MITCHELL DAYSH

Hawke's Bay Regional Council – Regional Assets Section

APPLICATION TO EXTRACT GRAVEL FROM THE TUKITUKI CATCHMENT RIVERS

October 2017

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REPORT INFORMATION

Report Status	Final (October 2017)
Our Reference	30034N
File Location	Taupo
Author	Jeremy Williams David Ray
Review By	Simon Bendall

A

PART A

Application for Resource Consent

FORM 9

APPLICATION FOR RESOURCE CONSENT

Sections 88 Resource Management Act 1991

To Hawke's Bay Regional Council
Private Bag 6006
Napier 4142

1. **Hawke's Bay Regional Council (Regional Assets section) applies for new resource consent as described below.**

2. **The activity to which the application relates (the 'proposed activity') is:**

   To extract gravel (defined as gravel and associated sand, silt and other riverbed sediments) from the river bed, comprising the active river channel and berms, for the purposes of maintaining the design channel capacity and the alleviation of flood and erosion risk in the following rivers (Tukituki Catchment Rivers):

   Tukituki River, Waipawa River, Makaretu River, Mangaonuku Stream, Tukipo River

   The volume to be extracted each year shall be based on:

   a) **Calculation and comparison of mean bed levels and reach volumes between cross sections and between 3 yearly surveys**
   b) **Comparison of mean bed levels and reach volumes with bed level design grade lines**
   c) **Based on (a) and (b), an assessment of the sustainable gravel extraction for the current year.**

3. **The site at which the proposed activity is to occur along with the relevant legal descriptions are as follows:**

   HBRC seeks consent for the extraction of gravel from the Tukituki Catchment Rivers in the locations highlighted in blue in Appendix A to this application, which includes:

   Tukituki River: from the coast upstream to map reference NZTM 1875983 east, 5581489 north (approximately 107 km from the coast towards the end of Tukituki Road).

   Waipawa River: from the confluence with the Tukituki River upstream to map reference NZTM 1871062 east, 5584833 north, near the end of Pendle Hill Road.

   Mangaonuku River: from the confluence with the Waipawa River to the confluence of the Mangamauku at map reference NZTM 1899100 east, 5588312 north near the end of Wharetoka Road.

   Tukipo River: from the confluence with the Tukituki River to SH50 at map reference NZTM 1884775 east, 5570745 north.

   Makaretu River: from the confluence with the Tukipo River to SH50 at map reference NZTM 1883583 east, 5565223 north.

4. **The land/site is mostly owned by the Crown and administered by the Hawke's Bay Regional Council. Exceptions are on the smaller streams or rivers where more recent flow meanders have left the historical channel and are now on private land.**

5. **I attach:**

   a) in accordance with the Fourth Schedule of the Resource Management Act 1991, an assessment of environmental effects (as Part B of this document) in the detail that corresponds with the scale and significance of the effects that the proposed activity may have on the environment.

   b) an assessment of the proposed activity against the matters set out in Part 2 of the Resource Management Act 1991, and

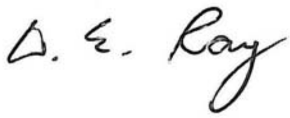
   c) a discussion of the matters specified in Rule 74 of the Regional Resource Management Plan (RRMP) and Rule 61 of the Regional Coastal Environmental Plan (RCEP).

6. **I attach an assessment of the proposed activity against any relevant provisions of a document referred to in section 104(1)(b) of the Resource Management Act 1991, including the information required by clause 2(2) of Schedule 4 of that Act.**

7. **The applicant seeks a consent duration of 25 years.**

Dated this 13th day of October 2017.

Signature: Hawke's Bay Regional Council by their duly authorised agents Mitchell Daysh Limited.



David Ray

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Please contact both the applicant and agent representatives on all relevant correspondence relating to the application for resource consent.

B

PART B

Assessment of Effects on the Environment

1. INTRODUCTION

1.1 BACKGROUND

Historically, the Hawke's Bay rivers draining the Ruahine, Kaimanawa, and Kaweka Ranges have transported large volumes of greywacke gravels and other sediments from those ranges, depositing it onto alluvial plains to the east of the ranges. This sediment transport process resulted in the rivers meandering across the alluvial plains over time as braided and semi-braided river channels.

During the second half of the 20th century, flood protection schemes were established to protect rural and urban development from flooding from these rivers. The Hawke's Bay Regional Council – Regional Assets Section (HBRC[1]) has the responsibility for managing these schemes.

An important component of the schemes is a series of stopbanks, which contain floodwaters within a defined 'floodway'. The stopbanks and other flood protection assets (such as riparian planting and other erosion protection works) have confined the braided rivers to the floodway, which is typically 100 to 250 metres wide, depending on the river reach. The floodway is designed to safely convey a design flood event, which requires the floodway to have a minimum width and depth at any particular location so that the floodwaters can pass through the floodway without overtopping or compromising the stopbanks.

The rivers continue to transport gravel and sediments from the ranges into the braided and semi-braided river channels. Major flood events move these sediments through the system, while at the same time bringing more material down from the ranges. Partly because the braided channels no longer meander freely across the plains, and partly because any significant movement of gravel relies on intermittent and unpredictable flood events, sediment can build up in some locations, raising the bed level and reducing the channel capacity between the river bed and the top of the stopbanks. This reduces the flood protection provided by the stopbanks and can raise water tables, making it difficult to manage adjacent farmland.

If this sediment build-up was allowed to continue without intervention, the stopbanks would eventually be overtopped during large flood events. Localised aggradation can also cause river meanders to switch from a preferred tangential flow alignment into a more destructive alignment into the vegetated active edge or the stopbanks, causing them to be undermined and subsequently fail. Such circumstances would result in hazards to people and damage to rural and urban development.

Under the Soil Conservation and Rivers Control Act 1941, regional councils have a statutory responsibility for flood control. To achieve this in the context of sediment build-up, HBRC encourages aggregate suppliers to excavate gravel from the dry parts of the river beds (sometimes referred to as 'beaches'), with the objective of maintaining the bed at a 'design

[1] Throughout this document the term 'HBRC' refers to the Assets Section of HBRC, unless noted otherwise.

grade'. The design grade is the calculated grade of the river bed (i.e. the bed level at any particular location) required to maintain the required floodway height and area.

The gravel extraction has until now been authorised by very short-term consents, typically one year, using a Council-managed consent application template system. This system is however not delivering the desired results for extractors who seek longer term certainty, or for HBRC in terms of achieving its flood management objectives.

To address these issues, HBRC has developed a Gravel Management Plan (GMP) with the objective of improving the management of gravel for flood control purposes. This GMP was been adopted by Council in September 2017 following a special consultative procedure.

Ultimately, HBRC intends to seek a variation to the Hawke's Bay Regional Resource Management Plan (RRMP) and potentially the Regional Coastal Environment Plan (RCEP) with a view to establishing a permitted activity regime for gravel extraction undertaken in certain circumstances, and in support of flood management objectives.

Given the length of time such a process will take (the next review of the RRMP is not slated to start until 2020/2021), and the increasing issues associated with gravel aggradation, HBRC considers it necessary to obtain comprehensive gravel extraction resource consents for the five main rivers from which gravel is extracted. The consents sought will authorise gravel extraction for flood control purposes that will not be able to comply with the existing permitted activity rule standards. These five rivers are:

- Ngaruroro River
- Tutaekuri River
- Tukituki River (including the major Ruataniwha tributaries Tukipo, Makaretu, and Mangaonuku)
- Waipawa River (also Ruataniwha tributary)
- Esk River

Considerably greater volumes of gravel have been extracted from the Ngaruroro River than in the other four rivers, with on average 60% of the total regional river gravel volumes being sourced from the Ngaruroro in recent decades. This is likely to continue into the future, due to greater allocable volumes being available in the Ngaruroro, and its proximity to the sources of gravel demand. Nevertheless, gravel extraction will be required from the other four rivers as and when their bed levels aggrade above the design grade, and/or when one-off construction projects arise.

This document comprises the resource consent application and associated Assessment of Environmental Effects (AEE) for gravel extraction from the Tukituki Catchment Rivers.

1.2 REPORT STRUCTURE

In Part A: Resource Consent Application

- Sets out an application for a gravel extraction resource consent from the Tukituki Catchment Rivers. Hawke's Bay Regional Council Application Forms (A & B) are also provided in **Appendix C**.

In Part B: Assessment of Environmental Effects

- Describes the existing environment (Section 2)
- Describes the proposed activity (Section 3)
- Describes the activity status of the proposal as set out in the Hawke's Bay Regional Plan (Section 4)
- Describes the analysis and information requirements as set out in the Resource Management Act 1991 (Section 5)
- Discusses any actual or potential environmental effects associated with the proposal (Section 6)
- Analyses the proposal in terms of the relevant statutory documents under the RMA
- Outlines the consultation undertaken

1.3 SUPPORTING DOCUMENTS

There are a number of documents that support these consent applications, which are summarised below.

'Environmental Code of Practice for River and Waterway Works'. February 2017. HBRC Report No. 3256 – AM 04/15

This Code of Practice defines the range of operational activities undertaken by HBRC and its contractors, and describes best practice environmental standards that apply to HBRC's river control and drainage works. The Code of Practice does not have any statutory powers, but a number of the environmental standards have been embodied in the proposed consent conditions of this AEE.

'Tukituki Catchment Rivers: Ecological Management and Enhancement Plan'. HBRC Plan No. 4925, May 2017.

The HBRC's Ecological Management and Enhancement Plan (Forbes, 2017b) (EMEP) has two purposes. Firstly, it identifies the ecological values associated with the reach of the particular river managed for drainage and flood control purposes (Section 2), and presents management objectives and methods to avoid or otherwise minimise adverse ecological effects from flood control operations (Section 3). Secondly, options are presented to enhance ecological aspects of the scheme area, specifically: (1) areas of encroached gravel riverbed and (2) native flora values of the scheme berm areas (Section 4).

'Scoping Report: Review of Riverbed Gravel Management'. Prepared for HBRC by Tonkin & Taylor, November 2010.

The purpose of this report was to outline a programme of work to help improve HBRC's understanding of riverbed gravel management and the impact of gravel extraction on flood protection works and coastal processes, and to review HBRC's management regime for assessing the gravel resource and allocating its use.

'Gravel Review: Terrestrial Ecology Impact Assessment'. Prepared for HBRC by Forbes Ecology, April 2017.

This report assesses the impacts of HBRC's river beach raking and gravel extraction activities on the terrestrial ecology of the Hawke's Bay braided river network, and recommends appropriate measures to address those impacts.

'Effects of Gravel Extraction and Beach Raking on Key Instream Species in Hawke's Bay Rivers'. Prepared for HBRC by the Cawthron Institute, January 2017.

This report assesses the impacts of HBRC's beach raking and gravel extraction activities on the water quality and aquatic ecology of the Hawke's Bay braided river network, and recommends appropriate measures to address those impacts.

Tukituki River Catchment. State and Trends of River Water Quality and Ecology 2004-2013; Prepared by Aquanet Consulting, July 2016

This report summarises state and trends in river water quality and ecology across the Tukituki River catchment. The report is 1 of 6 State of the Environment (SoE) reports for the Hawke's Bay region summarising river water quality and ecology data. The reports form the detailed regional 5 yearly review of surface water quality and ecology and are an update from the previous round of reports completed in 2009.

1.4 DEFINITIONS AND ABBREVIATIONS

For the purposes of this AEE, the following terms are defined as follows (refer also to **Figure 1** below):

Active river channel	The entire width of the braided river channel, including dry gravel beaches, but excluding the berm.
Actively flowing channel	Comprises the wetted river area of the active river channel being that part of the channel that is in contact with water.
Aggradation	An increase in river bed level over time, typically within a specific reach of the river, through the build-up of river sediments. Aggradation is a natural river process, but can be exacerbated by human actions, e.g. by preventing the river meandering across a floodplain.
Beach	The dry parts of the active river channel (from which gravel is typically extracted). This includes islands surrounded by water.
Berm	Land between the active river channel and the stopbank (1) or naturally elevated land that forms part of the floodplain (2). The berm is an area that is generally only inundated during large flood events, i.e. greater than the mean annual flood.

Code of Practice	HBRC's 'Environmental Code of Practice for River Control and Waterway Works' (contained in **Appendix D** of this AEE).
Degradation	A decrease in river bed level over time, typically within a specific reach of the river, through erosive processes (sometimes exacerbated by a decrease in sediment supply from upstream reaches). Degradation is a natural river process, but can be exacerbated by human actions, e.g. over-extraction of sediments.
Design grade	The design grade of the river bed at any particular location is based on the ability of the river to convey the flood flows such that the energy of the river is best used to deepen the bed rather than causing lateral scour of the banks. In practice this is achieved through keeping the active channel capacity, before it flows onto the berms, at the mean annual flood flow (2.3 year return period event).
EMEP	Tukituki River Ecological Management and Enhancement Plan (Forbes 2017b)
Gravel	Refer to 'sediment' definition below.
Sediment	Includes all alluvial material found in the active river channel and berms. Sediment consists of the broad categories of gravels, sands and silts. For convenience, the term 'gravel' is often used in this AEE and proposed conditions, as it is the bulk of the extraction in most cases.

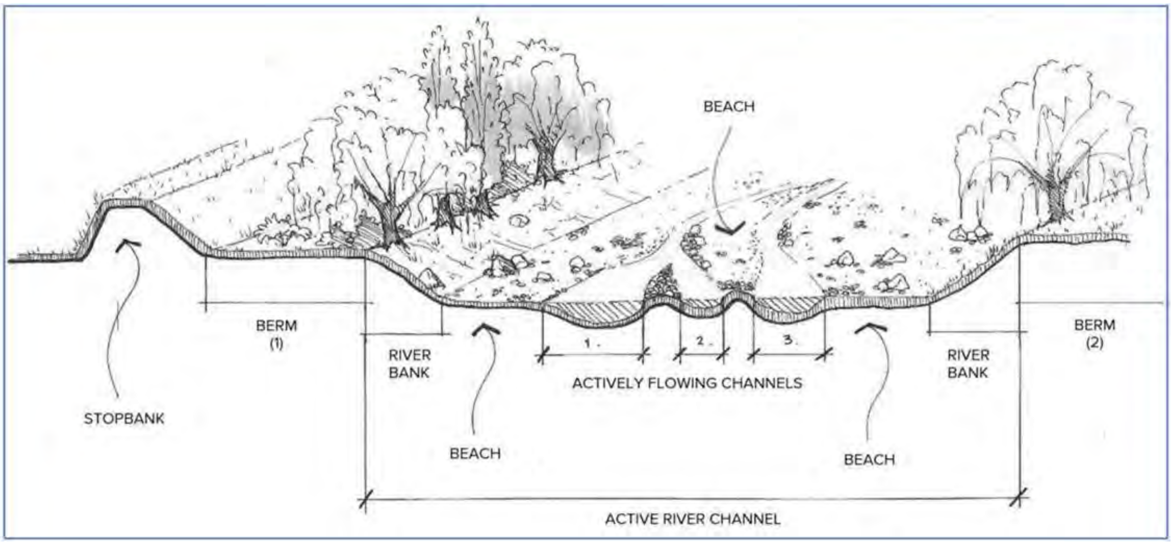


Figure 1: Definitions of terms relating to the braided river channel

2. EXISTING ENVIRONMENT

2.1 OVERVIEW

The Tukituki River (‘Tukituki’) originates in the Ruahine Ranges, draining an area of approximately 2,500 km^2. The river flows generally eastward from the ranges and through the Ruataniwha Plains until its confluence with the Waipawa River, after which it turns north-east, flowing between the Kaokaoroa and Silver Ranges before discharging to Hawke Bay near Haumoana (**Figure 2**). Within the section of the river within which consent is sought for gravel extraction, the river is generally a wide braided channel (e.g., **Figure 3**).

The characteristics of the Tukituki in terms of sediment transport are somewhat different from the Ngaruroro, Tutaekuri and Esk Rivers, as the Tukituki subsided during the 1931 Hawke’s Bay earthquake, whereas the lower reaches of the Tutaekuri, Ngaruroro and Esk Rivers were uplifted, trapping the gravels of those three rivers further inland. The Tukituki is therefore the only large Hawkes Bay river that still provides a source of gravel and sand to the ocean beaches. This is discussed further in Section 4.7 below.

For the purposes of this AEE, the Tukituki is split into three broad reaches:

- Upper Tukituki: From the upper extent of gravel management to the Tamamu Bridge (5 km downstream of the Waipawa River confluence)
- Middle Tukituki: From the Tamamu Bridge to the Red Bridge (near Havelock North)
- Lower Tukituki: From the Red Bridge to the coast

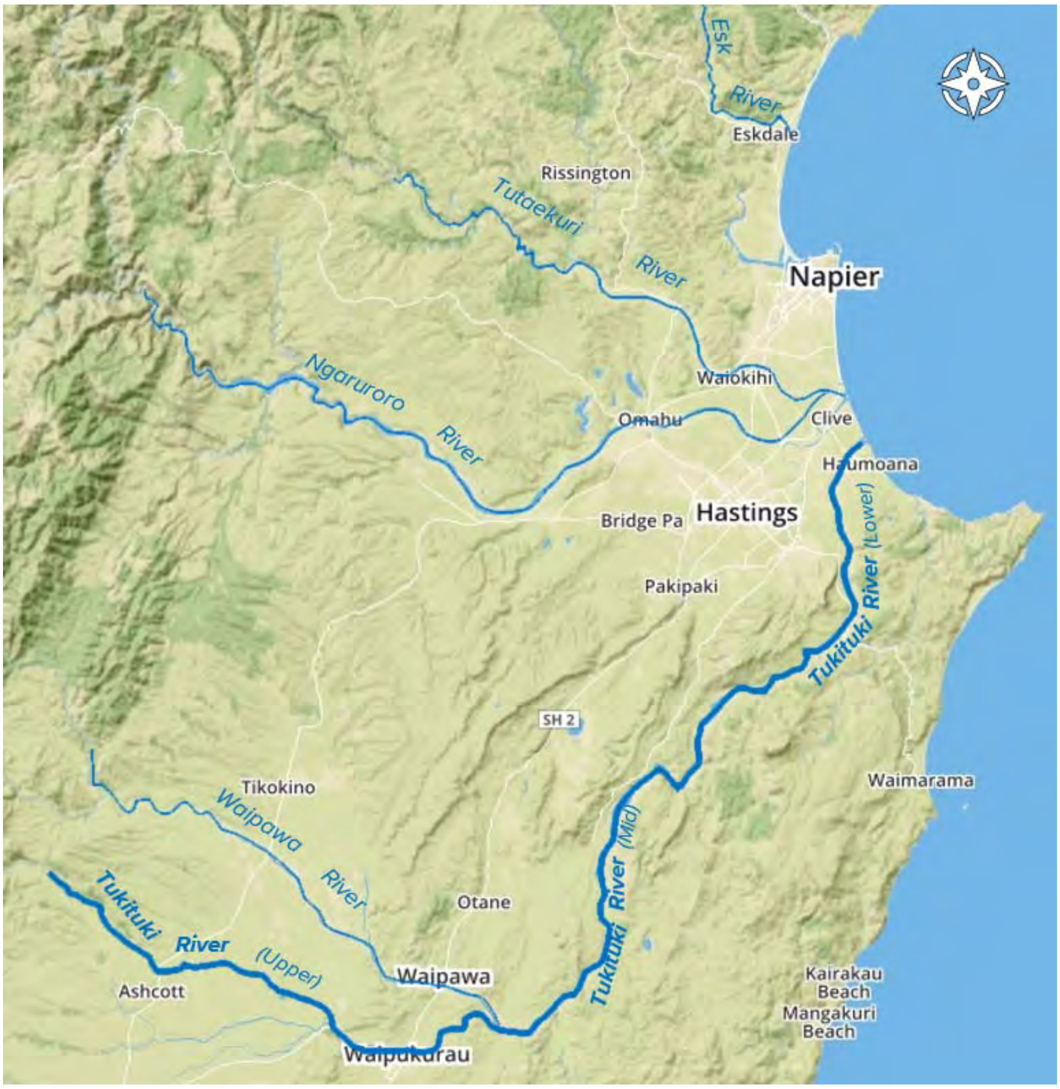


Figure 2: **Locality Plan**

Figure 3: Typical section of braided Tukituki River channel (looking upstream, at the confluence with the Mangatarata Stream, east of Waipukurau)

2.2 FLOOD PROTECTION

HBRC has responsibility for several flood protection schemes in the region, particularly on the Ngaruroro, Tutaekuri, Waipawa and Tukituki rivers. These have been in place since the 1960s, with significant reviews occurring in the 1980s to 2000. Flood protection from the upper Tukituki River and tributaries is provided by the Upper Tukituki Flood Protection Scheme (UTFPS), which protects about 25,000 ha of productive farmland and around 5,000 people who live within the scheme boundaries, including the urban centres of Waipawa and Waipukurau. Protection from the lower Tukituki is provided by the Heretaunga Plains Flood Protection Scheme (HPFPS), which protects Havelock North, other settlements near the coast, and surrounding farmland.

The schemes have been constructed to specific design standards, and their effectiveness is dependent on maintaining these design standards. HBRC has commenced a review of the level of service that these schemes provide, including seeking feedback from the community to see what level of risk they are willing to accept.

In managed scheme areas where flood protection measures consist of stopbanks and active berm and channel management, it is important to monitor and manage the effects of changing sediment supply to the reaches. Both aggradation and erosion are of concern. Currently the most cost effective means of dealing with aggradation is through commercial extraction, and erosion is dealt with through limiting extraction. The effect of riverbed level increases due to gravel aggradation on flood levels has been examined through the use of Council's hydrodynamic models of the rivers.

In summary, this resource consent is being sought to support HBRC's statutory flood hazard management responsibilities, by enabling active management of the riverbed sediment (gravel, sand and silt) resource. Extraction of sediment from riverbeds is essential for the community's safety, as it maintains channel capacities, avoids flooding, and projects adjacent land. Conversely, too much extraction can lead to degrading rivers that would undermine bridges and banks and lead to erosion of land.

2.3 HISTORIC AND CURRENT RIVER GRAVEL MANAGEMENT

2.3.1 Historic Gravel Extraction

Upper Tukituki

Peak extraction in the Upper Tukituki occurred in the early 1980's (Figure 4) for construction of the embankments for the UTFPS. Extraction then reduced due to the long transport distances and associated costs. In recent years extraction has also been limited as part of HBRC's policy of trying to bring the Lower Tukituki back to grade line, and to get more gravel delivered to the coast.

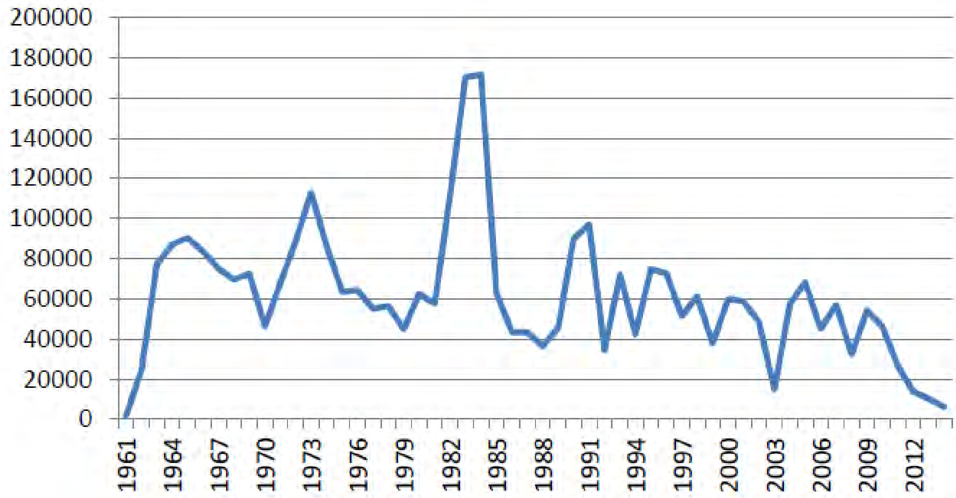


Figure 4: Historic gravel extraction from the Upper Tukituki River

Middle Tukituki

Peak extraction in the Middle Tukituki occurred in 1970 and between 1984 and 1988 (Figure 5). Extraction then reduced due to difficulties with access. There is significant aggradation in this reach, but extraction is dependent on further morphological modelling of this section of the river to determine the grade line design and sustainable extraction.

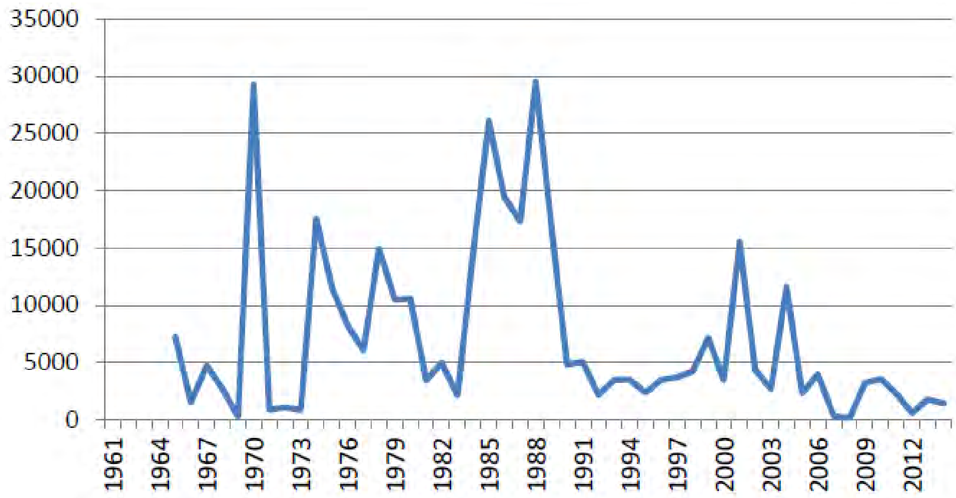


Figure 5: Historic gravel extraction from the Middle Tukituki River

Lower Tukituki

Peak extractions in the Lower Tukituki occurred in 1979 and 1997, which resulted in over-extraction (Figure 6). The Tukituki is the only river that transports gravel to the Haumoana coast, which has foreshore erosion issues. HBRC policy has therefore been to reduce extraction to allow gravel to reach the coast, and minimal extraction is likely to occur for some time (apart from sand and silt) to allow the bed to aggrade and increase gravel supply to the coast.

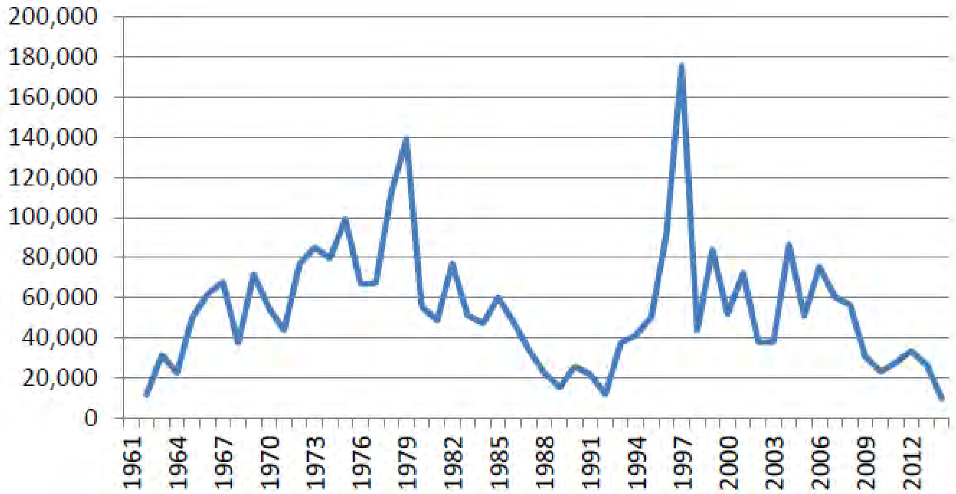


Figure 6: Historic gravel extraction from the Lower Tukituki River

2.3.2 Tonkin & Taylor Scoping Study and Subsequent Investigations

Given the importance of managing the sediment within the Hawke's Bay's braided rivers for flood protection purposes, and the challenges involved in that, HBRC has been reviewing its management strategy for a number of years, which has included several technical investigations.

A scoping report was completed by Tonkin & Taylor in 2010 to review the way in which HBRC managed riverbed and coastal gravel resources within Hawke's Bay (Tonkin & Taylor 2010). The scoping report concluded that a review was required, with the aim of:

- Improving the Council's understanding of riverbed gravel movement and the impact of gravel extraction on flood protection works and coastal processes.
- Reviewing the Council's management regime for assessing the gravel resource and allocating its use.

The scoping study identified a range of issues to be further assessed, and recommended further investigations be carried out to assist in meeting the above aims. HBRC adopted the recommendations of the report, and work proceeded over the following 6 years to complete the tasks described in the report, summarised as follows:

1. Review of river hydrology
2. Assessment of gravel supply and transport
3. Preparation of a gravel resource inventory
4. Determining the implications of gravel management for flood protection
5. Forecasting gravel demand
6. Monitoring of gravel and determining the available resource
7. Assessment of effects on instream ecology
8. Assessment of effects on riverbed birds and vegetation
9. Assessment of tangata whenua values and management options
10. Assessment of the effectiveness of beach-raking
11. Consideration of RMA issues that influence gravel management
12. Review of allocation and financial mechanisms that influence gravel management
13. Preparation of a Gravel Management Plan.

The results and outcomes of the above investigations help to support the information requirements of these consent applications.

2.4 RIPARIAN LAND USE

2.4.1 Catchment Land Use

The Tukituki catchment extends from the Ruahine Range – the source of the Tukituki and Waipawa rivers – to the Pacific Ocean at the coast of Hawke's Bay. The catchment is approximately 2,500 km^2 with 5 management zones:

- Upper Tukituki/Waipawa,
- Ruataniwha North,
- Ruataniwha South,
- Papanui and
- Lower Tukituki corridor.

The extent of the Tukituki catchment within the Hawke's Bay Region is identified in **Figure 7**.

Figure 8 identifies the land cover database for both the Tukituki River catchment.

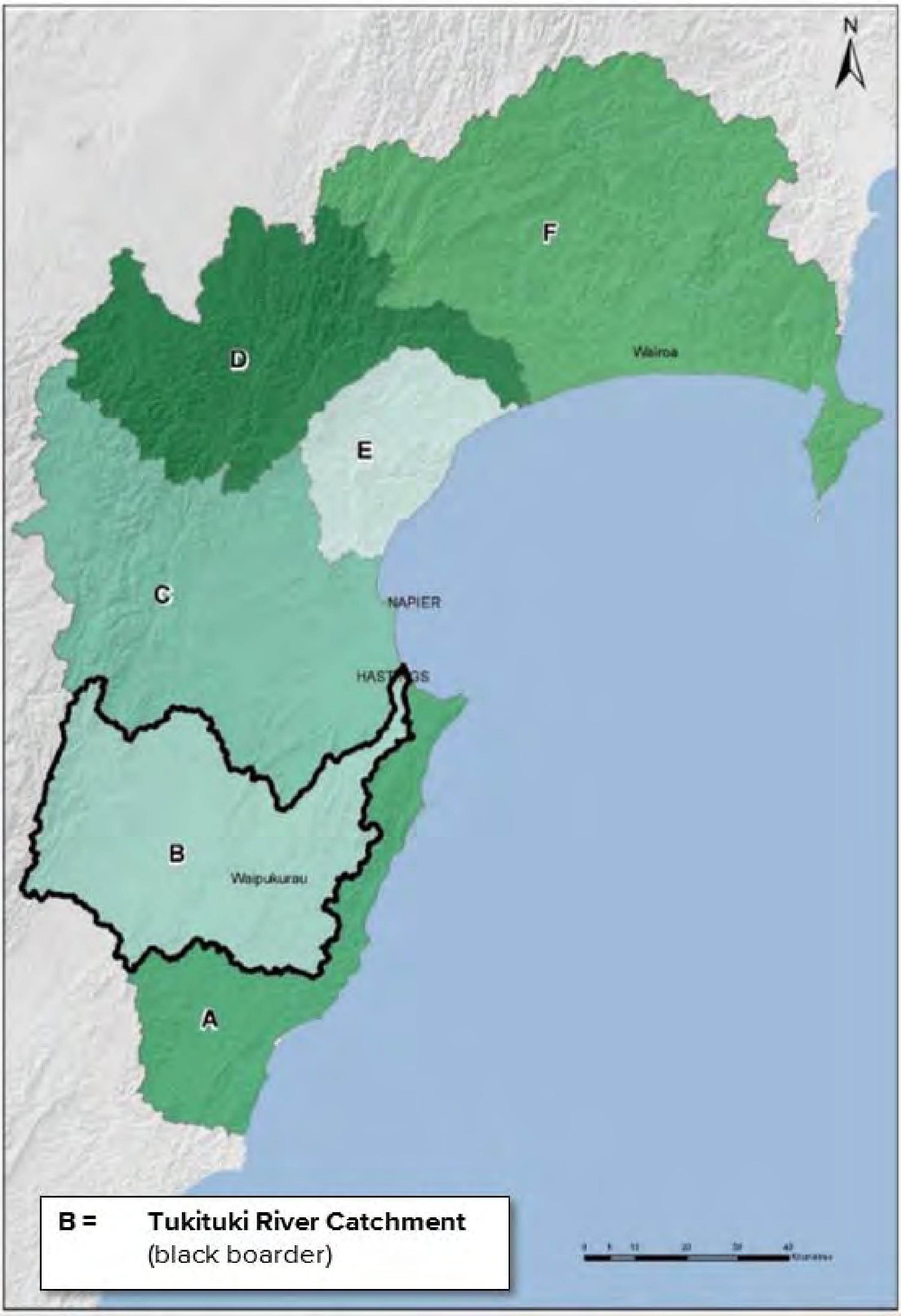


Figure 7: Tukituki catchment

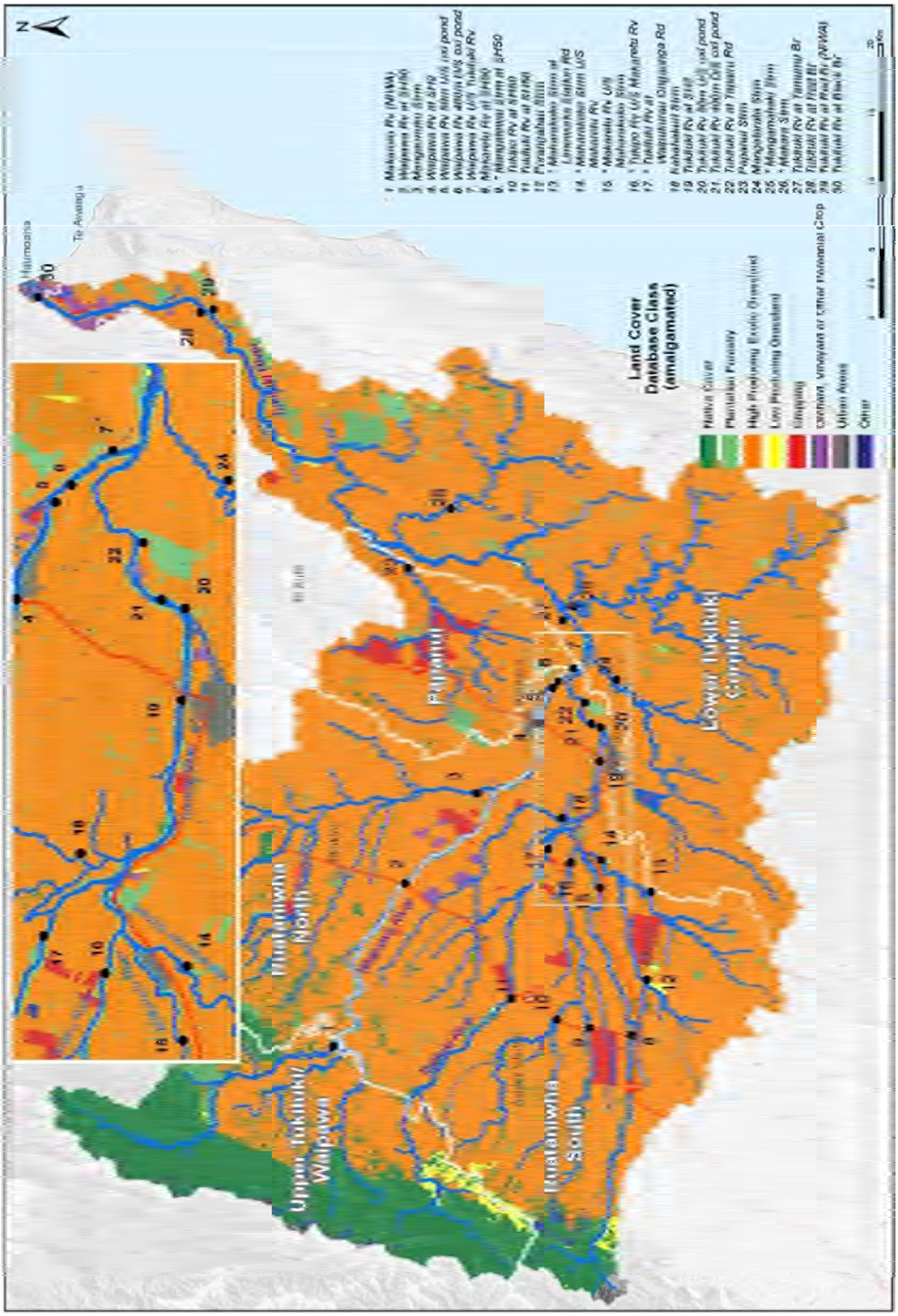


Figure 8: Land cover for Tukituki Catchment

In terms of the physical geography of the Tukituki catchment, a description is provided[2] as follows:

The Tukituki River and its largest tributary, the Waipawa River, begin high in the Ruahine Range. The other major tributaries originate in the foothills of the Ruahine Range (Tukipo River and the Makaretu Stream). The Argyll Ranges border the catchment to the north (Mangaonuku Stream), and the Two Peaks Ranges are to the south (Porangahau Stream, Mangatarata Stream) (Ausseil 2008).

The hard sedimentary rock of the Ruahine Range, source of the Tukituki and the Waipawa headwaters, is dominated by Triassic-Jurassic greywacke. The Ruahine Range foothills are underlain by tertiary mudstone and sandstone. Gravels deposited on the extensive sedimentary basin make up the Ruataniwha Plains. The basin is bounded to the south, north and east by medium elevation hill ranges. The hill ranges are dominated by sandstones and mudstones, but with significant outcrops of limestone, particularly in the middle catchment (Ausseil, 2008). More detailed information and maps can be found in previous HBRC technical reports (Ludecke, 1988) (HBRC, 2003).

The Ruahine Range, from which the Tukituki and Waipawa rivers flow, receive more rainfall than the Ruataniwha Plains and are the source of much of the rivers' flow and gravel bed load. The drier Ruataniwha Plains lie at the base of the ranges, having formed from sediment that has eroded from the mountains. The Waipawa, Makaretu and upper Tukituki rivers lose water as they traverse the plains because the channels are perched on permeable gravels deposited by the rivers. The water that is lost to groundwater subsequently re-emerges, together with direct rainfall recharge, in spring-fed streams of the Ruataniwha Plains, such as the Kahahakuri Stream.

At the eastern edge of the Ruataniwha Plains, both gaining and losing tributaries come together to form the main stem of the Tukituki River. The Tukituki River then flows through hill country of soft sedimentary rock where inflowing tributaries have more variable flows and less groundwater contribution (Wilding and Waldron 2012).

Relatively higher rainfall and lower evaporation increases river flows in winter. In addition to seasonal cycles, river flows respond to longer-term climate cycles. El Niño events reduce rainfall, and increase the risk of drought, because the moisture from more prevalent westerly winds is intercepted by the Ruahine Range before reaching the Ruataniwha Plains (Wilding and Waldron 2012). Dry settled weather is brought into Hawke's Bay by westerly airflows. Southerly and easterly airflows bring wet weather to the region and that rainfall increases river flows. Tropical cyclones and subtropical depressions are also known to affect Hawke's Bay weather, causing landslips and flooding. The mean annual rainfall on the Ruataniwha Plains ranges from 910-1308 mm (Kozyniak 2012).

A key feature of the Tukituki catchment is the degree of interaction between surface water and groundwater in the Ruataniwha Aquifer, which deeply influences both the hydrology and the water quality of streams and rivers within the Ruataniwha Plains, and of the middle and lower reaches of the Tukituki River itself. Spatial and temporal patterns of river flows and water quality in the Tukituki catchment cannot be understood without an appreciation of this groundwater influence.

The upper parts of the Ruataniwha Plains are identified as a groundwater recharge area, where rivers flowing down from the Ruahine Range and foothill lose flow to the aquifer, to a point where reaches of the Waipawa and Tukituki River are known to dry up in summer. By contrast, the lower parts of the Ruataniwha Plains are characterised by groundwater upwelling back into spring-fed streams and the main stems of the Tukituki and Waipawa rivers, contributing a major part of the surface flows in these rivers during dry periods. With

[2] Tukituki River Catchment State and Trends of River Water Quality and Ecology 2004-2013; July 2016; HBRC Report No. RM16-09 4788; Section 1.1; Pages 15-16

groundwater comes dissolved nutrients (in particular nitrate-nitrogen), which strongly influence the spatial and temporal patterns of water quality described in this report.

2.4.2 Adjacent Land Use

A more detailed land cover/use of land adjacent to the Tukituki River is provided in vegetation data provided by Land Information New Zealand (LINZ) (**Figure 9**). The Tukituki River Catchment State and Trends of River Water Quality and Ecology report provides the characteristics for the 5 management zones, with the predominant land use for each zone identified as:

- Upper Tukituki/Waipawa (Native Cover 63%, High Producing 29%),
- Ruataniwha North (Plantation Forestry 14%, High Producing 77%),
- Ruataniwha South (High Producing 83%, Plantation Forestry 4%, Cropping 3%),
- Papanui (High Producing 83%, Cropping 10%) and
- Lower Tukituki corridor (High Producing 87%, Plantation Forestry 7%).

In terms land use and development within the Tukituki catchment, a description is provided[3] as follows:

The Tukituki catchment has been heavily modified by historical vegetation clearance, land drainage and land development. In the 1930s and 40s, HBRC's predecessors built a flood control and drainage scheme with stopbanks and living tree edge protection for the Upper Tukituki catchment. Gravel extraction is used in Ruataniwha Plains rivers to remove excess gravel and to maintain channel capacity. After further improvements in the 1980s, stopbanks were also built in the lower part of the Tukituki catchment (Uytendaal and Ausseil, 2013).

The vegetation cover within the Tukituki River catchment varies extensively from the upper reaches to the middle and lower reaches. The upper reaches of the catchment, where the land is protected for conservation purposes as in Ruahine Forest Park, has steeper topography and is dominated largely by native vegetation. Through the middle reaches of the catchment, where the steeper ground begins to level out across the plains, the land is a matrix of native vegetation, pastoral farming and plantation forestry. In the lower reaches of the catchment, on the plains, the land cover is a mixture of high producing exotic grasslands, horticulture, and exotic forestry, with very little native vegetation (Forbes et al. 2011).

Like the vegetation, the land-use within the Tukituki Catchment is largely determined by the topography and the accessibility of the land. The upper reaches are largely inaccessible for human uses, and here most of the 22,987 hectares of native forest are situated (Lynch 2012). In the hill country the land-use is low- to medium impact dry stock and forestry (Forbes et al. 2011). On the plains the land-use is largely dry stock farming, intensive dairying, viticulture and horticulture.

The dominant land-use type is sheep and beef farming, with a distinct band of native vegetation along the western edge of the catchment across the Ruahine Range. Intensive farming enterprises, such as dairy and arable cropping, are focussed on the Ruataniwha Plains and the Otane/Papanui Stream areas (Uytendaal and Ausseil, 2013).

[3] Tukituki River Catchment State and Trends of River Water Quality and Ecology 2004-2013; July 2016; HBRC Report No. RM16-09 4788; Section 1.2; Page 19

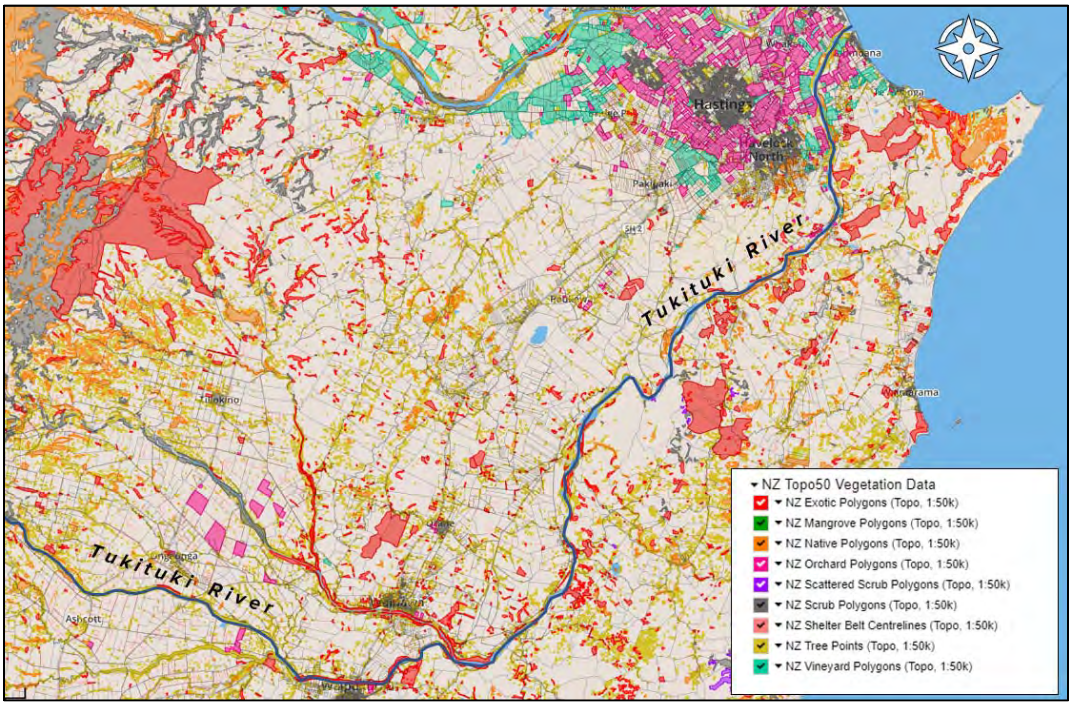


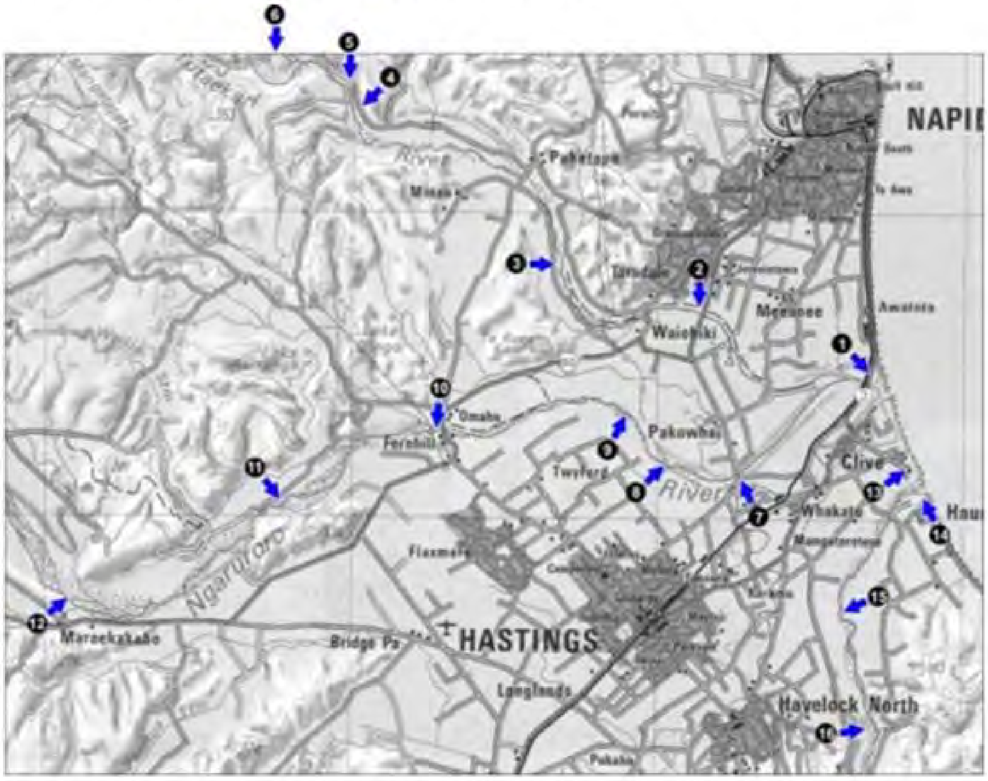
Figure 9: **Vegetation Cover**

Specific public access points to the Tukituki River are identified in Figure 10 below. Public access points to the Tukituki River are identified as points 14 - 16 in Figure 10.

2.4.3 River Access

Public river access to the Tukituki River Access is provided at points: Walker Rd, Ford Rd, Lindsay Rd, Waipukurau Township, Pukeora, Ongaonga Rd, Burnside Rd (Lower Tukituki access points are located on the Heretaunga Plains). The Heretaunga Plains Access Points to the Tukituki River are identified in Figure 10 with the Ruataniwha Plains Access Points identified in Figure 11.

Heretaunga Plains Access Points



1. Waitangi at Ngaruroro River Mouth
2. End of Tapairu Road
3. Omaranui Road
4. Hakowhai
5. Kaipapa
6. Dartmoor
7. Chesterhope Bridge, Pakowhai Road
8. Ormond Road, Twyford
9. Waipukurau Township
10. Omahu/Fernhill
11. Ohiti
12. Maraekakaho
13. Clive estuary
14. Tukituki River Mouth
15. Tennant Road
16. River Road

Figure 10: Heretaunga Plains Public Access Points

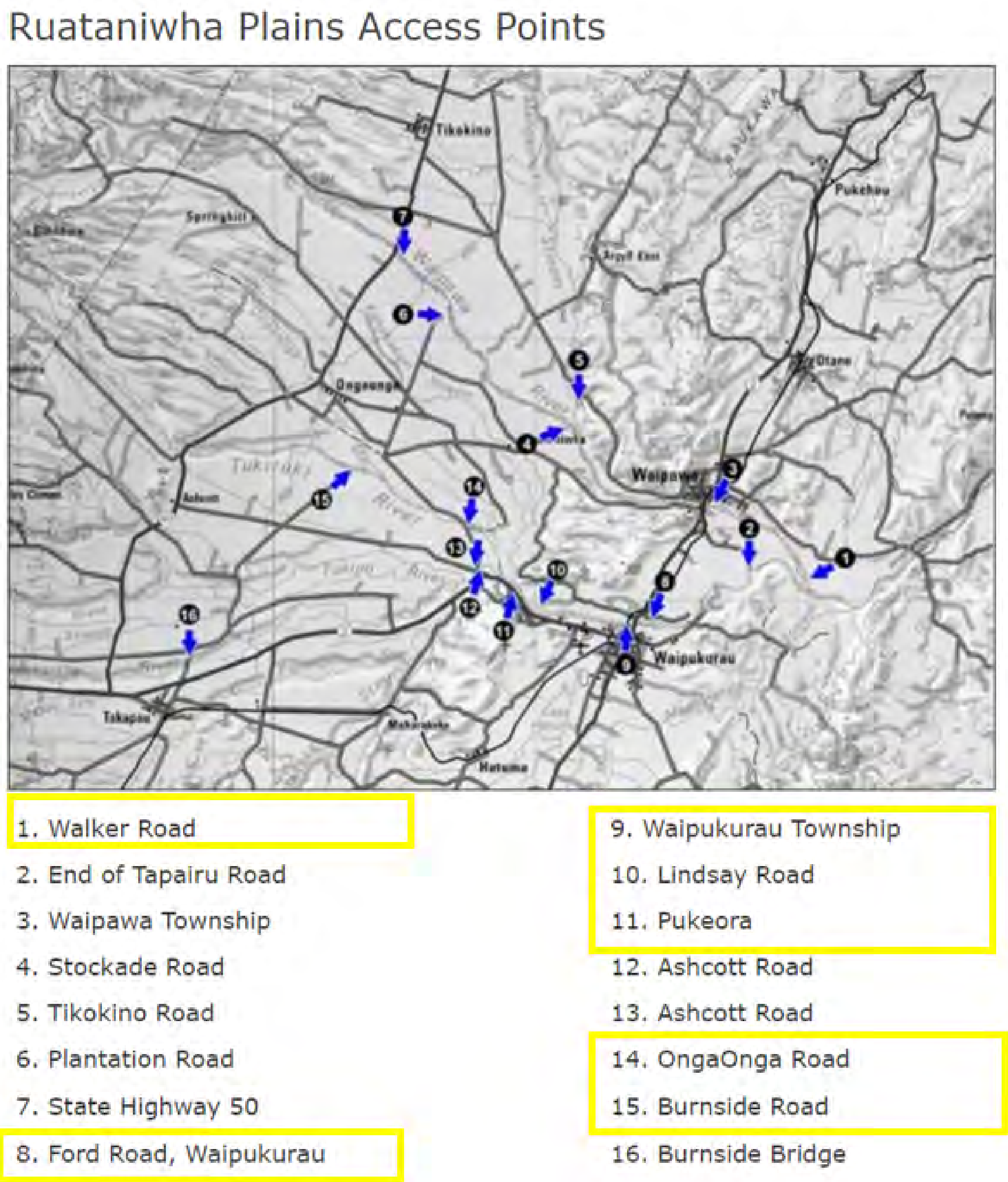


Figure 11: **Ruataniwha Plains Public Access Points**

2.5 WATER QUALITY AND AQUATIC ECOLOGY

The water quality and ecology of the Tukituki is described in an HBRC report prepared by Ausseil et al (2016). A relevant extract from the Executive Summary of that report in relation to water clarity and turbidity is reproduced below.

> *"None of the 24 SoE monitoring sites for which water clarity data were available met median water clarities recommended for significant trout fisheries of 3.5 m, let alone the recommended guideline for "outstanding trout fisheries" of 5 m, although the Makaroro River, the Mangaonuku Stream and the Tukituki River at Black Bridge had water clarity of 5 m or more at times. These included all lower Tukituki River monitoring sites (from Tamumu Bridge to Black Bridge), and several tributaries including the Makaroro River and the Mangaonuku Stream –*

with the clearest water of all sites - the Tukipo River, and the Porangahau, Maharakeke and Kahahakuri streams.

No improvements or deterioration in black disc water clarity were detected over time at any of the Tukituki catchment sites, apart from the Mangatarata Stream, where there was a 7.7% decrease each year. However, turbidity deteriorated at 8 sites across the catchment (Mangaonuku Stream, Waipawa at SH2, Waipawa U/S Tukituki River, Tukipo River at SH50, Tukituki at SH2, Tukituki at Tapairu Rd, Tukituki at Tamumu Bridge and Tukituki at Red Bridge).

The Mangaonuku Stream had the best black disk water clarity of the catchment's SoE sites, being 12th out of 98 regional sites. The Mangatarata Stream, by contrast, was the worst in the catchment at 90th out of 98 regional sites."

Further to the above report, HBRC commissioned the Cawthron Institute to assess the effects of gravel extraction on the aquatic ecology of five rivers in the Region (Holmes, 2017). That report is reproduced in **Appendix F** of this AEE. The report describes the aquatic ecology of the Tukituki, mainly in relation to fish species. Table 1 in the report shows the typical native fish species of the braided river channels within the gravel management areas include the following:

Redfin bully	Longfin eel
Shortfin eel	Torrentfish
Common bully	Bluegill bully
Inanga	Giant bully
Koaro	Dwarf galaxias
Black flounder	Yellow eyed mullet
Crans bully	Common smelt

Refer to the Cawthron report for a full description of the river's aquatic ecology.

2.6 TERRESTRIAL ECOLOGY

HBRC commissioned Forbes Environmental to assess the effects of gravel extraction on the terrestrial ecology of rivers in the Region from which gravel extraction occurs (Forbes, 2017a). That report is reproduced in **Appendix E** of this AEE.

Section 2 of Forbes (2017a) notes that the braided rivers found in New Zealand are rare internationally, and tend to occur only in areas of active mountain uplift and erosion. The Hawke's Bay Region contains the largest combined area of braided riverbed habitats in the North Island. Braided riverbeds are classed as Naturally Uncommon Ecosystems, meaning the ecosystem type was rare before human arrival. Braided rivers are notable for their diversity values; they naturally support highly specialised and diverse assemblages of flora and fauna.

Prior to the arrival of Europeans, the Hawke's Bay riverbeds would have been sparsely vegetated. Since then, they have become extensively covered with exotic vegetation including tree lupin, willow species, gorse, broom, and annual and perennial weeds, which have reduced potential riverbed bird habitat.

Key riverbed bird species found in the Tukituki braided river beds include the paradise shelduck, banded dotterel, black-fronted dotterel, pied stilt, and black-billed gull (refer to Table 3 on page 11 of Forbes 2017a). A number of these are threatened or at risk of extinction and are therefore of particular conservation concern. The report noted that of the Ngaruroro, Tutaekuri and Tukituki Rivers, the Tukituki had the highest recorded numbers of black-fronted dotterels, black-billed gulls and pied stilt, and the largest abundance and diversity of waterfowl.

Refer to the Forbes report for a full description of the river's terrestrial ecology, as well as the assessed values of the ecology.

3. DESCRIPTION OF THE PROPOSED ACTIVITY

3.1 CONCEPT

Gravel extraction has historically occurred at locations that are easily accessible (e.g. close to highways) and close to the end use of the gravel, because haulage costs significantly affect the viability of commercial operations.

However, this has meant that in some reaches, gravel has continued to accumulate because it is not being removed by extractors or is not moving downstream to any significant degree through natural processes.

In addition to sediment accumulation in the active river channel, sediment accumulates on the river berms (refer to **Figure 1** in Section 1.4 above). This is predominantly sand and silt occurring in the lower reach of the river. Extraction is carried out (clear of the actively flowing channel) which helps maintain the flood capacity in these reaches. The excavated sediment mainly comprises silt material. Berm excavation occurs well clear of the stopbanks and the banks of the active river channel, to avoid any destabilisation of those elements. The volumes of excavated sediment are recorded, and the berm is surveyed (at the same time as the active river channel) every six years, compared to 3 yearly for the active channel.

HBRC are seeking to improve administrative processes to enable excess gravel to be extracted more efficiently, to help maintain the design grade and flood capacity throughout the braided river system.

The concept is that HBRC will seek global consents for gravel extraction activity over the key rivers being managed for flood control purposes. While HBRC will be the consent holder, and responsible for meeting all consent conditions, it will issue authorisations to gravel extractors to operate under the consents it holds. This will enable:

- A more comprehensive management regime with a single, accountable consent holder;
- Better management of any actual and potential adverse effects of gravel extraction;
- A more streamlined process for extractors, reducing costs and delays;
- Greater ability for gravel extractors to hold multi-year authorisations to extract gravel (operating under HBRC consents) improving certainty for the extractors and ultimately improving gravel extraction outcomes for flood control purposes; and

- The ability for Iwi and other stakeholders to engage with one consent holder, rather than multiple parties.

3.2 EXTRACTION LOCATIONS

HBRC seeks consent for extraction from the Tukituki Catchment Rivers highlighted in blue in **Figure 11** below (and **Appendix A**), and as described in the application for resource consent in Part A of this document.

The primary factor for choosing the location of gravel extraction is the current mean height of the riverbed above design grade. Access to the extraction site and distance from markets (i.e. the location of the end use of the gravel) are also factors in site selection.

The Tukituki Catchment River channels at the extraction reaches are mainly semi-braided gravel channels, generally with riparian vegetation on both banks.

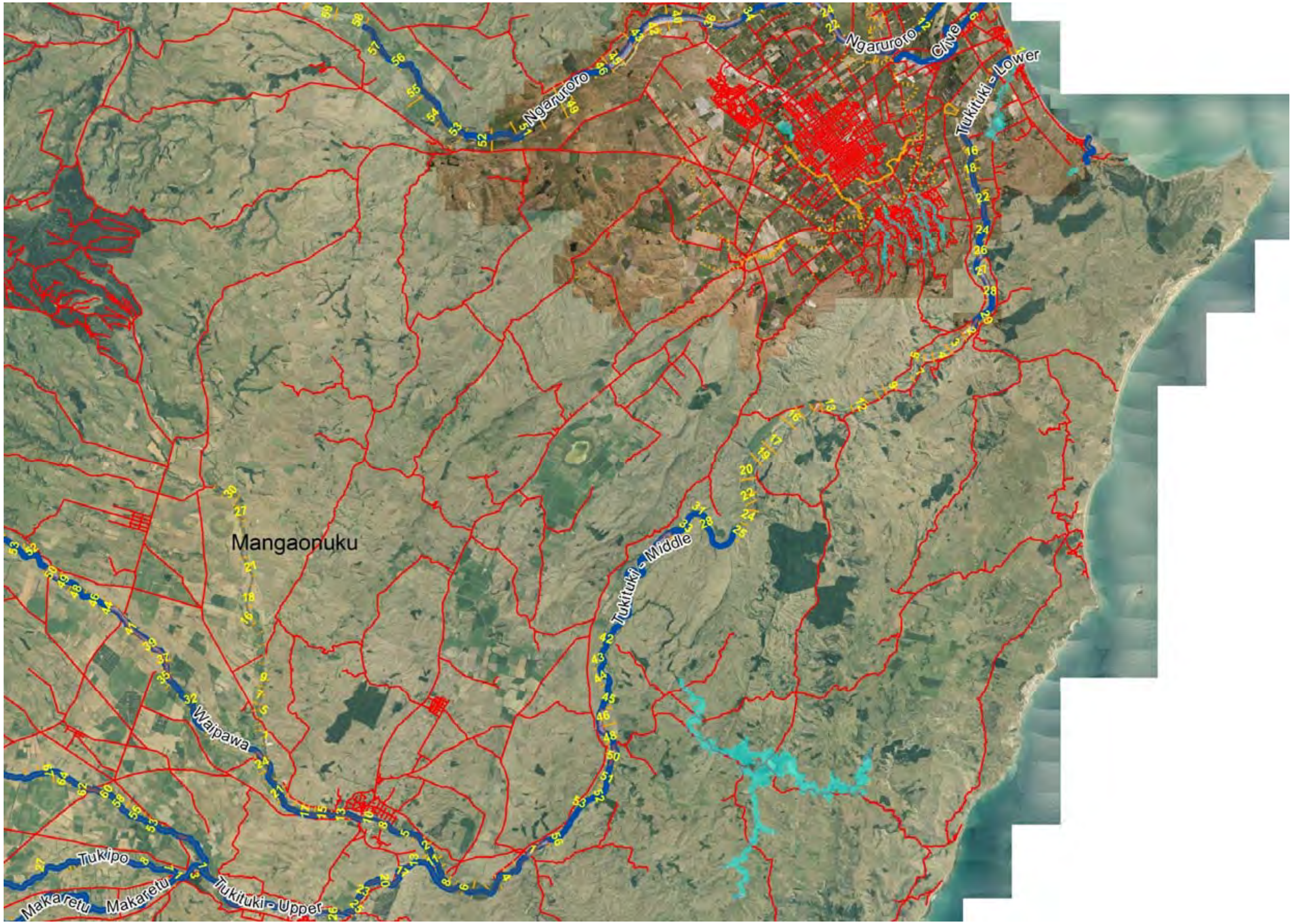


Figure 11: **Proposed reach of Tukituki River (middle and lower) within which gravel extraction may occur (shown in blue).**

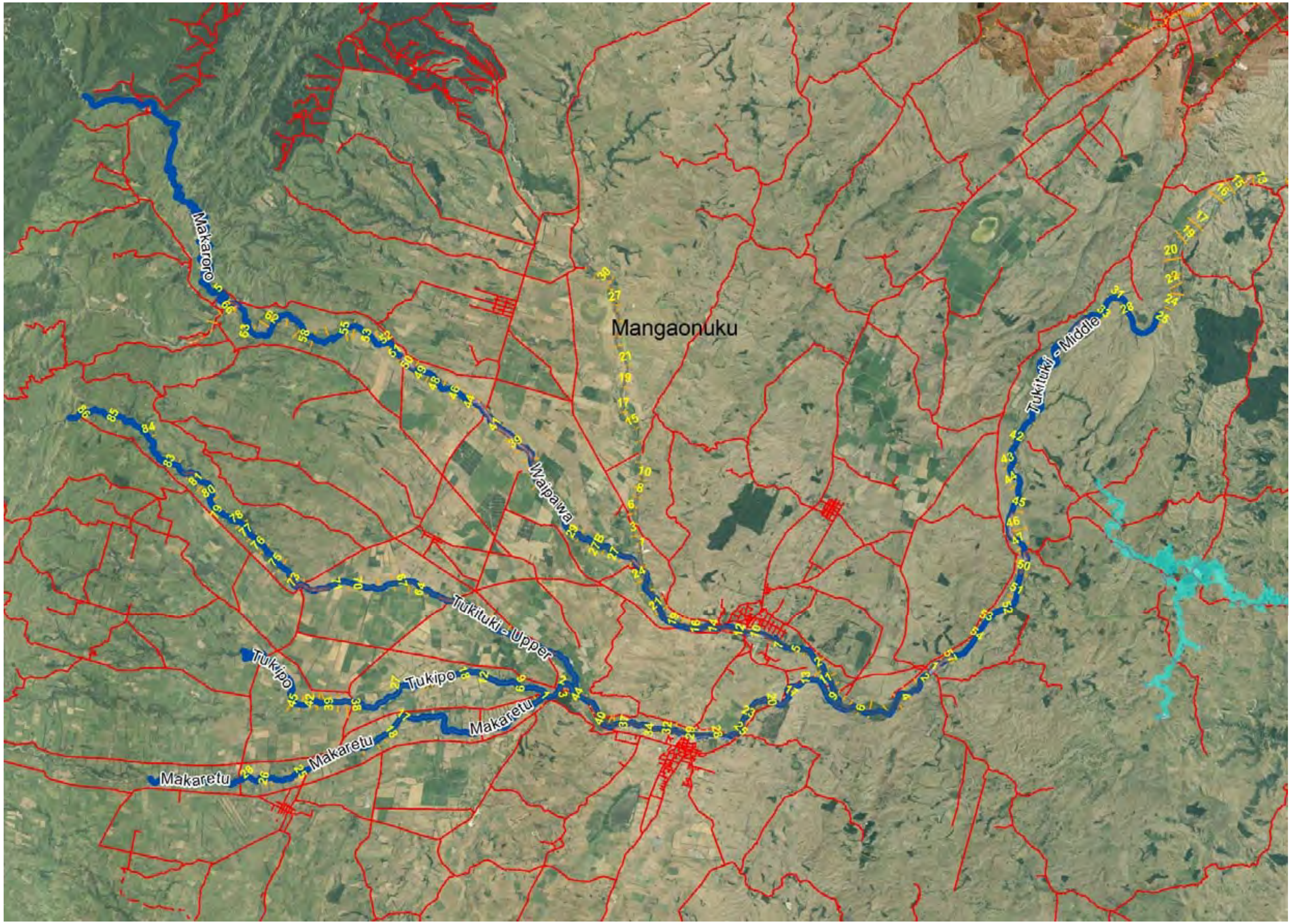


Figure 12: Tukituki Catchment Rivers where gravel extraction may occur

The actual extraction sites will be located on the basis of the following criteria:

- Achieves flood and river management objectives
- Mean bed level is above the design bed profile on average over the reach
- Aids transport of sediment through the river system
- Reduces berm height and maintains flood capacity
- Crossings of wetted channels avoided where possible, or otherwise minimised, both to minimise environmental effects and to make truck access easier

Areas where gravel is required to be extracted for river management purposes and areas where the bed height above design grade are greatest will be targeted for extraction, to maintain the required floodway area and hence level of flood protection.

3.3 EXTRACTION VOLUMES AND TIMING

Stevens and Larsen (2015) have investigated historic and projected gravel extraction rates for the Hawke's Bay rivers. As discussed in Section 2.3.1 above, historic over-extraction and concerns with coastal erosion at Haumoana have resulted in gravel extraction being reduced since 2008. Looking ahead:

- In the Upper Tukituki and Waipawa, there is likely to be an issue with the build-up of gravel above grade line over time, with an adverse effect on flood control. This is dependent on the rate of movement of gravel through the system to lower reaches, flood event frequency, aggradation rates and extraction. The situation for flood control is likely to be exacerbated if extraction does not increase back to average levels.
- The Middle Tukituki potentially has large resources of gravel. Stevens and Larsen (2015) estimate there is potentially 14 million m^3 of gravel available. Morphological modelling is in progress for the whole Tukituki River utilising the GRATE simulation programme. Once complete this will provide information on gravel supply and sustainability. Issues include:
  - accessibility to the resources,
  - volumes moving through the system to the Lower Tukituki to replenish over extracted resources and to ensure gravel continues to reach the sea in adequate volumes for beach protection,
  - travel distances to processing plant and the main contract areas for producers (economics and market demands).
- In the Lower Tukituki there is currently a net deficit of gravel. HBRC policy is to manage the resource sustainably, taking into account there has historically been over extraction in the Lower Tukituki, and the Tukituki is the only major river system delivering gravel to the coast. Therefore, it is anticipated that there will only be minor volumes of gravel extracted from this reach in the foreseeable future.
- In the other minor rivers of this application, extraction is carried out for river management and the quantities are relatively small.

The actual volumes extracted will vary, depending in particular on the incidence of flood events that might change the bed profile. For this reason, it is problematic to specify a maximum volume of gravel extracted on an annual basis under the proposed consent. This could vary significantly, in response to a variety of factors. To manage this, HBRC are proposing to limit extraction activities under this consent through proposed conditions which enable extraction to occur down to a maximum extraction point (refer to Section 3.8 and the proposed conditions provided as **Appendix B**).

The timing and duration of individual gravel extraction operations will vary. The peak period for extraction is over the summer, but it can occur at any time of the year, depending on weather patterns. Extraction typically occurs for relatively short durations, e.g. for a week or several weeks, and can stop temporarily and then recommence.

3.4 RESTRICTIONS DURING NESTING SEASONS

The critical period for minimising effects on riverbed birds is the nesting season. Therefore the following controls will be implemented in controlled areas and time frames as follows, (as specified in Section 3.3 of the EMEP):

- 1 August to 28 February:
    - Lower Tukituki (coast to Red Bridge):
    - Tukituki River: Tamamu Bridge to Eastwood Road
    - Waipawa River (Tukituki confluence to Holden Road)
    - Tukipo River
- 1 September to 30 November:
    - Mangaonuku Stream
    - Makaretu River

Before any gravel extraction works are carried out in the above areas/times, the following actions will be undertaken:

a. An inspection of the proposed area of works by a suitably qualified ecologist, no earlier than ten working days prior to any works being carried out, to locate bird breeding sites of any regionally or nationally designated “*At Risk*” or “*Threatened*” riverbed bird species.

b. The same person will prepare a written report that identifies each located bird breeding or nesting site and provide copies of that report to the HBRC and the extraction operator.

c. Any person carrying out physical works in the area will be informed of any bird breeding or nesting site site(s).

d. No physical works or machinery movements should be undertaken within 100 m of regionally or nationally designated “*At Risk*” or “*Threatened*” riverbird species that are nesting or rearing their young on the active river channel. Specifically, no works or machinery movements should be undertaken within 200 m of black-billed gulls and white-fronted terns. These setback distances can be reduced to a minimum of 50 m with assessment and advice from a suitably qualified ecologist.

e. Where gravel work ceases for more than 10 days, the site will be reinspected for bird breeding or nesting sites in accordance with ‘a.’ – ‘d.’ above.

3.5 EXTRACTION CONTRACTORS

While HBRC will hold the resource consent for the gravel extraction, contractors will be authorised to undertake the extraction work on behalf of HBRC as the consent holder. HBRC only authorises reputable contractors with a proven track record of avoiding or minimising environmental effects (e.g. through good vehicle maintenance, staff training and best-practice operating procedures). All contractors will be made aware of the resource consent conditions and will be required to comply with those conditions. They will also be required to comply with an updated version of the ‘Environmental Code of Practice for River Control and Waterway Works’ (referred to hereafter as the ‘Code of Practice’, which is attached as **Appendix D**).

3.6 GRAVEL EXTRACTION METHODOLOGY

Extractors operating under the consents held by HBRC will be required to adhere to the Code of Practice and EMEP. The following outlines the gravel extraction methodology they will be required to follow, in accordance with the Code of Practice and EMEP.

3.6.1 Preparatory Works

At the time of site selection and scoping of the extraction job, a bird nest survey will be undertaken if required, and required setbacks from nests will be clearly identified on site, as set out in Section 3.4 above.

A gravel track will be formed across grassed areas, from the stockpile area to the extraction site, to provide a stable base for the dump trucks, and to prevent damage of stopbanks.

The contractor will erect a warning sign adjacent to the site of extraction where, as a result of the extraction, the stretch of river is or is likely to become dangerous to the public. Standard HBRC signage will be used. These signs will be used wherever holes are made in the active river channel, which could become a danger to fishers and others who may use the active river channel. The signs will be removed on completion of the operation or when the area is no longer a danger to the public.

3.6.2 Gravel Extraction and Removal

Gravel will be extracted using an excavator (‘digger’) or loader, which generally will load the gravel directly into a large dump truck, to avoid double-handling (**Figure 14**). Where extraction occurs close to an actively flowing channel, extraction will begin a minimum of one metre from the edge of the actively flowing channel. This minimum one metre ‘barrier’ will be maintained for the duration of the extraction job.

Because the riverbed is typically only a small distance above the river water surface, the excavated area usually forms a pond, and the digger will be excavating through the water surface into the gravel beneath, typically to a depth of about 1 m below the water surface. The pond is therefore highly turbid while the excavation is underway, but the majority of the suspended sediment settles out of the water within a few hours and is contained within the bunded area.

The design grade is achieved through survey of the area to be extracted and subtracting the design grade at the reach concerned.

The dump trucks will remove the gravel to a site off the 'active' riverbed, where it will be further processed or stockpiled. Trucks will follow the minimum number of tracks (routes) as possible, to minimise effects on riverbed birds. A single haulage route will be signposted for drivers to follow.

Road trucks will be loaded from the stockpile, from where the gravel will usually be delivered directly to its final point of use.

Gravel extraction usually only occurs during low river flows, to avoid or minimise crossing of actively flowing channel, and to maximise the area and height of gravel beaches. Where favourable meanders of the river occur, it will be sometimes possible to avoid crossing the actively flowing channel altogether, but crossing(s) are normally required.

While installing a temporary culvert crossing will theoretically be possible, this will not normally be done due to the substantial costs involved, and the difficultly of avoiding significant environmental effects (chiefly disturbance of sediments into the river flow, and creation of fish barriers due to increased local flow velocities) when constructing the crossing.

The digger will usually be removed from the active river channel at the end of each day. Weather forecasts will be monitored daily, and if heavy rain is forecast, all machinery and equipment will be moved well above the expected flood level. HBRC warns contractors of heavy rain forecasts. In practice, the contractors closely monitor weather and river conditions on a daily basis to avoid risks to equipment and personnel.

Vehicle refuelling occurs outside of the active river channel. Vehicles are maintained on a routine basis to minimise the risk of oil or fuel spills.

3.6.3 Completion of Works

When excavation from a gravel extraction pond is completed, the water will be allowed to settle for a minimum of 24 hours, after which the downstream end of the barrier will be removed, followed by the upstream end. This allows the pond to form a new river channel, and minimises the risk of fish stranding.

At the completion of works in a gravel beach, the disturbed beach areas including any temporary gravel stockpiles will be levelled out.

All machinery will be checked, cleaned and dried prior to moving to another site, to minimise the risk of the spread of aquatic pests. No machinery will be permitted to be used for gravel extraction that has been used in South Island waterways within the previous two years. Machinery and equipment that has worked in a watercourse will be cleaned with suitable chemicals or agents to kill didymo both prior to entering and leaving the site.

3.7 EFFECTS AVOIDANCE AND MITIGATION MEASURES

A number of environmental effects avoidance and mitigation measures have been identified and implemented over the past several years, and developed more recently through the development of this consent application, which form part of this gravel extraction proposal. These are summarised as follows:

- Activity restrictions in relation to the nesting season will be adhered to, as set out in Section 3.4 above.
- No machinery will be refuelled within 20 m of the active river channel.
- No fuel will be stored within 30 m of the active river channel.
- Crossing of the actively flowing channel by machinery will be avoided where practicable during fish spawning months of May to September, inclusive.
- Crossing of an actively flowing channel at other times will be minimised as much as is practicable.
- Trucks will be directed to follow a single haulage route across the gravel beaches, as much as is practicable.
- No gravel extraction will occur within one metre of the actively flowing channel, unless specifically authorised by HBRC (an example of such authorisation will be when an excavated pond is connected to the flowing river channel at the completion of works).
- Gravel stockpiling within the active river channel shall only occur temporarily, while extraction is occurring. Longer term stockpiles will be located outside the riverbed.
- HBRC will provide designated access paths through any live edge protection plantings. Gravel extractors will not be permitted to cut their own access paths without prior Council authorisation.
- The gravel extractor will be required to immediately repair any damage caused to river banks or river protection works, other than damage associated with authorised access paths through live edge protection plantings.
- The gravel extraction site will be restored upon the completion of extraction activities as follows:
    - All gravel previously heaped up or stockpiled will be spread out to conform with the general ground profile; and,
    - Reject, surplus or unused gravel from a gravel processing plant will not be deposited within the actively flowing channel unless specific study into the effects has been completed and the adverse effects are less than minimal.
- Gravel extractors will be required to minimise the generation of dust from access tracks and storage and processing sites, through measures such as water application.

Figure 13 Typical gravel extraction operations (Note: photos are of Ngaruroro River)

Figure 14: Typical gravel extraction operations showing works bunded from main river on far left (adjacent to willow trees).

3.8 PROPOSED CONSENT CONDITIONS

The applicant proposes a suite of consent conditions, contained in **Appendix B** of this AEE. These conditions are considered to represent 'best practice' approaches to undertaking gravel extraction works in Hawke's Bay. Compliance with these proposed consent conditions will result in any actual or potential environment effects resulting from the proposed activity being avoided or mitigated.

3.9 CONSENT TERM

A term of 25 years is sought for this consent application.

In response to feedback gathered during consultation, and in circumstances where it is appropriate and will better enable flood control objectives, HBRC wishes to retain the flexibility to issue up to 10 year authorisations to extractors operating under this consent. A 25 year term will enable HBRC to issue 2 concurrent 10 year authorisations to extractors (i.e. 20 years) while allowing some initial set-up and process establishment time.

It is also noted that HBRC is intending to seek the introduction of a permitted activity rule to the RRMP (and potentially the Regional Coastal Environment Plan (RCEP)) as part of the next reviews. This would replace the need for HBRC to hold global consents. However, there is uncertainty regarding the timing of any such provisions becoming operative. HBRC seeks to ensure the subject consent being sought will fully bridge this process.

4. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The following assessment identifies and discusses the actual and potential effects of the proposed extraction activities. Where actual or potential adverse effects have been identified, a response is identified, to be implemented through either a suite of proposed conditions (as provided in **Appendix B**) or through the Code of Practice (provided as **Appendix D**).

4.1 POSITIVE EFFECTS

4.1.1 Flood Risk Mitigation

The main benefit of the proposal, which is the purpose of this consent application, is to help maintain the river channel capacity and thereby mitigate the flooding risk from the Tukituki Catchment Rivers, in particular the risk of the stopbanks being overtopped and edge protection works being destroyed. This will help protect not only rural farmland but also the towns of Waipukurau, Havelock North, and nearby coastal communities, including the protection of both property and people from harm.

Hence, the proposed activity will result in considerable positive effects by reducing flood risk from the Tukituki Catchment Rivers. The specific positive effects include:

- Channel capacity will be increased when required and flood levels will be lowered, ultimately reducing the threat of flood waters overtopping stopbanks and inundating land and property;
- Concentration of flow against riverbanks and resultant lateral erosion, and localised bed scour is minimised;
- Stable channel alignment and optimum bed level is maintained.

The removal of gravel (when required) will also help prevent water tables rising in adjacent farmland, which makes that farmland more difficult to manage.

4.1.2 Aggregate Supply

The proposal represents the extraction of a renewable gravel resource for local construction and economic development. Gravel from Hawke's Bay rivers is some of the best quality aggregate in New Zealand, and is essential for the Region's construction industry, whether it is used for local roads, cement production or even decorative stones for landscaping.

Riverbed extraction also avoids or reduces the need for land and coastal sourced gravel extraction. Land extraction can result in the deterioration in value of productive farmland, including high-value horticultural land. Coastal extraction can cause or increase coastal erosion and reduce or limit beach crests, increasing exposure to coastal inundation.

4.1.3 Removal of Exotic Plants

Forbes (2017a) states that exotic plants on the riverbed beaches reduce habitat for native riverbed birds, and therefore cause an overall detrimental effect on native wildlife. In some instances, the removal of some of this vegetation therefore results in a positive environmental effect, although it is acknowledged that the area of removed vegetation will be relatively small in the context of the entire Tukituki catchment braided river system. However, HBRC as part of its river management regularly beach-rakes river reaches in order to assist the river transporting sediment through the system. This has a significant benefit in preventing the establishment of unwanted vegetation on the gravel beaches and islands.

4.2 SUSTAINABILITY OF THE GRAVEL SYSTEM RESOURCE

It is important that the volumes of gravel extracted from rivers is at a rate that is sustainable and does not exceed the natural supply from the upper catchment (i.e. extraction rates need to exceed supply rates for a time in order to reduce in-river gravel volume). HBRC specifically wishes to avoid over-extraction of gravel in the Lower Tukituki due historic over-extraction in this reach, and the Tukituki being the only river that supplies gravel to the coast. Over-extraction can also lead to destabilisation of the river channel and threaten edge protection and structures such as stopbanks and bridges. To this end, HBRC has carried out considerable technical assessment of the dynamics of the gravel resource, as discussed below. This information has largely been taken from the 'gravel resource inventory' report prepared for HBRC by Stevens and Larsen (2015) based on data obtained from HBRC's records.

Major reviews by the Hawke's Bay Catchment Board and Regional Water Board in 1987 plus additional studies for the HBRC on the Tukituki River lead to defining a set of parameters to sustainably manage the river systems and control aggregate extraction.

HBRC has established a series of cross sections at regular intervals on all major river systems in the region. These range from approximately 0.5 km to 1.3 km apart and are surveyed approximately every three years. This sectional data has been used to determine a design grade line for each major river based on a 2.3 year return period flood event (mean annual flood), although volumetric data is not currently available and thus a grade line has not yet been determined for the Middle Tukituki.

HBRC policy has been to manage extraction so that, in general, extraction is only allowed in parts of the rivers where gravel accumulations are above grade line. This is the base case for determining available gravel supplies for extraction. Notwithstanding this, the current gravel deficit of the Lower Tukituki bed will be taken into account when determining sustainable extraction in the Upper and Middle Tukituki.

HBRC estimates the sediment volumes based on the cross-sectional areas above or below the grade line times the distance between cross sections for the active river channel only.

It is evident from the HBRC records that the volume of aggregate supply to the river catchments is episodic, and driven primarily by flood events.

Morphological modelling work for the Ngaruroro River was carried out for HBRC by NIWA (reported on in NIWA 2012) to provide an alternative methodology for analysing flows and sediment budget, and influences and constraints on gravel supply and gravel transport. This model was refined using the cross-sectional database on aggregate volumes since 1961. The Ngaruroro River is the main source of gravel for commercial extraction on the Heretaunga Plains and the modelling yielded some significant results for a number of scenarios. This has provided valuable assistance to HBRC in assessing the sustainable gravel supply for the river. Some of these findings are also applicable to the other Hawke's Bay gravel rivers where the modelling is also being carried out.

The modelling work had two main aims:

- Inform better understanding of the gravel transport processes on the river and investigate the impact of different drivers including gravel extraction, beach raking, changes in supply and climate change.
- Pilot the application of calibrated morphological models for informing gravel management in the Hawke's Bay Region. (The process developed for modelling the Ngaruroro River should be applicable to other rivers in the region and has been applied to the Tukituki River, which is significantly more complex. The modelling has not been completed to date).

HBRC will continue to use the morphological model to assist with gravel management.

Better surveying techniques using LIDAR, mobile laser scanning and photogrammetry may soon be available for more general use in gravel management. Meanwhile, conventional techniques will be applied and are sufficient as long as the limitations are recognised and duly allowed for. Preliminary analysis of gravel volumes and deficit / accumulation using LIDAR has been carried out by HBRC, and the results look promising and provide a good visual indication of the distribution of sediment along a reach, although further verification of the method is required.

In conclusion, in the absence of a more refined tool or model, an adaptive management approach is required for the proposed extraction, in which the gravel resource is monitored and modelled to check that extraction rates remain sustainable. As part of this approach, the applicant proposes the following measures to minimise the risks of over extraction:

- Continue to monitor and record extraction locations and volumes, annually
- Continue to analyse the 3 yearly river cross section surveys to monitor bed levels and the gravel resource.
- Continue to investigate and utilise where appropriate new modelling and LIDAR techniques to improve volume estimates.

