the works area. (Cameron, D, 2015) notes that a suspended solids increase of this order would cause a sharp reduction in water clarity and would be clearly visible from the bank. It would, however, be less than that generated by a moderate fresh in the river, as discussed in Section 6.2. Monitoring in the Te Awa Kairangi / Hutt River has confirmed that turbidity and suspended solids concentrations return rapidly to near ambient levels once the in-stream activity ceases, usually within 1 hour. These results indicate that even during intense and sustained periods of in-stream channel works the aquatic biota throughout the reach would have the benefit of normal or near normal water quality for at least half of each 24 hour period. Mechanical disturbance of the bed would disrupt the macroinvertebrate community within the immediate works area and may cause some mortality of smaller fish which seek shelter within the substrate, but these effects are likely to be relatively minor. Trout and other large fish are more likely to move away from the disturbance and so are less likely to be harmed.

Other potential short term effects of groyne construction such as disruption of nesting birds, inconvenience to recreational users of the river or river banks and noise intrusion in the neighbouring community are anticipated to be less than minor, and can be adequately avoided or mitigated through adoption of appropriate practice and timing of works. This is outlined further in the COP.

Long term effects

(Cameron, D, 2015) notes that rock groynes may increase the morphological complexity of the river particularly if they are constructed against what was previously an eroding bank. This often results in deep pools associated with the toe of the structure, and water sheltered from the current downstream of the structure. The combination of fast water, sheltered water, deep pools and large crevices amongst the boulders can potentially provide a variety of habitat for both native fish and trout. (Perrie, A, 2013a) recorded shortfin eel, longfin eel, koaro, inanga, crans bully, common bully, giant bully, brown trout and shrimp in deep water habitat associated with groynes on the Te Awa Kairangi / Hutt River near Kennedy Good Bridge. The longfins were up to

800mm and trout up to 500mm in length. Mitchell (1997) considered that rock groynes could provide feeding lies for trout in areas where this type of habitat is naturally uncommon. A recent Fish & Game NZ survey shows that trout numbers through this reach are relatively high, and that many were located in deep holes associated with the rock groynes. Taking this into account, it was concluded that rock groynes have the potential to enhance some forms of fish habitat and that the overall effect of such structures on native fish and trout populations in Wellington's western rivers is likely to range from neutral to positive.

The purpose of rock groynes is to alter the river flow pattern to protect the river banks at that location from erosion. To ensure that erosion problems are not generated downstream of the new structures in the long term, comprehensive engineering design is undertaken prior to construction.

6.3.2 Rock lining

As noted in Table 19, approximately 25% of the river banks in the application area are rock-lined, and over the 14 year period from 1999 to 2013 a total lineal length of 1703 m of rock rip-rap has been constructed, at an average rate 122 lineal metres (or 0.2% of the total length of river bank) per year. If this rate of rock lining were to continue over the next 35 years this would amount to an additional 7% (or approximately 4 km) of rock lining in total.

Short term effects

Construction of a trench and placement of rock would include disturbance of bed materials and a localised increase in suspended solids concentrations. (Cameron, D, 2015) notes that short term effects on water quality and habitat quality are likely to be similar to those described for the construction of rock groynes in the previous section.

Similarly, mechanical disturbance of the bed will disrupt invertebrate habitat and may cause some mortality of smaller fish which seek shelter within the substrate. The extent of this disturbance would depend on the quantum of rip-rap to be constructed and the type of habitat which is being replaced. The overall significance of this effect needs to be considered in the context of the total area in which it occurs, which is relatively small.

Other potential short term effects of groyne construction such as disruption of nesting birds, inconvenience to recreational users of the river or river banks and noise intrusion in the neighbouring community are anticipated to be less than minor, and can be adequately avoided or mitigated through adoption of appropriate practice. This is outlined further in the COP.

Long term effects

(Cameron, D, 2015) notes that the longer term effects of rock rip-rap lining are likely to be site specific. Bank battering could destroy valuable fish habitat beneath undercut banks or overhanging vegetation, and placement of boulders against the bank may reduce the availability of deep water habitat for larger fish. However, in other instances, where deep water is maintained against the toe of the rock rip-rap lining, protruding boulders and those which have worked free might potentially provide feeding lies for trout and shelter for other fish species. Crevices between boulders may provide shelter for small and in some cases larger fish. The establishment of vegetation amongst the rock lining has the potential to provide overhanging cover, which may improve fish habitat, although GWRC staff have advised it may also generate potential terrestrial weed management issues.

(Cameron, D, 2015) considers that overall this method would appear to have a neutral to negative impact on aquatic ecology at any specific location, depending on the extent of undercut banks and/or the net loss of overhanging vegetation. It is important to note in this context that recent surveys of native fish and trout numbers in the Te Awa Kairangi / Hutt River at Belmont where river banks are extensively lined with rip-rap indicate a relatively diverse and abundant fish fauna (see Section 3.8.3) exists despite the potential for such adverse effect.

Rock lining does alter the visual appearance of the river channel, but this is an accepted aspect of the river management regime. It can be mitigated to a reasonable extent by the choice of appropriate rock material compatible with the existing river bed material, and by establishment of appropriate vegetation behind the rocklines.

6.3.3 Other structures

Construction of other impermeable erosion protection structures including gabion baskets, Reno mattresses and driven rail and mesh gabion walls construction include the same basic components and similar types of effects as outlined above for rock rip-rap linings. Some excavation or disturbance of riverbed material is required in preparation for construction, and the finished structure will generally result in some loss of channel complexity. This may include some loss of fish habitat, particularly if the structure is replacing an undercut bank or dense overhanging vegetation. However, in other instances erosion protection structures may enhance channel complexity and create new habitat for fish. Given the relative infrequency with which these works are undertaken in comparison to rock lining, the overall impact of these works in terms of the total affected area is considered to be much less than those associated with rock lining.

Construction of rock or concrete grade control structures would also include minor, localised riverbed disturbance, and in the longer term could have the potential to impede fish passage and present an obstacle to recreational users. This will be avoided or mitigated by making suitable provision for these matters in the design of the structure. This is outlined further in the COP.

6.4 Construction of permeable erosion protection structures

This category of structure includes debris fences, debris arresters and timber groynes. As explained in Table 19, these structures are used relatively infrequently in the Te Awa Kairangi / Hutt River.

Short term effects

Construction would involve localised diversion of the river and disturbance of the river bed by mechanical shaping and preparation of the site. The initial diversion of the river flow away from the works area would result in the discharge of suspended sediment into the flowing river, causing elevated turbidity and suspended solids levels, probably in the upper end of the range as discussed in Section 6.2. However the diversion would typically be completed quickly, usually within a matter of hours, after which the works are undertaken mostly in the dry, with minimal effects on river water quality.

Mechanical disturbance of riverbed materials would disrupt invertebrate habitat and may cause some mortality of smaller fish which seek shelter within the substrate. The extent of this disturbance would depend on the size of the structure and the type of habitat that is affected. Based on the total amount of river bed that would be affected the overall potential impact would generally be expected to be relatively minor.

Long term effects

Over time these structures work to trap flood-borne debris, which can provide sheltered habitat for juvenile and larger fish. However, as periodic clearance of debris is required to maintain the structure and prevent the accumulation of large obstacles in the flood channel, this may counter this positive effect to an extent. (Cameron, D, 2015) notes that on balance these structures would appear to have a positive to neutral effect on aquatic habitat and fish.

Other potential adverse effects on recreational users and the amenity values of the river arising from these structures are considered to be less than minor.

6.5 Construction of works outside the river bed

The construction of cycle ways, walkways, fences, drainage channels and other minor works outside of the river bed (on berms and stop banks within the river corridor) are unlikely to have any direct effect on water quality or the aquatic ecology of the rivers, provided that appropriate control of stormwater runoff from any areas of earthworks is undertaken. This would include undertaking works in accord with the Erosion and Sediment Control Guidelines for the Wellington Region (Greater Wellington Regional Council, 2006). All other short-term effects associated with this type of construction work are expected to be less than minor. In the long-term, these works contribute to the development of the linear park as described in the Te Awa Kairangi / Hutt River Environmental Strategy, which will have overall positive benefits for the local and wider community.

6.6 Demolition and removal of existing structures

(Cameron, D, 2015) notes that the effects of demolition and removal of an existing structure on water quality aquatic ecology will be site specific, depending on the type of structure and its location, and that the magnitude of these effects could be expected to fall within a range up to and including those described above for the construction of those structures. Generally structures are only removed if they have been damaged and/or have become redundant because of changes in the river channel. The removal of such structures reduces the health and safety risk to river users, as well as reducing adverse visual impacts.

6.7 Maintenance of structures on the river bed

Any potential adverse effects associated with the repair, replacement, extension or alteration of existing structures on or in the river bed will depend on the type of structure, its location and the extent of the works required. The magnitude of these effects could be expected to fall within a range from less than minor, up to and including those described above for the construction of those structures.

6.8 Maintenance of works outside the river bed

Since these works occur outside the bed of the river there is little potential for them to have an adverse effect on the water quality or aquatic ecology of the rivers, provided that appropriate control of stormwater runoff from any areas of earthworks is undertaken.

Potential short-term adverse effects on recreational users and the neighbouring community of these activities are expected to be less than minor, and the long-term effect is to contribute to the development and maintenance of the linear park as described in the Te Awa Kairangi / Hutt River Environmental Strategy, which will have overall positive benefits for the local and wider community.

6.9 Establishment of vegetative bank protection

6.9.1 Willow planting

Vegetative bank protection is the most widespread flood protection activity in the Te Awa Kairangi / Hutt River, in terms of total affected area. In Table 21 it is recorded that approximately 57% of the river banks within the application area are currently willow lined.

It is anticipated that future work will be mainly focused on maintaining these established plantings, rather than extension of them. Hence over time, it is not expected that the area of willow planting will significantly increase. However, maintenance work requires on-going removal of old willows and replacement planting on an annual basis. The actual number of poles and rooted stock varies per year (see Appendix H for details); over the past thirteen years numbers have varied between approximately 300 and 2000 poles, and from 400 to 6,000 rooted plants annually.

Short term effects

As willow planting works are undertaken in the dry, the effects of construction on water quality and aquatic habitat are expected to be negligible, as noted by (Cameron, D, 2015).

No significant river bird nesting habitat or breeding pairs of river nesting birds have been identified in the Te Awa Kairangi / Hutt River, so the potential for adverse effects on these is less than minor. Potential short term effects on any other species of roosting birds are also expected to be less than minor.

Similarly, effects on recreational users and the neighbouring community are expected to be less than minor, and can be easily mitigated by the adoption of appropriate good practice (such as communication with affected parties prior to commencement of works, and confinement of operations to agreed working hours). This is outlined further in the COP.

Long term effects

According to (Cameron, D, 2015), planting and layering for edge protection can benefit the aquatic ecology of the river due to the creation of shade, cover and the supply of woody debris. He notes that on the other hand, it is also recognised that willow plantings and other bank protection methods may limit the natural tendency of the river to meander and could therefore restrict habitat diversity to some extent. He concludes that on balance vegetation bank protection is expected to enhance some forms of fish habitat and the overall effect on native fish and trout populations is likely to be positive.

Willows may also provide roosting habitat for river birds such as shags, however (McArthur, 2013) notes that planting of poles on previously open gravel beaches may lead to the loss of potential river bird roosting and nesting habitat. This is not expected to be an issue of significance.

The historical introduction of willows (a non-native species) along the river margins has reduced the natural biodiversity of the river ecosystem. This issue is difficult to avoid since the erosion protection results that can be achieved via the use of willows as front-line river bank protection cannot be replicated with the use of native species. However, the reduction in biodiversity is offset by two important factors:

a GWRC does not plan to significantly extend the total area of willow plantings in the river corridor in future.

b GWRC also undertakes significant planting of native trees in the river corridor in accordance with the objectives of the Te Awa Kairangi / Hutt River Environmental Strategy. Over the past thirteen years, almost 16,000 assorted native plants (or about 1,200 per year) have been planted (see Appendix H). This contributes significantly to the increase in biodiversity values of the river corridor.

6.9.2 Maintenance of vegetative works

As described in Table 21, maintenance of willow plantings include removal of old trees, replanting, or layering and tethering of existing trees. It also includes periodic trimming of willows to clear survey sight lines for channel maintenance or realignment work, and to maintain recreational access and visual connection to the river (in accordance with the Te Awa Kairangi / Hutt River Environmental Strategy).