The suggested 3 yearly review clause will enable the three-yearly review of the cross-section surveys to ensure that ongoing extraction throughout the life of the resource consent remains sustainable.

This approach is considered conservative and precautionary, given the net riverbed is currently aggrading, in spite of historic gravel abstraction.

Proposed conditions of consent have been developed to give effect to this approach (refer to **Appendix B**).

4.3 EFFECTS ON WATER QUALITY

The main potential effects of the proposed activities on water quality are temporary increases in suspended solids concentrations, and the risk of spills entering the actively flowing channel.

Effects on suspended solids concentrations

The most significant potential effect on water quality is elevated turbidity and suspended solids concentrations resulting from the gravel extraction operation. This can potentially reduce clarity for fish vision, cause clogging of the gills of aquatic animals, and smother benthic (i.e. riverbed) habitat. This will be avoided or minimised by only extracting gravel from river beaches isolated by bunding from flowing water. At no time will gravel be extracted from areas of actively flowing channels, and a minimum one metre wide bund will be maintained between the extraction area and the flowing channel.

The potential effects on aquatic animals (which is affected by suspended solids concentrations) is addressed in Section 4.4 below.

Spills

Spills from machinery refuelling and oil leaks will be avoided by using best practice procedures. All operations will be conducted in accordance with the HBRC Spill Management Plan, which is a requirement of the proposed consent conditions in **Appendix B** of this AEE. All refuelling will be undertaken beyond the active river channel.

Previous consent conditions have avoided any significant spills during gravel extraction operations for many years.

The potential effects on water quality are therefore considered less than minor.

4.4 EFFECTS ON AQUATIC ANIMALS

4.4.1 Overview

HBRC commissioned the Cawthron Institute to assess the effects of gravel extraction on the aquatic ecology of five rivers in the Region (Holmes, 2017). That report is reproduced in **Appendix F** of this AEE. The Executive Summary of the report is reproduced below, verbatim.

> *"The Hawke's Bay Regional Council (HBRC) is responsible for maintaining flood protection infrastructure throughout the major braided river systems in the Heretaunga Plains. These include the Tukituki, Waipawa, Ngaruroro, Esk and Tutaekuri. Gravel extraction and beach raking from dry river bars are tools HBRC uses to maintain flood-flow capacity and reduce erosion of flood control infrastructure.*
>
> *This report identifies the potential effects of these gravel management activities on key instream fish species. Recommendations for information requirements and monitoring are made along with some appraisal and suggestions of good gravel management practices.*
>
> *Broadly, large aggrading braided rivers such as those in the Hawke's Bay Gravel Management Areas (with the exception of the Esk) can be considered relatively resilient to gravel extraction, when compared with small single thread rivers. In addition, the current (draft) code of practice for river works affords a pragmatic level of protection for instream ecology, given the need to maintain effective flood protection infrastructure. However, the ability to assess the potential instream effects of gravel management in Hawke's Bay is currently very limited because of sparse ecological and geomorphological data.*
>
> *We suggest the following studies and monitoring projects could be implemented over time to fill information gaps:*
>
> *1. Catalogue the frequency, extent and duration of channel management events that require machinery to cross wetted channels (side braids included). This information could be supplied as part of a consent condition (for example).*
>
> *2. Assess the severity, extent and duration of turbidity plumes that result from re-suspended sediment below any gravel extraction areas that require machinery to cross wetted channels during works.*
>
> *3. Undertake long-term (at least annual) substrate and invertebrate community monitoring at gravel management reaches and paired upstream control reaches.*
>
> *4. Engage a qualified river geomorphologist to assess the response of channel form to gravel extraction and beach raking, using indicators of channel complexity that can be identified on aerial photography. Initially, by using existing aerial photography to compare managed and unmanaged reaches, this study should take a space-for-time substitution approach.*
>
> *5. Collect aerial imagery (e.g. using a UAV) after bed-defining flood events (at least annually) at gravel management reaches and paired upstream control sites. Once a time series of imagery data is developed, it could be analysed for changes in channel complexity indicators over time.*
>
> *6. Undertake visual assessments to assess the potential for fish stranding in gravel extraction depressions at gravel extraction areas following floods."*

HBRC will implement over 5 years the effects mitigation measures 1 to 6 described above. An investigation programme of work will be submitted to the Consents Manager prior to the start of the consent which will outline the required work and completion time for each stage. This approach has been reflected in the proposed conditions provided as **Appendix B**.

4.4.2 Direct Effects of Vehicles Crossing Actively Flowing Channels

Section 6.2 of the Cawthron report discusses the direct effects of vehicles (primarily trucks) crossing the actively flowing channels. Relevant excerpts from Section 6.2 are as follows:

> *"Where machinery accesses the wetted channel there is likely to be localised damage to the stream ecosystem through direct disturbance… …the gravel management (draft) COP already suggests that machinery should only enter the wetted channel if there is no other access option. Machinery access across wetted channels is further restricted to periods outside of May–September to protect trout spawning values (HBRC 2015). Given the scale of the rivers in the GMA[4] relative to the potential scale of the extraction activities, I suggest that the short term direct disturbance effects of some machinery within the wetted channel are unlikely to impact on fish at the population level. Nevertheless, because the localised effects of machinery in the wetted channel are obviously bad for river ecosystems, I recommend documenting the frequency and extent of gravel management operations that require access through wetted channels (including side braids). Once the degree of machinery activity within the wetted channels is known, the affected areas can be placed in context with the amount of un-impacted river (both in terms of extent and duration)."*

In summary, Cawthron therefore conclude that, noting the season restrictions that apply through the Code of Practice, the vehicles crossing the actively flowing channels are "unlikely to impact on fish at the population level", however it is recommended that this activity, where it occurs, is documented.

HBRC has committed to document the frequency and extent of gravel management operations that require access through wetted channels (including side braids), and have proffered consent conditions that require this (**Appendix B**). HBRC also proposes a consent condition that requires a review of the effects of channel crossings after five years from the commencement of the consent, at which time further operational restrictions (and associated consent conditions) may be imposed.

4.4.3 Effects of Increased Turbidity from Vehicles Crossing Actively Flowing Channels

In addition to considering the direct effects of vehicle crossings (as outlined above), Section 6.3 of the Cawthron report discusses the effects of increased turbidity caused by vehicles (primarily trucks) crossing the wetted channels. Relevant excerpts from Section 6.3 are as follows:

> *"Extraction operations are restricted to occur within areas no closer than one metre from the wetted river channel edge… This restriction is important because it means that mechanical disturbance and the resuspension of fine sediment during low flows is limited. However, in practice a one-metre buffer may not allow much tolerance between gravel works and the wetted channel. In addition, resuspension of fine sediments will occur from machinery accessing gravel bars across side braids and in areas where there is no bank access…*
>
> *To assess the potential for resuspension of fine sediment, as a result of gravel extraction works, I suggest monitoring turbidity levels around an extraction reach(s) that requires machinery access across river braids. This could be achieved by installing continuous turbidity loggers upstream of the works and at regular increments downstream of the extraction area (e.g. every 100 m for 300 m). Braiding patterns should also be considered when placing the loggers. For instance, below the convergence of two braids to account for dilution from unaffected braids. This study will determine the severity of turbidity plumes and typical*

[4] GMA = gravel management area

resettlement distances. Hay & Gabrielsson (2016) provides a suitable methodology for this study in detail."

While it is noted that Cawthron supports the use of the 1 m barrier between extraction and the actively flowing channel, HBRC proposes to follow up on Cawthon's recommendation to further investigate the potential for increased turbidity plumes from crossing vehicles. The exact nature of those investigations will be included in the investigation programme noted in Section 4.4.2 above. HBRC also proposes a consent condition for the review of the effects of channel crossings after 5 years from the commencement of the consent, at which time further operational restrictions (and associated consent conditions) may be imposed.

4.5 EFFECTS ON RIVERBED BIRDS

HBRC commissioned Forbes Ecology to assess the effects of gravel extraction on the terrestrial ecology of five rivers in the Region (Forbes, 2017a). That report is reproduced in **Appendix E** of this AEE. Key excepts from the report are reproduced below (from Section 4.2 [page 25] of Forbes 2017a):

> *"… the most serious adverse ecological effect would be the direct disturbance of riverbed birds, causing their mortality or disturbing their breeding. The threat status of the riverbed bird species affected provides a means of measuring the seriousness of such an effect, and the effect can be largely avoided through the existing seasonal restrictions placed on the timing of beach raking…*
>
> *Regarding the magnitude of the adverse effect of gravel extraction on river birds (before mitigation), the following descriptor is most appropriate to describe the magnitude of effect:*
>
> > ***Moderate/medium magnitude of effect*** *– Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR*
> >
> > *Loss of a moderate proportion of the known population or range of the element/feature.*
>
> *This effects magnitude descriptor is considered appropriate for gravel extraction activities on Hawke's Bay braided riverbeds as our analysis shows a reduction in the abundance of riverbed birds in areas where gravel extraction activity is noted, compared to the average number of riverbed birds in locations with no activities underway. This effect would be reversible. Given enough time following closure of the gravel extraction, we expect that riverbed birds would again utilise available habitats in the area. The time for this recovery might be seasonally dependent. Nevertheless, provided that direct effects on riverbed birds and their breeding activities are avoided, the effect of gravel extraction activities on the riverbed bird community is of a moderate magnitude and is both short term (i.e., <12 months) and reversible…"*

Table 8 in Forbes (2017a) states that, without mitigation, the effect of gravel extraction on the riverbed bird communities and their habitats on the Lower Tukituki and Upper Tukituki between Tamamu Bridge and SH2 would be 'Very High', while effects on other Tukituki reaches would be 'Low'. Forbes concludes that mitigation measures are required to address the potential very high levels of effect and operational care is required at all braided river extraction sites, to ensure direct effects on High/Very High value riverbed bird species are avoided.

Forbes (2017a) suggests the following measures to mitigate the potential for adverse effects on riverbed birds in the 'Very High' risk areas of the Tukituki (refer to Section 5.2 of Forbes 2017a):

> *"As with beach raking, avoidance of direct effects on riverbird species of conservation concern during their breeding or nesting is the critical impact management method. Seasonally triggered surveys carried out by a qualified ecologist to identify breeding activity and to delineate such sites so that a setback can be applied are the key means of achieving avoidance.*
>
> *Disturbance of the gravel riverbed should be minimised as far as practicable during haulage of gravel. Haulage vehicles should follow the smallest number of existing tracks as possible.*
>
> *The result of our analysis suggest that the riverbed bird community is affected (reduced total bird abundance) at sites where gravel extraction is operational. We identified this effect as short term and reversible. However, given the level of values associated with the riverbed bird communities of the Hawke's Bay braided riverbeds, a quantity of mitigation is considered necessary to address these repeated effects to the riverbed bird community.*
>
> *We suggest the following mitigation strategy to address the effects that are residual after avoidance:*
>
> *The objective is to increase the area of ERS[5] available to riverbed birds. This would be achieved by regularly clearing additional river reaches of exotic vegetation encroachment, particularly within the inner/mid channel to open up new islands for riverbed bird breeding. An area (ha) for enhancement should be scaled to be approximately equivalent to the combined area (ha) of gravel extraction activities at a given time during a representative year. Ideally, these habitat enhancement areas would be located near the coast. However, it is possible that the most suitable sites with respect to high existing levels of vegetation encroachment are located further inland, upstream of the existing beach raking extent. Ideally, the habitat enhancement areas would have little/no public access and little recreational use, so as to minimise disturbance of breeding river birds. Given the results of our analysis, highly braided reaches should be preferred over less braided reaches.*
>
> *Riverbed bird monitoring would need to be carried out within enhancement areas to confirm the effectiveness of the treatment in providing viable riverbed bird habitat."*

HBRC has implemented the recommended bird nest surveys and establishment of setback distances to works is provided for in the Code of Practice (**Appendix D**), as described in Sections 3.4 and 3.6 above. The number of haulage routes will also be kept to the minimum practical.

HBRC is supportive of the suggested extension of vegetation removal (above that which currently occurs), but the ratepayer-based scheme funding does not currently provide for this in addition to its flood control responsibilities. As part of the proposed research programme, the costs and benefits of removing exotic vegetation from braided river channels will be examined.

4.6 INVASIVE VEGETATION

When machinery is transported from one water body to another, there is a risk of unintentionally introducing or spreading pest aquatic plants from one water body to another. This risk is minimised by requiring all machinery to be checked, cleaned and dried prior to being moved from one site to another. No machinery is permitted to be used for

[5] ERS = exposed riverine sediment

gravel extraction that has been used in South Island waterways within the previous two years. Machinery and equipment that has worked in a watercourse is cleaned with suitable chemicals or agents to kill didymo both prior to entering and leaving the site. These requirements are outlined in the Code of Practice (**Appendix D**).

4.7 EFFECTS ON COASTAL SEDIMENT SUPPLY

The interaction between sediment supply to the coast from the region's rivers and gravel extraction activities is summarised in a memo from HBRC Regional Assets Section in **Appendix H** of this AEE.

In considering any impacts on coastal sediment supply, it is the stretch of coast between Clifton in the south and Tangoio in the North that must be considered. These beaches are composed of mixtures of gravels and sand.

It is worth noting that the gravel barrier beach that formed along the present-day shoreline was largely formed from the landward movement of gravels lain down on the seafloor during the last marine transgression during the Holocene period, as opposed to being formed from alluvial deposits.

A century ago some gravels were reaching the coast from the four large tributary rivers. In 1931 the tectonic uplift produced by the Hawke's Bay earthquake raised the lower reaches of the Tutaekuri, Ngaruroro and Esk Rivers, trapping the gravels further inland. In contrast, with its watershed having subsided at the time of the earthquake, the Tukituki River still provides a source of gravel and sand to the ocean beaches. The erosion of Cape Kidnappers also supplies some greywacke gravel to the beach system.

The net inputs into and outputs from the gravel beach systems north and south of Napier are summarised as follows in the memo from the HBRC Regional Assets Section as follows:

Sediment supply and losses to the gravel beach system south of Napier (m^3/year)

Tukituki River:	+13,000 to +28,000 of a possible yield of 35,000
Cape Kidnappers:	+18,000
Awatoto extraction:	-30,000 to 0 (consent not renewed, probably will be zero in future)
Pacific Beach Extraction:	-12,800 (ceased since 2016)
Gravel abrasion:	-91,000
Net balance:	-57,800 to -102,800

Sediment supply and losses to the gravel beach system north of Napier

Esk River:	+2,000
Beach nourishment:	+12,800
Gravel abrasion:	-27,000

Net balance:	-12,200

Given that it is the only major river that provides a source of gravel to the ocean beaches, gravel extraction from the Tukituki will be carefully managed by HBRC to ensure that extraction is sustainable and avoids coastal erosion effects.

4.8 EFFECTS ON CULTURAL AND SPIRITUAL VALUES

Section 6 provides objectives and policies from the RRMP which recognise "tikanga Maori values and the contribution they make to sustainable development and the fulfilment of HBRC's role as guardians, as established under the RMA, and tangata whenua roles as kaitiaki, in keeping with Maori culture and traditions".

A hui to hear iwi views on gravel management was advertised and held on 6 March 2010. At the hui a number of views were expressed, which included:

a) Extraction costs and use of extraction charges

b) Returning reject material back to the river

c) Māori cultural values, whakapapa, mana whenua and concept of atua values.

d) Opportunity for iwi / hāpu specialists to assist.

e) Concerns over loss of habitat, leaving rivers in natural state.

f) Islands for habitat, swimming, fishing recreation areas.

g) Incorporating river management into hāpu management plans.

A further hui was held at Moteo Marae on 13 October 2012 to discuss river management and gravel extraction, with particular reference to the Tutaekuri River, but also covering river management in general. As part of the GMP and COP processes, a hui with the E & S Committee, (Iwi representatives) was held with the Tamatea Taiwhenua and a public meeting in Waipukurau as part of the special consultative procedure under the Local Government Act (2002).

4.9 EFFECTS ON AMENITY

As there are areas which can be used for public amenity of various forms (swimming, walking, boating, angling), the gravel extraction operation can result in the temporary reduction in amenity of the area. Because gravel extraction activities are generally intrusive to passive recreation the extraction areas are largely avoided during these times.

Gravel extraction may also generate dust, which has the potential to impact on the amenity for adjacent activities and users of the river i.e. dwellings/populated areas.

Gravel extraction may also increase the amount of sediment that enters the river (refer to discussion under Section 4.2 above), causing potentially reduced water clarity which may impact on peoples' amenity derived from the river. It is acknowledged that the movement of sediment is a natural part of a functioning of the river system as well as dust generated in stretches of the river system where extraction activities are not taking place.

Stock piling of material in certain locations may also generate a visual impact which may impact on the amenity derived in places.

In identifying the potential effects, it is important to recognise that the matters over which Council has reserved discretion in the Hawke's Bay Regional Resource Management Plan (refer to discussion under Section 5.2.4.1 below) and Regional Coastal Environmental Plan (refer to discussion under Section 5.2.4.2 below) has directly been limited to 'dust management' while indirectly, through Policy 53, the avoidance of any increases in sediment discharge or water turbidity (principally during the fish spawning period of May to October) is also a criterion.

In response to these matters, conditions of consent have been proposed to adequately address potential effects which may result on amenity from dust or sediment.

Overall, the effects on amenity are considered to be temporary in nature, and are able to be managed appropriately. On that basis, these effects are considered to be and will be less than minor.

4.10 EFFECTS ON INFRASTRUCTURE

Excessive gravel abstraction could potentially adversely affect infrastructure such as bridges and flood protection works, for example by undermining bridge piers or abutments. The main way this will be avoided will be by ensuring the extraction does not allow the active river channel to degrade below the design grade, as discussed in Section 3 above. It is noted that bridge piers etc are designed to allow for a certain degree of riverbed degradation, as this is a natural morphological process.

It is concluded that the effects of the proposed activities on infrastructure will be less than minor, provided extraction is carried out in accordance with this AEE.

4.11 EFFECTS ON WATER TAKES

The location of consented water takes within Tutaekuri River active channel are identfied on a plan in **Appendix I**.

There are 14 known water takes registered/consented within the Tukituki River active channel. 13 consents[6] are for irrigation and or frost purposes. One consent (Ref: WP050017ta) is to take water from the lower Tukituki River to provide two existing properties and an 11 lot rural residential subdivision with domestic and stock water.

To avoid potential effects on these takes, a condition of consent has been proffered (**Appendix B**) where the applicant is committed to taking all reasonable efforts to avoid any impacts on registered water takes.

5. PLANNING ASSESSMENT

This section identifies the activity status of the proposed activity under the Hawke's Bay Regional Resource Management Plan(RRMP) and Regional Coastal Environmental Plan

[6] Resource Consent WP140395T (water take for crops irrigation) and Resource Consent WP080402T (water take for crops irrigation)

(RCEP) and sets out the relevant statutory considerations for the Hawke's Bay Regional Council (in its capacity as a consent authority) to consider when assessing the application.

The RRMP became operative on 28 August 2006 and is a combined Regional Policy Statement and Regional Plan which sets out objectives, polices and rules that guide the management of natural and physical resources within the Hawke's Bay Region.

The RCEP became operative on 8 November 2014 and is a regional plan under the RMA for the region's coastal environment. The RCEP includes objectives, policies, methods (including rules) that are applicable within the 'coastal environment' (which is mapped in the RCEP).

In accordance with the provisions of section 104(1) (b) of the RMA, this section also assesses the planning instruments considered to be relevant to the proposal. An assessment against Part 2 of the RMA is also provided.

5.1 RESOURCE CONSENT REQUIRED

5.1.1 Regional Resource Management Plan (RRMP)

The RMA activity status of activities proposed for the extraction of gravel from the Tukituki Catchment Rivers outside of the coastal environment can be determined with reference to Section 6 – Regional Rules of the RRMP. Overall resource consent approval is being sought for a Restricted Discretionary Activity as it relates to the following rules:

Table 1: RRMP Section 6.8.3 River Control & Drainage Works & Structures

Rule	Activity	Classification	Conditions/Standards/Terms
70 **River control & drainage works & structures** *Refer POL 79*	Any activity, as described in the Hawke's Bay Regional Council Environmental Code of Practice for River Control and Drainage Works (1999), that is carried out by a local authority exercising its powers, functions and duties under the Soil Conservation and Rivers Control Act 1941, the Land Drainage Act 1908, or the Local Government Act 1974, in relation to flood control and drainage, including: • edge protection works • planting • river protection maintenance works • irrigation intake maintenance • weed and vegetation control (excluding spraying) • drain maintenance, and drainage outlet maintenance • drain crossings • river mouth openings for the purpose of flood mitigation • river management and drainage for the maintenance of surface water quality • channel diversions within a river bed or drain, ancillary to the above activities that would otherwise contravene: • section 13 or section 14 of the RMA, or • section 15 of the RMA in relation to the discharge of sediment.	**Permitted**[154]	a. The activity or structure shall be undertaken in a manner that continues to provide for the existing passage of fish past the structure. b. The appropriate Fish and Game Council, iwi and Department of Conservation office, shall be notified at least 5 working days before any channel diversion is undertaken. c. There shall be no discharge of contaminants, other than sediment, arising from the use of machinery in the bed of any river or lake. d. The activity shall not adversely affect any wetland.[155] e. All activities shall be undertaken in accordance with the Hawke's Bay Regional Council Environmental Code of Practice for River Control and Drainage Works, 1999.

[154] If Rule 70 cannot be complied with, then the activity is a discretionary activity under Rule 69.
[155] For the purpose of this Plan the term ‘wetland’ does NOT include:

- wet pasture land
- artificial wetlands used for wastewater or stormwater treatment
- farm dams and detention dams
- land drainage canals and drains
- reservoirs for firefighting, domestic or municipal water supply
- temporary ponded rainfall
- artificial wetlands.

Rule 70 is intended to provide flexibility to enable HBRC to meet its legal obligations relating to flood control and drainage under the Soil Conservation and Rivers Control Act 1941, the Land Drainage Act 1908, or the Local Government Act 1974; however, Rule 70 does not specifically provide for gravel extraction activities. Rule 70 therefore does not apply.

Table 2: RRMP Section 6.8.5 River Bed Gravel Extraction

Rule	Activity	Classification	Conditions/Standards/Terms	Matters for Control/Discretion
73 **Small scale river bed gravel extraction** *Refer POL 79*	The extraction of sand, gravel or other material from the bed of a river using a hand-held, non-mechanical device (e.g. a shovel), and any associated disturbance of the bed.	**Permitted**	a. The quantity of bed material extracted by any person at any one time shall not exceed 0.25 m^3. b. The total quantity of bed material extracted by any person shall not exceed 1 m^3 per year. c. The material shall be extracted from an area of river bed that is not covered by water at the time of extraction. d. The area from which material is extracted shall be recontoured so that no mounds or depressions remain. e. There shall be no discharge of any contaminant directly into water.	

Rule	Activity	Classification	Conditions/Standards/Terms	Matters for Control/Discretion
74 **Large scale river bed gravel extraction** *Refer POL 53, 79*	The extraction of sand, gravel or other material from the bed of any river or lake, and: • any associated disturbance of the bed, and • any associated discharge of sediment, and • any associated diversion of water that is not provided for by Rule 73.	**Restricted discretionary**		a. Location of extraction sites and stockpile areas. b. Volume of gravel extracted. c. Rate of removal of gravel. d. Period of extraction. e. End use of the gravel. f. Dust management. g. Other matters set out in Policy 53. h. Financial contributions. i. Duration of consent. j. Review of consent conditions. k. Compliance monitoring.

Rule 73 provides for gravel extraction activities; however the proposal exceeds the volume limits of that rule, and therefore cannot be considered "small scale". Rule 74 therefore applies, and the proposal requires a resource consent for a Restricted Discretionary activity.

5.1.2 Regional Coastal Environmental Plan (RCEP)

The RMA activity status of activities proposed for the extraction of gravel from the Tukituki River within the coastal environment can be determined with reference to Part E of the RCEP. The resource consent required has been determined from the following analysis against Chapter 27.1 – Use and Development of land in the Coastal Margin and Chapter 27.4 – River and Lake Beds in Coastal Margin of the RRMP. Overall resource consent approval is being sought for a **Restricted Discretionary Activity** as it relates to the following rules:

Table 2: RRMP Section 6.8.5 River Bed Gravel Extraction

Rule	Activity	Classification	Conditions/Standards/Terms	Matters for Control/Discretion
55 **Small scale river bed gravel extraction**	The extraction of sand, gravel or other material from the bed of a river using a hand-held, non-mechanical device (eg: a shovel), and any associated disturbance of the bed in the Coastal Margin.	**Permitted**	a) The quantity of bed material extracted by any person on any single day shall not exceed $0.25m^3$. b) The total quantity of bed material extracted by any person over any 12-month period shall not exceed $1m^3$. c) The material shall be extracted from an area of river bed that is not covered by water at the time of extraction. d) The area from which material is extracted shall be recontoured so that no mounds or depressions remain. e) There shall be no discharge of any contaminant directly into water	
61 **Large scale river bed gravel extraction**	Except as provided for in Rule 55, the extraction of sand, gravel or other material from the bed of any river or lake in the Coastal Margin and: 1. any associated disturbance of the bed and 2. any associated discharge of sediment and 3. any associated diversion of water	**Restricted discretionary**		a) Location of extraction sites & stockpile areas b) Volume of gravel extracted c) Rate of removal of gravel d) Period of extraction e) End use of the gravel f) Dust management g) Compliance with the HBRC Code of Practice for River Control and Drainage Works h) Matters in Chapter 26.2

The gravel extraction activities proposed to occur under this consent will exceed the volume limits of Rule 55. Rule 61 therefore applies, and the proposal requires a resource consent for a **Restricted Discretionary activity**.

5.1.3 Summary

Overall, the gravel extraction activities proposed to occur under this consent requires a resource consent for a **Restricted Discretionary Activity** consent under Rule 74 of the RRMP and a **Restricted Discretionary Activity** consent under Rule 61 of the RCEP.

5.2 STATUTORY CONSIDERATIONS

5.2.1 Section 104 (RMA)

Section 104 of the RMA specifies the matters that a consent authority must have regard to when considering applications for resource consent. This document has been prepared in accordance with the requirements of Section 104, including an assessment of environmental effects (as outlined in the following section) and an assessment of the relevant provisions of following documents (provided below):

The following is an analysis of relevant policy and legislative guidance for decision-making on this consent application (the 'policy context').

This analysis reviews relevant objectives, policies and legislative requirements in:

- National Policy Statement for Freshwater Management (2014)
- National Environmental Standard for Sources of Drinking Water (2007)
- The Regional Resource Management Plan (RRMP) (2006)
  - Regional Policy Statement
  - Regional Plan
- The Regional Coastal Environmental Plan (2014)
- Other Matters
- RMA Part 2 (1991)

5.2.2 National Policy Statements

There are five National Policy Statements currently in force that are potentially relevant to this application being:

- National Policy Statement on Urban Development Capacity
- National Policy Statement for Freshwater Management
- National Policy Statement for Renewable Electricity Generation
- National Policy Statement on Electricity Transmission
- New Zealand Coastal Policy Statement

Of these, the National Policy Statement for Freshwater Management may be of relevance, and this is assessed below. Given the nature and location of the proposed activity, there are no matters of relevance associated with the other National Policy Statements that require further assessment.

5.2.2.1 National Policy Statement for Freshwater Management (2014)

This national policy statement provides a National Objectives Framework to assist regional councils and communities to more consistently and transparently plan for freshwater objectives. The national policy statement sets national bottom lines for two compulsory values – ecosystem health and human health for recreation – and minimum acceptable states for other national values

Regional Councils are required to give effect to the 2014 NPSFM through their regional plans.

HBRC are undertaking a progressive implementation programme to implement the 2014 National Policy Statement for Freshwater Management (NPS-FM)[7]. This resulted in the insertion of policies into the RRMP as directed by National Policy Statement for Freshwater Management 2014 as at 8 November 2014. The relevant policies of the RRMP are assessed by in section 5.2.5.

5.2.3 National Environmental Standards

There are four National Environmental Standards currently in force that are potentially relevant to this application being:

- National Environmental Standards for Air Quality
- National Environmental Standard for Sources of Drinking Water
- National Environmental Standards for Telecommunication Facilities
- National Environmental Standards for Electricity Transmission Activities
- National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health

Of these, the National Environmental Standard for Sources of Drinking Water may be of relevance, and this is assessed below. Given the nature and location of the proposed activity, there are no matters of relevance associated with the other national environmental standards that require further assessment.

5.2.3.1 National Environmental Standard for Sources of Drinking Water

The National Environmental Standards for Sources of Human Drinking Water (NES) sets requirements for protecting sources of human drinking water from becoming contaminated.

The NES applies to the following water supply takes:

1. Regulations 6 to 10 applies to a drinking-water supply to **no fewer than 501 people** with drinking water for not less than **60 days** each calendar year
2. Regulations 11 & 12 applies to a drinking-water supply to **no fewer than 25 people** with drinking water for not less than **60 days** each calendar year

On review of consented takes on the Tukituki River, there is one registered potable water supply (Ref: WP050017Ta) to take water from the lower Tukituki River (lower) to provide two existing properties and an 11 lot rural residential subdivision with domestic and stock water. This consent is granted for a period expiring on 31 May 2025. The subdivision is located in the Central Hawke's Bay District, which under the 2013 census has an average of 2.4 people per household. Based on the 13 rural residential properties the consent, this

[7] Hawkes Bay Regional Council: National Policy Statement for Freshwater Management – Progressive Implementation Programme for Hawkes Bay; 25 November 2015.

would equate to approximately 32 people. This meets the provisions for Regulations 11 & 12 of the NES-DW.

To avoid potential effects on these takes, a condition of consent has been proffered (**Appendix B**) where the applicant is committed to taking all reasonable efforts to avoid any impacts on registered water takes.

5.2.3.2 Section 104(1)(c) – Other Matters

When considering any application for resource consent, or associated submission, a consent authority must have regard to any other matter the consent authority considers relevant and reasonably necessary to determine the application. Effectively this enables a non-RMA document to be given 'weight' in a resource consent process.

HBRC has recently drafted the Hawke's Bay Riverbed Gravel Management (GMP). This GMP is in draft form at present, with public submissions being sought under the Local Government Act (2002) special consultative procedure. The GMP (draft) is attached as **Appendix G.**

The key aspect of the GMP is that it records, following formal consultation and submissions, the gravel management and allocation process particularly under the scenario where a Regional Council holds the resource consents.

The GMP integrates the duties and functions of HBRC in respect to managing flood risk (and by extension gravel management) resulting from three main Statutes:

- RMA (1991)
- Local Government Act (2002)
- Soil Conservation and Rivers Control Act (1941)

The relevant RMA matters have been addressed by this resource consent application, with the legal obligations of HBRC under the remaining two Statues outlined below.

Local Government Act 2002

Section 11A of the Local Government Act states:

In performing its role, a local authority must have particular regard to the contribution that the following core services make to its communities:

a) network infrastructure:

b) public transport services:

c) solid waste collection and disposal:

d) the avoidance or mitigation of natural hazards:

e) libraries, museums, reserves, recreational facilities, and other community infrastructure

As the gravel management extraction proposed in this application is for the purposes of is for flood control, the activity is consistent with Section 11A(d).

The Local Government Act also requires HBRC to undertake Long Term Plans and Annual Plans. As part of the Long Term Plan process, nine community outcomes for Hawke's Bays communities have been identified with one of the outcomes being A lifetime of good health and wellbeing. A 'key indicator' of this outcome is that Hawke's Bay people live in safe and secure communities where they are supported to live healthy lives and achieve their full potential. Maintenance of flood schemes is listed as HBRC activities which contribute to these outcomes. While this does not over-ride the RMA requirements to avoid, remedy or mitigate actual or potential effects of the proposed activity, this demonstrates that HBRC's flood hazard mitigation activities, including gravel management, are envisaged and expected as an activity area by the Hawke's Bay community.

Soil Conservation Rivers Control Act 1941

The overriding purpose of the Soil Conservation and Rivers Control Act 1941 is to make provision for the conservation of soil resources, the prevention of damage by erosion, and to make better provision for the protection of property from damage by floods. While the Act has been largely superseded by the provisions of the Resource Management Act 1991, the current provisions of the Soil Conservation and Rivers Control Act 1941 still provide the legal mandate to Regional Councils to protect communities from flooding using the most appropriate methods. The mandate that this Act confers to Regional Councils serves to differentiate a Council's gravel extraction operations from a commercial entity extracting gravel. This is an important legal distinction that has a bearing on the Consent Authority's consideration of applications from the Assets Section rather than from commercial extractors.

5.2.3.3 Summary of Other Matters

In summary, the suite of legislation gives the statutory mandate and responsibility to the HBRC Assets Section to carry out its duties and functions to avoid and mitigate the effects of flooding on the region's community. While HBRC must still comply with the RMA, where required, the wider statutory context should be considered by the Consent Authority to give appropriate consideration and weight to HBRC flood protection and gravel management functions.

5.2.4 Section 104C (RMA) - Determination of applications for restricted discretionary activities

Section 104C of the RMA reads:

(1) When considering an application for a resource consent for a restricted discretionary activity, a consent authority must consider only those matters over which—

(a) a discretion is restricted in national environmental standards or other regulations:

(b) it has restricted the exercise of its discretion in its plan or proposed plan.

(2) The consent authority may grant or refuse the application.

(3) However, if it grants the application, the consent authority may impose conditions under section 108 only for those matters over which—

(a) *a discretion is restricted in national environmental standards or other regulations:*

(b) *it has restricted the exercise of its discretion in its plan or proposed plan.*

An assessment against the potentially relevant National Environmental Standards, and the relevant provisions of the RRMP and RCEP, is provided below.

Under Section 104C, the HBRC may grant or refuse this application, but must only consider the activity based on the matters to which it has restricted the exercise of its discretion under the RRMP and RCEP. If a council chooses to grant consent, then conditions can only be imposed in relation to those matters over which discretion has been restricted in the respective Plans.

5.2.4.1 Regional Resource Management Plan

Under Section 104C, the HBRC may grant or refuse this application, but must only consider the activity based on the matters to which it has restricted the exercise of its discretion under the Regional Plan. If a council chooses to grant consent, then conditions can only be imposed in relation to those matters over which discretion has been restricted in the Regional Plan.

The matters which HBRC has limited its discretion are:

a. *Location of extraction sites and stockpile areas.*

b. *Volume of gravel extracted.*

c. *Rate of removal of gravel.*

d. *Period of extraction.*

e. *End use of the gravel.*

f. *Dust management.*

g. *Other matters set out in Policy 53.*

h. *Financial contributions.*

i. *Duration of consent.*

j. *Review of consent conditions.*

k. *Compliance monitoring.*

The 'other matters' provided at Policy 53 (Decision-Making Criteria – River Bed Gravel Extraction) are identified as in section 5.2.3 immediately below.

5.2.4.2 Regional Coastal Environmental Plan

The matters which HBRC has limited its discretion under the RCEP are:

a) *Location of extraction sites & stockpile areas*

b) *Volume of gravel extracted*

c) *Rate of removal of gravel*

d) *Period of extraction*

e) *End use of the gravel*

f) *Dust management*

g) Compliance with the HBRC Code of Practice for River Control and Drainage Works

h) Matters in Chapter 26.2

The matters provided at Chapter 26.2 are:

(c) Restricted discretionary, a resource consent is required, and HBRC will decide whether or not to grant the consent. However, HBRC's powers to decline consent and to impose conditions are restricted to exercising its discretion over the list of matters specified in the rule and the following matters:

(i) financial contributions in the form of money or land or a combination of these

(ii) bonds or covenants or both, to ensure performance of, or compliance with, any conditions imposed

(iii) works or services to ensure the protection, restoration, or enhancement of any natural or physical resource, including (but not limited to) planting or replanting, earthworks, or any other works or services necessary to ensure the avoidance, remediation or mitigation of adverse environmental effects

(iv) administrative charges to be paid to HBRC in respect of processing applications, administration, monitoring and supervision of resource consents, and for the carrying out of the HBRC's functions under s35 of the RMA

(v) requirements for a consent holder to supply HBRC with information relating to the exercise of the consent

(vi) requirements for a consent holder to record measurements, take samples, carry out analyses, surveys, investigations, inspections or other specified tests

(vii) requirements for a consent holder to adopt the best practicable option to prevent or minimise any actual or likely adverse effect on the environment of a discharge of contaminants

(viii) the duration of a resource consent, under s123 of the RMA

(ix) the lapsing of a resource consent, under s125 of the RMA

(x) provision for the review of some or all of the conditions at some time in the future, under s128 of the RMA.

NOTE: When considering resource consent applications and setting consent conditions, HBRC will have regard to relevant objectives and policies in the Regional Policy Statement parts of the Hawke's Bay Regional Resource Management Plan (particularly Chapter 3.2 and Schedule I); and the relevant objectives and policies elsewhere in this Plan.

5.2.5 Policy and Planning Documents

The following provides a planning analysis of the proposal in relation to the relevant policy and planning documents prepared under the RMA that need to be considered as part of the assessment of the resource consent application. The various documents are discussed in the order of their position in hierarchy of policy and planning documents under the RMA as follows.

5.2.5.1 Regional Policy Statement

The relevant regional policy statement objectives and policies for the management of riverbed gravel and flood hazards are analysed below in respect to the proposed activity.

POL 53 DECISION-MAKING CRITERIA - RIVER BED GRAVEL EXTRACTION

3.11.13 In considering consent applications for the extraction of river bed gravel, to have regard to the following criteria:

(a) The capability to restore the extraction site upon completion of the extraction operation, and to repair any damage caused to any banks, access roads, fences, gates, or other structures.

(b) The avoidance of any contaminants from machinery use entering water bodies.

(c) The avoidance of any increases in sediment discharge or water turbidity, particularly during the fish spawning period of May to October.

(d) The continuation of existing fish passage.

(e) The avoidance of any adverse effects on flood control assets or river protection works.

(f) The avoidance of any activity that would cause flood control measures or river protection works to be required.

(g) The avoidance of any offensive or objectionable discharge of dust.

(h) The end uses of the gravel, in order that high quality gravel is allocated to uses which require such gravel.

(i) The location of, and potential effect on, any downstream water takes/users.

(j) The effect on the ecology of the river.

(k) The extent to and the time over which natural processes will be capable of returning the river bed to a state of equilibrium following extractive activity

The proposed methodology for undertaking the work and the suggested consent conditions proposed for this activity, collectively ensure that the proposed activity is consistent with all of the above Decision Making Criteria.

POL 54 PROBLEM SOLVING APPROACH - INTEGRATION WITH RIVER CONTROL WORKS

3.11.15 To integrate the management of gravel extraction with river control works by:

(a) Encouraging gravel extraction where there is the potential to minimise flooding or the risk of damage to protection works or essential structures.

(b) Undertaking specific works to control erosion and encourage gravel movement where appropriate.

The proposed activity is consistent with Policy 54, and the requested consent duration will allow a greater integration of the Assets Sections overall river management mandate with gravel extraction. This is also addressed within the reports attached as **Appendix D** and **G**.

Anticipated Environmental Result

Anticipated Environmental Result	Indicator	Data source
Extraction of river bed gravel at a rate that does not exceed its natural replenishment (unless there is an environmental benefit in doing so)	River cross sections	Council data on river profiles

As outlined within the Assessment of Effects in Section 4, the proposed activity will be consistent with this Anticipated Environmental Result.

3.12 Natural Hazards

ISSUE

3.12.1 The susceptibility of the region to flooding, droughts, earthquakes, volcanic ash falls, and tsunami, and the potential impact of these on people's safety, property, and economic livelihood.

OBJECTIVE

OBJ 31 The avoidance or mitigation of the adverse effects of natural hazards on people's safety, property, and economic livelihood.

Section 4 of the Assessment of Effects demonstrates that the proposed activity is consistent with Issue 3.12.1 and Objective 31. It is the Issues, Objectives and Policies of both the RPS and RRMP in respect to avoiding and mitigating flood hazards in the Region that are a fundamental basis to this consent application. HBRC's other legislative mandates from the Local Government Act 2002 and the Soil Conservation and Rivers Control Act 1941, outlined in the Riverbed Gravel Management Plan (draft) (**Appendix G**), further provide the statutory mandate for this application from the Assets Section.

POL 55 ROLE OF NON-REGULATORY METHODS

3.12.10 To use non-regulatory methods set out in Chapter 4, as the principal means of addressing hazard avoidance and mitigation, in particular:

(a) Liaison with territorial authorities12 - To provide information on natural hazard risk to territorial authorities, and advocate that future development is managed in such a way that the risk of exposure to natural hazards is avoided, remedied or mitigated.

(b) Works and services - To provide hazard mitigation measures, in particular flood mitigation measures, where the benefits can be shown to outweigh the costs and the identified beneficiaries can meet the costs.

(c) Natural hazard priorities - To focus both hazard avoidance and mitigation on areas of high human population density as a first priority.

Policy 55 (b) clearly envisages "works and services" are undertaken to avoid and mitigate flood hazards; hence, the proposed activity is consistent with this policy. In terms of (c) above, the Tukituki River represents the most significant flood risk in the Region due to the nature of the floodplain development.

Anticipated Environmental Result	Indicator	Data source
Extraction of river bed gravel at a rate that does not exceed its natural replenishment (unless there is an environmental benefit in doing so)	River cross sections	Council data on river profiles

The proposed activity is considered a critical natural hazard mitigation measure and hence consistent with the Anticipated Environmental Result.

3.14 Recognition of Matters of Significance to Iwi/Hapu

3.14.1 These objectives and policies are developed from the issues of significance to iwi/hapu identified in sections 1.5 and 1.6 of this Plan.

Section

OBJECTIVE

OBJ 34 To recognise tikanga Maori values and the contribution they make to sustainable development and the fulfilment of HBRC's role as guardians, as established under the RMA, and tangata whenua roles as kaitiaki, in keeping with Maori culture and traditions.

POLICIES

POL 57 Where policy is being developed for the management of natural and physical resources the following matters shall be had regard to:

(a) Where the effects of an activity have minimal or no measurable impact on the state of mauri, the life sustaining capacity of a resource – no or minimal regulation (noa).

(b) Where the actual or potential effects of an activity on the state of mauri are significant – the activity shall be dealt with on a case-by-case basis according to those effects (rahui).

(c) Where the impacts of an activity have a severe and irreversible impact upon the state of mauri that activity shall be prohibited (tapu).

POL 58 To share information on matters of resource management significance to Maori and on processes to address them.

OBJECTIVE

OBJ 35 To consult with Maori in a manner that creates effective resource management outcomes.

POLICIES

POL 59 Consultation with tangata whenua should be undertaken in a manner that acknowledges Maori values, with the fundamental approach in consultation being "kanohi ki te kanohi" (face to face) or personal contact. Other matters necessary to be exercised are:

(a) consideration of a consent application not yet finally decided upon

(b) listening to what others have to say

(c) considering their responses

(d) deciding what will be done

(e) appropriate timing.

POL 63 Consultation involving iwi or hapu is expected generally to be undertaken on a marae. The place of consultation should be determined as a result of agreement between both parties.

OBJ 37 To protect and where necessary aid the preservation of mahinga kai (food cultivation areas), mahinga mataitai (sea-food gathering places), taonga raranga (plants used for weaving and resources used for traditional crafts) and taonga rongoa (medicinal plants, herbs and resource).

POLICIES

POL 64 Activities should not have any significant adverse effects on waahi tapu, or tauranga waka.

POL 65 Activities should not have any significant adverse effects on taonga raranga, mahinga kai or mahinga mataitai.

POL 66 The importance of coastal, lake, wetlands and river environments and their associated resources to Maori should be recognised in the management of those resources.

HBRC are in the process on engaging with tangata whenua to gain a better understanding on how the proposed activity may impact on their cultural and spiritual values. These discussions will continue following lodgement of this application and HBRC will provide an update on the process and outcome of this assessment in due course.

Non-Regulatory Methods

4.5 Provision of Works and Services

4.5.1 The HBRC also undertakes works and provides services as methods of implementation. 'Works' are actual. physical developments, such as river and flood control works, where as 'services' include such things as making staff available to provide planning or technical assistance.

4.5.2 The scope of works and services able to be provided is limited by the terms of the Local Government Act 1974. Examples of works and services undertaken by the HBRC, that will continue to be implemented where appropriate, include:

(a) Wetlands enhancement scheme – An ongoing wetlands enhancement programme for identified priority wetlands of the region. As a first priority, the HBRC will ensure that further degradation of a wetland does not occur; as a second priority the HBRC will seek to enhance the values of a wetland where there are significant biodiversity benefits in doing so and where it is economically feasible.

(b) Service delivery under other legislation – including:

(i) Animal pest control – The surveillance of pest populations, particularly possums and rabbits, on land in the region. The HBRC has also undertaken animal pest control programmes where necessary.

(ii) Plant pest control – The HBRC provides information to the public on the identification and control of plant pests in the region. The HBRC has also undertaken measures to control biological plant pests in the region through the application of a management programme.

(iii) Flood protection schemes – The HBRC has undertaken flood protection schemes and works within areas of the region's major rivers. Examples of these schemes are the Heretaunga Plains and Upper Tukituki flood control schemes, for which asset management plans have been developed.

The RPS within the above non-regulatory sections anticipates physical works such as gravel extraction as a method for achieving avoidance and mitigation of flood hazards.

5.2.5.2 Regional Plan

The relevant regional plan objectives, policies and rules for the management of riverbed gravel and flood hazards are analysed below in respect to the proposed activity.

5.4 Surface Water Quality

OBJECTIVE

OBJ 40 The maintenance of the water quality of specific rivers in order that the existing species and natural character are sustained, while providing for resource availability for a variety of purposes, including groundwater recharge.

It is considered that the proposed activity appropriately balances the positive effects that will accrue from undertaking the works, while avoiding and mitigating the actual and potential effects on water quality in the Tukituki River.

POLICIES

POL 71 ENVIRONMENTAL GUIDELINES - SURFACE WATER QUALITY

5.4.2 To manage the effects of activities affecting the quality of water in rivers, lakes and wetlands in accordance with the environmental guidelines set out in Tables 7 and 816.

Table 7. Environmental Guidelines – Surface Water Quality Part I – Guidelines that apply across the entire Hawke's Bay region

Issue	Guideline
1. Temperature	The temperature if the water should be suitable for sustaining the aquatic habitat.
2. Dissolved oxygen	The concentration of dissolved oxygen should exceed 80% of saturation concentration.
3. Ammoniacal nitrogen	The concentration of ammoniacal ($N-NH_4+$) should not exceed 0.1 mg/l.
4. Soluble reactive phosphorus	The concentration of soluble reactive phosphorus should not exceed 0.015 mg/l.
5. Clarity	In areas used for contact recreation, the horizontal sighting range of a 200 mm black disk should exceed 1.6 m.

These guidelines apply after reasonable mixing and disregarding the effect of any natural perturbations that may affect the water body, as set out in Policy 72.

Issue 5, Clarity is the only guideline potentially impacted by the proposal. Proposed conditions (**Appendix B**) have been developed to address this.

Table 8. Environmental guidelines – Surface Water Quality Part II – Guidelines that apply to Specific Catchments

Catchment Area	Faecal Coliforms (cfu/100ml)	Suspended Solids (mg/l)
Tukituki River upstream of Redclyffe Bridge	50	10
Tukituki River between Redclyffe Bridge and SH50	100	25
Tukituki River downstream of the Expressway Bridge	150	25

Measures (suggested conditions of consent) have been proposed to ensure during normal operating conditions, the undertaking of the activity will generally avoid generating suspended solids in the river system.

Anticipated Environmental Result	Indicator	Data Source
Surface water bodies suitable for sustaining aquatic ecosystems	1. Temperature not changed by more than 3°C, nor raised above 25°. 2. Dissolved oxygen not falling below guideline levels. 3. Ammoniacal nitrogen levels not exceeding guideline values. 4. Soluble reactive phosphorus values not exceeding guideline values. 5. Diversity and quantities of fish species or indigenous invertebrates is maintained,	Council Water Quality Monitoring Programme. Annual SER monitoring.

The Assessment of Effects, historical gravel extraction activities and previous state of environment monitoring have demonstrated that the proposed activity will be consistent with these Anticipated Environmental Results.

5.8 Beds of Rivers and Lakes

OBJECTIVE

OBJ 45 The maintenance or enhancement of the natural and physical resources, and use and values, of the beds of rivers and lakes within the region as a whole.

Refer section 2.2 of this Plan

The Assessment of Effects has concluded that the effects will be less than minor of the proposed activity hence will be consistent with Objective 45.

POLICY

POL 79 ENVIRONMENTAL GUIDELINES – BEDS OF RIVERS AND LAKES

5.8.1 To manage the effects of activities affecting river beds and lake beds in accordance with the environmental

Issue	Guideline
1. Fish passage	The activity should be undertaken in a manner that continues to provide for the existing passage of fish past the structure.
2. Fish spawning	In areas of fish spawning the activity should be undertaken in a manner that minimises adverse effects on overall fish spawning patterns.

Issue		Guideline
3.	Bed stability	No long term or ongoing acceleration of the rate of erosion or accretion of the bed of a river or lake as a result of any activity in a river or lake bed.
4.	Habitat	Adverse effects on the habitat of aquatic and terrestrial flora and fauna within the bed of a river or lake should be avoided, remedied or mitigated.
5.	Flow regimes	Adverse effects on natural flow regimes should be avoided where this is possible, or remedied or mitigated where avoidance is not possible.
6.	Other structures & activities.	There should be no significant adverse effects, including by way of destabilisation, on lawful existing structures or activities within the bed of a river or lake.
7.	Flood & debris risk	There should be no reduction in the ability of the channel to convey flood flows, and no significant impedance to the passage of floating debris.
8.	Damage to property	There should be no damage caused, and no increase in the risk of damage, to any property, including river control works, unless written approval is obtained from any affected parties.
9.	Temporary activities	Upon complete of any temporary activity affecting the bed of a river or lake, the bed should as far as practicable be restored to no less than the state it was in prior to the activity taking place.
10.	Outstanding natural features	Adverse effect on any outstanding natural features within river and lake beds should be avoided, remedied or mitigated.

Explanation and Reasons
Policy 79 sets out environmental guidelines for the management of activities affecting river beds and lake beds, including structures in, on, under or over river or lake beds, and bed disturbances. The environmental guidelines address the management of both natural and physical resources within river beds and lake beds.

The proposed methodology for undertaking the works and suggested consent conditions for this activity collectively ensure that the proposed activity is consistent with all of the above Environmental Guidelines.

No damage to any property is envisaged as a result of the proposed activity. None the less, the suggested consent condition 10 requires that any damage to property be repaired.

POL 80A WATER PERMITS – Matters for consideration

(1) When considering any application the consent authority must have regard to the following matters:

(a) The extent to which the change would adversely affect safeguarding the life-supporting capacity of fresh water and of any associated ecosystem and

(b) the extent to which it is feasible and dependable that any adverse effect on the life-supporting capacity of fresh water and of any associated ecosystem resulting from the change would be avoided.5

Explanation and Reasons

5.8.5 Policy 80A was inserted in accordance with the direction stated in Policy B7 of the National Policy Statement for Freshwater Management 2014 which took effect 1 August 2014.

The Assessment of Environmental Effects demonstrates that the proposed activity will have a less than minor effect on the life-supporting capacity of the Tukituki River, and hence is consistent with Policy 80. The National Policy Statement for Freshwater Management 2014 is further analysed in Section 5 above.

Anticipated Environmental Results

Anticipated Environmental Result	Indicator	Data Source
Fish passage and spawning are able to continue despite the erection or use of a structure or bed disturbance	Abundance of fish in selected locations	Department of Conservation Fish and Game HBRC
Avoidance, remedy or mitigation of adverse effects on natural flow regimes	Natural flow regimes	Flow monitoring programme
No significant adverse effects on existing structures or activities within the bed of a river or lake	Destabilisation of existing structures or activities	Compliance monitoring
No reduction in ability of channels to convey flood flows	River bed cross section profiles	Asset Management Plans and flow monitoring
No damage to property by works in river beds, without owner's consent	Reports of damage from river control works	Occasional event reports

Anticipated Environmental Result	Indicator	Data Source
Restoration of river or lake bed following temporary activity	As far as practicable the bed is restored to at least its state prior to activity occurring	Compliance monitoring
Aquatic habitat is maintained at a sustainable level	1 Temperature not changed by more than 3°C, nor raised above 25°. 2. Dissolved oxygen not exceeding guideline levels. 3. Ammoniacal nitrogen levels not exceeding guideline values. 4. Soluble reactive phosphorus values not exceeding guideline values. 5. No loss of fish species or indigenous invertebrates	Council water quality monitoring programme

The methodology of the proposed activity and the suggested consent conditions (**Appendix B**) will ensure that the Anticipated Environmental Results will be realised.

Overall, in terms of the relevant policy framework, the gravel extraction from the Tukituki River is considered to be consistent with the objectives and policies of the RRMP.

5.2.5.3 Regional Coastal Environment Plan

Table 26-1 (Summary of Regional Coastal Environment rules) of the RCEP identifies that the policies related to Rule 61 are Objective / Policy 9.1 and Objective / Policy 13.1. These objectives and policies are assessed below.

CHAPTER 9 SURFACE WATER QUALITY

Objective 9.1

The maintenance and enhancement of the water quality of rivers and lakes in order that the existing species and natural character are sustained, while providing for resource availability for a variety of purposes, including groundwater recharge, maintenance or enhancement of mauri, and the protection of aquatic ecosystems. Policies

Policy 9.1

To manage the effects of activities affecting the quality of water in rivers, lakes and wetlands in accordance with the environmental guidelines set out in Table 9-1 and Table 9-2.

It is noted that the Tables provided at 9-1 and 9-2 deliver the same parameters as those provided under the RRMP at Policy 71 (Environmental Guidelines – Surface Water Quality) above. However, for completeness, the tables as provided in the RCEP are repeated below:

Table 9-1: Environmental Guidelines – Surface Water Quality (Guidelines that apply across the entire Coastal Margin).

Issue	Guideline
1. Temperature	The temperature if the water should be suitable for sustaining the aquatic habitat.
2. Dissolved oxygen	The concentration of dissolved oxygen should exceed 80% of saturation concentration.
3. Ammoniacal nitrogen	The concentration of ammoniacal ($N\text{-}NH_4{+}$) should not exceed 0.1 mg/l.
4. Soluble reactive phosphorus	The concentration of soluble reactive phosphorus should not exceed 0.015 mg/l.
5. Clarity	In areas used for contact recreation, the horizontal sighting range of a 200 mm black disk should exceed 1.6 m.
6. Heavy metals	The concentration of heavy metals should not exceed the relevant limits contained in: (a) The contact recreation guidelines contained in 'Microbial Guidelines for Marine and Freshwater Recreational Areas' (Ministry of Health and Ministry for the Environment, June 2003); and (b) The guidelines for the protection of aquatic ecosystems contained in the 'Guidelines for Fresh and Marine Water Quality 2000' (ANZECC, 2000).

Table 9-2: Environmental Guidelines – Surface Water Quality (Guidelines that apply to specific catchments).

Catchment Area	Faecal Coliforms (cfu/100ml)	Suspended Solids (mg/l)
Tukituki River downstream of Tamumu bridge	100	10

* The figures in Table 9-2 represent concentrations of contaminants in the water body that should not be exceeded after reasonable mixing.

As identified above, measures (suggested conditions of consent) have been proposed to ensure that during normal operating conditions, the undertaking of the activity will generally avoid generating suspended solids in the river system.

CHAPTER 13 BEDS OR RIVERS AND LAKES

Objective 13.1

The maintenance or enhancement of the natural and physical resources, and use and values, of the beds of rivers and lakes within the Region as a whole.

Policy 13.1

To manage the effects of activities affecting river beds and lake beds in accordance with the environmental guidelines set out in Table 13-1.

Issue	Guideline
1. Fish passage	The activity should be undertaken in a manner that continues to provide for the existing passage of fish past the structure.
2. Fish spawning	In areas of fish spawning the activity should be undertaken in a manner that minimises adverse effects on overall fish spawning patterns.
3. Bed stability	No long term or ongoing acceleration of the rate of erosion or accretion of the bed of a river or lake as a result of any activity in a river or lake bed.
4. Habitat	Adverse effects on the habitat of aquatic and terrestrial flora and fauna within the bed of a river or lake should be avoided, remedied or mitigated.
5. Flow regimes	Adverse effects on natural flow regimes should be avoided where this is possible, or remedied or mitigated where avoidance is not possible.
6. Other structures & activities.	There should be no significant adverse effects, including by way of destabilisation, on lawful existing structures or activities within the bed of a river or lake.
7. Flood risk	There should be no reduction in the channel's capacity that results in adverse flooding effects
8. Debris risk	There should be no significant impedance to the passage of floating debris.
9. Damage to property	There should be no damage caused, and no increase in the risk of damage, to any property, including river control works, unless written approval is obtained from any affected parties.
10. Temporary activities	Upon complete of any temporary activity affecting the bed of a river or lake, the bed should as far as practicable be restored to no less than the state it was in prior to the activity taking place.

Issue		Guideline
11.	Outstanding natural features	Adverse effect on any outstanding natural features within river and lake beds should be avoided, remedied or mitigated.
12.	Historic heritage and significant cultural values	Adverse effects on historic heritage features and areas of significant cultural heritage within river and lake beds should be avoided, remedied or mitigated

Policy 13.2

To implement the environmental guidelines for river beds and lake beds set out in Policy 13.1 predominantly in the following manner:

…

(b) Resource consents - The environmental guidelines will also be used in the process of making decisions on resource consents, in accordance with the RMA.

The proposed methodology for undertaking the works and suggested consent conditions for this activity collectively ensure that the proposed activity is consistent with the above Environmental Guidelines.

No damage to any property is envisaged as a result of the proposed activity. None the less, the suggested consent condition 10 requires that any damage to property be repaired.

Overall, in terms of the relevant policy framework, the gravel extraction from the Tukituki River is considered to be consistent with the objectives and policies of the RCEP.

5.2.6 Part 2 Matters

As required by Schedule 4, Clause 2(1)(f) of the Act, the following is an assessment against the matters set out in Part 2. It is noted that recent case law in the High Court decision on *RJ Davidson Family Trust v Marlborough District Council (2017)* NZHC 52 determined that "*the Court is not required to consider Part 2 of the RMA beyond its expression in the planning documents…"*. However, for completeness, in regard to RMA Schedule 4, an assessment against Part 2 is provided as follows.

5.2.6.1 Section 5

The matters to be considered under section 104 are subject to Part 2 of the RMA. The cornerstone of Part 2 is the Purpose of the Act as set out in section 5(1), which is:

To promote the sustainable management of natural and physical resources

Section 5(2) of the RMA defines sustainable management as:

Managing the use, development and protection of natural and physical resources in a way or at a rate which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while:

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

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

c. *Avoiding, remedying or mitigating any adverse effects of activities on the environment."*

The promotion of sustainable management requires an overall broad judgement of whether a proposal will meet the requirements of section 5 of the RMA. The approach recognises that the RMA has a single purpose – sustainable management. Such a judgement allows for the comparison of often conflicting considerations and the scale or degree of them and their relative significance or proportion in the final outcome.

In this case, given the considerable positive effects principally in terms of reducing the risks to people and property from flood effects, and the avoidance or mitigation of the potential or actual effects on the environment, it is concluded the proposed activity is consistent with Section 5 of the RMA.

The overall assessment of a proposal in relation to the purpose of the RMA is informed by the matters in sections 6, 7 and 8 of the RMA, discussed as follows.

5.2.6.2 Section 6 – Matters of National Importance

Section 6 of the RMA sets out the matters of national importance that must be recognised and provided for in managing the use, development and protection of natural and physical resources. The following parts of Section 6 are considered potentially relevant to the proposal:

(a) The preservation of the natural character of the coastal environment (including coastal marine area) wetlands and lakes and rivers and their margins and the protection of them from inappropriate subdivision, use and development:

(c) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:

(e) The relationship of Maori and their culture and traditions with their ancestral lands, water, waahi tapu, and other taonga;

(f) The protection of recognised customary activities.

Section 4 (Assessment of Environmental Effects) identifies that the activity, in combination with the suite of conditions proposed, will result in less than minor effect on the Tukituki River, and will also have less than minor effects on the ecological values of the waterway (s6 (a) and (c) above).

In terms of s 6(e) and (f), HBRC are engaging in ongoing consultation with mana whenua on the application to extract gravel from the Tukituki River. At a broader level, HBRC have engaged with mana whenua to hear their views on the potential effect of gravel extraction activities on values and sites of significance to mana whenua, including taonga and mauri of the rivers under the Riverbed Gravel Management Plan. This process is ongoing with mana whenua expressing an interest in the Riverbed Gravel Management Plan review process and seek opportunity to be involved in management of gravel extraction.

On the basis of the above, the proposal is not considered to be contrary to any of the matters of national importance set out in section 6 of the RMA.

5.2.6.3 Section 7 – Other Matters

Section 7 of the RMA sets out the matters that particular regard must be given to in managing the use, development and protection of natural and physical resources. Section 7 of the Act, 'Other Matters', is as follows:

> *In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall have particular regard to—*
>
> *(a) kaitiakitanga:*
>
> *(aa) the ethic of stewardship:*
>
> *(b) the efficient use and development of natural and physical resources:*
>
> *(ba) the efficiency of the end use of energy:*
>
> *(c) the maintenance and enhancement of amenity values:*
>
> *(d) intrinsic values of ecosystems:*
>
> *(e) [Repealed]*
>
> *(f) maintenance and enhancement of the quality of the environment:*
>
> *(g) any finite characteristics of natural and physical resources:*
>
> *(h) the protection of the habitat of trout and salmon:*
>
> *(i) the effects of climate change:*
>
> *(j) the benefits to be derived from the use and development of renewable energy.*
>
> *(Emphasis added)*

In terms of Section 7(a) and (aa), it is considered that the ongoing discussions with appropriate representatives provides for these matters.

With regards to s7(b) the proposed activity is an efficient use and development of natural and physical resources as the gravel resource to be extracted is considered sustainable and the proposed activity reduces the need for other land or coastal based extraction sites.

The proposed activity also gives consideration to the effects of climate change (7(i)) in that gravel extraction is an essential river management approach in preparing for more intense rainfall events, resulting in increased flood frequencies and magnitudes.

The proposed activity will protect the habitat of trout by avoiding works within the active river channel and limiting extraction to the gravel beaches. The proposed methodology for undertaking the works and the suggested consent conditions also avoid and mitigate effects on water quality.

5.2.6.4 Section 8 – Treaty of Waitangi

Section 8 of the RMA states:

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

The requirement to take into account the principles of the Treaty of Waitangi is an obligation on those exercising functions and powers under the RMA, including in this case HBRC in making decisions on the applications. HBRC are continuing to work with mana whenua in a manner consistent with the principles of the Treaty. This process is ongoing and will continue following the lodging of this consent.

6. CONSULTATION

HBRC has been engaging with multiple parties through the gravel management review process, principally:

- Mana Whenua
- Gravel Extractors
- Fish and Game
- Department of Conservation
- Landowners contributing to the Heretaunga Plains Flood Protection Scheme
- Forest and Bird

HBRC has engaged with these parties in a two-part conversation regarding the current proposal (resource consent), and on the broader Hawke's Bay GMP and the Code of Practice, currently being prepared under the Local Government Act (2002) and consulted on through a special consultative procedure under the Act.

7. CONCLUSION

HBRC (Regional Assets section) is seeking to obtain a comprehensive gravel extraction resource consent for the Tukituki Catchment Rivers. The consent as sought will authorise gravel extraction for flood control purposes that is not able to comply with the existing permitted activity rule standards of the Regional Resource Management Plan and Regional Coastal Environment Plan.

There is currently significant aggradation of gravel in some reaches Upper and Middle Tukituki. If this gravel continues to aggrade in the bed of the Upper and Middle Tukituki without intervention, the stopbanks and flood protection works which line the river would eventually be overtopped during large flood events. Localised aggradation can also direct river flows into destructive alignment with stopbanks causing them to be undermined and fail. Such circumstances would result in hazards to people and damage to rural and urban development.

Under the Soil Conservation and Rivers Control Act 1941, regional councils have a statutory responsibility for flood control. To achieve this purpose in the context of sediment build-up, HBRC encourages aggregate suppliers to excavate gravel from the dry parts of the river beds (sometimes referred to as ‘beaches’), with the objective of maintaining the bed at a ‘design grade’. The design grade is the calculated grade of the river bed (i.e. the bed level at any particular location) required to maintain the required floodway height and area.

Gravel extraction activities have until now been authorised through very short term consents, typically one year, issued to gravel extractors using a Council-managed consent application template system. This system is however not delivering the desired results for extractors who seek longer term certainty, or for HBRC in terms of achieving its flood management objectives.

To address these issues, HBRC is developing a Gravel Management Plan (GMP) with the objective of improving the management of gravel for flood control purposes.

Ultimately, HBRC intend to seek a variation to the Hawke’s Bay Regional Resource Management Plan (RRMP) and potentially the Regional Coastal Environment Plan (RCEP) with a view to establishing a permitted activity regime for gravel extraction undertaken in certain circumstances, and in support of flood management objectives.

Given the length of time such a process will take (the next review of the RRMP is not slated to start until 2020/2021) and the RCEP not until 2023/24, and the increasing issues associated with gravel aggradation, HBRC (Regional Assets section) considers it necessary to obtain a comprehensive gravel extraction resource consent for the Tukituki Catchment Rivers as an interim measure. This would allow HBRC (Regional Assets section) to issue authorisations to extractors under the resource consent it would hold, rather than requiring extractors to seek their own resource consents, and in doing so allow more flexibility and responsiveness in the effort to manage in-river gravel volumes.

HBRC (Regional Assets section) has received a range of technical assessments from independent experts and have carried out their own in-house assessments in support of this consent application. These assessments have, overall, and subject to a set of proposed controls (conditions), meant that HBRC (Regional Assets section) is able to effectively manage the activity over the term of the consent being sought to ensure that any potential or actual effects are adequately avoided, remedied or mitigated. Given that it is the only major river that provides a source of gravel to the ocean beaches, gravel extraction from the Tukituki will be carefully managed by HBRC to ensure that extraction is sustainable and avoids coastal erosion effects.

In terms of the relevant policy framework, the gravel extraction from the Tukituki River is considered to be consistent with the objectives and policies of the RRMP and RCEP.

A term of 25 years is sought for the consent.

REFERENCES

Ausseil, O., Hicks, A., Wade H. (2016). 'Tukituki River Catchment – State and Trends of River Water Quality and Ecology 2004-2013'. HBRC Report No. RM16-09 – 4788, July 2016.

Forbes, A. (2017a). 'Gravel Review: Terrestrial Ecology Impact Assessment'. Forbes Ecology, April 2017.

Forbes A. (2017b). 'Tukituki River Ecological Management and Enhancement Plan'. HBRC Plan No. 4925. May 2017.

HBRC (2015). 'Environmental Code of Practice for River Control and Waterway Works (Draft)'. HBRC Report No. 3256 – AM 04/15. February 2017.

Holmes, R. (2017). 'Effects of Gravel Extraction and Beach Raking on Key Instream Species in Hawke's Bay Rivers'. Cawthron Institute Report No. 2968, January 2017.

NIWA (2012). 'Modelling gravel transport, extraction and bed level change in the Ngaruroro River, October 2012'. October 2012.

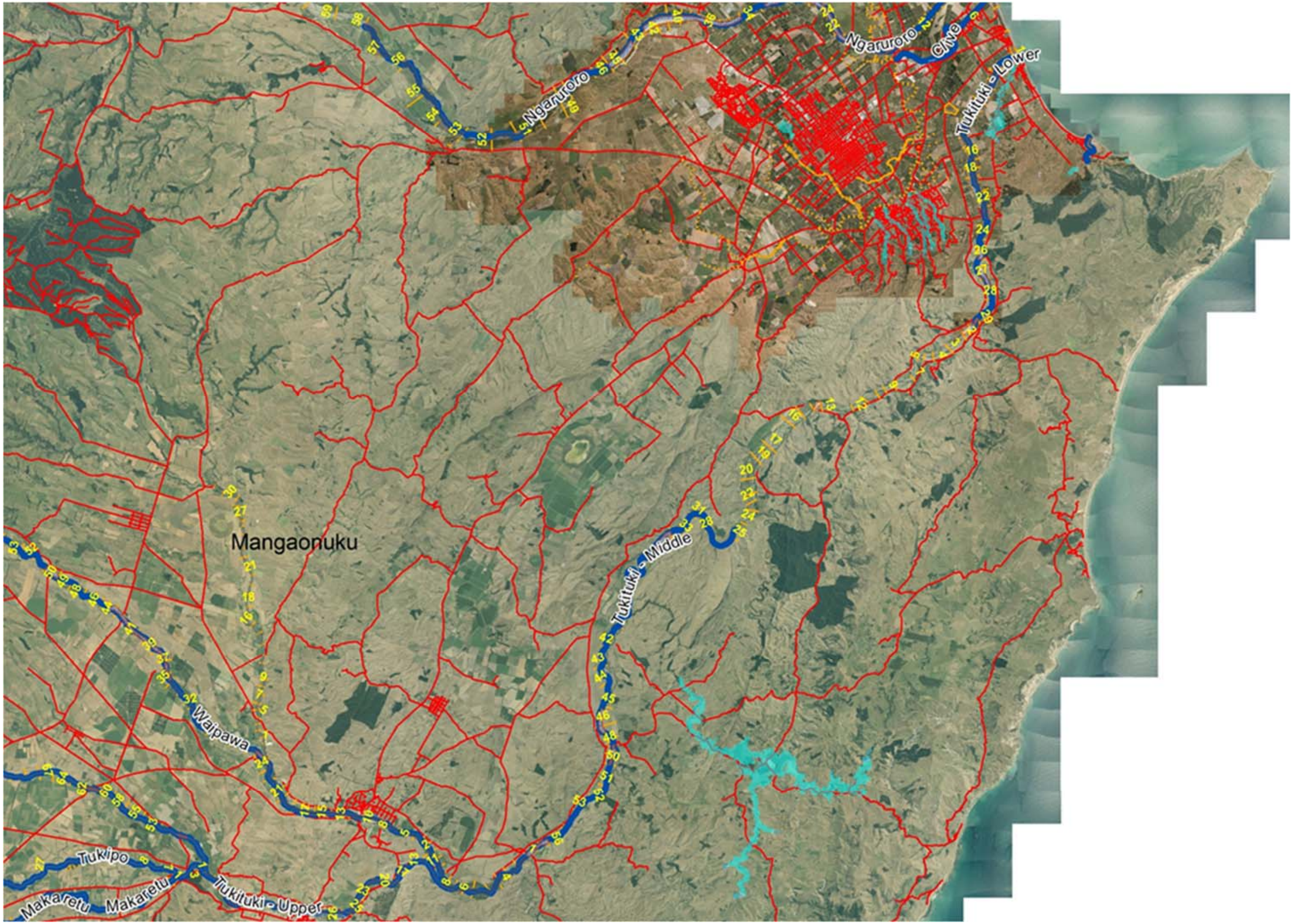
Stevens, M. and Larsen, B. (2015). 'Gravel Management Plan: Gravel Resource Inventory (Issue 3) for Hawke's Bay Regional Council'. 11 August 2015.

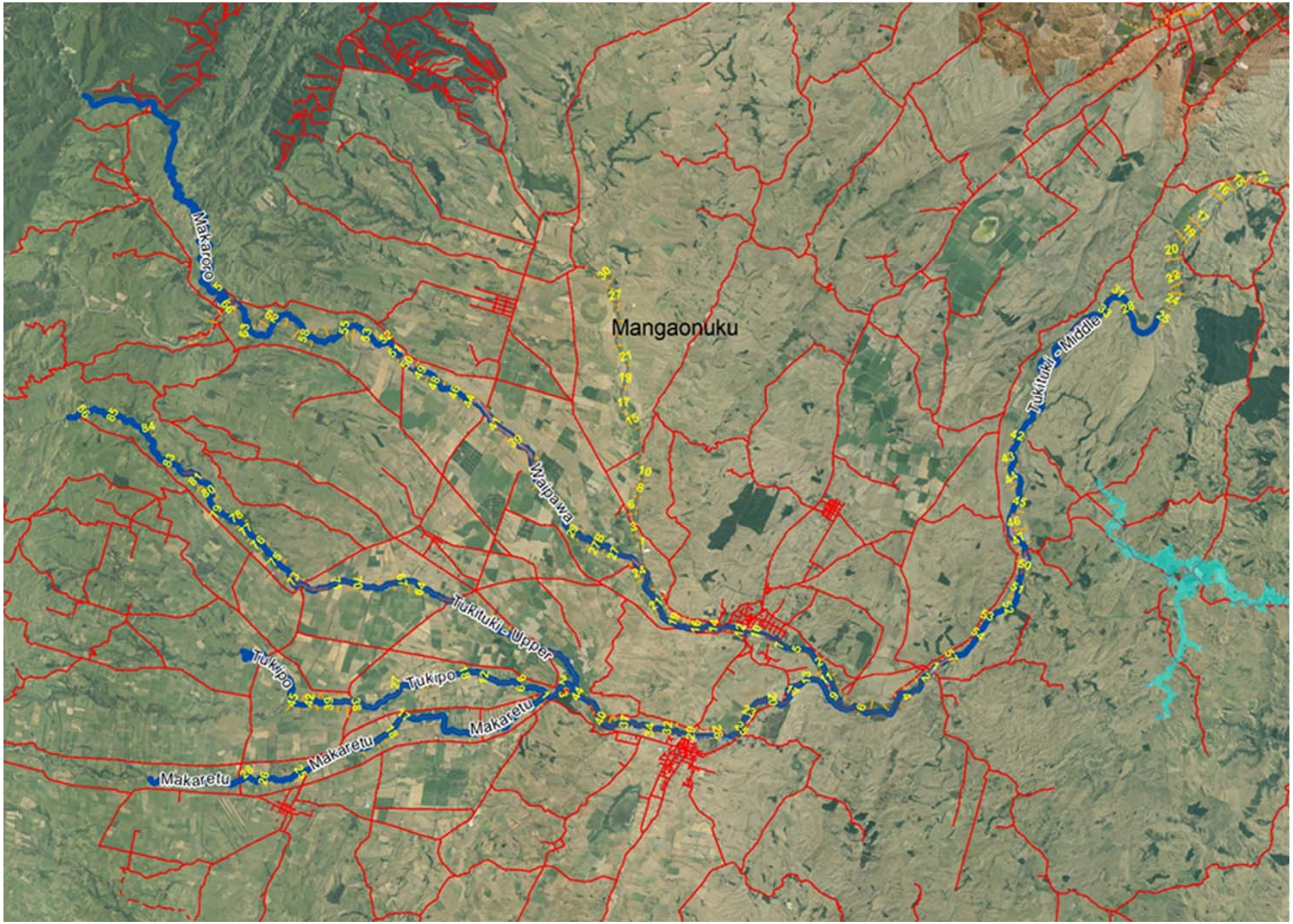
Tonkin & Taylor (2010). 'Scoping Report: Review of Riverbed Gravel Management'. Prepared for Hawke's Bay Regional Council, November 2010 (Version A). T&T Ref 85047.

A

APPENDIX A

Gravel Extraction Area - Tukituki River


Ngaruroro
Clive
Tukituki - Lower
Mangaonuku
Tukituki - Middle
Waipawa
Tukipo
Makaretu
Tukituki - Upper


Makaroro
Mangaonuku
Waipawa
Tukituki - Middle
Tukituki - Upper
Tukipo
Tukipo
Makaretu
Makaretu
Makaretu

B

APPENDIX B

Suggested Consent Conditions

RESOURCE CONSENT

Land use Consent

In accordance with the provisions of the Resource Management Act 1991(RMA), and subject to the attached conditions, the Hawke's Bay Regional Council (the Council) grants a resource consent for a restricted discretionary activity to:

Extract sand, gravel or other material from the bed of the Tukituki Catchment Rivers and to undertake other activities directly associated with the activity that may be restricted by Section 13 of the RMA.

LOCATION

Address of site: [to be added]

Legal description (site of extraction): [to be added]

Map reference: [to be added]

CONSENT DURATION

This consent is granted for a period expiring on <to be added – 25 years after date of commencement>.

LAPSING OF CONSENT

This consent shall lapse in accordance with section 125 of the RMA on the 1 April 2022, if it is not exercised before that date

Manager Consents
RESOURCE MANAGEMENT GROUP
Under authority delegated by Hawke's Bay Regional Council
Enter Date

CONDITIONS

Definitions:

For the purposes of this consent, the following definitions apply:

Term	Definition
Active river channel	The entire width of the river channel including gravel beaches, actively flowing channels, and river banks, but excluding berms, as shown in Figure 1.
Actively Flowing Channel	Comprises the wetted river area of the active river channel being that part of the channel that is in contact with water. See Figure 1
Council	Hawke's Bay Regional Council
Manager Compliance	The Manager Compliance of the Hawke's Bay Regional Council
Berm	Land between the active river channel and the stopbank or naturally elevated land that forms part of the floodplain.
Gravel	Refer to 'sediment' definition below.
Sediment	Includes all alluvial material found in the active river channel and berms. Sediment consists of the broad categories of gravels, sands and silts. For convenience, the term 'gravel' is often used as it is the bulk of the extraction in most cases.

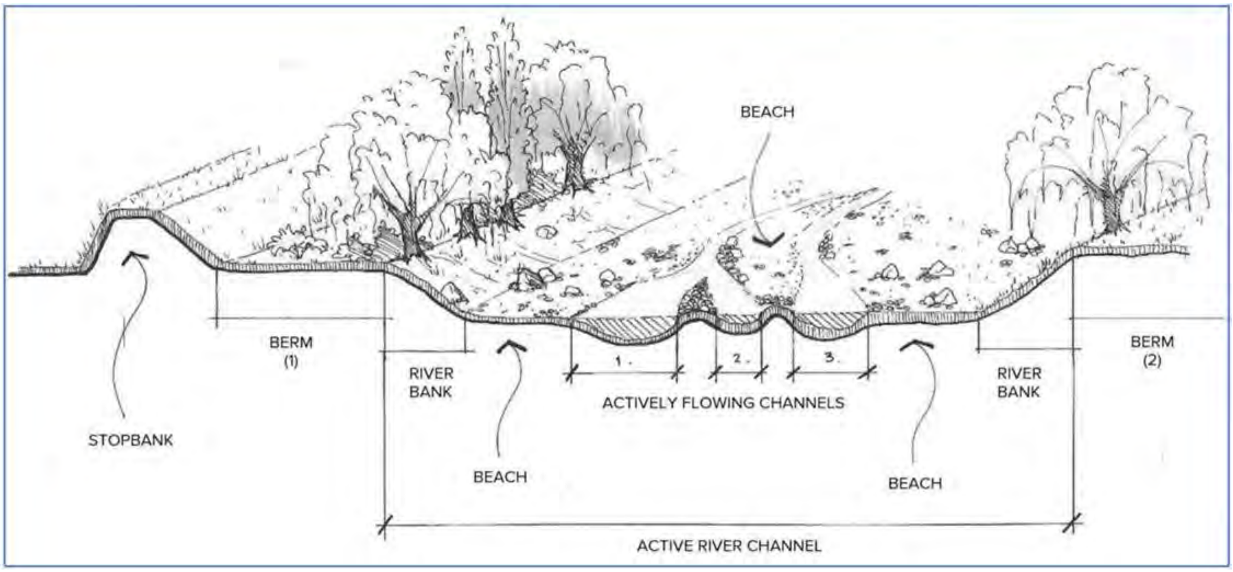


Figure 1: Definitions of terms used in these consent conditions

1. The consent holder is authorised to extract gravel (defined as gravel and associated sand, silt and other riverbed sediments) from the active river channel and berm areas of the Tukituki Catchment Rivers as identified within the Plan attached in Appendix A.

2. Except as specifically provided for by other conditions of this consent, all activities to which this consent relates shall be undertaken generally in accordance with the information

contained in the application for this consent including: "Hawke's Bay Regional Council – Regional Assets Section: Application to Extract Gravel from the Tukituki Catchment Rivers" prepared by Mitchell Daysh Ltd, dated October 2017, HBRC ref xxx; and further documentation and correspondence submitted in support of the application, as follows:

- **Xxx list any further documentation that arises through the consent processing**

Where there is any disagreement between the application documentation and resource consent conditions the resource consent conditions below shall prevail.

3. The consent holder shall ensure that any contractors engaged to undertake work authorised by this consent abide by the conditions of this consent. The person responsible for the work on site shall be made familiar with the consent conditions and a copy of the consent conditions shall be included with any authorisation issued to contractors by the consent holder.

4. The consent holder shall notify the Council five working days prior to any new extraction operation commencing within the area specified by the resource consent.

5. The consent holder shall maintain an accurate and accessible monthly record of the locations and volumes of gravel taken under this consent. All quantities are to be based on loose measure and rounded to the nearest cubic metre.

6. The consent holder shall immediately repair any damage caused to river banks or river protection works, other than damage associated with authorised access paths.

7. The consent holder shall immediately repair any damage caused by the exercise of this consent to any banks, access roads, fences, gates, protection or other works relating to the control of the river. The cost of such repair shall be met by the consent holder.

8. All machinery, equipment and material shall be stored above the maximum anticipated flood level at the end of each working day, or whenever the site is to be left unattended.

9. Gravel stockpiling within the active river channel shall only occur temporarily, while extraction is occurring.

10. The consent holder shall ensure that contractors engaged to undertake work authorised by this consent take all reasonable efforts to avoid causing adverse effects on registered water takes within the active river channel.

    Advice Note: A registered water take is one which has a current resource consent from the Hawkes Bay Regional Council.

11. The consent holder shall ensure that the site is restored on completion of the gravel extraction operation as follows:

    a) Gravel heaped up during the process of removal shall be spread out by the consent holder on completion of the gravel extraction operation.
    b) Consent holder shall remove all plant, machinery, equipment, signs and other structures associated with the operation from the riverbed immediately on completion of operations.
    c) No reject, surplus or unused gravel from a gravel processing plant is to be deposited into or onto the active river channel.
    d) All disturbed areas shall be reinstated as far as is practical to minimise the release of sediment to flowing waters.

12. The consent holder shall erect a warning sign (generally in the form shown in Appendix B) adjacent to the site of extraction where, as a result of the extraction, the stretch of river has or is likely to become dangerous to the public. These signs will be required wherever holes are made in the riverbed, which could become a danger to fishers and others who may use the riverbed. The signs shall be removed on completion of the operation or when the area is no longer a potential danger to the public.

13. No refuelling shall occur within 20 m of the active river channel. No fuel shall be stored within 30 m of the active river channel.

14. To ensure worksite spills are avoided and otherwise managed appropriately, the consent holder shall produce a Spill Management Plan (SMP) appropriate for the activities being undertaken on site (see Advice Note (V)). The SMP must:

    a) Include procedures for preventing contaminants such as hydrocarbons or chemicals entering any waterbody in the event of a spill;
    b) Be prepared by a suitably qualified person;
    c) Be provided to the Council prior to commencement of the works.

15. The consent holder and any contractors shall abide by the SMP and a copy of this SMP must be present on site at all times while the work is being undertaken.

16. Where, for any cause (accidental or otherwise), contaminants associated with the consent holder's operations escape to water other than in conformity with the consent, the consent holder shall:

    a) Immediately take all practicable steps to contain and then remove the contamination from the environment, and;
    b) Immediately notify the Council of the escape, and;
    c) Report to the Council, in writing and within 7 days, describing the manner and cause of the escape and steps taken to control it and prevent its reoccurrence.

17. In the event of any archaeological site or waahi tapu being uncovered during the exercise of this consent, activities in the vicinity of the discovery shall cease. The consent holder shall contact the Council (Manager Resource Use) to obtain contact details of the relevant tangata whenua. The consent holder shall then consult with the relevant local hapu or marae and the Heritage New Zealand Pouhere Taonga, and shall not recommence works in the area of the discovery until the relevant Heritage New Zealand Pouhere Taonga and tangata whenua approvals to damage, destroy or modify such sites have been obtained.

18. The exercise of this consent, including machinery working in the active river channel and in the vicinity of riverbed bird nesting sites, shall be managed in accordance with the Tukituki Catchment Rivers Ecological Management and Enhancement Plan May 2017 (HBRC Plan 4925), and any subsequent revisions of that Plan that are approved by the Council in a technical authorisation capacity.

    Advice Note: Reference should be made in particular to Section 3.3, ''Ecological Management Objectives, Methods, and Monitoring', of the Ecological Management and Enhancement Plan.

19. Should the gravel extraction operation result in increased turbidity of active flowing channel, the consent holder shall take all practicable steps, including any actions directed by an officer of the Council, to remedy the turbidity. The consent holder shall give particular attention to avoiding turbidity within waterways during the fish-spawning period of May-October.

20. Dust control methods shall be used to mitigate potential dust effects where dust from works may otherwise reach residential dwellings.

21. Bed level cross section surveys shall be undertaken every three years, at the established benchmarks illustrated in the plan attached as Appendix D.

22. Riverbed gravel particle size monitoring surveys shall be undertaken on a six yearly basis at the established benchmarks that represent the extraction reach illustrated in the plan attached as Appendix D.

23. Based on the survey results of Conditions 20 and 21, an Annual Gravel Status Report shall be submitted to the Manager Compliance by the end of June each year for approval by the Manager Compliance in a technical authorisation capacity. The report shall address but not be limited to:

    a) Calculation and comparison of mean bed levels and reach volumes between cross sections and between annual surveys
    b) Comparison of mean bed levels and reach volumes with bed level design grade lines.
    c) Based on (a) and (b), an assessment of the Sustainable Gravel Allocation (cubic metres per year [loose measure]) for the upcoming year of 1 January to 31 December.

    Gravel extraction in any one year shall not exceed the authorised Sustainable Gravel Allocation for that year without the written approval of the Manager Compliance.

24. The Consent Holder shall submit to the Manager Compliance a 'Water Quality Effects Investigation Programme of Work' four weeks before the first exercise of this consent. The Programme shall take into account the recommendations of Cawthron Report No. 2968 dated January 2017, submitted with the application for this resource consent. The Programme shall be implemented in full within 5 years of the commencement of this consent. Interim progress reports on relevant stages of the Programme shall be submitted to the Manager Compliance annually, by 1 July each year.

ADVICE NOTES

i. An officer of the Council shall have the right, during business hours, of access to the site of extraction and to the books and documents relating to the extraction of gravel authorised by this consent and kept by the holder in order to check the accuracy of the returns made to the Council.

ii. The consent does not of itself confer any right of access over private and/or public property. Arrangements for access must be made between the consent holder and the property owner (including land under the control of the HBRC).

iii. Where the consent holder requires access across river berm areas held by Council under the Reserves Act (or any other relevant Act) and leased to a third party, the consent holder must negotiate access across that land with the lessee.

iv. The consent does not confer any exclusive right of occupation over the area allotted to the holder.

v. A generic Council prepared Spill Management Plan template is attached as Appendix C. If this generic SMP covers all of the activities, and risks for the site, then it may be adopted in full with notification given to Council (Manager Resource Use) of its adoption prior to work commencing. If the attached SMP does not meet the site specific requirements, the consent holder must submit another suitable alternative plan to the Council prior to commencement of the works in accordance with Condition 13.

vi. All information required by Condition 22 and 23 can be provided to the Council by email to ComplianceReturns@hbrc.govt.nz

REVIEW OF CONSENT CONDITIONS BY THE COUNCIL

The Council may review conditions of this consent pursuant to sections 128, 129, 130, 131 and 132 of the RMA. The actual and reasonable costs of any review undertaken will be charged to the consent holder, in accordance with section 36 of the RMA.

Times of service of notice of any review: During the month of May, of any year.

Purposes of review:	To deal with any adverse effect on the environment which may arise from the exercise of this consent, which it is appropriate to deal with at that time, or which became evident after the date of issue.
	To require the adoption of the best practicable option to remove or reduce any adverse effects on the environment.
	To modify any monitoring programme, or to require additional monitoring if there is evidence that current monitoring requirements are inappropriate or inadequate.
	To deal with findings of the Water Quality Effects Investigation Programme of Work'

MONITORING NOTE

Routine monitoring

Routine monitoring inspections will be undertaken by Council officers on at least one occasion during construction and/or after the completion of works. The costs of **any** routine monitoring will be charged to the consent holder in accordance with the Council's Annual Plan of the time.

Non-Routine monitoring

"Non routine" monitoring will be undertaken if there is cause to consider (e.g. following a complaint from the public, or routine monitoring) that the consent holder is in breach of the conditions of this consent. The cost of non-routine monitoring will be charged to the consent holder in the event that non-compliance with conditions is determined, or if the consent holder is deemed not to be fulfilling the obligations specified in section 17(1) of the RMA shown below.

Section 17(1) of the RMA states:

> *Every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by or on behalf of the person, whether or not the activity is carried on in accordance with*
>
> *a) any of sections 10, 10A, 10B, and 20A; or*
>
> *b) a national environmental standard, a rule, a resource consent, or a designation.*

DEBT RECOVERY

It is agreed by the consent holder that it is a term of the granting of this resource consent that all costs incurred by the Council for, and incidental to, the collection of any debt relating to this resource consent, whether as an individual or as a member of a group, and charged under section 36 of the RMA, shall be borne by the consent holder as a debt due to the Council, and for that purpose the Council reserves the right to produce this document in support of any claim for recovery.

Consent History

Consent No. (Version)	Date	Event	Relevant Rule Number	Plan
LUXXXXXXC	Xx/xx/xxxx	Consent initially granted	74	Regional Resource Management Plan (August 2006)

Appendix A
Plan of Gravel Extraction Areas

Appendix B
Warning Sign

Appendix C
Spill Management Plan

HAWKE'S BAY REGIONAL COUNCIL

SPILL MANAGEMENT PLAN

Prepared by Ian Lilburn

Hawke's Bay Regional Council

August 2011

SPILL MANAGEMENT PLAN

Resource Management

The Resource Management Act (RMA) sets out how we should manage our environment. It is based on the idea of sustainable management of our resources – or in other words, protecting the quality of our soil, air and water from being damaged beyond repair. The RMA isn't about stopping any activity that effects the environment. It is about undertaking activities in a manner that will have minimal impact to the environment. *'Every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment…'* Section 17 of the RMA.

For any significant incident that could affect the environment, the steps taken should be:

- Cease all work in that area immediately and secure the site.
- Containment and control actions are to be employed as soon as possible.
- Call the project manager and let them know what has happened.
- **Notify HBRC of incident 0800 108 838 (Pollution Hotline).**
- A site manager should visit and inspect the site immediately, overseeing containment and control actions.
- Management and/or HBRC will issue authority to recommence work.
- An incident report be completed and submitted to the Regional Council.

Site management key factors:

- The site manager/overseer is familiar with the resource consent conditions and this plan.
- A copy of the consent and this Spill Management Plan is held on site.
- All those working at the site are aware of their obligations and know what to do in the event of an incident.
- A spill clean-up kit be available on site.
- Regular 'tool-box' meetings are recommended to discuss site progress, safety, and environmental matters.

Hazards and Controls:

ACTIVITY	RISK	ENVIRONMENTAL EFFECT	CONTROLS
REFUELLING	• Spillage • Wash-off • Fire	• Pollution of waterways, streams, and storm-water systems • Soil Contamination • Ecological Damage (plant life, wild life)	Prevent spills: • Inspect machines for any leaking fluids prior to starting job. • Use established refuelling points • Locate fuel tanks away from waterways. • Bunding of fuel tanks. • Not hot refuelling. • Fire Prevention Plan. Contaminant: • Dig hole, create a bund, or use container to contain spill. • Stop the spill or leak, if safe to do so • Create a barrier to keep out of waterway and contain.

			Immediate Clean Up: • Sawdust or suitable absorbent to soak up excess • Scrape off affected topsoil and dump spoil in approved dumping site only. • Contact HBRC pollution hotline 0800 108 838.
WORKING NEAR/IN RIVERS, STREAMS, and COASTAL AREAS	• Machinery failure • Leakage / Spillage • Bank and or bed damage • Wash-off	• Pollution of waterways, streams and storm-water systems • Soil contamination • Ecological Contamination • Ecological Damage (plant life, wild life)	• Work to resource consent conditions (copy to be kept on site) • Work to contact specifications • Store plant, stores and equipment in approved storage areas only and away from water-courses • Contact HBRC pollution hotline 0800 108 838 in the event of a spill that may or will escape to water • Have a spill kit on hand • Be familiar with what to do in the event of a spill or leak
CHEMICAL USE	• Leakage – Spillage • Wash-off • Poisonous fumes • Explosion / Fire	• Short or Long term contamination of waterways, land and air • Ecological poisoning • Population poisoning through ingestion / inhalation	• Abide by Material Safety Data Sheets (MSDS) for handling, storage and containment / clean-up information • Emergency Plans • Use effective and appropriate personal protective equipment (PPE) • Contain and clean up, IF SAFE TO DO SO • Contact HBRC pollution hotline 0800 108 838
DUMPING AND STORAGE OF MATERIAL, RUBBISH AND SPOIL	• Spillage • Wash-off • Fire • Rodent / Insect infestations • Blocked waterways	• Pollution of waterways, steams and storm-water systems • -Soil Contamination • Ecological Damage (plant life, wild life) • Smell	• Work to resource consent conditions (copy to be kept on site) • Containment to prevent spread / wash-off • Restricted access • Waste material sites planned and managed • Planned cartage and dumping for specific waste / spoil (including soil or waste contamination from fuel, oils, human & animal waste, excess concrete HSNO) • Proper rubbish disposal (skip bin, 200L drum etc.)

Environmental Sheet on Environmental Matters

ACTIVITY	RISK	ENVIRONMENTAL EFFECT	CONTROLS
DUST	• Reduced visibility • Air irritation • Company Image	• Personal – irritation, stress • Amenity / aesthetics	• Dampen down tracks and areas of loose spoil • Management arrange for mailbox drop if necessary

		• Crop damage	• Restrict hours of work • Restricted vehicle movement and speed • Designated park-up areas • Use effective and appropriate PPE
NOISE	• Excessive noise • Noise vibration • Company Image	• Personal irritation and stress • Disruption to wild-life	• Restrict vehicle, plant and equipment revs • Baffles and muffling • Restrict hours of work • Management arrange for mailbox drop if necessary • Use effective and appropriate PPE
EARTH WORKS	• Undermining • Destabilisation • Flooding • Silt runoff	• Pollution of waterways, steams and storm-water systems • Soil Contamination • Ecological damage (plant life, wild life) • Erosion • Silt build-up / flooding	• Work to resource consent conditions • Use erosion and sediment controls as per HBRC guidelines, and as per plans and project methodology • Work to boundaries in contact specifications • Water pumps – water diversion • Control storm-water and surface water run-off • Daily site checks • Restricted access / barriers • Stabilise surfaces as soon as practical
SITES OF NATURAL, HISTORICAL, AND CULTURAL SIGNIFICANCE (e.g. birds, wetlands, old pa sites, tapu sites, bodily remains etc.)	• Desecration of burial sites • Destruction of artefacts • Disruption of wild life breeding sites • Destruction of are breeds of fauna and flora • Company Image	• Ecological Impact (plant life, wild life) • Cultural offence • Loss of historical items	• Pre-work inspection – Site research • Clearly identify and cordon off areas of significant interest • If in doubt – cease work in immediate area and cordon the site off • Don't move anything • Restrict access – no visitors etc. • Wait for site to be cleared by relevant authorities before work starts • Contact Manger to okay recommencement of work • Contact HBRC pollution hotline 0800 108 838

Appendix D
Riverbed Cross Section Survey Locations

C

APPENDIX C

Hawke's Bay Regional Council
Application Forms (A & B)

HAWKE'S BAY
REGIONAL COUNCIL

Office Use

Previous Consent No. ______________

Charge No. ______________

Client No. ______________

Consent No. ______________

Administration Form 'A'

This application is for:	
A New Consent Deposit of $1150.00	☑
A Change to an Existing Consent Deposit of $575.00	☐
A Replacement of an Expiring Consent Deposit of $1150.00	☐
A Permitted Activity	☐
All fixed deposits are Inclusive of GST (GST # 051 227 875)	

Please note: if your consent is notified additional deposits are required,
We will advise you if your application will be notified once assessed

INSTRUCTIONS: PLEASE READ

1. An application must consist of an Administration **Form 'A' and Form 'B'** (Technical information relevant to the type of activity being applied for).
2. If you have any questions please contact Council's Consents Advisor, Annette Brosnan on 06 833 8090, or email: annette@hbrc.govt.nz
3. Your deposit must accompany your application.
4. Fill in all fields or write not applicable if appropriate.
5. Post, Email or deliver the application along with any other supporting information and the required deposit to: Consents Advisor, Hawke's Bay Regional Council, Private Bag 6006, NAPIER 4142. 159 Dalton Street, Napier or
6. For payments via online banking, please email the Consent Advisor with the applicant's name, postal address and ask for a payment reference,
   a. Account BNZ - 02 0700 030 2819 00
7. Please note, as Council does not create invoices for application deposit, this sheet can be used in lieu of an Invoice, GST information found in top box
8. Maps, GPS coordinates, Legal descriptions and existing consent information can be found using councils online map/ consents portal at hbrc.govt.nz (bottom of home page)
9. **Ensure you have signed the form and included/arranged for payment of the deposit before submitting.**

1. ADMINISTRATION DETAILS

1.1 **Existing Consent number** ______________ or NA/New consent ☐

For replacement of expiring consents, do you agree that your application can be processed any time before the current expiry date: Yes ☐

1.2 **No. of consent applications:** ☑ Single Consent ☐ Multiple Consents

1.3 **Type of Resource Consent(s) being applied for:**

☐ Bore Permit ☐ Water Permit ☑ Land Use Permit

☐ Discharge Permit ☐ Discharge from on-site Waste Water Systems to land

☐ Other ______________

1.4 **Applicant Details:**

Who will the consent be issued to (The Applicant):

☐ Private Person(s) ☐ Company ☐ Trust ☐ Partnership

Company Name Hawkes Bay Regional Council - Regional Assets Section skip to Q1.5

Trust/Partnership Name ______________

NB* For Trusts & Partnerships, the full legal names of all trustees/partners are required (each party is an applicant).

The Full legal name of the Private Person(s)/Trustee/Partners

Applicant 1 ______________

Applicant 2 (if applicable) ______________

Applicant 3 (if applicable) ______________

1.5 Main Contact Person Gary Clode

1.6 **Applicant's Postal address**

Private Bag 6006

Napier

Post Code: 4142

Telephone Pvt. ______________

Bus. 06 835 9200

Mob. ______________

E-mail garyc@hbrc.govt.nz

1.7 **Address for service.** This is a consultant or other person handling the application on your behalf - *leave blank if not applicable.*

Name Mitchell Daysh Ltd (att: David Ray)

Address PO Box 1307

Hamilton

Post Code: 3240

Telephone Pvt. ______________

Bus. 07 838 5677

Mob. 0274 191 166

E-mail david.ray@mitchelldaysh.co.nz

Who is the final invoice (bill) to be sent to? ☐ The Address for service ☑ The Applicant

2. SITE DETAILS

2.1 **Property Owner's Name & Address**

☐ Same as Applicant (*skip to next question)*

Crown owned; administered by HBRC

Telephone Pvt. ____________

Bus. ____________

Mob. ____________

E-mail ____________

2.2 **Location of Activity** (The Street Address of the property)

Tukituki Catchment Rivers

2.3 **Map reference** (NZMG Easting and Northing) Refer to attached AEE

2.4 **Do you have an existing resource consents on this property?** Yes ☐ No ☑

If yes, consent ID no(s). ____________

2.5 **Legal Description of Property(s) at site of take/discharge** (Lot and DP number)

N/A

2.6 **For water takes: Legal Description of Property(s) at site of use**

N/A

2.7 **Please provide a site map** clearly showing points where the activity will occur. A Google map or HBRC Map (from hbrc.govt.nz) is acceptable.

3. PROPERTY OWNERSHIP

Is the Applicant the owner of all properties that this application applies to? Yes ☐ No ☑

If Yes, move onto Q4

If **No,** have you discussed the application with the property owner(s)? Yes ☐ No ☑

Have the owner(s) given their approval for the application? Yes ☐ No ☑

If yes, have the owners fill in the approvals section below:

To be completed by the **Property Owner – Only if different from applicant:**
An application to undertake an activity on your property is being made. Please confirm your approval for the activity to occur on your property by signing below. Please ensure you have reviewed forms A & B and/or any attached AEE document.

Signature of Property owner: ____________

Name: ____________ Date: ____________
Please print full name of person who signed above.

Should you have any questions with regards to the giving of approval for this application and the legal implications, please contact the Council's Consents Advisor on 06 833 8090.

4. General Information

4.2 Costs of Debt Recovery

It is agreed by the consent holder that it is a term of the granting of this resource consent that all costs incurred by the Council for, and incidental to, the collection of any debt relating to this resource consent, whether as an individual or as a member of a group, and charged under s36 of the Resource Management Act, shall be borne by the consent holder as a debt due to the Council, and for that purpose the Council reserves the right to produce this document in support of any claim for recovery.

4.3 Information held by Hawke's Bay Regional Council

Please note that all information collected and held by the Hawke's Bay Regional Council is public information under section 2 of the Local Government Official Information and Meetings Act 1987 (LGOIMA), as such any and all information may be requested by a third party. Access to information held by Council is administered in accordance with LOGIMA and the Privacy Act 1993. If you have any concerns over the disclosure of any aspect of your consent or personal/property details, either in person or electronically, you must raise your concern in writing to The Council and detail what "good reason" you believe there is for withholding information pursuant to section 7 of LGOIMA. Council will assess your request and advise you of any decision made. Please note that no person has the right of veto over any information held by Council. Council intends for all information it holds, submitted without a request for nondisclosure (as above), to be public, and accessible to any persons who requests it pursuant to LGOIMA. If you require more information on the situations that information may be provided, please contact the Councils Consents Advisor

4.4 Additional Information Required

You must also complete a relevant Form 'B' – Assessment of Environmental Effects, and attach to this Form A before submitting.

Please indicate the total number of additional documents attached to this application:

Relevant Form B:	☑	*Required*
Separate AEE document(s):	☑	or NA ☐
Map(s):	☑	*Required*
Other: ______________		or NA ☐

4.5 Applicants Signature

To be completed by the Applicant: Application is hereby made for the consent(s) detailed in both forms A & B and any attached additional information. I have read, understood and agree to the information provided in this application. All information provided is true and correct.

Signature of applicant or authorised agent: G Clode

Name: Gary Clode Date: 13/10/17

Please print full name of person who signed above.

A deposit must accompany the application. The application will not be processed until the deposit is received. Additional costs will be charged when the final cost of processing is known

HAWKE'S BAY
REGIONAL COUNCIL

Office Use

Previous Consent No. ____________

Charge No. ____________

Client No. ____________

Consent No. ____________

Form 'B' – Assessment of Environmental Effects
Application to Use and Develop the Beds of Lakes and Rivers

Applicant Name : Hawke's Bay Regional Council - Regional Assets Section (from form A, Q1.4)

1. Details of the Changes of Conditions Requested
or NA New consent ☑ (move to Q 2)

1.1 **What is the number of the consent you wish to change?** ____________

1.2 Attach a copy of the consent, with annotations showing the changes you are requesting, or state specifically the changes you wish to make below.

Now go through the form and confirm the details of your proposed works, as some will change as a result of your application to change the conditions.

2. DETAILS OF THE ACTIVITY

2.1 **What type of waterbody will be affected?** River ☑ Lake ☐ Wetland ☐

2.2 **What is the name of the affected waterbody?** Tukituki Catchment Rivers

2.3 **Is the activity in within a flood control or land drainage scheme managed by a local authority?** Yes ☑ No ☐

2.4 **If yes, what is it called?** ____________________

2.5 **Is the activity in the Coastal Margin?** Yes ☑ No ☐

2.6 **What type of works are you proposing?**

Installing/works or a Culvert ☐ Erecting/works on a Bridge ☐

Erecting Other Structure (i.e. dam) ☐ Excavation, drilling or tunnelling ☑

Deposition of a substance ☐

Other ☐ *Specify:* ____________________

2.7 **Describe the activity.** Provide a detailed description of the works you are proposing to carry out, any materials to be used, construction methodology (including whether any of the work will be in the water and whether you will be permanently or temporarily damming and/or diverting the waterway), construction timetable and duration of the works, and details about why the activity is being undertaken.

Attach an engineering report/plans and structure design calculations – e.g culvert sizing in relation to flood flows, how calculated and what AEP?

To extract gravel (as defined in attached AEE) from the Tukituki Catchment Rivers (comprising the active river channel and berms) for the purpose of maintaining the design channel capacity and the alleviation of flood and erosion risk.

The proposed volume to be extracetd is details in the attached AEE.

A term of 25 years is sought for the resource consent.

Please attach any engineering plans you have (i.e. design specifications) ☑

2.8 **Site plan.** Provide a map of the proposed site that clearly shows the location of the proposed works, waterway, property boundaries and any other significant features. Please label it clearly, and ensure it has a scale and a North arrow.

Site plan attached ☑

2.9 **Describe the receiving environment**. Please describe the physical characteristics of the site, vegetation, ecology, sediment, nearby structures, catchment hydrology and hydraulic characteristics.

See attached AEE

3. Assessment of Environmental Effects (AEE)

Please refer to the relevant guidance note and then write your AEE in the space provided below. As noted in the guidance note, if you need to attach additional information, please feel free to do so.
For structures – explain how fish passage will provided for (during construction and after construction is complete).

See attached AEE

4. HAVE YOU REMEMBERED TO INCLUDE?

Design specifications/Plans, Site Map	✓
Your deposit	✓
Administration Form A	✓

D

APPENDIX D

Environmental Code of Practice for River Control and Waterway Works (Draft)

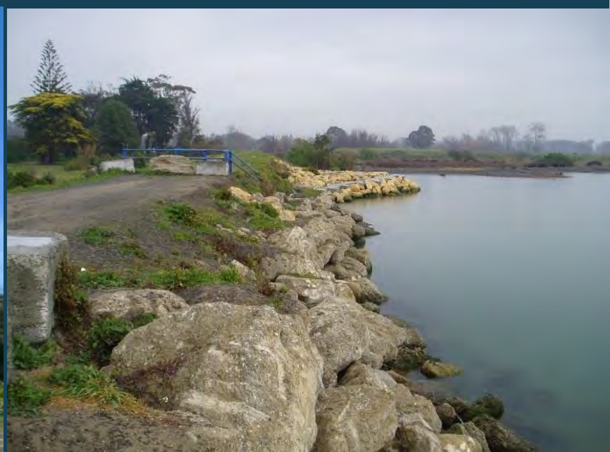
HAWKE'S BAY
REGIONAL COUNCIL

DRAFT

Environmental Code of Practice

For River Control and Waterway Works

November 2015
HBRC Report No. 3256 – AM 04/15



Asset Management Group

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Version 4

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Engineering

Environmental Code of Practice

For River Control and Waterway Works

November 2015
HBRC Report No. 3256 – – AM 04/15

………………………………………………………………………….

Prepared By:

Martina Groves, Civil Engineer Environmental

Reviewed By:

Gary Clode – Engineering Manager

Approved By:

Mike Adye – Group Asset Manager

Signed:

Asset Management Group

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1 Introduction

1.1 Purpose of the Environmental Code of Practice for River Control and Drainage Works.

The Hawkes Bay Regional Council (HBRC) Asset Management, Works Group and their subcontractors carry out most their functions and duties under the Soil Conservation and Rivers Control Act 1941, the Land Drainage Act 1908 and the local Government Act 2002 in relation to river control and drainage, as a **permitted activity** in the Hawke's Bay Regional Resource Management Plan (RRMP) and the Hawke's Bay Regional Coastal Environment Plan (RCEP).

This purpose of this **Environmental Code of Practice (ECoP)** is to define both the range of activities undertaken by Council and its contractors, and to describe best practice environmental standards that will apply to river control and drainage works. Specifically, this ECoP will:

- Identify a range of values for the region's waterways, to be considered as activities are designed, authorized and undertaken.
- Adopt best practice standards to avoid, mitigate and minimise an activity's effect on the environment.
- Define activities and reasons for activities.
- Specify methodologies for each activity.
- List the procedures for consultation and notification, monitoring and reporting;
- Ensure works undertaken under the Environmental Code of Practice will acknowledge water body values and work in a way that does not adversely impact on those values.

Embedded in this Code of Practice are descriptions of the type of works carried out on riverbeds and waterways associated with these operations in order that there is a fuller explanation of the issues that arise and how these are managed as best practicable options.

1.2 Hawkes Bay Regional Council Responsibility to Undertake River Control and Drainage Works

The Hawkes Bay Regional Council is committed to providing affordable flood control, erosion protection and drainage works that ensure community safety and well-being, and allow for sustainable economic development without compromising environmental values. The activities undertaken to achieve this are underpinned by the following statutory framework and principles:

- Local Government Act 2002.
- Resource Management Act 1991
- Civil Defence Act 1983.
- Public Works Act 1981.
- Soil Conservation and Rivers Control Act 1941.
- Land Drainage Act 1908.

It is important to note that the principles of the above Acts are subject to the purpose and principles of the Resource Management Act, Hawke's Bay Regional Coastal Environment Plan (RCEP) and Hawkes Bay Regional Resource Management Plan (RRMP).

1.3 River Control and Drainage Activity

The Hawkes Bay Regional Council (HBRC) undertakes a range of construction and maintenance works in rivers and waterways within the Region. For a description of these refer to **Table 2** River Works and Waterways Activities later in this document.

The majority of significant works occur within designated Scheme areas. There are two major schemes where significant flood control and drainage works occur and these are listed in Table 1 below. As well as the major schemes there are eleven smaller schemes and two general schemes that cover the Central and Southern Rivers and Streams and the Northern Rivers and Schemes.

Table 1*:* Major Schemes

Scheme	Length	Main Waterways
Heretaunga Plains Flood Control and Drainage Scheme	87 km	Tutaekuri, Ngaruroro, Lower Tukituki
Upper Tukituki Flood Control Scheme	183 km	Tukituki, Waipawa, Tukipo, Mangaonuku, Makaretu

These two major Schemes cover around 350 km of rivers, or approximately 22% of the total 1600 km of significant rivers and streams located within the Hawke's Bay region. In addition to these, Council oversees flood control and drainage programmes for eleven areas, from Kopuawhara in the Wairoa district to Porangahau in Central Hawke's Bay. Council also manages 470 km of drainage network (open waterways) throughout the Heretaunga Plains.

Within the two large schemes, the Council owns and actively manages large tracts of river and waterway berm land. The river berm areas are popular recreational venues for a diverse range of groups and individuals. They also provide good habitat and biodiversity values. The land owned by Council is shown in **Error! eference source not found.** and .

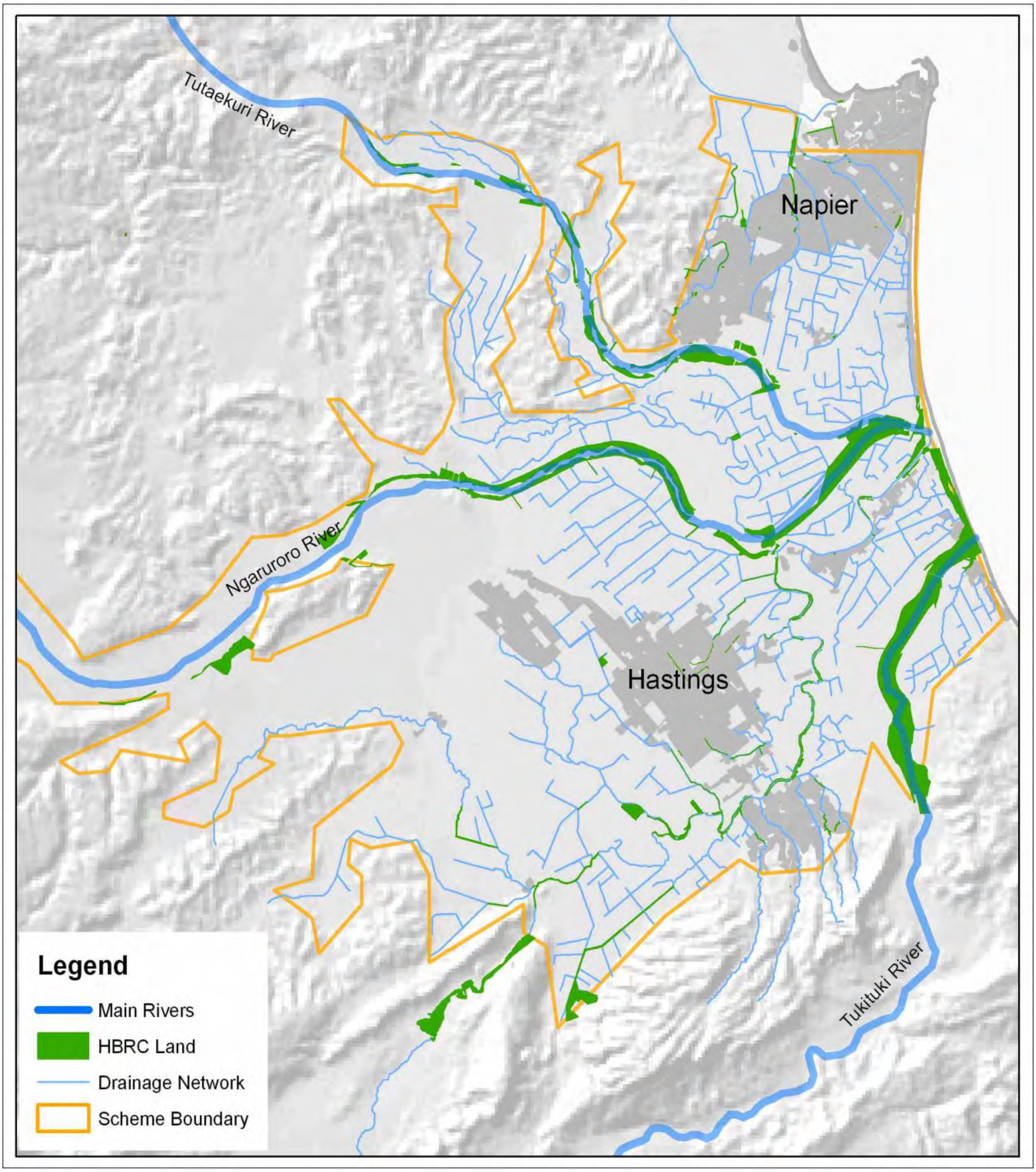

Figure 1: HBRC land within the Heretaunga Plains Flood Control and Drainage Scheme..

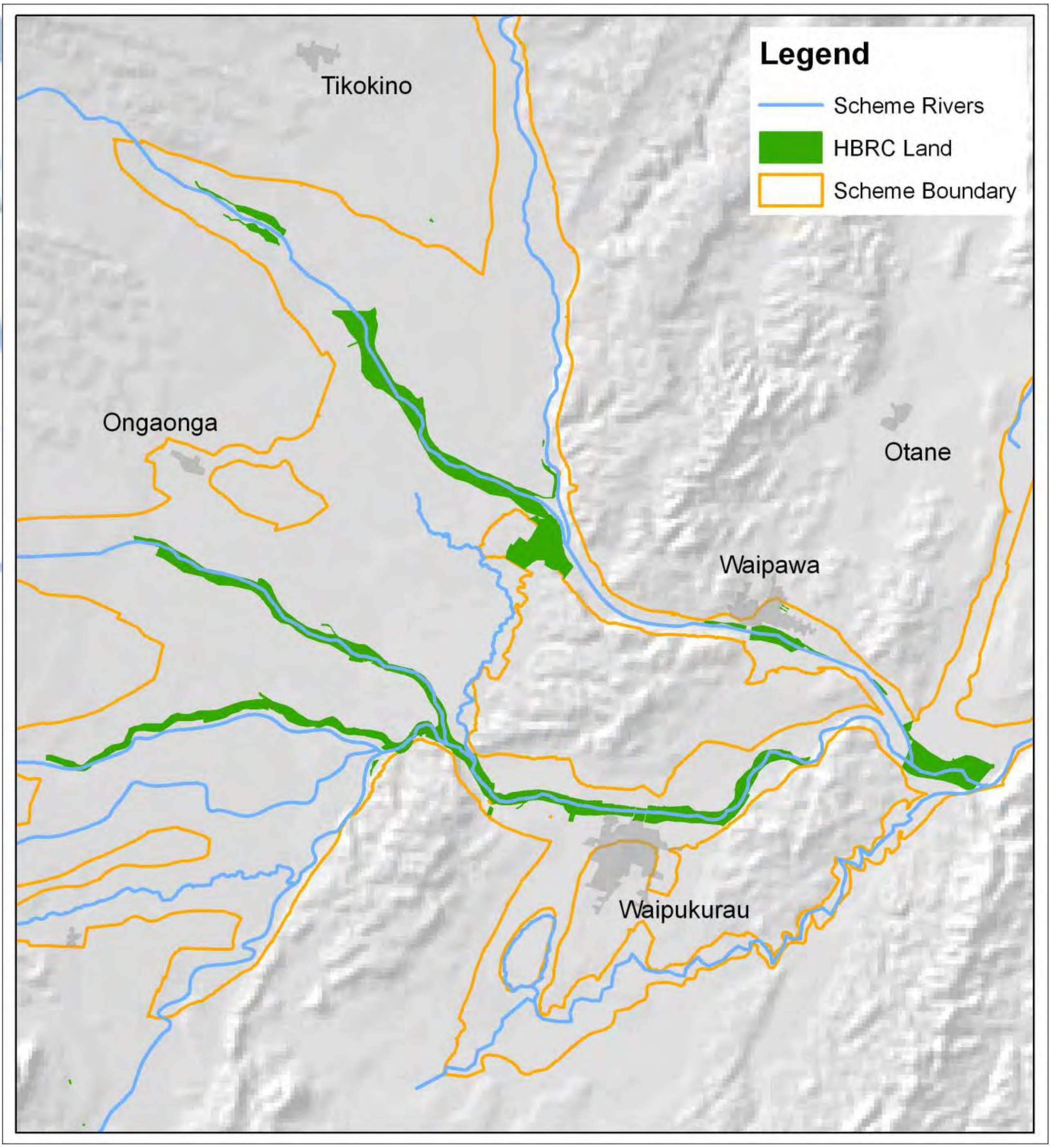

Figure 2: HBRC land within the Upper Tukituki Catchment Flood Control Scheme.

The Council's Regional Resource Management Plan[1] and Regional Coastal Environment Plan contains a permitted activity rule that encompasses the majority of Council river and drainage works undertaken within and near waterways, the active river channel, bed of the river and adjoining berm or riparian areas. Similar permitted activity rules have been adopted in the region's District Plans for the adjoining berm areas, particularly for those areas between established stopbanks and the river channel.

[1] Regional Plans are produced under the Resource Management Act to authorise or establish standards for activities restricted under the Act such as works in riverbeds.

1.4 Environmental Code of Practice

An Environmental Management Strategy for the Waterways of the Heretaunga Plains and Upper Tukituki Schemes, prepared for Council in 1998, recommended that Council produce an integrated “Rivers and Waterways Environmental Plan” for the development, management and enhancement of the waterways, and also an “Environmental Code of Practice” that would have input from the region’s iwi, the Department of Conservation and Fish and Game.

Council staff agreed that the production of these additional detailed documents would be beneficial. Given the diverse views, aspirations and priorities amongst all of the groups and individuals with an interest in the river and drainage areas, a process was required to:

- Clearly identify those divergent views through consultation;
- Analyse those views and document the areas of agreement and divergence; and,
- Prepare an *Environmental Code of Practice* (the *Code*) that would dictate the way in which river and drainage works are undertaken, and the way in which river berm and drainage areas are managed by Council.

The first version of the *Code* was prepared and adopted in 1999 to:

- Provide clear standards of practice for river control and waterway works;
- Document the environmental enhancement and preservation practices to be followed to protect conservation interests, and identify areas for future enhancement or protection;
- Document the locations to be made available for public vehicular access, and the restrictions on public vehicular access imposed in other locations; and,
- Clearly identify those works that were covered by the permitted activity Rule within the Regional Plan.

The *Code* also provides a future common point of reference for all parties with an interest in the river and drainage berm areas, and removes any uncertainty regarding the Council policies or practices being implemented in specific locations.

The “Rivers and Waterways Environmental Plan” has taken the form of a comprehensive ***Ecological Management and Enhancement Plan*** **(EMEP),** which has been produced for each of the major scheme rivers and the recommendations are now being implemented. Firstly these plans focus on the physical activities and associated ecological/environmental effects of Scheme activities. They are considered in relation to the spatial arrangement and significance of ecological values within the Scheme areas. Secondly the EMEP sets out a strategy and prioritised plan for the enhancement of existing ecological values and for the creation of new ecological sites. Where possible, enhancement activities are planned to achieve outcomes across multiple values, in particular to achieve ecological as well as cultural and recreational benefits.

The 1999 Environmental Code of Practice for River Control and Drainage Works is embedded in the RRMP. This version incorporates the Ecological Management and Enhancement Plans, recognising the importance of the multi values associated with waterways.

1.5 Code Development Process

In order to provide effective guidance for Council staff, while also being acceptable to the various interest groups, the development of the Code was based on a robust consultative process involving all known stakeholder organisations having an interest in the Rivers and waterway areas.

The consultation process undertaken and the results obtained are documented in a separate background report titled Environmental Code of Practice for River Works: Consultation Process and Results, 1999 (the Consultation Report). The Consultation Report sets out the parties identified for consultation, the consultation process adopted for each party and the views expressed by them. For the sake of brevity, the contents of the Consultation Report are not repeated in the Code, but were utilised in its preparation.

1.6 Relationship with Other Relevant Documentation and HBRC Functions

The code of Practice is one of a suite of documents that provides guidance planning and standards for activities undertaken by Hawkes Bay Regional Council in rivers and waterways. The flowchart below shows how the Environmental Code of Practice for River and Waterways works fits into the planning framework. The links between Hawke's Bay Regional Council's activities and interests is described in Figure 4.

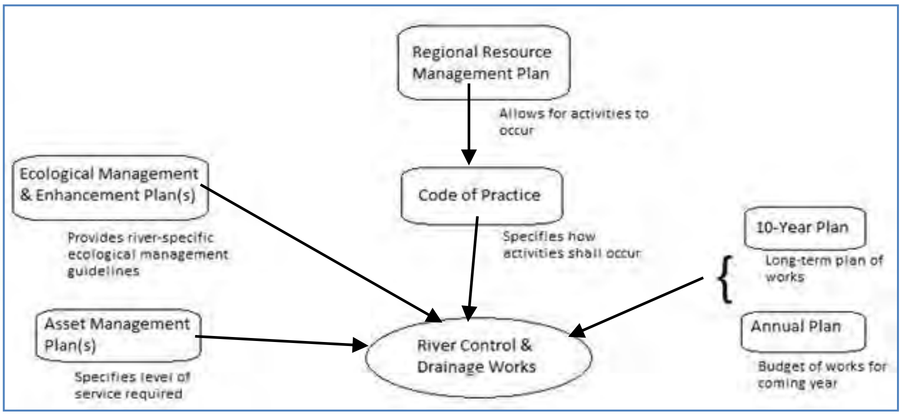

Figure 3: Relationship of Code of Practice with other Council plans..

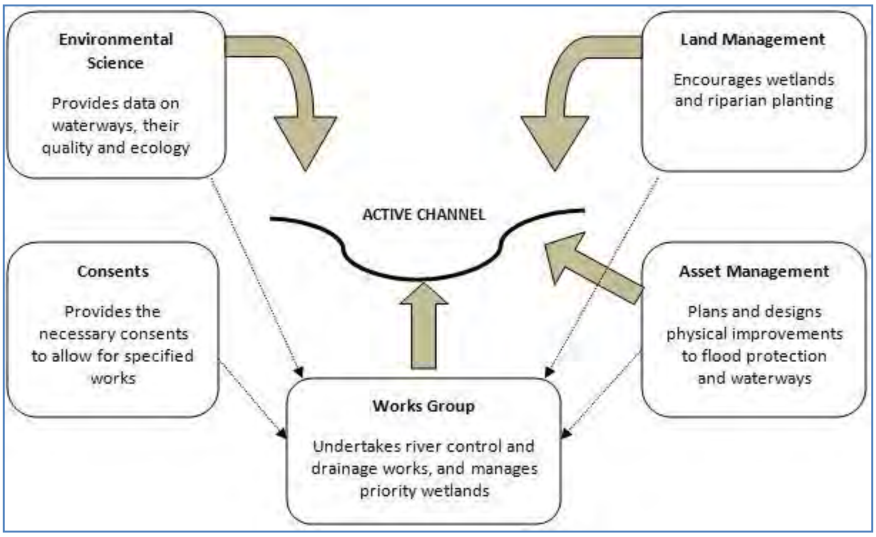

Figure 4: Relationship with other HBRC functions.

1.7 Prioritised Objectives

There are a wide range of views and interest with regard to the use and management of the rivers and waterway areas within the region. Consequently there is a need for Council to state its management priorities for the rivers, drains and associated riparian areas. Based on the range of views and Council's responsibilities under various Acts, a hierarchy of priorities has been developed.

These ranked priorities are set out below.

Council's Hierarchy of River Management Priorities:

1. Protection of human life and property through the design and efficient operation of river and flood control works, and drainage systems.
2. Maintenance and protection of existing ecological values.
3. Acknowledgement of customary rights under the Treaty of Waitangi.
4. Enhancement of fishery, wetland and riparian wildlife habitats.
5. Avoidance of health and safety risks posed by:
   - Grass and scrub fires;
   - General theft and stock rustling;
   - Vandalism;
   - Rubbish and car body dumping;
   - Public interaction with river works or gravel extraction operations.
6. Facilitation of vehicular and pedestrian public access to publicly owned river and drainage areas where such access does not conflict with the higher order management priorities (1) to (5) above.

2 Review

As well as setting general standards of practice for Council's river work activities, the Code also identifies other matters such as specific locations for public access for example. There are also plan changes and changes to river and drainage management practice. Consequently, it is preferable that the Code is reviewed from time to time so that the appropriateness of the standards and site specific information can be assessed over time.

The Code will be reviewed to align with Asset Management Plan reviews which are every six years. The review process will involve consultation with:

- Iwi of the Hawke's Bay region;
- Department of Conservation;
- Fish and Game;
- Royal Forest and Bird Protection Society.

In addition, other parties requesting a direct involvement in the review process will be consulted, together with any other parties that Council considers appropriate at the time.

3 Description of River work and Waterways Activities.

Hawke's Bay Regional Council undertakes a wide range of physical works in the rivers and waterways across the region. Most of these works are covered by a permitted activity Rule in the Regional Resource Management Plan and the Regional Coastal Environment Plan. A description of the works undertaken and their regulatory status is set out in Table 2. Figure 5 below shows a stylised representation of a river corridor with the berms, active channel and stopbanks shown. The active channel is the area of gravel/sand/silt, non-vegetated riverbed between natural banks of the river. The active channels may or may not have flowing water in them from time to time.

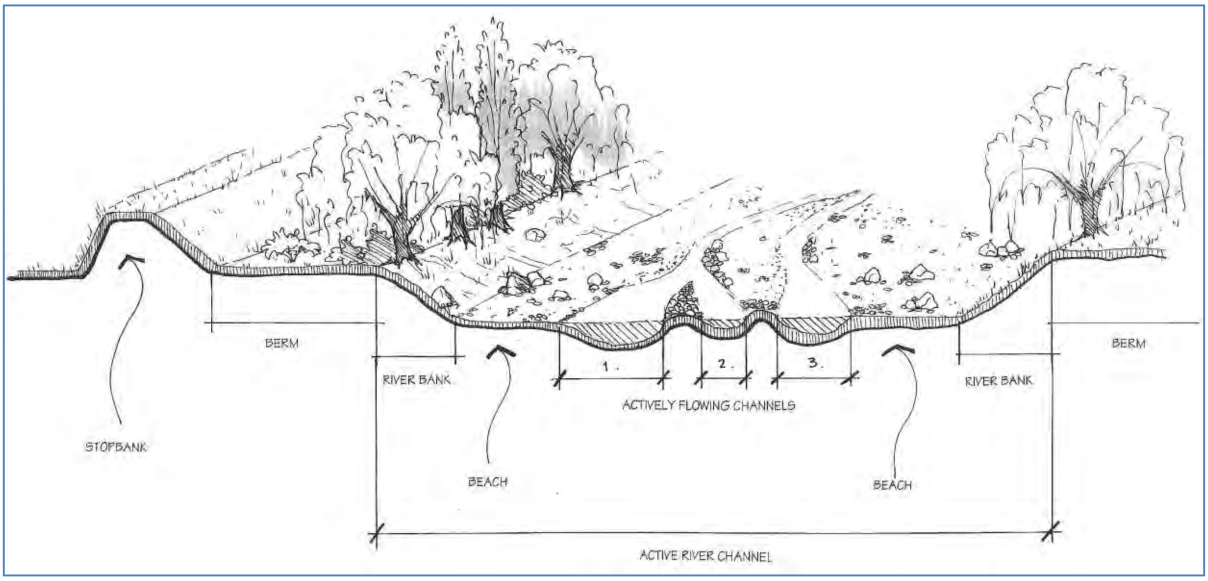

Figure 5: Active River Channel, Berms and Stopbanks Diagram. .

Any works not covered by Permitted Activity rules in the Hawke's Bay Regional Resource Management Plan (RRMP) and Regional Coastal Management Plan (RCMP) will require resource consent from the Hawke's Bay Regional Council Environmental Regulation Section. In such cases, Council's Asset Management staff will consult with the following parties, where it is appropriate in accordance with the plan provisions, prior to seeking resource consent:

- Iwi or hāpu;
- Department of Conservation;
- Fish and Game Council;
- Royal Forest and Bird Protection Society;
- Identified user groups, such as whitebaiters, remote-controlled airplane club, and others;
- Neighbouring landowners.

This consultation process shall attempt to inform, gather comments, concerns, and advice from these external parties, and help shape the proposed activity plans to the extent possible.

Table 2: River Work and Waterways Activities.

Activity	Covered by Permitted Activity Rule	Description
Live edge protection	✓	Includes trees planted on the river berm adjacent to the active river channel and on the river bank. The trees reduce lateral scour and help confine high velocity flood flows to the main river channel. The species most commonly used are willows (*Salix* spp.), due to their hardy nature and large fibrous root mass.
Tree lopping and layering	✓	The process of felling existing live edge protection trees on to the ground while maintaining an adequate connection with the stump such that vigorous regrowth is encouraged at bank level where it is most useful.
Tree removal	✓	Live edge protection trees and unwanted trees on the berms etc. are physically removed for either reuse or disposal. The trees are usually stacked and burned, or reused as edge protection.
Edge retreat	✓	The riverbank and adjacent berm is physically excavated and removed or allowed to erode during flood events. This technique is used to realign or develop the active river channel to its design width.
Rockwork and hard edge protection	✓	Includes lining, revetments, groynes and riverbanks that consist mainly of rock other durable material to prevent erosion and stabilise the banks.
Groynes and spur banks	✓	Projections of rock or other durable material are constructed to protrude into the active river channel. They may be permeable or impermeable. These projections may also utilise gabions (wire mattresses filled with rocks), concrete shapes, steel cables or railway irons driven into the ground for extra stability. Groynes are used to deflect the active river channel away from vulnerable river banks. Earth groynes or spur banks are also used adjacent to stopbanks for the same purpose.
Beach raking	✓	Raking of exposed gravel beaches with a bulldozer or tractor towing large rippers to disturb the top armoured layer of stones and unwanted vegetation growth. Once the top layer of stones is disturbed, subsequent flood flows are able to erode the gravel within the beach and transport the material downstream. This is critical to prevent the formation of islands or beaches which deflect the flow and cause a lateral shift in the flow meander. This in turn puts pressure on the river banks. Beach raking also assists with weed control, especially species that colonise open gravel areas such as Lupin, suckering willows, gorse and *Buddleia*.

Activity	Covered by Permitted Activity Rule	Description
Berm mowing	✓	The mowing of weeds and grass on river and waterway banks and berms.
Unwanted vegetation, plant pest spraying	✓	The spraying of various weeds, plant pests and unwanted vegetation on river beds, berms and drains by approved applicators.
Willow regrowth spraying	✓	The spraying of unwanted willow regrowth within the active river channel.
Weed boating	✓	Cutting aquatic weeks within waterways and rivers with the Council weed boat. Where practicable the cut weeds are collected and removed from the river or waterway.
Pole planting	✓	Planting of willow or poplar poles on river berm areas and banks.
Planting Native and Exotic plants	✓	Planting of native shrubs and trees. Planting of exotic shrubs and trees other than willows and poplars for biodiversity, enhancement and flood control purposes.
Bank reinstatement	✓	The reinstatement of eroded river and waterway banks to their original (pre-flood) state and profile or improved profile. This may involve using gravel material from within the active river channel, combined with either live edge protection plantings, rock revetments or other structural means.
Irrigation intake maintenance	✓	Removing accumulated sediment from around irrigation intakes, or directing flowing water to those intakes if the active river channel has migrated away from them.
Waterway maintenance[2]	✓	Removing accumulated sediment, weed or other debris from waterways. Reinstating slumped or eroded waterway side batters to their design standards. Includes clearing blocked or impeded floodgates.
Waterway upgrading	✓	The widening or regrading of waterways to improve the level of service. The replacement of culverts and other channel and bank control structures. Minor waterway diversion and realignment.
Waterway mowing	✓	Mowing the waterway banks and berms.
Waterway crossing	✓	Constructing vehicular and pedestrian crossings over waterways through the use of bridges or culverts or fords.
River mouth openings	✓	Physically breaching of river mouths that have become blocked with sediment (eg shingle) due to either low river flows or

[2] This does not include sediment or gravel removal from rivers or streams outside of drainage scheme areas.

Activity	Covered by Permitted Activity Rule	Description
		adverse sea conditions. River mouth openings are only undertaken when upstream flooding or degraded water quality is causing a problem, or where an agreed management regime exists such as at Whakaki.
Fencing	✓	Fencing river berms for the purpose of controlling stock or unauthorised vehicle access. Fencing of refuge areas, wetlands and whitebait habitat areas.
Pool creation	✓	The creation of pools on the outside of river bends in order to provide fishery habitat. Pool creation for fishing purposes will occur in consultation with Fish and Game NZ. Pool creation for recreation purposes in consultation with hāpu / iwi.
Minor diversions	✓	Diversions or redirection of the flowing river channel, where the diversion path is fully contained within the confines of the active river channel[3]. This includes temporary diversions associated with the construction of structures, such as culverts and weirs, and the maintenance or irrigation intakes.
Major diversions	×	Diverting the active river channel from its present course by excavating a new channel through previous berm areas.
Gravel Extraction (using a mechanical device)	×	Used as a tool to manage riverbed levels at predetermined profiles. Separate consents are issued for this activity.

Some of the activities permitted in the Regional Resource Management Plan and the Regional Coastal Environment Plan have rules relating to the scale of the permitted activity. Where any activity to be carried out exceeds the permitted scale identified, resource consent must be obtained before that activity is undertaken.

[3] The active river channel is the area of gravelled, non-vegetated river bed between the natural banks of the river. The active river channel may or may not be covered with flowing water. Actively flowing channels are channels within the active river bed that have flowing water in them (see **Error! Reference source not found.**Figure 5)

4 General Standards of Practice

The Council undertakes river and drainage works throughout the Hawke's Bay region. As noted many of these works are carried out as a 'permitted activity' by the Regional Resource Management Plan and the Regional Coastal Environmental Plan, subject to a number of conditions that must be met by the Council when it undertakes the work. There are also other standards of practice that Council voluntarily abides by. These standards[4] are detailed below.

(1) Only Contractor approved through the approved contractor register or through the formal contractor tendering process, and with a track record of using well maintained machinery, shall be engaged in river and waterway work.

(2) Machinery shall be kept out of water to the extent possible. Where this is unavoidable all measures shall be taken to minimise bed disturbance and release of sediment (e.g. use only one crossing point, typically upstream of riffles, sediment control or minimisation measures).

(3) Appropriate machinery shall be used to ensure effective and efficient operations with minimal environmental impact.

(4) Machine refuelling and fuel storage shall occur where no fuel can enter a water body in the event of spillage.

(5) All machinery, equipment and material shall be stored above the anticipated flood level at the end of working day or when the site is unattended.

(6) Machinery leaking fuel, lubricant, hydraulic fluids or solvents shall not work within a water body.

(7) On completion of activity or in the event of anticipated extended suspension of works, all disturbed areas and access tracks, including public and recreational points, that have the potential to release sediment to water shall be reinstated.

(8) All spray and fuel containers shall be safely disposed of at an authorised landfill site or re-used.

(9) On the completion of works all surplus vegetative material shall be either removed from the site or disposed of either by burying or burning as soon as material and weather conditions allow.

(10) Burning on public land shall be supervised at all times and fire control equipment shall be available at the site.

(11) On the completion of works all surplus construction material shall be removed from the site.

(12) Debris that has the potential to increase the risk of flooding or erosion will be cleared as soon as conditions allow and if possible in conjunction with programmed activities.

(13) On completion of the works all surplus excavated bed material shall be spread evenly leaving beaches well shaped and tapering uniformly from the water's edge to the river bank.

(14) All stock animals shall be excluded from the works area until vegetation is well established and fenced.

(15) Fish passage shall be maintained in rivers at all flows during the execution of in-channel works.

[4] All terms used in the standards shall have the same definition as Section 2 of the Resource Management Act, or as commonly defined in the Oxford Dictionary if they are not defined in the Act.

(16) Risk management procedures shall be in place on all work sites to minimise the potential for damage arising from inclement weather and/or elevated river levels during the course of work.

(17) Where the activity poses, or is likely to pose a risk to the public, the contractor shall erect warning signs adjacent to the site. These signs will be removed when the activities on the site are no longer a danger to the public.

(18) Activities shall not use any material that has a potential to have a significant ecological effect on the environment.

(19) Activities shall comply with New Zealand Electrical Code of Practice for Electrical Safe Distance (NZECP 34:2001).

(20) Machinery and plant shall maintain a minimum clearance distance of 4 meters from the transmission line conductors at all times.

(21) The objectionable effect from the disposition of dust on neighbouring properties when undertaking activities shall be minimised by water spraying.

(22) Concrete shall only be poured in a bunded area to prevent fresh concrete or cement entering the watercourse.

4.1 Beach Raking

Beach raking will be undertaken in areas where gravel accumulation and excessive vegetation growth is evident and likely to pose a risk to edge protection works. It will also be undertaken in areas where commercial gravel extraction is not viable.

Beach spraying will be undertaken in other areas as a means of controlling unwanted vegetation.

Figure 6 identifies areas where beach raking and/or spraying is carried out.

Beach raking and other riverbed disturbances will not be undertaken during the Black-billed gull, Banded dotterel, Black-fronted dotterel and Pied stilt critical nesting period of September to November. The critical nesting times and opportunities for beach raking are describe in the river **Ecology Management and Enhancement Plans**. River workers have been made familiar with these requirements and arrange work schedules around them.

Machinery used for beach raking or beach spraying shall not enter the active flowing river channel(s), other than to gain access to the beach being raked or sprayed.

Beach raking will not be undertaken within 0.5 m of actively flowing channels.

The windrowing of beaches shall not prevent the passage of small 4WD vehicles over the river beaches, except where critical nesting, breeding or rearing habitat has been identified for native bird populations.

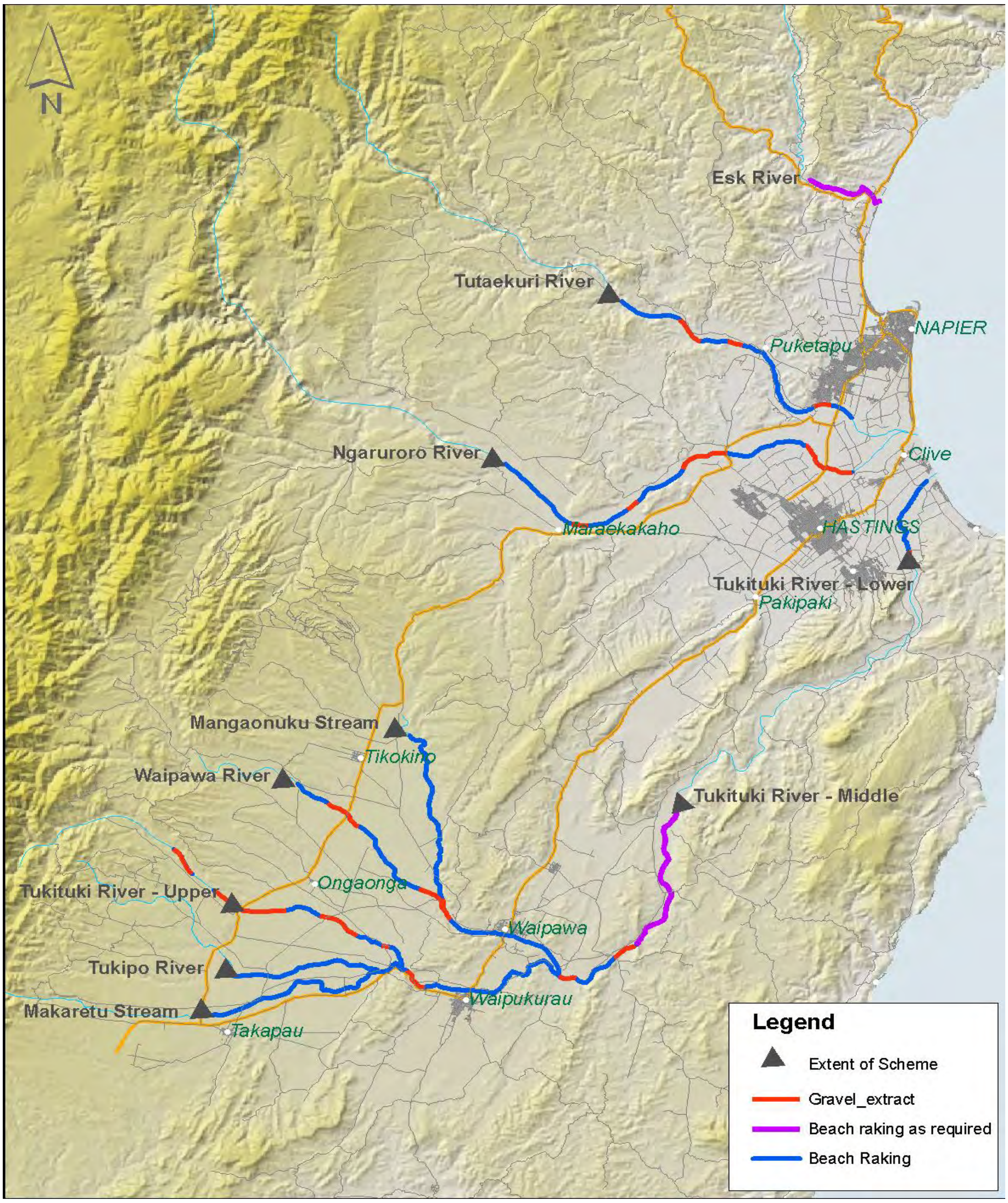

Figure 6: Beach Raking and spraying on Council managed land. .

Existing vehicular tracks to the water's edge shall be left undisturbed or shall be reinstated once beach raking is completed. To the fullest extent possible, existing vehicular tracks shall be used in lieu of creating a new track.

The respective lengths of beach raking, gravel extraction and beach spraying river reaches, as shown on Figure 6 are indicative only, and may vary from year to year.

4.2 Berm Mowing

Berm mowing can be used on areas to control rank grass, pasture grass, and weeds. This activity is primarily carried out in the public access area.
A dense sward of grass, free of plant pests, shall be retained once mowing is completed.

Those areas that are not mowed (or grazed) support a scrub or tree habitat ideal for wildlife and upland game birds in particular.

4.3 Buffer Zone Plantings

Buffer zone plantings are established behind the live edge protection and do not usually directly adjoin the river's edge. Current buffer zone planting species include varieties of willows, poplars and other exotic species. Native species are also used in specific sections of the buffer zone where ground conditions are suitable, and the integrity of the flood control assets being protected will not be compromised if the native species do not survive or grow as expected.

4.4 Channel Diversions

Any new channel shall be as similar to the natural shape of the river as practicable, both in cross-section and longitudinal slope, so as to maintain the physical habitat features occurring in the natural river channel (e.g. pools and riffles). In order to facilitate waterfowl access to drains and vegetative cover for nesting, drain sides shall not have a batter steeper than 1:1, unless steeper batters are necessary due to space restrictions. Steeper batters shall be evaluated for engineering options to reduce erosion and slip potential.

Channel diversion works shall avoid the primary fish spawning period of May to September unless suitable fish passage is provided past the works.

4.5 Drain Maintenance, Upgrading and Mowing

Sediment or vegetation removed from a waterway shall be deposited where it is unable to flow back into the waterway, and does not create an impediment to overland flow into the channel. Where drain inverts are to be excavated over a significant reach for grade improvement or cleaning purposes and assessment shall be made for the presence of fish by an aquatic ecologist. Where required fish shall be temporarily removed from harm's way and replaced once the activity has been carried out or placed in another suitable reach of the stream.

In order to provide a filtering effect from overland flow, and to ensure the stability of the channel sides, a healthy, dense sward of grass cover shall be retained on the sides of all channels, berms and wherever possible, also on the maintenance access tracks. Ideally grass length shall be maintained in the range of 50 mm to 150 mm so that scour from flood flows is minimised and sediment deposition onto the berm is likewise minimised.

4.6 Crossings

Any waterway crossing installed shall:

- Be able to pass the design flood flow for that particular[5] drain;
- Incorporate downstream scour prevention measures, such as gabions or rockwork, if bed erosion is likely to occur as a result of high flow velocities through the structure; and,
- Not impede fish passage (see '*Hawke's Bay Fish Passage Guidelines',* HBRC 2011).

[5] Recognising that different design standards apply in different areas.

4.7 Edge Retreat

Fish and Game NZ will be consulted on an annual basis regarding areas to be targeted for edge retreat.

River edge vegetation that is cleared shall be removed to a location where the likelihood of the material re-entering the active channel is minimised. No material (vegetation or aggregate) shall be pushed or placed into the active river channel.

4.8 General Use of Machinery

Warning signs shall be erected adjacent to the site of machinery operations if the site is, or is likely to be, hazardous to the public.
Machinery shall be removed from the riverbed at the end of each working day.
No refuelling of machinery shall occur within 20m of the active river channel.
No fuel shall be stored within 30m of the edge of the active river channel.
In the event of a fuel spill or other chemical (oil, lubricant, hydraulic fluid) leak, the appropriate Works Group contact shall be notified immediately, and efforts shall be made to clean up the contaminant(s).

Crossing of the active river channel by machinery shall be avoided where practicable during the fish spawning months of May to September.

4.9 Gravel Extraction

Gravel extraction requiring resource consent[6] shall only occur in areas specifically allocated by Council following its annual assessment of the sustainable gravel yield available from each river, and once the appropriate resource consents have been obtained.

No gravel extraction shall occur within one metre of the active river channel with flowing water, unless specifically authorised by Council.

No hāngī stones are to be removed from the Mohaka River without the prior permission of the affected Ngati Pahauwera hāpu.

Gravel stockpiling within the riverbed shall only occur temporarily while gravel extraction is being actively undertaken. All other stockpiles shall be located outside the river bed.

Council will provide designated access paths through any live edge protection plantings, and gravel extractors will not be permitted to cut their own access paths without prior Council authorisation.

The gravel extractor shall immediately repair any damage caused to river banks or river protection works, other than damage associated with authorised access paths through live edge protection plantings.

The gravel extraction site shall be restored upon the completion of extraction activities as follows:

- All gravel previously heaped up or stockpiled shall be spread out to conform with the general ground profile; and,
- Reject, surplus or unused gravel from a gravel processing plant shall not be deposited within the active river channel.

[6] The Regional Resource Management Plan sets out the rules for river bed gravel extraction.

Gravel extractors shall minimise the generation of dust from access tracks and storage and processing sites, through measures such as water application.

Gravel extractors shall be allowed to temporarily exclude the general public from gravel extraction and processing sites if the general public's health and safety is likely to be adversely effected by specific gravel extraction activities. If the public is excluded, the gravel extractors shall erect appropriate warning signs[7]. However, at all other times gravel extraction activities shall be undertaken in such a manner that public access is not compromised.

4.10 Groynes

Groynes will not protrude across more than 20% of the active river channel. Groynes will preferentially utilise local rock sources where possible. However flow conditions in the larger rivers will dictate sizes and local rock sources are not usually available in sufficient quantities. In this case especially designed concrete shapes (ie Akmons) can be used. Demolition material (other than clean concrete with no protruding reinforcing steel[8]) and car bodies will not be used in the construction of groynes.

4.11 Irrigation Intake Maintenance

Providing and maintaining water supply to irrigation intakes is generally undertaken within the active channel of the river. Any excavation works associated with this activity shall, wherever possible, be carried out in an area separate from the main river flow. Once this diversion work is complete the link between the river and the intake will be made.

Any necessary works within the flowing channel shall be undertaken as quickly as possible to minimise the disturbance to the waterway.

4.12 Live Edge Protection (including pole planting)

Edge protection plantings generally consist of willow species. It is vital that edge protection plantings are able to survive the harsh river edge environment, and are able to quickly establish and maintain an effective edge protection zone. Willows meet these needs where most other species may not. Consequently, other species will not generally be considered for edge protection plantings.

Edge protection plantings shall be fenced on their landward side if the area adjacent to them is used for stock grazing.

Edge protection plantings shall not include invasive exotic species, including those willow species known to aggressively spread.

4.13 River Mouth Openings

River mouth opening shall be undertaken if:

- The river mouth is blocked and river is in risk of flooding.

[7] Note that the general Health and Safety matters associated with gravel extraction activities are the responsibility of the gravel extractor.
[8] Any reinforcing material that is subsequently exposed will be removed.

- The river mouth is located in an undesirable location due to it migrating too far from an ideal position.
- Poor mouth conditions are adversely affecting drainage within the lower sections of the river.
- Poor water quality in the impounded river is having a significant adverse effect on the aquatic ecosystem.

Excavated material shall be placed alongside the newly cut river channel[9] where it can be washed back into the tidal zone by the developing river mouth.

4.14 Rock Revetments

Rock revetments will be:

- Used only where live edge protection is not a feasible alternative;
- Not generally constructed on slopes steeper than 2:1;
- Constructed of local rock sources where these are structurally suitable, and a cost effective supply of rock is available; and,
- Designed and constructed to preserve the natural character of the river berm area as far as is practicable.

4.15 Tree Removal

Tree removal shall be carried out from the dry berm area, not the active river channel, unless the tree has become established in the active river channel and is likely to cause a problem.

Trees overhanging the active channel shall generally be removed in a manner that minimises the need to fell trees into the active river channel. Any trees felled into the active river channel shall be removed immediately once the felling work is completed.

The root systems of felled trees shall remain undisturbed (to avoid excess sediment generation) unless the area being cleared is targeted for edge retreat. Trees that are removed shall be stockpiled, and where possible, made available to the general public for removal as firewood. Otherwise, the stockpiles will be burnt in accordance with air discharge rules and good practice at an appropriate time, or physically removed off-site and disposed of at appropriate tree or stump dumps.

4.16 Weed Cutting including Weed Boating

Wherever practicable cut weeds shall be removed from the river or waterway and disposed of on dry land. An exception to this involves weed clearance using the weed boat, as weed cuttings from the weed boating operation may be floated downstream rather than piled adjacent to the waterway. Weed cutting shall not be undertaken on the Clive River or Grange Creek during the whitebait season (15 August to 30 November). An exception to this is where whitebaiters have been notified and a defined time period is specified for the work.

[9] River mouths are generally opened using excavators and bulldozers to excavate a new channel between the river and the sea. The excavated material tends to be relatively clean and well graded with minimal silt and suspended sediments.

5 Scheme Specific Standards of Practice

The general standards specified in Section 4 will apply to the majority of works undertaken within the Scheme areas. However, additional policies and standards are required for widespread grass control (grazing and mowing) as this only occurs within Scheme areas. In addition, there is the opportunity to undertake or facilitate environmental enhancement works on Council owned land. This matter is also addressed below.

5.1 Grazing

Due to the risk of grass and scrub fires during the dry summer months, and to minimise the excess siltation of river berm areas, it is essential that any open grass river berm areas within Scheme owned land are actively managed so that grass is generally kept below 300 mm in height. If this does not occur the Rural Fire Control Authorities are entitled to issue Council with legal notices requiring the grass to be cut.

There are only two practical options for grass management:

- Cattle grazing; and
- Mechanical mowing and associated weed spraying.

Approximately 55% of all Council owned river berm land on the Heretaunga Plains is grazed. This compares to 5% in the Upper Tukituki Scheme (Ruataniwha Plains).

Overall, approximately 35% of the Council owned berm area within the major Schemes is grazed. The remaining berm area supports a grass, scrub and tree habitat ideal for wildlife, and upland game birds in particular.

Mechanical mowing and associated spraying costs is expensive. By comparison, stock grazing yields some annual revenue. Because of the high cost of mowing grazing has continued to be used as the primary grass management option. However, grazing has allowed stock access to waterways that results in fouling of the waterways that is offensive, and damaging to the in-stream and riparian ecology and habitat. Pressure from the public, pending changes to national environmental standards and plan changes mean that alternative methods to grazing are likely to be implemented in the future.

Council currently mows areas of high public use where grazing is either impractical or undesirable. In addition, HBRC's Asset Management and Works Group departments are working to minimize or eliminate access to the waterways for grazing stock.

5.1.1 Grazing Regime

River berm grazing generally only occurs within the major Schemes on Council owned berm land. The overall situation with respect to significant rivers is summarised in **Table 3.**

Table 3: Overview of Grazing.

Rivers in Schemes where grazing occurs	Whole rivers located within Schemes where no grazing occurs	Rivers located within Schemes where significant reaches are not grazed	Rivers outside Schemes where no Council initiated grazing occurs
Tutaekuri Ngaruroro Lower Tukituki	Esk	Mangaonuku Makaretu Porangahau Tukipo Waipawa Upper Tukituki	Wairoa Nuhaka Mohaka

Grazing occurs along approximately 80km of significant river berms within the major Schemes (**Figure 7**, below). There are a number of different grazing regimes used, including:

- Uncontrolled grazing, where stock are able to freely access to the water's edge. This occurs on the Ngaruroro River from 1km below Chesterhope (4.5 km), where there is no edge protection planting and it is impractical to fence the entire river edge due to the risk of flood damage and the desire for unrestricted public access. The channel widths in these areas are considerably narrower than the design width and subject to natural erosion. Until such time as these sections of river develop to their desired width this erosion process will not be controlled. Stock damage in these areas is not considered to be a major issue. Whitebait spawning areas, wetland enhancement areas and buffer zone plantings are fenced off within these reaches.

- Controlled grazing, where there is no edge protection planting, but the river edge is fenced off for short distances in and around public access points. Separate stock water supplies are provided. This occurs in and around most public access points.

- Controlled grazing, where there may be no edge protection planting, but the river edge is fenced off to prevent direct access to the waterway by grazing stock.

- Controlled grazing where edge protection planting is established. Planted areas are fenced to exclude stock from accessing vegetation and the river itself. Separate stock water supplies are provided. These planting zones produce a natural filtering mechanism for runoff between the grazed berms and the active channel. This regime applies to over 70 km of the total grazing area.

The specific locations of these grazing regimes on the Ngaruroro, Tutaekuri and Lower Tukituki Rivers are held within Council's Geographic Information System and provided to lessees and members of the public as required.

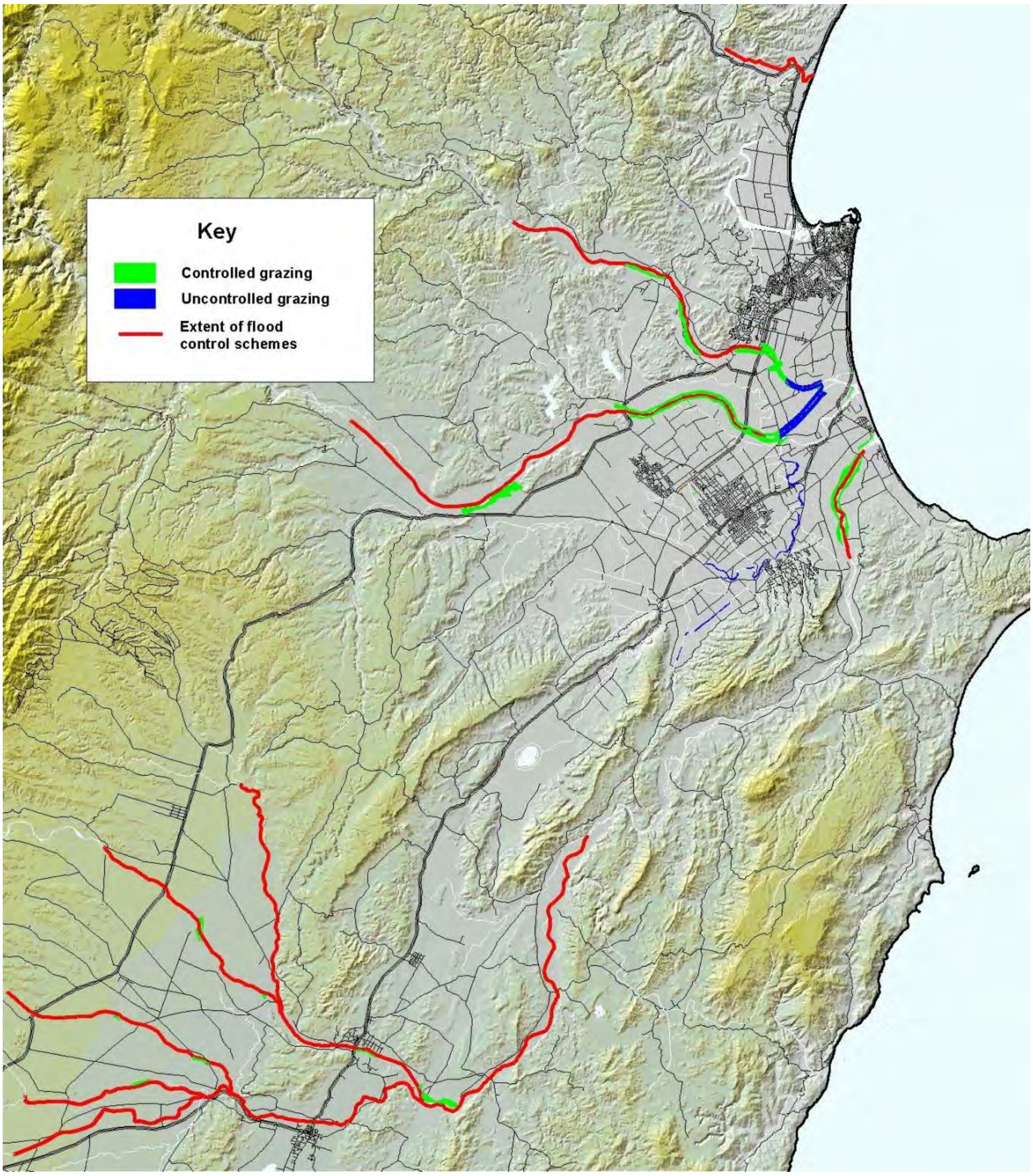

Figure 7: Grazing adjacent to rivers on Council managed land. .

5.2 Wetland Enhancement

Wetlands in the river berm areas provide valuable habitat for wildlife and waterfowl.

Wetland areas are generally identified for enhancement through the Ecological Management and Enhancement Plans (EMEPs) and their associated Programmes of Work. In general, wetland enhancement works follow a criteria that will help ensure the best outcome.

The criteria used to identify areas for wetland enhancement are set out below.

Wetland Enhancement Criteria

Areas for wetland enhancement must be:

- Unlikely to compromise flood control or river management objectives*;
- Able to be fenced from livestock;
- Remote from areas of high public use;
- Accessible to pedestrians;
- Designed so as to prevent excessive infill or siltation during floods;
- Preferably containing non-invasive exotic and/or indigenous vegetation suitable as a food source and for shelter for wildlife; and,
- Based around a reliable water source (such as springs, drains or streams) to ensure ponding or saturation for at least 9 months per annum.

Wetland areas to have:

- At least 30% of margins in full vegetative cover;
- Undulating margins of variable water depth;
- At least 50% open water;
- Vegetated islands where possible; and,
- Good water quality

*Wetland areas established on river berms are at risk of destruction during major floods. Should this occur, the future of the site may be reconsidered jointly with the conservation interest groups. Any funding required for the reinstatement of the site may not be available from Council.

Once wetland areas have been established, all practical steps will be taken to ensure that future river control works and activities do not damage the wetland areas.

The identification of potential enhancement areas does not indicate a commitment from Council to fund the development of these areas. Clear lines of responsibility will need to be established between the interested parties; including establishment and long term maintenance costs. Council will assist where possible with these costs, but this will need to be determined on a case by case basis.

5.3 Terrestrial Wildlife Habitat Enhancement

Areas of rank grass and scrub on the river berm areas can provide valuable habitat for wild fowl and upland game bird species. These areas need to be carefully selected and managed to ensure that they are viable in the long term. Council envisages that user and interest groups such as Iwi, Fish and Game and the Royal Forest and Bird Protection Society will be actively involved in establishing, managing and maintaining these areas.

Terrestrial wildlife areas will generally be identified for enhancement works through the EMEPs. In areas where there is no established EMEP, enhancement works will be identified in consultation with the parties noted above. The criteria to be used to identify areas for terrestrial wildlife habitat enhancement are set out below.

Terrestrial Habitat Enhancement Criteria

Areas for terrestrial wildlife habitat enhancement must be:

- Unlikely to compromise flood control or river management objectives*;
- Able to be fenced to exclude livestock;
- Remote from residential areas and areas of high public use;
- Accessible to pedestrians; and,
- Preferably containing vegetation, non-invasive exotic and/or indigenous, that provides suitable forage and/or shelter for wildlife.

If suitable vegetation is not already present, then HBRC will permit planting of approved plants by interest groups.

Grazing management for non-fenced wildlife habitat areas:

- Grazing is to be precluded during the August to December bird nesting period; and,
- A close grazed pasture effect is to be avoided by mob-stocking for short-term periods only.

Temporary inundation from floods is acceptable, provided silt deposits are minimised.

*Any areas established are at risk of destruction during major floods. Should this occur, the future of the site may be reconsidered jointly with the interest groups. Any funding required for the reinstatement of the site may not be available from Council.

5.4 Biodiversity

Previous reports[10] have noted the predominance of willow species in the Council's live edge protection plantings. From a landscape perspective, some commentators cite this as beneficial and some do not. Bee Keepers for example value the willows for the early nectar availability in early autumn. HBRC's Asset Management and Works Group departments are actively working to develop and implement a riparian protection scheme that includes significant biodiversity values.

From a biodiversity perspective, a greater variety of tree species would be beneficial for enhancing wildlife habitat. Unfortunately, the application of Council's first order management priority for the rivers requires species to be used that are fast growing, drought tolerant, able to easily withstand the erosive effects of floods, and able to survive heavy silt deposition. Some willow species meet these needs and are the preferred species, however, due to the impact of willow sawfly (Nematus ogilospilus), a range of alternative species are being established. These include exotic species such as birch (Betula spp.), alder (Alnus spp.) and acacia (Acacia sp.), in addition to selected plantings of native species, such as flax (Phormium spp.), cabbage tree (Cordyline australis), manuka (Leptospermum scoparium), lacebark (Hoheria populnea), ribbonwood (Plagianthus regius) and tree daisy (Olearia solandri). Alternative planting areas are generally complimented with permeable rope and rail groynes for additional strength and protection in this zone.

Council will continue to actively protect any native species that are naturally emerging within the willow plantings, and where possible will favour tree species that offer food and shelter qualities for wildlife.

Recommendations for strengthening biodiversity in river berm areas are set out in Council's EMEPs. Where there is no established EMEP, the following criteria will apply:

Biodiversity Criteria

1. Council will actively protect significant native tree species growing within edge protection plantings (except that this will not preclude Council from removing silt deposited following a flood).
2. Council will plant alternative native and exotic species (such as cabbage trees, maples, alders, and oaks) on areas located away from the active river channel, if those areas are conducive to the long term survival of those alternative species.
3. Appropriate alternative species will be selected in consultation with Iwi, the Department of Conservation, the Fish and Game Council and the Royal Forest and Bird Protection Society.

[10] Boffa Miskell, Hawke's Bay Catchment Board, Hawke's Bay Regional Council.

5.5 Whitebait Spawning

Whitebait spawning occurs in rank grass and rushes at the saltwater interface on the banks of estuaries and rivers. These spawning areas are susceptible to damage from grazing stock, weed spraying and general public access. However, merely fencing these areas off can easily protect them from such damage.

Whitebait spawning in the Heretaunga Plains and Napier Hastings areas that have been identified and fenced off to date are shown in **Figure 8 and 9**. Any further whitebait spawning areas[11] identified in conjunction with the region's Iwi and the Department of Conservation will also be fenced off[12].

The criteria to be used to identify areas for whitebait habitat enhancement are set out below.

Whitebait Habitat Enhancement Criteria

Areas for whitebait habitat enhancement must be:
- Identified as supporting whitebait spawning;
- Able to be fenced from livestock;
- In locations where either river works are unlikely, or existing river works are not compromised; and,
- Containing natural, rank grasses with no willows (or willows are able to be removed).

[11] The Department of Conservation estimates that up to 90% of known whitebait spawning areas have already been fenced off.
[12] Generally, the Hawke's Bay Regional Council will provide for fencing materials and DOC will provide labour to erect the fence.

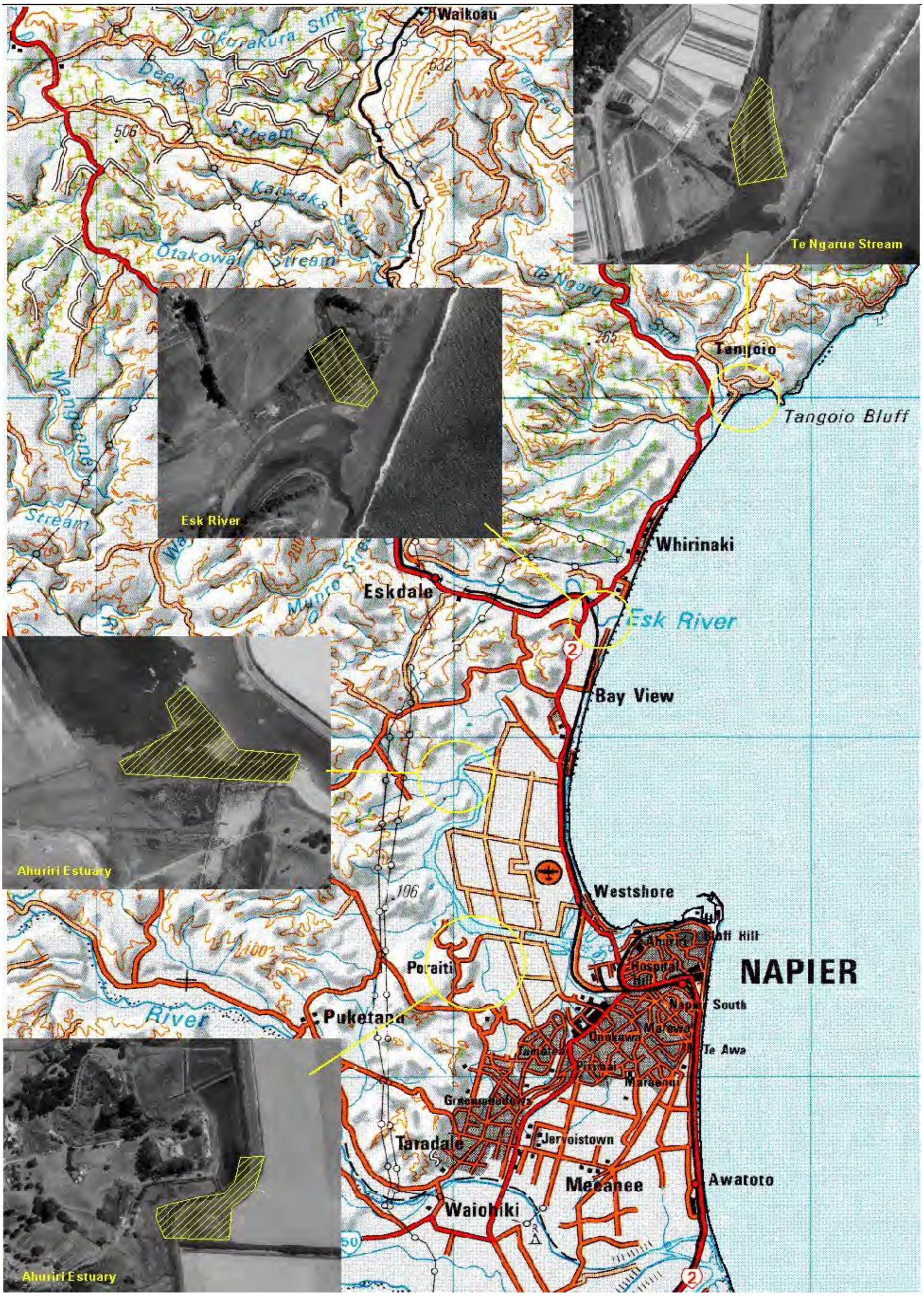

Figure 8: Protected Whitebait Spawning Areas (North).