Short term effects

The short term effects of maintenance work is expected to be negligible, however the removal of old trees may result in the immediate loss of fish habitat.

Long term effects

(Cameron, D, 2015) notes that willow layering for edge protection can benefit the aquatic ecology due to the creation of shade, cover and the supply of woody debris to the river. Willow trunks layered over the bank into the channel may provide many opportunities for cover for eels and other fish species.

On the other hand, the removal of trees may result in the loss of good quality fish habitat. While re-planting would normally be undertaken following tree removal, there may be a delay of 10 to 15 years before the full benefits of riparian planting on aquatic ecology are realised. In practice however new willow lines are often established behind existing willows several years before front line willows are removed. This allows for newer willows to become established before removing old trees, thus reducing potential adverse effects.

Massey University students, supervised by Dr Mike Joy, have been monitoring fish numbers in a reach of the Waitohu Stream where willow removal was undertaken, and follow up monitoring after the event has been undertaken. The monitoring results, when available, might provide useful information on potential effects of this activity and/or provide guidance for future monitoring.

In relation to other long term effects, maintenance and rejuvenation of willow plantings contributes to the implementation of the Te Awa Kairangi / Hutt River Environmental Strategy by enhancing and maintaining the visual amenity values of the river corridor.

6.10 Channel maintenance

6.10.1 Removal of woody vegetation

This activity covers the removal of excessive or unwanted willows or other tree species from the channel, so as to minimise potential for blockages during floods, or to prevent dislodged willows re-growing in the channel. Short and long term effects are as described for willow maintenance work (Section 6.9.2).

6.10.2 Removal of beach vegetation

(Cameron, D, 2015) notes that there is evidence that removing weeds from river beaches has considerable value for those birds which roost and breed on open river beds (i.e. Rebergen 2011 & 2012). However, as noted in Section 3.9, McArthur *et al* (2013) found that the Te Awa Kairangi / Hutt River does not currently support breeding populations of such birds (banded or black-fronted dotterel, or pied stilt).

6.10.3 Removal of aquatic vegetation & silt

The area covered by this application includes a number of stormwater drains on berm areas which are mechanically cleared of vegetation and silts from time to time. While these may provide habitat for eels or other fish, (Cameron, D, 2015) considers them to be of marginal ecological value and thus the overall effect on this activity would appear to be minor. Adverse effects can be mitigated by adherence to good practice, such as undertaking the work when drains are dry. This is outlined further in the COP.

Vegetation, silts and accumulated flood debris is also removed from the Opahu Stream. Good practice methodology to mitigate the adverse effects of this activity has also been included in the COP.

6.10.4 Clearance of flood debris

Clearance of flood debris may involve operation of machinery on both gravel beaches and in the active channel. In the latter situation, there is likely to be localised short-term disturbance of the river bed and generation of elevated suspended sediments in the water column. The effects on water quality will depend on the machinery involved and the time spent in the channel. Overall, these effects are expected to be similar or less than those described for the maintenance of structures.

(Cameron, D, 2015) considers that overall, there is little doubt that flood debris can increase the range of water depth and velocities which in turn provide for a variety of habitat preferences for fish, although he notes that Jowett (1995) suggested that flood debris are not sufficiently abundant to influence fish distribution to any great extent. He concludes that a balanced approach, whereby flood debris is left in the river where it presents no immediate risk, would ensure that adverse effects on fish habitat are minimal.

6.11 Channel shaping and realignment

6.11.1 Beach ripping

(Cameron, D, 2014) considers that this activity is unlikely to have any immediate downstream effects on water quality or aquatic habitat, since it is undertaken on the dry beaches rather than in the active channel. The effects are to loosen the beach gravels so that in the next flood the bed material will be more readily mobilised, possibly causing an initial flush of silt and gravel downstream. These processes already occur during floods and consequently river biota is well adapted to a dynamic, mobile bed environment. In this context the additional silt and gravel entrained from lengths of ripped beaches is unlikely to be important.

6.11.2 Beach recontouring

Short term effects

Beach recontouring work is undertaken in the dry bed away from the active channel, and consequently there is little risk of short term construction impacts on water quality or aquatic ecology.

The activity may have implications for river birds although as noted, there are currently no known populations of such birds in the Te Awa Kairangi / Hutt River. The possibility that such birds may become established in the river at some time in the future is provided for in the COP, which proposes sets of three annual bird surveys on a regular cycle with 5 yearly intervals between them (i.e. 2012, 2013, 2014; 2020, 2021, 2022; etc.).

Other potential adverse effects such as the generation of noise and dust can be managed by appropriate practice (as included in the COP) and are expected to be less than minor.

Long term effects

(Cameron, D, 2015) considers the medium and long term effects of beach recontouring may be neutral to positive in terms of river bird habitat and probably neutral to marginally negative in respect of the aquatic ecology. The latter conclusion is based on the premise that the activity contributes to the straightening of the water course and thus may result in the loss of some channel complexity and potentially aquatic habitat. However, he concludes that this effect is likely to be negligible.

6.11.3 Channel diversion cut

Establishment of the diversion cut involves mechanical excavation of a new channel on the desired new alignment; generally this is through a beach area, away from the flowing channel. The excavated material may be placed between the side of the new channel and the flowing channel which is to be realigned or it may be removed to another location in the river bed.

The excavation cut is bunded at the upstream end and a flow restriction barrier placed at the downstream end while excavation work proceeds to minimise silt discharges. When the new channel is completed, the end bunds are removed to allow diversion of the active channel into the newly formed channel (this may either be done immediately by mechanical means or may be done naturally by the river over time). Some bed recontouring, to push excavated material across the old channel alignment (if it is not to be retained as a backwater habitat area) may also be required to achieve the finished profile.

Potential adverse effects of this activity during construction involve disturbance of dry river bed habitat (which has the potential to affect river birds) and disturbance or restriction of recreational use. Provided works are undertaken in accordance with the COP, these effects are expected to be minor.

Once the diversion cut becomes operational, and water is diverted into the new channel, there is likely to be an initial release of suspended sediment to the river from the disturbed river gravels in the bed of the new channel. This may result in some deposition of sediment downstream. The effects of this would not be as significant as those associated with bed recontouring or gravel extraction, and are expected to be short-lived.

6.11.4 Bed ripping in the flowing channel

Wet ripping involves mechanical disturbance of sections of the riverbed, and is similar to beach ripping except that it occurs within the flowing channel. It would typically be performed in the riffle sections of the channel in order to break up any armour layer and mobilise the gravels, which helps to mitigate any sharp directional changes in the channel. Although the activity involves mechanical disturbance of the bed, with associated aquatic habitat disturbance and temporary release of sediment to the water column, the activity is less invasive and less extensive than bed recontouring, and thus the scale of these effects is relatively less than with bed recontouring (see below).

6.11.5 Bed recontouring

Short term effects

Bed recontouring involves working in the active channel and entails extensive disturbance of bed material and significant release of suspended sediment into the water column. The short term construction effects on water quality and macroinvertebrate populations are likely to be similar to those described in Section 4.2.3.5 for wet gravel extraction (which includes bed recontouring). However, when used to realign the low flow channel, the extent and duration of works in the active channel may be less than required for wet gravel extraction (days rather than weeks) because much of the work can be completed in the dry.

Previously it has been noted by Mitchell (1997), in a review of GWRC's Flood Protection practices in Wairarapa Rivers, that:

"*Channel realignment tends to resemble the impact of a flood and a resulting course change. Aquatic life in larger channels is dominated by insects adapted to such unstable conditions. The major biological impact will be the amount of loss of riffle sections, simply because riffles are the major sites of invertebrate production in rivers….Obviously realignment works that involved the loss of large areas of riffles could impact local fish production."*

(Cameron, D, 2015) notes there is, however, strong evidence that macroinvertebrate re-colonisation of shallow riffle areas disturbed by channel realignment is rapid and that any impacts are likely to be short lived, i.e., Perrie (2009); Sagar (1983). This has been confirmed in recent studies on the Te Awa Kairangi / Hutt River: (Perrie, A, 2013a) and (Death, R. & Death, F., 2013). Both these studies identified short term impacts on macroinvertebrate communities immediately after the works but within seven weeks they had recovered to the pre-works condition, typically after the first significant fresh.

(Perrie, A, 2013b) found that bed recontouring in the Te Awa Kairangi / Hutt River associated with gravel extraction significantly changed the habitat at the extraction site, which could potentially affect fish populations in the short term, but the studies were inconclusive.

Long term effects

(Cameron, D, 2015) considers that bed recontouring, where it is used to straighten the channel, is likely to result in loss of channel complexity and a consequent overall reduction in aquatic habitat diversity. Mitchell (1997) observed that major channel alignment involves the direct loss of habitat and offers few direct ecological benefits apart from greater channel stability. Mitchell concluded that channel realignment was the flood protection practice most likely to have significant impacts on the environment (but noted that, overall, the river management approaches used on Wairarapa Rivers should result in an enhancement of biological activity).

Perrie (2009) observed that channel realignment on the Waingawa River resulted in significant straightening of the river channel in the study reach and had a clear impact on the diversity of habitat types. In particular deep runs were reduced in overall extent and pools were completely removed, while the proportion of shallow run and riffle habitats increased. Perrie considered this to be a net reduction in the overall diversity of habitat in this reach because of the relative scarcity of deep water habitat and because of the higher complexity of that habitat type relative to shallow water habitats.

In summary, (Cameron, D, 2015) concludes that the medium to long term effects on the aquatic ecology of bed recontouring, where it is used to straighten the channel, are mostly negative, and the significance of those effects for the river ecology at the reach scale will depend on the quantum of bed recontouring undertaken over time. He notes, however, that it is possible that this activity could be undertaken at a rate that balances the destabilising effects of floods, without on-going loss of habitat complexity, provided measures are in place to ensure the number of pools and riffles within a specified reach are not reduced below an agreed optimum level.

There is also an opportunity to mitigate many of these adverse effects by applying the principles developed for the Te Awa Kairangi / Hutt River gravel extraction programme, whereby the works are designed to form a well-defined low flow channel with a 'natural' slope to the beach and well-formed pools and riffles, which provide good quality habitat for invertebrates and fish. The addition of other design elements, such as the maintenance or creation of backwaters as part of these works, could also be considered to assist in the retention of habitat diversity. This methodology has been included in the COP.

6.12 Gravel extraction

6.12.1 Birds

McArthur et al (2015) identified six sites of value for native birds on the Te Awa Kairangi / Hutt River including 2 breeding colonies of pied stilt, two small nesting colonies of black shag and two roosting/feeding sites (near the Silverstream Bridge and the Ava Rail Bridge). Recommendations about further monitoring to be carried out to provide quantitative data to describe on-going trends in the distribution and abundance of river birds are included Section 8 of Cameron, 2015.

6.12.2 Herpetofauna

Several lizard species and two frog species are recorded within the Hutt Valley flood corridor. These are the Ngahere gecko, barking gecko, Raukawa gecko, copper skink, northern grass skink and ornate skink, and two introduced frogs. Flood protection activities may affect the margin of some lizard populations in the Hutt Valley, however lizards are likely to be sparsely disturbed in those areas where flooding occurs frequently; and rare in built-up urban areas. Accordingly, the risk to herpetofauna associated with flood protection activities in the riverbed are assessed as negligible as identified in Cameron, 2015.

6.12.3 Fine sediment mobilisation and deposition

Gravel extraction from the dry is likely to have minimal effects on water quality of the Te Awa Kairangi / Hutt River, although in those cases where trucks are required to cross the river there is potential for minor discharge of suspended sediment (refer Section 5.2 of Cameron, 2015) and disturbance of bed material.

(Cameron, 2015) notes that gravel extraction in the dry can lead to the accumulation of fine sediment on the river bank at locations where it can be carried into the river during a small fresh. That is likely to be a consequence of the mudstone geology and high fine sediment content of gravels in the Pohangina River, which is not the case for the Hutt catchment which has hard-sedimentary geology, and where the fine sediment content of gravels is low.

Gravel extraction which involves working in the active channel, as is proposed in the Te Awa Kairangi / Hutt River, entails extensive disturbance of bed material and release of suspended sediment into the water column over an extended period of some weeks. Monitoring of river water quality indicates that this activity generates suspended solids concentrations in the river immediately downstream of the works of up to 800 mg/L, or about the same order as an annual flood. Monitoring results also indicate that suspended solids concentrations decrease fairly rapidly with distance downstream, and return to near ambient levels within an hour of the completion of works.