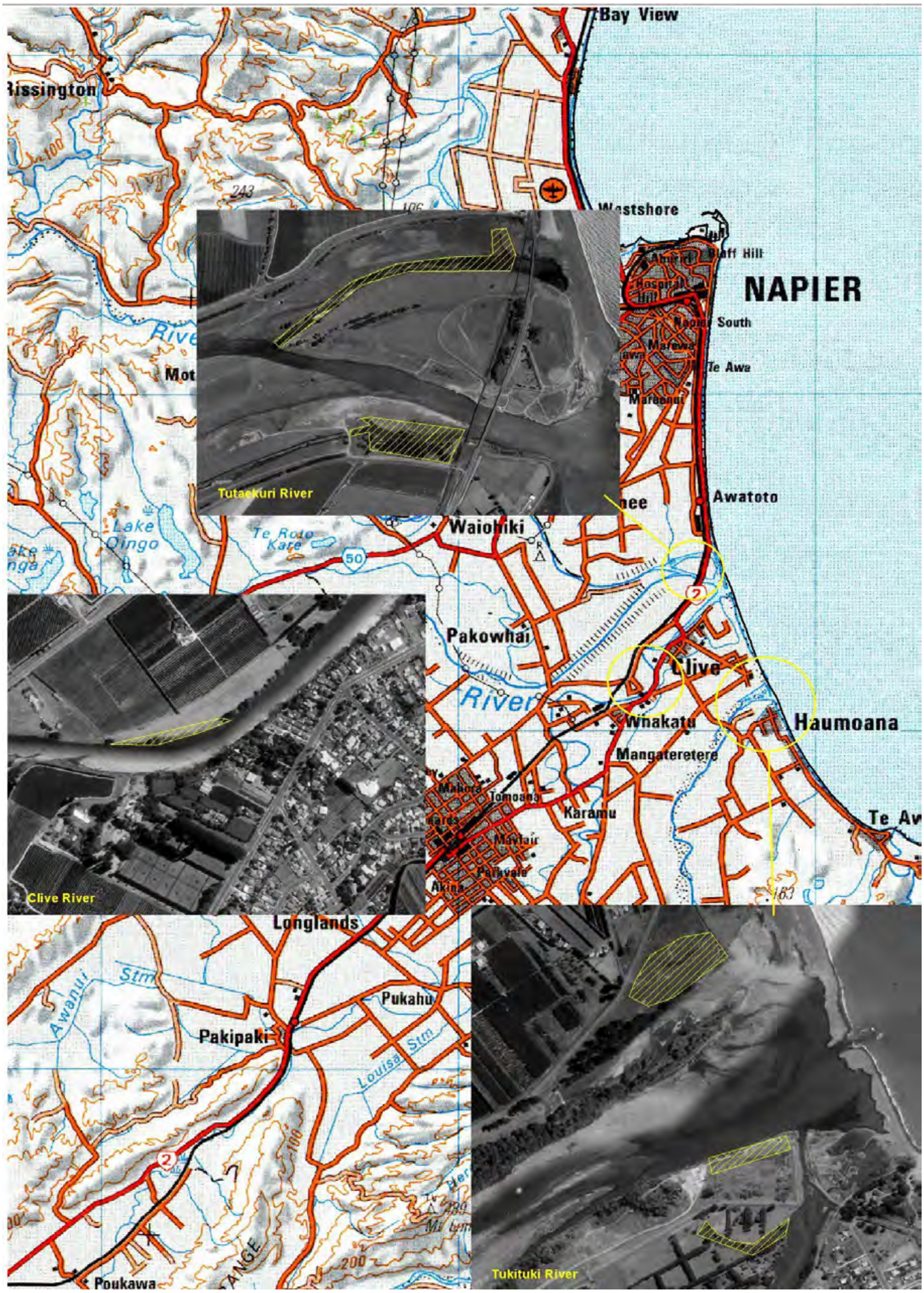

Figure 9: Protected Whitebait Spawning Areas (South). .

5.6 Waterway Wildlife Habitat

Specific areas of waterway that are suitable for waterfowl habitat enhancement will be identified in consultation with the Fish and Game Council. The criteria to be used to identify areas for drain habitat enhancement are set out below.

Waterway Habitat Enhancement Criteria

Areas for waterfowl habitat enhancement must have:

- Been identified as a known breeding area for waterfowl;
- Moderate to low gradient side batters; and,
- Flowing or standing water at least nine months of the year.

Identified areas will be excluded from edge mowing or spraying during the waterfowl breeding months of August through to November.

5.7 Pool Creation

The maintenance of permanent deep pools in rivers is important for providing habitat for fisheries, particularly as refugia during low flows. Pools and riffles naturally migrate over time within a river system. However, there is potential for some river work activities, such as beach raking and edge retreat, to contribute to or exacerbate the natural instability of pool and riffle systems.

Consequently, the creation of artificial deep pools can be highly beneficial. These can also have the added advantage of being able to be used as swimming holes by the public and as water supply sources by the Rural Fire Control authorities. River locations that are suitable for pool creation will be identified in consultation with Iwi and the Fish and Game Council.

The criteria to be used to identify river locations for pool creation are set out below.

Pool Creation Criteria

Areas for pool creation must be:

- In locations that will not unduly interfere with Council river works or machinery movements; and,
- On the outside of river bends adjacent to existing tree cover able to shade the pool.
- Pools primarily created for swimming holes are to be selected based on first criteria above and tree cover need not be a requirement.

6 Public Access

6.1 Council Policy

Different interest groups have conflicting aspirations regarding access to the river berm areas. Some groups and individuals desire public access to all parts of the river system by both foot and vehicle, while other groups and individuals wish to see access restricted to certain areas or certain times of the year.

Council's present policy is to allow public pedestrian access to all river berm land owned or administered by Council. This policy is to be retained. The exception is the need to prevent access to areas where work is being carried out for health and safety reasons.

Council is aware that free and open public access can create problems in terms of:

- High management costs;
- Vandalism to Scheme works and other infrastructure;
- Rubbish and car body dumping;
- General theft from adjoining properties and stock rustling from the river berms;
- Increased risk of grass and scrub fires; and,
- Illegal practices such as cannabis cultivation.
- Wildlife disturbance (e.g. from dogs)

These problems are particularly prevalent in areas where vehicular access is provided. Consequently, there is a need to restrict free and open public vehicular access.

Vehicular access for the general public is provided at 16 points on the Heretaunga Plains and 16 points in the Upper Tukituki River Catchment, as shown **Figure 10** and listed in **Table 4**. These existing vehicular access points will be maintained, and additional access points will be considered as required.

The existing vehicular access points result in 30% of the Council owned or administered river berm area being open to vehicle access by the general public.

The existing vehicular access points are being steadily enhanced in accordance with the *Public Access Development Programme, October 1996* (HBRC). Following consultation with the NZ Police, all existing access points have been designed with only one entrance and exit, to avoid the use of the river areas as travel corridors by criminals. This practice will be maintained.

Other vehicular access points are maintained so that Council can undertake its river management activities. These access points have locked gates.

6.2 General Public Access

The following Council Policy has been adopted for the major Schemes where Council owns the land adjoining the river system.

Public Access Policy

1. Pedestrian access to the river berm and river channel areas owned or administered by Council will be generally unrestricted, other than where a potential risk to public health and safety arises from:
   - River management or gravel extraction activities; or
   - The risk of grass and scrub fires.

2. General vehicular access will be restricted to designated entry points and adjoining berm areas listed in Table 4: Public Vehicular Access Points.**Error! Reference source ot found.**. These vehicular access points may be closed at any time at Council's sole discretion.

3. Council will maintain controlled vehicular access points (with locked gates) at other locations, primarily for river management purposes.

4. Entry and use privileges may be provided through river management access points for special interest user groups on a case-by-case basis. However, no individual, group or sector of the community, will be provided with general vehicular access through all of the river management access points.

5. Hawke's Bay Regional Council security system keys shall not be given out to the general public, but may be for recognised special interest user groups.

6. No camping shall be permitted on river berms.

7. Dogs may be excluded from some areas or required to be on a lead.

Council actively promotes public use within the management areas, by constructing pathways along stopbanks and in other areas. Pathways have multiple use designations, including cycling, pedestrian use and dog walking, and equestrian. Different sections of pathway have specific designation, to both provide a variety of recreational formats while also avoiding conflict of use.

Policy 4 above is designed to cater for special interest user groups that require vehicular access to a particular part of the river berm system that is not open to general vehicular access. However, Council does not consider it appropriate to provide any group with general vehicular access to all parts of the river berm system, due to the problems identified above.

Individual members of the public are not granted access privileges through Council gates as the proliferation of the number of keys handed out to individuals would soon make the security gate system unworkable.

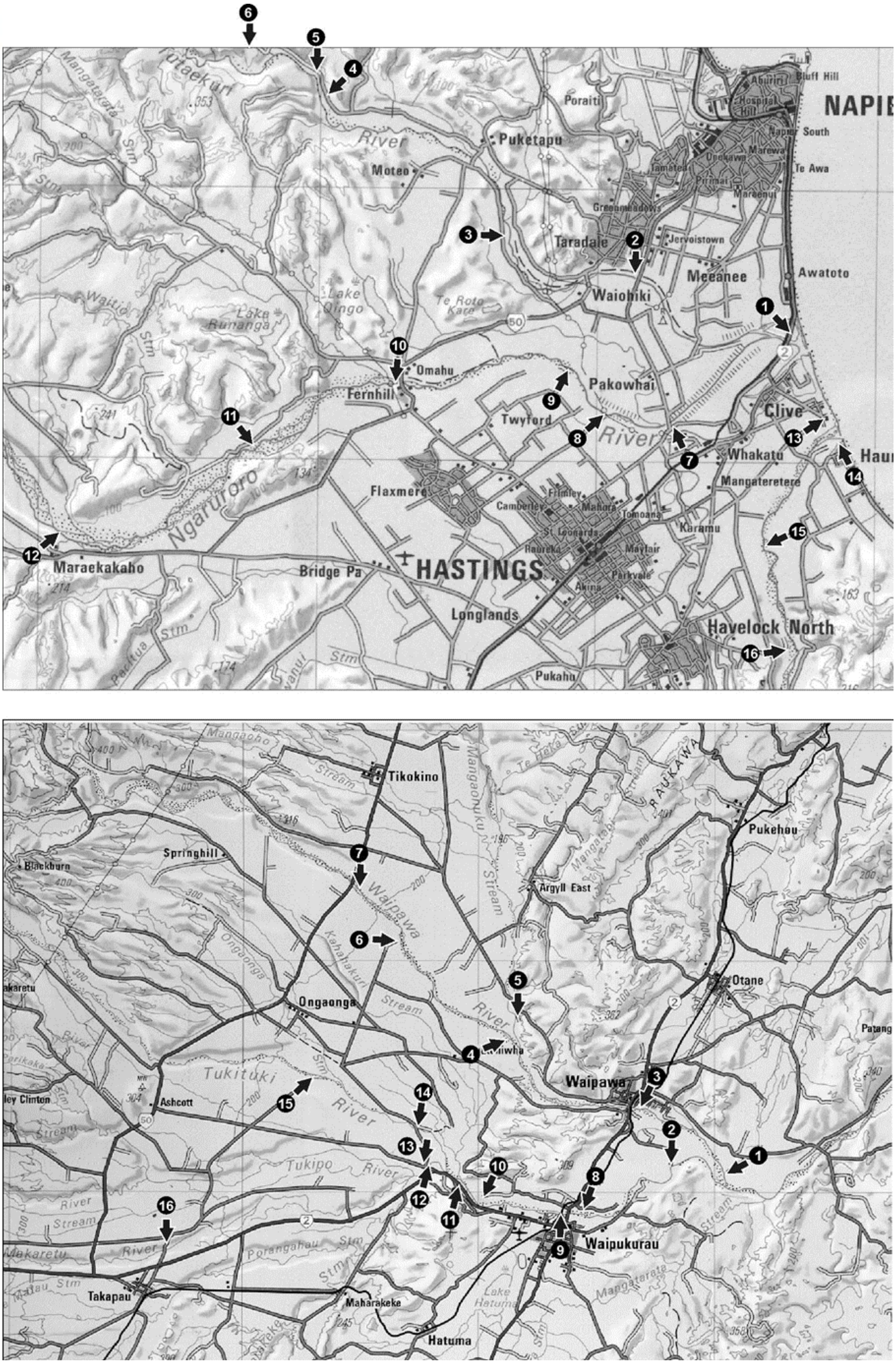

Figure 10: Public Access Points on the Heretaunga Plains (top) and Ruataniwha Plains (bottom).

Table 4: Public Vehicular Access Points.

River	Site Reference Number	Site Name
Heretaunga Plains		
Tutaekuri/Ngaruroro	1	Waitangi
Tutaekuri	2	Guppy Road
Tutaekuri	3	Omarunui Road
Tutaekuri	4	Hakowhai
Tutaekuri	5	Dartmoor
Tutaekuri	6	Mangaone
Ngaruroro	7	Pakowhai
Ngaruroro	8	Ormond Road
Ngaruroro	9	Carrick Road
Ngaruroro	10	Omahu
Ngaruroro	11	Ohiti
Ngaruroro	12	Maraekakako
East Clive Sea	13	Richmond Road
Lower Tukituki	14	Black Bridge
Lower Tukituki	15	Tennants Road
Lower Tukituki	16	River road
Ruataniwha Plains		
Upper Tukituki	1	Walker Road
Upper Tukituki	2	Tapairu Road
Waipawa	3	Reserve
Waipawa	4	Stockade Road
Mangaonuku Stream	5	Tikokino Road
Waipawa	6	Plantation Road
Waipawa	7	SH 50
Upper Tukituki	8	Ford Road
Upper Tukituki	9	Waipukurau
Upper Tukituki	10	Lindsay Road
Upper Tukituki	11	Pukeora
Tukipo	12	Ashcott Road
Tukipo	13	Mabins
Upper Tukituki	14	Ongaonga Road
Upper Tukituki	15	Burnside Road
Makaretu	16	Burnside Bridge

The public vehicle access points more fully described in a report titled *Public Access Development Programme, October 1996* (HBRC). That Report also details proposed recreational enhancement works at each public access point, including entrance ways, car parking, barbecue areas, rubbish bins and information maps. Proposed horse-riding trails along the Tutaekuri, Ngaruroro and Tukituki Rivers are also described. For the sake of brevity, that descriptive information is not repeated in this *Code*.

6.3 Special Interest User Group

A range of special interest user groups have been provided with access and entry privileges through river management access gates that are normally locked.

A special interest user group is recognised by the following characteristics:

- A demonstrated responsible attitude;
- A nominated contact person responsible for liaison with Council;
- A specific documented purpose, function or constitution;
- A documented membership list;
- A regular meeting or activity schedule;
- A demonstrated need to use river berm areas as opposed to other public open spaces provided by territorial authorities (such as general parks and reserves);
- A willingness to maintain the area of river berm designated for their use, including rubbish removal; and,
- It supplies its own locks and gate security system (where appropriate).

The *Public Access Development Programme* documents the current special interest user groups. These groups and their associated sites and designated access points are listed in the following Table.

Table 5: Special Interest User Group.

User Group	River	Site Location and Access Point	Access Arrangement
Hawke's Bay Radio Flyers	Tutaekuri	Waitangi	Own lock and key
Hawke's Bay Motorcycle Club	Ngaruroro	Chesterhope	Public access points. No key necessary
Hawke's Bay Jet Sprint Club	Ngaruroro	Chesterhope Ormond Road Waitangi	Public access points. No key necessary
Hawke's Bay Search and Rescue	Tutaekuri	Omaranui Road	Own lock and key
Kennels Gun Club	Tutaekuri	Allen's Road	Own lock and key
Paintball Hawke's Bay	Tutaekuri	Moteo	HBRC key
Riding for the Disabled	Tutaekuri	Powdrell Road Guppy Road Sandy Road	HBRC key
Whitebaiters	Tukituki Ngaruroro Tutaekuri		Own lock and key

The Hawke's Bay Radio Flyers, Kennels Gun Club, Paintball Hawke's Bay and whitebaiters have specific land use agreements and licences to occupy with the Council.

The special interest groups may erect structures on the river berm areas, subject to the terms of their licences to occupy, and the normal restrictions set out in the District Plan and Building Act.

The access and entry privileges awarded to these special interest user groups requires them to act in a responsible manner, as the groups are allowed to put their own locks on Council gates and distribute keys to those locks amongst their members. This can result in the widespread distribution of keys to the locks, which in turn increases the potential risk of problems such as rubbish-dumping and vandalism occurring. Accordingly, Council has developed an Access Policy for these special interest user groups.

Special Interest User Group Access Policy

1. Where appropriate, special interest user groups as listed in Table 5 **Error! Reference ource not found.** will be allowed to place their own locks on the river management access point gate closest to their site of activity.

2. The special interest groups shall ensure that entry keys are only distributed to recognised members of their group. The special interest groups shall maintain a Register documenting the holders of entry keys, and shall provide copies of that Register to Council upon request.

3. Council will review the access arrangements for each special interest group annually and any significant occurrence of rubbish dumping, vandalism or other nuisance may lead to the termination of the access privileges granted to that specific special interest group.

4. Council may establish land use agreements or licences to occupy berm land with the special interest groups.

7 Reference

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Tutaekuri River: Ecological Management and Enhancement Plan. Report AM 15/13

E

APPENDIX E

Terrestrial Ecology Impact Assessment (Forbes Ecology)

Forbes Ecology

Gravel Review: Terrestrial Ecology Impact Assessment

Prepared for the Hawke's Bay Regional Council; April 2017

CONTENTS

FIGURES

TABLES

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Cover photograph: Gravel extraction operation underway on the Waipawa River.

1.0 Introduction

1.1 Objective

The Hawke's Bay Regional Council (HBRC) contracted Forbes Ecology to undertake a terrestrial ecology impact assessment of the existing river beach raking and commercial gravel extraction operations.

The objective was to assess the impacts on the terrestrial ecology components of the Hawke's Bay braided river network and to recommend appropriate measures to address those impacts.

An assessment of freshwater values and impacts is provided as a separate report.

1.2 Methods

Existing literature and contract reports regarding the values of New Zealand and Hawke's Bay braided river ecosystems were reviewed. This involved a review and incorporation of previous relevant studies (e.g., Forbes & Whitesell 2013; Hughey et al. 2012; Ward 2012, 2011; Forbes 2011) carried out on the same rivers.

Riverbed bird data were collected during November 2014 from the Tukituki and Waipawa Rivers. These data allowed for specific analysis of the effects of beach raking and gravel extraction on the riverbed bird community. Riverbed bird data were analysed by Sarah Herbert, using Generalised Linear Mixed Models.

The assessment of the ecological impact of beach raking and gravel extraction was conducted in accordance with the methods set out in the Environment Institute of Australia and New Zealand (EIANZ 2015) guidelines for use in New Zealand terrestrial and freshwater environments.

2.0 Existing Environment: The Braided Rivers of Hawke's Bay

2.1 International, National, and Regional Contexts

The braided rivers found in New Zealand are rare internationally (O'Donnell & Moore 1983) and tend to occur only in areas of active mountain uplift and active erosion (Miall 1977). In both the North and South Islands of New Zealand, braided rivers tend to be restricted to the eastern side of the axial mountains (Maloney, Rebergen & Wells 1997). The Hawke's Bay region contains five large braided rivers, comprising a combined total of 10,375 ha of braided riverbed area, which equates to 4.2% of New Zealand's total braided riverbed area (Fig. 1; Wilson 2001). As 94% of New Zealand's braided riverbed habitat occurs in the South Island, the Hawke's Bay region notably contains the largest combined area of braided riverbed habitat in the North Island.

Figure 1. Examples of Hawke's Bay braided riverbed habitats from the (Left) Ngaruroro River and (Right) Waipawa River.

New Zealand's braided riverbeds are classed as Naturally Uncommon Ecosystems—meaning the ecosystem type was rare prior to human arrival. Braided rivers are notable for their biodiversity values; they naturally support highly specialised and diverse assemblages of flora and fauna (Wiser et al. 2013). Under the International Union for Conservation of Nature (IUCN) criteria for determining threatened ecosystems (Rodriguez et al. 2011), New Zealand's braided rivers are classified as "Threatened–Endangered" (Holdaway et al. 2012).

The Threatened status of New Zealand's braided riverbed ecosystems is due to a severe decline in ecosystem function over ≥80% of the extant braided riverbed ecosystems (Holdaway et al. 2012). Declines in native vegetation cover, increases in non-native plant and animal abundance, and ecosystem disruption are key indicators of declining ecosystem function in New Zealand's braided river ecosystems. Key threats to braided river ecosystems are presented by invasive animal pests and non-native plants (Holdaway et al. 2012).

2.2 Geographical Location and Habitat Types

Geographical Location

Gravel is extracted and beach raking occurs on four braided rivers in three major catchments (Fig. 2). The catchments are the Tutaekuri, the Ngaruroro, the Tukituki. The Tukituki catchment includes a number of major river tributaries in its upper catchment area, namely the Tukipo River, the Waipawa River, and the Mangaonuku Stream. These catchments all drain from the western ranges to Hawke Bay in the east.

The northernmost river, the Tutaekuri, has headwaters in the Kaweka Ranges, has a gravel bed and is entrenched within cliffs until Dartmoor, below which point the river flows across valley floor landforms.

Where the river is confined by cliffs, there is little vegetation encroachment of the riverbed. Below State Highway 50, there is little to no exposed gravel substrates[1] as pasture extends to the water's edge.

The Ngaruroro River drains from the Kaimanawa Range, within gorges until Whanawhana, below which point the riverbed widens and follows multiple channels, until State Highway 50, where a single channel is more frequent. Between Chesterhope and the sea, the river flows within a single soft-bottomed channel.

The Tukituki River drains from the Ruahine Range and converges with the Waipawa River approximately 5.5 km downstream of State Highway 2. Over this reach, the river features minor braiding and is confined within either terraces or stop banks. The Waipawa River, being a tributary of the Tukituki River, is wide with many braids. The Tukipo and Mangaonuku are more minor tributaries of the Tukituki and Waipawa rivers, respectively.

Climate

National-level cluster analysis of climate domains shows that climate statistics of Hawke's Bay braided rivers are similar to other North Island braided rivers (from Bay of Plenty south) and to the braided rivers located in the lowland Kaikoura and Nelson-Marlborough areas in the northern South Island (Fig. 5 of Wilson 2001). This grouping suggests that the climatic conditions of Hawke's Bay braided rivers are shared amongst 15% of New Zealand's braided river area (Wilson 2001).

[1] Exposed river gravels are referred to as exposed riverine sediment (ERS) from here on, in accordance with Fuller and Smart (2007).

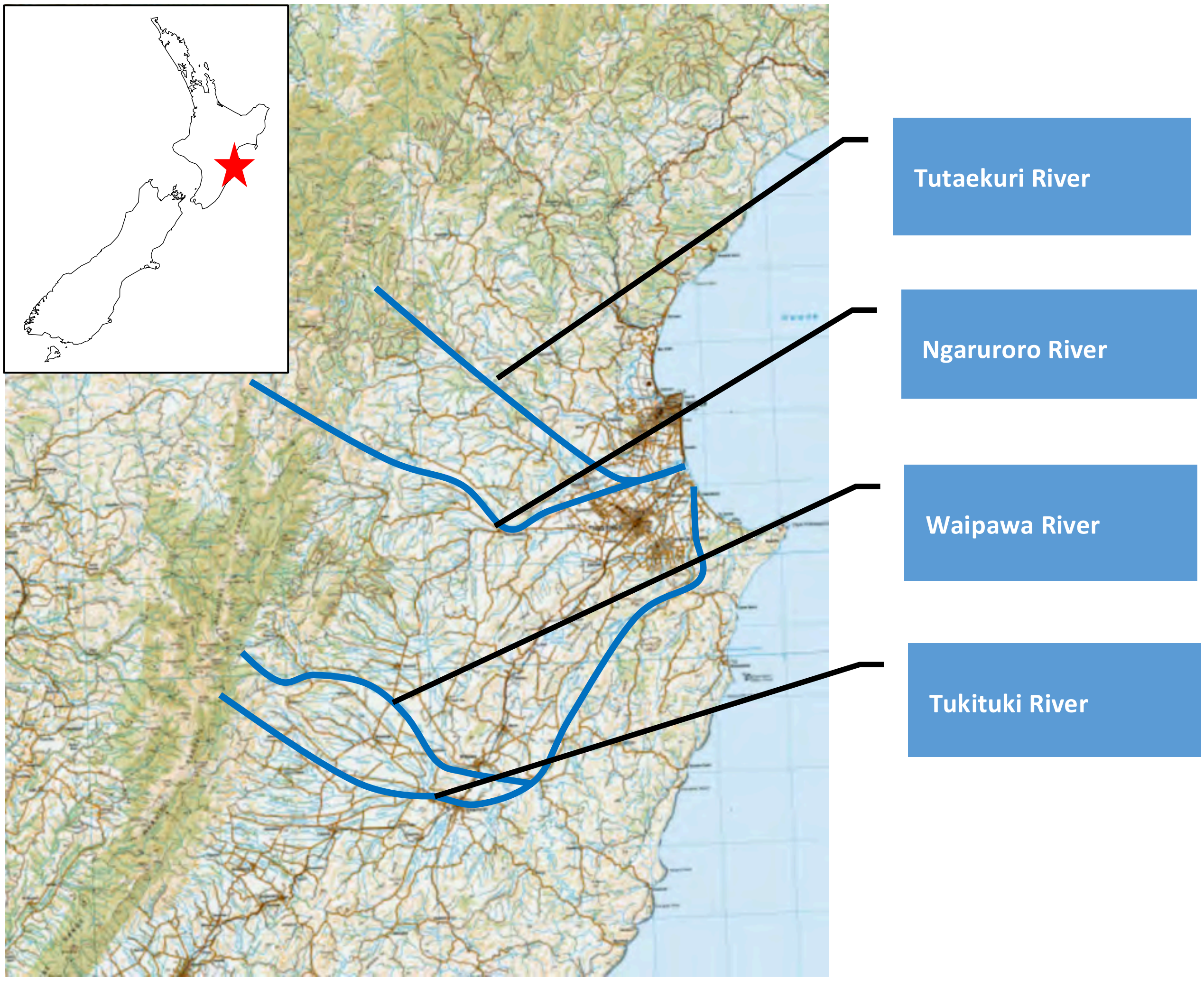

Figure 2. Schematic diagram showing the general location of the Tutaekuri, Ngaruroro, Tukituki and Waipawa, Rivers.

Habitat Types

Regarding the general habitat requirements of river bird species for nesting, waders, gulls, and terns require bare gravel riverbeds with little or no significant vegetation (Balneaves & Hughey 1990), and these species forage mostly in aquatic habitats (waders in small channels and terns over large channels; Balneaves & Hughey 1990). Territorial birds such as banded dotterel and South Island pied oystercatcher require large areas (several hectares), while colonial birds require only small areas. Waterfowl require the shelter of riparian vegetation to nest and these species feed on vegetated areas (Balneaves & Hughey 1990).

Parrish (1987) provides a description of the terrestrial and aquatic habitats of Hawke's Bay rivers. This is reproduced below where relevant to riverbed birds adapted to gravel substrates Table 1.

Table 1. Braided river aquatic and terrestrial habitats and their use.

Habitat Type	Description	Use
Aquatic Habitats		
Unbroken flowing pools and runs.	The water may be deep and slow-moving in pools, and swifter and shallower in runs; it can be in the main channel or a side channel.	Mainly shags, with white-fronted terns in the lower reaches. The edge and shallow side runs are used by dotterels, stilts, gulls and some waterfowl.
Riffles/rapids.	These are usually much shallower than pools and runs.	Shallow swifter-moving riffles are an important feeding habitat for dotterels, oystercatchers and stilts.
Backwater.	A backwater is formed by water backing up into it from the main flows and has only one connection to the channel.	Mainly by dotterels, stilts, oystercatchers, herons and gulls.
Seep.	A depression/hollow on a gravel flat into which seepage of water occurs, forming a shallow surface film of slow-moving water.	Waders.
Disconnected pool.	These may form after a change in river channel flows, for example, when a backwater is isolated by sediment deposition. They are semi-permanent with static water and are often lined by fine silt.	Waders.
Terrestrial Habitats		
Low flood terrace or island on river.	Islands at a similar riverbed level are formed by changes in watercourse and down-cutting of that terrace. Subject to infrequent flooding and most have well-developed vegetation of lupin, willow, gorse and broom.	Passerines, upland game birds, waterfowl breeding.
Gravel bar, flat, spit.	Sparsely-vegetated or bare gravel. Might be mid-channel, an island of gravel or large gravel flats on the leeward side of a riverbend.	Main riverbed breeding habitat for dotterels, stilt, oystercatcher, black-backed and black-billed gulls. Feeding habitat for dotterel and pipit.
Rocks, cliffs, outcrop.	Exposed rocks in river channel and cliffs and rock outcrops on edge of river.	Roosting shags and herons.
Dry watercourse.	Where river channel has dried out and substrate is exposed often with dried film or silt and/or algae.	Feeding habitat for dotterel, stilt and pipit.

2.3 Physical Environment and Processes

The Hawke's Bay braided river flows are predominantly rain fed, with some snowmelt contribution during winter and spring. River substrates are derived from a greywacke parent material, which forms expansive gravel bars, flats and spits within the river channel. These areas of ERS form the dominant terrestrial substrate of the braided river ecosystem.

Our analyses show a significant positive relationship (see Appendix B) between the area (e.g., ha) of ERS and both total riverbird abundance (i.e., the total number of riverbirds found at a location on the river; see Fig. 3A) and total species richness (i.e., the number of different bird species found at a location on the river; see Fig. 3B). However, it is important to note that these relationships are non-linear, meaning that only low levels of ERS availability had a limiting effect on total bird abundance and on total bird species richness. On the Tukituki and Waipawa Rivers, total river bird abundance increased with the increasing area of ERS until about 7.5 ha of ERS per linear km of river was available. At around 11 ha of ERS availability per linear km, total species richness levelled off. The abundance of adult banded dotterels and pied stilts (Fig. 3C) had a similar relationship to ERS as for the total bird abundance, but levelled off at about 9 ha and 8 ha of ERS per linear km of river, respectively (Fig. 3 A). These results are generally consistent with research by Maloney et al. (1997) who found that bird densities were greater on braided rivers with larger gravel areas.

Total bird abundance appeared to be the most sensitive measure in response to the factors measured. Abundance was negatively impacted on at sites where gravel extraction activities were evident, where 4WDs were used, and where there was exotic or weedy riparian vegetation (with respect to river sections with farm or native riparian vegetation; Appendix B, Table Be). Sites where gravel extraction activities were carried out had on average nine fewer birds, sites with 4WD use had 10 fewer birds on average, and sites with exotic or weedy riparian vegetation had 16 fewer birds on average when compared with the average bird abundance of sites that had none of these factors. The degree of braidedness of the river positively impacted on the total bird abundance (Fig. 3D).

Gravel extraction had a negative effect on banded dotterel and pied stilt abundance (Appendix B, Table Be). However, while the effect of gravel extraction was not significant for both species, its inclusion was important for model fit which suggests that this does have some importance for abundance of these two species. 4WD use had a significant negative impact on banded dotterel abundance. However, beach raking had a significantly positive effect on pied stilt abundance.

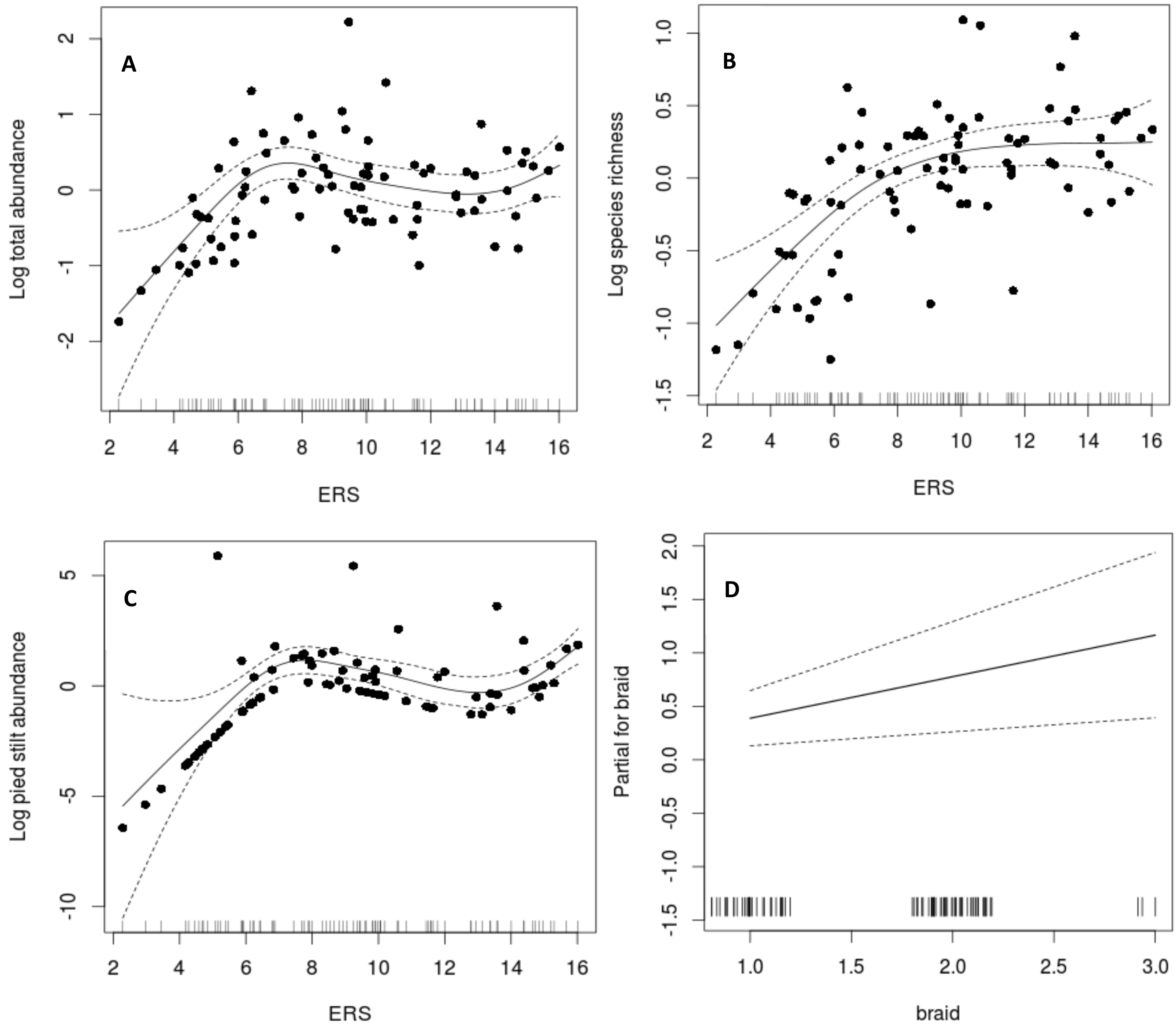

Figure 3. Predicted log total (A) bird abundance and (B) bird species richness by the amount of ERS (ha) available per km river section. Both (C) pied stilt and banded dotterel abundance had a similar relationship to ERS as for the total bird abundance (A). (D) Fitted log bird abundance by braidedness (1 = single channel, 2 = 2-3 channels, 3 = 3+ channels). Solid lines are the fitted response variables, dashed lines are ± 1 standard error of the fitted response variable and the points are the actual values. *N* = 84.

Our results demonstrating the importance of ERS (positive) and vegetation encroachment (negative) of the riverbed have important implications when assessing the effect of beach raking in particular. Cumulative plots (Figs. 4 & 5) drawn from ERS and vegetation encroachment data provide examples of how these important variables differ both within a river and among different rivers.

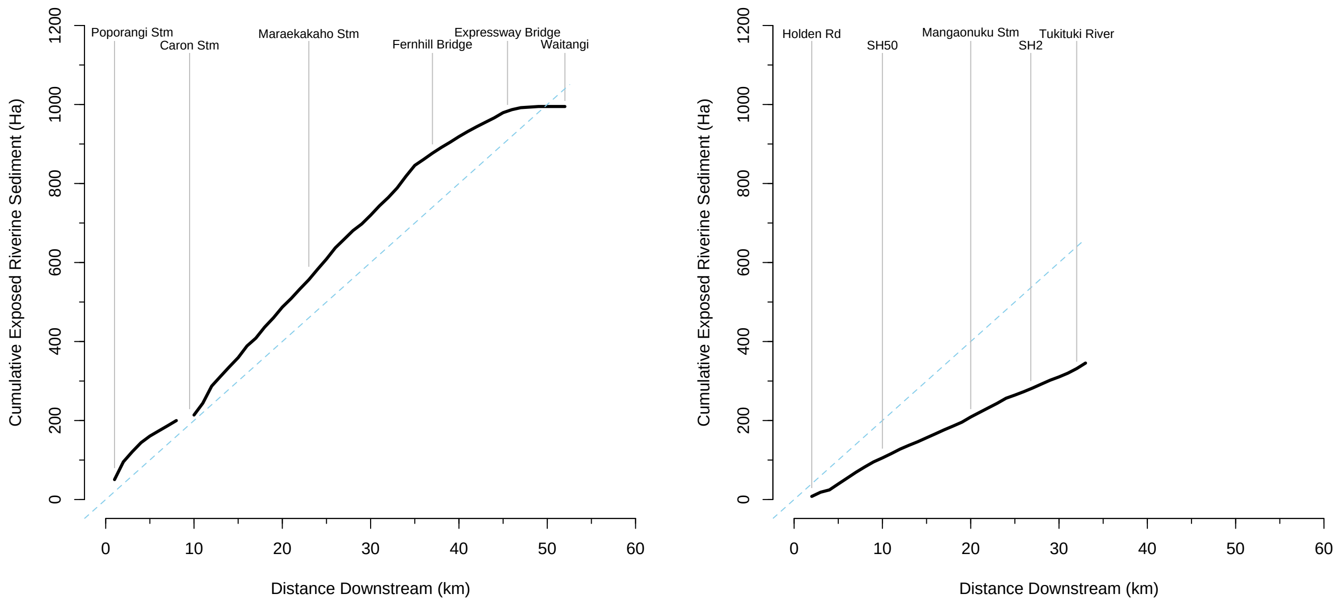

Figure 4. Cumulative plots of exposed riverine sediment (ERS) for the (Left) Ngaruroro River from the Poporangi Stream convergence downstream to the rivermouth at Waitangi, and (Right) the Waipawa River from Holden Road downstream to the Tukituki River confluence.

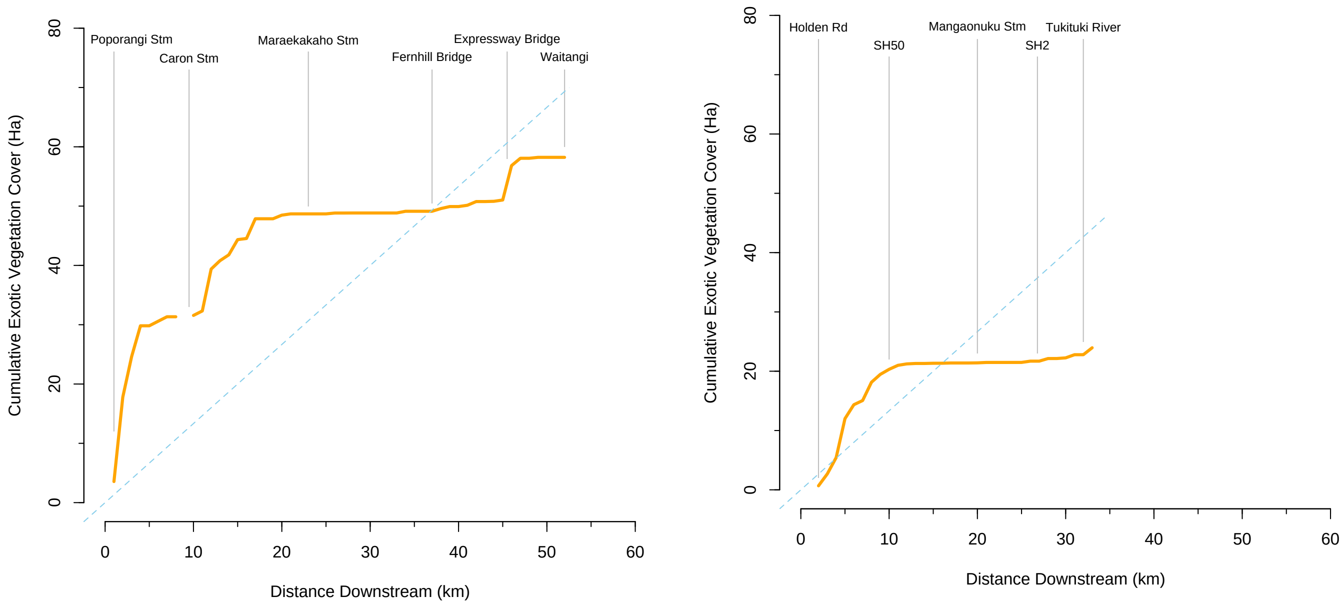

Figure 5. Cumulative area of braided riverbed covered by exotic vegetation for (Left) Ngaruroro River from the Poporangi Stream convergence downstream to the rivermouth at Waitangi, and (Right) the Waipawa River from Holden Road downstream to the Tukituki River confluence.

2.4 Biological Components

Flora

Prior to the arrival of Europeans, the Hawke's Bay riverbeds would have been only sparsely vegetated, principally with native mat-forming plant species, such as *Raoulia* and *Epilobium* (Parrish 1987). However, since then, the Hawke's Bay braided rivers have become extensively covered with exotic vegetation (Wilson 2001; Table 2). In 2001, it was determined that Hawke's Bay's braided riverbeds were 44.4% open and 49.6% encroached with exotic vegetation (Wilson 2001). Exotic trees and shrubs (e.g., tree lupin, willow spp., gorse, broom and annual and perennial weeds) now cover large extents of braided river gravels and this has eliminated potential riverbed bird habitat (Parrish 1987).

This pattern of encroachment of the lower reaches of braided rivers has been demonstrated elsewhere in New Zealand. A gradient of increasing frequency and dominance by exotic flora has been observed in a number of South Island braided rivers (Woolmore 2011, Williams & Wiser 2004). The most natural riverbed communities tend to be found at higher elevations and where adjoining land has very little human activity or infrastructure development (Woolmore 2011, Williams & Wiser 2004).

As a result, the Hawke's Bay braided river reaches that are today managed for gravel extraction and beach raking are affected by an encroachment of exotic flora, and native flora is not a feature of these lower braided river reaches.

Table 2. Areas of open braided riverbed versus vegetated areas of the Hawke's Bay rivers from which gravel is extracted and on which beach raking occurs. Tukituki data include the Waipawa River. Data sourced from Wilson (2001).

River	Open Area (ha)	(%)	Vegetated Area (ha)	(%)	Total Area (ha)
Tutaekuri	285.6	35.1	527.8	64.9	813.4
Ngaruroro	1596.5	45.6	1904.3	54.4	3500.8
Tukituki	2367.2	42.4	3221.8	57.6	5589

Terrestrial and Aquatic Invertebrates

A small pitfall-trap survey was undertaken to characterise the terrestrial invertebrate community of gravel substrates of the Ngaruroro River, and comparisons were drawn with equivalent pitfall sampling from willow and native vegetation habitats (Ward 2011, 2012; Appendix C). Those data demonstrated that the gravel substrates sampled supported a moderate richness and low abundance of beetles (Coleoptera) and wasps/ants (Hymenoptera). The terrestrial invertebrate community was characterised by earwigs – being scavengers and opportunistic; spiders – with an ability to colonise habitat that changes rapidly; a low abundance of beetles and wasps – indicating lower general diversity; introduced ants and bumble bees – indicating more disturbed habitat and a presence of flowering plants in riverbeds; and common scavenger beetles (*Odontria*, Staphylinidae, *Heteronychus*, *Anthicus*) – indicating disturbed habitat and opportunistic species. Overall, the community was quite distinct (see nMDS ordination in Fig. 6), and was characterised by species adapted to disturbance (scavengers, and species able to rapidly recolonise following disturbance).

The species' richness and abundance were similar to that sampled from riparian willow habitats (Ward 2011, 2012).

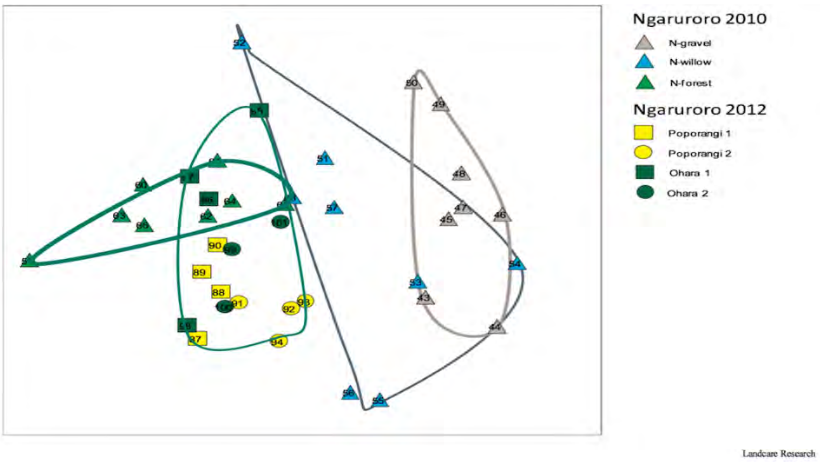

Figure 6. nMDS ordination plot comparing the abundance of terrestrial invertebrate sampled from pit-fall traps over 30 days, from gravel/gravel habitats of the Ngaruroro River, compared with equivalent samples from exotic riparian willow and native vegetation communities.

Aquatic macroinvertebrates are an important food source of many species of riverbed birds. Collier and Henriques (1991) assessed the naturalness, rarity, diversity, and representativeness of aquatic macroinvertebrates across five sites between (approx.) Whanawhana downstream to 200 m above the Chesterhope Road Bridge. They found most sites sampled returned a score of either medium to high. Collier and Henriques (1991) noted that macroinvertebrate densities in braded rivers tended to be highly variable over time, with density related to frequency of flooding and subsequent bed load movement. *Deleatidium* tended to dominate, as they have rapid recolonization abilities and flexible habitat requirements and life histories.

Avifauna

Riverbed birds are the main known terrestrial fauna elements of conservation concern regarding the Hawke's Bay braided rivers. Parrish (1987) provided one of the few multi-river descriptions of riverbed bird values of Hawke's Bay braided rivers; braided riverbed habitats were noted to support 32 wetland and 27 terrestrial bird species (total species richness 59). Of these species, a number are obligate[2] to the braided river ecosystem (O'Donnell, Sanders, & Woolmore n.d.). In particular, specialist adaptations for living on braided rivers include migratory patterns, specialised morphological features, specialised foraging behaviour, a narrow range of preferred habitats, and the ability to breed in the unstable riverbed habitat, including rapid re-nesting and short intervals between egg laying (O'Donnell & Moore 1983).

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[2] Capable of functioning or surviving only in a particular condition or by assuming a particular behaviour.

Key riverbed bird species of the respective braided riverbeds are reproduced from Parrish (1987) below (Table 3). A number of these species are threatened or at risk of extinction and thus are of particular conservation concern. This aspect is further addressed in Section 3.0 below.

Table 3. Key riverbed bird species reproduced from Parrish (1987).

River	Key Riverbed Bird Species	Comments
Tutaekuri	Banded dotterel, black-fronted dotterel, pied stilt.	Smaller and more confined than Ngaruroro or Tukituki rivers but with comparable numbers of dotterels
Ngaruroro	Paradise shelduck, banded dotterel, black-fronted dotterel, pied stilt, southern black-backed gull, black-billed gull, South Island pied oystercatcher.	Widest Hawke's Bay river. High numbers of breeding banded and black-fronted dotterels, black-billed gulls.
Tukituki	Paradise shelduck, duck spp., banded dotterel, black-fronted dotterel, pied stilt, black billed gull.	Highest recorded numbers of banded and black-fronted dotterels, black-billed gull and pied stilt. Largest abundance and diversity of waterfowl.

Introduced Mammals

The presence of introduced mammals is a key component and threat to the ecological integrity of contemporary braided riverbed ecosystems (O'Donnell et al. n.d.). Not only are the predator and prey relationships important, but other factors can act in combination to influence the effect of introduced mammals on braided riverbed communities, such as weed cover density on the riverbed, river flow level and the degree to which islands are available, and surrounding land use that influences habitat availability for predators (O'Donnell 2004).

3.0 Ecological Values

3.1 Ecological Values Assessment Framework

The ecological values of species and habitats of Hawke's Bay braided riverbeds are evaluated below. In this context, the terms ecological value and ecological importance are synonymous. The ecological value/importance of features present is evaluated at both the habitat and species level, on national and local (regional and/or Ecological District) scales, following the EIANZ (2015) Ecological Impact Assessment method. This method takes into account both the quantity (rarity or extent) and quality (functionality or condition) of the ecological values present.

Within the beach raking and gravel extraction areas there is an absence of indigenous vegetation on the braided riverbed (Section 2.0). We have not identified significant terrestrial invertebrate values of the braided riverbed, and as such, the focus of the values and effects assessments is on the braided riverbed habitat and the associated riverbed bird fauna. Freshwater (in-stream) aspects are addressed in a separate report.

Broad Scale Habitat Values Assessment

Generic habitat values of the braided riverbed are assessed through the application of the following national guidance and local inventory data:

- Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land (Ministry for the Environment [MfE] 2007),
- Naturally Uncommon Ecosystems (Holdaway et al. 2012),
- Heretaunga Plains Ecological District Survey Report for the Protected Natural Areas Programme (PNAP), which incorporates results from Sites of Special Wildlife Interest (SSWI) (Lee 1994).

With the exception of PNAP data, these are national-level information sources that are most applicable at the landscape scale, in this case generally the whole-of-river scale, and are applied to habitat types broadly. Although these results provide important nationally-consistent context regarding the ecological importance of the braided river habitats, reach-scale and species-specific values are more useful in distinguishing the relative ecological importance of different river reaches.

Reach-Scale Habitat and Species Values Assessment

The combined habitat and species values of Hawke's Bay braided river reaches were assessed in 2012, using the River Values Assessment System (RiVAS; Hughey et al. 2012; Appendix D). RiVAS (2012) represents the most up-to-date reach-scale assessment of habitat and species values of Hawke's Bay braided rivers. For this reason, RiVAS values were delineated for river reaches where beach raking and gravel extraction occur (Table 5). To enable a comparison of values, river reaches unaffected by beach raking and gravel extraction were also delineated according to RiVAS values. RiVAS covered the following attributes of Hawke's Bay braided river reaches to determine their level of significance (being nationally, regionally, or locally significant):

- Distinctiveness – Measures the relative distinctiveness of the habitat type and/or bird species presence compared to others represented in New Zealand,
- Habitat size – Measures the amount of habitat in hectares,
- Number of birds – Records the total number for all (except Southern black-backed gull) native species recorded,
- Foraging guilds – Provides a measure of species diversity on the river,
- Number of Threatened or At Risk species – Provides a measure of the diversity of Threatened or At Risk bird species using the river,
- Significant breeding site – Provides a measure of relative importance of rivers as strongholds for populations of Threatened or At Risk species in New Zealand.

3.2 Species-Specific Values Assessment

Species of conservation concern using the braided riverbed habitat were evaluated through an assessment of national and draft regional threat classification, in accordance with EIANZ (2015). Species known from Hawke's Bay braided river reaches, either permanently or occasionally, were assigned a level of value according to the following criteria:

- Nationally Threatened species – Very High value,
- At Risk–Declining species – High value,
- Any other At Risk category – Moderate-High value,
- Locally rare or distinctive species – High value,
- If none of the above – Low value/importance.

The species values of a given braided river reach might vary temporally as Threatened species relocate to establish new ranges or as new colony locations are taken up. As stated above, the arrival of a Nationally Threatened bird species would elevate the reach-scale riverbed value/importance to Very High. However, this spatial and temporal variation in ecological value is difficult to predict with certainty, and as Nationally Threatened species do not occur on all river reaches, it is not helpful to assign a default Very High value to all braided river reaches, based on a species' potential presence. For this reason, the following values assessment is based primarily on the RiVAS analysis[3], and any additional value associated with a specific Nationally Threatened bird species of conservation concern establishing themselves in areas where gravel extraction or beach raking is to occur is a matter best addressed through the specific avoidance and mitigation actions listed in the Impact Management section.

[3] RiVAS includes the attribute "number of Threatened or At Risk species" meaning species threat status is included in RiVAS, and thus also in this values assessment.

3.3 The Habitat and Species Ecological Values of Hawke's Bay Braided Riverbeds

Landscape Scale Habitat Classifications

The existing recognised habitat/ecosystem level classifications applicable to Hawke's Bay braided riverbeds are presented in Table 4. For each classification and criterion, a comment is given with respect to Hawke's Bay braided riverbeds and a corresponding EIANZ assessment score is given. In accordance with EIANZ (2015), applicable National Priorities (MfE 2007) or the presence of Naturally Uncommon Ecosystems automatically qualify as High value, as do existing listings in PNAP and SSWI surveys. These results provide a general basis for assigning a High value to the braided riverbed ecosystem. However, where the quality or quantity of braided riverbed habitats is diminished at the reach scale, assigning a lesser value is appropriate.

Table 4. Broad-scale classifications of Hawke's Bay braided riverbed habitats.

Classification system	Criteria	Comment	EIANZ assessment score
Government's National Priorities for Protecting Biodiversity	Priority 4: Habitats of acutely and chronically threatened indigenous species	Hawke's Bay braided riverbeds are habitats of acutely and chronically threatened bird species.	High (habitat value)
Naturally Uncommon Ecosystems	IUCN status: Threatened–Endangered (Holdaway et al. 2012)	Short term decline in ecological function – decline severe throughout ≥80% of extant distribution.	High (habitat value)
Heretaunga Ecological District Protected Natural Areas Programme (Lee 1994)	Recommended area for protection (RAP)	Ngaruroro River between Whanawhana and Fernhill (RAP 12) of High overall ecological significance. RAP ranked High under Sites of Special Wildlife Interest (SSWI) criteria.	High (habitat and species)

		Tukituki/Waipawa Riverbed (RAP 42) of High overall ecological significance. RAP ranked High under Sites of Special Wildlife Interest (SSWI) criteria.	High (habitat and species)

Reach-Scale Habitat and Species Assessment (RiVAS)

The RiVAS attribute scores and overall importance ranking for the beach raking and gravel extraction reaches, along with adjacent reaches (given for comparison), are shown in Table 5. In summary, both the Tutaekuri and Ngaruroro flood control reaches have High (regionally significant) ecological value, as do other reaches of these two rivers. Both the lower and upper Tukituki (below SH2) have Very High (nationally significant) value. A reach of Very High value also sits outside the flood control scheme, between Red Bridge to Tamumu Bridge. The Tukituki River reach between SH2 and SH50 (regionally significant), the Tukipo (regionally significant), and the Mangaonuku (locally significant) are all of Moderate ecological value. The Waipawa River, both inside and outside the flood protection reach, is of Moderate ecological value.

Table 5. The RiVAS attribute scores, overall importance ranking, and EIANZ (2015) assessment score for the beach raking and gravel extraction reaches, along with adjacent reaches.

River	Reach	Relative distinctiveness	Amount of habitat	Bird numbers	Foraging guilds	# Threatened or At Risk species	Species strongholds	RiVAS overall importance	EIANZ assessment score
Tutaekuri	Flood control reach	Medium	High	Medium	Medium	Medium	Low	Moderate/Regional	High
	Dartmoor–Mangatutu	Medium	High	Medium	Medium	Medium	Low	Moderate/Regional	High
	Above Mangatutu	Low	Medium	Low	Medium	Low	None	Low/Local	Moderate
Ngaruroro	Flood control reach	Low	High	Medium	Medium	High	Low	Moderate/Regional	High
	Mangatahi Stm to Whanawhana Cableway	Low	High	Medium	Medium	High	Low	Moderate/Regional	High
	Above Whanawhana Cableway	Medium	High	Low	Medium	Medium	Low	Moderate/Regional	High
Lower Tukituki	Flood control reach	Medium	Low	Medium	High	High	High	High/National	Very High
	Red Bridge to Tamumu Bridge	Medium	Low	Medium	High	High	High	High/National	Very High
Upper Tukituki	Flood control reach: Tamumu Bridge to SH2	Medium	Low	Medium	High	High	High	High/National	Very High
	Flood control reach: SH2 to SH50	Low	Medium	Low	Medium	Medium	None	Moderate/Regional	Moderate
	Flood control reach: Tukipo	Low	High	Low	Medium	Medium	None	Moderate/Regional	Moderate
	Flood control reach: Mangaonuku	Low	Medium	Low	Medium	Medium	None	Low/Local	Moderate
	Above SH50	Low	High	Low	High	Medium	Low	Low/Local	High
Waipawa	Flood control reach: Tukituki confl. to Holden Rd	Low	High	Low	Medium	Medium	None	Moderate/Regional	Moderate
	Above Holden Rd	Low	High	Low	Medium	Medium	None	Moderate/Regional	Moderate

Species Values

Riverbed bird species recorded during the November 2014 Tukituki/Waipawa riverbird survey of conservation concern (i.e., holding national or regional Threatened or At Risk status) are listed in Table 6. The EIANZ species level assessment score is given for each species.

Table 6. List of riverbed bird species identified during November 2014 Tukituki River bird survey and holding regional and national threat classifications.

Common Name	Latin Name	HB Draft Regional Conservation Status	National Threat Classification[4]	EIANZ Assessment Score
Black-billed gull	*Larus bulleri*	Regionally Critical	Nationally Critical	Very High
Grey duck	*Anas superciliosa superciliosa*	Regionally Critical	Nationally Critical	Very High
Caspian tern	*Hydroprogne caspia*	Regionally Critical	Nationally Vulnerable	Very High
Banded dotterel	*Charadrius bicinctus bicinctus*	Regionally Vulnerable	Nationally Vulnerable	Very High
Red-billed gull	*Larus novaehollandiae scopulinus*	Regionally Vulnerable	Nationally Vulnerable	Very High
Large black shag	*Phalacrocorax carbo*	Regionally Data Deficient	Naturally Uncommon	Moderate-High
Little black shag	*Phalacrocorax sulcirostris*	Regionally Data Deficient	Naturally Uncommon	Moderate-High
Little pied shag	*Phalacrocorax melanoleucos*	Regionally Endangered	Not Threatened	High
Variable oystercatcher	*Haematopus unicolor*	Regionally Critical	Recovering	High
Pied stilt	*Himantopus himantopus leucocephalus*	Regionally Vulnerable	Declining	High
White-fronted tern	*Sterna striata striata*	Regionally Not Threatened	Declining	High
New Zealand pipit	*Anthus novaeseelandiae novaeseelandiae*	Regionally Not Threatened	Declining	High
White-faced heron	*Egretta novehollandiae*	Regionally Vulnerable	Not Threatened	High

In addition to the Threatened and At Risk species identified in the 2014 Tukituki riverbird survey (Table 6), over previous decades the following species of conservation concern have also been observed on Hawke's Bay braided riverbeds:

- South Island pied oystercatcher (*Haematopus finschi*) – Occasionally found breeding on Hawke's Bay braided riverbeds (e.g., Stephenson 2011, Lee 1994; Parish 1987). National Threat Classification: At

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[4] Robertson et al. (2012).

Risk–Declining, Draft Regional Threat Classification: Threatened–Regionally Critical. EIANZ assessment score: High.

- Black-fronted tern (*Chlidonias albostriatus*) – Occasionally seen inland on Hawke's Bay braided rivers (Parrish 1987). National Threat Classification: Threatened–Nationally Endangered, Draft Regional Threat Classification: Regional Migrant. EIANZ assessment score: Very High.

Forbes Ecology

4.0 Ecological Effects Assessment

A description of beach raking and gravel extraction activities and corresponding ecological effects is provided below. The level of adverse effect is then assessed in a matrix of effect magnitude versus ecological value (taken from Section 3.0). Effect magnitude is described below in Table 9 of EIANZ (2015):

Table 9 Criteria for describing magnitude of effect
Adapted from Regini (2000) and Boffa Miskell (2011)

Magnitude	Description
Very high/severe	Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally change and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature
Moderate/medium	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature
Low/minor	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature

4.1 Description of Beach Raking Activity and Ecological Effects

River Beach Raking Activity Description

A tractor fitted with a raking attachment methodically rakes exposed river beaches along the river reaches shaded purple in Figure 7 below. The objective of this activity is to break the armoured surface structure of the exposed riverbed (Fig. 8). This armouring forms naturally during high flows, and breaking the armoured layer enables the riverbed substrates to be mobilised more readily in subsequent floods. Ongoing downstream transport of riverbed substrates is an essential component of the HBRC's Asset Management river management activities.

In addition to breaking the armoured riverbed surface, beach raking destroys any encroachment of vegetation on the riverbed. This prevents the establishment of woody plant species that could stabilise areas of the riverbed, potentially leading to the development of raised riverbed levels (islands) and thus reducing the capacity of the channel to convey flood flows. Removal of vegetation from the riverbed is therefore a second essential component of river management activities.

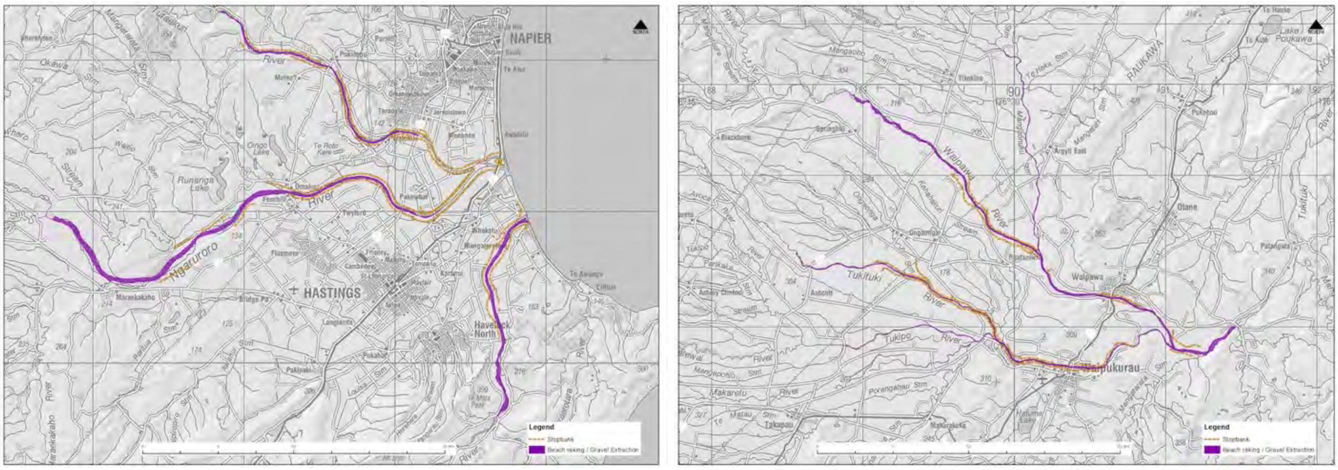

Figure 7. The spatial extent of beach raking and gravel extraction activities across the Tutaekuri, Ngaruroro, and Lower and Upper Tukituki Rivers.

Beach raking is undertaken by the HBRC Works Group and currently occurs once annually at each river reach. As such, the beach raking activity is temporary and is of short duration at any one location.

Figure 8. Example of a Hawke's Bay braided riverbed having recently been beach raked.

The seasonal timing of beach raking on the Tutaekuri and Ngaruroro Rivers is controlled through the provisions of specific Ecological Management and Enhancement Plans (EMEPs; Tutaekuri EMEP: Forbes & Whitesell 2013; Ngaruroro EMEP: Forbes 2011), so as to avoid direct effects on breeding riverbirds during their optimal nesting seasons. The following timing restrictions are set out in existing EMEPs for the Tutaekuri and Ngaruroro Rivers. Note that the EMEP for the Tukituki River is currently being prepared.

- Beach raking on the Tutaekuri River between SH50A and the Mangaone–Tutaekuri confluence shall not be undertaken between 1st August and 28th February each year.
- Beach raking on the Ngaruroro River between Chesterhope Road Bridge and Fernhill Road Bridge shall not be undertaken between the 1st September and 30th November each year.
- Beach raking on the Ngaruroro River between Fernhill Road Bridge and the black-billed/South Island pied oystercatcher management zone downstream extent (near Mangatahi Stream confluence;

2817770.065E 6170982.477N NZMG) shall not be undertaken between the 1st August and 28th February each year.

Subsequent to the release of the Tutaekuri and Ngaruroro EMEPs, a 'shoulder season' has since been agreed[5] in that beach raking could occur in either August or February, provided that the beach-raking activity for a given river reach is approved by a qualified Ecologist with respect to acceptable setbacks being achieved from riverbird nesting activities. In this context, the agreed setbacks are as follows:

- Setbacks for all species except black-billed gulls and white-fronted terns are 100 m.
- Setbacks for black-billed gulls and white-fronted terns are 200 m.
- Setbacks for all species, South Island oystercatchers, and black-billed gulls and white-fronted terns could be further reduced with assessment and advice from a qualified Ecologist, to a minimum of 50 m.

Ecological Effects of River Beach Raking

The most serious adverse ecological effect arising from beach raking would be the direct disturbance of riverbirds, causing their mortality or disturbing their breeding. The seriousness of such an effect would be determined from the threat status of the riverbird species affected. The risk of such an effect can be largely avoided through the existing seasonal restrictions placed on the timing of beach raking (discussed above). If beach raking is to be undertaken during the 'shoulder season' described above, then the requirement for a survey to identify breeding birds by a suitability qualified Ecologist and for the imposition of a setback around any such site(s) further mitigates this risk of adverse effects.

The following descriptor is most appropriate to describe the effect magnitude of beach raking on river birds (before mitigation):

> ***Low/minor magnitude of effect*** *– Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns;*
> *AND/OR*
> *Having a minor effect on the known population or range of the element/feature.*

The results of our analyses show that vegetation encroachment has a negative effect on both the abundance and species richness of the riverbird communities of Hawke's Bay braided riverbed habitats. As such, the removal of vegetation encroachment by beach raking would have a positive effect on the braided river habitat quality of riverbirds adapted to open gravel substrates.

[5] A 'blanket' 200 m setback applied in the first versions of the Ngaruroro and Tutaekuri EMEPs. Both documents were revised in April 2017 to include the agreed revised setback distances (above).

Describing level of effects of beach raking on river birds – before avoidance, remedy or mitigation measures

The following matrix (taken from EIANZ 2015) provides a method of determining the level of effects (before avoidance, remedy or mitigation measures are applied).

Table 12 Criteria for describing level of effects

Ecological Value → Magnitude ↓	Very high	High	Moderate	Low
Very high	**Very high**	**Very high**	**High**	Moderate
High	**Very high**	**Very high**	**Moderate**	Low
Moderate	**Very high**	**High**	Low	Very low
Low	**Moderate**	Low	Low	Very low
Negligible	Low	Very low	Very low	Very low

Table 7. Evaluation of level of adverse effects from beach raking on Hawke's Bay braided river reaches managed for beach raking (before mitigation). The level of effect is determined using the EIANZ (2015) method of evaluating adverse effects.

River and reach	Magnitude of effect	Ecological value	Level of effect
Tutaekuri – flood control reach	Low/minor	High	Low
Ngaruroro – flood control reach	Low/minor	High	Low
Lower Tukituki – flood control reach	Low/minor	Very High	Moderate
Upper Tukituki, Tamumu Bridge to SH2 – flood control reach	Low/minor	Very High	Moderate
Upper Tukituki, SH2 to SH50 – flood control reach	Low/minor	Moderate	Low
Upper Tukituki, Tukipo – flood control reach	Low/minor	Moderate	Low
Upper Tukituki, Mangaonuku – flood control reach	Low/minor	Moderate	Low
Waipawa, Tukituki confl. to Holden Rd –flood control reach	Low/minor	Moderate	Low

With the exception of the Very High value Tukituki River reaches, the adverse effects of beach raking on river birds is assessed as low (Table 7). These results suggest that the effects are not of particular concern, although operational care (seasonal restrictions and an Ecologist's assessments during 'shoulder season' months) to avoid direct impacts on river birds of conservation concern are required.

The Lower Tukituki and Tamumu Bridge to SH2 reach of the Tukituki River has high riverbird guild diversity and a high number of Threatened or At Risk species, and is an area of important species stronghold. Before mitigation, the riverbird effects across these river reaches are assessed as Moderate. The avoidance of direct effects to Threatened or At Risk species during beach raking operations is very important, to ensure that the actual effects of the activity are reduced to Low or Very Low. Seasonal restrictions on the timing of beach raking to ensure that the activity avoids the critical nesting season are the key operational approach to minimising the level of effects in these river reaches.

Where direct effects on riverbirds are avoided through seasonal restrictions, the ecological consequence of removing vegetation encroachment from the riverbeds has a considerable positive effect to riverbird habitat quality.

4.2 Description of Gravel Extraction Activity and Ecological Effects

Gravel Extraction Activity Description

Gravel extraction occurs at a number of locations within the river reaches shaded purple in Figure 7. The activity involves the excavation of rock material from river beaches located above the river water level (Fig. 9). Gravel excavation is typically carried out by a private contractor using an excavator. Gravel might be dropped through a slotted screen to control the size of the gravel that is extracted from the river. The excavator typically loads the gravel into a Moxy Truck, which then hauls the gravel from the extraction site off the riverbed where it is further processed or stockpiled, and ultimately the gravel is distributed from there to gravel consumers.

The timing and duration of individual gravel extraction operations vary. The rivers are accessed at a number of locations where gravel extraction is operational for relatively short durations, for a week or several weeks. Extraction might temporarily cease, only to recommence at the same site at a later time. Other extraction sites are associated with industrial scale processing facilities located on the river berm, outside the riverbed. Gravel extraction from the riverbed at these sites occurs more frequently, with a larger area of riverbed being intermittently affected by extraction and heavy vehicles hauling gravel out of the riverbed. At any site, gravel extraction might be interrupted by flood flows in the river, at which time machinery is generally moved from the riverbed or otherwise made safe from harm by flooding.

To avoid direct effects on breeding riverbed birds during their optimal nesting season, an Ecologist's survey is needed if gravel extraction is required during the periods and at the locations below. These provisions are specified in existing HBRC Ecological Management and Enhancement Plans (EMEPs; Tutaekuri EMEP: Forbes & Whitesell 2013; Ngaruroro EMEP: Forbes 2011). Note that the EMEP for the Tukituki River is currently being prepared.

Figure 9. Examples of gravel extraction operations underway on Hawke's Bay gravel riverbeds.

The existing EMEPs require that, if gravel extraction occurs

- On the Tutaekuri River between SH50A and the Mangaone–Tutaekuri confluence between 1st August and 28th February each year, or
- On the Ngaruroro River between Chesterhope Road Bridge and Fernhill Road Bridge between the 1st September and 30th November each year, or
- On the Ngaruroro River between Fernhill Road Bridge and the black-billed/South Island pied oystercatcher management zone downstream extent (near Mangatahi Stream confluence; 2817770.065E 6170982.477N NZMG) between the 1st August and 28th February each year,

then an inspection of the proposed area of works must be carried out by a suitably qualified ecologist, no earlier than 10 working days prior to any works being carried out, to locate any breeding sites of banded dotterel, black-billed gull, black-fronted dotterel, or South Island pied oystercatcher, and any other river bird species listed in the current DoC threat classification system as "Threatened".

The same person is then to prepare a written report which identifies all the located bird breeding or nesting sites and to provide copies of that report to the HBRC and the extraction operator.

Any person carrying out physical works in the area should be informed of any bird breeding at nesting site locations.

No physical works or machinery movements should be undertaken within a setback distance (as described above and below) of birds which are nesting or rearing their young in the bed of the river.

Where gravel extraction work ceases for more than 10 days, the site will be re-inspected for bird breeding or nesting sites in accordance with the provisions above.

Subsequent to the release of the Tutaekuri and Ngaruroro EMEPs, revised setback distances have been agreed for gravel extraction activities relative to riverbed bird nesting activities. In this context, the agreed setbacks are as follows:

- Setbacks for all species except black-billed gulls and white-fronted terns are 100 m.
- Setbacks for black-billed gulls and white-fronted terns are 200 m.
- Setbacks for all species, South Island oystercatchers, and black-billed gulls and white-fronted terns could be further reduced with assessment and advice from a qualified Ecologist, to a minimum of 50 m.

Ecological Effects of Gravel Extraction

As with beach raking, the most serious adverse ecological effect would be the direct disturbance of riverbed birds, causing their mortality or disturbing their breeding. The threat status of the riverbed bird species affected provides a means of measuring the seriousness of such an effect, and the effect can be largely avoided through the existing seasonal restrictions placed on the timing of beach raking (discussed above).

Regarding the magnitude of the adverse effect of gravel extraction on river birds (before mitigation), the following descriptor is most appropriate to describe the magnitude of effect:

> ***Moderate/medium magnitude of effect*** *– Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR*
>
> *Loss of a moderate proportion of the known population or range of the element/feature.*

This effects magnitude descriptor is considered appropriate for gravel extraction activities on Hawke's Bay braided riverbeds as our analysis shows a reduction in the abundance of riverbed birds in areas where gravel extraction activity is noted, compared to the average number of riverbed birds in locations with no activities underway. This effect would be reversible. Given enough time following closure of the gravel extraction, we expect that riverbed birds would again utilise available habitats in the area. The time for this recovery might be seasonally dependent. Nevertheless, provided that direct effects on riverbed birds and their breeding activities are avoided, the effect of gravel extraction activities on the riverbed bird community is of a moderate magnitude and is both short term (i.e., <12 months) and reversible.

Describing Level of Effects of Gravel Extraction on Riverbed Birds– Before Avoidance, Remedy or Mitigation

The following matrix (taken from EIANZ 2015) provides a method of determining the level of effects (before avoidance, remedy or mitigation measures are applied).

Table 12 Criteria for describing level of effects

Ecological Value → Magnitude ↓	Very high	High	Moderate	Low
Very high	**Very high**	**Very high**	**High**	Moderate
High	**Very high**	**Very high**	**Moderate**	Low
Moderate	**Very high**	**High**	Low	Very low
Low	**Moderate**	Low	Low	Very low
Negligible	Low	Very low	Very low	Very low

Table 8. Evaluation of level of adverse effects from gravel extraction on Hawke's Bay braided river reaches managed for gravel extraction (before mitigation). The level of effect is determined using the EIANZ (2015) method of evaluating adverse effects.

River and reach	Magnitude of effect	Ecological value	Level of effect
Tutaekuri – flood control reach	Moderate/medium	High	High
Ngaruroro – flood control reach	Moderate/medium	High	High
Lower Tukituki – flood control reach	Moderate/medium	Very High	Very High
Upper Tukituki, Tamumu Bridge to SH2 – flood control reach	Moderate/medium	Very High	Very High
Upper Tukituki, SH2 to SH50 – flood control reach	Moderate/medium	Moderate	Low
Upper Tukituki, Tukipo – flood control reach	Moderate/medium	Moderate	Low
Upper Tukituki, Mangaonuku – flood control reach	Moderate/medium	Moderate	Low
Waipawa, Tukituki confl. to Holden Rd –flood control reach	Moderate/medium	Moderate	Low

Without mitigation, the effect of gravel extraction on the riverbed bird communities and their habitats on the main braided rivers would be either High or Very High (Table 8). The effect of gravel extraction on the Moderate value rivers equates to low levels of adverse effect.

As such, mitigation measures are required to address the high levels of effect on the main rivers, and operational care is required at all braided river extraction sites, to ensure direct effects on High/Very High value riverbed bird species are avoided.

5.0 Impact Management and Monitoring

A key objective of ecological impact management is to sustain and, where possible, enhance the existing biodiversity values of a site (EIANZ 2015). Generally, opportunities to address ecological impacts arising from an activity are considered in the following order:

1. Avoid
2. Remedy
3. Mitigate
4. Offset
5. Compensate
6. Provide supporting actions

The assessment of biodiversity value affected and the scale of adverse effects guide what action is needed and where (EIANZ 2015).

The national biodiversity policy guidance (MfE 2007) specifies that habitats of Acutely and Chronically Threatened species are priorities for protection. Hawke's Bay braided riverbeds support a large number of Acutely and Chronically threatened riverbed bird species (High and Very High values), and as such, the avoidance of impacts on these species of conservation concern is an essential consideration when planning and carrying out beach raking and gravel extraction.

5.1 Managing the Impacts of Beach Raking

The assessed effects of beach raking were determined to be low for all river reaches other than the Lower Tukituki and the Upper Tukituki from Tamumu Bridge to SH2, which were assessed as a Moderate level of effect. In addition to adverse effects, our results demonstrate a positive effect of beach raking through the removal of vegetation encroachment on the braided riverbed, which improves the quality and quantity of the braided riverbed habitats available.

Avoidance of direct effects on breeding riverbed birds is the most appropriate method of managing the impacts of beach raking on riverbed birds. Provided that the seasonal restrictions set out below are adhered to, the existing riverbed bird values would be maintained and beach raking might enhance river bird values through habitat improvements.

5.2 Managing the Impacts of Gravel Extraction

Before impact management, the effect of gravel extraction on riverbed bird values was assessed as follows:

- Tutaekuri flood control reach: High level of effect
- Ngaruroro flood control reach: High level of effect
- Lower Tukituki flood control reach: Very High level of effect
- Upper Tukituki, Tamumu Bridge to SH2 flood control reach: Very High level of effect

As such, impact management measures are required to address the unacceptable levels of adverse effect.

As with beach raking, avoidance of direct effects on riverbird species of conservation concern during their breeding or nesting is the critical impact management method. Seasonally triggered surveys carried out by a qualified ecologist to identify breeding activity and to delineate such sites so that a setback can be applied are the key means of achieving avoidance.

Disturbance of the gravel riverbed should be minimised as far as practicable during haulage of gravel. Haulage vehicles should follow the smallest number of existing tracks as possible.

The result of our analysis suggest that the riverbed bird community is affected (reduced total bird abundance) at sites where gravel extraction is operational. We identified this effect as short term and reversible. However, given the level of values associated with the riverbed bird communities of the Hawke's Bay braided riverbeds, a quantity of mitigation is considered necessary to address these repeated effects to the riverbed bird community.

We suggest the following mitigation strategy to address the effects that are residual after avoidance:

The objective is to increase the area of ERS available to riverbed birds. This would be achieved by regularly clearing additional river reaches of exotic vegetation encroachment, particularly within the inner/mid channel to open up new islands for riverbed bird breeding. An area (ha) for enhancement should be scaled to be approximately equivalent to the combined area (ha) of gravel extraction activities at a given time during a representative year. Ideally, these habitat enhancement areas would be located near the coast. However, it is possible that the most suitable sites with respect to high existing levels of vegetation encroachment are located further inland, upstream of the existing beach raking extent. Ideally, the habitat enhancement areas would have little/no public access and little recreational use, so as to minimise disturbance of breeding river birds. Given the results of our analysis, highly braided reaches should be preferred over less braided reaches.

Riverbed bird monitoring would need to be carried out within enhancement areas to confirm the effectiveness of the treatment in providing viable riverbed bird habitat. Examples of candidate river reaches for the above mitigation treatment are illustrated below (Figs. 10 & 11).

Figure 10. Upper Waipawa River (39°49'52.98"S 176°22'28.85"E WGS) above the existing upper extent of beach raking.

Figure 11. Upper Tukituki River above SH50 and the existing upper extent of beach raking (39°54'27.08"S 176°18'31.98"E WGS)

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7.0 Appendices

Appendix A: Riverbed Bird Survey (2014) Field Data Collection Form

Hawkes Bay River Surveys

Section ______________, Waipawa River, by ____________________

Start point:				
Finish point:				
Start time:				
Finish time:				
Average vegetation cover:	0-25%	26-50%	51-75%	76-100%
Average vegetation height:	N/A	Up to knee height	Above knee height	
Braidedness of river:	Single channel	2-3 channels	3+ channels	
Riparian vegetation:	Farmland	Exotic/Weeds	Native	
River management:	None visible	Beach raking	Extraction	4WD vehicle
	If extraction please indicate location			

Species	**Tally**
White-faced heron	
Banded dotterel	
Black-fronted dotterel	
Pied stilt	
Spur-winged plover	
SI pied oystercatcher	
Black-backed gull	
Black-billed gull	
Red-billed gull	
Caspian tern	
New Zealand pipit	
Large black shag	
Little pied shag	
Little black shag	
Mallard	
Paradise shelduck	
Shoveler	
Grey duck	
Grey teal	
Feral goose	
New Zealand pipit	
Shining cuckoo	

Notes:

Emergency contact information - Brent Stephenson 0274 426 638

Appendix B: Statistical Analysis Notes

Statistical Analysis Notes

The five indicator variables chosen for bird abundance were positively correlated (Fig. Ab). However, black-billed gull presence was weakly correlated with each of the other variables (Spearman's $\rho < 0.3$).

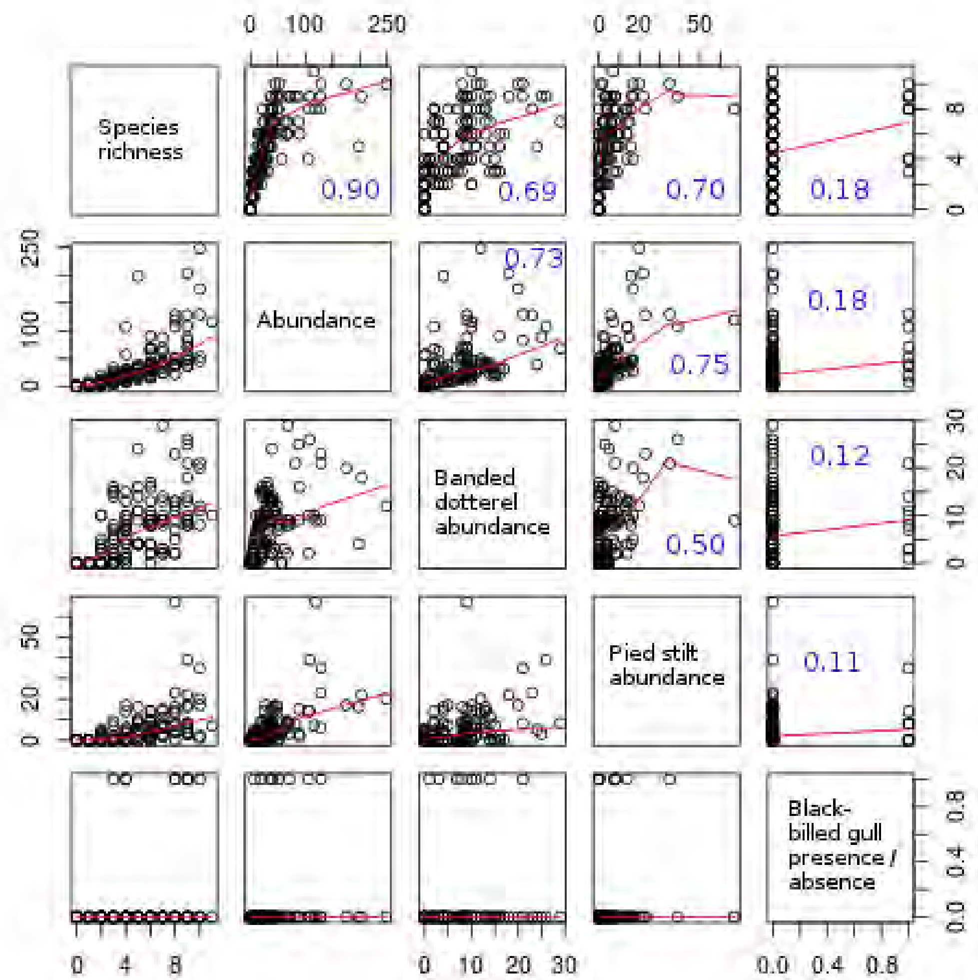


Figure Ba. Pairwise plots showing relationships between each of the five indicator variables chosen to describe the bird conservation value of sections of the Tukutuki and Waipawa rivers. Numbers in blue are the Spearman rank correlation coefficient, ρ, of each pair of variables and the red lines are trend lines with a non-parametric lowess smoother.

Species richness, total abundance and ERS were positively correlated with decreasing distance from the river mouth in the Tukituki river.

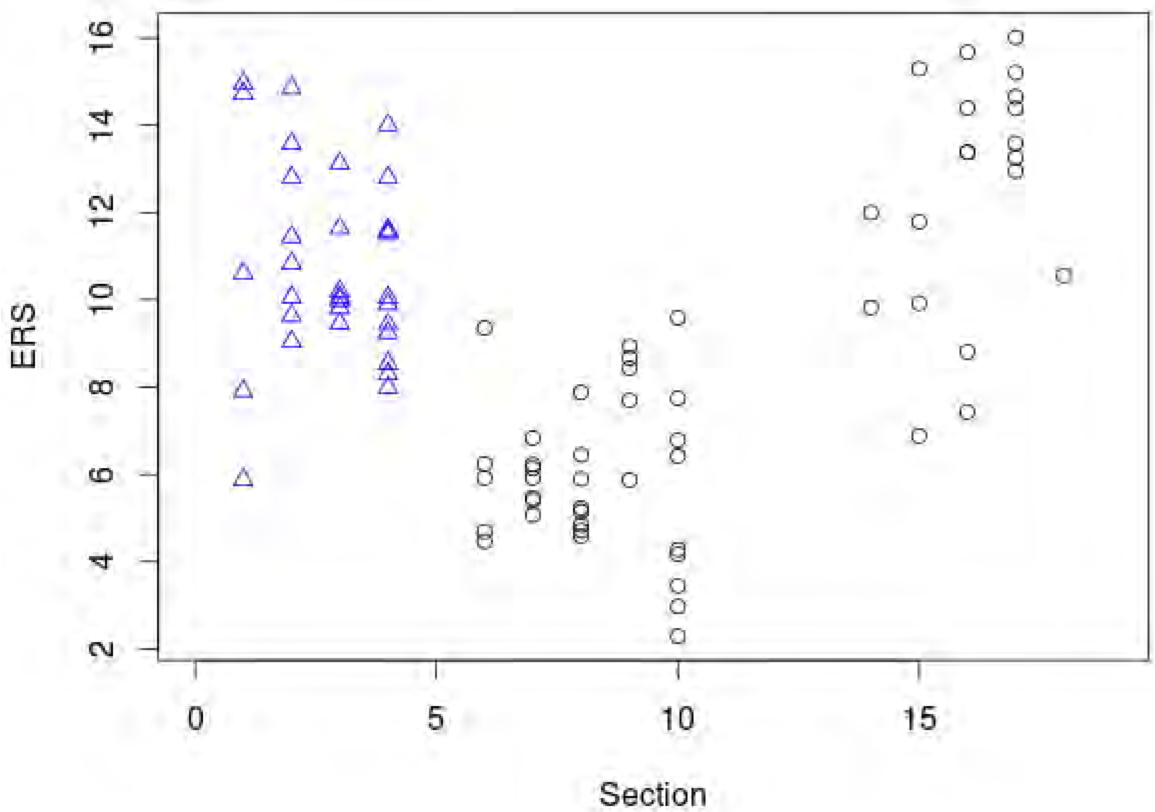


Figure Bb. Relationships of bird species richness, total abundance and ERS to stream section. Stream sections were numbered downstream – the largest numbers are the closet to the river mouth. The black circles are sections of the Tukituki River, and the blue triangles are sections from the Waipawa River.