In summary, these works cause a major increase in water column suspended solids, but this effect is temporary and does not continue much beyond the cessation of works. The works also caused increased rates of sediment deposition in downstream river habitats but this effect has been demonstrated to be short term in nature.

6.12.4 Disturbance of benthic habitats

Habitat mapping studies undertaken in the Waingawa River during channel re-alignment (Perrie, 2009), the Te Awa Kairangi / Hutt River during gravel extraction (Cameron, 2015) and the Te Awa Kairangi / Hutt River during channel re-alignment (Cameron, 2015) show that these works can cause a major change in the relative areas of in-stream habitat types, often resulting in a reduction of pool and swift riffle habitat and an increase in run habitat; with an associated loss in hydraulic complexity.

6.12.5 Disturbance of macroinvertebrate communities

Gravel extraction in the Te Awa Kairangi / Hutt River is expected to create major mechanical disturbances of benthic habitats and sedimentation effects immediately downstream. (Cameron, 2015) found that despite the major disturbance created by in-stream gravel extraction operations, in large braided rivers like the Waimakariri River, which are characterised by frequent floods and discoloured waters, gravel extraction from the active channel does not appear to have a major effect on the benthic fauna downstream of the works area, although some changes in invertebrate faunal composition occurred.

Adverse effects on water quality can be generated by the deliberate movement of river bed material associated with activities such as the construction of structures, bed recontouring and gravel extraction. The release of suspended sediment into the water lasts for as long as the activities are occurring, and typically gravel extraction, which may take place over several weeks per year, is likely to have the greatest effect in this regard. These effects can be avoided as far as is practicable by the adoption of good practice as outlined in the COP, which involves design and planning of works prior to any on the ground activity, to ensure works are undertaken in the most effective and efficient manner.

6.12.6 Disturbance of fish communities

An analysis of the studies completed to-date in regards to the disturbance of fish communities where gravel extraction has occurred is contained in (Cameron, 2015) annexed to this report.

It concludes that where there is a potential for loss of important habitat due to river engineering works, consideration should be given to options for avoiding or mitigating such loss, by incorporating a design meander pattern into the works, with a focus on creation of riffle, pool and/or backwater habitat. For large scale works affecting a long length of river and multiple riffles, consideration should also be given to leaving some riffles untouched so as to maintain sufficient reserves in the local fish population to enable the efficient recolonization of the engineered reaches. The matter of design meanders has been incorporated into the COP.

6.13 Disruption of fish spawning and/or migration

As described in Section 3.1.7, the Te Awa Kairangi / Hutt River area provides spawning habitat for a variety of fish, as follows:

- Inanga spawning habit is located in tidal estuary edge vegetation and occurs during March, April and May. Despite the general unsuitability of the Te Awa Kairangi / Hutt River main-stem for inanga spawning, there are records of inanga spawning in areas in the tidal reach where bank armouring is absent. These include observations near the Sladden Park boat ramp in Petone, at Te Mome Stream and Opahu Stream;
- Other galaxiid species including koaro, banded kokopu and giant kokopu, spawn in vegetation or cobbles at the riparian margin between April and August. Spawning habitat is generally thought to occur near typical adult habitats which, for most of these species will be in minor water courses outside (upstream) of the application area;
- Bullies spawn in riverbed substrate, often under large rocks, between August and February. Spawning habitat is thought to occur near or upstream of adult habitats. Some spawning habitat will occur within the application area; and
- Trout move into headwater tributaries to spawn during May and June. The lower 100m reach the Akatarawa River is the only reach within the application area which may potentially include trout spawning habitat.

The proposed gravel extraction activities have the potential to cause significant adverse effects on the river ecology, at least in the short term. Bed disturbance and discharge plumes have the potential to interfere with juvenile fish migration and to disrupt spawning of inanga, bullies, torrentfish and brown trout. These effects could, however, can be mitigated by limiting the amount of bed disturbance that can occur during periods of peak upstream migration & spawning, as specified in Table 5-8 of (Cameron, 2015).

6.13.1 Potential Effects in the Hutt Estuary

Mobilisation of fine sediments from gravel extraction works in the river has the potential to increase sedimentation rates further downstream in the estuary. Monitoring undertaken between 2010 and 2014 indicates low sedimentation rates in the Hutt Estuary (Stevens & Robertson, 2014), despite gravel extraction works being undertaken in the Te Awa Kairangi / Hutt River over that period. (Cameron, 2015) considers that with the application of the mitigation measures identified in Section 7.6 of that report, the potential effects on the Hutt Estuary will be short term and minor

6.14 Aquatic ecology

The ecological effects of each river management activity will be site specific, depending on interactions between river channel morphology and the composition and distribution of riparian and aquatic communities in the affected reach. Some practices such as the establishment of vegetative buffer zones, willow planting and layering, and construction of rock groynes, will have mostly positive effects on river ecology, while other activities such as channel realignment by bed recontouring will have mostly adverse short term effects. (Cameron, D, 2015) notes that vegetative bank protection is by far the most widespread activity in the Te Awa Kairangi / Hutt River, and its effect on riverine ecology is mostly positive. Other activities with higher potential for adverse effects are undertaken on a relatively smaller proportion of the river. He concludes that when viewed as an overall package, it seems likely that net effect of all these activities on native fish and trout populations is likely to be close to neutral and that existing values will be maintained.

The COP proposes baseline environmental monitoring of a number of ecological variables to build a database of information that can be used to assess the effects of river management activities over time. Included are; riparian vegetation, native fish & trout surveys, inanga spawning habitat, pool and riffle counts, substrate size & cover, river bank undercutting & overhanging vegetation & NCI. Event monitoring for works that involve significant disturbance of the river bed in the flowing channel, such as wet gravel extraction and bed recontouring, is also proposed. This would involve before and after monitoring of water quality, habitat quality, biological monitoring and NCI.

The methodology to be used in this monitoring work is still under development. This includes the identification of thresholds and ‘triggers’ which if exceeded, would result in further detailed investigation or a review of the river management activity being monitored. The findings of such a review would determine if any changes to the COP were required.

6.15 Birds

As noted above, adverse effects on river birds are likely to be minor, largely due to the absence of threatened or vulnerable species in the Te Awa Kairangi / Hutt River. Monitoring surveys as proposed in the COP will ensure that if any future change in bird populations occurs, this can be identified and appropriate mitigation developed.

6.16 Landscape and visual

The overall adverse effects of GWRC's river management activities on the visual amenity and landscape values of the Te Awa Kairangi / Hutt River and tributaries will be less than minor. Specific avoidance and mitigation can include adherence to good practice, such as:

- ensuring the use of construction materials that are compatible with the natural geology of the river environment, and
- avoidance of storage of materials or machinery in the river bed.

The effects of GWRC's on-going planting of natives, management of existing willow plantings, mowing of river berms and other works undertaken outside the river bed, together with the removal of debris and vegetation from the river bed all contribute in a positive way to the visual appeal of the river corridor (within the agreed context of a managed setting) and to the outcomes sought in the Te Awa Kairangi / Hutt River Environmental Strategy.

6.16.1 Stokes Valley Stream bank maintenance

GWRC maintains the lower 1.6km of the Stokes Valley Stream from the confluence with the Te Awa Kairangi / Hutt River to the confluence with Tui Glen Stream. The main activities undertaken in Stokes Valley Stream are the mowing of berms and removal of rubbish and debris (including from the stilling basin), with some structural repairs as required. Mowing of the berms involves tractor operation within the stream, which includes some disturbance to the streambed and a temporary release of sediment.

Stokes Valley Stream is enclosed by culverts under the Stokes Valley Shopping Centre, and is concrete lined downstream as far as Stokes Valley Road. The lower reach, from Stokes Valley Road to the Te Awa Kairangi / Hutt River has a more natural bed substrate consisting of gravel, silt and sand, however the channel retains the straightened and simplified character and has generally degraded habitat quality, particularly in respect of bank vegetation, riparian width and fish cover. A single fish record within the application area, together with FENZ predictions indicates that the core fish fauna of the lower stream is likely to consist of shortfin eel, longfin eel, redfin bully, common bully, juvenile trout and inanga. However, due to limited habitat availability the abundance of fish may be low.

Given the highly modified condition of the lower stream, neither the macroinvertebrate nor fish fauna are likely to be sensitive to the type of disturbance caused by the occasional passing of a tractor along the channel or the operation of a digger bucket to remove debris. It is noted in (Cameron, 2015) however, that the practice of mowing right down to the waters' edge has reduced the quality and quantity of habitat for invertebrates and fish.

6.17 Recreation

In the short-term, any adverse effects of GWRC's river management activities are most likely to be relatively minor, involving restriction of access to sections of the river or river berms. These could be avoided as far as is practicable by restrictions on the most disruptive activities (such as wet gravel extraction or bed recontouring) at times of peak recreational use at those locations. These provisions have been included in the COP.

In the longer term, the impacts on off-river recreational users are likely to be positive, as the development of the linear park in accordance with the Te Awa Kairangi / Hutt River Environmental Strategy progresses.

In relation to adverse impacts in the longer term on in-river users; (TRC Tourism, 2013)has identified flood and other debris, old willows and redundant structures as creating potential safety issues. It is suggested that this could be addressed by GWRC continuing to work with user groups to identify key safety concerns and to pinpoint any specific locations that may require attention.

(TRC Tourism, 2013) also noted that the sewer crossing at Silverstream is dangerous for paddlers at high river flows because it creates a standing wave across the river in which paddlers can become trapped. This is a possible adverse effect to consider in the design of any future grade control structures that GWRC might wish to install. This provision has been included in the COP.

6.18 Neighbouring community

Based on past experience and the very small number of complaints that have been received over the past fifteen years in relation to GWRC's river works and maintenance activities, the overall adverse effects on the neighbouring community are anticipated to be less than minor overall.

Any effects are most likely to be associated with noise, and are most likely to occur in areas where residences are closest to the river corridor.

The potential for such effects can be adequately avoided by such things as:

- The restriction of activities to reasonable working hours
- Management of traffic movements
- Good communication with affected residents
- Ensuring that a readily accessible system for making complaints exists, so that any complaints can be conveyed to the appropriate staff and addressed promptly.

These provisions have been included in the COP.

6.19 Cultural

Reports on cultural values relevant to the application area, and an assessment of impacts of river management works on cultural values have been prepared for GWRC by Raukawa Consultants (on behalf of Port Nicholson Block Settlement Trust & Wellington Tenths Trust – PNBST/TT) and Te Runanga o Toa Rangatira Inc. These reports are included in Appendix K; note that the report by Raukawa Consultants is still in draft. Key points made in each report are summarised briefly below.

6.19.1 PNBST/TT

Te Awakairangi has dominated life in the Hutt Valley since earliest times of Maori settlement. The form of the river has changed significantly since the time of the arrival of European settlers. Maori settlements were from earliest times concentrated on the estuarine area, as this was the area where many resources such as fish (freshwater and marine) and birds were easily found. Maori did not clear the forest and did not choose to live deep in it. Some villages were located along the Te Awa Kairangi / Hutt River, with their numbers diminishing with distance upstream. Most of the pa and kainga up the valley were located close to the river or along its main tributaries such as the Akatarewa (sic), Whakatiki, Mangaroa and Pakuratahi Rivers.

Large changes in the course of the Te Awa Kairangi / Hutt River over time have meant that many of the pa, urupa, kainga and other sites formerly located beside the river now lie far from the river.

Te Awakairangi was a significant freshwater fishery and fed into a large estuarine fishery. Species such as flat fish (patiki/flounder), mullet/kanae, piharau/korokoro/lamprey, kokopu, inanga/whitebait, ngaore/smelt and longfinned eel/tuna were abundant.

Today the significance of Te Awakairangi may not be greatly different to many Maori from that of the population in general, however there are parts of the environment that are more treasured by Maori. An example is the tuna/eel population, compared with the trout population. Today the river is still used by the tangata whenua for fishing, including for whitebait and eeling, and sea fish (mullet and kahawai) at the river mouth.

In relation to river management activities it is noted that two sites of significance to Te Atiawa are located near the river corridor (the sites of the former Motutawa Pa and Maraenuku Pa), but most cultural concern relates to the possibility of effects on the flora and fauna of the main stem of the Te Awa Kairangi / Hutt River.

The conditions and Code are premised on careful management ensuring that works are not timed during critical periods around tuna migration (heke) upstream and downstream unless it can be demonstrated that effects are appropriately minimised, and water quality and fish passage are maintained. Planting work adjacent to the river can benefit invertebrate production, providing food sources for eels and is therefore desirable.

Finally, the role of Te Atiawa/Taranaki Whanui as kaitiaki of the river should be included as part of the monitoring of the Te Awa Kairangi / Hutt River and the overall Wellington River systems. As kaitiaki, tangata whenua should have an active role in both the formulation of river management plans as well as with general river management.

6.19.2 Ngati Toa

Historically the Hutt Valley was dominated by dense native forest which supported a vast array of natural resources that were important for Ngati Toa's cultural and physical sustenance.

Ngati Toa is principally concerned with one site of significance, namely Te Whanganui-a-Tara/Wellington Harbour, downstream of the application area. This area is unlikely to be affected by the proposed activities.

The role of kaitiaki with respect to customary rohe and the promotion of sustainable management is one that Ngati Toa considers to be of the utmost importance. Of paramount concern is to ensure that mauri (life force) of streams and rivers is protected and enhanced. This happens when environmental health and natural balances are sustained. When environmental degradation and destruction occurs in any form, mauri is weakened or extinguished. In the latter case, active efforts to restore mauri are essential.

Te Runanga employ a number of cultural indicators to assess mauri of rivers and streams and to inform assessment of effects to mauri of human activities. These include:

- Life supporting capacity and ecosystem health;
- Clarity and quality of water;
- Natural flow and processes;
- Abundance and diversity of endemic species;
- Productive capacity;
- Suitability and accessibility for cultural use;
- Status and accessibility of sites of cultural significance;
- Existing and potential riparian vegetation;
- Ratio of native plants to exotic plants; and
- Catchment land use.

From consideration of these factors, Ngati Toa believes that the mauri of Te Awa Kairangi, in respect of the area encompassed by the application to be in a state of degradation, such that remedial and restorative efforts are needed as a matter of priority. Further, the iwi is also of the view that activities such as those proposed in this application have the potential to affect water quality and ecosystem health, and thus to diminish mauri.

It is acknowledged that GWRC have initiated efforts to mitigate adverse effects, and these will be instrumental in minimising negative impacts to mauri. Key issues of concern are as follows:

- The views and values of Ngati Toa are not represented in the Te Awa Kairangi / Hutt River FMP or Environmental Strategy, as the iwi was not directly consulted in their development. Having said that, it is noted that the documents do identify cultural values and recommendations to remedy or restore adverse effects to those values. Most of these have not been incorporated into the current application[22].
- Future management of precious freshwater resources must seek to achieve more than merely maintaining the existing and often compromised standards of ecological health in rivers and streams. Enhancement of waterways should be a primary objective.
- A heavy reliance is placed on river flow to disperse sediments generated during heavy works in the river bed. Additional measures to remedy and address the effects of sedimentation (including input to Te Whanganui-a-Tara/Wellington Harbour) are possible through the design and establishment of native wetland areas to aid in the filtering and reducing sediment within the main river channel and ultimately deposited at the river mouth.
- The significant depletion of fish stocks as a result of pressures placed on the river area subject to the application. This includes fish mortality and temporary or permanent loss of habitat arising from river management activities. Active steps must be taken to mitigate or remedy this. A programme to monitor fish abundance and diversity should be included in the monitoring plan, and an optimum level of pools and riffles maintained. The establishment of wetlands and backwaters with native vegetation would achieve habitat enhancement for endemic species.
- Any structures constructed across the waterway must provide for fish passage (it is noted that the sewer crossing at Silverstream currently obstructs the upstream passage of inanga and smelt). Mechanical disturbance of the river bed and use of any vehicles in the river should be prohibited during the primary fish passage season from 1 September to 9 November.
- Modification of tidally affected regions by flood control works have contributed to the destruction of inanga spawning habitat. Rock lining and the use of willow plantings along the river bank are not supported beyond current use due to the perception that they remove inanga spawning habitat and reduce ecological diversity.
- The use of vegetative protection is preferred by Ngati Toa, however the use of willows is of significant concern, and there is a need to develop a more diverse approach to management of vegetation protection and the use of native species. This includes the need for more robust trials of the use of native species as an alternative or integrated bank protection method. Native planting should exceed the amount of exotic planting.
- Ngati Toa supports the on-going monitoring of birds.
- Although some families continue to fish in parts of the Te Awa Kairangi / Hutt River, the application area as a whole cannot be considered to function as a viable mahinga kai. Other resources traditionally harvested in this area are similarly depleted due to major loss of

[22] It should be noted that these comments were made in response to an earlier draft of the application.

habitat and ecosystem support. Mitigation of these effects can only be achieved through restoration of native plants and trees on the river edge, enhancement of taonga species ecosystem support and re-establishment of sustainable species populations.

- Te Runanga disagrees with Cameron's assessment of the severity of environmental effects.
- A lack of ability to participate in management of the Te Awa Kairangi / Hutt River at a high level has contributed to the severity of cultural impacts of river management activities. Ngati Toa seeks a joint management arrangement between the Regional Council and Mana Whenua to better reflect the customary interests of tangata whenua.

6.19.3 GWRC response

Progress on development of the COP has been significant since the two iwi reports were prepared. Many of the measures to avoid or mitigate adverse effects of the environment, and particularly those affecting fish and aquatic habitat, which GWRC has now included in the COP, will also achieve positive outcomes in terms of one or more cultural values. However, there are some cultural and spiritual values and goals that are more problematic to make provision for within the current river management paradigm. GWRC also acknowledges that much has aslo changed within the Iwi organisations themselves since these documents were prepared. GWRC is continuing to explore further opportunities to engage with Iwi.

6.20 Cumulative effects

The potential for the effects of GWRC operations and maintenance activities to be increased by other similar activities undertaken in the catchment by other parties is very low. This is because the only other similar consented works are those undertaken by the New Zealand Transport Agency (NZTA) in relation to extension or maintenance of existing culverts. Available evidence suggests that although works and maintenance operations have been undertaken over a long period of time, the Te Awa Kairangi / Hutt River supports a relatively diverse range of fish and aquatic biota. This suggests that major cumulative adverse effects on aquatic ecology do not occur.

There may be a cumulative effect resulting from the extension of permanent works (i.e. rip-rap linings). However, recent surveys of native fish and trout numbers in the Te Awa Kairangi / Hutt River at Belmont where river banks are extensively lined with rip-rap indicate a relatively diverse and abundant fish fauna, suggesting that the cumulative effect of river management activities on the riverine ecology may be relatively minor.

7 Consultation

Consultation on river management work affecting the Te Awa Kairangi / Hutt River is an integral part of GWRC activities. River management activities have a high profile in the Hutt Valley community. This is due, in part, to the floods regularly experienced in the catchment and through consultation processes undertaken by GWRC. GWRC works within the river are well reported in local newspapers, further reflecting the interest shown by the community.

The most recent phase of public consultation for undertaking river management works along the Te Awa Kairangi / Hutt River began in 1990, as part of the Te Awa Kairangi / Hutt River Flood Control Scheme Review. The community's views from this consultation process are summarised in "Living with the River", produced in November 1996, which in turn was an integral part of the Te Awa Kairangi / Hutt River Floodplain Management Plan (HFMP). Consultation continued with the community, starting in 1998, to develop the plan.

The review in the early 1990s, consultation on the Te Awa Kairangi / Hutt River Floodplain Management Plan 1998-2001, and ongoing resource consent applications (2001-2012) provide a solid base for consultation on the work proposed in this application.

7.1 Parties consulted on the application

The consultation process to date has involved individual and combined meetings with an appointed Science Group, Hutt City Council, Upper Hutt City Council, iwi, ,Fish & Game NZ, DOC, recreation groups, Hutt Rotary and the Hutt Valley Flood Management Subcommittee. More particularly:

- Science Group;
- Port Nicolson Block Settlement Trust and Te Runanganui o Taranaki Whanui ki Te Upoko o Te Ika a Maui;
- Ngati Toa;
- Hutt City Council;
- Upper Hutt City Council;
- Department of Conservation;
- Fish & Game NZ;
- Hutt Rotary;
- Friends of the Te Awa Kairangi / Hutt River;
- Recreational Users Groups: Hutt Valley Canoe Club, Hutt Valley Anglers, Wellington Flyfishers, Kupe Canoe Club, Boulcott's Farm Heritage Golf Course, Shandon Golf course, Manor Park Golf course, Te Marua Golf course and Royal Wellington Golf course; and
- Infrastructure Providers (Transpower, Telstra Clear, NZTA, Wellington Electricity Lines Ltd, PowerCo, KiwiRail, Electra Ltd, Vector Ltd, Chorus Ltd) Winstone Aggregates.

The extent of consultation, comments received and, where appropriate, the GWRC response are summarised below.

7.2 Feedback received to date

7.2.1 Science Group

As outlined in Section **Error! Reference source not found.**, one of the key consultation components has been the establishment by GWRC of a 'Science Group' to provide advice to assist the consent application process and in particular the environmental monitoring that has been undertaken as part of preparing this application and the wider consenting process. This group has met routinely since June 2012, and their involvement is anticipated to continue throughout the processing of this application and beyond. The group includes a cross section of scientists from within GWRC and external parties including Fish & Game NZ, DOC and Massey University, together with a consultant river management engineer.

The group has been instrumental in guiding the design of environmental monitoring in the Te Awa Kairangi / Hutt River and rivers in the Wairarapa. This has included recognition of the potential value of the Natural Character Index that is under development in the New Zealand context by researchers from Massey University (namely Amanda Death, Dr Russell Death and Dr Ian Fuller). The Group's input has also contributed significantly to development of the COP.

The Science Group meeting in March 2013 discussed the draft Te Awa Kairangi / Hutt River application (which was subsequently lodged in early April) specifically, including the proposed approach, conditions, the adoption of new methods and the new COP.

Subsequent to this, the Science Group has given further consideration to the specific matters and effects arising from the proposed works in the Te Awa Kairangi / Hutt River as part of the ongoing drafting of the COP. This is an iterative process which is on-going and is extremely valuable to the project. It should be noted that the statements in this report do not necessarily reflect the opinions of individual members of the Science Group.

7.2.2 Port Nicolson Block Settlement Trust and Te Runanganui o Taranaki Whanui ki Te Upoko o Te Ika a Maui

Iwi representatives, from the Port Nicolson Block Settlement Trust and Te Runanganui o Taranaki Whanui ki te Upoko o te Ika a Maui, were part of the HFMP Advisory Committee. Meetings were held in late 2012 with the Teri Puketapu, from Te Runanganui o Taranaki Whanui ki te Upoko o te Ika a Maui, and Liz Melish from Port Nicolson Block Settlement Trust.

An outcome of these meetings was the commissioning by GWRC of the Cultural Values report, prepared by Raukura Consultants for the Port Nicolson Block Settlement Trust and the Wellington Tenths Trust, included in Appendix K and discussed in Section 6.19.

7.2.3 Ngati Toa

GWRC also met with the representatives of Te Runanga o Toa Rangatira Inc. and subsequently corresponded further with them via email. A copy of the draft resource consent application was provided to the iwi, and they have subsequently provided a Cultural Impact Assessment, which is included in Appendix K and discussed in Section 6.19.

GWRC Response

Wellington Regional Council recognises the importance of its relationship with mana whenua for river management activities across the region and its ongoing commitment to this relationship. As acknowledged above GWRC will continue to explore opportunities to engage with Iwi over these consent applications. As a consequence, it proposes to establish a Māori Consultative Group for river management activities which will convene once every 12 months.

The intention of this Group is to facilitate information flow between the Wellington Regional Council and tangata whenua regarding river management activities canvassed in these applications, identifying any issues of concern during implementation. It will also provide a forum to identify and describe how river management activities can affect the cultural values within each reach and within the footprint of the river corridor over time. Wellington Regional Council also acknowledges that there are other Council forums which are, or may be established, where river management activities could be discussed as part of a consultative forum.

A Kaitiaki Monitoring Strategy is also proposed to enable the identification of tohu (attributes), mahinga kai, tikanga which will inform the Māori Consultative Group and to provide greater detail on those attributes which have been identified in the Cultural Values Assessments.