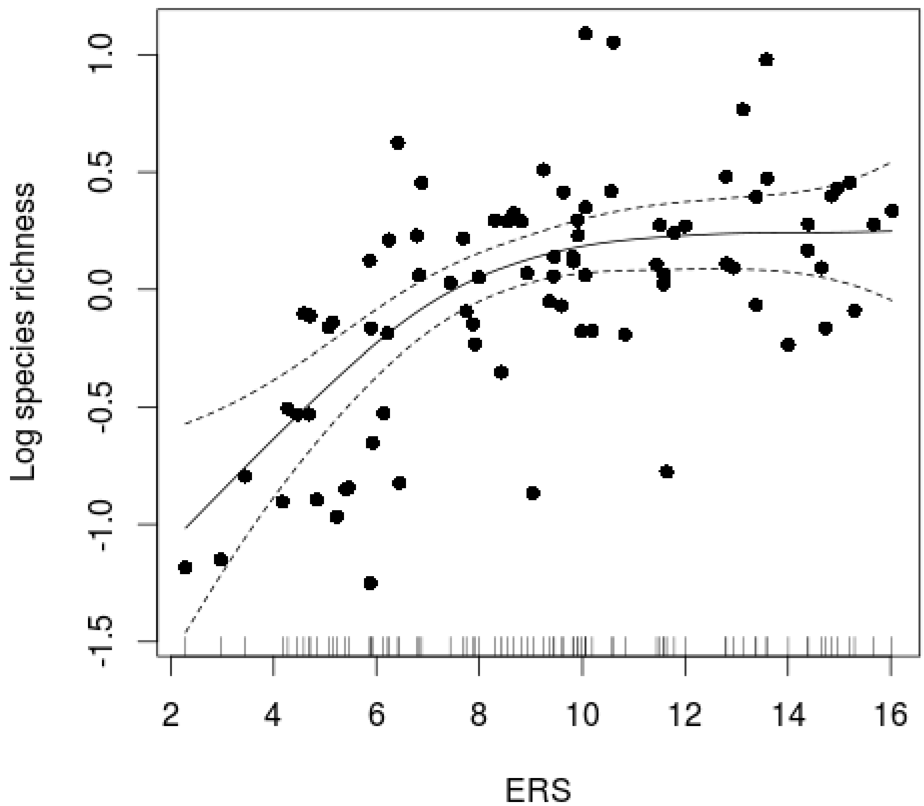


Figure Bc. Predicted log species richness by the amount of ERS available per km river section.

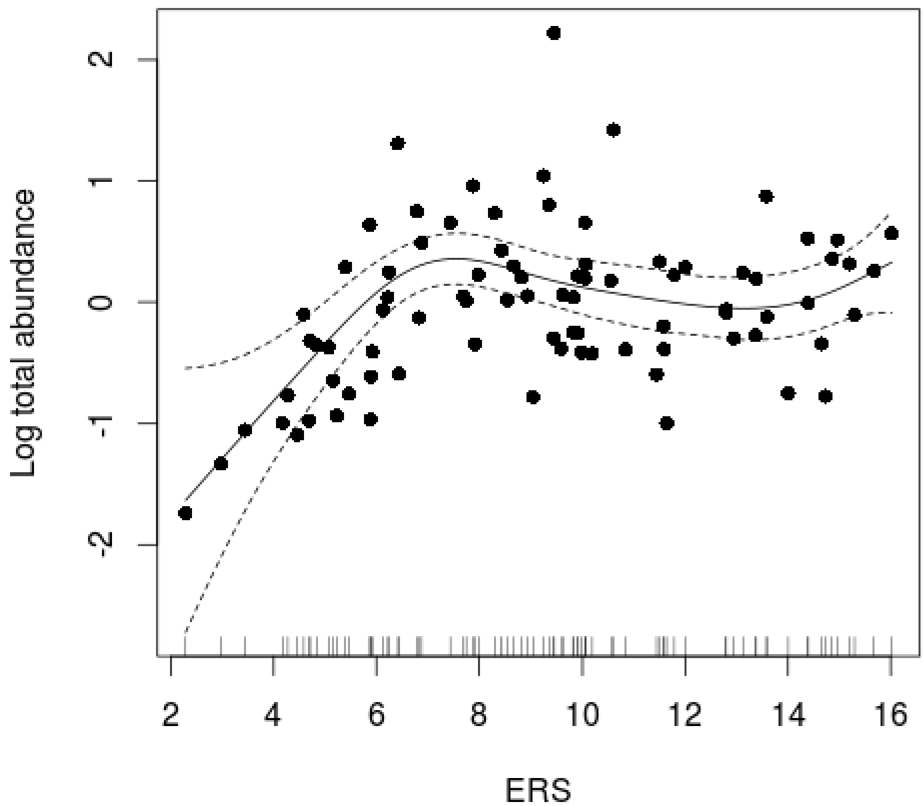


Figure Bd. Predicted log total abundance by the amount of ERS available per km river section.

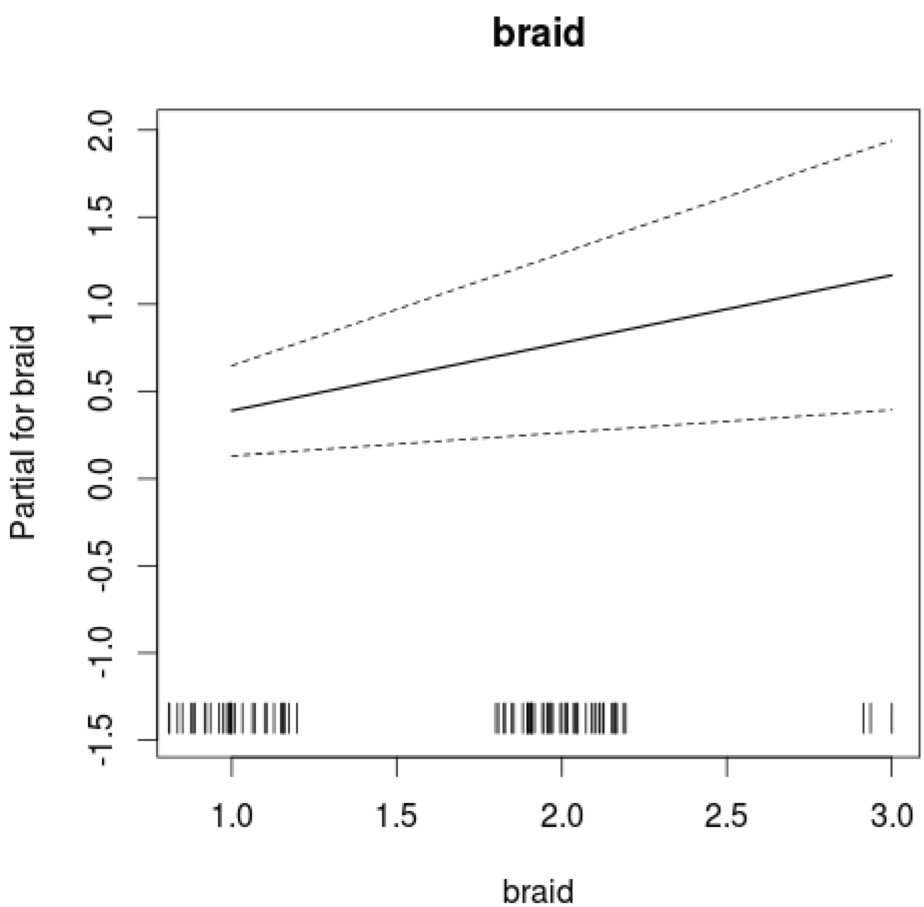
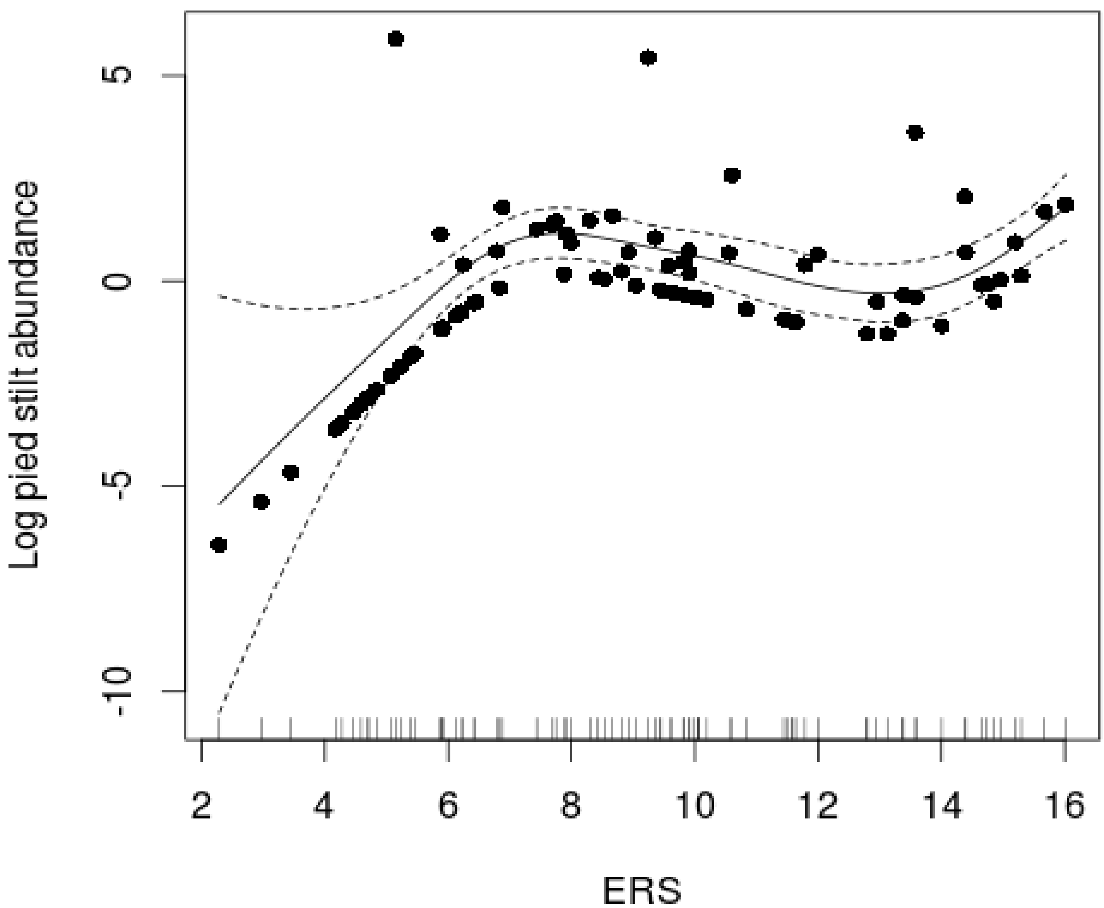


Figure Be. Fitted log bird abundance by braidedness (1 = single channel, 2 = 2-3 channels, 3 = 3+ channels). The 'rugs' at the bottom indicate the number of river sections in each category).

Abundance of adult banded dotterels and pied stilts had a similar relationship to ers as for the total bird abundance.

Figure Bf.



Predicted log pied stilt abundance by the amount of ERS available per km river section.

Table Ba. Models trialled and model selection statistics for riverine bird species richness

Model fixed factor structure (all models have random factor structure of: random=list(Tributary=~1,Section=~1) ,correlation=corAR1()	**AIC**	**ΔAIC**	**AIC weight**	**Model likelihood**	**R-sq**
SR11<-gamm(totalspprich~s(ers)+rivermngt3	118.2034	0	0.28	1.00	0.169
SR10<-gamm(totalspprich~s(ers)+rivermngt3 +ripveg3	118.4891	0.2857	0.24	0.87	0.192
SR9<-gamm(totalspprich~s(ers)+rivermngt3+ripveg1 +ripveg3	118.9116	0.7082	0.20	0.70	0.249
SR0<-gamm(totalspprich~s(ers),	119.9773	1.7739	0.11	0.41	0.16
SR8<-gamm(totalspprich~s(ers)+vegefactor +rivermngt3 +ripveg1 +ripveg3,	120.3213	2.1179	0.10	0.35	0.266
SR7<-gamm(totalspprich~s(ers)+vegeht+vegefactor +rivermngt3 +ripveg1+ripveg3,	122.6853	4.4819	0.03	0.11	0.235
SR6<-gamm(totalspprich~s(ers)+vegeht+vegefactor +rivermngt3 +rivermngt4+ripveg1+ripveg3,	123.4182	5.2148	0.02	0.07	0.21
SR5<-gamm(totalspprich~s(ers)+braid+vegeht +vegefactor +rivermngt3+rivermngt4+ripveg1+ripveg3,	124.2088	6.0054	0.01	0.05	0.139
SR4<-gamm(totalspprich~s(ers)+braid+vegeht +vegefactor +rivermngt2+rivermngt3+rivermngt4 +ripveg1+ripveg3,	125.5815	7.3781	0.01	0.02	0.131
SR3<- gamm(totalspprich~s(ers)+braid+vegeht+vegefactor +rivermngt2+rivermngt3+rivermngt4+ripveg1+ripveg2+ ripveg3,	127.5123	9.3089	0.00	0.01	0.0981
SR2n<-gamm(totalspprich~s(ers)+pexotvege+braid+ vegeht+vegefactor +rivermngt2+rivermngt3+rivermngt4+ripveg1 +ripveg2+ripveg3,	129.0978	10.8944	0.00	0.00	0.11
SR2<-gamm(totalspprich~s(ers)+s(pexotvege)+braid +vegeht +vegefactor+rivermngt2+rivermngt3 +rivermngt4+ripveg1+ripveg2+ripveg3,	130.2915	12.0881	0.00	0.00	0.11

Table Bb. Models trialled and model selection statistics for riverine bird species richness

Model fixed factor structure (all models have random factor structure of: random=list(Tributary=~1,Section=~1) ,correlation=corAR1()	**AIC**	**ΔAIC**	**AIC weight**	**Model likelihood**	**R-sq**
TA9<-gamm(totabundall~s(ers)+braid+rivermngt3 +rivermngt4+ripveg2,	209.5227	0	0.36	1.00	0.222
TA8<-gamm(totabundall~s(ers)+pexotvege+braid +rivermngt3+rivermngt4+ripveg2,	209.7043	0.1816	0.33	0.91	0.311
TA7<-gamm(totabundall~s(ers)+s(pexotvege) +braid+rivermngt3+rivermngt4+ripveg2,	211.6678	2.1451	0.12	0.34	0.324
TA10<-gamm(totabundall~s(ers)+braid +rivermngt4 +ripveg2,	212.1977	2.675	0.09	0.26	0.175
TA6<-gamm(totabundall~s(ers)+s(pexotvege) +braid+rivermngt3+rivermngt4+ripveg2+ripveg3,	213.2022	3.6795	0.06	0.16	0.291
TA5<-gamm(totabundall~s(ers)+s(pexotvege) +braid+vegeht+rivermngt3+rivermngt4 +ripveg2+ripveg3,	215.0939	5.5712	0.02	0.06	0.262
TA4<-gamm(totabundall~s(ers)+s(pexotvege) +braid+vegeht+rivermngt2+rivermngt3+rivermngt4 +ripveg2+ripveg3,	216.9234	7.4007	0.01	0.02	0.243
TA3<-gamm(totabundall~s(ers)+s(pexotvege) +braid+vegeht+vegefactor+rivermngt2+rivermngt3 +rivermngt4+ripveg2+ripveg3,	219.0655	9.5428	0.00	0.01	0.218
TA2<-gamm(totabundall~s(ers)+s(pexotvege) +braid+vegeht+vegefactor+rivermngt2+rivermngt3 +rivermngt4+ripveg1+ripveg2+ripveg3,	221.0653	11.5426	0.00	0.00	0.207
TA0<-gamm(totabundall~s(ers),	235.9703	26.4476	0.00	0.00	0.0695

Table Bc. Models trialled and model selection statistics for riverine bird species richness

Model fixed factor structure (all models have random factor structure of: random=list(Tributary=~1,Section=~1) ,correlation=corAR1()	**AIC**	**ΔAIC**	**AIC weight**	**Model likelihood**	**R-sq**
BD12<-gamm(banded.dotterel~s(ers) +rivermngt3+rivermngt4	232.7399	0	0.35	1.00	0.287
BD13<-gamm(banded.dotterel~s(ers) +rivermngt4	233.8735	1.1336	0.20	0.57	0.318
BD11<-gamm(banded.dotterel~s(ers) +vegefactor+rivermngt3+rivermngt4	234.1743	1.4344	0.17	0.49	0.306
BD14<-gamm(banded.dotterel~s(ers) +rivermngt3+rivermngt4+rivermngt3:rivermngt4	234.6757	1.9358	0.13	0.38	0.297
BD9<-gamm(banded.dotterel~s(ers) +vegeht+vegefactor+rivermngt3+rivermngt4	236.4074	3.6675	0.06	0.16	0.284
BD0<-gamm(banded.dotterel~s(ers)	237.5063	4.7664	0.03	0.09	0.329
BD10<-gamm(banded.dotterel~s(ers) +vegeht+vegefactor+rivermngt4	237.6024	4.8625	0.03	0.09	0.312
BD8<-gamm(banded.dotterel~s(ers) +pexotvege+vegeht+vegefactor +rivermngt3+rivermngt4	238.3733	5.6334	0.02	0.06	0.276
BD7<-gamm(banded.dotterel~s(ers) +s(pexotvege)+vegeht+vegefactor +rivermngt3+rivermngt4	239.3192	6.5793	0.01	0.04	0.263
BD6<-gamm(banded.dotterel~s(ers) +s(pexotvege)+vegeht+vegefactor +rivermngt3+rivermngt4 +ripveg1	241.0841	8.3442	0.01	0.02	0.245
BD5<-gamm(banded.dotterel~s(ers) +s(pexotvege)+vegeht+vegefactor +rivermngt2+rivermngt3 +rivermngt4+ripveg1	242.6863	9.9464	0.00	0.01	0.259
BD4<-gamm(banded.dotterel~s(ers) +s(pexotvege)+vegeht+vegefactor +rivermngt2+rivermngt3 +rivermngt4+ripveg1+ripveg3	244.62	11.8801	0.00	0.00	0.245
BD3<-gamm(banded.dotterel~s(ers) +s(pexotvege)+vegeht+vegefactor +rivermngt2+rivermngt3 +rivermngt4+ripveg1+ripveg2+ripveg3	247.2292	14.4893	0.00	0.00	0.221
BD2<-gamm(banded.dotterel~s(ers) +s(pexotvege)+braid+vegeht+vegefactor +rivermngt2+rivermngt3 +rivermngt4+ripveg1+ripveg2+ripveg3	249.4453	16.7054	0.00	0.00	0.2

Table Bd. Models trialled and model selection statistics for riverine bird species richness

Model fixed factor structure (all models have random factor structure of: random=list(Tributary=~1,Section=~1) ,correlation=corAR1()	**AIC**	**ΔAIC**	**AIC weight**	**Model likelihood**	**R-sq**
PS14<-gamm(piedst~s(ers) +rivermngt2+rivermngt3,	368.8826	0	0.35	1.00	0.154
PS10<-gamm(piedst~s(ers) +rivermngt3,	369.4193	0.5367	0.27	0.76	0.0968
PS13<-gamm(piedst~s(ers) +rivermngt3+rivermngt4,	370.6671	1.7845	0.14	0.41	0.0813
PS11<-gamm(piedst~s(ers)+braid+rivermngt3,	371.6296	2.747	0.09	0.25	0.0685
PS8<-gamm(piedst~s(ers) +braid+rivermngt2+rivermngt3 +rivermngt4+ripveg1	372.7931	3.9105	0.05	0.14	0.0168
PS0<-gamm(piedst~s(ers),	373.151	4.2684	0.04	0.12	0.141
PS12<-gamm(piedst~s(ers) +rivermngt3+ripveg1,	373.4551	4.5725	0.04	0.10	0.0727
PS9<-gamm(piedst~s(ers) +braid+rivermngt2+rivermngt4 +ripveg1,	375.2645	6.3819	0.01	0.04	0.0327
PS7<-gamm(piedst~s(ers) +braid+vegeht+rivermngt2 +rivermngt3+rivermngt4+ripveg1	376.7986	7.916	0.01	0.02	0.00223
PS6<-gamm(piedst~s(ers) +braid+vegeht+rivermngt2 +rivermngt3+rivermngt4+ripveg1+ripveg2,	380.7946	11.912	0.00	0.00	0.0109
PS5<-gamm(piedst~s(ers) +pexotvege+braid+vegeht +rivermngt2+rivermngt3+rivermngt4+ripveg1+ripveg2,	382.7422	13.8596	0.00	0.00	-0.0101
PS4<-gamm(piedst~s(ers) +s(pexotvege)+braid+vegeht +rivermngt2+rivermngt3+rivermngt4+ripveg1+ripveg2,	384.7422	15.8596	0.00	0.00	-0.0101
PS2<-gamm(piedst~s(ers) +s(pexotvege)+braid+vegeht+vegefactor+rivermngt2 +rivermngt3+rivermngt4+ripveg1+ripveg2+ripveg3,	390.7744	21.8918	0.00	0.00	-0.0569

Table Be Summary statistics for the 'best' generalized additive mixed models for the four indicator variables for bird conservation values of river sections

Species richness				
Parametric coefficient	**Estimate**	**Standard error**	**T value**	**p**
Intercept	1.4132	0.2419	5.843	<<0.001
Extraction (rivermngt3)	-0.2370	0.1073	-2.209	0.0301
Smooth term	**edf**	**Ref.df**	**F**	**p**
S(ers)	2.702	2.702	8.905	<<0.001
Total abundance				
Parametric coefficient	**Estimate**	**Standard error**	**T value**	**p**
Intercept	3.3836	0.4339	7.798	<<0.001
Braidedness	0.3886	0.1289	3.015	0.0035
Extraction (rivermngt3)	-0.3759	0.1679	-2.239	0.0281
4WD use (rivermngt4)	-0.4159	0.1469	-2.830	0.0060
Ripveg2	-0.7813	0.2164	-3.610	0.0006
Smooth term	**edf**	**Ref.df**	**F**	**p**
s(ers)	4.202	4.202	4.675	0.0021
Adult banded dotterels				
Parametric coefficient	**Estimate**	**Standard error**	**T value**	**p**
Intercept	1.8561	0.1800	10.312	<<0.001
Extraction (rivermngt3)	-0.2920	0.2157	-1.353	0.1799
4WD use (rivermngt4)	-0.4208	0.1911	-2.203	0.0306
Smooth term	**edf**	**Ref.df**	**F**	**p**
s(ers)	3.564	3.564	5.967	0.0005
Adult pied stilts				
Parametric coefficient	**Estimate**	**Standard error**	**T value**	**p**
Intercept	0.0962	0.6061	0.159	0.87431
Beach raking (rivermngt2)	0.8077	0.2844	2.840	0.0058
Extraction (rivermngt3)	-0.8095	0.4272	-1.895	0.0619
Smooth term	**edf**	**Ref.df**	**F**	**p**
s(ers)	4.754	4.754	8.27	<<0.001

Appendix C: Terrestrial Invertebrate Reports (Karamu & Tukituki 2011; Ngaruroro 2012)

Terrestrial Invertebrate Identification and Interpretation from Ngaruroro River Habitats 2012

Short Report Prepared for:
Adam Forbes
MWH New Zealand Ltd
100 Warren Street South
PO Box 1190
HASTINGS

By:
Darren Ward
Landcare Research
Private Bag 92170
Auckland
New Zealand

DATE: April 2012

Contents

Summary

Project and Client
MWH approached Landcare Research Ltd to process and identify terrestrial invertebrate samples from riparian habitats on the Ngaruroro River in 2012 (Poporangi, Ohara sites), and compare these systems with those taken from the Ngaruroro River in 2010.

Methods
MWH supplied pitfall trap samples from 2012. Invertebrates from these samples were identified to order, and for Coleoptera (beetles) and Hymenoptera (wasps/bees/ants), lower level identification was provided were feasible. MWH also supplied light trap samples where Lepidoptera were identified to the lowest possible level.

Statistical analyses of the data included: i) assessments of richness and abundance to compare habitats, and ii) multivariate ordination/cluster analyses to show the similarity of sites and habitats. Terrestrial invertebrate data was interpreted under a bioindicator framework. That is, use of i) sub-sampling, ii) higher taxonomic levels, iii) the use of RTUs (recognisable taxonomic units), and iv) the use of focal groups (e.g. Coleoptera, Hymenoptera, Lepidoptera).

Results
Samples from Poporangi and Ohara in 2012 were most similar to “native/forest” sites from the 2010 samples. Sites of ‘gravel’ and ‘willow’ were quite different from Poporangi and Ohara samples.

Light trap samples of moths (Lepidoptera) from Poporangi had a similar richness and diversity to Tussock habitats (Tukituki 2011 samples), but their overall composition was more similar to Forest sites at Tukituki. Poporangi light trap samples are quite different to Ohara samples. The lower diversity in the Ohara samples is because the samples were dominated (65-79% specimens) by one species, *Hygraula nitens* (Crambidae). This is a moth with aquatic larvae, so its abundance in the Ohara samples is a reflection of the proximity of the light traps to water.

Conclusions
This study showed that invertebrates could be used to distinguish the differences between broad habitat categories. The results could be used to form a very basic baseline for what is expected in other sites of similar habitats. Furthermore, the results could be used to monitor disturbance/changes in such habitats over time.

Guidelines for interpreting terrestrial invertebrate data are basically non-existent in New Zealand. Unfortunately, there is no comparable “MC Index” used for freshwater habitats. Such a system for terrestrial environments is urgently needed in New Zealand to assist many agencies with interpreting invertebrate data associated with landuse change, restoration, land management etc.

1. Introduction

Invertebrates are now recognised as important components of biodiversity (Yen and Butcher, 1997, Ward 2004, Ward & Lariviere 2004). They are important in all ecosystems in terms of species numbers and biomass, and play vital roles in processes such as pollination, soil formation and fertility, plant productivity, organic decomposition, and the regulation of populations of other organisms through predation and parasitism (Yen and Butcher, 1997, Ward 2004, Ward & Lariviere 2004).

Furthermore, invertebrates are increasingly being recognised as important indicators of environmental changes. Kremen *et al*. (1993) suggested that terrestrial arthropods could be used for virtually any monitoring challenge. Conservation and biodiversity assessments that use invertebrates allow patterns of diversity and environmental quality to be measured at scales that are often more meaningful than those measured using plants and vertebrates (Yen and Butcher, 1997). The majority of invertebrates are also more sensitive to environmental perturbations than plants and vertebrates due to their rapid breeding rates and relatively short generation times (Kremen *et al*., 1993). In addition, invertebrates exhibit a wide range of body sizes, growth rates, life history strategies and ecological preferences, which can be linked with specific variables to provide a greater understanding of invertebrate responses to environmental conditions and to generate predictive models for ecosystem biodiversity (Yen and Butcher, 1997).

The wider acceptance of invertebrates as indispensable components of biodiversity has led to a rapid increase in broad-based surveys (i.e. a survey incorporating a wide range of invertebrate taxa) and greater pressure to provide information and guidelines for invertebrate conservation and monitoring.

A number of rapid biodiversity assessment (RBA) approaches have been suggested to overcome these problems. RBA approaches generally fall into four categories: (1) restricted sampling in place of intensive sampling (sampling surrogacy); (2) the use of higher taxonomic levels than species (species surrogacy); (3) the use of recognisable taxonomic units (RTUs) identified by non-specialists (taxonomic surrogacy); and (4) the use of surrogate taxa in place of all taxa (taxon-focusing).

Rapid Biodiversity Assessment (RBA) approaches have arisen mainly to help overcome many of the difficulties associated with large-scale invertebrate surveys. The two main objectives of RBA are to reduce the effort and cost of sampling, and to summarise complex ecological details so they can be understood by non-specialists (Yen and Butcher, 1997).

This report interprets terrestrial invertebrate data from i) riparian habitats on the Ngaruroro River collected in 2012, and ii) compares these samples with previous samples on the Ngaruroro River collected in 2010 under the context of using invertebrates as bioindicators of different habitats, and habitat condition.

2. Objectives

The objective of this project is to assess and interpret terrestrial invertebrate data from a series of Ngaruroro River habitats in 2012, and compare these systems with those taken from the Ngaruroro River in 2010.

3. Methods

Invertebrate sampling and analysis
MWH supplied pitfall trap samples. Invertebrates from these samples were identified to order, and for Coleoptera (beetles) and Hymenoptera (wasps/bees/ants), lower level identification was provided were feasible. MWH also supplied light trap samples, where Lepidoptera were identified to the lowest possible level.

Samples from 2012 came from two localities (Poporangi, Ohara) were there were two sites and four replicates (total = 16 samples; but 1 replicate from Ohara was not collected).

Samples from 2010 were grouped *a priori* into three habitats for interpretation: native habitats, willow, and gravel (see below). There were four replicates of each habitat, sampled using 6 pitfall traps for one month. At each site (n=12) there were two invertebrate samples (each consisting of three pitfall traps), for a total of 24 samples.

Habitat categories from 2010 samples

“Habitat”	Sites	Notes
Gravel	1, 4, 7, 12	Includes sites with a high ‘gravel’ element to their substrate, likely to strongly influence invertebrate communities
Willow	2, 3, 5	Includes sites with stabilised floodplain sites with Willow
Native	6, 8, 9, 10, 11	Includes native forest sites, flaxland, mahoe wetland

Invertebrate samples were processed by straining the sample through a series of sieves to remove debris (wood, leaves, and dirt). The sample was then poured onto a 35 x 45 cm tray and invertebrates were examined using a swing-arm microscope with magnification of 100x. The first 100 invertebrates seen in the sample were identified to order and counted for analysis. If occurring within the ‘first 100’, any beetles (Coleoptera) and wasps/ants (Hymenoptera) were removed from the sample for lower level identification – these acted as bioindicators. Lepidoptera, from light trap samples, were identified to the lowest possible level. Identification was carried out using keys and comparing specimens in the New Zealand Arthropod Collection.

For statistical analyses, species richness and abundance were calculated in PRIMER’s DIVERSE module. The composition of invertebrates was compared across sites using an nMDS ordination in PRIMER v5.0 software, using a Bray-Curtis similarity matrix (4^{th} root transformation) from 10 restarts. This analysis was carried out for all invertebrates together, except light trap samples which were analysed separately. Species which contributed the most to differences between habitats were examined using a SIMPER analysis in PRIMER.

4. Results

Richness (Figure 1). This refers to the number of species collected from each sample. In general the highest richness was in the native habitats in 2010. Samples from 2012 were more similar to habitats of Gravel and Willow. This pattern is the same for beetles (Coleoptera) and wasps/ants (Hymenoptera).

Abundance (Figure 2). This refers to the number of individuals collected from each sample. In general the highest abundance was in the native habitats in 2010. Samples from 2012 were intermediate between native habitats and habitats of Gravel and Willow. This pattern is the same for beetles (Coleoptera) and wasps/ants (Hymenoptera).

Composition (Figure 3). This measurement compares the abundance of each species in a sample, with all other samples, and produces an ordination plot. This plot groups samples which are similar together (and conversely if samples are far apart they are more different).

The green samples represent either "native/forest" sites from 2010; or samples from Poporangi and Ohara in 2012. Analysis indicates that these sites have a similar composition of invertebrates in relation to each other (Figure 3).

Sites of 'gravel' (grey) and 'willow' (blue) also i) reasonably well separately from each other; ii) from native sites (2010) and iii) from Poporangi and Ohara samples.

Lepidoptera from light trap samples. Samples from Ngaruroro2012 were compared to samples from habitats in the Tukituki region collected in 2011 (Table 1, Figure 4; no samples from Ngaruroro in 2010 were collected).

Although samples from Poporangi had a similar richness and diversity to Tussock habitats, their overall composition was more similar to Forest sites at Tukituki (Figure 4). They are quite different to Ohara samples.

The lower diversity in the Ohara samples (similar diversity to Pine and pasture habitats) is because the samples were dominated (65-79% specimens) by one species, *Hygraula nitens* (Crambidae). This is a moth with aquatic larvae, so its abundance in the Ohara samples is a reflection of the proximity of the light traps to water.

A summary of the terrestrial invertebrate characteristics of the three general habitats of the Ngaruroro River study area is presented in Table 2.

Figure 1. Richness of beetles (Coleoptera) and wasps/ants (Hymenoptera).

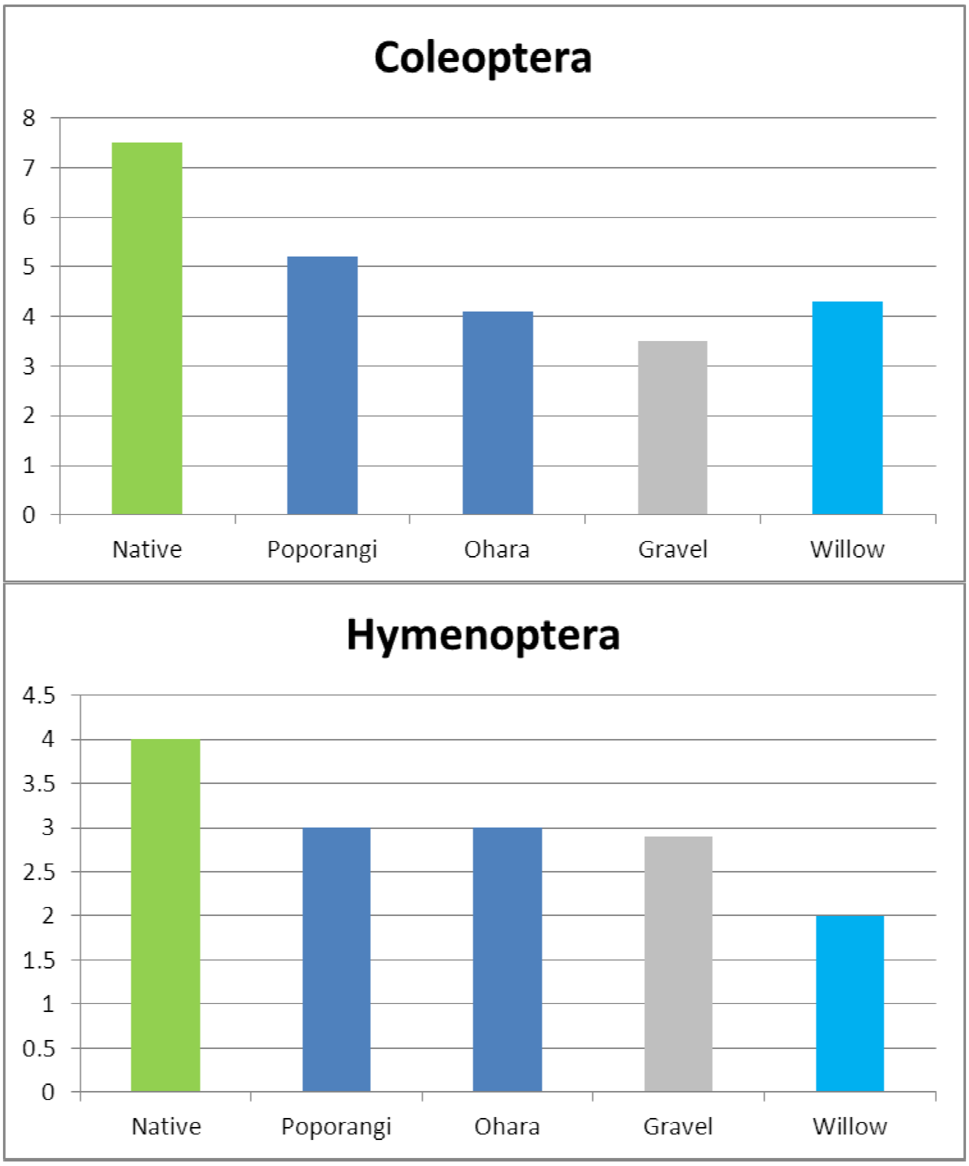


Figure 2. Abundance of beetles (Coleoptera) and wasps/ants (Hymenoptera).

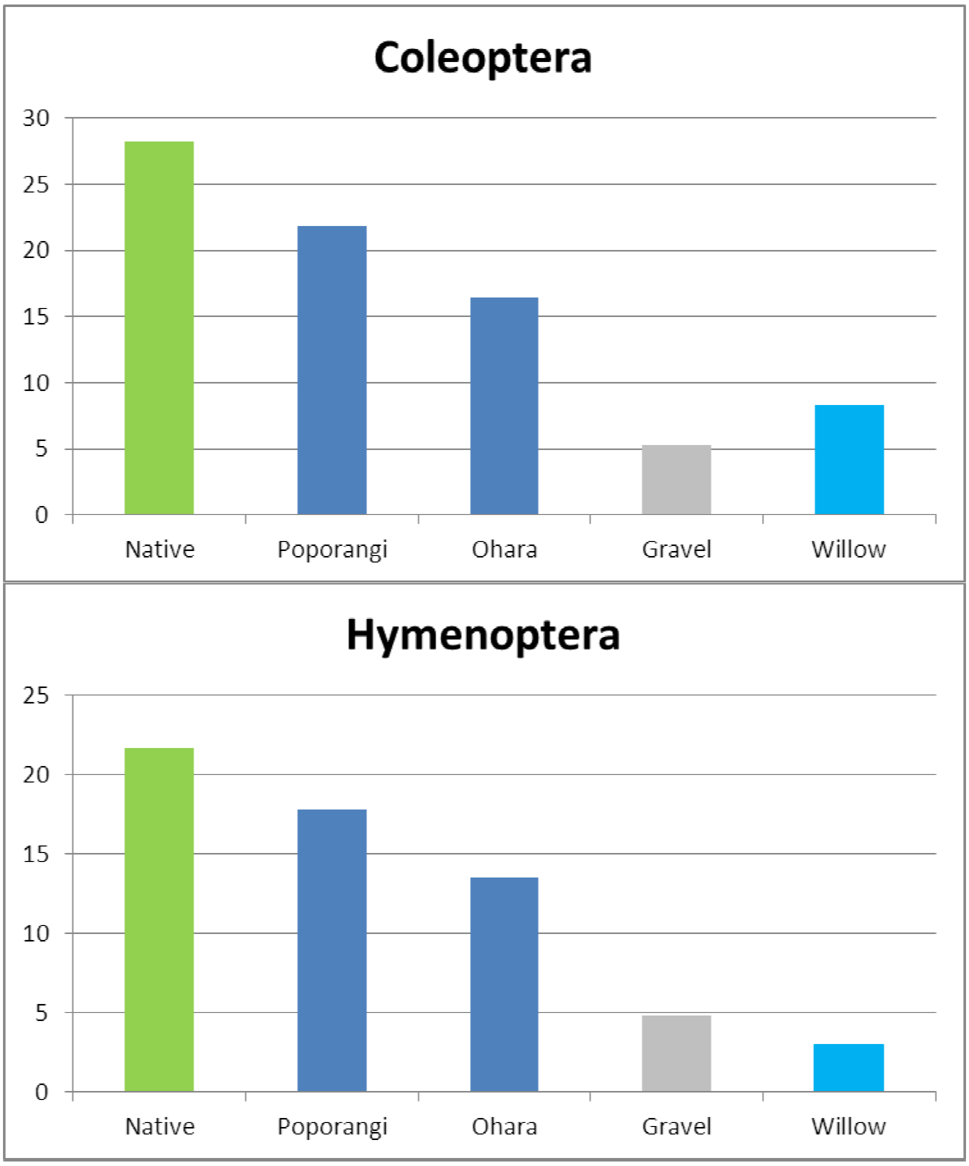


Table 1. Light trap results for Lepidoptera at Tukituki 2011 and Ngaruroro 2012

	Site	Richness	Abundance	Diversity
Tukituki 2011				
Tussock	**1**	26	137	2.6
Tussock	**2**	29	194	2.6
Forest	**1**	10	23	1.7
Forest	**2**	9	13	2.0
Pine	**1**	5	10	1.4
Pine	**2**	7	8	1.9
Pasture	**1**	4	4	1.3
Pasture	**2**	1	1	na
Ngaruroro 2012				
Poporangi	**1**	27	63	3.0
Poporangi	**2**	20	31	2.8
Ohara	**1**	9	32	1.3
Ohara	**2**	7	29	0.9

Table 2. Habitat quality signs provided by terrestrial invertebrates

Invertebrates Characteristic	What the feature indicates
Native sites	
High numbers beetles, and native wasps	High general diversity
Millipedes	Abundant leaf litter for decomposition
Pachycondyla (native forest ant)	Common in forests
Spider hunting wasps	Diversity of prey for these top predators
Parasitoid wasps	High general diversity
Beetle predators and fungal feeders	High general diversity, decomposition, nutrient cycling
Gravel sites	
Earwigs	Scavengers, opportunistic species
Spiders	Ability to colonise habitat which changes rapidly
Relatively low numbers of beetles and wasps	Lower general diversity
Introduced ants and bumble bees	More disturbed habitat, flowering plants in riverbeds
Endemic parasitoid wasp - *Maaminga*	Found in coastal/open habitats
Common beetles are scavengers (*Odontria*, Staphylinidae, *Heteronychus*, *Anthicus*)	More disturbed habitat, opportunistic species
Willow sites	
Amphipods	Common in moist habitats, decomposers
Crickets	Common in grass habitats
Relatively low numbers of beetles and wasps	Lower general diversity

Figure 3. Composition. This measurement compares the abundance of each species in a sample, with all other samples, and produces an ordination plot (see below). This plot groups samples which are similar together (and conversely if samples are far apart they are more different).

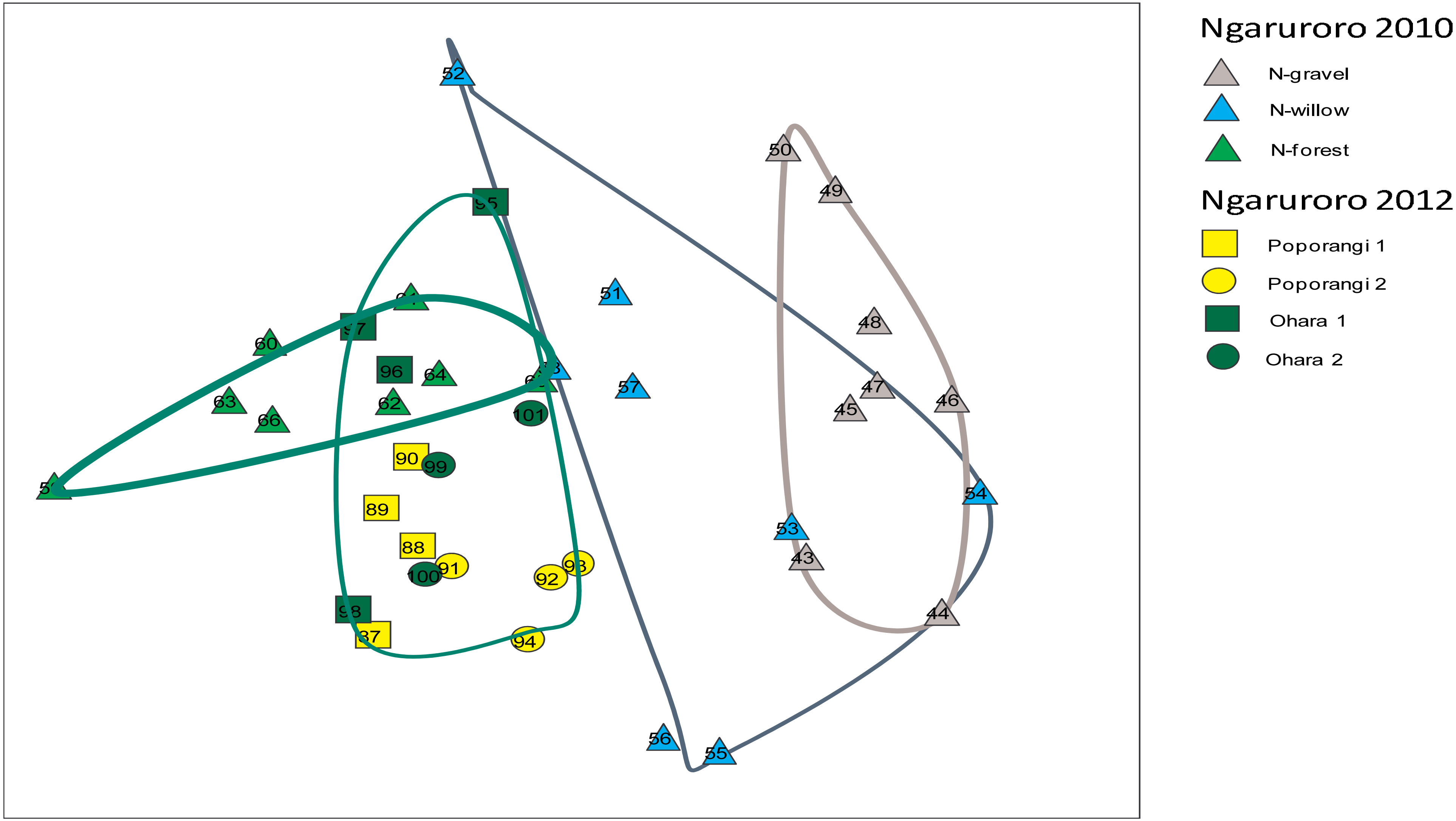
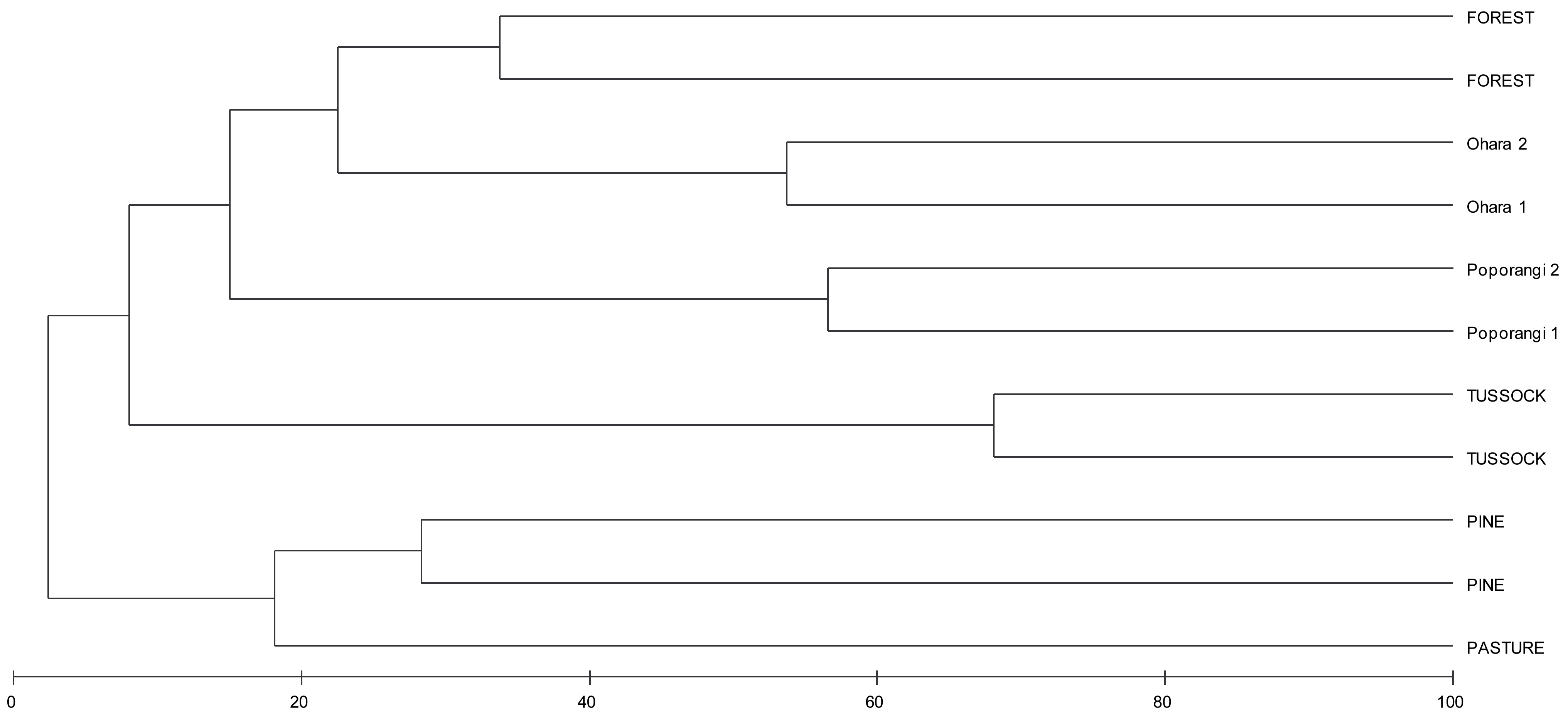


Figure 4. CLUSTER diagram for light trap results for Lepidoptera at Ngaruroro (2012; Poporangi/Ohara sites) and from Tukituki (2011). Similar samples are grouped more closely together.



5. Conclusions

The composition of invertebrate communities is influenced by many environmental factors, but key habitat variables include: vegetation type, history of disturbance, stock grazing, size of the site, and isolation of the site (Didham et al 2009). In this study, invertebrates could be used to distinguish i) different types of habitats, and ii) compare habitats between different time periods.

Comparisons from samples of invertebrates collected from 2010 and 2012 revealed that

- Samples from Poporangi and Ohara were most similar to native/forest sites sampled in 2010. And were different to willow and gravel habitats sampled in 2010.

- Similar invertebrate species and groups were collect in 2012 as in 2010 (from native/forest sites).

The results above could be used to also form a very basic baseline for what is expected in other sites of similar habitats to what was sampled here. Furthermore, the results could be used to monitor disturbance/changes in such habitats over time. However, some caution is needed. Placing a site into broad habitat classifications can sometimes be problematic because local site differences or small scale effects (spraying, floods, and different plant/weeds) can result in aberrations in the data. In particular, making generalisations to other locations outside the current set of data need to be done with some caution.

Recommendations

- In the future, further 'clarification' between sites and habitats may need a more comprehensive analysis, including linking environmental attributes (e.g. canopy cover, canopy composition, ground cover) with invertebrate numbers.

- The study by Didham et al (2009), should be used to help guide any long-term assessment and restoration along these riparian habitats. The Didham study was undertaken in very similar habitats to those in the present study, that is, fragmented, pasture-disturbed habitats in the Waikato. It is the most comprehensive study in New Zealand. The main conclusion from Didham et al (2009) showed that livestock exclusion was the most important factor for retaining and maintaining invertebrate diversity.

- Guidelines for interpreting terrestrial invertebrate data are basically non-existent in New Zealand. Unfortunately, there is no comparable "MC Index" used for freshwater habitats. Such a system for terrestrial environments is urgently needed in New Zealand to assist many agencies with interpreting invertebrate data associated with landuse change, restoration, land management etc.

6. Acknowledgements

Robert Hoare for identification of Lepidoptera.

7. References

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Terrestrial Invertebrate Identification and Interpretation from Karamu and Tukituki River Habitats

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DATE: April 2011

Contents

Summary

Project and Client
MWH approached Landcare Research Ltd in November 2010 to process terrestrial invertebrate samples from Karamu and Tukituki River Habitats, identify taxa and interpret the data under a bioindicator framework as part of an assessment of the health of terrestrial vegetation systems.

Methods
MWH supplied pitfall trap samples. Invertebrates from these samples were identified to order, and for Coleoptera (beetles) and Hymenoptera (wasps/bees/ants), lower level identification was provided were feasible. MWH also supplied light trap samples at Tukituki, where Lepidoptera were identified to the lowest possible level.

At Karamu, sites were grouped *a priori* into three habitats for interpretation: native riparian enhancement planting, mown riparian exotic grassland (called pasture in this report), native forest retired from stock grazing c.9 years ago. There were four replicates of each habitat, sampled using 6 pitfall traps for one month.

At Tukituki, sites were grouped *a priori* into three broad habitat categories for interpretation: tall tussock grassland; lowland Broadleaved indigenous forest (forest remnant); *Pinus radiata* forest. There were four replicates of each habitat, sampled using 6 pitfall traps for one month. Light traps samples were also provided for two pasture sites.

Both studies were also combined to compare differences and similarities in the habitats.

Statistical analyses of the data included: i) assessments of richness and diversity to compare habitats, and ii) multivariate ordination to show the similarity of sites and habitats. Terrestrial invertebrate data was interpreted under a bioindicator framework. That is, use of i) sub-sampling, ii) higher taxonomic levels, iii) the use of RTUs (recognisable taxonomic units) and their subsequent identification, and iv) the use of focal groups (e.g. Coleoptera, Hymenoptera, Lepidoptera).

Results
In general, invertebrates could be used to distinguish the different types of habitats. In the combined analysis, three major habitats groupings were evident. First, tussock is clearly separated from other habitats. Pasture and riparian habitats (both at Karamu) are grouped together, and these are separated from the third group of “forest sites”. In the forest grouping, Tukituki forest and pine are more similar to each other than forest at Karamu.

Light trapping of Lepidoptera revealed tussock sites had very high diversity and richness, several significant moth species (uncommon endemics) were found.

There was a detectable difference in community structure between the native riparian enhancement planting and pasture. However, Riparian sites had not progressed to the stage of

being comparable to forest habitats. This was best demonstrated when the two studies were combined and a larger number of samples examined. Pasture and riparian sites were still grouped together, indicating they were most similar.

The forested sites at Karamu ('Mahana') and Tukituki (Inglis Bush) were different (Figure 4). Differences in the invertebrate fauna point to Tukituki having a greater leaf litter component as millipedes and *Saphobius* are decomposers and very common in leaf litter. This fits with the fact that 'Mahana' is still recovering from grazing, and would presumably have less leaf litter and woody debris covering the forest floor.

Conclusions

This study showed that even using a relatively simple protocol, invertebrates could easily be used to distinguish the differences of habitats. The results could be used to form a very basic baseline for what is expected in other sites of similar habitats. Furthermore, the results could be used to monitor disturbance/changes in such habitats over time.

Guidelines for interpreting terrestrial invertebrate data are basically non-existent in New Zealand. Unfortunately, there is no comparable "MC Index" used for freshwater habitats. Such a system for terrestrial environments is urgently needed in New Zealand to assist many agencies with interpreting invertebrate data associated with landuse change, restoration, land management etc.

1. Introduction

Invertebrates are now recognised as important components of biodiversity (Yen and Butcher, 1997, Ward 2004, Ward & Lariviere 2004). They are important in all ecosystems in terms of species numbers and biomass, and play vital roles in processes such as pollination, soil formation and fertility, plant productivity, organic decomposition, and the regulation of populations of other organisms through predation and parasitism (Yen and Butcher, 1997, Ward 2004, Ward & Lariviere 2004).

Furthermore, invertebrates are increasingly being recognised as important indicators of environmental changes. Kremen *et al*. (1993) suggested that terrestrial arthropods could be used for virtually any monitoring challenge. Conservation and biodiversity assessments that use invertebrates allow patterns of diversity and environmental quality to be measured at scales that are often more meaningful than those measured using plants and vertebrates (Yen and Butcher, 1997). The majority of invertebrates are also more sensitive to environmental perturbations than plants and vertebrates due to their rapid breeding rates and relatively short generation times (Kremen *et al*., 1993). In addition, invertebrates exhibit a wide range of body sizes, growth rates, life history strategies and ecological preferences, which can be linked with specific variables to provide a greater understanding of invertebrate responses to environmental conditions and to generate predictive models for ecosystem biodiversity (Yen and Butcher, 1997).

The wider acceptance of invertebrates as indispensable components of biodiversity has led to a rapid increase in broad-based surveys (i.e. a survey incorporating a wide range of invertebrate taxa) and greater pressure to provide information and guidelines for invertebrate conservation and monitoring.

A number of rapid biodiversity assessment (RBA) approaches have been suggested to overcome these problems. RBA approaches generally fall into four categories: (1) restricted sampling in place of intensive sampling (sampling surrogacy); (2) the use of higher taxonomic levels than species (species surrogacy); (3) the use of recognisable taxonomic units (RTUs) identified by non-specialists (taxonomic surrogacy); and (4) the use of surrogate taxa in place of all taxa (taxon-focusing).

Rapid Biodiversity Assessment (RBA) approaches have arisen mainly to help overcome many of the difficulties associated with large-scale invertebrate surveys. The two main objectives of RBA are to reduce the effort and cost of sampling, and to summarise complex ecological details so they can be understood by non-specialists (Yen and Butcher, 1997).

This report interprets terrestrial invertebrate data from a series of Karamu and Tukituki River habitats under the context of using invertebrates as bioindicators of different habitats, and habitat condition.

2. Objectives

The objective of this project is to assess and interpret terrestrial invertebrate data from a series of Karamu and Tukituki River habitats and determine if invertebrates can act as bioindicators of different habitats, and habitat condition.

3. Methods

Invertebrate sampling and analysis

MWH supplied pitfall trap samples. Invertebrates from these samples were identified to order, and for Coleoptera (beetles) and Hymenoptera (wasps/bees/ants), lower level identification was provided were feasible. MWH also supplied light trap samples at Tukituki, where Lepidoptera were identified to the lowest possible level.

At Karamu, sites were grouped *a priori* into three habitats for interpretation: native riparian enhancement planting, mown riparian exotic grassland, native forest retired from stock grazing c.9 years ago. There were four replicates of each habitat, sampled using 6 pitfall traps for one month.

At Tukituki, sites were grouped *a priori* into three broad habitat categories for interpretation: tall tussock grassland; lowland Broadleaved indigenous forest (forest remnant); *Pinus radiata* forest. There were four replicates of each habitat, sampled using 6 pitfall traps for one month. Light traps samples were also provided for two pasture sites.

Invertebrate samples were processed by straining the sample through a series of sieves to remove debris (wood, leaves, dirt). The sample was then poured onto a 35 x 45 cm tray and invertebrates were examined using a swing-arm microscope with magnification of 100x. The first 100 invertebrates seen in the sample were identified to order and counted for analysis. If occurring within the ‘first 100’, any beetles (Coleoptera) and wasps/ants (Hymenoptera) were removed from the sample for lower level identification – these acted as bioindicators. Lepidoptera, from light trap samples, were identified to the lowest possible level. Identification was carried out using keys and comparing specimens in the New Zealand Arthropod Collection.

For statistical analyses, species richness, abundance and diversity (Shannon’s H`) were calculated in PRIMER’s DIVERSE module. The composition of invertebrates was compared across sites using an nMDS ordination in PRIMER v5.0 software, using a Bray-Curtis similarity matrix (4^{th} root transformation) from 10 restarts. This analysis was carried out for all invertebrate together, except light trap samples which were analysed separately. Species which contributed the most to differences between habitats were examined using a SIMPER analysis in PRIMER.

4. Results

The composition of invertebrate communities is influenced by many environmental factors, but key habitat variables include: vegetation type, history of disturbance, stock grazing, size of the site, and isolation of the site (Didham et al 2009).

Karamu

There was a very strong difference between each type of habitat at Karamu. Table 1 shows that richness and diversity were significantly different, with Forest having higher number of species (i.e. richness) and diversity. Figure 1 shows no overlap in the three habitats in terms of invertebrate composition, meaning that there were very strong differences between the habitats. Species which contributed the most to these differences are listed in Table 2.

Overall, there was still some similarity between pasture and riparian habitats, in that i) richness and diversity were lower than forest, and ii) there was more of a "generalist fauna" compared to forest. However, the native riparian enhancement planting was also clearly intermediate between pasture and forest. Yet riparian had not progressed to the stage of being comparable to forest habitats. The nature of these differences are given in Table 6.

Table 1. Patterns of terrestrial invertebrates for habitats at Karamu (*significant results in bold). Averages based on using sites as replicates.

	Riparian	**Pasture**	**Forest**	**P value**
Richness (S)	10.5	11.7	20.5	**0.003***
Abundance (N)	113	119	134	0.44
Diversity (H`)	1.4	1.8	2.2	**0.02***

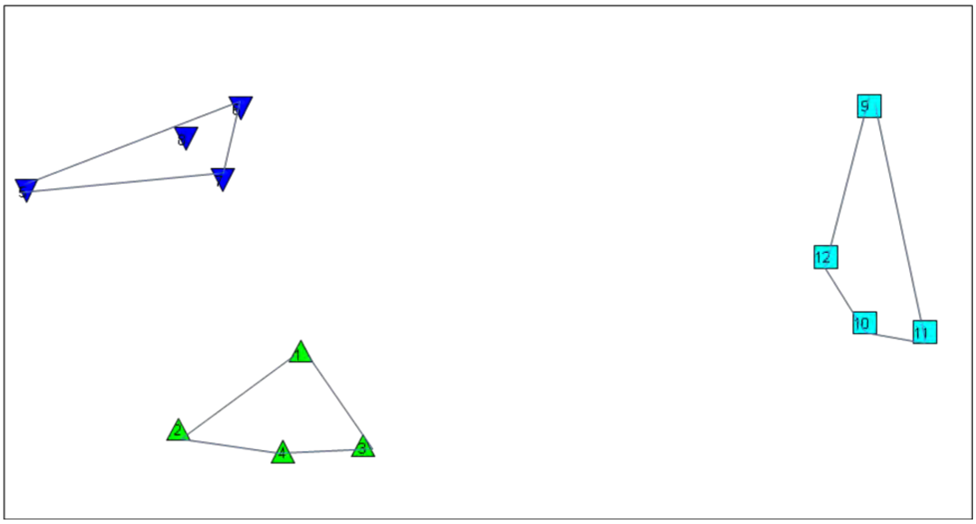

Figure 1. Composition of terrestrial invertebrates analyses for Karamu habitats: riparian (green triangle), pasture (dark blue inverted triangle), forest (light blue square).

Table 2. Showing which taxa contribute the most to differences between habitats (i.e. bioindicators) at Karamu.% contribution accumulates. Table splits into three subsections.

Riparian v Pasture	**Taxa**	**Riparian**	**Pasture**		**%Contribution**
Crickets/grasshoppers	Orthoptera		xxx		13
Parasitoid wasps	Diapriidae	xxx			22
Landhoppers	Amphipoda	xxx			28
Spider hunter wasp	*Priocnemis* Sp1		xxx		34
Ground beetle	*Rhytisternus miser*	xxx			39
Ant	*Nylanderia* sp		xxx		44
Rove beetle	Staphylinidae 1	xxx			48
Riparian v Forest	**Taxa**	**Riparian**		**Forest**	**Cum. %Contribution**
Slaters	Isopoda	xxx			9
Ant	*Prolasius advenus*			xxx	15
Ant	*Pacycondyla*			xxx	20
Landhoppers	Amphipoda	xxx			25
Beetle	*Hypodacnella*			xxx	29
Spider hunter wasp	*Sphictostethus*			xxx	33
Larvae	Larvae			xxx	37
Moths	Lepidoptera			xxx	41
Parasitoid wasps	Hymenoptera			xxx	45
Ground beetle	*Rhytisternus miser*	xxx			48
Pasture v Forest	**Taxa**		**Pasture**	**Forest**	**Cum. %Contribution**
Slaters	Isopoda		xxx		7
Crickets/grasshoppers	Orthoptera		xxx		14
Ant	*Prolasius advenus*			xxx	19
Ant	*Pacycondyla*			xxx	23
Landhoppers	Amphipoda			xxx	28
Parasitoid wasps	Diapriidae			xxx	32
Beetle	*Hypodacnella*			xxx	35
Spider hunter wasp	*Sphictostethus*			xxx	39
Larvae	Larvae			xxx	42
Spider hunter wasp	*Priocnemis* Sp1		xxx		45
Ground beetle	*Megadromus*			xxx	48

Tukituki

There was a very strong difference between each type of habitat at Tukituki. Table 3 shows that richness and diversity were significantly different, with Forest having higher number of species (i.e. richness) and diversity. Figure 2 shows no overlap in the three habitats in terms of invertebrate composition, meaning that there were very strong differences between the habitats. Species which contributed the most to these differences are listed in Table 4. The nature of these differences are given in Table 6.

Table 3. Patterns of terrestrial invertebrates for habitats at Tukituki (*significant results in bold). Averages based on using sites as replicates.

	Riparian	Pine	Forest	P value
Richness (S)	10	10	14.5	**0.03***
Abundance (N)	121	106	117	0.44
Diversity (H`)	1.40	1.43	1.86	**0.03***

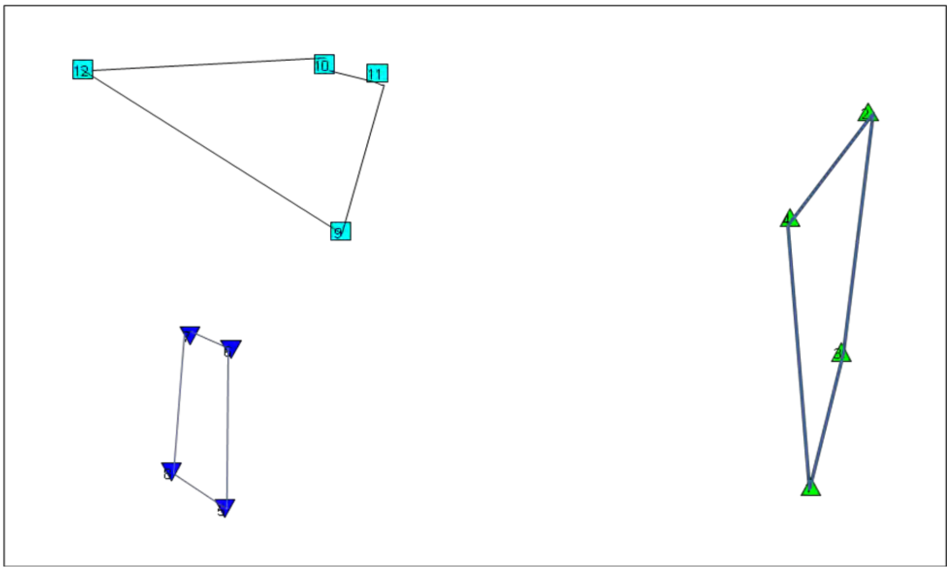

Figure 2. Composition of terrestrial invertebrates analyses for Tukituki habitats: tussock (green triangle), pine (dark blue inverted triangle), forest (light blue square).

In general;

- Tussock samples were characterised by high numbers of mites, a native ant - Monomorium antarcticum, and tiger beetle *Cicindela tuberculata* (tiger beetle)
- Pine samples were characterised by high numbers of harvestmen, darkling beetles, and wasps (*Aucklandella*, *Sphictostethus*)
- Forest samples were characterised by landhoppers, the native ant *Pachycondyla*, millipedes, *Saphobius inflatipes*. These insects are heavily involved with decomposition, and indicate significant leaf litter and woody debris.

Table 4. Showing which taxa contribute the most to differences between habitats (i.e. bioindicators) at Tukituki.% contribution accumulates. Table splits into three subsections.

Tussock v Pine	**Taxa**	**Tussock**	**Pine**		**%Contribution**
Landhoppers	Amphipoda		xxx		15
Mites	Acarina	xxx			29
Harvestmen	Harvestmen		xxx		38
Ant	*Monomorium antarcticum*	xxx			45
Parasitoid wasp	*Aucklandella*		xxx		50
Tussock v Forest	**Taxa**	**Tussock**		**Forest**	**%Contribution**
Mites	Acarina	xxx			13
Landhoppers	Amphipoda			xxx	23
Ant	*Pachycondyla*			xxx	30
Ant	*Monomorium antarcticum*	xxx			37
Millipedes	Diplopoda			xxx	42
Spiders	Araneida			xxx	48
Scarab beetle	*Saphobius inflatipes*			xxx	52
Pine v Forest	**Taxa**		**Pine**	**Forest**	**%Contribution**
Harvestmen	Harvestmen		xxx		10
Millipedes	Diplopoda			xxx	17
Scarab beetle	*Saphobius inflatipes*			xxx	24
Ant	*Pachycondyla*			xxx	30
Darkling beetle	*Kaszabedelium aucklandicum*		xxx		35
Ground beetle	*Holcaspis*			xxx	40
Parasitoid wasp	*Aucklandella*		xxx		45
Spider Hunter wasp	*Sphictostethus*		xxx		50

For light trapping, tussock sites had much higher species richness and abundance of Lepidoptera than other habitats (Table 5). Forest sites were most like tussock sites but had only 20% similarity (Figure 3). Pine and pasture sites had very few moths caught (Table 5).

Notable species include (all from tussock sites, all in the family Noctuidae):

- *Tmetolophota hartii*. Previously known from very few specimens, but 35 were caught in this study. Usually flying late Feb to March. Life history is unknown. Endemic
- *'Aletia' longstaffi*. Very localised species, probably associated with fine-leaved *Dracophyllum* in open habitats.
- *Graphania olivea*. Rare species, restricted to central/southern North Island.
- *Proteuxoa sanguinipuncta*. Australian species, established in North Island since 2007, and especially known from Hawkes Bay. Larva on grasses.

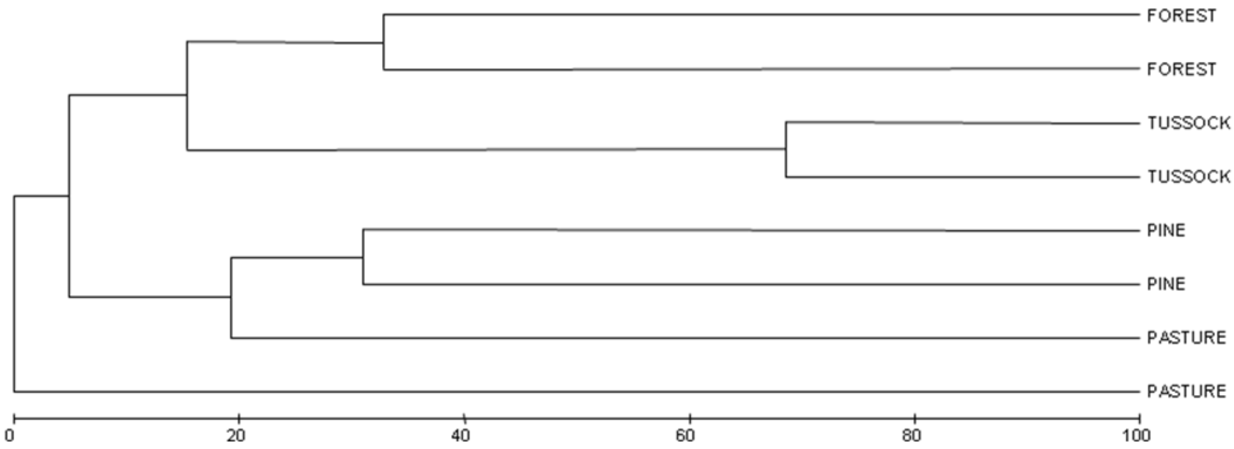

Figure 3. CLUSTER diagram for light trap results for Lepidoptera at Tukituki. Similar samples are grouped more closely together.

Table 5. Light trap results for Lepidoptera at Tukituki.

	Site	**Richness (S)**	**Abundance (N)**	**Diversity (H`)**
Tussock	**1**	26	137	2.6
Tussock	**2**	29	194	2.6
Forest	**1**	10	23	1.7
Forest	**2**	9	13	2.0
Pine	**1**	5	10	1.4
Pine	**2**	7	8	1.9
Pasture	**1**	4	4	1.3
Pasture	**2**	1	1	na

Combining the Karamu and Tukituki data

Because these two studies were carried out with the same sampling and sample processing the data from them can be combined to compare further differences and similarities between habitat types.

Figure 4 shows three major habitats groupings. First, tussock is clearly separated from other habitats. Pasture and riparian habitats (both at Karamu) are grouped together, and these are separated from the third group of "forest sites".

In the forest grouping, Tukituki forest and pine are more similar to each other than forest at Karamu. Although one replicate of Tukituki forest was found in the Karamu forest grouping.

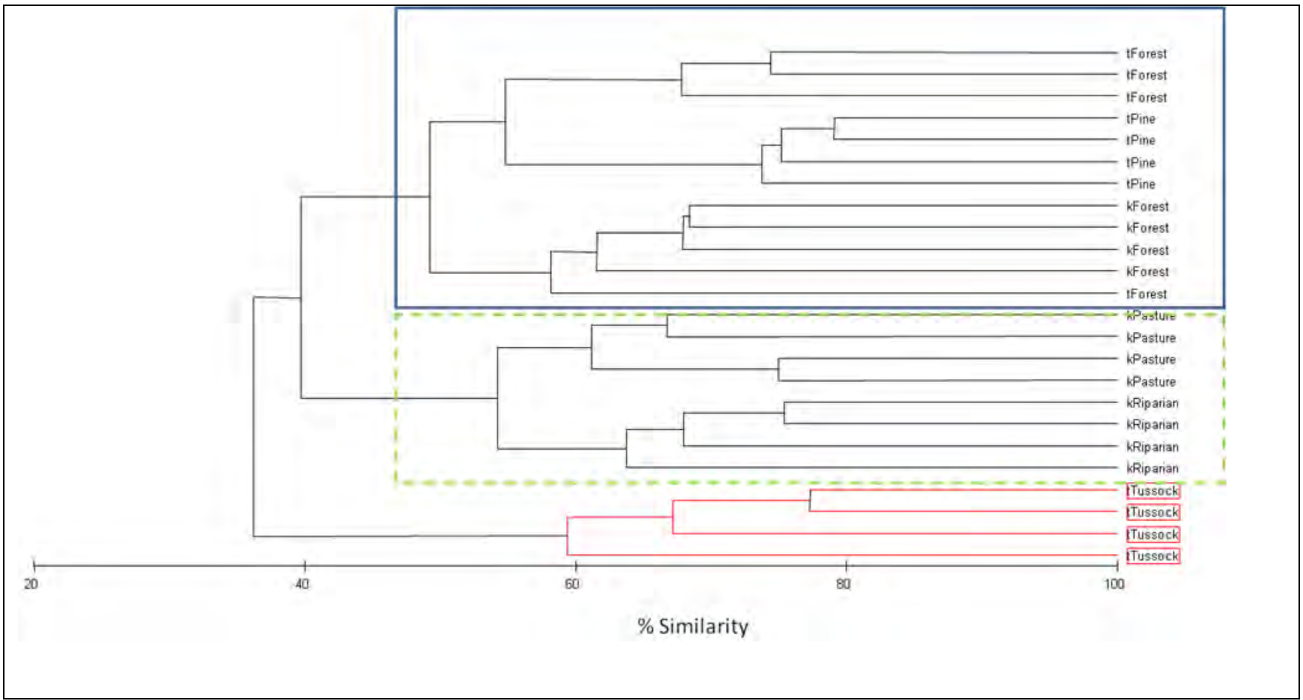

Figure 4. CLUSTER diagram for invertebrate data for both Karamu (k) and Tukituki (t) habitats. Similar samples are grouped more closely together.

Summary of habitat signs from the biota

A summary of the terrestrial invertebrate characteristics of the habitats of the Karamu and Tukituki River study area.

Table 6. Habitat quality signs provided by terrestrial invertebrates

Invertebrates Characteristic	**What the feature indicates**
Forest (Tukituki)	
Landhoppers, *Pachycondyla* (Ant), Millipedes, *Saphobius inflatipes* (Scarab beetle)	heavily involved with decomposition, and indicate significant leaf litter and woody debris
Pine Forest (Tukituki)	
Harvestmen, darkling beetles, parasitoid wasps (*Aucklandella*, *Sphictostethus*)	General diversity but not overly specialised
Forest (Karamu)	
Prolasius advenus (ant), Diapriidae (parasitoid wasps)	Common taxa in forests which have some type of disturbance
Riparian (Karamu)	
Slaters and Landhoppers	General decomposition in disturbed areas
Rove beetles	Generalists, scavengers
Relatively low numbers of beetles and wasps	Lower general diversity
Pasture (Karamu)	
Crickets	Common in grass habitats
Nylanderia sp (ant)	Introduced ant, common in disturbed areas
Relatively low numbers of beetles and wasps	Lower general diversity
Tussock (Tukituki)	
Mites	Associated with grasses?
Monomorium antarcticum (ant)	Common in tussock/bare ground
Cicindela tuberculata (tiger beetle)	Usually found in open bare ground

5. Conclusions

Not surprisingly, habitat factors strongly influenced the terrestrial invertebrate samples. In general there were very strong differences between each of the habitats.

Pasture and Riparian

There was a detectable difference in community structure between the native riparian enhancement planting and pasture. However, there was still some strong similarity between these two habitats, in that i) richness and diversity were lower than forest, and ii) there was more of a "generalist fauna" compared to forest.

Riparian had not progressed to the stage of being comparable to forest habitats. This was best demonstrated when the two studies were combined and a larger number of samples examined. Pasture and riparian sites were still grouped together, indicating they were most similar. If riparian plantings were further progressed we would have seen them grouped with 'forest sites'.

Comparison of Forests

The forested sites at Karamu ('Mahana') and Tukituki (Inglis Bush) were different (Figure 4). If they had been very similar they would have been mixed together in the Cluster figure. Karamu forest had (relatively) more *Prolasius advenus* (ant) and Diapriidae (parasitoid wasp), but less millipedes, *Saphobius inflatipes* and *Holcaspis* (SIMPER analysis).

It is difficult to say why these two forest had a different invertebrate composition without knowing more about any differences in ground cover, substrate, type measurements. However, the above differences point to Tukituki having a greater leaf litter component as millipedes and *Saphobius* are decomposers and very common in leaf litter. This fits with the fact that 'Mahana' is still recovering from grazing, and would presumably have less leaf litter and woody debris covering the forest floor.

In this study, invertebrates could be used to distinguish the different types of habitats, at either Karamu or Tukituki. The results could be used to also form a very basic baseline for what is expected in other sites of similar habitats to what was sampled here. Furthermore, the results could be used to monitor disturbance/changes in such habitats over time.

Guidelines for interpreting terrestrial invertebrate data are basically non-existent in New Zealand. Unfortunately, there is no comparable "MC Index" used for freshwater habitats. Such a system for terrestrial environments is urgently needed in New Zealand to assist many agencies with interpreting invertebrate data associated with landuse change, restoration, land management etc.

6. Acknowledgements

Chris Winks for identification of Beetles, and Robert Hoare for identification of Lepidoptera.

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Appendix D: Hawke's Bay River Values Assessment 2012

Native Birdlife in Hawke's Bay:

Application of the River Values Assessment System (RiVAS and RiVAS+)

K.F.D Hughey

Fiona Cameron

John Cheyne

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LEaP Research Paper No.14

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Land Environment & People

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1. INTRODUCTION

1.1 PURPOSE

This report presents an application of the River Values Assessment System for existing value (RiVAS) and for potential value (RiVAS+) to native birdlife in the Hawkes Bay Region. A workshop was held in Napier on 3rd October 2011 to apply the method. This Hawkes Bay Region bird report needs to be read in conjunction with the method and with the first native bird application reports (see Hughey et al. 2010 and Gaze et al. 2010).

1.2 PREPARATORY STEP: ESTABLISH AN EXPERT PANEL AND IDENTIFY PEER REVIEWERS

The Expert Panel for the native birdlife application in the Hawkes Bay comprised John Cheyne, Fiona Cameron, Rod Dickson, Adam Forbes, Keiko Hashiba, Hans Rook, Tim Sharp, Brent Stephenson and Bryan Welch, advised by Ken Hughey (Lincoln University) who managed the case study. Credentials of the Expert Panel are provided in Appendix 1.

2. APPLICATION OF THE METHOD

There are two parts of the system: RiVAS is applied to existing value in steps 1-9 and RiVAS+ to potential value in steps 10-14.

STEP 1: DEFINE RIVER VALUE CATEGORIES AND RIVER SEGMENTS

RIVER VALUE CONTEXT FOR NATIVE BIRDLIFE IN HAWKES BAY

Most Hawkes Bay rivers are single channel and have their headwaters in catchments largely dominated by native forest – in these catchments the rivers are dominated by single channel bird fauna, typically in this region by the endangered blue duck. The lower sections of these rivers typically run through intensively developed farmland and into estuarine or lagoon systems. In these sections of single channel rivers the birdlife is dominated by shags and waterfowl. There are a few braided rivers in Hawkes Bay, notably the Tukituki – this river, not surprisingly, has a more diverse fauna than the others.

RIVER VALUE CATEGORIES

There is a distinction, typically, between the birdlife of braided rivers and that of single channel rivers. The former is typified by a community of birds that includes gulls and terns, waders, shags and a variety of waterfowl – multiple species are considered 'threatened or at risk'; the latter is typified by waterfowl and shags with far fewer species threatened or at risk, Despite this distinction it is proposed to treat all rivers primarily in the same way, except where distinctive indicators for the prime attributes (see steps 3 and 4 below) can be identified and used appropriately.

RIVER SEGMENTS

Work in advance of the expert panel meeting to collate existing data, indicated that expert knowledge primarily held by the Department of Conservation[1], but also by OSNZ on occasions, would be the primary data source. Considerable data exist for the braided sections of key rivers and for blue duck in the region, including formal survey information for most rivers. For the purposes of this analysis we generally consider catchments as a whole (except for the Tukituki which is separated into 3 sections).

[1] Note that this resource includes occasional surveys undertaken by individuals, consultants and NGOs (e.g., community groups, Forest and Bird, the Ornithological Society of NZ).

Lagoons and/or estuarine systems are excluded from analysis and a separate evaluation of all lagoons, estuaries, etc., is required.

OTHER CONSIDERATIONS

Related to the above, an important feature of many surveys and much evidence presented in hearings is associated with total bird numbers of a river. We note the imprecision of the survey data, but again reiterate it is the best available information. Note the following, again consistent with the Canterbury report:

- Some species are particularly difficult to find, e.g., crake and bittern, and until a reliable survey method is found, are excluded from this analysis. Equally, threatened and at risk species such as grey duck are present, but difficult to identify correctly – they too are excluded from that part of the analysis dealing with threatened and at risk species. At least one other species identified as 'threatened or at risk', i.e., NZ pipit, is not considered as it is mostly not recorded (for some unknown reason) in surveys.

OUTCOMES

Use whole catchments as the primary data set and populate with existing river bird survey data and/or expert panel considerations, except as already noted for the Tukituki.

Ignore the presence of swamp species such as bittern and marsh crake until reliable survey data become available.

Do not include NZ pipit until routinely required within the standard survey method, and then record appropriately.

Do not include grey duck.

STEP 2: IDENTIFY ATTRIBUTES

Attributes i.e., the facets of the birdlife river value. The same attributes as used by Hughey et al. (2010) and Gaze et al. (2010) for Canterbury and Tasman respectively were used here (see Appendix 2).

STEP 3: SELECT AND DESCRIBE PRIMARY ATTRIBUTES

The same six primary attributes used by Hughey et al. (2010) and Gaze et al. (2010) are used here (see Appendix 2).

STEP 4: IDENTIFY INDICATORS

The same indicators used by Hughey et al. (2010) and Gaze et al. (2010) are used here.

STEP 5: DETERMINE INDICATOR THRESHOLDS

Thresholds are applied to an indicator to determine high, medium and low relative importance for that indicator. Thresholds are defined by real data (e.g. for recreational fishing <1,000 angler days per annum = relatively low importance, or expert panel judgements) for each indicator and were identified by the Expert Panel. Because native birdlife is comparatively data rich (c.f. some other river values), this step was informed by 'hard' data (albeit much from expert panel assessment for this region) for five of the six indicators.

STEP 6: APPLY INDICATORS AND INDICATOR THRESHOLDS

Most indicators were assessed using expert panel based quantitative survey data - this step involved entering data from the relevant data sources (primarily the experts). Data were kept in their original format (e.g. *actual area* of habitat, *number* of birds). This assisted the Expert Panel when evaluating the data, and helps achieve process transparency.

STEP 7: WEIGHTING OF PRIMARY ATTRIBUTES

As per the Hughey et al. (2010) and Gaze et al. (2010) applications weightings are equal.

OUTCOME

Equal weighting.

As a consequence of this decision it was decided for Canterbury and Tasman to introduce a 'species stronghold' criterion into the decision support system for defining priorities, i.e., if a river contains 5% or more of a population of a 'threatened or at risk' species then it is of national importance – such a criterion is consistent with decisions made for national water conservation orders. In the case of Tasman no species on any river reached this criterion – however, it should be noted that blue duck is being managed to get to 50 pairs as one of 8 selected sites nationally - if successful then it will rise to more than the 5% threshold and the river will rise to National significance. This same criterion is used here.

STEP 8: DETERMINE RIVER SIGNIFICANCE

STEP 8A: RANK RIVERS

The spreadsheet in Appendix 3 was used to sum the indicator threshold scores for each river. The sums of the indicator threshold scores were placed in a column and then sorted in descending order. This provided the list of rivers ranked by their significance scores.

STEP 8B: IDENTIFY RIVER SIGNIFICANCE

Using the ranked list from Step 8a, the Expert Panel closely examined the rivers, and their attribute scores. As per the Canterbury report the following criteria were applied to defining importance within the Appendix 3 evaluation:

National significance:

Criterion 1: *Species strongholds* – if any river contained one or more species with over 5% of the total population(s) then = 3, and automatic national significance. We chose 5% as this level has been used in a number of Water Conservation Order decisions as being a threshold for national importance (despite the fact that the World Conservation Union (IUCN) uses a 1% level for international significance); or

Criterion 2: total score is 15 or more then national significance.

Regional significance:

Those rivers in the table not defined as nationally or locally significant, and scoring 11-14.

Local significance:

Sole criterion: *Number of 'threatened or at risk' species present* = 0 and all other indicator columns (i.e., 1-5) are 2 or less then automatic local significance; or if the total score <11 = local significance.

Translation of these functions to rivers is shown in Appendix 3.

The Expert Panel assessed the output from this process against the results of existing assessments and other relevant considerations, including:

1. Sites of Special Wildlife Interest for braided rivers in Hawkes Bay
2. Existing Water Conservation Orders associated with birdlife
3. Existing planning documents, including Regional Plans under the RMA, and
4. Reference to MfE Waters of National Importance work.

It is acknowledged that, owing to the judgmental nature of this exercise, rivers close to the threshold points could 'swing either way', and that in time the Mohaka River is likely to be of national significance for blue duck but is not currently.

OUTCOME

- A list of rivers ranked by a scoring system from highest to lowest represents an initial significance ranking list. See Appendix 3 (columns highlighted in green).
- Rivers identified as significant at the national, regional and local level - see Appendix 3 (and Figure 1).
- Rivers in the Hawkes Bay Region not listed have either very low value to birdlife dependent on rivers or streams or are of unknown value.

STEP 9: OUTLINE OTHER FACTORS RELEVANT TO THE ASSESSMENT OF SIGNIFICANCE

Perhaps the most telling other issue concerns the 'state' of the survey data – there is little that is format that is up to date. As a consequence, and unlike for Canterbury, there is little quantitative data available and this needs to be noted. Despite these comments we are of the view that our assessments are likely to be 'reasonably accurate' at least as far as diversity is concerned, if not in terms of absolute numbers.

OUTCOME
Notes have been made in Appendix 2 about data sources.

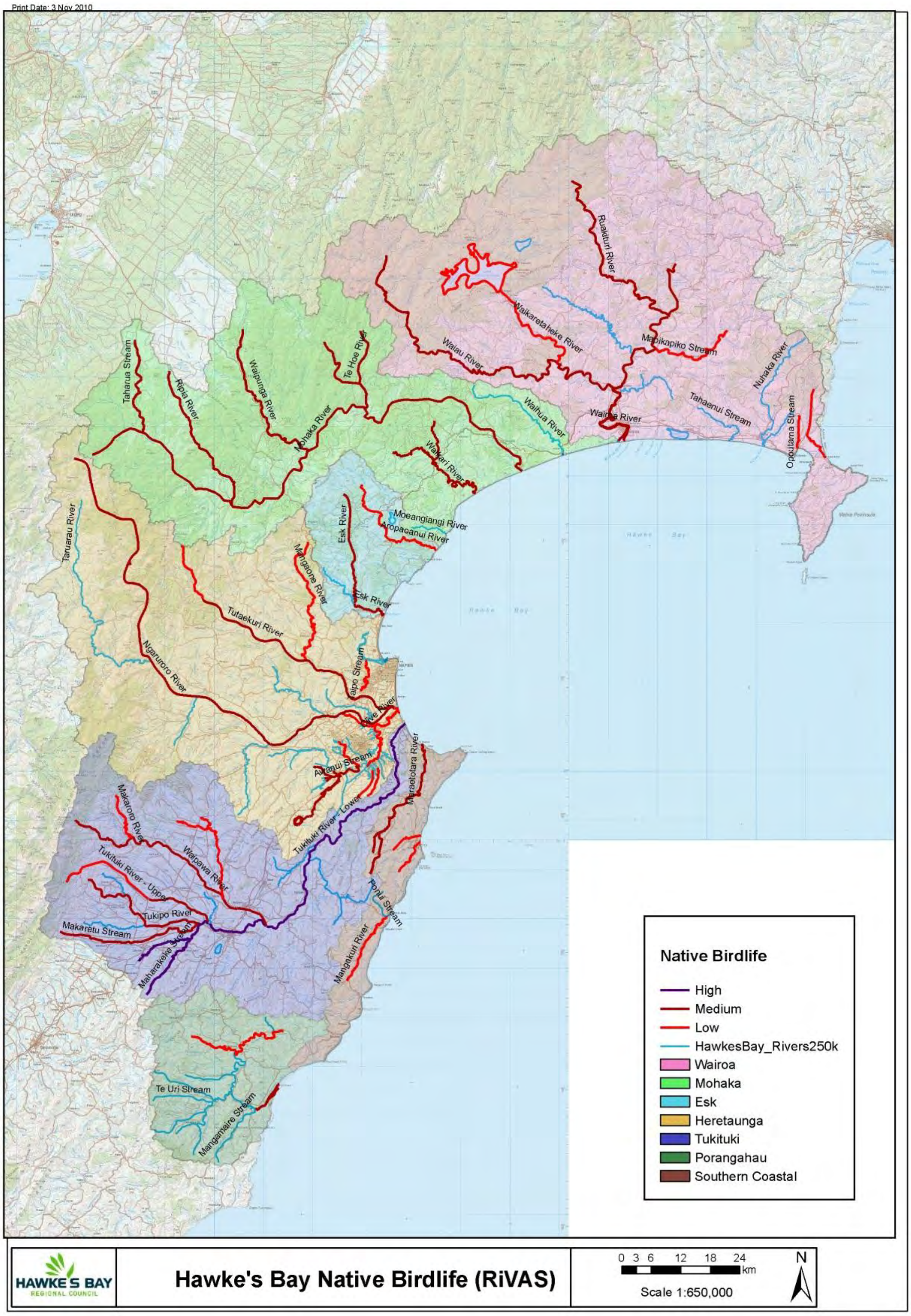

Figure 1: Hawkes Bay native birdlife rivers mapped by significance level

STEP 10: IDENTIFY RIVERS AND INTERVENTIONS

RIVERS FOR POTENTIAL STATE ASSESSMENT

All river sections identified in the RiVAS assessment (see Appendix 3) were used as the basis for the RiVAS+ analysis (Appendix 4). The Expert Panel considered every river section for its potential value, however only a few were thought worthy of considering interventions in reality.

No new river reaches were added that represent rivers with potential value for native birdlife but hold little current value.

POTENTIAL INTERVENTIONS

Means by which river conditions may be enhanced are listed in Table 1.

Table 1: **Potential interventions to enhance river values**

1. Manage access
1a. Enhance access and/or 1b. Control access
i) Helicopter access
ii) Vehicle access
iii) Boat access
iv) Foot access
2. Enhance flow
a. Increase minimum
b. Stabilise (around targeted specific flow)
c. More natural variability
d. Restore flood flows
e. Transfer water between catchments
3. Improve bed & in-stream habitat
a. Maintain channel works (e.g. groynes, other structures) that enhance worth
b. Remove channel works (groynes, stop banks etc) that detract from worth
c. Control weeds (in-stream, including active river bed) to enhance worth
d. Remove hazards (e.g., wire, trees, old structures, forestry slash)
e. Leave woody debris in river that enhance worth
f. Improve timing of management within flood control area, including root raking
4. Remove or mitigate fish barriers
a. Culverts
b. Dams
c. Flood gates
d. Chemical
5. Set back stopbanks
6. Improve riparian habitat
a. Weed control
b. Pest control
c. Native revegetation
d. Remove litter
7. Enhance water quality
a. Remove/fence out stock
b. Reduce non-point source nutrient pollution (e.g., farm nutrient budgets)
c. Reduce point source pollution (e.g., mining waste)
d. Reduce sediment input (e.g., forest management practices)
8. Stock with fish

9. Provide amenities	
a. Boat launching facilities	
b. Car parking	
c. Toilets	
d. Storage facilities (for kayaks etc)	
e. Artificial hydraulic feature (for kayakers, swimmers, anglers)	
i) Slalom course	
ii) Play wave	
iii) Swimming hole	
f. Interpretive signage	
g. Riverside track (for access)	
10. Construct water storage	
a. In-river	
b. Out-of-river	
11. Develop a run-of-the-river diversion	
12. Provide telemetered flow monitoring (& communicate readings)	

OUTCOMES

Appendix 4 lists the Hawkes Bay Region river sections used for the RiVAS+ assessment.

Table 1 and Appendix 4 record potential interventions.

STEP 11: APPLY INDICATORS AND INDICATOR THRESHOLDS FOR POTENTIAL VALUE

Taking each river in turn, the Expert Panel considered which interventions were relevant to that river. These were recorded in Appendix 4.

Then the Panel considered the net effect of these interventions upon the value of the river to native birdlife. The degree or extent of intervention was discussed. The RiVAS+ methodology calls for the panel to select the two most important interventions for each river, and for these to be practical and feasible rather than ideal.

The effect of the potential interventions was assessed for each indicator by considering the current score (from RiVAS) and identifying whether the score would change as a result of the interventions.

By definition, there are no raw data for native birdlife based on potential future conditions of a river, so the Panel focused primarily on the scores. Occasionally, the Panel considered whether interventions would be likely to shift the raw data over the relevant threshold value to a higher score.

The new scores were recorded. Where the Panel believed the interventions were likely to enhance (or degrade) river conditions for native birdlife, but that the score itself would not change, '+' or '-' was recorded, indicating a positive or negative shift respectively. Where no change was thought likely, the RIVAS score was not altered (cells were left blank for convenience).

As may be expected, rivers with high current value seldom changed – rivers with low current value offer the greatest opportunities for enhancement.

Sometimes discussion slipped into consideration of protecting current value or avoiding its degradation. It was reinforced that the RiVAS provides information to assist decision-makers with those questions, and the Panel was steered back to addressing potential future value.

OUTCOME

Appendix 4 records the indicator scores for potential value.

STEP 12: WEIGHT THE PRIMARY ATTRIBUTES FOR POTENTIAL VALUE

Because no attributes or indicators were altered for the RIVAS+ exercise, weightings were not revisited (i.e. an equal weighting regime was automatically applied to the RIVAS+ exercise).

OUTCOME

The RIVAS weighting regime (equal weighting) applied.

STEP 13: DETERMINE RIVER POTENTIAL VALUE

The scores were summed for each river. A score of 0.5 was given to each '+' and '-' (i.e. +0.5 or -0.5).

Of the 38 river segments considered in RiVAS, five when considered for RiVAS+ altered their sum, all in a positive direction. The Mohaka River shifted dramatically (from regional to national importance). This relates to the view that this river, with pest control, could be a major contributor to blue duck recovery and thus be a stronghold for the species.

Other river sections typically recorded small shifts in value, with no consequential change in their river importance classification.

In total, five rivers were identified as having potential to improve river conditions in a way that would enhance native birdlife value. The interventions most frequently identified for enhancing native birdlife value (with the number of times it was identified across all rivers given in brackets) were:

3: Improve bed and instream habitat: c. Control weeds (in-stream, including active river bed) to enhance worth (x3)
3: Improve bed and instream habitat: f. Improve timing of management within flood control area, including root raking (x2)
6: Improve riparian habitat: b. Pest control (x3)

OUTCOMES

Appendix 4 provides a list of rivers ranked by their potential increase in value for native birdlife, with possible interventions identified for each river.

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APPENDIX 1: CREDENTIALS OF THE EXPERT PANEL MEMBERS

The Expert Panel comprised three members. Their credentials are:

Fiona Cameron is a Senior Resource Analyst for the Hawke's Bay Regional Council working within the Water Quality and Ecology team. Fiona has been working for HBRC for 5 years, managing the regional wetland monitoring programme and specialises in river and wetland bird monitoring.

John Cheyne has spent 44 years working on the conservation of birds for the NZ Wildlife Service, Department of Conservation and Fish and Game Hawke's Bay. John has been based in Hawke's Bay for the last 24 years. A significant part of this time has been spent working on improving the management of wetland and riverine bird species. Johns' work in this area has involved population surveys, habitat protection and development of improved management programmes.

Rod Dickson is a Biosecurity advisor for the Hawke's Bay Regional Council who specialises in Biodiversity protection and predator control. Rod has previously worked for the Department of Conservation and has worked on a range of bird related projects including New Zealand Dotterel monitoring and protection on Waiheke Island, baseline bush-bird and lizard surveys on Great Barrier Island and little spotted kiwi surveys on Tiritiri Matangi Island. Rod co-ordinates and manages HBRC's bird monitoring programme and assists community groups to protect birdlife by establishing predator control.

Adam Forbes consults widely within public and private sectors as a generalist ecologist. He commonly undertakes ecological baseline and effects studies, involving specialists when necessary, mainly in association with infrastructure projects, such as river flood protection schemes, hydro power generation development, transmission line development, quarrying and State Highway development. Over recent years Adam has also undertaken a number of studies of ecological values and advised on appropriate ecological management.

Keiko Hashiba is a Resource Technician for the Hawke's Bay Regional Council looking after the quality assurance system of the Environmental Science section, and is also involved in terrestrial ecology, water quality and ecology monitoring. Keiko has a background in forestry and forest ecology.

Ken Hughey is Professor Environmental Management at Lincoln University. His expert knowledge of river birdlife spans the period 1981-2011, including his PhD thesis (habitat needs of birds of braided rivers), multiple river bird surveys in almost all regions of the South Island, expert evidence at multiple hearings and published research papers (e.g., Hughey 1997, 1998, Duncan et al., 2008). Ken is overall project manager of the river values project. Selected references:

Hans Rook is a biodiversity ranger for the Department of Conservation. Hans has spent 40 years working in the conservation of wildlife around New Zealand first with the NZ Wildlife Service and then, the Department of Conservation. Based in Hawke's Bay for the last 30 years, Hans has spent a considerable part of this time working to restore spawning sites for whitebait, breeding grounds for the nationally endangered Australasian bittern and leading the way in marine mammal conservation.

Tim Sharp is a Strategic Policy Advisor for the Hawke's Bay Regional Council where he coordinates the RiVAS programme for Council. He has an environmental management background, specialising in resource management to assess and support community values. Tim's interests include amateur bird photography and he has been involved in bird habitat restoration programmes.

Brent Stephenson has been studying birds in Hawke's Bay all his life and completed his PhD, Ecology and breeding biology of Australasian gannets at Cape Kidnappers in 2005. Brent began the BIRDING-NZ newsgroup, to help with the exchange of birding information in New Zealand. Brent has worked for the Department of Conservation (Boundary Stream Mainland Island), is involved in the Cape Kidnappers and Ocean Beach Wildlife Preserve, and has worked on many research expeditions globally including to Antarctica and the Arctic. Brent is a professional wildlife photographer and guides bird watching tours.

Bryan Welch, Hawke's Bay Biodiversity Programme Manager, Department of Conservation

APPENDIX 2: ASSESSMENT CRITERIA FOR BIRDLIFE (STEPS 2-4)

ATTRIBUTE CLUSTERS	ATTRIBUTE (primary attributes in bold)	DESCRIPTION OF PRIMARY ATTRIBUTES	INDICATORS	INDICATOR SIGNIFICANCE THRESHOLDS	DATA SOURCES (AND RELIABILITY)
Step 2: Identify attributes Step 3: Select and describe primary attributes		Step 3: Select and describe primary attributes	Step 4: Identify indicators	Step 5: Determine significance thresholds	
Represent-ativeness	Guild presence				
	Endemism				
	Quality of habitat				
	Distinctiveness	Measures the relative distinctiveness of the habitat type and/or bird species presence compared to others represented in New Zealand	Relative distinctiveness	1= low; 2= medium; 3= high Threshold data result from the following assessment: 1= Habitat type or species assemblage/presence widely represented elsewhere in NZ; 2= Habitat type or species assemblage/presence rarely represented elsewhere in NZ; 3= Habitat type or species assemblage/presence not represented in other regions in NZ	This is a subjective assessment based on the knowledge of the expert panel. As reliable as the experience and knowledge represented by the panel – in this case very high.
Life supporting capacity	**Habitat size**	Amount of Habitat - measured in area for braided rivers and distance for single channel rivers. Note that while some braided rivers also have single channel reaches it is the dominant habitat that is recorded.	Objective and quantitative measures of: Area (ha) of riverbed for braided rivers; Distance (km) for single channel rivers	For area/distance combined: 1=<5000ha and/or <10km; 2=5000-9999ha and/or 11-30km; 3= >10000ha and/or >30km	Area is based on Wilson, J. 2001. National Distribution of Braided Rivers and the Extent of Vegetation Colonisation. Landcare Research Contract Report LC0001/068, Lincoln. Distance based on Google Map estimate.
	Numbers	Measures 'actual' numbers of native birds surveyed on the river (excluding southern black-backed gulls – see main text at section 2, step 1).	Total number for all (except Southern black-backed gull) native species recorded	1 = <1000 individuals; 2= 1000-4999 individuals; 3= >5000 individuals	Most 'significant for birdlife' NZ rivers have been subject to some survey effort but it varies greatly in spatial coverage and sometimes reliability. Where possible all survey information is referenced; otherwise expert panel judgement is also included.
	Foraging guilds	Provides a measure of species diversity on the river	Number of guilds present ranges from 0-8, i.e., a= open-water divers; b= deep water waders; c= shallow water waders; d= dabbling waterfowl; e= torrent specialists; f= aerial hunting gulls and terns; g= swamp specialists; h= riparian wetland birds	1= 1-4 = low; 2= 5-6= medium; 3= 7-8= high	Guilds for wetland birds are defined in O'Donnell, C.F.J. 2000. The significance of river and open water habitats for indigenous birds in Canterbury, New Zealand. Environment Canterbury Unpublished Report U00/37. Environment Canterbury, Christchurch.
	Feeding guilds				
	Roosting guilds				

Natural diversity	Within guilds				
	Microhabitat diversity				
	Number threatened species	Provides a measure of the diversity of threatened or at risk bird species using the river.	Actual number of species within 'threatened or at risk' conservation status categories, i.e., blue duck (BD); black stilt (BS); pied stilt (PS); wrybill (WB); banded dotterel (BDo); NZ pied oystercatcher (NZPO); black-fronted tern (B-FT); black-billed gull (B-BG); white-fronted tern (W-FT); red-billed gull (R-BG); Caspian tern (CT); southern crested grebe (SCG); dabchick (DC)	1=1 species; 2= 2-3 species; 3= 4 or more species	Based on actual surveys or expert panel knowledge: generally very reliable although some potential to under report.
Distinctiveness/ stronghold site	Overwintering				
	Migration stopover				
	Significant breeding site	Provides a measure of relative importance of rivers as strongholds for populations of 'threatened or at risk' species in New Zealand. (Note that Australasian bittern, marsh crake, and grey duck have been excluded due to imprecision with survey technique (first two species) and with identification (final species)	Proportion of 'threatened or at risk' species present with a significant (>1% or >5%) proportion of their total populations, ranges from 0-10, i.e., blue duck (BD), black stilt (BS), pied stilt, NZ pied oystercatcher (NZPO), wrybill (WB), banded dotterel (BDo), black-fronted tern (B-FT), black-billed gull (B-BG), white-fronted tern (W-FT); red-billed gull (R-BG); Caspian tern (CT); ; southern crested grebe (SCG); dabchick (DC)	0= no species >1%; 1= 1 species at 1-4.9% = low; 2= 2 species at 1-4.9% = medium; 3= 1 or more species > 5%, or 3 or more 1-4.9% of total population = high	Based on actual surveys or expert panel knowledge: for some rivers and species, e.g., blue duck, the reliability is likely to be only moderate because of doubt about total population size and doubt about numbers on the river concerned, i.e., two sources of error.
	Significant moulting site				
	Only region typically supporting a particular species				
	Habitat for specialist needs				
	Habitat for species with special diet or foraging behaviour				
Intactness/ naturalness	Level of modification				
Long term viability	Vulnerability to natural perturbations				

APPENDIX 3: EXISTING SIGNIFICANCE ASSESSMENT CALCULATIONS FOR BIRDLIFE (RIVAS) (STEPS 1 AND 5-8)

River 'grouping' or river	River or section thereof	PRIMARY ATTRIBUTES – Step 6A: Apply indicators and thresholds: 1. Relative distinctiveness (Subj)	2. Amount of Habitat (Obj) - measured in area for braided rivers and distance for single channel rivers. Note that while some braided rivers also have single channel reaches it is the dominant habitat		3. Numbers (Obj)	4. Foraging guilds (Obj)	5. Number of 'threatened or at risk' species present (Obj) (Note: 3 species not included: grey duck, NZ pipit, Australasian bittern - see main report for reasons)	6. Proportion of 'threatened or at risk' species present with a significant (>1% or >5%) proportion of their total populations (Obj/Subj)	SCORING OF PRIMARY ATTRIBUTES – Step 6B: Apply indicators and thresholds: 1. Relative distinctiveness of habitat	2. Amount of Habitat	3. Numbers (ranked with SBBG removal adjustment)	4. Foraging guilds	5. Number of 'threatened or at risk' species present (Obj)	6. Species strongholds	Step 8: River significance: Sum Weights 1	Rank1	Overall evaluation of importance	Comments
		INDICATORS: 1= Habitat type or species assemblage widely represented elsewhere in NZ; 2= Habitat type or species assemblage rarely represented elsewhere in NZ; 3= Habitat type or species assemblage not represented in other regions in NZ	ha for braided river birds	km for mainly single channel bird rivers	Number adjusted by removing SBBGs	Ranges from 0-8, i.e., a= open-water divers; b= deep water waders; c= shallow water waders; d= dabbling waterfowl; e= torrent specialists; f= aerial hunting gulls and terns; g= swamp specialists; h= riparian wetland birds	Principally: blue duck (BD), black stilt (BS), wrybill (WB), banded dotterel (BDo), black-fronted tern (B-FT), black-billed gull (B-BG), pied stilt (PS), NZ pied oystercatcher (NZPO), white-fronted tern (W-FT); red-billed gull (R-BG); Caspian tern (CT); southern crested grebe (SCG); NZ dabchick (DC); White heron (WH); Royal spoonbill (RSB)	Principally: blue duck (BD), black stilt (BS), wrybill (WB), banded dotterel (BDo), black-fronted tern (B-FT), black-billed gull (B-BG), pied stilt (PS), NZ pied oystercatcher (NZPO), white-fronted tern (W-FT); red-billed gull (R-BG); Caspian tern (CT); southern crested grebe (SCG); NZ dabchick (DC) - note that where surveys are based only on part sections then expert assessment is used to estimate proportionality.	INDICATOR THRESHOLDS: 1= low; 2= medium; 3= high	1=<5000ha and/or <10km; 2=5000-9999ha and/or 10-30km; 3= >10000ha and/or >30km	1=<1000 individuals; 2= 1000-4999 individuals; 3= >5000 individuals	1-4 = low = 1; 5-6= medium = 2; 7-8= high = 3	1=1; 2-3= 2; 4 or more = 3	0= no species with >1% of the total population; 1= 1 at 1-4.9% = low; 2= 2 at 1-4.9% = medium; 3= 1 or more > 5%, or 3 or more 1-4.9% = high	Standard	Rank1	**DSS**: If column 6, of Step 6B, (threatened spp >5%) = 3; or total score is 15 or more = national importance; if all columns 1-5 are 2 or less and column 6 is 0; or the total score <10 = local; otherwise regional	Comments
Northern coastal	Opoutama stream (includes swamp)	1		6.99	100	a,b,d,g,h	DC	0	1	1	1	2	1	0	6	30	Local	Spotless crake; Bittern boomiing; grey duck; banded rail?; NI ferbird
	Kopuawhara stream	1		6	100	a,b,d,f,g,h	PS,CT	0	1	1	1	2	2	0	7	27	Local	Spotlless; Bittern; grey duck; banded rail?; NI ferbird
Wairoa	Lake Waikaremoana catchment	1		c.50	100	a,b,d,e,h	BD	0	1	3	1	2	1	0	8	21	Local	c.20 whio
	Waikaretaheke river	1		24.35	100	a,b,d		0	1	2	1	1	0	0	5	33	Local	
	Waiau river	2		85.8	500	a,b,d,e,h	BD, PS	0	2	3	1	2	2	0	10	9	Regional	Whirinaki connectivity for BD; further info required, poorly surveyed; grey duck
	Ruakituri river	2		47.13	200	a,b,d,e,h	BD	0	2	3	1	2	1	0	9	13	Regional	Grey duck
	Mangapoike river	1		25	100	a,b,d,h	PS	0	1	2	1	1	1	0	6	30	Local	Grey duck
	Wairoa river	1	268	36.88	1200	a,b,c,d,f,h	PS,BDo,B-BG,R-BG,W-FT,CT	0	1	3	2	2	3	0	11	5	Regional	
Waikari	Waikari river (incl Anaura Stm)	1		30.47	200	a,b,c,d,e,f,h	BDo, PS, BD	0	1	3	1	3	2	0	10	9	Regional	Occasional BD reports, incl. -Recent; grey duck
Aropaouanui	Aropaouanui river/Waikoau	1		28.62	200	a,b,c,d,e,f,h	BDo, PS, BD	0	1	2	1	3	2	0	9	13	Local	Occasional BD reports, incl. - recent in headwater; grey duck
Mohaka	Upper (above Te Hoe - includ tribs)	2		c.200	1500	a,b,c,d,e,h	BDo, PS, BD	BD (1-2%)	2	3	2	2	2	1	12	2	Regional	Grey duck; needs moore work re BD

	Lower Mohaka river	1	88.6	50	500	a,b,c,d,f,h	BDo,PS,CT, W-FT		0	1	3	1	2	2	0	9	13	Local	
Esk	Esk river	1		33.75	200	a,b,c,d,e,f,h	BDo, PS, BD		0	1	3	1	3	2	0	10	9	Regional	Occasional BD reports
Tutaekuri	Mangaone river	1		33.01	100	a,b,d,h			0	1	3	1	1	0	0	6	30	Local	
	Upper (Mangatutu & above)	1		c.30	100	a,b,d,h	BDo		0	1	2	1	2	1	0	7	27	Local	Very old blue duck records 1984 NZFS
	Lower	2	285.6	c.60	1400	a,b,c,d,f,h	BDo,PS,NZPO	BDo(c.1%)		2	3	2	2	2	1	12	2	Regional	OSNZ-NZWS 1986; NZ pipit; grey duck
Ngaruroro	Upper (Whanawhana cableway)	2		62	500	a,b,d,e,h	BD,BDo,PS	BD (1% if pop 3000)		2	3	1	2	2	1	11	5	Regional	BD increasing; grey duck
	Lower (below Whanawhana cableway)	1	1597	54	1300	a,b,c,d,f,h	BDo,PS,NZPO,B-BG,CT,R-BG	BDo (2.5% - 480)		1	3	2	2	3	1	12	2	Regional	NZ pipit, grey duck
Karamu/Urban	Upper (Poukawa, Awanui, Karewarewa stream)	1		29.92	1000	a,b,c,d,f,g,h	PS,DC,BDo,B-BG,CT		0	1	2	1	3	3	0	10	9	Regional	Connected Lake Poukawa; bittern, crake spp
	Muddy Creek	1		2	500	a,b,c,d,f,g,h	PS,BDo,CT,DC,RSB		0	1	1	1	3	3	0	9	13	Local	Bittern, Spotless Crake, Grey duck
	Lower (Clive, Ruahapia stream, Irongate, Raupare	1		c.30	500	a,b,c,d,f,g,h	PS,R-BG,B-BG,CT,W-FT		0	1	2	1	2	2	0	8	21	Local	Bittern
	Havelock stms (Mangarau stream, Herehere stream)	1		10	200	a,d,h	PS		0	1	2	1	1	0	0	5	33	Local	
Ahuriri	Taipo stream	1		9.6	200	a,b,d,g,h	PS,CT		0	1	1	1	2	2	0	7	27	Local	Odd bittern,
Tukituki	Makaretu stream	1		31.24	150	a,b,c,d,h	BDo,PS,BD		0	1	3	1	2	2	0	9	13	Regional	Odd old BD sighting; NZ pipit, grey duck
	Upper (SH 50 above)	1		51	c.1000	a,b,c,d,e,h	BD,BDo,PS	(BD possibility - if 20-30 birds)		1	3	1	3	2	1	11	5	Local	NZ pipit, grey duck, NI fernnbird
	Lower (downstm, incl Maharakeke and Porangahau stream)	2	2000	77	3000	a,b,c,d,f,g,h	BDo, B-BG, PS, NZPO, W-FT, RBG, CT, WH, RSB, B-FT	BDo (5%); PS(1.5%)		2	1	2	3	3	3	14	1	National	Bittern, NZ Pipit, Grey, Spotless crake
	Tukipo river	1		33.14	200	a,b,c,d,h	BDo,PS		0	1	3	1	2	2	0	9	13	Regional	
	Makaroro river	1		17.79	200	a,b,c,d,e,h	BDo, BD,PS		0	1	2	1	2	2	0	8	21	Local	
	Mangaonuku river	1		18.67	200	a,b,c,d,g,h	BDo,PS		0	1	2	1	2	2	0	8	21	Local	
	Waipawa river	1		37.31	200	a,b,c,d,h	BDo, PS		0	1	3	1	2	2	0	9	13	Regional	
	Tukituki river (middle btw SH2 and SH 50)	1		20	200	a,b,c,d,e,h	BDo, PS		0	1	2	1	2	2	0	8	21	Regional	
Southern Coastal	Maraetotara river	1		35.24	150	a,b,c,d,h	BDo,PS		0	1	3	1	2	2	0	9	13	Regional	
	Waingongoro stream	1		8	100	b,c,d,h	PS		0	1	1	1	1	1	0	5	33	Local	
	Puhokio stream	1		12.5	100	a,b,d,f,h	PS,B-BG,R-BG		0	1	2	1	2	2	0	8	21	Local	
	Mangakuri stream	1		17.48	50	a,b,d,f,h	PS,R-BG		0	1	2	1	1	0	0	5	33	Local	
	Porangahau river	1		35.31	500	a,b,c,d,f,g,h	PS,CT,RSB,NZPO,B-BG,R-BG,Bdo		0	1	3	1	3	3	0	11	5	Regional	
	Huatokitoki	1		17.15	50	a,d,h	PS,CT,RSB,NZPO,B-BG,R-BG,Bdo		0	1	2	1	1	0	0	5	33	Local	

Colour Code Key (as at 28 May 2012)

Significance thresholds (highlighted columns)

Green	High = National
Blue	Moderate = Regional
Yellow	Low = Local

Misc (highlighted rivers)

Pink	Rivers overlap with neighbouring council

Data reliability (font colour)

Blue/Purple	Less reliable data
Red	Data checked by Expert Panel and has been adjusted

APPENDIX 4: POTENTIAL SIGNIFICANCE ASSESSMENT CALCULATIONS FOR BIRDLIFE (RIVAS+)

			PRIMARY ATTRIBUTES							SCORING OF PRIMARY ATTRIBUTES								
			Step 6A: Apply indicators and thresholds							Step 6B: Apply indicators and thresholds						Step 8: River significance		
			1. Relative distinctiveness (Subj)	2. Amount of Habitat (Obj) - measured in area for braided rivers and distance for single channel rivers. Note that while some braided rivers also have single channel reaches it is the dominant habitat that is recorded		3. Numbers (Obj)	4. Foraging guilds (Obj)	5. Number of 'threatened or at risk' species present (Obj) (Note: 3 species not included: grey duck, NZ pipit, Australasian bittern - see main report for reasons)	6. Proportion of 'threatened or at risk' species present with a significant (>1% or >5%) proportion of their total populations (Obj/Subj)	1. Relative distinctiveness of habitat	2. Amount of Habitat	3. Numbers (ranked with SBBG removal adjustment)	4. Foraging guilds	5. Number of 'threatened or at risk' species present (Obj)	6. Species strongholds	Sum Weights 1	Sumweights2 RiVAS+	Overall evaluation of importance
			INDICATORS							INDICATOR THRESHOLDS								
River 'grouping' or river	River or section thereof	Interventions (choose from pick list)	1= Habitat type or species assemblage widely represented elsewhere in NZ; 2= Habitat type or species assemblage rarely represented elsewhere in NZ; 3= Habitat type or species assemblage not represented in other regions in NZ	ha for braided river birds	km for mainly single channel bird rivers	Number adjusted by removing SBBGs	Ranges from 0-8, i.e., a= open-water divers; b= deep water waders; c= shallow water waders; d= dabbling waterfowl; e= torrent specialists; f= aerial hunting gulls and terns; g= swamp specialists; h= riparian wetland birds	Principally: blue duck (BD), black stilt (BS), wrybill (WB), banded dotterel (BDo), black-fronted tern (B-FT), black-billed gull (B-BG), pied stilt (PS), NZ pied oystercatcher (NZPO), white-fronted tern (W-FT); red-billed gull (R-BG); Caspian tern (CT); southern crested grebe (SCG); NZ dabchick (DC)	Principally: blue duck (BD), black stilt (BS), wrybill (WB), banded dotterel (BDo), black-fronted tern (B-FT), black-billed gull (B-BG), pied stilt (PS), NZ pied oystercatcher (NZPO), white-fronted tern (W-FT); red-billed gull (R-BG); Caspian tern (CT); southern crested grebe (SCG); NZ dabchick (DC) - note that where surveys are based only on part sections then expert assessment is used to estimate proportionality.	1= low; 2= medium; 3= high	1=<5000ha and/or <10km; 2=5000-9999ha and/or 10-30km; 3= >10000ha and/or >30km	1=<1000 individuals; 2= 1000-4999 individuals; 3= >5000 individuals	1-4 = low = 1; 5-6= medium = 2; 7-8= high = 3	1=1; 2-3= 2; 4 or more = 3	0= no species with >1% of the total population; 1= 1 at 1-4.9% = low; 2= 2 at 1-4.9% = medium; 3= 1 or more > 5%, or 3 or more 1-4.9% = high	Standard	RiVAS+ score	**DSS**: If column 6, of Step 6B, (threatened spp >5%) = 3; or total score is 15 or more = national importance; if all columns 1-5 are 2 or less and column 6 is 0; or the total score <10 = local; otherwise regional
Northern coastal	Opoutama stream (includes swamp)		2		6.99	100	a,b,d,g,h	DC,	0	2	1	1	2	1	0	7		Local
	Kopuawhara stream		2		c.10	100	a,b,d,f,g,h	PS,CT	0	2	1	1	2	2	0	8		Local
Wairoa	Lake Waikaremoana catchment		1		c.50	100	a,b,d,e,h	BD	0	1	1	1	2	1	0	6		Local
	Waikaretaheke river		1		24.35	100	a,b,d		0	1	1	1	1	0	0	4		Local
	Waiau river		2		85.8	??500	a,b,d,e,h	BD, PS	0	2	3	1	2	2	0	10		Regional
	Ruakituri river		2		47.13	200	a,b,d,e,h	BD	0	2	2	1	2	1	0	8		Regional
	Mangapoike river		1		25	100	a,b,d,h	PS	0	1	1	1	1	1	0	5		Local
	Wairoa river		1	268	36.88	1200	a,b,c,d,fh	PS,BDo,B-BG,R-BG,W-FT,CT	0	1	2	2	2	3	0	10		Regional
Waikari	Waikari river (incl Anaura Stm)		1		30.47	200	a,b,c,d,e,f,h	BDo, PS, BD	0	1	2	1	3	2	0	9		Regional
Aropaouanui	Aropaouanui river/Waikoau		1		c.25	200	a,b,c,d,e,f,h	BDo, PS, BD	0	1	2	1	3	2	0	9		Local
Mohaka	Upper (above Te Hoe - includ tribs)	6b	3		c.200 +	1500	a,b,c,d,e,h	BDo, PS, BD	BD (5%)+	3	3(+0.5)	2	2	2	1(+2)	13	15.5	National
	Lower Mohaka river		1	88.6	50	300	a,b,c,d,f,h	BDo,PS,CT	0	1	1	1	2	2	0	7		Local
Esk	Esk river		1		30.47	200	a,b,c,d,e,f,h	BDo, PS, BD	0	1	2	1	3	2	0	9		Regional
Tutaekuri	Mangaone river		1		33.01	100	a,b,d,h		0	1	2	1	1	0	0	5		Local

	Upper (Mangatutu & above)			1		c.60	100	a,c,d,h	BDo		0	1	2	1	2	1	0	7		Local
	Lower	3c, **3f**		2	285.6+	c.30	1400+	a,b,c,d,f,h	BDo,PS,NZPO	BDo(c.1%)+, PS		2	2(+0.5)	2(+0.5)	2	2	1(+0.5)	11	12.5	Regional
Ngaruroro	Upper (Whanawhana cableway)			2		>50	500	a,b,d,e,h	BD,BDo,PS	BD (1% if pop 3000)		2	2	1	2	2	1	10		Regional
	Lower (below)	3c		1	1596.5+	115.93	1300+	a,b,c,d,f,h	BDo,PS,NZPO,B-BG,CT,R-BG	BDo (2.5% - 480),PS+		1	3(+0.5)	2(+0.5)	2	3	1(+0.5)	12	13.5	Regional
Karamu/Urban	Upper (Poukawa, Awanui, Karewarewa stream			2		29.92	1000	a,b,c,d,f,g,h	PS,DC,BDo,B-BG,CT		0	2	2	1	3	3	0	11		Regional
	Muddy Creek			2		2	500	a,b,c,d,f,g,h	PS,BDo,CT,DC,RSB		0	2	1	1	3	3	0	10		Local
	Lower (Clive, Ruahapia stream, Irongate, Raupare			1		11.85	500	a,b,c,d,f,g,h	PS,R-BG,B-BG,CT,W-FT		0	1	2	1	2	2	0	8		Local
	Havelock stms (Mangarau stream, Here Here stream)			1		20	200	b,c,d,h	PS		0	1	2	1	1	0	0	5		Local
Ahuriri	Taipo stream			1		10	200	a,b,d,g,h	PS,DC,CT		0	1	1	1	2	2	0	7		Local
Tukituki	Makaretu stream			1		31.24	150	a,b,c,d,h	BDo,PS		0	1	3	1	2	2	0	9		Regional
	Upper (HW 50 above)			1		c.100	c.1000	a,b,c,d,e,f,h	BD,BDo,PS	(BD possibility - if 20-30 birds)		1	3	1	3	2	1	11		Local
	Lower (downstm, incl Porangahau stream)	3c,6b,**3f**		3	2000+		3000+	a,b,c,d,f,g,h	BDo, B-BG, PS, NZPO, W-FT, RBG, CT, WH,RSB	BDo (5%); PS(1.5%)+		3	1(+0.5)	2(+0.5)	3	3	3(+0.5)	15	16.5	National
	Tukipo river			1		33.14	200	a,b,c,d,h	BDo,PS		0	1	2	1	2	2	0	8		Regional
	Makaroro river	6b		1		17.79	200	a,b,c,d,e,h	BDo, BD,PS	BD: 6 to 9 pairs +		1	1	1	2	2	0(+0.5)	7	7.5	Local
	Mangaonuku river			1		18.67	200	a,b,c,d,g,h	BDo,PS		0	1	2	1	2	2	0	8		Local
	Waipawa river			1		37.27	200	a,b,c,d,h	BDo, PS		0	1	3	1	2	2	0	9		Regional
	Tukituki river (tributary in own right)			1		c.50	200	a,b,c,d,h	BDo, PS		0	1	3	1	2	2	0	9		Regional
Southern Coastal	Maraetotara river			1		35.24	150	a,b,c,d,h	BDo,PS		0	1	3	1	2	2	0	9		Regional
	Waingongoro stream			1		8	100	b,c,d,h	PS		0	1	1	1	1	1	0	5		Local
	Puhokio stream			1		12.5	100	a,b,c,d,f,h	PS,B-BG,R-BG		0	1	2	1	2	2	0	8		Local
	Mangakuri stream			1		17.48	50	a,b,d			0	1	2	1	1	0	0	5		Local
	Porangahau river			1		35.31	500	a,b,c,d,f,g,h	PS,CT,RSB,NZPO,B-BG,R-BG,Bdo		0	1	3	1	3	3	0	11		Regional
	Huatokitoki			1		8	50	a,h			0	1	1	1	1	0	0	4		Local

Colour Code Key (as at 28 May 2012)

Significance thresholds (highlighted columns)

Green	High = National
Blue	Moderate = Regional
Yellow	Low = Local

Misc (highlighted rivers)

Pink	Rivers overlap with neighbouring council

Data reliability (font colour)

Blue/Purple	Less reliable data
Red	Data checked by Expert Panel and has been adjusted

RiVAS+ (highlighted rows)

Blue	Also assessed for potential future state (RiVAS+)
Orange	Score changed by proposed interventions (RiVAS+)
Green	Positive influence on attribute but not enough to shift value - counted as an increase of 0.5 (RiVAS+)

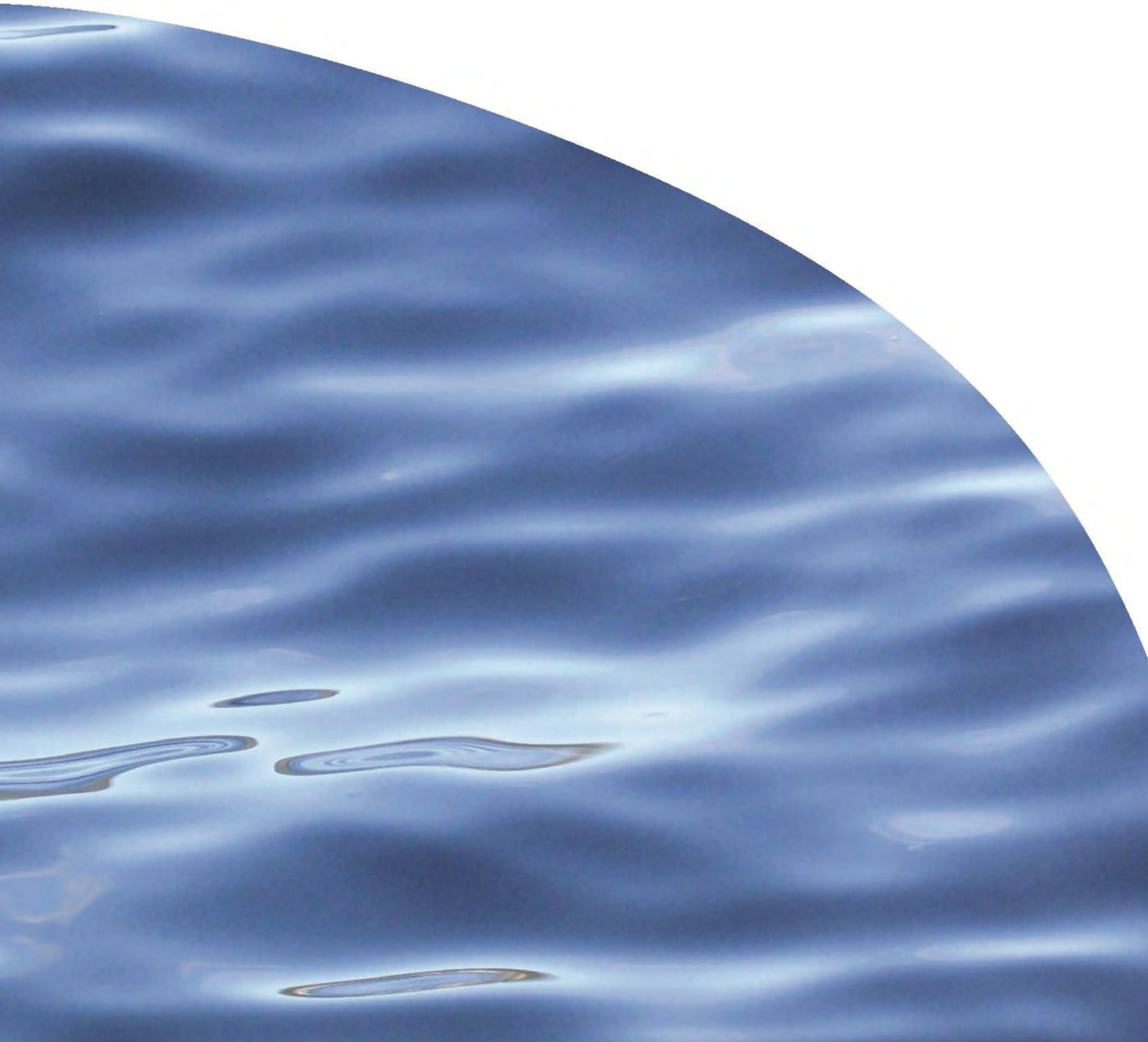
F

APPENDIX F

Effects on Instream Species in Hawke's Bay Rivers (Cawthron Institute)

REPORT NO. 2968

EFFECTS OF GRAVEL EXTRACTION AND BEACH RAKING ON KEY INSTREAM SPECIES IN HAWKE'S BAY RIVERS



EFFECTS OF GRAVEL EXTRACTION AND BEACH RAKING ON KEY INSTREAM SPECIES IN HAWKE'S BAY RIVERS

ROBIN HOLMES

Prepared for Hawke's Bay Regional Council

HBRC Report No. AM17-01 HBRC Plan No. 4915

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EXECUTIVE SUMMARY

The Hawke's Bay Regional Council (HBRC) is responsible for maintaining flood protection infrastructure throughout the major braided river systems in the Heretaunga Plains. These include the Tukituki, Waipawa, Ngaruroro, Esk and Tutaekuri. Gravel extraction and beach raking from dry river bars are tools HBRC uses to maintain flood-flow capacity and reduce erosion of flood control infrastructure.

This report identifies the potential effects of these gravel management activities on key instream fish species. Recommendations for information requirements and monitoring are made along with some appraisal and suggestions of good gravel management practices.

Broadly, large aggrading braided rivers such as those in the Hawke's Bay Gravel Management Areas (with the exception of the Esk) can be considered relatively resilient to gravel extraction, when compared with small single thread rivers. In addition, the current (draft) code of practice for river works affords a pragmatic level of protection for instream ecology, given the need to maintain effective flood protection infrastructure. However, the ability to assess the potential instream effects of gravel management in Hawke's Bay is currently very limited because of sparse ecological and geomorphological data.

We suggest the following studies and monitoring projects could be implemented over time to fill information gaps:

1. Catalogue the frequency, extent and duration of channel management events that require machinery to cross wetted channels (side braids included). This information could be supplied as part of a consent condition (for example).
2. Assess the severity, extent and duration of turbidity plumes that result from re-suspended sediment below any gravel extraction areas that require machinery to cross wetted channels during works.
3. Undertake long-term (at least annual) substrate and invertebrate community monitoring at gravel management reaches and paired upstream control reaches.
4. Engage a qualified river geomorphologist to assess the response of channel form to gravel extraction and beach raking, using indicators of channel complexity that can be identified on aerial photography. Initially, by using existing aerial photography to compare managed and unmanaged reaches, this study should take a space-for-time substitution approach.
5. Collect aerial imagery (e.g. using a UAV) after bed-defining flood events (at least annually) at gravel management reaches and paired upstream control sites. Once a time series of imagery data is developed, it could be analysed for changes in channel complexity indicators over time.
6. Undertake visual assessments to assess the potential for fish stranding in gravel extraction depressions at gravel extraction areas following floods.

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LIST OF APPENDICES

1. INTRODUCTION

Hawke's Bay Regional Council (HBRC) is reviewing the management of the river gravel resource. This exercise includes investigating the potential effects of gravel management activities on the region's braided river ecosystems. A report on the effects of gravel extraction on terrestrial ecology has been completed. Key findings and actions have been incorporated into a (draft) Environmental Code of Practice (COP) for River Control and Waterway Works (HBRC 2015). For example, river bed activities are now restricted to occur outside selected native river-bird nesting periods. Other terrestrial ecological values (e.g. native lizards and riparian vegetation) are being considered under individual catchment ecological management and enhancement plans.

The focus of this report is on the potential effects of riverbed gravel extraction and riverbed beach raking (henceforth: raking) on aquatic ecological heath. For context, it is important to note that the foremost management priority for the HBRC under the gravel management plan is '… the protection of human life and property through the design and efficient operation of river and flood control works...' In addition, the management plan also acknowledges that…'where the demands of flood management allow, the management plan aims to maximise benefits to ecology from Scheme management'.

1.1. Report aims

Specific aims in this report are to:

1. identify the potential effects of riverbed gravel extraction in the Hawke's Bay braided rivers on significant instream species (including native fish and introduced salmonids)
2. identify monitoring programmes that will assist with providing aquatic ecological information for improving ongoing management of the resource
3. outline best practice in managing gravel extraction and raking given the river management, economic and ecological interactions.

2. GRAVEL MANAGEMENT IN HAWKE'S BAY BRAIDED RIVERS

The Hawke's Bay Regional Council is responsible for maintaining flood protection infrastructure throughout the major braided river systems in the Gravel Management Area (GMA) of the Heretaunga Plains. These include the Tukituki, Waipawa, Ngaruroro, Esk and Tutaekuri rivers. As part of maintaining flood protection infrastructure HBRC undertakes targeted gravel extraction and raking (Figure 1).

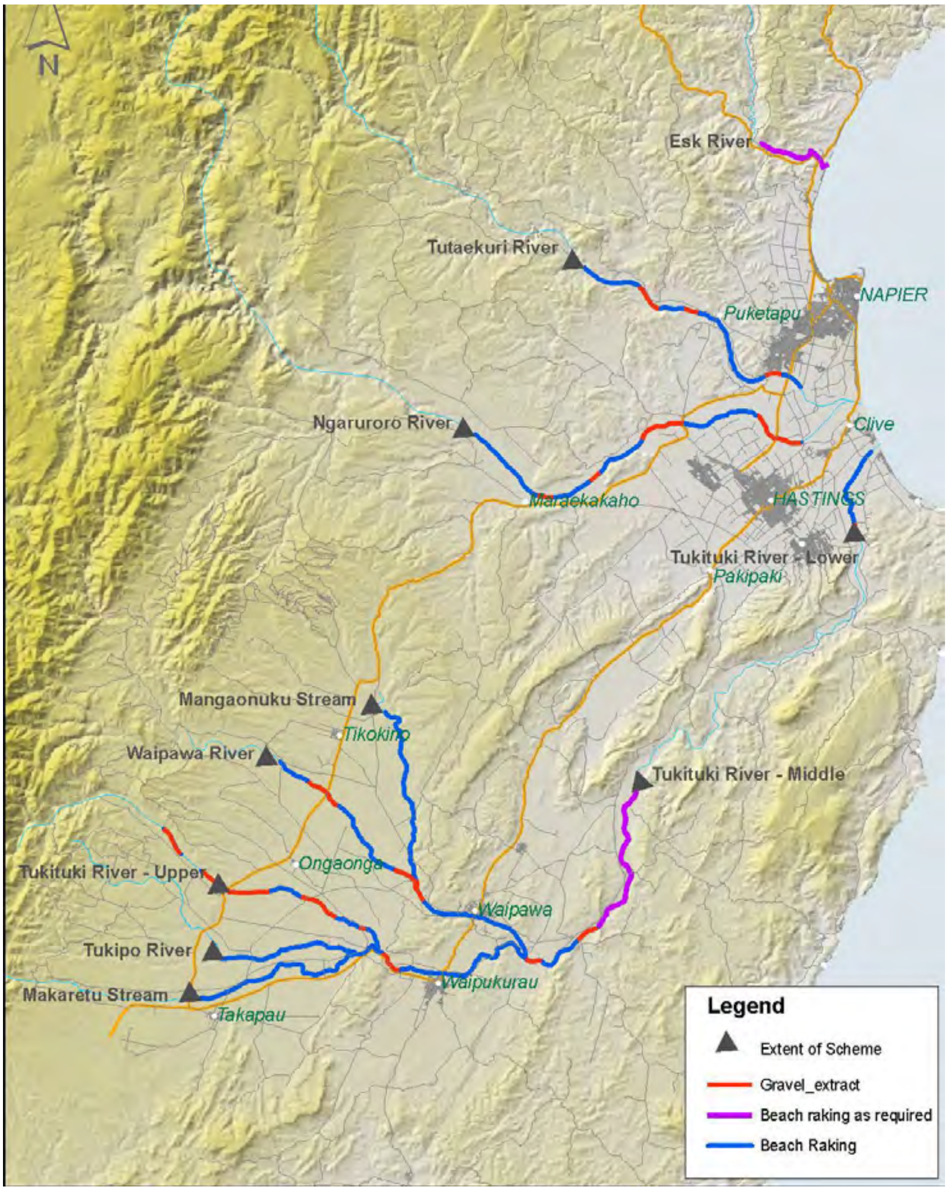

Figure 1. Extent of gravel extraction and beach raking in the Heretaunga Plans area. The extent of the gravel management area is shown by the grey triangles (image sourced from HBRC 2015).

Gravel extraction and raking are targeted at locations where the mean riverbed level is above the design bed profile. Gravel extraction and raking are undertaken to reduce aggradation of gravel within the managed channel. In turn, this maintains flood flow capacity and prevents lateral channel movement and subsequent erosion of flood protection infrastructure (such as stopbanks). Raking also helps to prevent the establishment of plants (e.g. tree lupin) that lock up river gravels with root wads. Essentially, gravel extraction and raking is undertaken in an attempt to maintain flood channel capacity for a range of flows up to the peak flow of a 100-year return period.

2.1. Dry river bar gravel extraction

The mode of gravel extraction within active channel areas of the GMA is limited to skimming gravel beaches on dry river bars during low flow periods (Gary Clode, HBRC river engineer, pers. comm.). By avoiding the low-flow wetted channel area this method limits the direct disturbance effects of gravel mining on instream ecology. Nevertheless, Rempel and Church (2009) consider that the *indirect* ecological effects of gravel mining, those transmitted through effects on the habitat template, are likely to have the greatest impact on river ecosystems. Morphological effects on channel structure will occur after bed defining flows inundate, and interact with, extraction areas on the river bars.

In common with Gray and Harding (2007), I could not find any New Zealand-specific research on the instream ecological effects of gravel extraction in braided rivers. However, there is a reasonably large body of international literature, particularly from the United States, that has investigated issues related to river gravel extraction in a range of river types including braided rivers (e.g. see reviews: Kondolf 1997; Kondolf et al. 2001; USA Fish & Wildlife Service 2006). The consensus among the international experts is that gravel extraction can have profound effects on the structure of a river—reducing the quality and quantity of habitat for instream biota—although the effects largely depend on the balance between extraction rates and amounts and gravel supply. Based a review by Packer et al. (2005), dry riverbed gravel mining can potentially:

1. create a wide, flat channel cross section in the extraction reach reducing the confinement of the low flow channel and increasing channel instability (Kondolf 1994, 1997).
2. disrupt the pool-riffle sequence and pool morphology, creating longer pools and less riffle area (Pauley et al. 1989; Weigand 1991)
3. reduce the occurrence and amount of side channels areas (Pauley et al. 1989; Weigand 1991)
4. reduce the sediment transport capacity in extracting reaches because of an increased width to depth ratio, causing deposition and subsequent channel instability (Kondolf 1998)

5. cause head-cutting leading to upstream channelisation and streambed armouring (Kondolf 1997)
6. cause bed degradation that lowers the water table causing desiccation of off-channel habitat (e.g. floodplain wetlands)
7. cause bed degradation immediately downstream of the extraction reaches because during flooding, sediment-deficient flow picks up more sediment (Kondolf 1997)
8. remove the gravel ‘pavement,’ or armoured layer leaving the finer subsurface particles more vulnerable to entrainment (erosion) during freshes (Kondolf 1994, 1998; OWRRI 1995)
9. create depressions in gravel bars formed from extraction activities which may lead to fish stranding following flow recessions—fish may be left in the depressions rather than making their way back to the main channel.

In general, small (e.g. wadeable) single channel rivers, with headwater dams or limited sediment supplies, are the most vulnerable to gravel extraction (Kelly et al. 2005). Conversely, large aggrading braided rivers, such as those in the Hawke’s Bay GMA (with the exception of the Esk) are considered to be the most resilient (Brown et al. 1998; Rempel & Church 2009). In such rivers, the effects of extraction may be insubstantial relative to natural disturbance events. For example, Davis and Paukert (2008) found that gravel bar skimming in the Neosho River (Kansas USA) had no population level effect on a small riffle-dwelling catfish (Neosho madtom *Noturus placidus*), which occupies a broadly similar niche to the NZ torrentfish.

2.2. Dry river bar beach raking

Beach raking involves dragging a tractor-mounted ripper across exposed gravel bars during low flows (Figure 2). The aim is to disturb the armoured gravel layer and uproot plants before they can get established and stabilise the beach gravels. In theory, this will increase downstream gravel transport during river freshes and floods (Warman 2013).

Figure 2. Gravel bar ripper tractor trailer assembly (figure reproduced from Warman 2013).

The management goal is to prevent the formation of stable islands or beach bars which cause lateral shifts in the flow meander. If stable armoured lateral channels develop, this increases the potential for erosion by undercutting flood protection infrastructure along the banks (Gary Clode, HBRC river engineer, pers. comm.).

Raking does not occur within the wetted channel. Therefore, its ecological effects are largely limited to potential morphological changes to the river habitat template following bed-defining floods. I could not find any literature (local or international) on the effects of raking on instream ecology.

Gravel raking encourages the transport of gravel down the river corridor and a more even distribution of gravel throughout the managed river channels. Therefore, it follows that raking will to some degree counteract some of the potential morphological changes that occur as a result of gravel extraction. These include upstream or downstream degradation (caused by locally depleted areas of gravel). Raking potentially has the following effects on river habitat in common with gravel extraction:

1. reduced confinement of the low flow channel and increased channel instability
2. disruption of the pool-riffle sequences and pool morphology
3. reduced occurrence and amount of side channel areas
4. removal of the armoured layer leaving the finer subsurface particles more vulnerable to entrainment (erosion) during freshes and floods.

3. NATIVE FISH AND FISHERY SPECIES IN THE GRAVEL MANAGEMENT AREA AND THEIR HABITAT REQUIREMENTS

The focus of the following sections is to briefly detail the instream requirements of ‘significant instream species’ that have biodiversity and / or fishery values to set the stage for the monitoring recommendations.

3.1. Native fish

The typical native fish communities of the braided rivers within the GMA are shown in Table 1. Using the RiVAS (River Values Assessment System) framework, Hughey et al. (2012) identified three of the rivers in the GMA (the Tukituki, Ngaruroro and Tutaekuri) as nationally significant native fish habitats. Indeed, several of the species recorded from the Hawkes Bay braided river catchments, including torrentfish, bluegill bully and longfin eel are listed as ‘At Risk, Declining’ in the latest threat classification listings (Goodman et al. 2014). Given their conservation status, any actions that can preserve habitat for these species should be considered a management priority. In particular, the GMA rivers are considered to be strongholds for populations of torrentfish and bluegill bullies (Andy Hicks, HBRC ecologist, pers. comm.).

Table 1. Fish species recorded in the New Zealand Freshwater Fish Database from the mid reach mainstem of the Tukituki, and Ngaruroro catchments and their national threat classification from Goodman et al. (2014). 'At risk' species are highlighted in grey.

Common Name	**Scientific name**	**Threat classification**
Redfin bully	*Gobiomorphus huttoni*	At Risk, Declining
Longfin eel	*Anguilla dieffenbachii*	At Risk, Declining
Torrentfish	*Cheimarrichthys fosteri*	At Risk, Declining
Rainbow trout	*Oncorhynchus mykiss*	Introduced and Naturalised
Common bully	*Gobiomorphus cotidianus*	Not Threatened
Brown trout	*Salmo trutta*	Introduced and Naturalised
Shortfin eel	*Anguilla australis*	Not Threatened
Bluegill bully	*Gobiomorphus hubbsi*	At Risk, Declining
Inanga	*Galaxias maculatus*	At Risk, Declining
Giant bully	*Gobiomorphus gobioides*	Not Threatened
Koaro	*Galaxias brevipinnis*	At Risk, Declining
Dwarf galaxias	*Galaxias divergens*	At Risk, Declining
Black flounder	*Rhombosolea retiaria*	Not Threatened
Yellow-eyed mullet	*Aldrichetta forsteri*	Not Threatened
Gambusia	*Gambusia affinis*	Introduced and Naturalised
Crans bully	*Gobiomorphus basalis*	Not Threatened
Common smelt	*Retropinna retropinna*	Not Threatened

3.1.1. Torrentfish, bluegill bullies, small longfin eels (< 400 mm), koaro, redfin bullies

All these species prefer riffle habitat with moderate to swift water velocities (McDowall 2000; DOC in prep.). Some differences in substrate preferences exist between the species, with bluegill bullies and torrentfish preferring finer gravels and juvenile longfin eels, redfin bullies and koaro preferring coarse gravels and cobbles. The spawning requirements of these fish are varied. Torrentfish are thought to spawn in gravel substrates. Bluegill bullies spawn amongst large boulders or instream vegetative debris. Koaro spawn in areas alongside adult habitat during high flows in damp areas of stream bed margins (koaro spawning is likely to be limited to smaller tributaries outside the GMA). Redfin bullies spawn in unconsolidated gravels in slower flowing areas of riffle crests (McDowall 2000; DOC in prep.).

3.1.2. Dwarf galaxiids

Dwarf galaxias do not require access to the ocean or estuaries—unlike all the other 'at risk' diadromous species highlighted in Table 1. They are expected to be more common in the river headwaters and the upper parts of the GMA catchments. Dwarf galaxias prefer riffle habitat with unconsolidated coarse substrate and moderate velocities (McDowall 2000). They also have a strong affinity for side-channel habitats, often occupying riffles in small shallow side braids, possibly to avoid predation (Hay 2009). The spawning requirements of dwarf galaxias are unknown but they are likely to spawn in the same habitat as the adults reside (McDowall 2000).

3.1.3. Large longfin eels

Large longfin eels prefer moderate velocity riffle habitat for nocturnal feeding and deep pool (e.g. > 1 m) and / or slow runs with undercut banks and instream vegetative debris for day time hiding habitat (McDowall 2000). They do not breed in freshwater.

3.1.4. Inanga

Inanga tend to occupy slow flowing runs in the lower areas of a catchment. They spawn in dense stream edge vegetation during spring tides at the upper extent of the tidal intrusion zone (DOC in prep.). Note that HBRC has mapped inanga spawning habitat (draft COP) and no gravel extraction or raking activity takes place in these locations.

3.2. Salmonids

The major braided rivers in the flood management areas of the GMA all support regionally important trout fisheries. The Tukituki is by far the most popular fishery (Table 2). In addition, the headwater area of the Ngaruroro (outside the GMA) is considered to be a nationally significant backcountry fishery (Tierney et al. 1982).

Table 2. Trout angler use data for rivers in the Gravel Management Area for the 2007 / 2008 season (Unwin 2009).

River	Angler visits in the 2007 / 2008 season
Tukituki (Waipawa–Patangata)	3838
Tukituki (below Patangata)	2920
Ngaruroro (below Tarurarau)	1680
Tutaekuri	4780
Esk	870

Rainbow trout are the dominant species and are widespread throughout the river systems with lower numbers of brown trout in the lower reaches and spring fed tributaries (Richardson et al. 1984).

There are no reliable trout abundance or density estimates because the rivers are considered too turbid to be regularly drift dived (the standard method used to assess adult trout numbers and distribution) (Maxwell undated). Anecdotally, it is thought that the bulk of the adult rainbow trout populations in these rivers are highly mobile (Maclean 2011). For instance, parts of the mid-reaches of the Tukituki and Waipawa can become very low and warm during mid to late summer. The warm temperatures and excessive algal growths temporarily reduce the quality of the trout habitat in these reaches (Ausseil 2008). It is perceived that large numbers of trout move from the warm water reaches to the upper catchment and / or lowland tributaries until higher and more variable flows resume in autumn (Maxwell undated). However, a recent study of rainbow trout migratory life-history in the Ngaruroro, which is the most unstable river in the GMA, found that the headwater population is relatively distinct from the lower river population (Gabrielsson & Goodwin 2013).

Trout spawn in unconsolidated (golf ball-sized) gravels, usually at the tail of a pool or in shallow moderate velocity runs. Most of the upper mainstem rivers and headwater tributaries of the GMA catchments appear to provide adequate spawning habitat. The exception would be the Ngaruroro mainstem which appears to be too unstable (pers. obs. by author). Rainbow trout spawning effort may occur extensively throughout the catchments tending to be most prevalent in the headwater streams. Brown trout are known to focus spawning effort in lowland spring creek tributaries of the catchments (Richardson et al 1984; Mclean 2011).

Migration periods for trout are shown in Appendix 1. Emerging trout fry require slow velocities and use edge habitat with vegetation in slow runs. Juvenile trout preferentially occupy riffle habitat with coarse substrata, although they will also occupy runs with moderate velocities and pools during the night (Armstrong et al. 2003).

Adult riverine brown and rainbow trout tend occupy deep water (e.g. > 0.5 m) and prefer moderate velocities (0.3–0.8 m/s). In addition, velocity shear zones (for example, at the velocity boundary between a fast run and a pool, or present around bank protrusions along runs) are also important features of adult trout habitat. This is because they provide an opportunity for efficient drift feeding. Trout can conserve energy in ‘slow’ water whilst actively feeding in adjacent fast water that has higher rates of drifting invertebrates (Hayes et al. 2000).

4. EFFECTS OF GRAVEL MANAGEMENT IN RELATION TO FLOOD PROTECTION INFRASTRUCTURE

Before considering the effects of gravel management activities on key instream species it will be necessary to define the potential morphological effects. However, defining the morphological changes in the GMA which occur as a result of gravel management, is complicated as the extensive stop-banks that have been in place for decades are also likely to have had a major effect on river morphology. The stop-banks effectively constrain the channel and force it to adopt a more single-thread form with reduced lateral activity (Fuller & Basher 2013; Fuller et al. 2014). For context, Figure 3 shows the effects of stopbanks on river morphology and gravel extraction in the Waimea River (Tasman District).

Figure 3. The Waimea River (Tasman District) before (upper) and after (lower) stop-banks were instated showing the simplification of channel form after flood protection infrastructure.

Before extensive flood protection infrastructure, the rivers in the GMA in their 'natural' state would probably all have had wider flood plains with multiple shifting threads and islands. However, the stopbanks are now a permanent and necessary feature of the GMA landscape to protect land from flooding. Separating the effects of stopbanks from gravel extraction would be very difficult. This is because the two have occurred simultaneously during the development of the region. Nevertheless, some investigation of the ecological effects of gravel extraction *within* the constraints of the channel stopbanks is warranted. Gravel management activities can be considered in terms of whether they exacerbate or counteract the effects of extensive flood protection infrastructure on instream ecology.

5. POTENTIAL EFFECTS OF GRAVEL MANAGEMENT ON KEY INSTREAM SPECIES

Apart from the widely spaced river cross-sectional data that are used to inform river bed levels, I am not aware of any information on the effect of gravel extraction on channel form in the GMA. Therefore, based purely on the generic principles given in Section 2, below I provide some possible key species-specific effects of the gravel management activities. It must be noted that there is currently no information available to define the severity of these potential effects on fish populations, relative to other naturally-occurring stressors such as floods.

5.1. Torrentfish, bluegill bullies, juvenile longfin eels, koaro, redfin bullies

Because all these fish are predominantly riffle dwellers, any activity that affects the amount of riffle area or reduces the occurrences of shallow (e.g. < 0.3 m) and fast (0.3–1 m/s) areas of river will impact these fish (Jowett & Richardson 1995). Gravel extraction may encourage down cutting resulting in longer areas of single thread river with proportionally less riffle and larger areas of slow run and / or shallow pool habitat (Packer et al. 2005; Fuller & Basher 2013). However, to some degree gravel raking would counteract this effect by increasing the downstream supply of gravel and encouraging a more dynamic braided morphology.

5.2. Dwarf galaxias

The potential reduction of side channel habitats through gravel extraction and raking may reduce available habitat for dwarf galaxias. Side channels and riffle / seeps (i.e. good dwarf galaxias habitat) often form at the lower bank-edge end of gravel bars and may be connected by a thin braid from the upstream leading edge of a gravel bar (or by shallow groundwater at low flows). Flattening of the bar profile through gravel extraction and raking could reduce the occurrence of these habitats by reducing the tendency of a river to form stable river islands (Fuller & Basher 2013).

5.3. Large longfin eels

Riffle areas are rich with macroinvertebrates and forage fish. Therefore, if gravel management activities reduce riffle area then this would reduce profitable nocturnal feeding locations for eels. During the day, large eels have a strong affinity for deep water and / or vegetative edge cover. In general, instream cover (e.g. woody debris) is in short supply in the shallow braided rivers of the GMA (pers. obs. by author). Therefore, eels are likely to favour areas of the rivers that are in contact with riparian vegetation. Any management action that encourages the river away from the riparian margins has potential to reduce the amount of large eel daytime hiding habitat. At present, it is unknown if gravel management activities would increase or decrease the amount of contact the river has with vegetated riparian margins. Currently the management aims are to encourage a meandering pattern with alternating left and right bank edge contact.

5.4. Inanga

Gravel extraction has potential to increase habitat for these species by creating more slow-run habitat (Packer et al. 2005). Spawning habitat for these species is in estuary areas and is therefore unlikely to be affected by gravel extraction.

5.5. Juvenile rainbow and brown trout

Juvenile trout habitat may be reduced if gravel management activities reduce the amount of riffle area. In addition, riverine trout are predominantly drift feeders. Therefore, elevated turbidity levels will impair growth rates by reducing foraging efficiency (Hayes et al. 2000; Armstrong et al. 2003). Elevated turbidity levels could result either from machinery accessing the wetted channel or through raking disturbing the armour layer and increasing the potential for fine sediment entrainment during high flows.

5.6. Adult rainbow and brown trout

In general, reducing lateral channel movement and concentrating flow into a single thread has the potential to improve adult trout habitat in large rivers by increasing average depths and velocities. In contrast, any management action that reduces the *frequency* of deep pools, over a given length of river, could reduce the amount of velocity shear zones that enable efficient drift feeding. Furthermore, reducing the riffle area will reduce juvenile trout habitat and the amount of macroinvertebrate and forage-fish food producing habitat (Brown & Brussock 1991). This may cause flow-on negative impacts on the adult population despite increased average depths (Baran et al. 1997; Heggenes et al. 1999; Armstrong et al. 2003).

5.7. Substrate effects of gravel management (which could affect macroinvertebrates and fish)

If gravel management activities (raking in particular) affect the substrate characteristics downstream in the low flow channel area, either by altering grain size or increasing deposited and intra-gravel fine sediment levels, then this will have flow-on effects for macroinvertebrate communities—the food base for fish and riverine birds. Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa tend to be relatively large macroinvertebrates which are more prone to be entrained in the drift and therefore they are considered to be of higher food quality for drift-feeding fish. EPT taxa tend to prefer gravel and cobble substrates with low levels of intra-gravel fine sediment. A reduction in the substrate quality, as defined by its ability to support EPT taxa, will reduce food quality for trout (and maybe eels and other native fish as well) (Shearer et al. 2003).

There is currently not enough information to determine if gravel management activities improve or degrade low flow channel substrate quality for EPT taxa. It is plausible that gravel extraction and raking will affect the quality of substrate in the low flow channel. Warman (2013) attempted field studies to investigate the effects of raking on sediment grain size distribution (and active channel topography) in the GMA rivers. These studies would have provided valuable insights into potential ecological effects of gravel management but were not completed.

6. INFORMATION REQUIREMENTS TO INFORM AN ASSESSMENT OF POTENTIAL EFFECTS ON KEY INSTREAM SPECIES

6.1. Fish population monitoring

Monitoring the GMA river fish populations over a sufficient area and over a long enough period to determine a response to localised gravel management activities is likely to require an impractical amount of resources. Any cumulative effects of the various gravel management activities on fish will potentially be dispersed throughout the entire rivers’ fish populations. In addition, the GMA rivers are large and prone to flooding. Therefore, the effects of flooding on the fish population will create substantial noise in any time series data set. Furthermore, gravel management activities are undertaken sporadically based on management needs. This will complicate site selection and potentially compromise the development of a time series fish-data set because extraction rates and locations may change. I suggest that a more fruitful approach to assessing the effects of gravel management on key fish values will be to measure habitat structure and then infer effects on fish through knowledge of their habitat requirements. Without fish population data, the question of whether the catchment’s fish populations will be affected by any measured habitat changes will remain. However, a conservative management approach would be to take practical steps to limit the reduction of good quality habitat for key instream species with high biodiversity and / or fishery values.

6.2. Machinery access causing direct disturbance of ecosystem

Where machinery accesses the wetted channel there is likely to be localised damage to the stream ecosystem through direct disturbance (Hay & Gabrielsson 2016). Gary Clode (HBRC river engineer) suggests that much of the braided river bermlands in the management area are accessible. Therefore, these disturbance events are probably limited in extent. Moreover, the gravel management (draft) COP already suggests that machinery should only enter the wetted channel if there is no other access option. Machinery access across wetted channels is further restricted to periods outside of May–September to protect trout spawning values (HBRC 2015). Given the scale of the rivers in the GMA relative to the potential scale of the extraction activities, I suggest that the short term direct disturbance effects of some machinery within the wetted channel are unlikely to impact on fish at the population level. Nevertheless, because the localised effects of machinery in the wetted channel are obviously bad for river ecosystems, I recommend documenting the frequency and extent of gravel management operations that require access through wetted channels (including side braids). Once the degree of machinery activity within the wetted channels is known, the affected areas can be placed in context with the amount of un-impacted river (both in terms of extent and duration).

6.3. Machinery access and gravel extraction resulting in increased turbidity

Extraction operations are restricted to occur within areas no closer than one metre from the wetted river channel edge under the new (draft) COP (HBRC 2015). This restriction is important because it means that mechanical disturbance and the resuspension of fine sediment during low flows is limited. However, in practice a one-metre buffer may not allow much tolerance between gravel works and the wetted channel. In addition, resuspension of fine sediments will occur from machinery accessing gravel bars across side braids and in areas where there is no bank access (e.g. see Figure 4, lower photograph).

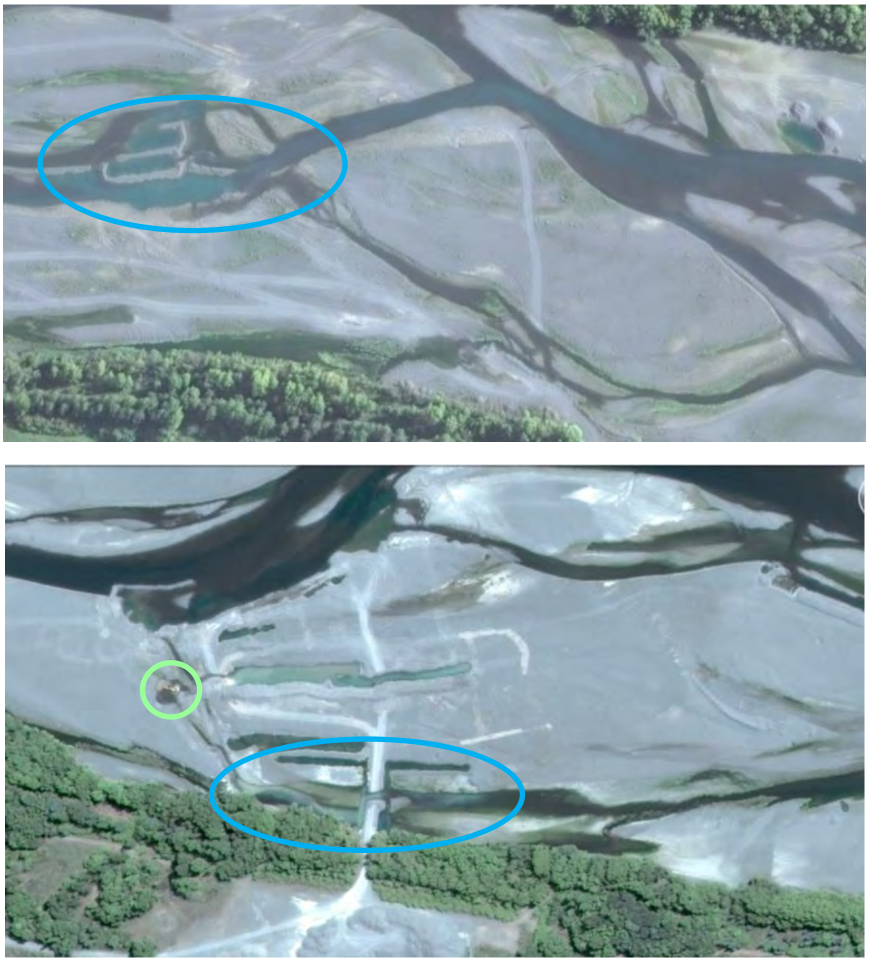

Figure 4. Aerial imagery of a gravel extraction site in the Ngaruroro River downstream of Maraekakaho during 2015 (top) and 2016 (bottom). Note turbidity plumes in side braids (light blue and brown coloured water within blue ovals) indicating elevated levels of suspended fine sediment. Turbidity plumes are associated the bunded gravel areas (top blue oval) and machinery crossing areas (bottom blue oval). Machinery can be seen working under green circle (bottom).

To assess the potential for resuspension of fine sediment, as a result of gravel extraction works, I suggest monitoring turbidity levels around an extraction reach(s) that requires machinery access across river braids. This could be achieved by installing continuous turbidity loggers upstream of the works and at regular increments downstream of the extraction area (e.g. every 100 m for 300 m). Braiding patterns should also be considered when placing the loggers. For instance, below the convergence of two braids to account for dilution from unaffected braids. This study will determine the severity of turbidity plumes and typical resettlement distances. Hay & Gabrielsson (2016) provides a suitable methodology for this study in detail.

6.4. Turbidity effects of inundated raked beaches

Breaking up the armour layer of river bars through raking will increase the entrainment of fine sediment during high flows. It is unclear whether this will cause an increase in turbidity to levels that would have ecologically meaningful effects, e.g., by reducing the visual clarity of river water to levels that would reduce fish feeding efficiency. The GMA rivers are naturally very turbid during high flows. Therefore, I suggest that the increased suspended solids during freshes and floods through raking will be insubstantial—relative to background turbidity levels. In any case, determining if there are increases in high flow turbidity levels as a result of raking would be impractical.

6.5. Substrate and macroinvertebrate community effects

At present it is unknown how gravel management activities affect substrate quality. Clapcott et al. (2011) provides a set of sediment quality assessment protocols that could be used to develop a time series of data from the regularly managed reaches. Because of the large scale of the GMA rivers I recommend using assessment protocol 2 (instream visual assessment of percent fines) and protocol 3 (Wolman pebble count) to monitor the substrate in terms of its quality as macroinvertebrate and fish habitat. I suggest selecting three impact sites with paired upstream control sites in each GMA river. If resourcing would allow, this study would be complemented by taking annual quantitative macroinvertebrate Surber samples at each site (both impact and control sites according to Protocol C3 in Stark et al. 2001). Six macroinvertebrate samples should be taken at each site as a minimum (Wood et al. 2014). Macroinvertebrate data could be interpreted with standard community health metrics (e.g. %EPT abundance), as well as emerging macroinvertebrate community indices that link macroinvertebrates to fish values based on their quality as a food resource (Matherson et al. 2016).

6.6. Channel form effects

Gravel extraction and raking will potentially encourage a more simplistic channel form within the GMA (Fuller & Basher 2013). Beyond the broad cross-sectional data that is collected to assess river bed levels, I am not aware of any quantitative data available on the response of the river channel to gravel extraction or raking in any of the GMA rivers.

Broad-scale analysis

A simple and (relatively) low cost broad-scale approach to assessing how the river channel responds to gravel management would be to analyse existing aerial photographs. Imagery of managed and non-managed reaches could be examined using GIS to determine if there are any differences in key river channel complexity indices. This desktop study could be done initially using a space-for-time substitution approach over the entire GMA. Fuller et al. (2014) provides a simplified list of channel complexity indices that can be identified on aerial imagery including: sinuosity, braiding index, frequency of pools and thalweg length. These indices were developed as part a framework for assessing the natural character of large New Zealand rivers like those in the GMA. The length of river in contact with vegetated riparian margins could be another useful habitat metric to measure that would indicate ideal large eel and trout daytime hiding habitat. Following an initial space-for-time study, I suggest collecting and cataloguing annual (at least) aerial photography (e.g. by unmanned aerial vehicle or satellite) at regularly managed segments and paired upstream unmanaged controls sites. This would enable a time series dataset to be developed. Analysing time series imagery using the same channel complexity / habitat metrics could then be undertaken to see if there is a channel morphology response to gravel management over time. Imagery would preferably be obtained after the first bed-defining flood event following gravel management activities at each site and at consistent flow rates each time. If morphological differences are detected in the managed segments, relative to paired control sites, then these could then be interpreted in view of their effect on habitat quality for key fish species identified in this report.

Residual pool depth is a key habitat measurement that indicates habitat quality for salmonids and large eels (Holmes & Hayes 2011; Holmes et al. 2015). Using the same study designs (as above), collecting residual pool depth measurements from managed and paired unmanaged (control) segments would indicate if this habitat variable changes in response to gravel management activities. These measurements could be taken easily over large areas of river by drifting a raft along the thalweg of the river and taking multiple depth measurements. Time matched GPS data would enable mapping of river depths over time. These data would complement the analysis of aerial imagery for channel complexity indicators suggested above.

Site specific studies

It is largely beyond the (ecological) expertise of the author to make recommendations on how detailed site specific channel morphology data would best be best obtained. However, there are a number of techniques and recommendations made in Fuller et al. (2013) that are suitable for assessing morphological changes in the GMA rivers that may result from gravel management activities. For instance, digital elevation models (DEMs) of a ‘typical’ river segment that is subject to regular gravel extraction could be compared with LIDAR derived DEMs from unmanaged upstream control sites (Fuller & Basher 2011; Williams et al. 2011). Detailed channel morphology assessments may require an unrealistic amount of resources. However, emerging technologies that use video imagery and structure-from-motion software offer a potentially more cost efficient technique for developing floodplain DEMs (Westoby et al. 2012; Javernick et al. 2015).

6.7. Fish stranding

Visually assessing gravel extraction sites for ponding on river bars following inundation by floods should confirm if fish stranding is a real risk. Photographic documentation of the degree of ponding (or lack thereof) should be undertaken during these site visits. To assess the potential worst case scenario, ideally this assessment should be undertaken following moderately high flows that inundate gravel extraction areas but do not cause substantial bedload movement (that would smooth out any depressions). If ponding areas exist, then electric fishing within the ponded areas would determine if fish are in fact becoming stranded in substantial numbers.

7. GOOD GRAVEL MANAGEMENT PRACTICE

It is difficult to inform gravel management practices that would minimise potential effects on aquatic ecology because there is no quantitative (site specific) information on the ecological impacts of the current practices. In theory, there is no instream gravel mining in Hawke's Bay (except during emergency maintenance). Therefore, there should be limited ecological disturbance during low flows. It follows that there should be no need to consider the timing of works in relation to fish spawning and / or migration periods—which could otherwise be disrupted by elevated turbidity levels or changes to the low flow channel. The exception would be for sites that require machinery access across wetted channels. Access could be restricted to occur outside spawning / migration periods. Below I provide some recommendations in relation to instream ecology following good practice gravel management documents from overseas white papers.

7.1. Mechanical disturbance

Machinery in the wetted channel should be avoided as much as possible - as already stated in the draft COP. Ideally, if a side braid develops between an access point and a gravel management area then an alternative extraction site would be selected (that does not require access through wetted channels). However, this may not fit under the draft COP definition of 'practical', given the changeable nature of the rivers in the GMA and the need to manage gravel levels on a reach by reach basis.

Further restrictions on access through wetted channels during vulnerable spawning and migration periods for key species identified in this report could be considered. The draft COP already expresses that machinery access across the wetted channel is restricted during May through September to protect salmonid spawning values. Early life history stage trout are more vulnerable to crushing and sedimentation than more mobile, greater than 1 year old fish. However, given the range of spawning and migration times for various native fish species (Appendix 1), it would be difficult to time gravel management works to avoid impacts during these periods for all species. In any case, small benthic native fish are unlikely to be more vulnerable to direct machinery disturbance during spawning, or migration periods, than during any other period in their life history. Some information about of the extent, duration and severity of fine sediment resuspension events, that are related to gravel management activities, would be required before any recommendation to further restrict access across wetted channels could be made.

7.2. Channel morphology

The ideal gravel management practice would maintain the design bed level whilst also maximising channel complexity, pool frequency, riffle frequency and velocity diversity. For example, undertaking gravel management in a manner that creates and / or maintains stable backwaters or side channel habitat would have ecological benefits. These areas are known to have disproportionally high macroinvertebrate and native fish diversity (and densities) in unmodified braided river systems (Gray & Harding 2007). However, further information on the effect of the current gravel management practices on channel morphology in the GMA is required before any good practice recommendations can be made in this regard.