7.2.4 Hutt City Council (City Infrastructure)

Consultation with the Hutt City Council (HCC) has been ongoing since October 1998 when work started on the HFMP. In addition, Hutt City Councillors are representatives on the Hutt Valley Flood Management Sub Committee.

GWRC officers met with HCC officers prior to the draft resource consent application being prepared. The draft application was sent to City Infrastructure, HCC in March 2013.

Comments Received

No specific concerns were raised, and in general officers are supportive of the work undertaken in the Te Awa Kairangi / Hutt River.

GWRC Response

Further discussion will be undertaken as comments are received.

7.2.5 Upper Hutt City Council

As with Hutt City consultation with the Upper Hutt City Council (UHCC) has been ongoing since October 1998 when work started on the HFMP. In addition, Upper Hutt City Councillors are representatives on the Hutt Valley Flood Management Sub Committee.

GWRC officers met with UHCC officers prior to the draft resource consent application being prepared. The draft application was sent to UHCC in March 2013.

Comments Received

No specific concerns were raised, and in general officers are supportive of the work undertaken in the Te Awa Kairangi / Hutt River.

GWRC Response

Further discussion will be undertaken as comments are received.

7.2.6 Hutt Rotary

Hutt Rotary has been part of the Te Awa Kairangi / Hutt River Trail Group since its inception. Rotary plays a key role in the success of the trail together with Hutt, Upper Hutt and Greater Wellington Councils. They are keenly interested in the work that GWRC undertakes in the Te Awa Kairangi / Hutt River and meet regularly with officers of the three councils to discuss what is happening in the river, with a particular interest in the Te Awa Kairangi / Hutt River Trail.

As part of the consultation on this application GWRC officers have meet with both the Te Awa Kairangi / Hutt River Trail committee and Hutt Rotary specifically. The draft resource consent application was sent to the Hutt Rotary in March 2013.

Comments Received

Key points include the following:

- The primary statement should include compliance with the Te Awa Kairangi / Hutt River Environmental Strategy of the Te Awa Kairangi / Hutt River Management Plan
- Over the 35 year term of this Consent, GWRC personnel will change and so some 'institutional knowledge' will be lost. To ensure that the Environmental Strategy for this public space is protected, that strategy should be part of the condition of consent
- The Consent should recognise the long term intention of Hutt City to improve the CBD interaction with the river corridor
- The terms of the consent should be such that in addition to GWRC Flood Protection, all agencies and contractors plus UHCC and HCC are required to comply with the intention of the Te Awa Kairangi / Hutt River Environmental Strategy in creating a recreational environment throughout the length of the Te Awa Kairangi / Hutt River corridor, and in particular 'a linear park that provides a tranquil environment where people go to escape the hustle and bustle of urban life, and enjoy the natural character of the river environment'
- In regard to Opahu Stream, white baiters really appreciate that GWRC has provided this lagoon to enhance the fishery and so it should be celebrated by all of us.

GWRC Response

GWRC are supportive of ensuring that the HFMP and its long-term vision are not 'lost' and the application has been amended to take account of Hutt Rotary's suggestions and to make reference to the Strategy where appropriate. It is noted that the COP contains the detail on how works in the Te Awa Kairangi / Hutt River will be undertaken in the future. Further consideration of the Te Awa Kairangi / Hutt River Environmental Strategy goals and actions and how they may be incorporated into the COP will be undertaken as it develops.

7.2.7 Friends of the Te Awa Kairangi / Hutt River

Friends of the Te Awa Kairangi / Hutt River (the Friends) are now actively engaged with GWRC on the health of the Te Awa Kairangi / Hutt River. As part of this application GWRC officers have met with the Friends group to discuss the application and the activities GWRC undertakes in the Te Awa Kairangi / Hutt River. The draft resource consent application was sent to the Friends in March 2013.

Comments Received

i. Initial feedback:

"Thank you for the valuable workshop with you on 18 Feb attended by you, Jacky Cox, and Mike Jensen from GWRC, and Teresa Homan, Stewart Homan, and Pat van Berkel from Friends of the Te Awa Kairangi / Hutt River.

At the workshop we discussed, amongst other things, the importance of swimmable swimming holes in the Te Awa Kairangi / Hutt River. To be able to swim in swimming holes requires that the holes physically exist and the water is not toxic – so they require that the river be well managed. Here is the list of the 11 swimming holes/spots in Upper Hutt:

1. Pakuratahi – Te Awa Kairangi / Hutt River confluence in Kaitoke
2. Te Awa Kairangi / Hutt River Gorge outflow near the Te Marua twin lakes pumphouse
3. Big Rock at SH2 just south of Mangaroa River confluence (opp. Beechwood Lane)
4. Edward Lomas hole – off Gillespies Rd
5. Twin bridges at Akatarawa River confluence
6. Opposite Birch Tce - 500m south of Akatarawa River confluence

7. Maoribank bend – Fergusson Dr meets SH2
8. Whakatikei River confluence
9. Whakamoonie (Poets Park) – 500m north of Moonshine Bridge
10. Long stretch of multiple reaches from Moonshine Park to Trentham Memorial Park, with access from both sides of the river
11. Silverstream rail bridge

Note, holes 3-11 are in the GWRC-managed section of the river.

ii. Additional feedback:

"The Friends seek to minimise the impact on the river's ecosystem and amenity value.

- We would like to see shading of the river to reduce water temperature and so reduce the occurrence of cyanobacteria (but it also makes it colder to swim – win some, lose some!), at least until we find some other way of reducing cyanobacteria concentration
- The use of natural rock over concrete blocks for groyne construction is definitely an aesthetic benefit and possibly a habitat benefit
- It would be good to have a plan in place should the Silverstream weir fail. Its replacement should not be in-river.
- We understand the usefulness of willow but would like to see natives interspersed among willows so there are habitats that encourage birdlife and creatures that favour natives. It would be helpful if GWRC Science Dept investigates alternatives."

GWRC response

GWRC is supportive of the overall objectives of the Friends. How GWRC works with the Friends and other stakeholders who have similar concerns to achieve those objectives will be multi-faceted across the Council and will continue to evolve as development of the COP progresses.

7.2.8 Recreational Users Groups

These include Hutt Valley Canoe Club, Hutt Valley Anglers, Wellington Flyfishers - Kupe Canoe Club, Boulcott's Farm Heritage Golf Course, Shandon Golf course, Manor Park Golf course, Te Marua Golf course and Royal Wellington Golf course.

GWRC recreation and tourism consultant TRC met with or contacted all the recreation groups listed above. The feedback and comments have been incorporated into the TRC reported in Appendix J to this application. TRC provides recommendation and mitigation in section 5 of their report.

Following on from these initial responses the draft application was sent to Hutt Valley Canoe Club, Hutt Valley Canoe Club and Wellington Flyfishers in March 2013.

Comments Received

No comments have been received as yet.

GWRC response

GWRC's views on the five resultant recommendations in the TRC report are:

- Consider recreational users in future design, planning and construction:
- This is already part of current practice and has been built into the COP.
- Ongoing education and communication with user groups, especially fishermen and kayakers - information sessions with GWRC to present maintenance plans and explain rationale and processes: this may be a useful approach.

- River survey of hazards by Hutt Canoe Club: The potential of this as a useful tool can be further explored with the HVCC.
- No net loss of pools on Te Awa Kairangi / Hutt River: This practice is already undertaken and is a condition of the existing consent. GWRC intends for this to continue as part of the COP.
- Access through Silverstream Weir for paddlers: The potential of this as an option can be further explored with canoe clubs.

7.2.9 Infrastructure Providers

GWRC sent a letter to Transpower, Telstra Clear, NZTA, Wellington Electricity Lines Ltd, PowerCo, KiwiRail, Electra Ltd, Vector Ltd, Chorus Ltd in January 2013. Following on from responses received the draft application was sent to KiwiRail in March 2013.

Comments Received

No relevant comments have been received.

GWRC Response: Further discussion will be undertaken as comments are received.

8 Continuous improvement and management

Consideration of mitigation needs to be undertaken in the context of the assessment of the significance of overall effects and the absolute need for river management to occur. It is important that any mitigation of river management activities achieves an overall net positive benefit for both the community and the environment. It is important that any constraints applied to river management activities do not negate the positive benefits to the community of the flood protection system or impose unrealistic costs on the community.

8.1 Proposed management and mitigation measures

8.1.1 Operational Management Plans

Operational Management Plans are a key tool for how river management operators plan and execute their work. The Plans manage work on a reach by reach basis, provide for identifying and managing reach specific values, and reflect the high-level direction provided in the Te Awa Kairangi / Hutt River Floodplain Management Plan.

The Operational Management Plans will also:

- describe the management objectives;
- describe the channel type and key morphological characteristics;
- contain the design channel and river corridor;
- describe minimum and maximum bed levels;
- describe any buffer zone;
- describe any areas with significant indigenous ecosystems or significant indigenous biodiversity values;
- describe any recreational values and areas of safety concern;
- identify and describe the cultural values of kaitiaki sites, established by the Māori Consultative Group;
- describe the range of management methods which may be implemented, taking into account:
  - effects on ecological and other significant environmental values; and
  - any recommendations from the Māori Consultative Group ; and
- include any other matters to comply with the COP

  The implementation of Operational Management Plans will enable the efficient and effect management of river management activities over time.

8.1.2 Site Specific Management

River management activities have the potential for short term adverse effects as addressed in Section 6 above. Wellington Regional Council proposes specific management procedures in the event that significant activities in identified sensitive locations and seasons are required. Significant activities are set out in the COP, and are generally related to one or more of the following:

- wet gravel extraction;
- bed recontouring;
- ripping in the active channel; or
- channel diversion cuts.

When site specific management is required, a Site Specific Environmental Management plan (SSEMP) will be prepared to demonstrate how the proposed river management activities will be limited to the extent necessary to undertake the activities in a manner that remedies or mitigates adverse effects on the environment. More specifically, an SSEMP will describe:

- the works proposed, including methodology and timing;
- the reasons why the proposed activities must be undertaken during that period and within that habitat, as applicable, and specific measures to remedy or mitigate effects;
- the site specific environmental monitoring;
- requirements of communication with key stakeholders;
- how the design channel and bed levels will be maintained;
- how any reach specific values identified by the Māori Consultative Group have been taken into account; and
- a suitably trained or qualified expert's opinion that appropriate steps will be taken to remedy or mitigate adverse effects or, if not, why an expert opinion was not required.

8.1.3 Ecological Enhancement Fund

In response to increasing the knowledge of river management activities and their effects on the Te Awa Kairangi / Hutt River, feedback from the Science Group, and feedback from key stakeholders such as mana whenua and DoC, Wellington Regional Council proposes to establish an Ecological Enhancement Fund (EEF). The EEF will implement recommendations identified in the Annual Report to maintain or enhance:

- the space available for the river (for example, by acquiring adjacent land);
- areas of vegetation with high biodiversity values (including the planting of native species) in the river corridor;
- in-stream values; or
- any other area of important habitat.

8.1.4 Environmental Monitoring Plan

GWRC propose to prepare an Environmental Monitoring Plan which will sit alongside the COP. It will provide a programme of environmental monitoring, involving collection of a range of physical parameters that reflect aspects of river natural character and processes, and which can be used as indicators of the effects of river management activities on selected environmental values. The EMP will consist of:

- the baseline monitoring parameters;
- survey methodologies;
- event monitoring; and
- procedures and methods for baseline reporting.

8.2 Existing mitigation measures

Mitigation that GWRC currently undertakes, and proposes to continue, in conjunction with management of the river environment includes:

- Funding of the Te Awa Kairangi / Hutt River Ranger. The Ranger helps to implement the Te Awa Kairangi / Hutt River Environmental Strategy by facilitating public access to the river, educating and informing users (via liaison with schools, and community and recreational groups interested in the river), managing the regional outdoors programme for the river (for example gravel grabs, fly fishing, walking events on the river), managing and directing the development of the river trail and preventing/taking enforcement action against inappropriate behaviour (e.g. dumping rubbish, vandalism and inappropriate use of motorised vehicles) that affects the positive experience of other users of the river environment.