7.3. Buffer between gravel works and the wetted channel

A one metre buffer between gravel works and the wetted channel as prescribed in the COP may provide little tolerance between gravel works and flowing water. We are not aware of any evidence to suggest that this buffer width is either adequate or inadequate to prevent sediment resuspension. Where possible gravel extraction should occur further away from wetted channels to minimise the chances of flowing water intruding into extraction areas and entraining suspended sediments (e.g. as seen in Figure 4).

7.4. Fish stranding

The potential for fish stranding from gravel management operations in the GMA is currently unknown. In relation to dry river bar skimming the Oregon Department of Fish and Wildlife white paper strongly recommends that '…gravel extraction permit conditions include a requirement for grading and shaping of the site post-extraction to ensure that there are no potholes, pits, or small pools left at the extraction site that may cause fish entrapment'. They also recommend that the bar be sloped to maintain a positive flow back toward the main channel to prevent stranding (OWRRI 1995). Similar practices could be adopted by HBRC if it is deemed practical.

8. CONCLUSIONS

Gravel extraction has been shown to cause profound changes to instream habitat and ecological condition in a range of river types. However, compared with small single thread rivers with limited gravel supplies, the large braided and semi-braided rivers within the GMA will be relatively resilient to gravel extraction. The new (draft) COP limits extraction to occur only on dry river bars and provides restrictions for machinery access through wetted channels. Accepting the need to maintain effective flood protection infrastructure, the (draft) COP for river works affords a pragmatic level of protection for instream ecology.

There may be indirect effects of gravel extraction on channel morphology with flow-on consequences for key instream species. Currently, the ability to assess the potential instream effects of gravel management in Hawke's Bay is very limited because of sparse geomorphological and ecological data. In particular, broad-scale and site-specific information on the effects of gravel management on channel form is recommended. This information would enable an evidence-based approach to managing the balance between maintaining flood protection and key instream values.

9. ACKNOWLEDGEMENTS

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11. APPENDIX

Appendix 1. New Zealand freshwater fish migration calendar from Smith (2015), showing migration timing, range and peak, migration direction, and fish life stages involved for nine regions of New Zealand.

Key: Peak ■ Range ▒ Larvae/Fry/Juveniles present ░ non migrant * present ●

Functional Group	Species	Conservation Status	Summer			Autumn			Winter			Spring				North Island					South Island			
			D	J	F	M	A	M	J	J	A	S	O	N	All	NL	CNI	EC	HB	SNI	NM	WC	CAN	OS
Bullies (fast flow) and Torrentfish	Bluegill bully	●	▒	▒	▒						▒	▒	▒	▒	●									
	Redfin bully	●									▒	▒	▒	▒	●									
	Torrentfish	●	▒	■	■	■	■	▒						▒	●									
Bullies (slow flow)	Common bully	○	▒	▒	▒						▒	▒	▒	▒	●									
	Crans bully	○	▒░	▒░	▒░	░	░	░			▒	▒░	▒░	▒░		●	●	●	●	●				
	Giant bully	○	▒	▒	▒						▒	▒	▒	▒	●									
	Tarndale bully*	□	▒░	▒░	▒░	░	░	░			▒	▒░	▒░	▒░							●			
	Upland bully*	○	■	▒░	▒░	░	░	░			▒	▒░	■	■	●									
Eels	Longfin eel	●													●									
	Shortfin eel	○													●									
Inanga and smelt	Common smelt	○	▒	▒	▒	■	■	■	▒	▒					●									
	Inanga	●	▒	▒	▒	■	■	■	■	▒		▒	▒	▒	●									
	Stokells smelt	□	■	■	▒						▒	▒	▒	▒									●	
Lamprey	Lamprey	+	▒								▒	▒	■	▒	●									
Large Galaxiids	Banded kokopu	○				▒	▒	■	■	▒	▒				●									
	Giant kokopu	●					▒	■	■	▒	▒					●	●	●		●	●	●	●	●
	Koaro	●					■	■	▒	▒	▒				●									
	Shortjaw kokopu	+					▒	■	■	▒						●	●	●		●	●	●		●
Mudfish*	Black mudfish	●	░	░			▒	▒░	▒░	▒░	▒░	▒░	▒░	░		●	●							
	Brown mudfish	●				▒	▒░	▒░	▒░	▒░	░	░	░				●					●		
	Canterbury mudfish	●	░	░	░					▒	▒░	▒░	▒░	▒░									●	
	Northland mudfish	+	▒░	░	░	▒	▒░	▒░	▒░	▒░	▒░	▒░	▒░			●								
Non-Migratory Galaxiids*	Alpine galaxias	□	░	░	░						▒	▒░	▒░	▒░									●	●
	Bignose galaxias	+	░						▒	▒░	▒░	▒░	░	░									●	
	Canterbury galaxias	●	░	░	░					▒	▒░	▒░	▒░	▒░							●		●	●
	Dusky galaxias	++	░	░	░						▒	▒░	▒░	▒░										●
	Dwarf galaxias	●	░	░	░						▒	▒░	▒░	▒░			●		●	●	●	●	●	
	Eldons galaxias	++	░	░	░						▒	▒░	▒░	▒░										●
	Taieri flathead galaxias	+	░	░	░						▒	▒░	▒░	▒░										●
	Gollum galaxias	+	░	░	░						▒	▒░	▒░	▒░										●
	Upland longjaw galaxias	+	░	░	░						▒	▒░	▒░	▒░									●	
	Lowland longjaw galaxias	+++	▒░	░	░	░					▒	▒░	▒░	▒░									●	●
	Roundhead galaxias	++	░	░	░						▒	▒░	▒░	▒░										●
	Dwarf inanga	●	▒	▒░	▒░	▒░	▒░	▒░	░	░	░					●								
Salmonid Sportfish	Atlantic salmon	Δ				▒	▒	■	■	▒														●
	Brook Char	Δ				▒	▒	■	■	▒							●						●	●
	Brown trout	Δ				▒	▒░	■	■	▒░	░	░	░				●	●	●	●	●	●	●	●
	Chinook salmon	Δ				▒	■	■	▒													●	●	●
	Mackinaw*	Δ			▒	▒	■	■	▒░	░	░	░											●	
	Rainbow trout	Δ	░					▒	■	■	■	▒░	░	░	●									
	Sockeye salmon	Δ				■	▒	▒															●	●

○ Not Threatened ● At Risk Declining □ At Risk Naturally Uncommon + Threatened Nationally vulnerable ++ Threatened Nationally Endangered

+++ Threatened Nationally Critical Δ Sportsfish

G

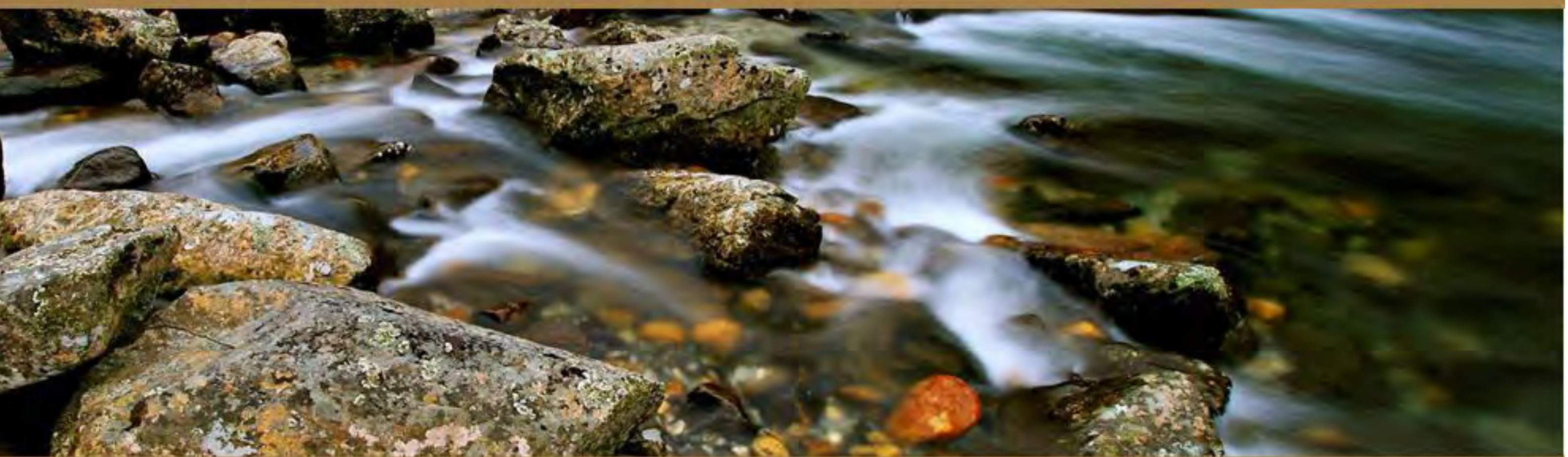
APPENDIX G

Hawke's Bay Riverbed Gravel Management Plan

Hawkes Bay Gravel Management Study
RMA Issues and
Gravel Demand Drivers

Hawkes Bay Regional Council

June 2016



Environmental Management Services

Executive Summary

This report is part of a wider gravel management review project that began in 2010, which consists of 13 separate sub-projects. This report completes “Issues” 11 and 12 of the gravel review, being:

- Issue 11 - Consideration of RMA issues that influence gravel management
- Issue 12 – Review of allocation and financial mechanisms that influence gravel management

The objectives of this report are twofold; first, to assess the Resource Management Act 1991 and other relevant legislation in respect to the management of the Hawkes Bay riverbed gravel resource; and second, to assesses the financial and market demand issues that influence gravel extraction operations.

This report only deals with the management of the “riverbed” gravel resource in Hawkes Bay, as this is under the direct management control of Hawkes Bay Regional Council (HBRC). Other sources of gravel aggregate, such as land based quarries and river terrace deposits, are assessed within this report due to their influence on the demand for the riverbed gravel resource.

The management of riverbed gravel resources by a Regional Council is a ‘balancing act’ of multiple considerations including:

- Maintaining channel capacity;
- Avoiding over extraction and destabilising protection works;
- Quality of gravel source;
- Avoiding unintended outcomes of promoting land based abstraction;
- Financial and practical availability for extractors (transport economics, haul roads etc.);
- Resource management and stakeholder management.

The Hawkes Bay Gravel Resource

The Hawkes Bay regional riverbed gravel resource is characterised by generally high quality gravel, but is subject to significant variability in both its natural supply and commercial demand. The following summarises the gravel status for each of the main Hawkes Bay Rivers where commercial gravel demand exists.

Northern Hawkes Bay Rivers

No issues have been identified in the northern Hawkes Bay river systems including the Mohaka, Wairoa or Waiau rivers, in respect to their gravel resources. Historically, demand is reasonably low and as such, no concerns exist over the sustainability of the resource and no significant channel capacity issues exist. Of special note are the specific provisions for the Mohaka River resulting from a recent Treaty of Waitangi Settlement which provides for hangi stones values for local iwi.

Esk River

The Esk River has historically been over extracted and therefore no major extraction currently occurs.

Tutaekuri River

The Tutaekuri River has also historically been over extracted and future significant extraction would be unsustainable from this resource. Currently, only small volumes are consented on an annual basis in recognition of this.

Ngaruroro River

The Ngaruroro River is the most important gravel resource in Hawkes Bay due to the quality and suitability of its gravel for a range of engineering end uses, and its proximity to demand centres. The Ngaruroro River has been carefully managed in recent years and consented extraction is consistent with current natural supply. Demand for the Ngaruroro gravel resource remains high and is in excess of consented volumes.

Waipawa River

The Waipawa River is showing a moderate aggradation trend, particularly in the middle reaches. Increased gravel extraction in the coming years will be required in the Waipawa River, but current demand is low. This is especially important as the Waipawa gravel is particularly large and proving too difficult to beach rake. The potential construction of the Ruataniwha Dam will cease sediment supply to the Waipawa River from the major Makaroro tributary; however, considerable other tributary inputs do exist that are unaffected by the potential dam project.

Tukituki River

The upper and mid reaches of the Tukituki River are showing the greatest evidence of aggradation of any river in the region and gravel extraction demand has markedly declined in recent years. Conversely, the lower Tukituki has been significantly over extracted and only small localised amounts of gravel are allocated below Red Bridge. Analysis shows that approximately 800,000 cubic metres of gravel exists above the defined 'grade line' in the upper Tukituki; and a significant 14 million cubic metres above 'grade line' in the mid Tukituki reaches. However, the aggradation is not uniform across these long reaches, with some cross sections recording at or lower than grade line levels. Hence, the aggradation is at times localised and often associated with flat channel grades where the sediment drops out.

Summary of Current Position

Historically, between 500,000 to 700,000 cubic metres per annum was extracted from all Hawkes Bay riverbed sources at the demand peak, but over the last five years this has decreased to just over 400,000 cubic metres per year. These figures do not include coastal gravel extraction at Awatoto and adjacent to Marine parade in Napier that totals approximately 45,000 cubic metres per year. Demand exceeds supply for the Heretaunga riverbed gravel resources, while the Central Hawkes Bay gravel resources are experiencing low demand and riverbeds are aggrading, causing localised channel capacity and drainage issues. Excess demand on the Heretaunga Plains is being met by land based quarry or river terrace sources.

Legal Framework Review

This study carried out a review of all legislation that governs HBRC's mandate to manage flood hazards and gravel resources. This review summarises the suite of relevant legislation and in particular, the Soil Conservation and Rivers Control Act 1941, that gives Regional Councils a specific set of responsibilities to manage rivers to avoid or mitigate flooding including the management of gravel to aid in this objective.

The Resource Management Act 1991 is the key Act that governs the resource consent and administrative charging processes for riverbed gravel.

Review of HBRC's Existing Gravel Management Approach and Benchmarking with Other Regional Councils

An in-depth review has been conducted in this study relating to the existing Hawkes Bay Regional Council approach to managing gravel, including RMA plan provisions, resource consenting processes and the work program to monitor and allocate the gravel resource.

In addition, this study reports on a benchmarking exercise with other Regional Councils, including a comprehensive questionnaire, to identify best practice and lessons learnt in the management of gravel resources in other regions that share similar gravel management issues. This benchmarking approach was used to evaluate the existing HBRC approach and aid in the options assessment for consideration of alternative gravel management approaches.

The key findings of the HBRC review and benchmarking with other Regional Councils are:

- No critical or urgent amendments are required to the Hawkes Bay Regional Policy Statement or Regional Resource Management Plan although changes at the next appropriate plan review opportunity will assist in future gravel management.
- Some process improvements could be made to strengthen the existing HBRC gravel consent process.
- In all Regional Councils surveyed, the Engineering Departments apply for, and hold, resource consents for gravel extraction, while all consents are held by commercial gravel extractors in Hawkes Bay.
- The Consent Authority function is undertaken by the Regulatory 'arms' of all other Regional Councils surveyed while HBRC has delegated its operational 'arm' as the Consent Authority.
- A degree of regulatory duplication and increased compliance costs exists between the regional and district plans in Hawkes Bay.
- Gravel extraction is an activity funded by some flood schemes across the Regional Councils surveyed, but not by Hawkes Bay flood schemes which rely on commercial extractor demand.

Demand Analysis and Financial Drivers

It is important to understand the past and possible future gravel demand and financial drivers that are influencing the commercial market for gravel in Hawkes Bay.

Gravel is used for a diverse range of aggregate uses in Hawkes Bay with only very small amounts 'exported' outside the region. The over-riding commercial imperative for the aggregate market is to secure access to suitable material as close as possible to demand. In Hawkes Bay, approximately 400,000 to 450,000 cubic metres (m^3) of gravel is extracted from rivers on average in recent years, which is equivalent to approximately 60,000 truckloads. Of this, approximately 100,000 - 150,000 m^3 has historically been from the Tukituki and Waipawa rivers; but in recent years this has reduced to less than 20,000 m^3/year. The remaining 400,000 m^3 per annum has been from rivers on the Heretaunga Plains, with the vast majority from the Ngaruroro River.

The most significant issue identified in this section is the downturn in demand from the Tukituki and Waipawa rivers. However, opportunities for future riverbed extraction do exist. These opportunities are associated with the potential Ruataniwha Dam project and associated development; future roading upgrade projects and commercial discussions with a number of parties including Central Hawkes Bay District Council.

Iwi Issues in Relation to the Gravel Resource

Across New Zealand, iwi have long standing interests in freshwater, including the bed and banks of rivers and lakes that together make up the "*mauri*" or 'life-force' of the water body. To date, Treaty of Waitangi Settlements across the country have recognised iwi interest in freshwater in a range of ways specific to the area involved.

To date, Hawkes Bay Iwi has been involved in managing Hawkes Bay's freshwater resources via an agreed process on individual resource consents, during regional plan changes and more recently through the joint planning committee. The ongoing work of the joint planning committee and its consideration of the suggested recommendations of this report will further strengthen iwi co-management of the gravel resource.

In 2010, a Hui was held at Kohupatiki Marae with iwi members from across Hawkes Bay attending. The Hui minutes record useful discussion on gravel management issues and an improved understanding by all participants of the challenges that surround gravel management in Hawkes Bay. An extensive range of recommendations are presented for Hawkes Bay Iwi ongoing and strengthened role in gravel management.

Iwi in Hawkes Bay now have a key policy input role in managing Hawkes Bay's freshwater resources via an agreed process for input on individual resource consents, during regional plan changes and more recently through the Joint Planning Committee, which gives Mana Whenua input to plan change review processes.

Options Assessment and Recommendations

It is clear that challenges exist in the management of the Hawkes Bay gravel resource and in particular, in the Central Hawkes Bay catchments, given the aggradation and low commercial demand in the area.

A variety of options have been considered for improving the existing gravel management approach in Hawkes Bay, including:

1. Financially based options
2. Regulatory options
3. Non-regulatory options

While the options analysis identified only a limited number of 'levers' across the three options for improving the management of gravel in the region, this report has identified a range of recommendations to improve gravel management outcomes. A comprehensive list of 32 short, medium, and long term recommendations are presented, with the key recommendations of this report as follows:

1. Draft a Hawkes Bay Gravel Management Strategy involving key stakeholder input before initiating a Special Consultative Process under the Local Government Act for its adoption by Council.

2. Commence discussions with a range of key gravel users to discuss options and opportunities for future gravel extraction from the Central Hawkes Bay catchments.
3. Formally recommend to Council and Upper Tukituki Scheme ratepayers that gravel extraction be added to the programme of works for maintenance of the flood scheme (given that gravel extraction has not previously been funded by Flood Scheme funded works in the past).
4. Undertake a review of localised problematic areas within the upper Tukituki Scheme and establish how much gravel is required to be extracted and what associated channel management works would complement gravel extraction. Use this information to prepare a schedule of works for future years that balances flood risk and drainage issues with cost.
5. Formally review the upper Tukituki Scheme rating to ascertain whether scheme funded gravel extraction can be financed by either diverting existing scheme rates, or increasing scheme rates, to fund this new activity.
6. That HBRC Assets Section develops suitably detailed resource consent applications for a requested duration of 10 years and becomes the consent holder for all major gravel extraction in the region, starting with the Ngaruroro catchment.
7. That the Consent Authority function for gravel is internally transferred to the Regulatory Department of Council to avoid conflict of interest and separation of statutory functions, and all necessary internal system and process changes are made to facilitate this. Ensure that any new permitting processes adhere to the Guiding Principles developed in Section 6.3 of this report.
8. Assuming long term consents are successfully granted to the Engineering Department, offer long term access via an authorisation processes to commercial operators in the Tukituki and Waipawa catchments (as opposed to annual consented volumes). Some form of competitive tendering maybe in order to award the gravel allocations. Where advantageous, HBRC consider coordinating all land access agreements and other arrangements (e.g. stockpile sites etc.) in the Tukituki and Waipawa catchments.
9. Continue to decline resource consents for gravel extraction in rivers where evidence shows that gravel extraction is not sustainable, except in particularly localised reaches that are causing significant channel management issues (e.g. flood banks erosion). This includes the Esk, Tutaekuri, and lower Tukituki rivers.
10. Undertake a funding options study for a mid-Tukituki flood scheme that considers the costs and benefits for:
    - mid Tukituki riparian landowners;
    - lower Tukituki riparian landowners;
    - coastal hazard issues;
    - increasing gravel availability for extraction in the lower Tukituki;
    - The region as a whole.

No one recommendation can work in isolation of other initiatives and no approach can guarantee a better outcome given flood events and market demand (the key matters that influence the gravel resource) are both outside the control of HBRC.

Research Strategy

The report presents a research strategy for ongoing monitoring and investigations into the regions gravel resources, which is considered important for its prudent management.

Contents

APPENDICES

FIGURES

REPORT INFORMATION

Report Status	**File Location**	**Our Reference**
Final	Napier	DFL012

Author	**Signed**
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Reviewer	
Alexandra Johansen	

1 Introduction

1.1 Gravel Management – 'The Balancing Act'

This report is part of a wider gravel management review project that began in 2010, which consists of 13 separate sub-projects. This report completes "Issues" 11 and 12 of the gravel review, being:

- Issue 11 - Consideration of RMA issues that influence gravel management
- Issue 12 – Review of allocation and financial mechanisms that influence gravel management

The objectives of this report are twofold; first, to assess the Resource Management Act 1991 and other relevant legislation in respect to the management of the Hawkes Bay riverbed gravel resource; and second, to assesses the financial and market demand issues that influence gravel extraction operations.

This report only deals with the management of the "riverbed" gravel resource in Hawkes Bay, as this is under the direct management control of Hawkes Bay Regional Council (HBRC). Other sources of gravel aggregate, such as land based quarries and river terrace deposits, are assessed within this report due to their influence on the demand for the riverbed gravel resource.

The management of a gravel resource by a Regional Council is a 'balancing act' of multiple considerations including:

- Maintaining channel capacity
- Avoiding over extraction and destabilising protection works
- Quality and suitability of gravel sources for end uses
- Avoiding unintended outcomes of promoting land-based abstraction
- Financial and practical availability of a gravel resource for the economic development of a region
- Avoiding and mitigating environmental effects of gravel extraction
- Resource management and stakeholder management

Throughout New Zealand, the availability of good quality riverbed gravel that meets a range of engineering specifications for construction, ease of extraction and often close proximity to end uses, has ensured lower costs of development and construction of public infrastructure, particularly roads, for many decades. As catchment erosion processes have markedly decreased, with control of grazing animals and in some areas of New Zealand, a lack of significant flood activity; this has resulted in a lack of available gravel resource. In some cases, this has been compounded by historical over-extraction of the gravel resource or conversely, due to a lack of new development projects, gravel demand has reduced significantly or even ceased, posing issues for Council river engineers and flood scheme ratepayers wanting to maintain channel capacity. Lastly, the importance of gravel supply to coastlines, given coastal erosion issues, has also become well understood.

Hence, the management of a region's gravel resource is a multi-faceted, 'whole of region' issue.

1.2 The Hawkes Bay Gravel Resource

Historically, the main river systems in Hawkes Bay that have been in demand for their gravel resource are:

- Northern Hawkes Bay rivers (Mohaka, Wairoa or Waiau rivers)
- Esk
- Ngaruroro
- Tutaekuri
- Waipawa
- Tukituki

Figure 1 shows that over the last five years most gravel has been extracted from the Ngaruroro River (approximately 300,000 m^3/year). Of note is the relatively small amount that has been extracted from other rivers compared to the Ngaruroro and the general reduction in gravel extraction from the Waipawa, mid and upper Tukituki rivers.

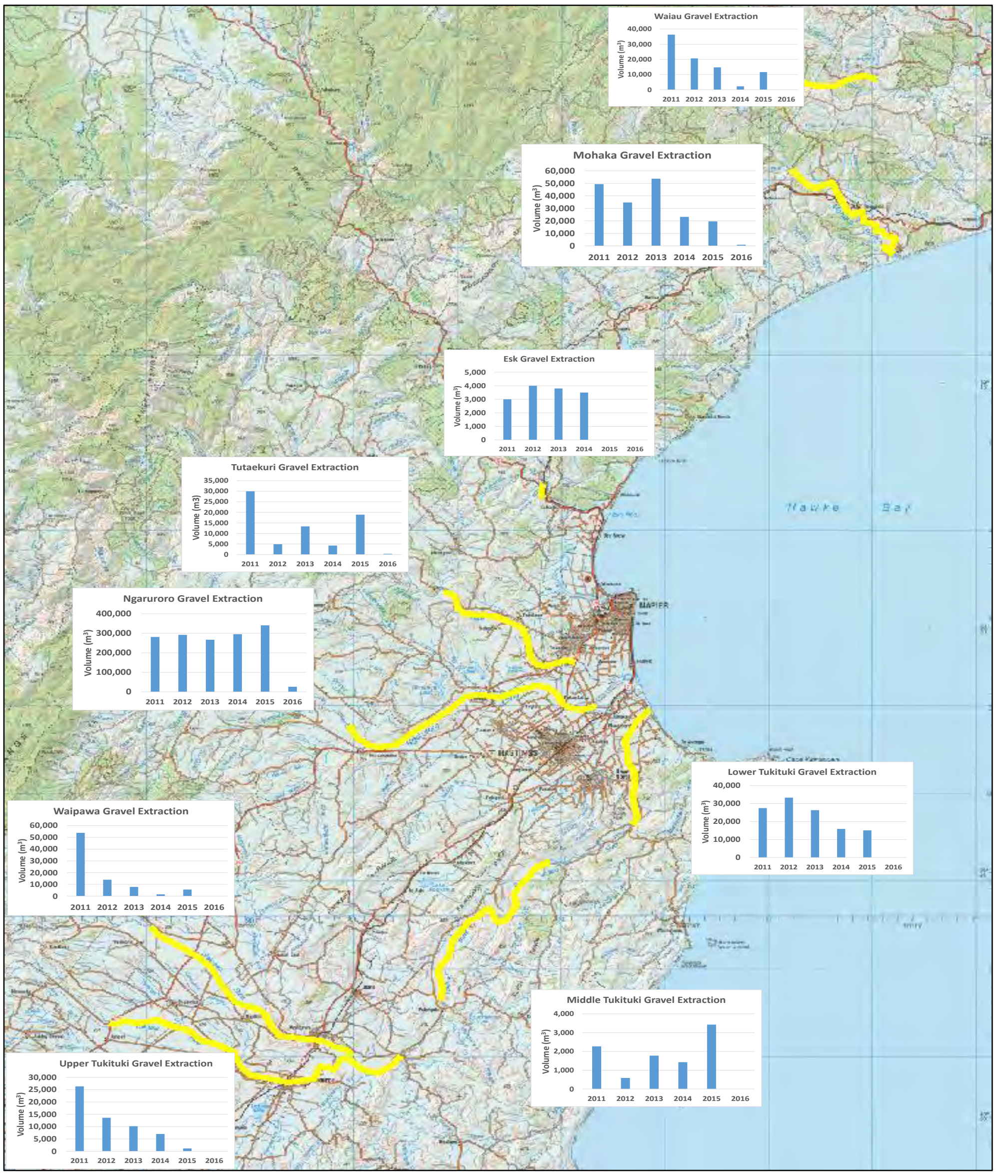

Figure 1. Main Gravel Extraction Rivers and Amounts Extracted in Last Five Years

Gravel supply to these Hawkes Bay River systems has been highly episodic, and based on storm events and flood activity to erode, entrain and transport gravel from the Ruahine and Kaweka ranges to the coast. The most extreme example was Cyclone Bola in 1988 which resulted in significant sediment input into the northern Hawkes Bay River systems. More historically, the Hawkes Bay flood events in the 1930's were a major catalyst for the enacting of the Soil Conservation and Rivers Control Act in 1941, during the World War II years, which is an indication of the significance of the issue. The main Hawke's Bay rivers have not experienced significant flood events for some decades, resulting in a reduced gravel supply from headwater areas and reduced movement of sediment through the river systems. For instance, in the Ngaruroro River, there has only been approximately 1.5 km of natural downstream gravel movement in the last 40 years. This is also compounded by invasive vegetation species, such as lupins, in Hawkes Bay's semi-braided riverbeds and banks which are preventing sediment movement and leading to aggradation. Invasive vegetation can also threaten native bird habitat.

Riverbed 'beach raking' breaks up the surface layer of interlocked gravel (known as the 'armour layer'), which is undertaken by HBRC in areas where there is no gravel extraction to encourage downstream movement of gravel through the river systems. However, this still requires flood events (albeit of lower flood magnitudes) to move this sediment.

Seismic activity has also been observed as causing major sediment input into river systems, or conversely, as occurred in the 1931 Napier earthquake, uplift on the plains which flattened river gradients, has decreased the region's rivers' hydraulic ability to transport gravel through to the lower reaches and coast.

Some Hawkes Bay river reaches, in areas of high gravel demand, have historically been over extracted and this over extraction is now apparent within longer term monitoring records. In such rivers, gravel extraction has now largely ceased – the result of very small amounts or no gravel being allocated via the RMA resource consent process.

1.3 Status of the Hawkes Bay Gravel Resource

The following summarises the gravel resource status of each of the main Hawkes Bay river systems:

Northern Hawkes Bay Rivers

No issues have been identified in the northern Hawkes Bay river systems including the Mohaka, Wairoa or Waiau Rivers, in respect to their gravel resources. Historically, demand is reasonably low and as such, no concerns exist over the sustainability of the resource and no significant channel capacity issues exist. Of special note are the specific provisions for the Mohaka River resulting from a recent Treaty of Waitangi Settlement which provides for hangi stone values for local iwi.

Esk River

The Esk River has experienced significant channel degradation (lowering of the bed) since the mid 1970's partly through over extraction and partly through willow clearance work to maintain flood capacity. The degraded reach is from the SH2 Bridge near the coast, to past the Waipunga Bridge (cross sections 1 to 11) therefore no major consented extraction occurs. A minor amount of extraction occurs at the Whirinaki Pulp Mill water intake site.

Tutaekuri River

The Tutaekuri River has also historically been over extracted within the vicinity of Waiohiki and downstream with two fixed aggregate plants operating for local supply. These have long since ceased operation but nevertheless recovery of the gravel resource has been slow and as a result practically no extraction (other than for river maintenance) takes place below Puketapu where there is currently some surplus. Future significant extraction would be unsustainable from this resource.

Ngaruroro River

The Ngaruroro River is the most important gravel resource in Hawkes Bay due to the quality and suitability of its gravel for a range of engineering end uses, and its proximity to demand centres. The Ngaruroro River has been carefully managed in recent years and consented extraction is consistent with current natural gravel supply. Demand for the Ngaruroro gravel resource remains high and is in excess of consented volumes.

As part of this study, a gravel resource inventory was carried out and the findings are in the report *"Gravel Resource Inventory (Issue 3) by Stevens and Larsen 2015".* This report summarises the current state of the gravel resource in the region and should be referred to for more in depth information. However, of note is the implication by Stevens and Larsen (2015) that there could be as little as 5 years' supply remaining in the main extraction reach depending on the demand estimates assumed for the next five year period. Further work by Gary Clode (*pers comm*) demonstrates that the methodology used to reach the conclusion that the current rate of extraction is unsustainable is not entirely accurate when applied to past extraction and surveyed gravel volumes. Furthermore, it also demonstrates that there is evidence of an under estimation of transport rates used in the assessment, as there must be more gravel moving into the extraction reach to allow the rate of extraction to continue at present volumes and not fall below the design grade line. Importantly, it is essential that good monitoring of the gravel resource in the Ngaruroro continues and that extraction rates and sustainability are closely aligned to avoid problems in the future and to give some certainty to the gravel extraction industry.

Waipawa River

The Waipawa River is showing a moderate aggradation trend, particularly in the middle reaches. Increased gravel extraction in the coming years will be required in the Waipawa River, but current demand is low and has been markedly declining in the last five years (Figure 2). This is especially important as the Waipawa gravel is particularly large above State Highway 50, and is proving too difficult to beach rake. However, potential construction of the Ruataniwha Dam will cease sediment supply to the Waipawa River from the major Makaroro tributary, which will allow the current aggradation to be transported downstream over time.

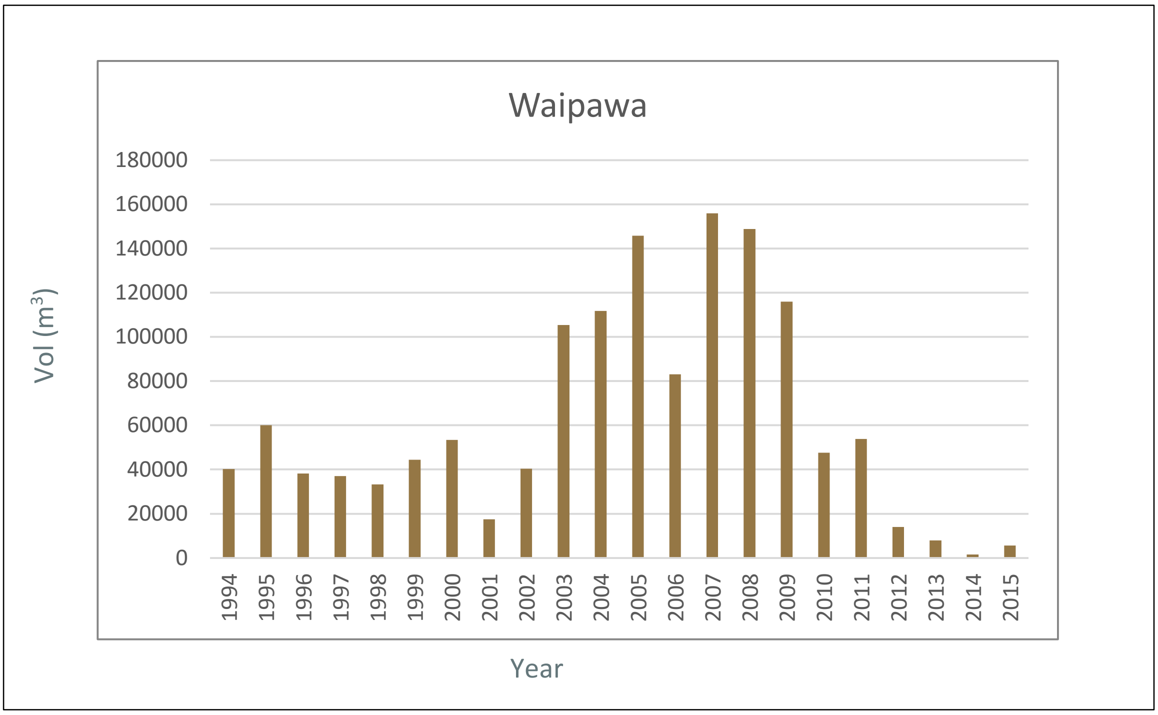

Figure 2. Gravel Volumes Extracted from Waipawa River between 1994 and 2015

Tukituki River

The upper and mid reaches of the Tukituki River are showing the greatest evidence of aggradation and gravel extraction demand has been declining in recent years (Figure 3). Conversely, the lower Tukituki has been most significantly over extracted and only small localised amounts of gravel are allocated below Red Bridge.

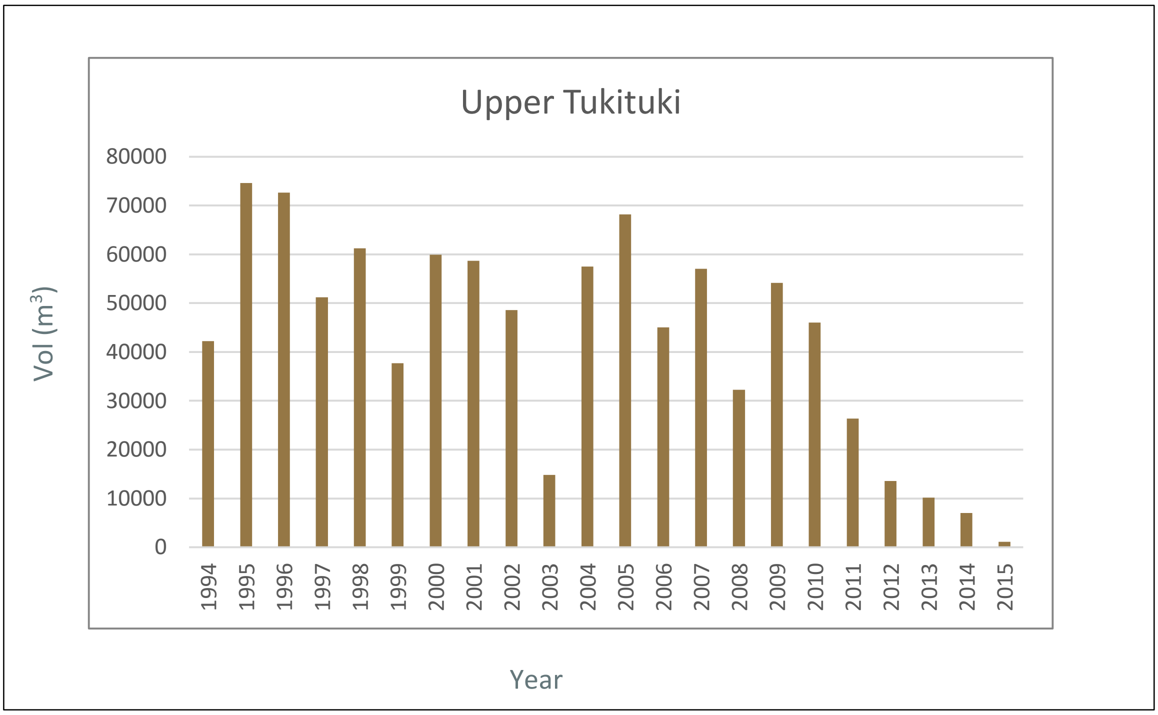

Figure 3. Gravel Volumes Extracted from Upper Tukituki River between 1994 and 2015

Analysis shows that approximately 800,000 cubic metres of gravel exists above the defined 'grade line' in the upper Tukituki; and a significant 14 million cubic metres above 'grade line' in the mid Tukituki reaches. However, the aggradation is not uniform across these long reaches, with some cross sections recording at or lower than grade line levels. Hence, the aggradation is at times localised and often associated with flat channel grades where the sediment drops out. This is particularly evident in some tributaries and at their confluences. This issue is covered in greater detail in Section 7, which considers opportunities for combined gravel extraction/channel management approaches.

1.4 Coastal Beach Extraction

In addition to the riverbed gravel sources, HBRC has issued historic resource consents for extraction of beach gravel to Winstones at Awatoto, and Napier City Council adjacent to Marine Parade. In recent years, the volumes extracted at these locations have been approximately 30,000 cubic metres per annum by Winstones, and 12,000 - 15,000 cubic metres per annum by Napier City Council. Some concern over the sustainability and effects of this extraction have been raised and will be considered upon consent expiry if renewal applications are lodged.

1.5 Summary

In summary, the Hawkes Bay regional riverbed gravel resource is characterised by high quality gravel that is in high demand from the Ngaruroro River, with this demand successfully managing channel capacity for flood management purposes for this river. Conversely, low demand for gravel exists from the upper and mid Tukituki and Waipawa rivers which are showing aggradation trends, and in some reaches resulting in channel capacity and drainage issues. All other rivers are either subject to low levels of gravel extraction due to sustainability concerns of the resource, or low demand (e.g. Northern Hawkes Bay rivers).

1.6 2010 Scoping Report

In 2010, Tonkin and Taylor published a scoping report review of riverbed gravel management that defined a medium term work program for the management of the regional gravel resource. The report highlighted 13 issues and recommended that each issue be the subject of specific investigations and reports, leading up to the drafting of an overall gravel management plan for the Hawkes Bay region. This report responds to issues 11 and 12, being:

- Issue 11 - Consideration of RMA issues that influence gravel management
- Issue 12 – Review of allocation and financial mechanisms that influence gravel management

Issues 1 to 10 have either been completed or are in progress. Issue 13 is a recommendation to prepare a gravel management plan for Hawkes Bay, which this report will inform and provide a basis for.

2 Legal Framework

There are a number of statutes of specific relevance to floodplain management and by extension gravel management. These are:

- Resource Management Act 1991
- Building Act 2004 (and Building Code 1992)
- Local Government Act 2002
- Land Drainage Act 1908
- Soil Conservation and Rivers Control Act 1941

Each of these statutes performs a distinct role in managing flood risk and provides a range of legislative mechanisms to enable effective flood management across local and central government.

To a lesser degree, a number of other statutes also influence flood risk management. These include:

- Public Works Act 1981
- Local Government Official Information and Meetings Act 1987
- Earthquake Commission Act 1993
- Environment Act 1986
- Local Government (Rating) Act 2002
- Rivers Board Act 1908
- Civil Defence Emergency Management Act 2002

This suite of statutes allows for a wide range of approaches to be applied to managing flood risk as follows:

- Hazard control measures
- Flooding information and education
- Flood hazard preparedness, response and recovery
- Flood loss insurance and financial assistance

The specific provisions from the most relevant of these Acts and as they relate to the management of riverbed gravel are outlined below.

2.1 Local Government Act 2002

Section 11A of the Local Government Act states:

In performing its role, a local authority must have particular regard to the contribution that the following core services make to its communities:

a) network infrastructure:
b) public transport services:
c) solid waste collection and disposal:
d) the avoidance or mitigation of natural hazards:
e) libraries, museums, reserves, recreational facilities, and other community infrastructure

As the gravel management functions primary purpose is for flood control, the activity is consistent with Section 11A(d).

2.2 Resource Management Act 1991

In respect to gravel management, the RMA has six broad legislative areas of relevance:

1. Natural hazards
2. Resource consents for gravel extraction
3. Charging regime
4. Section 1049(c)
5. National Instruments
6. Iwi management plans

2.2.1 Natural Hazards

Under Section 30 (iv), the functions of a Regional Council extend to the control of the use of land for the avoidance or mitigation of natural hazards. The Regional Policy Statement (RPS) and Regional Resource Management Plan (RRMP) either directly, or by requiring District Plans, are the main statutory instruments to exercise this function.

At an operational level, gravel extraction is one of HBRC's principle approaches to mitigating flood hazards.

2.2.2 Resource Consents for Gravel Extraction

The legal responsibility of Regional Councils to issue resource consents for gravel extraction comes from Section 13(b) which states no person can....*disturb the bed of a river…unless expressly allowed by a rule in a regional plan or by resource consent.* The RMA definition of 'bed' in relation to a river is…*the space of land which the waters of the river cover at its fullest flow without overtopping its banks*.

As the HB RRMP and the four District Plans have regional and district rules pertaining to gravel extraction activities, consents are required in Hawkes Bay for this activity (apart from very small volumes which is a permitted activity).

2.2.3 Section 36 Charges

Section 36 enables a local authority to fix charges for carrying out its functions under section 35 of the RMA and other relevant sections. Specifically under s36(1)(c), a local authority may fix charges payable by holders of resource consents, for the carrying out by the local authority of its functions in relation to the administration, monitoring, and supervision of resource consents, and for the carrying out of its resource management functions under section 35.

When it fixes charges under s36, a local authority must have regard to a number of criteria including the following:

1. The sole purpose of a charge is to recover the reasonable costs incurred by the local authority in respect of the activity to which the charge relates (s36(4)(a) RMA). The word "activity" is used to mean the local authority's activity to which the charge relates (that is, the activity of administering, monitoring or supervising the resource consent), not the applicant's proposed activity (the extraction of gravel).

2. A particular person should only be required to pay a charge "where the need for the local authority's actions to which the charge relates is occasioned by the actions of those persons (s36(4)(b)(ii) RMA). In other words, HBRC can only require a consent holder to pay a charge if the consent holder did something which required HBRC to take action and the charge being recovered relates to that action.

As is the case with New Zealand's freshwater resources, the Section 36 charge is not a unit charge for the quantity of gravel extracted (i.e. a price for the resource) but rather a charge for the administration, supervision and management of the resource.

The charging of S36 fees is not mandatory, that is, a Council can choose to charge or not. Hence, in relation to gravel, charges may be levied for some catchments and not others, dependant on Council resolutions.

(c) charges payable by holders of resource consents, for the carrying out by the local authority of its functions in relation to the administration, monitoring, and supervision of resource consents (including certificates of compliance and existing use certificates), and for the carrying out of its resource management functions under section 35:

2.2.4 Section 108

Section 108 of the RMA deals with 'conditions on resource consents'. Section 108 is relevant to gravel management as it deals with financial contributions, which are a current feature of the existing HBRC process. The relevant specific provisions of s108 are as follows:

(9)

In this section, **financial contribution** means a contribution of—

(a) money; or

(b) land, including an esplanade reserve or esplanade strip (other than in relation to a subdivision consent), but excluding Maori land within the meaning of Te Ture Whenua Maori Act 1993 unless that Act provides otherwise; or

(c) a combination of money and land.

(10)

A consent authority must not include a condition in a resource consent requiring a financial contribution unless—

(a) the condition is imposed in accordance with the purposes specified in the plan or proposed plan (including the purpose of ensuring positive effects on the environment to offset any adverse effect); and

(b) the level of contribution is determined in the manner described in the plan or proposed plan.

HBRC has the relevant plan provisions with the RRMP.

2.2.5 Section 104(1)(c)

When considering any application for resource consent, or associated submission, a consent authority must have regard to any other matter the consent authority considers relevant and reasonably necessary to determine the application. Effectively this enables a non-RMA document to be given 'weight' in a resource consent process. This is expanded upon further in Section 6 of this report.

2.2.6 National Instruments under the RMA

National Policy Statements (NPS), prepared under Part 5 of the RMA, can provide direction to local government on how competing national benefits and local costs should be balanced. National Environmental Standards (NES) are regulations that set baseline nationwide minimum standards for particular issues. To date, there are no NPS or NES for flood hazards in general, or specifically for gravel management. The New Zealand Coastal Policy Statement (NZCPS) 2010, identifies coastal erosion and other natural hazards as a key issue facing the coastal environment. The NZCPS includes policies on the identification of coastal hazards: subdivision, use and development in areas of coastal hazard risk; natural defences against coastal hazards; and strategies for protecting significant existing development from coastal hazard risk.

The Minister for the Environment has announced that national direction in relation to natural hazards will be in place by 2018. HBRC will need to remain aware of developments at the national level in the event that new NPS and NES are developed.

2.2.7 Iwi Management Plans/Planning Documents

Sections 61(2A) and 74(2A) of the RMA require that regional and district plans take into account relevant planning documents recognised by an iwi authority and lodged with the council.

An iwi management plan is a policy document that identifies important issues to iwi regarding the use of natural and physical resources within their area. As evident in the Treaty of Waitangi Settlement for the Mohaka River, Māori can have a unique interest in the management of a rivers gravel resource, and such plans can be developed as one avenue to have these cultural considerations incorporated into statutory Plan and resource consent processes.

2.3 Soil Conservation Rivers Control Act 1941

The overriding purpose of the Soil Conservation and Rivers Control Act 1941 is to make provision for the conservation of soil resources, the prevention of damage by erosion and to make better provision for the protection of property from damage by floods. While the Act has been largely superseded by the provisions of the Resource Management Act 1991, the current provisions of the Soil Conservation and Rivers Control Act 1941 still provide the legal mandate to Regional Councils to protect communities from flooding using the most appropriate methods. The mandate that this Act confers to Regional Councils serves to differentiate a Council's gravel extraction operations from a commercial entity extracting gravel. This is an important legal distinction that has a bearing on the recommendations of this report.

2.4 Land Drainage Act 1908

This Act establishes drainage districts and boards and powers of local authorities relating to watercourses and drains. This Act does not convey powers in respect to natural rivers and gravel extraction but does give a legal mandate for formation and management contracted watercourses.

2.5 Summary of Existing Acts

In summary, the suite of legislation gives the statutory mandate to HBRC to carry outs its duties and functions to avoid and mitigate the effects of flooding on the regions community. While HBRC must still comply with the RMA, where required, the wider statutory context can be used within RMA processes to give primacy to the HBRC flood protection and gravel management function. Examples of how this has been undertaken by other Regional Councils is identified in the benchmarking section (Section 4) and is the basis of some recommendations of this report.

3 HBRC Existing Approach to Gravel Management

3.1 Regional Policy Statement and Regional Resource Management Plan

Appendix A lists all key provisions of the HBRC RPS and RRMP as they relate to management of the gravel resource.

The RPS issues, objectives and Policies relating specifically to gravel cover the range of issues to be considered in managing a regional gravel resource. These specific provisions are complimented by the flood hazard provisions of the RPS which are aimed at avoiding and mitigating flood hazards.

Except where very small quantities are involved, which are a permitted activity, the extraction of gravel from the bed of a river requires resource consent under RRMP Rule 74. Rule 74 has a Restricted Discretionary activity status, meaning that the council as decision-maker in respect of an application can only consider those matters over which it has restricted its discretion in the RRMP. Those matters are:

- Location of extraction sites and stockpile areas;
- Volume of gravel extracted;
- Rate of removal of gravel;
- Period of extraction;
- Use of the gravel;
- Dust management;
- The matters set out in Policy 53 of the RRMP;
- Financial contributions;
- Duration of consent;
- Review of consent conditions; and
- Compliance monitoring.

Of note is the fact that Rule 70 of the RRMP, which allows flood protection works to be carried out as a permitted activity by the HBRC, does not legally extend to gravel extraction activities. Therefore, HBRC like other commercial extractors, must obtain Restricted Discretionary consent if it wishes to undertake gravel extraction as part of its channel management functions.

HBRC has an Environmental Code of Practice in place which provides clear standards of practice for river control and drainage works. It also documents the environmental enhancement or conservation protection, identifies areas for public access and recreation, and identifies future enhancement or protection requirements. The 1999 version of this code is referred to in Rule 70 of the RRMP, but notably is not referred to in Rule 74 pertaining to gravel extraction. In addition, two updated versions of the Code have been produced since 1999, which highlight the difficulty in lengthy and costly plan change processes to keep up to date with referenced document version changes. Due to the legal requirements of the RMA, it is not possible to ‘automatically’ update successive versions of such documents in a Plan.

3.2 Resource Consent Process

The current HBRC gravel permitting process is administered by the Asset Management Team of HBRC. The process steps are as follows and were documented following an interview with the responsible staff member.

1. A “Gravel/Silt Requirements 1 July to 30 June” form is issued to extractors for their completion and returned to the HBRC.
2. Input is received from various Asset Management staff on how much of the submitted requirement should be allocated based on surveyed cross sections and local knowledge.
3. Following an assessment of the “Gravel/Silt Requirement” form, a document is issued to the extractor advising them of the gravel availability at the requested locations for their information, but it is noted that this is not the resource consent authorisation.
4. At any time throughout the year an extractor can contact HBRC and request resource consent based on step 3 above.
5. The resource consent application form is prepared and signed by the Asset Management staff member on behalf of the extractor and then consent is issued with conditions.
6. Compliance monitoring of the consent conditions is undertaken by the Works Group staff member.
7. HBRC recovers the cost of managing gravel extraction through s36 and s108 of the RMA. Each year, these charges are set through the council’s annual plan or long term planning process. Consent holders (commercial operators who have been granted resource consent to extract gravel) pay charges that reflect the cost of compliance monitoring and administration of those consents based on the volume of gravel extracted and its quality. An 80c per cubic meter charge is levied on all extractors apart from the upper Tukituki area, where 20c per cubic metre is charged. Previously, the gravel charge was 60cents per cubic meter and was raised to 80 cents to enable the gravel investigations program outlined in the 2010 Scoping Report.
8. Any money charged and not spent is returned on a pro rata basis back to the gravel extractors.
9. A formal RMA delegation is in place to the Council officer issuing gravel consents
10. Legal declaration
11. The consent process is very efficient with generally consent decisions issued within one day of receipt and only an $80 processing fee is charged.

Appendix B contains examples of the relevant forms and documents used in this process.

The following observations are made in relation to this process:

- Essentially the system involves extraction companies applying for and holding individual resource consents.
- The resource consent conditions are generally well worded and meet legal condition drafting requirements.
- The fact that the resource consent application is signed by the Asset Management staff member on behalf of the applicant and then the resulting resource consent is signed by the same staff member is not an ideal process.
- Internal system and process documentation surrounding the permits could be improved.
- While the ability to impose financial contributions for damages and effects caused by gravel extraction activities exist in the RRMP, no conditions exist on the granted permits for this, which

legally results in such charges not being able to be imposed. However, financial contributions are charged as a proportion of the administration fee charged per cubic metre of gravel extracted.

- While the compliance delegation for this function is correctly in place, no specific training under the RMA has been conducted to ensure the correct legal approach to compliance and enforcement is undertaken.
- As with water permits, the “first come first served” principle exists for issuing gravel consents. Given the high demand from sources such as the Ngaruroro River, it is unclear how this legal principle is being administered.

3.3 District Plans

The District Plans of Wairoa and Hastings district councils and Napier City Council have rules in relation to earthworks for various quantities and matters of control. Central Hawkes Bay District Council only has such rules in relation to certain cultural/archaeological sites. The respective district plan rules apply to gravel extraction also as an ‘earthwork’ which creates regulatory duplication and increased compliance costs. Other earthwork controls that are more legitimately the prevue of a district/city council are traffic safety, vehicle movements and noise etc.

As District Plans have no jurisdiction over fresh water bodies, they cannot be used to encourage gravel extraction from rivers. Rather, this is an RPS matter.

4 Benchmarking with other Regional Council Approaches

A benchmarking exercise has been undertaken across selected Regional Councils in an attempt to identify best practice and lessons learnt. The Regional Councils were selected on the basis of having similar gravel issues to Hawkes Bay or were known to have completed significant work in terms of gravel management. The Regional Councils selected were:

- Otago Regional Council
- Environmental Canterbury
- Greater Wellington Regional Council
- Horizons Regional Council
- Bay of Plenty Regional Council

Initially each Regional Councils regional plan provisions for gravel were reviewed, followed by a questionnaire and in some cases a follow-up interview.

4.1 Regional Plan Analysis

Appendix C lists key regional plan provisions from selected Regional Plans. This analysis has identified the following key observations:

Greater Wellington Regional Council (GWRC) Proposed Natural Resources Plan, Waikato Regional Council (WRC), Bay of Plenty Regional Council (BOPRC) Proposed Land and Water Regional Plan all have a fully discretionary activity status for gravel abstraction, over a small volume which is permitted. BOPRC also have an operative 'first generation' regional plan specifically for gravel dating from the 1990's. This will be rescinded when the Proposed Land and Water Plan becomes operative, but even in this Plan the activity status is discretionary. ECANs Proposed Natural Resources Plan has a permitted activity status, if the gravel extraction is undertaken by the Council itself, and is justified on the basis of its Soil Conservation Rivers Control Act 1941 mandate.

The Horizons Regional Council One Plan, while also having a discretionary activity status for gravel extraction, has a more detailed set of plan provisions. The One Plan specifies in Policy the annual average volume that can be extracted from a given river reach. Other parts of this policy give the consent authority flexibility in respect to increasing and decreasing these volumes for the purposes of flood protection. The extraction of gravel above a permitted threshold is a discretionary activity except in areas of rare or threatened habitat where a 'tailored' discretionary activity rule applies.

The key finding of this regional plan benchmarking analysis is that HBRC's restricted discretionary status for gravel extraction and the limited extent of its discretion is inconsistent with all other regional plans analysed that have a fully discretionary activity status. The Horizons One Plan provisions are the most advanced of any council in respect to gravel management. It should be noted that even with a fully discretionary activity status, a resource consent application for gravel extraction must still be assessed as to its environmental effects. Hence, declining consent for an easy to access abundant gravel resource that avoids environmental effects in favour of an area where gravel is required to be extracted for river control reasons is not a valid reason for the decline of consent.

4.2 Questionnaire

Appendix D contains the questionnaire circulated to the selected Regional Councils and their responses. Key documents supplied as part of the questionnaire responses are listed within the bibliography. All Regional Councils who were requested to take part in the survey participated and provided full answers and associated documentation to each question. In some cases, follow up phone calls were made for clarification. This has enabled the approaches undertaken by Regional Councils with similar gravel issues to be fully understood and evaluated for best practice, and proved to be critical base information for the recommendations of this report.

4.3 Otago Regional Council

ORC hold some gravel extraction resource consents, but to date most have been held by other organisations or individuals. However ORC state that while to date they have principally relied on commercial operators to extract gravel, ORC will need to directly fund extraction in some areas in the future.

Gravel extraction is used in a limited way within some flood control scheme areas by ORC but comment that there is an increasing expectation is some parts of Otago that they will take a more active role in managing river form (rather than capacity) using gravel extraction as a tool.

Further, ORC make the comments:

"Decision-making on resource consents must take account of matters that are broader than "engineering" considerations.

There must also be clear separation between regulatory and operational functions within an organisation. For these reasons ORC's consents section have the responsibility for deciding and issuing resource consents for gravel extraction."

While ORC does not have a specific regional gravel management strategy, ORC is preparing River Morphology and Riparian Management Plans for some rivers in Otago. The rivers being targeted are those where river morphology is dynamic over short time scales and where there is high community interest in how the river and its margins should be managed. The plans are prepared in consultation with the community and stakeholders. Whilst the plans have no statutory basis they act as a guide for ORC's river management activity and help inform the Annual Plan process. The plans help ensure that community expectations around river control and gravel extraction are managed and that the respective roles of ORC and landholders are clear. They also ensure that decision-making takes account of wider community values and that river are not simply seen as gravel quarries.

4.4 Environment Canterbury

ECAN manages gravel extraction via a variety of methods including:

- Resource Consents held by commercial extractors

- Gravel Authorities (Permits issued under a permitted rule of the Land and Water Regional Plan)
- Resource Consents held by the council (Permits under a resource consent held by Regional Engineer),
- Extraction via a permitted activity Rule in the Land and Water Regional Plan.

This system is described below.

4.4.1 Gravel Demand

In 2006, a Regional Gravel Management Report predicted increasing gravel demand in the Canterbury Region. The demand then eased in line with the global financial climate, but the 2010/2011 Canterbury earthquakes have meant that a significant quantity of gravel has been required as the rebuild progresses. Until recently, rural areas also experienced an increase in demand for gravel associated with dairying and growth in farming activities across Canterbury. Demands from central government and territorial authorities for the development and maintenance of their infrastructural assets have also increased.

4.4.2 Key Documents

ECAN manages gravel in its region via the following documents:

- Canterbury Gravel Management Strategy
- Canterbury River Gravel Extraction Code of Practice
- Gravel Liaison Committee
- South Canterbury Gravel Agreement (Gravel MOU)

4.4.3 Gravel Management Strategy

The Canterbury Regional River Gravel Management Strategy (GMS) was adopted by ECAN in November 2012. The GMS was written to inform decision makers about the management of gravel sourced from Canterbury's rivers. The GMS was prepared in accordance with sections 82 and 83 of the Local Government Act's Special Consultative Process, and was adopted following a consultation, submission and hearing process.

The GMS provides the framework for sustainable management of gravel extraction from rivers throughout Canterbury and is aimed at achieving affordable flood hazard protection and sustainable economic development without compromising cultural, social, environmental outcomes and values.

This Strategy, prepared under the Local Government Act, was used to inform RMA processes and decision making, and in particular the Proposed Land and Water Regional Plan. Importantly, it also enabled ECAN to meet the responsibilities for hazard mitigation defined in the Soil Conservation and Rivers Control Act (1941).

4.4.4 Canterbury River Gravel Extraction Code of Practice

The Canterbury River Gravel Extraction Code of Practice sets out good practice guidelines for managing the physical extraction of gravel from riverbeds. Development of the Code was a recommendation in the Gravel Management Strategy. The Code is designed as a guide to contractors so that they can extract gravel whilst avoiding, or where possible mitigating or remedying, adverse environmental effects.

The Code of Practice consolidates commonly used resource consent conditions with the aim of simplifying the authorisation process. The Code also sets out guiding principles and objectives and standard rules for gravel extraction. The Gravel Authorisations refer to the Code of Practice, and require extraction to occur in accordance with the Code.

4.4.5 South Canterbury Gravel Agreement (Gravel MOU)

In South Canterbury (Rangitata River and south), Environment Canterbury and the industry signed the South Canterbury Gravel Agreement (MOU). The agreement limits all Consents and Authorisations to a maximum volume of 30,000m^3 and duration of 12 months, enabling better flood management in rivers and creates a level playing field for signatories.

To ensure the success of the Agreement, ECAN requires that any new gravel extractors to become signatories prior to applying for a Consent or Authorisation.

Additional discussions with ECAN are required to fully understand the basis for this agreement.

4.4.6 Gravel Liaison Committee

There is a Gravel Liaison Committee made up of 12 elected stakeholders (elected by commercial extractors themselves) to assist in the management of river gravel in the region.

4.4.7 Allocation Method

Within the GMS, ECAN recorded that section 124A – 124C of the RMA would not apply to resource consents for gravel extraction. This is referred to in the Strategy as 'Method 1 – Annual Extraction Rate Based Allocation'. Prior to the GMS being adopted, when assessing new applications for gravel extraction under the RMA, ECAN was required to consider existing consent holders and give priority to them in regard to reallocating gravel that was not extracted under a previous consent.

A number of submitters to the GMS process, particularly those with large investment in fixed plant, expressed concerns at the hearing on this matter. The reasons provided by Council officers and supported by some submitters for excluding the consideration of section 124A – 124C, included:

- The ability of ECAN to meet its flood hazard management responsibilities;
- Reduction in the quantity of gravel "tied up" in under-utilised resource consents;
- Community benefit through reduced gravel costs and provision of increased flood capacity;
- The need to provide a more formalised setting for the successful South Canterbury MoU which relied on a "gentlemen's agreement".

Hence, the exclusion of s124A-124C is a legal means of giving ECAN greater control over "gravel banking" and anti-competitive behaviour.

The South Canterbury Extractors Group supported the removal of section 124A-C provisions on the basis that it would create a level playing field across the region.

The reasons given by those submitters in favour of the retention of the section 124A-C were as follows:

- Certainty of supply over a longer duration, particularly in regard to the Waimakariri River which is in close proximity to Christchurch;
- Recognition of long term consent holders and the wider role they play in the management of rivers;
- Recognition of investment in fixed plants;
- Recognition of supply contracts that extend beyond a 12 month period.

The ECAN hearings panel came to the conclusion that the removal of the section 124A-C provisions of the RMA was the most appropriate mechanism to enable ECAN to manage gravel extraction for the purpose of maximising flood carrying capacity in the region, and reducing flood risk to people and properties. They also accepted that the approach will enable ECAN to better align consented (allocated) volumes with actual extraction volumes which goes some way to avoid 'gravel banking'. The approach also ensured that the river gravel resource was not over-allocated or over-extracted in the future.

Since the adoption of the GMS, this approach has been codified within the notified Land and Water Regional Plan (Rule 5.124).

4.4.8 Permission Method

The draft Strategy set out two "Permission" options, which are summarised as follows:

- Option 1. ECAN's Regional Engineer to have Permitted Activity status under the Proposed Land and Water Regional Plan, or hold a 'global' resource consent for the extraction of gravel for flood management purposes;
- Option 2. Continue the current individual long term resource consent approach under the RMA, where individual operators were the applicants and consent holders.

The issues raised by submitters in regard to these options, particularly in regard to Option 1 included:

- Why ECAN as an extractor, should be treated differently from other extractors in regard to the Permitted Activity status?
- If ECAN held a global resource consent, how would other extractors be able to apply to extract gravel from the same reach of a river?
- How would the permissions system actually be implemented?

In its hearing decision, the panel accepted ECAN being treated differently to other extractors in holding Permitted Activity status for gravel extraction, and while the Panel recognised this as ultimately an RMA issue to be considered within forthcoming regional plan hearings, this status was appropriate recognition of ECAN's wider statutory functions for flood management.

The Panel also accepted that the Permitted Activity status had an advantage in allowing lower cost entry to extractors and faster access to the resource, when extractors were operating under the ECAN permitted activity rule.

However, the Panel rejected the proposal for ECAN to hold global resource consent for all gravel extraction in Canterbury, as this would not allow for commercial extractors to apply for resource consents over areas where the global consent applied.

In general, gravel extractors supported ECAN holding the gravel permits and the authorisation process as the existing resource consent and land ownership processes took too long and this meant the commercial operators were often unable to rely on getting consents to extract gravel when placing competitive tender bids for work.

While commercial operators are able to individually apply for resource consent, the onus is on the applicant to prove a comprehensive consent application and evidence to prove sufficient gravel is available.

4.4.9 Questionnaire Responses

ECAN makes the following comment regarding their previous system of relying on commercial operators gaining resource consents, before the introduction of the ‘authorisation' system:

> *"This approach has had marginal success in the past due to inability to target extraction - but the newly imposed authorisation process under the Land and Water Regional Plan will improve our ability to target gravel extraction to maintain flood capacity."*

A further useful comment for directing extractors into problematic areas is:

> *"Gaining access to the riverbed over private land is often a constraint that the contractor must work through. The Gravel Authorisation process discussed above is an incentive to extract from those areas because the costs associated with gaining that permission is significantly less than resource consent. "*

ECAN do not finance gravel extraction from scheme rates and currently rely on commercial extractors. However, they do comment that this may be required in future in problematic areas where incentives will be considered.

In relation to 'gravel banking' Ecan comment:

> *"This was a problem in all rivers before the Regional Gravel Management Strategy – and remains a problem with larger & strategically located rivers such as the Ashley & Waimakariri which have long term large volume consents. The policies in the Land and Water Regional Plan are now giving stronger direction to consents officers to only issue short duration consents to ensure the gravel is taken over shorter durations (in alignment with our Gravel Management Strategy). Copy of policy 4.95A is below. The Gravel Authorisations are also ensuring gravel banking does not occur due to their short durations.*
>
> *The Regional Plan now directs that sections 124A to 124C of the RMA do not apply to gravel extraction in Canterbury. This means that upon the expiry of gravel consent, the un-used portion of the original allocation is now available for any party to apply to take, rather than the original consent holder having first priority to that resource. This incentivises extractors to take their full allocation within their consented timeframe, or else they may lose that allocation."*

Ecan also report poor alignment between Regional Council and District Council planning documents in terms of river bed definition. The gravel management fee charged to commercial extractors is for the entire consented volume and not just on a per cubic meter that is used basis.

4.4.10 Summary

In summary, the 'permission' process administered by the River Engineering Section and the Resource Consent process administered by the Regulatory 'arm' of ECAN have the following features:

- Section 124A to section 124C of the RMA do not apply to gravel extraction in Canterbury;
- Written authorisations (under a Permitted Activity rule) and resource consents will be issued to parties on a first in, first served basis;
- All extraction will be governed by a Gravel Extraction Code of Practice;
- Applications for written authorisations and resource consents will be required to include a statement of reasonable need for the volume sought;
- Resource consents and written authorisations to extract river gravel will not be granted in areas where a deficit of gravel has been identified or where proposed extraction may cause a deficit in gravel volumes i.e. gravel cannot be over-allocated;
- Written authorisations will be issued for a maximum duration of 12 months and a maximum volume of 60,000 cubic metres per consent
- Resource consents will be issued for a maximum duration of 12 months and a maximum volume of 60,000m^3 across the entire region, except on the Waimakariri River where durations of up to 5 years and volumes of up to the maximum available. This is because of the considerable infrastructure for gravel processing already present on the Waimakariri River;
- Quantity will be considered.

Figure 4 illustrates a flow chart of the ECAN process. This process applies to authorisations or resource consent applications for any volume or duration.

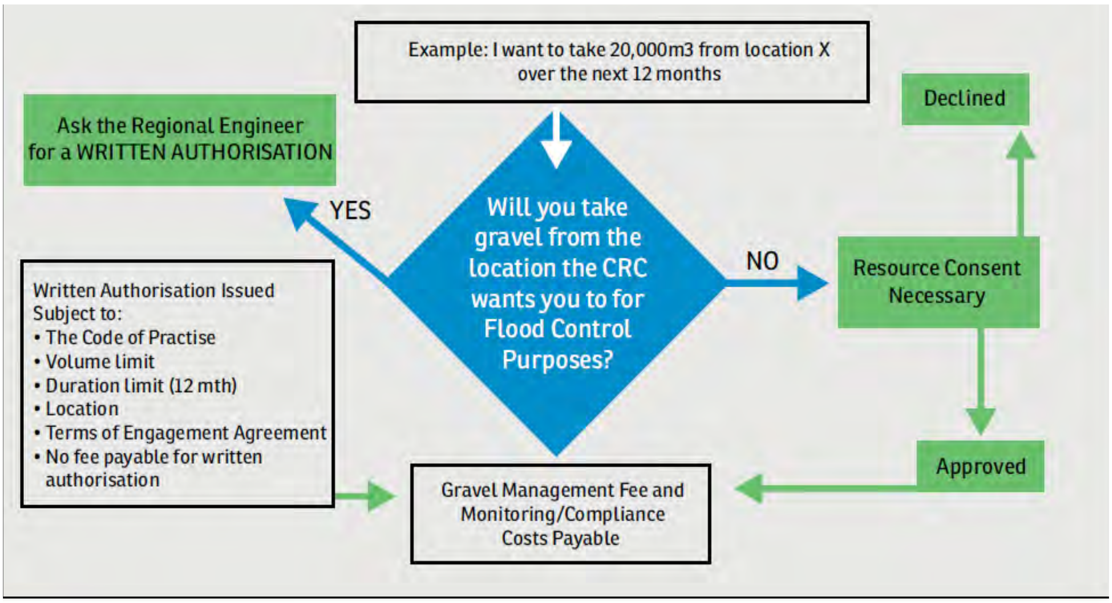

Figure 4. ECAN Gravel Allocation under the 'Permission' and Resource Consent Processes - Flow Chart

<QUESTIONNAIRE STILL TO BE PROVIDED>

4.5 Greater Wellington Regional Council

GWRC Flood Protection (FP) applies for, and holds, resource consents to extract gravel from all rivers in which operative river schemes exist and are administered by GWRC. Hence, the permitting system is administered by the regulatory 'arm' of GWRC. The volume, location and timing of permitted gravel extraction operations varies depending on the specific river. GWRC FP then issues 'licences' to individual contractors to extract a certain volume for a specified period. A fee is charged by the FP team to 'administer' the licenses.

Consent applications are generally a "consent suite" package which includes gravel extraction activities in addition to all other consented river management activities. This is due to no permitted activity status being afforded to the FP team by the Regional Plan.

GWRC is working on a Gravel Management Plan for their region, similar to the Strategy being recommended by this report.

GWRC has also produced a document entitled *Floodplain Management Guidelines w*hich provides guidance on the floodplain management planning process, and on the preparation of Floodplain Management Plans. The purpose of the guidelines are to apply international best practice, along with consistent principles and approaches in preparing Floodplain Management Plans throughout the region, based on good practice lessons in floodplain management planning, and to aid GWRC in meeting its legislative responsibilities.

The Floodplain Management Plans are developed for each river, and documents the approaches for avoiding and mitigating flood risk. This includes the use of gravel extraction where deemed necessary.

To date, GWRC has not funded gravel extraction but this is a future possibility, particularly for areas where commercial demand is low. There are significant budget and river management issues to consider if this is pursued. GWRC make the comment that even waiving the s36 charge is not a sufficient incentive, given haulage costs from such areas.

GWRC is one of the few Regional Councils in NZ that has defined 'River Corridors' in most District Plans in their Region and gravel extraction/river management activities are permitted by TA planning instruments. River corridors are defined through the FDFMP process.

Interestingly, as a concluding comment GWRC state:

> *"We are increasingly finding that we're not able to consider gravel volumes/levels in isolation and must consider them in relation to overall river management (e.g. how design channels and buffers work). We are addressing this through Floodplain Management Plans currently in development and review, and through our Gravel Strategy."*

This issue is also a part of this reports scope of work as HBRC is facing similar issues. This is further discussed in Section 7 of this report.

4.6 Horizons Regional Council

As outlined above, Horizons has a comprehensive set of regional plan provisions that specifies gravel volumes for allocation in a policy. The Regulatory Department of the Council undertakes the consent authority functions in respect to gravel. The Engineering Department is an applicant and often holds 'global consents' for gravel extraction in some rivers. Gravel extraction companies also hold their own resource consents in some situations.

While gravel extraction is not currently financed from Scheme funds, low demand in some areas, or poor quality gravel that is not suitable for end uses leading to aggradation may see this policy reviewed in future.

While not a widespread issue, gravel extractors have been required to gain gravel permits from Horizons and earthworks permits from a District Council in river berm areas.

Horizons make the following comment in terms of land based sources within their region:

> *"The latest gravel mining trends operated by large gravel extractors on private land is limiting the ability of river operations to effectively, and cost efficiently, utilise gravel extraction for channel management."*

4.7 Bay of Plenty Regional Council

BOPRC have three methods for undertaking gravel extraction:

- The River Engineering Department holds its own resource consents for gravel extraction and carries out this work itself;
- Commercial gravel extractors exercise permits on behalf of BOPRC and extract gravel from areas they are directed to;
- Commercial gravel extractors apply for their own consents.

Gravel consents are issued to the Regional Council for a 10 year duration. When BOPRC itself extracts gravel, this is funded by scheme rates.

Of note is the fact that iwi have applied for and hold resource consents for gravel extraction. This matter is further addressed in Sections 8.0 and 10.0 of this report.

The report - Natural Environmental Regional Monitoring Network (NERMN) - identifies the locations and amounts of gravel that require extraction to maintain channel capacity.

4.8 Conclusions

The following conclusions can be drawn from the benchmarking questionnaire exercise, but overall, a considerable amount of consistency has been identified across the Regional Councils surveyed.

- All Regional Council 'Engineering Sections' surveyed hold their own gravel extraction consents along with resource consents held by commercial extractors.
- In all Regional Councils surveyed, gravel extraction consents are administered by the Regulatory 'arms' of each Council along with all other resource consent processes.

- For consents held by Regional Councils, some form of non-RMA authorisation process is used that effectively 'contracts' commercial operators to undertake the extraction on behalf of the Regional Council.
- Most Regional Councils have not funded extraction from scheme rates but almost all report that this is being considered given low demand and localised aggradation.
- All regional Plans have a Discretionary activity status for gravel extraction, however some plans have a Permitted status for activities carried out by the Regional Council themselves.

These conclusions are further considered within the options analysis and report recommendations sections below.

5 Demand Analysis and Financial Drivers

It is important to understand the past and possible future gravel demand and financial drivers that are influencing the commercial market for gravel in Hawkes Bay. The extent of this analysis has been limited by commercial sensitivity of the gravel extraction companies who are understandably unwilling to declare who their clients are and what volumes of aggregate are being sold for what purpose.

The Stevens and Larsen (2015a) report on Gravel Demand Forecast is very comprehensive and this report does not attempt to reanalyse their analyses. However, the following demand analysis is presented with reference to RMA s36 charging issues and what financial drivers are (or are not) available to HBRC. The Stevens and Larsen (2015a) report recommends the low to mid 5 year riverbed gravel forecasts be used for planning purposes which predicts riverbed gravel demand increasing from 432,000m3 actually extracted in 2013, to a predicted range between 494,000m3 - 660,000m3 in 2019. Hence, it will be important to encourage this lift in demand over the next 5 years to be sourced from Central Hawkes Bay sources, as little additional supply is available from Heretaunga river sources, with the main 'competitor' being land based sources.

Drawing on additional information gained at a gravel extractor workshop held in 2010; HBRC operational staff knowledge of the industry; and recent discussions with key gravel extraction companies, has enabled the following understanding of gravel demand and financial drivers for gravel in Hawkes Bay.

The over-riding commercial imperative for the aggregate market is to secure access to suitable material as close as possible to demand. In Hawkes Bay, approximately 550,000 m^3 of gravel is extracted from rivers on average in recent years, which is equivalent to approximately 60,000 truckloads. Of this, approximately 100,000 - 150,000 m^3 has historically been from the Tukituki and Waipawa rivers; but in recent years this has reduced to less than 20,000 m^3/year. The remaining 300,000 to 350,000 m^3 per annum has been from rivers on the Heretaunga Plains, with the vast majority from the Ngaruroro River. This figure does not include the gravel sourced from the beach source at Awatoto consented to Winstone Ltd.

Gravel is used for a diverse range of aggregate uses in Hawkes Bay and includes:

- State Highway and local roading
- Forestry roads and tracks
- Network utility trenching
- Concrete and concrete products
- Landscaping
- Fill

There is some differentiation in market demand from commercial operators. For instance, at times, Winstones source smaller material but the majority of demand is for material that is 30 - 40mm in size. At times, gravel extraction companies 'swap' gravel based on client demand and supply at hand.

Of the total New Zealand aggregate resource, approximately 70% are non-carbonaceous. Most are greywacke (divided into 6 sub-categories), and 30% are volcanic. All of Hawkes Bay riverbed gravel is greywacke based. Significant contractual requirements surround the quality standards. River sourced gravel is a preferred supply option, as alluvial processes sort the gravels by removing the lower quality material. Land-based extraction is a more expensive source, putting aside any transport economics. Hawkes Bay has some of the highest quality aggregates in New Zealand, especially from the Ngaruroro River catchment.

Almost all of the material extracted is used in Hawkes Bay, with the amount leaving the region varying from year to year, which is usually bound for Gisborne. To date, no demand from the major North Island urban centres has occurred due to transport economics. This is in spite of some Auckland quarries (that are closest to market) yielding lower quality material, along with urban expansion resulting in the closure of quarries; while in Wellington, due to vastly diminished river yields, demand is serviced largely by Horokiwi and other land based quarries.

5.1 Gravel Extraction Companies

Stevens and Larsen (2015a) report:

"In the year to June 2014, there were currently more than 50 companies or organisations with river gravel extraction allocations, covering northern, central and southern parts of the region. Many of these are small operators with less than 10,000 m^3 extracted annually. The 3 largest extractors based in the central region (Winstone, Holcim and Higgins) have extracted on average 60% of the total reported Hawke's Bay regional river gravel allocation since 2000, although it has been up to an estimated 70% in peak years. In the 2013 calendar year 432,193 m^3 were extracted from the region's rivers."

Stevens and Larsen (2015a) also record that Winstone's coastal extraction plant at Awatoto has been extracting approximately 30,000m^3/year and this long term consent expires in May 2017. If this consent is not re-granted then every effort should be made to ensure this aggregate is not sourced from a new land based operation, but rather sourced from river sources. This situation also presents a potential risk to HBRCs management of the riverbed gravel resource as Winstones could legally mount a resource consent application for the entire amount currently extracted at Awatoto from the Ngaruroro River, and this would create legal allocation issues in terms of the current consent process used by HBRC.

5.2 Gravel Demand in Central Hawkes Bay

The demand from the Central Hawkes Bay area is worthy of more specific discussion given the issues in this area's rivers. Gravel extraction from Central Hawkes Bay river sources has been characterised by 'boom and bust' cycles over the last 30 years, whereas Heretaunga Plains' sources have had more consistent ongoing demand. In the 1980's and 1990's, demand did exist from the neighbouring Manawatu and Taranaki regions, being the result of 'backfill' transport opportunities, ease of access and consenting, but an over-riding reason of high market demand.

Up until 4 - 5 years ago, approximately 80,000 to 160,000 cubic metres per year was extracted from Central Hawkes Bay sources, with between 50,000 to 70,000 cubic metres per year specifically from the upper Tukituki River. This has diminished significantly in the last 4 – 5 years, and coincides with the receivership of three companies who were extracting this gravel - Infracon, Calais and Hurlstone. It is understood that the majority of end use of this gravel was for private development and gravel was being transported long distances by all three companies both north and south of Central Hawkes Bay. It is further understood that the long haul distances undertaken by these companies contributed to their receivership, along with the global financial downturn.

Infracon had a presence in Hastings, Dannevirke, Tararua and Palmerston North, with their base being in Central Hawkes Bay where the main quarry operations were situated. As such, a lot of material went in each direction to service these locations.

Several stockpiles Infracon left behind post receivership, were largely inferior or reject product which are not impacting on current extraction rates to any degree. Other stockpiles were purchased by the Port of Napier and are being slowly used for port and other developments over time.

Discussions with Horizons Regional Council has identified that demand exceeds supply in the southern extent of their region due to demand from the Roads of National importance projects in the Kapiti and Wellington areas. Demand in other parts of their region is now being at times compromised due to more land based sources being targeted.

Current extraction from the Central Hawkes Bay sources now only serves the Central Hawkes Bay area.

The Central Hawkes Bay District Council (CHBDC) demand for gravel has not changed since approximately 2004 and is small (due to budgetary constraints and NZTA subsidy regime) at approximately 15,000 cubic metres per year. Historically, this material was extracted from river sources, but in an effort to reduce costs (primarily haulage costs), this demand is now being met from land-based red metal and 'paddock-stripping operations. While previously CHBDC used the NZTA and then a South African based aggregate standards for local roads which required riverbed gravel quality aggregate sources, this proved too expensive in terms of haul costs, hence localised aggregate specifications are now being used that enables the red metal/paddock stripping sources to be used as a fit for purpose option. This approach has resulted in haul distances at times decreasing from 60 - 70km for river sources to less than 5km, and the resultant cost savings.

An opportunity does however exist to have a commercial discussion with CHBDC to identify cost effective opportunities for again extracting riverbed gravel sources, but this may require some financial offsetting of costs. This option is especially relevant for localised problem reaches where future flood scheme-financed works maybe required.

No significant NZTA projects are planned in the area that would create new demand for the gravel resource. Even if future NZTA projects go ahead, aggregate reuse and recycled material use have significantly diminished historical demand volumes for such works. However, opportunities do exist to supply gravel from this area to NZTA programmed roading projects on the Heretaunga Plains.

While reasonable numbers of subdivision consents are being issued by CHBDC, these are not being developed in any major way, resulting in low private demand for gravel.

The potential Ruataniwha Dam project represents the single most significant opportunity for future gravel extraction demand. However, this demand is not generated by the dam construction itself as only tens rather than hundreds of thousands of cubic metres will be required for the dam and this will be sourced from the constructed reservoir ponding area. Modern excavation and construction techniques require relatively small volumes for ancillary works associated with the dam (e.g. canal construction).

The potential major demand generated by the Ruataniwha Dam project is the on-farm development and the general economic upturn the scheme construction and operation will generate in Central Hawkes Bay. While this cannot be accurately quantified, it could be up to 100,000 cubic metres or more.

Major roading projects that will generate gravel demand such as the Whakatu Arterial and Napier/Karamu Rd intersection upgrade also provides an opportunity to supply this gravel from the Central Hawkes Bay sources. However, it is acknowledged that in respect to the Whakatu Arterial project, this project is facing some budget constraints and HBRC is already working collaboratively to source bulk fill from the Karamu Stream as part of a flood improvement scheme.

5.3 Gravel Demand by Other Councils

Stevens and Larsen (2015a) report that Wairoa, Napier and Hastings Councils are sourcing the majority of their aggregate from land based sources, and in the Hastings District Council case this equates to approximately 30,000 m^3/year. It is recommended that more proactive discussions be undertaken, particularly with Napier and Hastings councils, to understand the price point differences from their land based sources versus river sources.

5.4 Commercial Certainty

Feedback from some gravel extractors suggests that the current HBRC system of annual allocations can in some cases, not give commercial security required for companies. Land-based supplies are sometimes used because of long-term uncertainty associated with river supplies/allocations that are close to demand centres. If there are significant changes in allocation from year to year, this then impacts on the industry's supply chain security and ability to respond to tenders, whereas land-based supplies can flatten out the peaks and troughs of the current system.

For example, Holcim has had a 35 year consent for land-based operations and QRS sources approximately 60% of their supply from long term land-based consented sites.

Typically, a 10 year investment profile would be taken for the quantum of investment necessary to finance plant infrastructure. However, a longer consent term from riverbed sources would require a more comprehensive assessment of environmental effects to accompany a resource consent application, and a more rigorous consent authority process to ensure the requested allocations would be sustainable over such a longer term.

5.5 Influences on 'Price Points' for Gravel

Gravel demand is not sensitive to the S36/108 charge currently levied by HBRC. This is because the current charges are small in comparison to the transport and processing costs. Hence, if transport costs increased to a certain price point for riverbed sources, the relative economics of either land-based hard rock quarries or river terrace gravel 'stripping' can become viable. Such price point changes are purely dependant on the volume and location of the demand relative to the supply location. It is commercially advantageous for commercial operators to overstate this price point to retain cheaper riverbed sources. Increased price of land in Hawkes Bay now raises this price point for both new land based quarries, particularly for river terrace gravel stripping operations; hence, if industry purchases the land, then that becomes a significant proportion of the on-sold gravel cost.

The number and volumes being extracted from either existing land-based quarries or river terrace stripping operations is unavailable.

5.6 Summary

A detailed, quantitative analysis of gravel uses cannot be undertaken due to lack of information and commercial sensitivity. Hence, a largely qualitative assessment has been presented. Notwithstanding this, even if a more detailed understanding of gravel use was available, this would not be in itself a critical factor in addressing the current issues. Despite, Rule 74 of the RRMP requiring an assessment of "use" of the gravel, this is carried out at an operational level (e.g. to ensure high quality gravel is being used for a commensurate purpose such as state highway roading, as opposed to fill), this information is not routinely recorded. This is in contrast to resource consents for fresh water where the consent document and metering compliance reporting enables analyses of water use across the region.

Furthermore, HBRC has no technical information on the quality of the gravel resource, and this is left to the commercial companies to collect. Thus, HBRC is reliant on advice from gravel extractors when matching allocation to use.