- Funding of the annual drift dive surveys undertaken by Fish & Game NZ. This has been undertaken since 1999, and has built up a valuable database of fish numbers and trends since that time.
- Contribution to native plantings in the river corridor and development of the river corridor as a 'linear park' in accordance with the Te Awa Kairangi / Hutt River Environmental Strategy (2001.) As an example of this, Figure 13 below shows an area of native planting near the Silverstream Bridge, lying between Keith George Memorial Park and Trentham Memorial Park. Both of these parks are classified as Key Native Ecosystems (KNEs). The purpose of native planting is to enhance the river corridor between these two areas. Additionally, GWRC is also planting natives between the willow poles along the river edge in this area as a means of introducing native trees while still maintaining our flood defences. A similar approach is taken on all reaches of the river, although the recreation requirements of all users of the river corridor, including the need for open space, for sports fields and picnicking etc. governs the extent of planting. Once areas are planted, significant effort is made in maintaining the areas planted.

Figure 13: Native planting in the river corridor

9 Proposed conditions of consent

A proposed set of conditions of consent are appended to this application which seek to manage the potential adverse effects on the environment (Appendix L). River management activities have the potential for short term adverse effects, and cumulative effects as the river changes over time. The proposed conditions enable site specific management procedures for significant activities or activities in identified sensitive locations and seasons, and comprehensive monitoring and reporting methods to identify changes in the river system if it occurs.

Additionally, GWRC does not intend that any conditions of consent will impose quantum limits, as it needs to be able to undertake its operation and maintenance activities using its 'toolbox' as required, guided as necessary by limits established in the COP via the consideration of the outcomes of the environmental monitoring, rather than through the imposition of arbitrary limits.

The proposed conditions require that all river management works and maintenance activities are undertaken in accordance with good practice guidelines in the COP, which incorporate the extensive technical learnings on river management practices.

10 Statutory assessment

10.1 RMA assessment

Section 104 of the RMA sets out the matters to which a consent authority must have regard to, subject to Part 2 of the RMA, when considering an application for resource consent. These are:

- Any actual and potential effects on the environment of allowing the activity (refer Section 6 above)
  - Any relevant provisions of:
    - a national environmental standard
    - other regulations
    - a national policy statement
    - a New Zealand coastal policy statement
    - a regional policy statement or proposed regional policy statement
    - a plan or proposed plan; and
  - Any other matter the consent authority considers relevant and reasonably necessary to determine the application.

10.1.1 Part 2 of the RMA

Part 2 of the RMA sets out the purpose and principles of the Act. The purpose of the RMA is to promote the sustainable management of natural and physical resources.

The operations and maintenance activities undertaken by GWRC on the Te Awa Kairangi / Hutt River are imperative to protecting the social and economic wellbeing and health and safety of the people and assets of the Hutt Valley.

The COP, along with any necessary ongoing monitoring and the ability to review the COP where desirable will ensure that the life-supporting capacity of the river and its ecosystems are safeguarded and adverse effects are avoided, remedied or mitigated.

Additionally the works are proposed to be undertaken in a manner that minimises adverse effects on the natural character of the waterways and their margins, amenity values and the habitat of trout, and maintains public access to and along the waterways.

GWRC seeks to ensure that the relationship of Maori and their culture and traditions with the river are provided for.

In summary the river will be managed in a way which enables people and communities to provide for their social, economic and cultural wellbeing and their health and safety, while ensuring that the river itself has its life-supporting capacity safeguarded and adverse effects upon it avoided and mitigated. The proposal is in keeping with the purpose of the Act.

10.1.2 National Environmental Standards

There are currently five national environmental standards in effect as regulations under the RMA, for:

- Air quality
- Sources of human drinking water
- Telecommunications facilities
- Electricity transmission

- Assessing and managing contaminants in soil to protect human health
- None of the provisions of these standards are relevant to this application

10.1.3 National Policy Statements

Currently there are four national policy statements in force under the RMA:

- the New Zealand Coastal Policy Statement 2010
- the National Policy Statement on Electricity Transmission 2008
- the National Policy Statement on Renewable Electricity Generation 2011
- the National Policy Statement on Freshwater Management 2011

The National Policy Statement on Freshwater Management and the New Zealand Coastal Policy Statement are of potential relevance to this application.

10.1.3.1 National Policy Statement on Freshwater Management

Policy A4 of the NFM is an interim provision, requiring all regional councils to amend their regional plans to include the following requirements until changes made under Schedule 1 of the Act giving effect to Policies A1 and Policy A2 (dealing with freshwater quality limits and targets) become operative:

> *"1. When considering any application for a discharge the consent authority must have regard to the following matters:*
>
> *a) the extent to which the discharge would avoid contamination that will have an adverse effect on the life-supporting capacity of fresh water including on any ecosystem associated with fresh water and*
>
> *b) the extent to which it is feasible and dependable that any more than minor adverse effect on fresh water, and on any ecosystem associated with fresh water, resulting from the discharge would be avoided.*
>
> *2. This policy applies to the following discharges (including a diffuse discharge by any person or animal):*
>
> *a) a new discharge or*
>
> *b) a change or increase in any discharge –*
>
> *of any contaminant into fresh water, or onto or into land in circumstances that may result in that contaminant (or, as a result of any natural process from the discharge of that contaminant, any other contaminant) entering fresh water.*

The discharges of natural silts and sediments that result from the operations and maintenance works is not a new discharge in the sense that that this application is for a continuation of the works that are already undertaken on these waterways. In any event, the AEE illustrates that the manner in which the works will be undertaken avoids adverse effects on the life-supporting capacity of the waterways.

10.1.3.2 New Zealand Coastal Policy Statement

The New Zealand Coastal Policy Statement 2010 (NZCPS), prepared by the Minister of Conservation, sets out objectives and policies in order to achieve the purpose of the Act in regards to the coastal environment of New Zealand. The NZCPS 2010 took effect on 3 December 2010 and replaces the

NZCPS 1994. It contains objectives and policies which include those aimed at safeguarding the integrity, form, functioning and resilience of the coastal environment and sustaining its ecosystems, and preserving the natural character of the coastal environment.

The following objectives and policies of the NZCPS are relevant:

- Landscape and Natural Character: (NZCPS Objectives 1, 2, 5);
- Treaty of Waitangi, tangata whenua and cultural heritage (NZCPS Objective 3 and policy 2);
- Public access, recreational opportunity and open space (NZCPS Objective 4 and policies 19, 19, 20)

10.1.4 Regulations

The following regulations are of relevance to the application:

<u>Freshwater Fisheries Regulations 1983</u>

Clause 70 of these regulations states:

> *"(1) No person shall in any water intentionally kill or destroy indigenous fish.*
> *(2) No person, having taken indigenous fish from any water, shall leave the fish upon the bank or shore of any stream or lake, except where such indigenous fish is used in accordance with any provisions of a District Anglers Notice relating to lures".*

The proposed works are in accordance with these requirements. No indigenous fish are intentionally killed as the result of any of GWRC's works and maintenance activities, although there may be some inadvertent mortality of small fish or larvae living in the crevices of the river bed as a result of river bed disturbance associated with construction works, gravel extraction or bed re-contouring. Overall, the significance of this effect is expected to be less than minor due to the limited extent of any such effects. No large fish are expected to be affected as they are generally able to swim away from the affected areas. It is proposed that any eels or other fish found in drains affected by drain clearing activities could be re-located.

10.1.5 Regional Policy Statement

The proposal is in keeping with both the operative and proposed Regional Policy Statements for the Wellington Region. The requirements of the operative Regional Policy Statement are reflected in the current Regional Freshwater Plan.

GWRC notified a Proposed Regional Policy Statement in March 2009. This progressed through the Schedule 1 RMA process over the next 4 years, and was approved by Council to become operative in February 2013; formal notification of the new operative Regional Policy Statement is expected in late April 2013. This means that the current Operative Regional Policy Statement carries no weight in the assessment of this application. Accordingly, only a consideration of the relevant objectives and policies of the Proposed Regional Policy Statement is included. The relevant objectives and policies that the Regional Council is required to have regard to in consideration of this application are identified in Appendix M.

An analysis of the proposal against the relevant objectives and policies is outlined below. The objective and policy numbers given are those from the latest version (May 2010 - Decision Version) available on the GWRC website. It is understood that none of the changes to the Regional Policy Statement as a result of settlement of appeals.

Fresh water

Objectives 8 and 13 and Policies 16, 17, 42, 52 and 64.

Although the Te Awa Kairangi / Hutt River is a highly modified waterway, evidence shows that it supports a relatively healthy aquatic ecosystem that includes a diverse range of native fish, as well as a significant brown trout fishery. The proposal provides for the protection and possible enhancement of these values through the adoption of good practice at all times, and by the proposed monitoring which will continue to collect information on the effects of activities on aquatic and other ecological values and modify practices over time in response to the findings.

One of the objectives of the Te Awa Kairangi / Hutt River Environmental Strategy is the on-going improvement of access along the river corridor, and GWRC is committed to giving effect to this through its on-going works and activities in the river corridor.

Indigenous ecosystems

Objective 16 and Policies 22, 23, 46 and 64.

The approach proposed by GWRC is that the ecosystems and habitats within the application area will be maintained and in some cases enhanced. No habitats with significant biodiversity values have been identified.

Reduction of natural hazards

Objectives 18 and 19, and Policies 28, 50 and 51.

The proposed works and activities are in accord with the HFMP which has an overall key objective of minimising the risks and consequences of the effects of the flood hazard. They thus give effect to these objectives and policies. Adoption of good engineering and environmental practice, together with on-going monitoring will provide certainty that proposed works and activities are appropriate and will not increase hazard risks.

Tangata whenua

Objectives 22 to 27 and Policies 47, 48 and 66.

GWRC recognises the statutory and kaitiaki roles of iwi in relation to the Te Awa Kairangi / Hutt River and seeks an outcome that is agreeable to them which is in keeping with these objectives and policies. Engagement with tangata whenua is underway and will continue through the period of processing and consideration of the consent and the on-going development of the COP. Engagement will then continue through the life of the consent as the COP and monitoring are kept up to date.

10.1.6 Regional Freshwater Plan

RFP Appendix	Appendix Title	Are the water bodies the subject of this application included in the Appendix?	Relevant RFP policies
Appendix 2	Wetlands, lakes and rivers and their margins, with a high degree of natural character	No (Appendix includes Te Awa Kairangi / Hutt River above the water supply intake weir only)	
Appendix 3	Water bodies with nationally threatened indigenous fish recorded in the	No (and none of the identified nationally threatened indigenous aquatic plants are present)	

	catchment and nationally threatened indigenous aquatic plants		
Appendix 4	Water bodies with important trout habitat (including spawning areas) – water quality to be managed for fishery and fish spawning purposes	Yes – the Te Awa Kairangi / Hutt River from Te Marua to Melling Bridge, and much of the Akatarawa River down to its confluence with the Te Awa Kairangi / Hutt River, are identified in Appendix 4.	4.2.14, 5.2.3
Appendix 5	Water bodies with regionally important amenity and recreational values – water quality to be managed for contact recreation purposes	Yes - the entire Te Awa Kairangi / Hutt River within the application area is identified in Appendix 5 as follows: Te Marua to Silverstream - for canoeing, kayaking, swimming and angling; Silverstream to Melling - kayaking, power boating, swimming and angling Melling to the river mouth – for angling. Additionally the lower reaches of the Akatarawa River are identified for kayaking and swimming.	4.2.15, 5.2.4
Appendix 6	Water bodies with water quality to be managed for water supply purposes	No (Appendix includes Te Awa Kairangi / Hutt River above the water supply intake weir only)	
Appendix 7	Water bodies with water quality identified as needing enhancement	No	

The relationship of tangata whenua with fresh water

Objectives 4.1.1 – 4.1.3 and Policies 4.2.1 – 4.2.8

GWRC seeks an outcome that is agreeable to iwi and is in keeping with these objectives and policies. It seeks to ensure that the relationship of tangata whenua with the Te Awa Kairangi / Hutt River is recognised and provided for. Consultation with tangata whenua is underway and will continue through the period of processing and consideration of the consent and the development of the COP.

Natural values

Objectives 4.1.4 – 4.1.6 and Policies 4.2.9 – 4.2.14

The area of the application is not included in Appendix 2 of the RFP, being those waterbodies that have a high degree of natural character, nor in Appendix 3 of the RFP as being a river where nationally threatened freshwater fauna or plants are present.

The Te Awa Kairangi / Hutt River from Te Marua to Melling, and much of the Akatarawa River (including the reach at and immediately upstream of the confluence with the Te Awa Kairangi / Hutt River) is identified in Appendix 4 of the RFP as a water body with important trout habitat. GWRC's method of operation, the monitoring undertaken to date and their commitment to ongoing monitoring that might be necessary to further understand and avoid or mitigate any effect of its activities on trout reflect its commitment to avoiding, remedying and mitigating any adverse effects on important trout habitat.

The practices proposed by the applicant are to be undertaken in a manner that preserves the natural character of the Te Awa Kairangi / Hutt River and its margins as far as practicable. Similarly the approach seeks to safeguard the life-supporting capacity of the River and its ecosystems.

The work undertaken by Massey University and Gary Williams on the natural character of the Te Awa Kairangi / Hutt River further reinforces GWRC's desire to further understand the natural values of the Te Awa Kairangi / Hutt River and to ensure that they are not degraded.

Amenity value and access

Objectives 4.1.7 – 4.1.8 and Policies 4.2.15 – 4.2.17

The Te Awa Kairangi / Hutt River within the application area is identified in Appendix 5 of the RFP as having regionally important amenity and recreational values, as follows:

- Te Marua to Silverstream - for canoeing, kayaking, swimming and angling;
- Silverstream to Melling - kayaking, power boating, swimming and angling
- Melling to the river mouth – for angling.

Additionally the lower reaches of the Akatarawa River is identified in Appendix 5 as being important for kayaking and swimming.

The operations of the consent holder will be undertaken in a manner to avoid adverse effects on recreation, amenity and access. The applicant has historically avoided working in periods of peak recreation and times works so that adverse effects on amenity and recreational use are minimised. GWRC is actively engaging with recreational groups with a view to accommodating their needs as much as is practicable.

Public access is only restricted by the applicant within defined areas for the duration of particular works for public health and safety reasons. Otherwise, the applicant does not restrict public access.

- As well as avoiding adverse effects on recreation, amenity and access, GWRC actively facilitates the use of the Te Awa Kairangi / Hutt River and its margins for active and passive recreation. For example they provide native plantings in the river corridor and contribute to development of the 'Linear Park' for people to enjoy and experience the natural character of the river environment.
- GWRC also employs a Te Awa Kairangi / Hutt River ranger who implements the Te Awa Kairangi / Hutt River Environmental Strategy, facilitates public access to the river, educates and informs users (liaises with schools, and community and recreational groups interested in the river), manages the regional outdoors programme for the river (for example gravel grabs, fly fishing, walking events on the river), manages and directs the development of the river trail and prevents/takes enforcement against inappropriate behaviour that effects the experience of other users of the river environment, for example dumping rubbish, vandalism and inappropriate use of motorised vehicles.

Flood Mitigation

Objectives 4.1.9 – 4.1.10 and Policies 4.2.18 – 4.2.22

The operations and maintenance works that GWRC undertakes and seeks to continue undertaking are essential to meeting the outcomes sought by these objectives and policies.

The activities proposed to be re-consented by this proposal are undertaken to maintain the risk of flooding to human life, health and property to an acceptable level, being the level in accordance with the HFMP.

The development of the HFMP represented the culmination of a significant amount of work and gathering of information to define the flood hazard associated with the Te Awa Kairangi / Hutt River, and to develop a programme of flood mitigation works and activities that was acceptable to the local community. The activities proposed in this application are to be undertaken in this context.

In addition to the objectives and policies, the methods (other than rules) at 8.3 of the RFP require that GWRC maintains and enhances flood mitigation in river beds of the region.

Water Quality and Discharges to Fresh Water

Objectives 5.1.1 – 5.1.3 and Policies 5.2.1 – 5.2.16

These objectives and policies require that the area of the Te Awa Kairangi / Hutt River and tributaries the subject of this application be managed for aquatic ecosystem purposes, as a trout fishery/for trout spawning and for contact recreation purposes. The subject area of the Te Awa Kairangi / Hutt River and its tributaries are not listed in Appendix 2 of the RFP as bodies in which the water quality is to be managed in its natural state or for water supply purposes. Nor are they rivers to be managed so that water quality is enhanced (Policy 5.2.9).

The discharges associated with the works are of natural silts and sediments only. The works will be undertaken in a manner that manages the water body for its intended purpose. The COP will ensure that methodologies and times of works are developed so as to achieve this.

Water Quantity and the Taking, Use, Damming or Diversion of Fresh Water

Objectives 6.1.1 – 6.1.4 and Policies 6.2.1 – 6.2.19

Some of the works proposed require the temporary or permanent diversion of the watercourse for the purposes of undertaking the works. Any diversions required will be undertaken in a manner to avoid adverse effects.

Use of the Beds of Rivers and Lakes and Development of the Floodplain

Objectives 7.1.1 – 7.1.4 and Polices 7.2.1 – 7.2.15

These objectives and policies stress and illustrate the importance of GWRC's river management activities; the ability of GWRC to continue to undertake them and to maintain existing flood protection infrastructure.

Conclusion on objectives and policies

GWRC's proposal is in keeping with the objectives and policies of the RFP and achieves the environmental results anticipated.

The works proposed are essential to the wellbeing of the people of the Hutt Valley as they protect them to an agreed level of flood protection. The objectives, policies and methods require that this occurs, in a manner that provides for the recreational and natural values of the water bodies. GWRC are committed to doing this.

10.1.7 Regional Soil Plan

The proposal is in accordance with the requirements of the Regional Soil Plan for the Wellington Region (RSP).

The majority of the land in the river corridor, including the stopbanks and berms, falls outside the scope of the RSP.

The key objectives of the RSP of relevance to the proposal are:

- General - to ensure that land use practices reflect the inherent susceptibility of some landforms to erosion,
- Vegetation Cover - that vegetation cover is used wherever practical as a method of avoiding, remedying or mitigating erosion ,and
- Soil Disturbance - that sediment runoff is effectively managed

The need to address the inherent susceptibility of river banks to erosion is an integral part of all the flood protection works that GWRC undertakes, and the reason that many of the works are undertaken. Protection of the banks from erosion is primarily effected by the use of rock protection structures, riparian planting in conjunction with bed recontouring and other channel management practices. The use of vegetative cover to manage river bank erosion has been extensively employed in the Te Awa Kairangi / Hutt River, in conjunction with other methods where this is not practicable.

Generally the amount of soil disturbance associated with works out of the river bed will be limited. GWRC is committed to adopting good practice in such situations to ensure sediment runoff into the waterways is avoided as far as is possible.

10.1.8 Proposed Natural Resources Plan

The PNRP is the new generation combined regional plan for Wellington. The PNRP was publicly notified on 31 July 2015 and Council hearings will commence in April 2017. Until the conclusion of the necessary Hearings and any subsequent appeals, there is significant uncertainty as to the final rule provisions and objectives and policies that may be included in a Natural Resources Plan.

Therefore out of an abundance of caution, this application seeks resource consent under the Rules set out in Table 10.2 below. An assessment of the application under the themes of relevant objectives and policies is provided in Table 10.1 below. We note that confirmation of the relevance and applicability of these rules as the PNRP progresses will be discussed in conjunction with GWRC's regulatory team.

Table 10.1: PNRP Objectives and Policies

Objectives and policies theme	Objective/Policy	Comment
Mana whenua and relationships with air, land and water	Objectives 14 - 16	GWRC has established working relationships with mana whenua which recognises their connection to the air, land and water. Consultation with mana whenua has also been focussed on how the principals of kaitiakitanga can be realised through ongoing input into river management activities and cultural health monitoring.
Risk from natural hazards	Objective O20	GWRC's application relating to river management activities is focused on the Council's ability to manage risk from natural hazards and climate change in the form of flooding. This will mitigate the potential adverse effects of flooding on people, communities and infrastructure.
	Policy P29	GWRC's river management activities directly give regard to climate change and its ability to cause or exacerbate river flooding and erosion.

Objectives and policies theme	Objective/Policy	Comment
Riparian margins	Objective O27	GWRC's activities in relation to river management will involve establishing riparian vegetation. Other activities focused on improving flood resilience will maintain existing riparian vegetation.
Earthworks and vegetation clearance	Objective O44	GWRC may be required to carry out land use activities such as earthworks as part of its river management activities. GWRC will implement appropriate measures to minimise adverse effects on soil and water from these activities in accordance with the Good Practice guidelines set out in the COP (Annex 1).
	Policy P97	Earthworks and other land use activities will be managed to minimise discharges of sediments.
Minimising adverse effects	Policy P4	In this application, GWRC is proposing the use of good management practices during its river management activities, including timing activities appropriately and, where possible, locating the activities away from Scheduled sites.
Flood protection activities	Policy P15, P16	GWRC's river management activities are expressly provided for in policies P15 and P16. Both existing and new flood activities are recognised as being beneficial and generally appropriate.
	Policy P7	The proposed gravel extraction for flood protection and control purposes, are recognised as a form of beneficial use and development.
Managing gravel extraction	Policy P103	Gravel extraction activities will be carried out for the purpose of managing flooding and erosion and risk, and taking into account natural processes (including coastal processes).

Rules identified as relevant to the activities proposed have been identified as including (but not limited to) the following.

10.2 Proposed Rules in the PNRP

Rule	Rule wording	Activity Status
Rule R67	Discharges inside sites of significance	Non-complying
Rule R101	Earthworks and vegetation clearance	Discretionary
Rule R108	Activities in natural wetlands and significant natural wetlands	Non-complying
Rule R127	Reclamation of the beds of rivers or lakes	Non-complying
Rule R129	All other activities in river and lake beds	Discretionary
Rule R153	Removal or demolition of a structure or part of a structure	Restricted discretionary
Rule R195	Disturbance or damage inside sites of significance	Non-complying
Rule R201	Dredging for flood protection purposes or erosion mitigation inside sites of significance	Discretionary
Rule R205	Destruction, damage or disturbance inside sites of significance	non-complying

10.1.9 Section 104D

The application was lodged in April 2013. As described above, the activity status for the river management activities is discretionary under the operative plans. Therefore these consents continue to be considered, processed and decided on as discretionary activities. However out of an abundance of caution, if s104D applied the proposal will not be contrary to the objectives and policies of relevant plans and therefore meets the test of section 104D (1)(b).

10.2 Other matters

10.2.1 Te Awa Kairangi / Hutt River Floodplain Management Plan

Although the HFMP has no formal legal standing, it provides the context and underlying vision and direction for all the proposed works and maintenance activities. It is relevant to note that Policy 7.2.6 of the RFP is a requirement:

> *'To have regard to any relevant Floodplain Management Plan and the information provided in any relevant flood hazard assessment, or in connection with any River Management Scheme, when considering subdivision, use or development within any river bed or floodplain.'*

Accordingly, it is noted that the activities covered by this application are in accordance with the HFMP (and the Te Awa Kairangi / Hutt River Environmental Strategy, which forms part of it), and should be considered within this context.

10.2.2 Long Term Plan

GWRC's Long Term Plan is a requirement of the Local Government Act 2002, and contains information about the range of activities and services the council intends to provide to meet the region's needs, along with an explanation of expenditure and funding associated with them. The LTP for 2012 -2022 was adopted by Council on 27 June 2012.

Flood protection and control works to be undertaken over the next 10 years are outlined in Part 3 of the LTP. This reflects the strategy outlined in the HFMP and provides more specific detail around scheduling and funding of the works. The capital expenditure programme for the Te Awa Kairangi / Hutt River is included in Table 26, while the level of funding for the overall works and maintenance programme (for all rivers in the Wellington Region, including the Te Awa Kairangi / Hutt River) is shown in Table 27.

From these tables it can be seen that on average over $15 M is programmed to be spent annually in the next ten years on maintenance and operational activities in Wellington rivers, while over $1 M of investigations and studies, and more than $50 M of capital works and upgrades, are programmed for the Te Awa Kairangi / Hutt River alone over the same period.

In particular, it is of particular relevance to note that $229,000 has been identified for development of the new COP over the next two financial years.

The detail in the LTP provides the direction and basis for development of GWRC's annual operational works programmes.

Table 26: GWRC flood protection and control works capital expenditure programme 2012/13 to 2021/22

Flood protection and control works capital expenditure programme 2012/13 to 2021/22											
	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Total
Capital expenditure											
Investigations											
Mangaroa Flood Hazard Assessment	–	103,000	–	110,000	–	118,000	–	–	–	–	331,000
Pinehaven Flood Hazard Study	50,000	–	–	–	–	–	–	–	–	–	50,000
Waiwhetu FMP	100,000	–	–	–	–	–	–	–	–	–	100,000
Resource Consent Project	100,000	129,000	–	–	–	–	–	–	–	–	229,000
Environmental code of practice	100,000	129,000	–	–	–	–	–	–	–	–	229,000
Melling Bridge Investigations	–	–	–	109,000	–	–	–	–	–	–	–
Total	350,000	361,000	–	219,000	–	118,000	–	–	–	–	1,048,000
Capital works											
Hutt River											
Maoribank riverbed stabilisation	–	–	319,000	826,000	854,000	–	–	–	–	–	1,999,000
Ebdentown rocklining	–	–	–	–	–	824,000	–	–	–	–	824,000
City Centre Upgrade	150,000	206,000	727,000	876,000	5,180,000	5,295,000	5,468,000	5,654,000	1,557,000	–	25,113,000
Pinehaven Stream Improvements	–	–	–	273,000	282,000	291,000	300,000	309,000	319,000	330,000	2,104,000
Boulcott/Hutt Stopbank Construction	4,500,000	1,856,000	–	–	–	–	–	–	–	–	6,356,000
Melling Bridge Investigations	–	–	–	–	–	–	–	2,508,000	2,597,000	1,331,000	6,436,000
Pharazyn Stopbank Construction	–	–	–	–	–	–	–	–	2,602,000	4,041,000	6,643,000
Hutt Environmental strategy implementation	113,000	74,000	43,000	52,000	157,000	160,000	144,000	213,000	177,000	143,000	1,276,000
Waiwhetu Flood Improvements	100,000	–	–	–	–	–	–	–	–	–	100,000
Hutt River total	4,863,000	2,136,000	1,089,000	2,027,000	6,473,000	6,570,000	5,912,000	8,684,000	7,252,000	5,845,000	50,851,000

Table 27: GWRC flood protection works annual operating and capital expenditure

	2012/13 Plan $000s	2013/14 Plan $000s	2014/15 Plan $000s	2015/16 Plan $000s	2016/17 Plan $000s	2017/18 Plan $000s	2018/19 Plan $000s	2019/20 Plan $000s	2020/21 Plan $000s	2021/22 Plan $000s
Operating funding										
Understanding flood risk	2,162	1,925	1,793	1,834	1,906	1,943	1,999	2,042	2,032	2,042
Maintaining flood protection and control works and improving flood security	13,932	14,697	15,410	16,226	17,381	18,425	19,689	20,511	21,800	22,684
Total operating funding	**16,094**	**16,622**	**17,203**	**18,060**	**19,287**	**20,368**	**21,688**	**22,553**	**23,832**	**24,726**
Applications of operating funding										
Understanding flood risk	1,347	1,449	1,500	1,634	1,707	1,731	1,793	1,815	1,791	1,810
Maintaining flood protection and control works and improving flood security	10,610	11,171	11,688	12,137	13,005	13,713	14,773	15,132	16,132	16,872
Total applications of operating funding	**11,957**	**12,620**	**13,188**	**13,771**	**14,712**	**15,444**	**16,566**	**16,947**	**17,923**	**18,682**

Source: (Greater Wellington Regional Council, 2012)

10.2.3 GWRC Asset Management Plan

GWRC Asset Management Plan (AMP) contains further detail of the level of maintenance and anticipated expenditure relating to the assets (including flood protection infrastructure) managed by GWRC on behalf of the community. The requirements of the AMP are an important input to the development of GWRC's annual maintenance works programme.

10.3 Notification

The persons considered to be affected by the proposal are iwi, Upper Hutt City Council, Hutt City Council, Department of Conservation, Fish & Game NZ and recreational users of the River and selected tributaries.

In accordance with s95A (2) (b) of the RMA, GWRC requests that the application be publicly notified so as ensure that any other persons who may be interested in the proposal can become involved and have their say.

11 Summary and Conclusions

GWRC is seeking resource consents to enable the continuance of the suite of flood protection works and maintenance activities in the Te Awa Kairangi / Hutt River. This work is undertaken to fulfil GWRC's statutory obligations in respect of flood protection and management of flood hazard, and also give effect to the requirements of the Hutt Valley community, as outlined in the Te Awa Kairangi / Hutt River Floodplain Management Plan and Environmental Strategy.

The Te Awa Kairangi / Hutt River within the application area has been managed and modified since European settlement of the Hutt Valley. Today it flows beside significant areas of urban development and infrastructure. Despite this, the river generally has high water quality and supports a relatively diverse fish population. It is regarded as a significant recreational resource for the region.

The range of activities undertaken by GWRC in the river is comprehensive, covering the construction and maintenance of structures, establishment and maintenance of vegetative plantings and river bank protection and a variety of channel management and maintenance activities including bed recontouring and gravel extraction. Activities are undertaken both in the river bed and on public land within the river corridor. All of the activities identified are deemed to be necessary for the work, even if they have not been undertaken frequently in recent years.

The most extensive flood protection works in the river are willow protection plantings, which line approximately 57% of the banks within the application area, followed by rock lining, which affects approximately 25% of the total river bank length. The activities having the most potential for environmental impact are gravel extraction and bed recontouring; these occur in much smaller areas of the river.

The positive effects of the works are significant: the direct reduction of the flood hazard and risks to life, property and the economy of the Hutt Valley and the wider Wellington Region. They are a key component of the continued economic and social well-being of the Hutt Valley in particular and the region as a whole.

The main potential adverse effects can be grouped into five categories; those on:

- Water quality (arising from the input of suspended sediments to the water column arising from the direct disturbance of the bed or from works on banks or in culverts). The operation of machinery (particularly bulldozers) in the river bed gives rise to the greatest effects in this regard. Generally such work will be undertaken for several weeks per annum. Suspended solid concentrations of up to 700 mg/l can be generated for short periods, which is about the same as that arising from a one year return period flood. The aquatic biota are naturally adapted to cope with such variations in turbidity; available information to date suggests that in general the overall effect of increased suspended solids in the water is relatively minor and can be mitigated to a reasonable degree by restrictions of operations to no more than half of every 24 hour period.
- Aquatic ecology (arising from direct disturbance of the river bed habitat). Activities such as gravel extraction have a significant direct impact on the habitat and ecology of the affected reaches, however available information to date suggests that such effects may be relatively short-lived, with the river acting to re-work the bed naturally and the aquatic biota re-colonising impacted areas relatively quickly. Mitigation is currently focused on the continuance of good practice, as formalised in the COP, particularly incorporating final shaping of affected reaches to provide for more complexity of habitat to assist recovery. GWRC is committed to continued investigations into the impacts of in-river works on aquatic ecology (as outlined in the COP), which will ultimately help to improve practice and enhance mitigation.

- Birds (arising from disturbance, or from changes to potential nesting habitat on the river bed). Recent survey work has identified a wide range of bird species along the Te Awa Kairangi / Hutt River and its margins. Works currently undertaken in the river bed, especially the clearance of vegetation from the beaches within the river, is considered positive for the creation of potential nesting habitat. On-going regular survey work is proposed to identify any changes in river bird populations.
- Recreation (arising from restriction of access, or creation of hazards). Generally the adverse effects on in-river users from flood protection works do not appear to be significant. However it is recognised that GWRC needs to continue to work with user groups to address specific safety issues arising from damaged structures or debris in the river and to ensure that the design of any future grade control structures makes provision for in-river users as far as is practicable. This, and other mitigation, has been incorporated into the COP.
- Cultural (arising from changes to traditional areas of use and disturbance of areas of significance). Local iwi have traditionally valued the Te Awa Kairangi / Hutt River as a source of food and other resources; the iwi also have a wider cultural role as kaitiaki of the river, with a focus on the maintenance of its spiritual, cultural and physical values. Many of the provisions that have been incorporated in the COP to protect ecological values, such as works exclusion periods, requirements to include provision for fish passage, measures to avoid accidental fish mortality, and mitigation of adverse effects on aquatic habitat will also achieve positive outcomes in terms of cultural values.

  However, GWRC also acknowledges that there are some cultural and spiritual values that are more problematic to make provision for within the current river management paradigm.

GWRC is working with the iwi to ensure that understanding of cultural issues of importance and appropriate responses to them continue to be developed, and are incorporated into the COP.

Other potential adverse effects of the works on the landscape and visual amenity values of the river corridor are considered to be less than minor, particularly in the context of the other landscape enhancement work associated with implementation of the Te Awa Kairangi / Hutt River Environmental Strategy that GWRC undertakes.

GWRC has received very few complaints relating to its works and maintenance activities over the past 15 years, which suggests that potential adverse effects on the neighbouring community are relatively minor. The potential is likely to be greatest in areas where residences are closest to the river. GWRC proposes to continue to ensure that any complaints that are received are addressed and remedied in a prompt manner.

GWRC is seeking a 35 year term for the new consents, and is proposing not to include much of the specific detail relating to works, including work quanta, in the consent conditions. Instead, proposed conditions provide a framework to manage the effects of GWRC's flood protection works while allowing them to change over time in response to new information, technology and community demands.

A comprehensive COP is proposed to implement key decisions made under the Te Awa Kairangi / Hutt River Floodplain Management Plan, annual works and maintenance plans. An Environmental Monitoring Plan and Operational Management Plans will also guide GWRC's works and maintenance activities. The COP will provide specific detail and direction on the methodology to be adopted for individual activities. It will be a living document that reflects current good practice.

GWRC also proposes an on-going programme of research and monitoring of the key environmental effects of activities (such as gravel extraction). The outcomes of this monitoring will be subject to evaluation and review which in turn will lead to adjustments to the COP, through an agreed process. Iwi and stakeholders will be engaged in this process.

This approach allows for informed environmental decision making through-out the life of the consent, on the best information available. The approach avoids the need to seek changes to the consent conditions at unnecessary cost to the ratepayer but provides a robust system of ensuring that the activities and methodologies used are environmentally appropriate over the 35 year life sought for the consent.

A working draft of the COP is included with this application as Annex 1. Development of this document will be on-going through the application process, and beyond.

Consultation with affected parties and interested groups has been undertaken in the preparation of this application, and will be on-going in many cases throughout the processing of the application. GWRC is committed to giving appropriate effect to the statutory recognition afforded to iwi in relation to the Te Awa Kairangi / Hutt River. GWRC has requested that the application be notified to ensure any other affected or interested parties have the opportunity to have input to the consideration of the application.

This application has illustrated that the proposal is in keeping with the purposes of the RMA and the objectives and policies of the regional policy statement and plans and will deliver the anticipated environmental results that the policies of the regional plans are expected to achieve. For this reason we consider that the consents should be granted.

12 Applicability

This report has been prepared for the exclusive use of our client Greater Wellington Regional Council (Flood Protection), with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

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Appendix A: Consent Application Forms

Appendix B: Application Area & Land Ownership

Appendix C: Certificates of Title

Appendix D: Aerial photographs of Te Awa Kairangi / Hutt River reaches

Appendix E: Cameron (2016)

Effects of Flood Protection Activities on Aquatic and Riparian Ecology in the Te Awa Kairangi / Hutt River. Prepared for Greater Wellington Regional Council (Flood Protection).

Appendix F: Williams (2013)

Western River Schemes Natural Character. Report on the Natural Character of the Rivers and an assessment of Natural Character for Scheme Monitoring. Prepared for Greater Wellington Regional Council.

Appendix G: Activity Photographs

Appendix H: GWRC works and maintenance records

- Construction of groynes (tonnage, number and location) 1999-2013
- Maintenance of groynes (tonnage and location) 1999 -2013
- Construction of rock lining (tonnage, length and location) 1999-2013
- Maintenance of rock lining (tonnage and location) 1999 -2013
- Construction/maintenance/removal of debris fence
- Construction/maintenance/removal of timber groyne
- Willow and native planting
- Tree groyne construction
- Bed recontouring ('cross-blading') – location and length 1998 - 2011

Appendix I: Gravel extraction construction plans

Appendix J: TRC Tourism (2013)

Wellington Rivers Recreational and Tourism Assessment. Report prepared for Greater Wellington Regional Council.

Appendix K: Cultural Impact Reports

- **(Raukura Consultants, undated) – draft report**
- **(Te Runanga o Toa Rangitira Inc, 2013)**

Appendix L: Draft Conditions of Consent

Appendix M: Relevant Regional Objectives and Policies

- **Proposed Regional Policy Statement**
- **Regional Freshwater Plan**

Annex 1: Draft Code of Practice

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