The overriding issue that has been identified in this section, is the downturn in demand from the Tukituki and Waipawa rivers, however opportunities for future riverbed extraction do exist. These opportunities are associated with the Ruataniwha Dam project and associated development; future roading upgrade projects and commercial discussions with CHBDC; and a potential gravel extractor consortium interested in transporting and stockpiling gravel onto the Heretaunga Plains. If demand from these initiatives eventuates, the challenge then becomes having the ability to direct extraction from problematic locations and reaches. This is addressed in the following sections of this report.

6 Options Analysis

The central issue identified by this report is how to sustainably fund maintenance of channel capacity in the Waipawa and mid and upper Tukituki Rivers given the low commercial demand for gravel, while continuing to manage sustainable allocation of the gravel resource from other Hawkes Bay rivers, particularly the Ngaruroro River where demand exceeds supply. Three approaches with varied options are assessed:

- Financial -based options
- Regulatory options
- Non-regulatory options

6.1 Financial-Based Options

The financial levers that HBRC have are:

- Subsidising commercial gravel extraction
- Waiving or reducing S36 charges
- HBRC financing its own gravel extraction program and storing extracted gravel in long term storage areas close to source reaches

6.1.1 Subsidising Commercial Gravel Extraction

An estimated cost of $16/m^3$ has been provided to extract and transport gravel from the mid/upper Tukituki to demand centres on the Heretaunga Plains. As it is estimated that 882,000m^3 has aggraded in the upper Tukituki, this equates to over $14 million at the $16/m^3$ estimated rates for transporting to the Heretaunga Plans. These costs are obviously exponentially higher for the mid Tukituki that has an estimated 14 million m^3 of gravel above the grade line.

This would be a ‘one off’ cost over a number of years to deal with the above grade line gravel and does not account for additional gravel supply to the system which would become an ongoing cost, or future flood activity that may transport gravel to downstream reaches. This option obviously assumes no improvement in market demand for this gravel, and that the entire gravel resource above grade lines is required to be extracted which is not the case. Hence, this is a worst case scenario.

6.1.2 Waiving or Reducing Section 36 Charges

It has been demonstrated that this is unlikely to exert a significant influence on gravel extraction given the legal limitations of S36 and what price can be levied, versus the dominant price controls of market demand and transport economics. Hence, this option is largely discounted.

6.1.3 HBRC Financed Gravel Extraction Program

An upper estimate of $6/m^3$ has been made for HBRC to undertake its own operation to extract and ‘store’ gravel locally upon neighbouring land outside the flood banks. Again, just using the upper Tukituki example, the estimated 882,000 m^3 equates to over \$5 million to extract and store on neighbouring land owned by HBRC. Given the quantum of material, it would be challenging to find sufficient land for all of this material.

However as noted above, this is largely a theoretical analysis, as extremely localised tributary and main river stem reaches are causing the most significant problems for landowners, and if quantities in the order of 20,000 m^3/year were extracted using flood scheme funds, this immediately becomes more affordable and worthy of consideration.

Caution needs to be taken with this option as large stockpiles of gravel could distort future demand and compromise ongoing channel management operations for the region's rivers, especially if future flood activity results in an increase supply of gravel. Hence, extraction at the lower quantities suggested, of around 20,000 m^3 per year, would avoid this situation. Alternatively, a decision could be made to never use such stockpiles to ensure ongoing extraction occurs.

The upper Tukituki Flood Scheme is funded by a combination of direct and indirect beneficiary-targeted rates and general rates. A total of 6344 valuation numbers make up the direct and indirect targeted rate contribution with 5312 properties paying less than \$100 per annum targeted rates, but some properties paying in excess of \$16,000 per annum. Total scheme assets are valued at \$28.35 million. Ten land classes make up the scheme area with a total scheme rating from all classes of just under \$700,000 (exc. GST) per annum. Hence, at this level of scheme rating and given existing scheme maintenance requirements, a very large increase in scheme rates would be required to internalise the cost of a large scale gravel extraction operation, and it is unlikely that this is either needed or would be agreed to by scheme ratepayers. However, a modest increase or redirecting existing scheme funds into gravel extraction at localised areas should be considered. A more detailed investigation of these localised areas and quantities to be extracted with a potential works program and associated funding requirements is recommended however, before this option is adopted.

6.2 Regulatory Options

The following regulatory options have been assessed:

1. RMA plan options
2. RMA permitting options

6.2.1 RMA Plan Options

From the analyses of the existing HBRC plan provisions and the benchmarking analysis with other Regional Councils, the following section evaluates a range of possible regulatory options.

6.2.2 Regional Policy Statement

The review of the Hawkes Bay Regional Policy Statement Issues, Objectives and Policies has found that these plan provisions adequately cover the range of matters to manage the regionals gravel resources at an RPS level. Hence, no immediate amendments to the RPS are deemed necessary, although consideration to giving regional priority to riverbed gravel extraction over land-based operations does seem a more sustainable and 'wise' use of resources. This would require HBRC to use its statutory advocacy function in respect to district plan and TA consenting matters. This is because it is unlikely that this would be expressed as a Rule in a District Plan, and more likely be a Policy, and past experience would suggest a reliance on HBRC reinforcing such a Policy through its statutory advocacy formal submission function. This could even extent to a court appeal stage in an effort to establish a Hawkes Bay precedent on this issue.

6.2.2.1 Development of a Specific Regional Plan for Gravel Management

In 1994, HBRC adopted its first regional plan under the RMA – the *Regional Riverbed Gravel Extraction Plan*. This regional plan contained a full suite of plan provisions specifically for the gravel resource. In 2007, this Regional Plan was rescinded when the RRMP was adopted. An option exists to again formulate a specific regional plan for gravel; however, this is not recommended for the following two reasons:

1. Any changes or new provisions can be incorporated into the existing RRMP via the Schedule 1 process; and
2. Considerable efforts are being made across the country to eliminate 'single issue' regional plans in favour of integrated regional plans that enable the inter-relationships between natural resources and environments to be managed holistically.

6.2.3 Regional Resource Management Plan

The following observations have resulted from the review of the RRMP and benchmarking with other Regional Councils:

1. HBRC is the only one of five Councils surveyed that has a Restricted Discretionary activity status for gravel extraction above the permitted activity level. All other Regional Councils have a fully Discretionary activity status.

2. Some Regional Council River Engineering Departments have an explicit permitted activity rule for gravel extraction in recognition of their legal mandate under particularly the Soil Conservation and Rivers Control Act 1941. The existing permitted activity Rule 70 does not include gravel extraction; hence HBRC required consent under Rule 74. It is recommended that Rule 70 be amended to also include gravel extraction in a future plan change.

3. The matters in the RRMP that discretion is restricted to, do not explicitly include flood capacity or availability of the gravel resource, but rather records "location" as a matter of restricted discretion.

4. The RRMP does not provide any policy guidance on availability/allocation limits of the gravel resource to guide resource consent allocation decisions. Under Section 30 (iv) this opportunity does exist. The Horizons Regional Council One Plan lists by way of Policy, gravel allocations for given reaches and rivers, to inform the relevant rules. A disadvantage of this approach is the resource availability can change quickly based on storm/flood activity, whereas plan changes are lengthy processes. This is the reason for the One Plan policy status for the gravel allocation amounts rather than using a Rule. Consideration of other Councils' feedback on this, is the reason

for not using an 'allocation' approach within a Regional Plan, rather relying on the fully discretionary rule status combined with 'non-regulatory' documents.

5. While the current HBRC Rule 74 refers to the "use" of the resource, explicit discretion is not given to matching the quality of the gravel to its end use. As part of the current consent process, this is undertaken in an operational way, however, this is not documented in any way.

6. A plan change could also be used to incorporate a non-RMA Gravel Management Plan (see below) by reference, and update the reference to the current version of the code of practice. Rule 74 should also include a reference to the code of practice as this is a method employed by other Councils to achieve best practice for gravel extraction operations.

7. The ECAN approach of exempting gravel permits from RMA S124 has merit and is a good approach along with other methods to avoid gravel banking anti-competitive behaviour. This would require a plan change.

Notwithstanding these potential changes to the RRMP to enable HBRC to more effectively manage the region's gravel resource, all of the potential plan changes are not considered 'urgent', and can be considered during the next programmed plan change process scheduled to begin in 2020 or sooner if such changes are undertaken within the TANK plan change process. Given the relative importance of other plan changes required by HBRC, a stand-alone and earlier plan change for gravel management could not be justified or even practically achieved.

In conclusion, any amendments to the RRMP would be beneficial, but not urgently required in the short term; and a stand-alone plan change for these matters cannot be justified or even is a practical solution. The key issue in relation to this conclusion is this in turn requires the Assets Section to obtain resource consents for gravel extraction rather than relying on a permitted activity status (if this indeed was the outcome of a schedule 1 process). The section below entitled 'non-regulatory options' presents an alternative way forward to address some matters outlined in this section.

6.3 Permitting System Options

As a result of the legal framework review, analysis of the existing HBRC permitting regime and benchmarking analysis with other Regional Councils, this section evaluates the options and presents recommendations for an optimal permitting system. The overall aim of this section is twofold. The first is to ascertain whether any alternative permitting system can be used to overcome the gravel issues in central Hawkes Bay, and secondly a general review to ensure the current permitting system is legally robust and meets statutory requirements of the RMA.

It is stressed from the outset that the existing permitting system has performed adequately to date and no significant problems have been experienced; however, an evaluation of the options that are 'fit for purpose' given the present day issues that are now apparent, is warranted.

In undertaking an evaluation of 'fit for purpose' options, the following principles will be used to determine an optimal permitting process:

- Regulatory efficiency and reasonable regulatory and compliance costs;
- Commercial certainty for extractors;
- Avoidance of gravel 'banking' and monopoly situations;
- Appropriate consideration of environmental matters and respectful consideration of cultural interests;
- Ensuring the design flood carrying capacity of the river channel;
- Ensuring coastal processes and coastal erosion is not exacerbated by gravel extraction;
- A system free of conflicts of interest and has transparency;
- Using a system that is considered 'best practice' identified from the benchmarking analysis with other Regional Councils.

6.3.1 Who should be the Applicant?

Three options exist for who could hold the resource consents:

1. The gravel extraction company (status quo);
2. HBRC;
3. The gravel extraction company, but assisted by HBRC in their preparation of a more comprehensive application and assessment of environmental effects to gain longer duration consents;
4. HBRC holding consents just for the Central Hawkes Bay sources.

The current system whereby gravel extraction companies are the consent holders, has worked well until recent years. However, the current system is not delivering the channel management objectives in the Central Hawkes Bay river systems. Notwithstanding this, even if the current system is retained, improvements to robustness of the current system should be made.

On the Heretaunga Plains, when demand exceeds supply, the current system continues to be reasonably successful in delivering the Council's flood scheme objectives.

An alternative option is for the HBRC Assets Section to become the applicant and consent holder of all major gravel extraction resource consents in the region. This approach is used by ECAN, GWRC BOPRC and Horizons Regional Council. Based on these consents, the Assets Section can then allocate the consented gravel volumes to extractors via a variety of means from competitive tendering to 'authorisations' as used by ECAN.

This will require the Assets Section to prepare longer term and more detailed consent applications and accompanying Assessment of Environmental Effects. Under this option the 'consent Authority' function would be required to move to HBRC's Regulatory Department to avoid a conflict of interest and provide clear separation of functions as required by the Local Government Act. This option recognises that HBRC has the statutory role of "river manager" with specific legislative requirements to avoid and mitigate flood hazards, which separates it from the commercial gravel extractors. Hence, to a greater extent, the flood control imperative of the Council could be better performed by HBRC holding the consents.

Some risks and liabilities of this option will fall on the Assets Section as the consent holder, if the company exercising the consent is non-compliant with consent conditions; although this risk can be managed via appropriate supervision of the companies as currently occurs and having agreements in place with the HBRC Compliance Section as to how this situation will be managed. This is no different to many other situations where organisations hold consents and contractors undertake the works.

This option allows HBRC to give greater direction to where gravel should be taken as once it holds the consents itself, it is unencumbered by the RMA consent process. This option also allows the potential of gravel banking to be better managed.

The third option is to retain the gravel extraction company as the applicant but, particularly for longer duration consents, HBRC Assets Section to assist in the more detailed preparation of the required consent application. Again the 'Consents Authority' function would be required to move to HBRC's Regulatory Department under this option.

A fourth 'hybrid' option exists that retains status quo from all sources other than the Waipawa and mid/upper Tukituki, where HBRC could become the applicant. Under this option, it would be difficult for the Assets Section of HBRC to retain its delegation for processing some applications and not others where it becomes the applicant. Hence, the 'Consent Authority' function would be required to move to HBRC's Regulatory Department.

It should be noted that the ECAN hearings Panel did not preclude individual companies applying for their own consents; but for long term consent durations, the requirements of the consent process and ongoing channel monitoring often proved prohibitively expensive for individual companies to meet the ongoing monitoring costs. This is due to the S36 charges not being available to private companies to fund the activity. Hence, in practice, Canterbury extraction companies are applying for short duration (1 year) consents, for lower quantities in aggraded areas.

All four options are valid and have specific advantages and disadvantages as outlined. On balance, it is recommended that Option 2, where HBRC Assets Section apply for all major gravel extraction resource consents in Hawkes Bay and for longer duration consent terms, is adopted. This cannot in law preclude any commercial operator from applying for such consents. However, if the commercial extractor application was for a longer duration than say, 1 year, particularly robust consent applications would be required with ongoing monitoring consent conditions. If this recommendation was pursued by HBRC, this would ideally be a collaborative approach agreed with the gravel extraction industry.

Legal advice specifically obtained to inform this report, has confirmed that HBRC is legally unable to issue a resource consent under the RMA that requires a portion of the total amount of consented gravel to be extracted, over an amount considered necessary to demonstrate the consent has been 'exercised' under S125 (the "use it or lose it" section). The advice concludes that a commercial agreement under consents held by HBRC is the best way forward which is the same and an independent conclusion as the one reached above.

6.3.2 Consent Duration

Feedback from several gravel extractors has suggested the current annual resource consent process does not give sufficient commercial security to undertake site establishment and locate expensive infrastructure (e.g. crushing plants), particularly in Central Hawkes Bay. Hence, resource consents with longer consent durations commensurate with the commercial investment required should be facilitated. This could possibly extend to 10 year consent durations. The use of a consent review clause (e.g. at regular intervals throughout the consent duration) can be used to ensure the continued sustainability of the gravel resource for the remainder of the consent duration. Given the amount of gravel above the grade lines in the Tukituki and Waipawa River, it is difficult to envisage the consent review would significantly curtail the original gravel allocation.

Under the 'authorisation method' a longer term access to the gravel resource could be offered to gravel extractors. This is particularly relevant for the Central Hawkes Bay sources but also for the Northern Hawkes Bay rivers, given the land-based quarries that exist in that area.

If longer duration consents are sought, ongoing monitoring, consideration of environmental effects and review clauses would become important; and gravel allocations and consent conditions could become more conservative if the applications are not well supported by robust Assessments of Environmental Effects. The research strategy section presented later in this report will be important in this respect. Despite this, the many years of annual gravel consents has not resulted in any major adverse environmental effects that are known to date, hence, the issues may be more focused on gravel resource sustainability over the longer term.

6.3.3 Avoidance of 'Gravel Banking'

'Gravel banking' is a term used to describe when a gravel extractor holds resource consent for gravel extraction with no or little intention of exercising the consent in full or part, and does not surrender the consent. This allows a commercial advantage over competitors who may genuinely want the gravel from the same location or conversely does not allow market pricing to occur and a monopoly situation. Gravel banking can be managed in the following ways:

- Always having two companies able to supply gravel from a similar geographic area;
- Specifically exempting the use of S124 which recognises existing investment upon renewal of existing consents within a Regional Plan as used by ECAN. This does require a plan change;
- HBRC holding the resource consent and having a commercial contract with an extraction company with penalty and termination clauses for non-extraction;
- For consents held by extractors, using a very short consent lapse date which is a legal mechanism for 'use it or lose it' of the gravel resource. A lapse date of any duration can be imposed by the consent authority. Hence, if the gravel extraction is not exercised to a significant extent the consent lapses and can be granted to another extraction company upon application. This is a well-established legal process used by HBRC and other Councils in respect to water permits and may involve a formal Lapse Date Hearing if the consent holder wishes to contest the lapsing;
- The existing practice of short term consents does not allow gravel banking to persist for any length of time and is equally a valid way of avoiding anti-competitive behaviour; but as outlined, other disadvantages of annual consents exist, and a move to longer term consents should trigger pre-emptive remedies to be used.

All of the above options are valid and legally robust; hence, a 'fit for purpose' approach is recommended and appropriate selection of a preferred option for any given situation can be made.

In terms of the recommendation for utilising consent lapse dates, the consent authority can impose a shorter (or longer) lapse date than the statutory default period of 5 years. However, a shorter date can be appealed. To minimise appeal risk and to be valid in law, a lapse date condition must:

- Be for a resource management purpose, not for an ulterior one;
- Fairly and reasonably relate to the activity authorised by the consent to which the conditions attach;
- Not be so unreasonable that a realistic planning authority, duly appreciating its statutory duties, could not have approved it; and
- Be the most appropriate condition to achieve the purpose of the RMA.

While the consent authority should also consider whether it should grant consents but for a relatively short duration rather than relying on a shorter lapse date, the specific circumstances that surround gravel management would not prevent a shorter lapse date being used in conjunction with a longer duration consent term.

Although gravel banking has not been a significant issue to date in Hawkes Bay, the prospect of longer term consents and any lift in demand, can quickly create a gravel banking situation, and the above measures should be used pre-emptively to avoid this.

6.3.4 Legal Delegations

At present, the RMA consenting and compliance functions are formally delegated to HBRC staff by Council and this is a legal requirement. This review has found all necessary delegations to be in place with the current staff exercising these functions; however, it is recommended that any new consent/compliance process undertaken by new departments receive the appropriate delegations, and rescinding of existing delegations carried out.

6.3.5 Resource Consent Processing Efficiency

The following initiatives are recommended to maintain an efficient resource consent system. These recommendations are equally relevant irrespective of where the consent authority delegation resides or who the consent holder is, as they will ensure a best practice approach to this activity.

Pro Forma Application and AEE

For longer term consents, it is recommended that a catchment specific set of *pro forma* resource consent applications and AEE's be developed for gravel extraction across Hawkes Bay. These applications are required to address the overall sustainability of the resource, effects on flora and fauna, cultural values and coastal processes in association with addressing the positive environmental effects of mitigating the regions flood hazard exposure.

Under the option of moving the consent authority function to the Regulatory Department, concern has been expressed that for short term (e.g. 1 year) consents, that the current efficient system of being able to issue a consent in one day will be compromised. This can also be avoided for short term consents by the agreement of *pro forma* applications for short term consents. The development of internal Key Performance Indicators to govern this should also be undertaken.

Pro-Forma Consent Documents

Pro forma and standard consent conditions currently apply to resource consents for gravel extraction for short term (1 year) consents; this system works well and should continue. In some cases, consent conditions may require minor tailoring to specific catchments and/or rivers (e.g. for specific native fish and bird species). The most significant decisions surrounding the gravel consent process is from a river engineering perspective and whether the gravel should be extracted for flood management purposes which is based on the cross-section survey information. Hence, it is recommended that catchment-specific pro forma consent documents are prepared in addition to pro forma reasons for granting the resource consent to allow a 2 day processing and issuing of resource consents to be achieved for short term consents. This fully utilises the RMAs 'streamlining' amendments from 2013, and completely avoids the time and cost associated with a Section 42a officer's report, and the process should be largely administrative in nature.

For long term consents of up to 10 years, the normal consenting processes employed by the Regulatory Department should apply.

Consent Processing Charging

Given the streamlined approach recommended for resource consenting, the charging for processing of short term consents should be fixed pursuant to S36 of the RMA, or conversely covered by the general S36 charging regime such as currently in place, whereby the s36 charge covers all costs of processing, compliance and monitoring.

For longer term consents, the existing charging policies of Council should apply.

HBRC Resource Consent Database

It is recommended that all gravel resource consent applications and issued resource consents be stored electronically on the HBRC consent database along with all other resource consents issued by Council. This is regardless of where the consent authority function is exercised from. It is also recommended that the "use" of the resource be more formally recorded on a field inside the consent database.

6.3.6 Section 36 Charging

HBRC expenditure to manage and administer gravel extraction in the region has been approximately $270,000/year and is currently funded via s36 (75%), s35 (15%) and s108 (10%) of the RMA. This funds 100% of the following "activities":

- Staff input to the annual allocation assessment and its management throughout the year;
- Investigations necessary to understand the sustainability of gravel extraction;
- The provision and maintenance of access ways and stockpile areas;
- State of Environment monitoring.

Cross section monitoring costs are an ongoing programme and costs approximately $145,000/year Cross-sections are surveyed at 3 yearly intervals in the reaches where gravel is extracted, and at 6 yearly intervals elsewhere, and with the total survey cost apportioned in the following way:

- Gravel extraction 39%.
- Flood forecasting and flood hazard mapping and management 43%.
- Scheme design and level of service monitoring (Heretaunga Plains Scheme and Upper Tukituki Scheme) 18%.

The differential level of charges between the Upper Tukituki and other extraction areas has been the decision of successive Council annual plan/long term plan processes in an effort to minimise any barriers to gravel extraction from the Upper Tukituki River. This is consistent with the legal requirement of s36 stating that such costs ”may” be charged, hence a Council has discretion in this area and HBRC’s transparent exercise of this discretion via an annual plan process is considered best practice.

Hence, no changes or recommendations are made in respect to what the S35, 36 and 108 charges are levied for, but if the Consent Authority function is moved to the Regulatory ‘arm’ of HBRC, technically they should levy the charges and then reimburse the respective budgets that incur costs in other parts of Council. This is a purely administrative matter and makes no material difference to gravel extractors or other stakeholders.

6.3.7 Regulatory Efficiency between District Council HBRC Consent Requirements

The regulatory duplication between regional and district councils in respect of gravel permits and land use consents is a common issue across New Zealand and an area of inefficient planning practice, that can often result in unnecessary and excessive regulatory compliance costs for applicants. This can be avoided by demarcating river beds via a mapping exercise and either reaching an agreement that the district councils use their discretion in not requiring consent for earthworks in river beds, or following a more formal process of transferring the function to the HBRC. This does not apply to vehicle movement, traffic safety and noise considerations, which should remain a consenting function of the relevant district council.

This is not an issue in Central Hawkes Bay District as earthworks is a permitted activity.

6.4 Non-Regulatory Options

An option exists to develop a non-RMA Gravel Management Strategy and using Section 104(1)(c) of the RMA to consider such a strategy when deciding on resource consent applications. Such a strategy can be used to effectively guide the permitting process and was a recommendation of the 2010 scoping study. The key advantage of this option is that a non-RMA plan can be developed faster than a Regional Plan change via the Schedule 1 RMA process. This option is often used as an interim approach while a regional plan change process is followed. In practice, if there is good acceptance of the non-RMA plan and it is not subject of significant disagreement throughout its development or evidential challenges during successive resource consent process, then there may be no need for a full regional plan change to take place.

The key aspect of a Gravel Management Strategy is that it records, following formal consultation and submissions, the gravel management and allocation process particularly under the scenario where a Regional Council holds the resource consents.

The benchmarking exercise in Section 4 of this report has shown that such an approach has been employed very successfully for gravel management and more general floodplain management by ECAN and GWRC.

A further, successful example of a non-regulatory management strategy approach is Otago Regional Council's *Code of Practice for the Management of Vegetation Burning in the High Country of Otago* which has been adhered to for many years without the need for a formal regional plan process. This has had the advantage of allowing flexibility of approaches and not being tied to prescribed regulation while ensuring the outcomes of the Code are adhered to. In this case, it has been understood by the high country community that successive failures to comply with the Code would result in a more prescriptive planning regime being initiated via a regional plan process.

However, it is stressed that a high degree of commitment to such an approach is required by stakeholders from the outset for this approach to be successful.

The existing HBRC Code of Practice is a further example but goes to the next level of formality by being incorporated via reference within the RRMP Rule 70, and effectively guides work in and around freshwater. However, Rule 70 refers to the 1999 version of the code and since this time, two further versions of the Code have been produced. An option also exists for using the same Special Consultative Process under the LGA for the latest version of the Code as well as the Gravel Management Strategy at the same time.

With the next programmed review of the RRMP not scheduled to begin until 2020, and RMA Schedule 1 processes taking many years to become operative, the use of the LGA process is the most time efficient and pragmatic way forward to giving such a documents some legal weight within RMA processes. The process also allows any practical and operational implementation matters to be worked through and hopefully result in a less contentious plan change process if this is deemed necessary.

Legal advice has confirmed that management plans or strategies prepared by local government can be considered as 'another matter' under s104 (1)(c) of the RMA and further can be afforded significant or even 100% weight during resource consent decisions. This is conditional upon the following matters:

- That a robust public consultation process is followed during the strategy's development;
- That the Strategy is consistent with Regional Policy Statement and Regional Plan provisions;
- It is made clear in the Strategy that it is intended to 'sit alongside' the statutory RMA documents and it will be a factor taken into account in resource consent decisions under s104(1)(c);
- 'Weight' is further strengthened by incorporation by reference within a regional plan.

6.5 Conclusion

It is now clear that relying on a solely market based approach to gravel extraction has not been entirely successful in achieving HBRC's river management objectives in a climate of low demand, in Central Hawkes Bay catchments.

Hence, it is recommended that the option of the HBRC Assets Section becoming the consent holder and shifting the consent authority function to the Regulatory part of Council should be pursued.

The advantages of this approach are summarised as follows:

- The approach will give HBRC greater ability to direct (although not instruct) extraction to preferred locations;
- It removes the legal constraints of the RMA and enables a more contractual approach to managing the gravel resource if this is deemed desirable;
- Successful precedent exists from all other Regional Councils surveyed;
- The approach provides further security against gravel banking behaviour, especially if longer term consents are pursued;
- HBRC Assets Section is best placed to undertake comprehensive AEE's for long term consent durations, which gives greater commercial certainty for new operations to set up in Central Hawkes Bay;
- In the absence of a range of other major 'levers', this approach represents a tangible course of action to encourage extraction within Central Hawkes Bay;
- From a secondary perspective, this option will also ensure a more robust consenting approach.

It is acknowledged that such an approach could draw the criticism that HBRC is inappropriately interfering with the market and should not assume this role. In addition, a stronger direction to gravel extractors of where to take gravel from could result in higher gravel prices and resultant criticism of Council. However, this needs to be balanced by HBRC's role in respect to the wider community and its legal functions under the suite of Acts in respect to flood management.

While no permitting system can be perfect, on balance and given the current issues, the recommended approach is the best way forward for HBRC and its flood management objectives.

If market demand changes significantly, or major flood activity occurs that challenges the efficacy of this recommended approach, no barriers exist in changing the approach or even reverting back to the existing approach. However, the recommended approach does provide considerable flexibility to deal with changing future conditions.

Given it will be impractical to develop and gain new long term resource consents for all catchments at once, it is recommended that the consent process be initiated for Ngaruroro catchment first, and any lessons learnt can then be applied to the remaining consent processes.

7 Holistic Approach to Gravel Management and Flood Scheme Works

HBRC maintains the major flood schemes of the Heretaunga Plains and Upper Tukituki along with 13 other smaller flood schemes. Figure 5 illustrates the areas covered by these flood schemes.

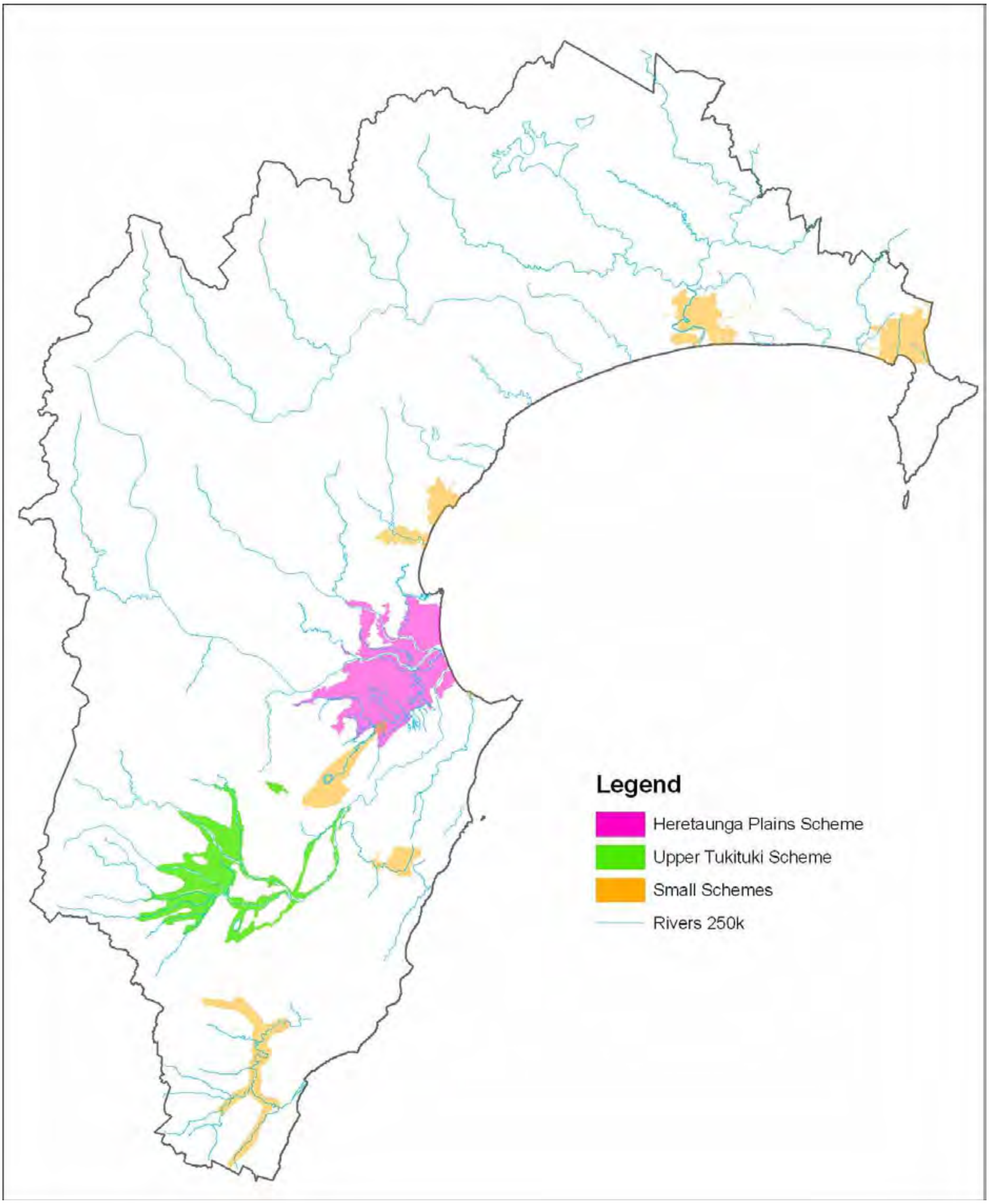

Figure 5. Hawkes Bay Flood Scheme Areas

Within these designated flood scheme areas, HBRC undertakes the following works financed primarily by targeted rating:

- Channel training
- Beach raking
- Flood bank maintenance
- Edge protection planting and maintenance
- Invasive vegetation control
- Land drainage

Gravel beach raking is a gravel-bed river management technique that uses a tractor to drag large metal ripping blades across exposed channel bars, mechanically disrupting the coarse armour layer. A study on the Tukituki River by Reeve (2016) entitled *Impact of gravel raking on surface grain size and channel morphological change: Tukituki River, Hawke's Bay, New Zealand* concluded that the study "provided strong evidence that gravel raking promotes marked changes in sediment transport capacity along the Tukituki River", and gives specific evidence for the Tukituki River that corroborates evidence from other parts of New Zealand and Hawkes Bay river engineering staff.

Gravel raking is carried out in the upper Tukituki scheme annually at a cost of approximately $100,000 per year and funded by scheme rates. Hence, it follows that the gravel raking program within the upper Tukituki is one factor leading to the aggradation in the mid Tukituki. Other significant factors are the lack of recent flood activity and the wider channel widths of the mid Tukituki channel.

It is noted that the aggradation within the mid Tukituki reaches is the most significant of all the Hawkes Bay River reaches, with 14 million cubic metres of gravel above the calculated grade line, and continued aggradation at the historical rates will result in less channel capacity and consequential flood and drainage issues. Hence, a gravel raking program within the mid Tukituki reaches would be beneficial to promote gravel transport to the lower Tukituki reaches. Transport economics of commercial gravel extraction are more favourable if the current gravel that exists in the mid reaches is transported by floods into the lower reaches.

The key issue with such a program is the mid Tukituki River is not within a rated flood scheme area and all current works are on a user pays basis. Legal advice was sought on the legality of using RMA s36 charges to fund a beach raking program in non-scheme areas to promote downstream transport of gravel, and in turn making this gravel available for extraction in an area that is in higher market demand. This legal advice has confirmed that it is not possible to use s36 charges revenue to fund channel management and a beach raking program.

Given the new sediment transport modelling capability, it is recommended that hydraulic and sediment transport analyses be used to predict the effectiveness of lesser probability flood events following beach raking to move sediment into the lower Tukituki River (or put another way - a smaller flood is necessary to mobilise the gravel because the armour layer has been broken up). This will require a better understanding of particle size distribution in these reaches. The extent of such a program should not be underestimated as the aggrading reaches in the mid Tukituki are over 60km in length, although not every kilometre will require raking. The key is to decide if the beach raking lowers the magnitude of future flood events to a significant level to justify the cost. .It is stressed that even if a beach raking program is deemed technically feasible and affordable, this does not guarantee that the desired sediment transport will occur, as it is solely dependent on the lower magnitude flood events occurring at their predicted probabilities of occurrence.

Such a program, if deemed technically feasible, will require a works program to be developed, and a costing analysis and formal consultation with prospective scheme ratepayers and gravel extractors.

If gravel raking and associated flood activity was successful in promoting sediment transport into the lower Tukituki reaches, it follows that this will increase sediment transport to the coast. From a coastal processes perspective this is an extremely positive outcome. Also, given this 'benefit', other funding options for the gravel raking program may be considered under the Local Government Act.

Given the currently very high costs of extracting the entire or a substantive portion of the gravel resource above the grade lines from the upper Tukituki River, the current comprehensive program of beach raking is recommended to continue on an annual basis. It is not considered that any increase in raking frequency, for example to twice a year raking, would be beneficial, as sediment transport is still dependant on close to an annual probability flood event occurring following the raking operation.

7.1 Conclusion

It is clear that the upper Tukituki scheme is under some pressure in terms of consistently achieving its scheme design standards due to the gravel build-up. This is not the entire scheme, but rather localised reaches, usually coinciding with channel grade changes and tributary confluence performance. In fact reasonably long reaches of the upper Tukituki scheme are at or even below the design grades, while in other reaches where bed levels are above grade, channel width and slopes and other hydraulic parameters mean that minor or no issues exist.

Hence, focusing either commercial gravel extraction or scheme funded extraction on specific localised problem areas (e.g. Makaretu, Tukipo and certain reaches of the Tukituki main channel) should be the forward strategy in conjunction with the ongoing beach raking program.

The potential construction of the Ruataniwha Dam and the resultant gravel entrapment within the reservoir will stop downstream sediment transport from the Makaroro to downstream reaches of the Waipawa River, which over time, will allow existing aggradation to be moved downstream. Having greater control and ability to direct demand generated from the Ruataniwha Dam and associated development, or any other major developments into localised problematic reaches is the most promising 'lever' available to HBRC, and is a key finding of this report. The recommendation for HBRC to hold the resource consents for gravel extraction and use an 'authorisation' approach to allocating and directing gravel extractors into required areas will enable the opportunities created by the dam to be capitalised on.

Given demand often exceeds allocated gravel supply in the Heretaunga Plains, it is recommended that commercial interest is canvassed on transporting and stockpiling high quality aggregate from Central Hawkes Bay sources to Heretaunga stockpile areas for future use over time. This will inevitably be a commercial negotiation between HBRC and interested companies or consortium of companies.

It must be kept in mind that the Hawkes Bay rivers are very much shorter in length and smaller than the fully braided river systems of the Canterbury region. This results in faster changes in gravel status. Hence, the current consenting approach of annual consents has given the most flexible method for accommodating such changes. However, a correctly designed authorisation process can accommodate the variable supply over the medium and long term horizons.

It is clear that the situation of considerable aggradation in the mid Tukituki River cannot be allowed to continue indefinitely. Even if gravel extraction could be directed into the mid Tukituki reaches, this alone and without other channel management works will lead to future flood hazard and drainage issues. At a minimum, a beach raking program within the mid Tukituki reaches is required.

While the formation of a flood scheme has been raised with ratepayers on a number of occasions and rejected, this should be considered again. In the past, a flood scheme has been discussed in a context of mid Tukituki channel capacity, and while this is a primary driver of a future scheme, the lower Tukituki and coastal erosion issues along the Hawkes Bay coastline (given the south to north longshore drift) are now new factors that could help justify and indeed fund a flood scheme for the mid Tukituki River.

8 Iwi Issues in Relation to the Gravel Resource

Across New Zealand, iwi have long standing interests in freshwater, including the bed and banks of rivers and lakes that together make up the “*mauri”* or life-force of the water body. To date, Treaty of Waitangi Settlements across the country have recognised iwi interest in freshwater.

To date Hawkes Bay Iwi has been involved in managing Hawkes Bay’s freshwater resources via an agreed process on individual resource consents, during regional plan changes and more recently through the joint planning committee.

In 2010, a Hui was held at Kohupatiki Marae with iwi members from across Hawkes Bay attending. The Hui minutes record useful discussion on gravel management issues and an improved understanding by all participants of the challenges that surround gravel management in Hawkes Bay. More specifically, the following points from the Hui are noted:

- The concepts of whakapapa, maunga, mana whenua and atua values need to be recognised and adopted into both gravel management and river management;
- There is a need for a better method for involvement of iwi in gravel management;
- It would be useful to have Waahi Tapu and key Mahinga Kai sites identified for key rivers so effects upon these sites can be avoided or managed during works operations;
- The consent process for Winstone’s coastal extraction was a good example of Tangata Whenua input into consent conditions that allows Tangata Whenua to participate and monitor the activity. This has allowed the development of a good relationship between parties and this approach could be used elsewhere;
- An opportunity was requested for Maori to gain hands on experience on the management of gravel in Hawkes Bay.

The formation of a Joint Planning Committee is a key avenue which gives Mana Whenua input to plan change review processes and allows the articulation of cultural values in respect to holistic waterway management including management of the gravel resource. In turn, any such values can be incorporated into resource consent condition where appropriate. Examples of this already exist stemming from the Treaty of Waitangi Settlement for the Mohaka River and the resultant specific arrangements within the RRMP, and the Statutory Acknowledgement for Maungaharuru.

9 Gravel Management Research Strategy

It is very evident that a good understanding of the gravel resource is vital to its ongoing management. The following research strategy for gravel management builds on and refines the comprehensive recommendations presented in all previous reports and outcomes from this report. This research strategy is not intended to contain detailed scopes of work, methodologies or costings, but rather present a comprehensive and consolidated strategy for all aspects of gravel management. The research strategy can be considered in six areas of research that cover:

- Geomorphological Monitoring and Investigations
- Sediment Transport Prediction
- River bed Level Monitoring
- Petrological and Geotechnical Studies
- Cultural Investigations and Monitoring
- Environmental Monitoring
- Aggregate Source Inventory

9.1 Geomorphological Monitoring

Geomorphological monitoring of upper catchment areas is recommended to ascertain the status of primary slip and erosion areas that are the key gravel supply areas for the Hawkes Bay Rivers. In later years, such riparian slip areas have become the main sources of gravel supply, as browsing animal control has allowed upper catchment vegetation to successfully regenerate and remove these areas as gravel sources. Such monitoring is also often undertaken for emergency management purposes, as landslides can partially or completely block river channels in their upper reaches and the resultant water level build-up can result in a catastrophic 'dam break' that poses significant downstream flood risk.

Essentially this involves updating the work of Black (1992) by identifying and mapping key slips and landslides. Once mapped, aerial reconnaissance by helicopter following each major flood event, or at three to five year intervals should be undertaken. This is standard practice by other Regional Councils.

9.2 Sediment Transport Prediction

This work essentially requires the ongoing maintenance and refinement of the sediment transport 'GRATE" model constructed by NIWA and now administered by HBRC. Appendix E contains a proposal from NIWA to the Ministry of Business, Innovation and Employment to continue New Zealand-wide research in the sediment modelling area, including specific field studies in Hawkes Bay. It is recommended that HBRC support this research either on an in-kind basis or financially, as the GRATE model is fundamental to the ongoing management of the resource.

Once sufficient confidence surrounds the GRATE model, it should be used to specifically analyse the following matters:

- The potential for a beach raking program in the mid Tukituki River. This should ascertain the benefit of such a program in terms of potential transport into the lower Tukituki reaches versus the costs of such a program;
- The effects of climate change on sediment transport processes. Essentially this involves using existing climate change scenarios of high intensity and duration rainfall to predict the frequency and magnitude of 'threshold of motion' sediment transport events;
- The degree of abrasion with distance downstream. Field inspection suggests this will be very significant in the Tukituki River and could have a bearing on a potential mid Tukituki beach raking program;
- The potential for greater sediment transport to reach the coast, particularly from the Tukituki and Waipawa rivers given the coastal erosion affecting the Hawkes Bay coastline.

9.3 River Bed Level Monitoring

River bed level monitoring is the most critical database for gravel management and required by the GRATE model and other computations to determine the amount of gravel to allocate or how much aggradation is occurring. While Stevens and Larsen (2015b) recommend that a more intensive cross-section monitoring network at a 250 m spacing interval is undertaken and monitored, recent work by HBRC has shown that LIDAR missions are giving at least comparable results and yield continuous spatial bed level information. Hence, a final decision should be made on the method of bed level monitoring once these initial investigation results are confirmed. Relative costs and associated resourcing will also be a factor in this decision.

9.4 Petrological and Geotechnical Studies

At present, little or no systematic particle size or petrological analyses exists for the Hawkes Bay rivers that is available to HBRC. It is likely that commercial operators collect such data at specific extraction sites, but this information is considered commercially sensitive and not generally released. This makes HBRC reliant on gravel extractors' advice on where suitable gravel sources for end uses exist. Hence, HBRC should undertake thin section and x-ray diffraction analysis at the key abstraction sites, particularly at sites where localised aggradation problems are occurring and where HBRC wants to direct commercial extraction. The key objectives from HBRC's river management perspective is to hopefully demonstrate that high quality gravel sources, with lower processing costs in aggrading reaches, is available, in an effort to promote these locations to extractors.

This should also include an investigation into mudstone sources and abrasion (via lithology Wolman counts) and associated modelling, as the presence of mudstone in the gravel is important to the extractors as it adversely impacts gravel quality.

Particle size monitoring of river sediments is used in sediment transport predictions and modelling, and is also valuable to understand the resource's suitability for end uses. While sediment particle size naturally decreases with distance downstream, extractors targeting the coarse fractions for key uses, results in smaller sizes occurring at extraction sites and also downstream. Within aggrading rivers, selective extraction of the larger particle sizes actually improves the sediment transporting capacity of smaller flood events. Hence, understanding particle size may inform critical gravel management and assist financial decisions; therefore, it is recommended that particle size data collection is undertaken. These samples should be taken at repeatable cross-section network locations and annual samples be taken for the first three years to create a baseline of information; and then every three to five years or after major flood events.

The sampling of the ‘armour layer’, beneath the armour layer and a ‘whole of bed’ analysis should be undertaken and resultant grading curves for the three categories calculated at each site. A sampling methodology is required to be carefully selected to ensure repeatable results. This will also enable informed decisions to be made when allocating gravel in different areas, and not be solely reliant on the commercial extractors’ advice on gravel size as a reason for only taking gravel from immediate local sources.

In 2006, Transit New Zealand (TNZ), now the New Zealand Transport Authority (NZTA), developed a set of aggregate specifications for New Zealand’s state highways, denoted as M/4: 2006, details of which are presented in Appendix F. Local councils generally default to using the TNZ specifications in lieu of developing their own, particularly when high quality aggregate is readily available and transport costs do not prohibit its use, as is the case for the Napier City Council. HDC engages independent contractors to carry out pavement sealing work, and specifies that TNZ M/4 aggregate specifications must be adhered to, along with evidence of aggregate testing and M/4 compliance at the commencement of every contract.

In Central Hawkes Bay, the district council also engages contractors to carry out resealing, who must meet the TNZ M/4 aggregate specification. For local roads administered by the council however, alternative materials (red metal and rotten rock) are used, due to transport costs associated with high quality aggregate. The council do not hold specifications for this alternative roading material.

In other areas with limited access to high quality aggregate, for example Northern Hawkes Bay, where sources of good quality aggregate are too distant and therefore expensive to transport, the local council has developed its own set of aggregate specifications for rural roads. These specifications appear more relaxed and less rigorous than the TNZ M/4 specifications which cater for high volume state highways. Lower volume roads, particularly rural roads and unsealed surfaces, can be successfully constructed using alternative materials such as aggregates with a lower testing threshold than TNZ M/4.

Examples of local councils’ aggregate specifications are also included in Appendix F.

As discussed above, in order for HBRC to obtain a better understanding of the resource they control, source qualities of the gravels at extraction points is a key consideration. Much of this information is already known by individual contractors. A regional ratings system for the different gravel sources across the region needs to be assigned through using TNZ standards for:

- California Bearing Test;
- Sand/Clay Equivalent;
- Crushing Resistance; and,
- Weathering index.

Testing would be repeated at regular intervals (not exceeding 2-yearly), or should it be noted that source quality was changing, to verify that representative aggregate source properties have not significantly changed and still comply with the assigned 'rating'. Test strips may be installed on roads for standard periods of time to evaluate performance of lower quality aggregate or alternative materials.

9.5 Cultural Investigations and Monitoring

The Cultural Health Index and other similar approaches are useful tools for Māori, especially in resource consent issues. It is understood that HBRC is keen to assist iwi to undertake these studies and to provide resource kits to asset the work.

Waahi Tapu and Mahinga Kai mapping within riverbeds has been identified as a possible work stream where scheme operations or gravel extraction activities occur.

9.6 Environmental Monitoring and Research

Work to date on environmental issues associated with the gravel resource, have progressed to the stage where future monitoring and research requirements in Hawkes Bay are understood. This includes the following:

- Monitoring threatened species of river bird colonies and ways to protect such species from river gravel operations;
- Specific monitoring of river bird activity in relation to gravel management activities carried out within the river bird protection (works exclusion) period;
- Tree lupin effects study and control strategy;
- Study of riverbed morphology change from flood control activities;
- Monitoring of river berm vegetation;
- Willow under planting and direct seedling trial (builds on bitter willow trial findings);
- Undertake an assessment of potential effects from riverbed gravel extraction to both indigenous fish and trout and mapping of the sensitivity of river reaches according to fish values.

9.7 Aggregate Source Inventory

Stevens and Larsen (2015).recommended that an inventory of land based gravel resources was needed including details on:

- Location
- Aggregate Quality
- Quantities extracted

This was considered necessary to better understand the total aggregate supply and demand within, the region.

9.8 Section 36 Charges

Once the recommended areas of further research are scoped in detail and then costed, the research program will be consulted upon via a Long Term Plan/Annual Plan Council process. Once the final research strategy and associated costs are known, the section 36 charges will require recalculation and its own Long term Plan/Annual Plan consultation.

10 Recommendations

No single recommendation will be successful in isolation in achieving the 'balancing act' outcomes for the Hawkes Bay gravel resource. Instead, it is when the various recommendations are used in unison and over the most optimal timeframes that the desired outcomes have the best chance of being realised. Notwithstanding the recommendations presented below, gravel management will always be 'weather dependant' as large flood events (or earthquakes) exert a dominate control over sediment transport processes along with 'market dependant' factors as economic activity directly drives gravel demand. The following recommendations are grouped into short, medium and long term actions to take advantage of the synergistic nature of the combined recommendations over time.

10.1 Short Term

It is recommended that within the next 1 to 3 years, the following is undertaken:

1. Draft a Hawkes Bay Gravel Management Strategy and attempt to obtain a high degree of stakeholder support before initiating a Special Consultative Process under the Local Government Act for its adoption by Council.

2. Consider using the same Local Government Act, Special Consultative Process, to adopt the current version of the Engineering Code of Practice.

3. Consider including by reference the Gravel Management Strategy and latest version of the Engineering Code of Practice within the next scheduled plan change process.

4. Commence commercial discussions with Central Hawkes Bay District Council to evaluate if gravel can be extracted from localised problematic areas for their roading program.

5. Commence discussions with the consortium of gravel extractors that have previously expressed interest in transporting Central Hawkes Bay gravel to the Heretaunga Plains for stockpiling and resale over time.

6. Commence discussions with NZTA on future State Highway projects and resultant gravel demand in an effort to influence where this gravel is sourced from before tenders are let for such projects.

7. Commence a commercial discussion with Winstone Ltd. regarding a future riverbed aggregate source, if the coastal extraction consent at Awatoto is not re-consented on its expiry in 2018.

8. That more proactive discussion is undertaken with particularly Napier and Hastings Councils to understand the price point differences from their land based sources versus river sources.

9. Formally recommend to Council and Upper Tukituki Scheme ratepayers that gravel extraction be added to the programme of works for the flood scheme (given that gravel extraction has not previously been funded by Flood Scheme works in the past).

10. Undertake a review of localised problematic areas within the upper Tukituki Scheme and establish how much gravel is required to be extracted and what associated channel management works would complement gravel extraction. Use this information to prepare a schedule of works for future years that balances flood risk and drainage issues with cost.

11. Formally review the upper Tukituki Scheme rating to ascertain whether scheme funded gravel extraction can be financed by either diverting existing scheme rates, or increasing scheme rates, to fund this new activity.

12. That HBRC Assets Section constructs suitably detailed resource consent applications, initially for the Ngaruroro catchment and then for all other major extraction sites across the region, for a requested duration of 10 years and becomes the consent holder for all major gravel extraction in the region.

13. That the Consent Authority function for gravel is internally transferred to the Regulatory Department of Council to avoid conflict of interest and separation of statutory functions, and all necessary internal system and process changes are made to facilitate this. Ensure that any new permitting processes adhere to the Guiding Principles developed in Section 6.3 of this report.

14. That any formal internal delegations are reassigned and the legal charging basis for the permitting activity contained within the Long Term Plan and successive Annual Plans is checked for accuracy.

15. That internal Key Performance Indicators are developed and agreed, to ensure efficient and timely consent processing is delivered particularly for short term gravel permits.

16. Begin to formally record information on 'gravel use' during the permitting process.

17. That 'pro forma' consent documents are prepared within the Regulatory Department for short term (1 year) consent decisions to maintain the current systems service level for such consents.

18. Assuming long term consents are successfully granted to the Assets Section, offer long term access via an 'authorisation processes to commercial operators in the Tukituki and Waipawa catchments (as opposed to annual consented volumes). Some form of competitive tendering maybe in order to award the gravel allocations. Where advantageous, HBRC consider internalising all land access agreements and other arrangements (e.g. stockpile sites etc.) in the Tukituki and Waipawa catchments.

19. Consider waiving any 36 or 108 charges for gravel extraction from the Waipawa and Tukituki for the next 3 years and then review.

20. Continue to decline resource consents for gravel extraction in rivers where evidence shows that gravel extraction is not sustainable, except in particularly localised reaches that are causing significant channel management issues (e.g. flood banks erosion). This includes the Esk, Tutaekuri, and lower Tukituki rivers.

21. Develop costings and a details program for the research strategy outlined in Section 9 of this report, and submit the program to the next annual plan/long term plan process. Following this develop detailed methodologies and project plans for each component of the research.

22. Once the final research strategy and associated costs are known, recalculate the section 36 charges and undertake consultation on these charges via the Long term Plan/Annual Plan process.

23. As recommended within the Research Strategy, undertake geotechnical and petrological analysis of initially the Central Hawkes Bay river sources to establish if this material matches the standards contained in Appendix F, in an effort to 'market' the quality of this resource.

24. Publish an annual riverbed gravel report that includes amounts of gravel taken from catchments, the use of this gravel and the bed level status of the Regions Rivers.

10.2 Medium Term

It is recommended that within the next 3 to 5 years, the following is undertaken:

1. Undertake a funding options study for a mid Tukituki flood scheme that considers the costs and benefits for:
    - mid Tukituki riparian landowners;
    - lower Tukituki riparian landowners;
    - coastal hazard issues;
    - increasing gravel availability for extraction in the lower Tukituki;
    - The region as a whole.

2. Within the regional plan review, commencing in 2020, include plan change provisions that address the matters outlined in Section 6.2 of this report.

3. Consider a plan change to the Regional Policy Statement (and possibly to the Regional Plan and District Plans) to give priority to river based aggregate sources over land based quarries and 'paddock stripping' operations.

4. Commence discussions with Hawkes Bay Territorial Authorities to address the RMA regulatory duplication in respect to earthworks and gravel permits and develop better planning practice in this area that reduces unnecessary compliance costs.

5. Complete a study similar to Black (1992) of sediment supply areas to the Heretaunga and Ruataniwha Plains and commence monitoring of sediment supply sources and for gravel management and Civil Defence purposes.

6. Undertake and maintain an inventory of land based gravel sources to better understand total aggregate demand in the region.

7. That 5 year gravel forecasts are regularly produced, consistent with the methodology outlined in Stevens and Larsen (2015a).

10.3 Long Term

It is recommended that within the next 10 years, the following is undertaken:

1. That a mid Tukituki Flood Scheme is set up and maintained, particularly focused on channel capacity maintenance.

10.4 Future Iwi Involvement in Gravel Management

Given the agreed outcomes of the 2010 Gravel Management Hui, the recommendations of this report and existing HBRC/Iwi process already in place, the following is recommended:

- Iwi input and consultation on the Gravel Management Strategy is undertaken;
- That the ongoing work of the joint planning committee consider the suggested plan changes for gravel management issues raised in this report;
- Combined gravel management stakeholders meetings with iwi are programmed;
- Iwi involvement is sought in the resource consent processes for long term gravel consents;
- A gravel ‘Hikoi’ is organised to key gravel extraction sites where gravel management operations are explained and feedback given from a cultural perspective;
- Consideration of Waahi Tapu and Mahinga Kai identification and mapping and resultant scheduling in future regional plan changes in respect to riverbeds;
- As in the Bay of Plenty Region, Hawkes Bay iwi could consider applying for resource consents for gravel, either as a commercial proposition or for a ‘cultural purpose’ (e.g. hangi stones), given the precedent that already exists for iwi holding a water permit from the Ngaruroro River for a ‘cultural purpose’.

11 References

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APPENDICES

Appendix A. HBRC Regional Policy Statement and Regional Plan Analysis

Hawkes Bay Regional Policy Statement

3.11 River Bed Gravel Extraction

ISSUE

3.11.1 River gravels provide a supply of a valuable resource utilised in a multiplicity of ways by the community. In extracting from rivers the risk of an imbalance between the natural supply of and the rate at which gravel is extracted, and of adverse effects as a consequence of extraction in the river bed needs to be managed.

This issue recognises the region wide importance of the regions gravel resource, but at the same time, the necessity to sustainability manage the resource. This is reflected in the holistic objectives of this study.

OBJECTIVES

OBJ 28

The avoidance of any gravel extraction at a rate which exceeds the rate of natural supply, except in areas where there are stored reserves which may be removed in a controlled manner such that flood protection and river control assets are not compromised.

OBJ 29

The facilitation of gravel extraction from areas where it is desirable to extract excess gravel for river management purposes and the minimisation of flood risk, or to maintain or protect the functional integrity of existing structures, whilst ensuring that any adverse effects of gravel extraction activities are avoided, remedied or mitigated.

OBJ 30

The maintenance of the use and values of the beds of rivers and the avoidance of any significant adverse effects on the river bed resulting from the extraction of gravel.

POLICIES

POL 50 RESOURCE ALLOCATION - GRAVEL ALLOCATION ASSESSMENT

3.11.7 To assess the availability of river bed gravel by:

(a) Defining both annual and long-term extraction rates for the regional gravel resource for each river bed within the region where major extraction takes place. These rates will be based on regular monitoring of the rate of extraction, and an assessment of the river design profile, supply of gravel to the coast, and supply of gravel from upstream sources (including land use activities).

(b) Ensuring that as far as practicable, long-term gravel extraction is undertaken at a level consistent with maintaining the rivers close to their design profiles, while maintaining compatibility with other resource management and environmental values.

Explanation and Reasons

3.11.8 Policy 50 establishes the approach to be taken by the HBRC when assessing the availability of river bed gravel for extraction and determining both annual and longer term levels of gravel allocation. This policy recognises that the quantity of gravel available for extraction from within the region's rivers may fluctuate depending on the rates of supply and the qualities of the individual river. This policy also seeks to ensure that, as far as practicable, long term gravel extraction is undertaken at a level that enables the natural flow and path of the river to be maintained.

Policy 50 has been diligently implemented by the ongoing and now long term activities of the River Engineering Department of HBRC.

POL 51 RESOURCE ALLOCATION - GRAVEL ALLOCATION PROCESS

3.11.9 To allocate gravel from river beds in Hawke's Bay generally on an annual basis, in accordance with the following approach:

(a) Determining by 15 April each year the likely demand for river bed gravel. Gravel extractors will be contacted at the beginning of March each year, and required to provide notice of their requirements for gravel by 15 April. Requests for gravel allocation will be required to specify the proposed end use of the gravel.

(b) Carrying out an assessment and allocation process between 15 April and 30 June each year, in accordance with Policy 50.

(c) Notifying gravel extractors of their annual allocation by 1 July each year.

Explanation and Reasons

3.11.10 Policy 51 establishes the approach to be taken by the HBRC when allocating the gravel reserves of the region's rivers. The HBRC will allocate gravel to resource users on an annual basis, based on the gravel extractors' requirements, the gravel resource determined to be available in accordance with Policy 50, the proposed end use of the gravel, and an assessment of the effects of extraction. Council will determine the appropriate location for sourcing the gravel especially where demand for gravel in a particular location exceeds supply and alternative locations are required.

Policy 51 describes the HBRC gravel management approach that has been in place for some years. The policy is very detailed and prescribes the current steps that are followed each year under the current system. As this is a policy, there is no issue with using a different approach to allocating gravel that is not fully consistent with Policy 51. However, it is recommended that a less prescriptive policy be drafted for any future plan change process.

POL 52 RIVER BED GRAVEL EXTRACTION – MOHAKA RIVER

3.11.11 In relation to the Mohaka River, the:

(a) annual total volume of extraction for the Mohaka River below the Te Hoe junction;
(b) location of any extraction sites; and
(c) periods and rates of extraction at each site are to be negotiated and agreed to prior to 30 June each year between the Hawke's Bay Regional Council and nominated representatives of Ngati Pahauwera.

Explanation and Reasons

3.11.12 Policy 52 implements a recommendation of the Waitangi Tribunal.

This is a reasonably recent change to reflect the Treaty Settlement and no practical issues have been experienced in its implementation.

POL 53 DECISION-MAKING CRITERIA - RIVER BED GRAVEL EXTRACTION

3.11.13 In considering consent applications for the extraction of river bed gravel, to have regard to the following criteria:

(a) The capability to restore the extraction site upon completion of the extraction operation, and to repair any damage caused to any banks, access roads, fences, gates, or other structures.
(b) The avoidance of any contaminants from machinery use entering water bodies.
(c) The avoidance of any increases in sediment discharge or water turbidity, particularly during the fish spawning period of May to October.
(d) The continuation of existing fish passage.
(e) The avoidance of any adverse effects on flood control assets or river protection works.
(f) The avoidance of any activity that would cause flood control measures or river protection works to be required.
(g) The avoidance of any offensive or objectionable discharge of dust.
(h) The end uses of the gravel, in order that high quality gravel is allocated to uses which require such gravel.
(i) The location of, and potential effect on, any downstream water takes/users.
(j) The effect on the ecology of the river.
(k) The extent to and the time over which natural processes will be capable of returning the river bed to a state of equilibrium following extractive activity.

Explanation and Reasons

3.11.14 Policy 53 provides guidance to resource consent applicants and decision makers in respect of applications to undertake gravel extraction within the region's rivers. This policy establishes criteria which the resource consent application will be assessed against. In addition any resource consent application to extract river bed gravel should have regard to Objective 45 and Policy 79 when assessing the adverse effects of any proposed extraction activity.

The Decision Making Criteria of Policy 53 cover some of the key aspects of gravel management and are routinely reflected in standard consent conditions. The majority of the criteria deal with effects upon the environment with the exception of (h), which deals with allocating high quality gravel to those end uses that require such quality, which is considered good resource management. No criteria exist on the use of gravel extraction as a critical method for maintenance of channel flood capacity, or sustainable allocation of the gravel resource. These criteria could be reviewed as part of a future plan change to encompass these matters.

POL 54 PROBLEM SOLVING APPROACH - INTEGRATION WITH RIVER CONTROL WORKS

3.11.15 To integrate the management of gravel extraction with river control works by:

(a) Encouraging gravel extraction where there is the potential to minimise flooding or the risk of damage to protection works or essential structures.

(b) Undertaking specific works to control erosion and encourage gravel movement where appropriate.

Explanation and Reasons

3.11.16 Policy 54 sets out the approach to be taken to integrate the management of gravel extraction with river control works in order to minimise flooding, erosion and the risk of damage to works and essential structures (e.g. bridges). This policy recognises the positive influence that the managed extraction of gravel can have on minimising flood risk and assisting with the overall management of the river.

Policy 54 is central to the management of the current regional gravel issues, and essential is a policy that provides the key link between flood capacity and gravel extraction activities. This policy can be used in the consent authority's statutory analysis for directing gravel extraction to areas of aggradation. The word 'encouraging' is noted, but this does not directly imply only the use of non-regulatory methods and can be one element to justify a consent decision.

Regional Resource Management Plan

OBJECTIVE

OBJ 45 The maintenance or enhancement of the natural and physical resources, and use and values, of the beds of rivers and lakes within the region as a whole.

This objective recognises the region wide importance of the regions gravel resource, but at the same time, the necessity to sustainability manage the resource. This is reflected in the holistic objectives of this study.

POL 79 ENVIRONMENTAL GUIDELINES – BEDS OF RIVERS AND LAKES

5.8.1 To manage the effects of activities affecting river beds and lake beds in accordance with the environmental guidelines set out in Table 12 below:

Table 12. Environmental Guidelines – Beds of Rivers and Lakes

Table 12. Environmental Guidelines – Beds of Rivers and Lakes

Issue	Guideline
1. Fish passage	The activity should be undertaken in a manner that continues to provide for the existing passage of fish past the structure.
2. Fish spawning	In areas of fish spawning the activity should be undertaken in a manner that minimises adverse effects on overall fish spawning patterns.
3. Bed stability	No long term or ongoing acceleration of the rate of erosion or accretion of the bed of a river or lake as a result of any activity in a river bed or lake bed.
4. Habitat	Adverse effects on the habitat of aquatic and terrestrial flora and fauna within the bed of a river or lake should be avoided, remedied or mitigated.
5.Flow regimes	Adverse effects on natural flow regimes should be avoided where this is possible, or remedied or mitigated where avoidance is not possible.
6.Other structures & activities	There should be no significant adverse effects, including by way of destabilisation, on lawful existing structures or activities within the bed of a river or lake.
7. Flood & debris risk	There should be no reduction in the ability of the channel to convey flood flows, and no significant impedance to the passage of floating debris.
8. Damage to property	There should be no damage caused, and no increase in the risk of damage, to any property, including river control works, unless written approval is obtained from any affected parties.
9. Temporary activities	Upon completion of any temporary activity affecting the bed of a river or lake, the bed should as far as practicable be restored to no less than the state it was in prior to the activity taking place.
10. Outstanding natural features	Adverse effects on any outstanding natural features within river and lake beds should be avoided, remedied or mitigated.

Explanation and Reasons
5.8.2 Policy 79 sets out environmental guidelines for the management of activities affecting river beds and lake beds, including structures in, on, under or over river or lake beds, and bed disturbances. The environmental guidelines address the management of both natural and physical resources within river beds and lake beds.

POL 80 IMPLEMENTATION OF ENVIRONMENTAL GUIDELINES – RIVER BEDS & LAKE BEDS

5.8.3 To implement the environmental guidelines for river beds and lake beds set out in Policy 79 predominantly in the following manner:
(a) Regional rules – The environmental guidelines have been incorporated in conditions, standards and terms in the rules set out in Chapter 6 of this Plan, and to guide the level of regulation, as appropriate. In particular, the use, maintenance and removal of structures have been allowed provided adverse effects are managed in accordance with the environmental guidelines.
(b) Resource consents – The environmental guidelines will also be used in the process of making decisions on resource consents, in accordance with section 104 (1)(b) of the RMA.

Explanation and Reasons
5.8.4 Policy 80 establishes that the environmental guidelines for river and lake beds will be used to guide regulation. They have been used in rules, and will be used in resource consent processes.

ANTICIPATED ENVIRONMENTAL RESULTS

Anticipated Environmental Result	Indicator	Data Source
Fish passage and spawning are able to continue despite the erection or use of a structure or bed disturbance	Abundance of fish in selected locations	Department of Conservation Fish and Game HBRC
Avoidance, remedy or mitigation of adverse effects on natural flow regimes	Natural flow regimes	Flow monitoring programme
No significant adverse effects on existing structures or activities within the bed of a river or lake	Destabilisation of existing structures or activities	Compliance monitoring
No reduction in ability of channels to convey flood flows	River bed cross section profiles	Asset Management Plans and flow monitoring
No damage to property by works in river beds, without owners consent	Reports of damage from river control works	Occasional event reports

Anticipated Environmental Result	Indicator	Data Source
Restoration of river or lake bed following temporary activity	As far as practicable the bed is restored to at least its state prior to activity occurring	Compliance monitoring
Aquatic habitat is maintained at a sustainable level	1. Temperature not changed by more than 3°C nor raised above 25°C; 2. dissolved oxygen not exceeding guideline values; 3. ammoniacal nitrogen levels not exceeding guideline values; 4. soluble reactive phosphorous values not exceeding guideline values; 5. no loss of fish species or indigenous invertebrates	Council water quality monitoring programme

Rules

The key rules that govern gravel extraction and river control works are Rules 70, 71, 73 and 74. Each Rule is analysed below.

6.8.3 River Control & Drainage Works & Structures

Rule	Activity	Classification	Conditions/Standards/Terms	Matters for Control/Discretion	Non-notification
70 **River control & drainage works & structures** *Refer POL 79*	Any activity, as described in the Hawke's Bay Regional Council Environmental Code of Practice for River Control and Drainage Works (1999), that is carried out by a local authority exercising its powers, functions and duties under the Soil Conservation and Rivers Control Act 1941, the Land Drainage Act 1908, or the Local Government Act 1974, in relation to flood control and drainage, including: • edge protection works • planting • river protection maintenance works • irrigation intake maintenance • weed and vegetation control (excluding spraying) • drain maintenance, and drainage outlet maintenance • drain crossings • river mouth openings for the purpose of flood mitigation • river management and drainage for the maintenance of surface water quality • channel diversions within a river bed or drain, ancillary to the above activities that would otherwise contravene: • section 13 or section 14 of the RMA, or • section 15 of the RMA in relation to the discharge of sediment.	**Permitted**[153]	a. The activity or structure shall be undertaken in a manner that continues to provide for the existing passage of fish past the structure. b. The appropriate Fish and Game Council, iwi and Department of Conservation office, shall be notified at least 5 working days before any channel diversion is undertaken. c. There shall be no discharge of contaminants, other than sediment, arising from the use of machinery in the bed of any river or lake. d. The activity shall not adversely affect any wetland.[154] e. All activities shall be undertaken in accordance with the Hawke's Bay Regional Council Environmental Code of Practice for River Control and Drainage Works, 1999.		

[153] If Rule 70 cannot be complied with, then the activity is a discretionary activity under Rule 69.

[154] For the purpose of this Plan the term 'wetland' does NOT include:

- wet pasture land
- artificial wetlands used for wastewater or stormwater treatment
- farm dams and detention dams
- land drainage canals and drains
- reservoirs for firefighting, domestic or municipal water supply
- temporary ponded rainfall
- artificial wetlands.

Rule 70 effectively allows the HBRC operations team to carry out the listed and referred activities as a permitted activity. It is noteworthy that this does not include gravel extraction.

Rule	Activity	Classification	Conditions/Standards/Terms	Matters for Control/Discretion	Non-notification
71 **Activities affecting river control & drainage schemes**[155, 156] *Refer POL 79*	Any of the following activities, where they are undertaken by persons other than the local authority or persons acting on their behalf, within a land drainage or flood control scheme area that is managed by a local authority exercising its powers, functions and duties under the Soil Conservation and Rivers Control Act 1941, the Land Drainage Act 1908, or the Local Government Act 1974: • The introduction or planting of any plant including any tree in, on, or under the bed of any river, lake or artificial water course, or within 6 metres of the bed. • The erection of any building, fence or other structure in, on, or under the bed of any river, lake or artificial water course, or within 6 metres of the bed. • The deposition of any rock, shingle, earth, debris or other substance in, on, or under the bed of any river, lake or artificial water course, or within 6 metres of the bed. • The reclamation or drainage of the bed of any river, lake or artificial water course. • The undertaking of any other land disturbance activity which impedes access to the bed of any river, lake or artificial water course, or within 6 metres of the bed. • The erection of any structure and the undertaking of any land disturbance activity which interferes with the integrity of any defence against water.[157]	**Discretionary**[158]			

[155] It is important to note that the Hawke's Bay Regional Council owns much of the land within River Control and Drainage Schemes, and thus has landowner rights and responsibilities in relation to this land.

[156] Any activity permitted by Rules 64 and 65 is not subject to Rule 71.

[157] "Defence against water" includes stopbanks and their foundations.

[158] The ongoing maintenance or repair of any structure authorized by a resource consent pursuant to Rule 71 is permitted pursuant to Rule 64.

Policy 71 has a discretionary activity status and applies to works undertaken by other parties other than HBRC.

6.8.5 River Bed Gravel Extraction

Rule	Activity	Classification	Conditions/Standards/Terms	Matters for Control/Discretion	Non-notification
73 **Small scale river bed gravel extraction** *Refer POL 79*	The extraction of sand, gravel or other material from the bed of a river using a hand-held, non-mechanical device (e.g. a shovel), and any associated disturbance of the bed.	**Permitted**	a. The quantity of bed material extracted by any person at any one time shall not exceed 0.25 m^3. b. The total quantity of bed material extracted by any person shall not exceed 1 m^3 per year. c. The material shall be extracted from an area of river bed that is not covered by water at the time of extraction. d. The area from which material is extracted shall be recontoured so that no mounds or depressions remain. e. There shall be no discharge of any contaminant directly into water.		
74 **Large scale river bed gravel extraction** *Refer POL 53, 79*	The extraction of sand, gravel or other material from the bed of any river or lake, and: • any associated disturbance of the bed, and • any associated discharge of sediment, and • any associated diversion of water that is not provided for by Rule 73.	**Restricted discretionary**		a. Location of extraction sites and stockpile areas. b. Volume of gravel extracted. c. Rate of removal of gravel. d. Period of extraction. e. End use of the gravel. f. Dust management. g. Other matters set out in Policy 53. h. Financial contributions. i. Duration of consent. j. Review of consent conditions. k. Compliance monitoring.	

Rule 73 is a standard permitted activity rule that all councils have for very small scale gravel extraction.

Rule 74 is the key Rule that governs gravel extraction and is a restricted discretionary activity. Section 3 of the report discusses this rule in detail.

8.3 FINANCIAL CONTRIBUTIONS for Gravel Extraction

8.3.1 Where the HBRC grants a resource consent, it may impose a condition requiring that a financial contribution be made for the purposes specified in this Plan.

8.3.2 The term "financial contribution" is defined in section 108 (9) of the RMA as:
"… a contribution of: (a) money, or (b) land, including an esplanade reserve or esplanade strip (other than in relation to a subdivision consent), but excluding Maori land within the meaning of the Maori Land Act 1993 unless that Act provides otherwise, or (c) a combination of money and land."

8.3.3 Section 108 (10) of the RMA states that:
"A consent authority must not include a condition in a resource consent requiring a financial contribution unless:

> (a) The condition is imposed in accordance with the purposes specified in the plan (including the purpose of ensuring positive effects on the environment to offset any adverse effect); and
> (b) The level of contribution is determined in the manner described in the plan."

8.3.4 Financial contributions may, therefore, be required for a variety of purposes, including the purpose of offsetting any adverse effects. In accordance with section 111 of the RMA, any financial contribution of money collected by the HBRC must be used in reasonable accordance with the purposes for which the money was received.

8.3.5 The following provisions reflect the requirements of the Act and set out:

> (a) the circumstances when a financial contribution may be imposed
> (b) the purposes for which the contribution may be used, and
> (c) the manner in which the level of contribution will be determined.

8.3.6 CIRCUMSTANCES

8.3.6.1 The HBRC will only use financial contributions as a resource management tool in relation to resource consents granted for river bed gravel extraction.

8.3.7 PURPOSES

8.3.7.1 The purposes for which financial contributions will be sought from river bed gravel extractors are as follows:

> (a) Construction of, or maintenance of, roads, fences and gates that are used or will be used to access the gravel extraction site.
> (b) Stop bank restoration or enhancement to offset the effects of gravel extraction on flooding.
> (c) Strengthening or restoration of affected flood control or river stabilisation works.

(d) Replanting of vegetation removed, destroyed or damaged by gravel extractors accessing gravel extraction sites, or by the gravel extraction process.
(e) Downstream planting of riparian margins to offset erosion caused or exacerbated by gravel extraction.

8.3.8 LEVEL OF CONTRIBUTION

8.3.8.1 The level of contribution will be determined in the following manner:

(a) The total annual cost of the works and services to be funded by the contributions (as determined in each year's annual plan prepared pursuant to the Local Government Act 1974) divided by the total annual estimated volume of river bed gravel extraction, thereby giving rise to a uniform financial contribution per cubic metre of gravel extracted.
(b) The final actual financial contributions sought will fairly and reasonably reflect the degree of adverse effects arising as a result of river bed gravel extraction.

This effectively allows the consent authority to impose financial contributions to mitigate the more physical effects and damages on infrastructure in the event of planned or unplanned damage. As discussed in Section 3 of this report, these provisions are not utilised in the existing gravel management process.

Appendix B. Relevant Forms and Documents used in HBRC Existing Gravel Consent Process

REASONS FOR DECISION

1. The consent conditions promote the sustainable management of the extraction operation by avoiding, remedying or mitigating any adverse effects of the activity on the environment.

2. The activity is not contrary to the objectives, policies or Rule 7.1 of the Regional River Bed Gravel Extraction Plan.

STANDARD CONSENT CONDITIONS

1. Unless otherwise indicated by the Council the period to which the consent relates is from 1 July to 30 June the following year.

2. An officer of the Council shall have the right, during business hours, of access to the site of extraction and to the books and documents relating to the extraction of gravel authorised by this consent and kept by the holder in order to check the accuracy of the returns made to the Council.

3. The consent holder shall notify the Council forty-eight (48) hours prior to any new extraction operation commencing within the area specified by the resource consent.

4. The consent does not of itself confer any right of access over private and/or public property. Arrangements for access must be made between the consent holder and the property owner (including land under the control of the HBRC).

5. Where the consent holder requires access across river berm areas held by Council under the Reserves Act (or any other relevant Act) and leased to a third party, the consent holder shall negotiate access across that land with the lessee.

6. The consent holder shall ensure that any person exercising the consent shall produce the consent to the Council when requested to do so by a duly authorized officer of the Council.

7. Any authorisation to extract gravel conferred by a consent does not guarantee that the quantity of quality required will be available.

8. Consent holders shall maintain an accurate and accessible daily record of the volume of gravel taken, the site of extraction and the date it was taken. All quantities are to be based on loose measure and rounded to the nearest cubic metre. Such records are to be provided monthly to the HB Regional Council on the Statutory Declaration forms provided.

9. The consent holder shall immediately repair any damage that they have caused to any banks, access roads, fences, gates, protection or other works relating to the control of the river. The cost of such repair shall be met by the consent holder.

10. The consent holder shall ensure that the site is restored on completion of the gravel extraction operation as follows:

   a) Gravel heaped up during the process of removal shall be spread out by the consent holder on completion of the gravel extraction operation.
   b) Consent holder shall remove all, plant, machinery, equipment, signs and other structures associated with the operation from the riverbed immediately on completion of operations.
   c) No reject, surplus or unused gravel from a gravel processing plant is to be deposited into or onto the riverbed.

11. A consent does not confer any exclusive right of occupation over the area allotted to the holder.

12. A consent holder shall erect a warning sign (generally in the form shown in Appendix A) adjacent to the site of extraction where as a result of the extraction the stretch of river has or is likely to become dangerous to the public. These signs will be required wherever holes are made in the riverbed, which could become a danger to fishers and others who may use the riverbed. The signs shall be removed on completion of the operation or when the area is no longer a danger to the public.

13. No refuelling or fuel storage shall occur on the riverbed.

14. Should any archaeological site be discovered within the area affected by the operation the consent holder shall as soon as possible notify the Historic Places Trust and the Council.

15. No machinery shall be driven across the active river channel without prior authorisation from the Council in consultation with the Department of Conservation and the Hawke's Bay Fish and Game Council or the Eastern Region Fish and Game Council to the north or and including the Waiau River and its tributaries. When driving a vehicle across the river flow, consent holders shall take all practicable steps to prevent an increase in the level of turbidity of the river. The consent holder shall give particular attention to avoiding turbidity within waterways during the fish-spawning period of May-October.

16. a) When extracting gravel from outside the river flow and above the water level, extraction will commence from the water's edge on an even face or as otherwise directed by an officer of the Council. Gravel may be removed only from specified areas, which must be leveled off before leaving the site.
   b) When extracting gravel from outside the river flow and below standing water level, consent holders shall maintain a one metre wide barrier between the river and excavation site so that any turbidity increase in the river is kept to a minimum. The barrier is to be removed at the end of the operation.
   c) When extracting gravel from the river flow, consent holders shall take all practicable steps to prevent increase in the level of turbidity of the river. Should the gravel extraction operation result in increased turbidity the consent holder shall take all practicable steps, including any actions directed by an officer of the Council, to remedy the turbidity. The consent holder shall give particular attention to avoiding turbidity within waterways during the fish-spawning period of May-October.

17. No hangi stones are to be removed from the Mohaka River, unless they are required for cultural purposes, and then the permission of affected hapu will be needed.

ADDITIONAL SPECIFIC CONSENT CONDITIONS (if required)

1. Access tracks to be watered regularly to keep dust down.

2. No heavy vehicle access to Maori Point at the Omahu public access before 7.00 am or after 6.00 pm, Monday to Friday. No work permitted on the weekends or public holiday.

3. No heavy vehicle access to Maraekakaho at the Monument before 7.00 am or after 6.00 pm, Monday to Friday. Access weekends or public holidays from 7.30 am to 3.00 pm only.

4. No heavy vehicle access at Waipawa on the south side, down stream from Waipawa river bridge before 6.00 am or after 10.00 pm, Monday to Friday. Access weekends or public holidays from 7.30 am to 5.00 pm only.

ADVICE NOTES

1. That pursuant to Section 36 of the Resource Management Act 1991, the applicant is responsible for paying costs relating to receiving and processing of this resource consent. This amount is shown on the application form.

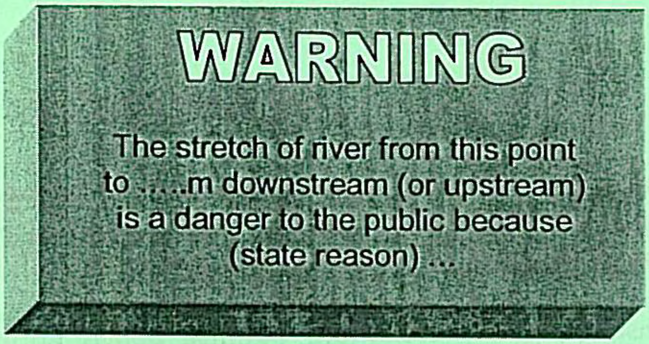
2. Notwithstanding any conditions outlined above, additional specific conditions may be imposed on gravel extraction activities in the region on any occasion, to take account of the site conditions at the time, to protect property, to protect human health, to ensure river or flood control is not prejudiced, or to avoid, remedy or mitigate any adverse effects on the environment.

3. This consent does not constitute authority to erect, reconstruct, place, alter, extend, remove or demolish any structure or to divert water or construct a causeway or discharge gravel wash into a river. These activities are controlled and you must seek a resource consent to carry them out.

4. The consent holder may apply to change the terms and conditions of the consent (except for the duration) if circumstances change (Section 127 of the Resource Management Act 1991).

5. The consent is transferable to any other person unless the consent states otherwise. The transfer has no effect until written notice of the transfer is given to the Council. The same conditions will apply to the new consent holder.

Warning signs erected in accordance with Rule 7.1.5 shall give the advise indicated below:



Appendix C. Other Councils Regulatory Plan Provisions

Greater Wellington Regional Council

Rule R129: All other activities in river and lake beds – discretionary activity
All other activities, except for damming and diverting of water, in river and lake beds that is not permitted or restricted discretionary by Rule R112 to Rule R125 is a discretionary activity except for those activities that are non-complying or prohibited under Rule R126, Rule R127 or Rule R128.

Policy 17-3: Gravel extraction

Having regard to Policies 5-22 to 5-25, activities in, on, under or over the *beds*^ of *rivers*^ and *lakes*^ that enable gravel extraction will generally be allowed provided that:

(a) The long term average annual volume of gravel available for extraction from those *rivers*^ and *river*^ reaches listed in Table 17.1 must be limited to the quantities stated in the table, unless:

- (i) there is a demonstrable *river*^ management need to increase or decrease this volume, or
- (ii) the gravel extraction is necessary to decrease the risk of flooding or damage to *structures*^, or
- (iii) future information establishes that actual sustainable rates of gravel extraction are higher or lower than those in Table 17.1 taking into account the cumulative volumes being extracted, the natural rates of replenishment and the *effects*^, including cumulative effects, of extraction.

(b) For any *river*^ or *river*^ reach not specified in Table 17.1, the *effects*^ of the cumulative volume of gravel being extracted on an annual basis in the *river*^ reaches must be considered, including matters in relation to:

- (i) the natural rates of gravel replenishment,
- (ii) the *effects*^, including cumulative *effects*^, of the gravel extraction,
- (iii) demonstrable *river*^ management needs, and
- (iv) the need to decrease the risk of flooding or damage to *structures*^.

(c) For the purposes of this policy "annual" is defined as 1 July to 30 June the following year.

Table 17.1 Long term average annual allocable volumes of gravel

River or Reach	Volume (m^3)
Kawhatau River	20,000
Makino Stream	3,000
Makuriiti Stream	3,000

River or Reach	Volume (m^3)
Manawatu River	
• From 1 km upstream of Ngawapurua Bridge to source	20,000
• 1 km upstream to 2.5 km downstream of Ngawapurua Bridge	No extraction
• 2.5 km downstream of Ngawapurua Bridge to Ballance Bridge	15,000
• Manawatu Gorge to Karere Rd	2,500
• Karere Rd to Hamilton's Line	15,000
• Hamilton's Line to Oroua confluence [2007 to 2009]	20,000
• Hamilton's Line to Oroua confluence [2009 onwards] the 2 km aggrading reach between 39 Miles (NZMS 260 S24:212-832) and Benchmark 643 (NZMS 260 S24:226-830)	17,500
• Hamilton's Line to Oroua confluence [2009 onwards] the 2 km aggrading reach between BM 604 (NZMS 260 S24:206-833) and BM 622 (NZMS 260 S24:207-826)	35,000
Mangahao River	15,000
Mangatainoka River	15,000
Ohau River	
• Upstream of a point 1 km above SH 1 bridge	5,000
• Downstream of a point 1 km above SH 1 bridge	10,000
Oroua River	
• Upstream of Menzies Ford	10,000
• Downstream of Menzies Ford	55,000
Pohangina River	25,000
Rangitikei River	
• Makahikatoa Stream to Man	15,000

Horizons Regional Council

17.9 Rules - Gravel Extraction, Bed Disturbances and Plants

Rule	Activity	Classification	Conditions/Standards/Terms	Control/Discretion Non-Notification
17-16 Small-scale gravel extraction	The excavation or other disturbance of the *bed*^ of a *river*^ or *lake*^ for the purpose of extracting gravel and other *bed*^ material, pursuant to s13(1) RMA and any ancillary: (a) damming or diversion of *water*^ pursuant to s14(2) RMA (b) *discharge*^ of *water*^ or sediment into *water*^ or onto or into *land*^ pursuant to ss15(1) or 15(2A) RMA (c) deposition of substances in or on the *bed*^ of the *river*^ or *lake*^ pursuant to s13(1).	**Permitted**	(a) The activity must not take place in a *river*^ or *lake*^ regulated under Rule 17-3. (b) The amount of gravel and *bed*^ material extracted must not exceed 50 m³ in any 12 month period. (c) The gravel or other material must only be extracted from an area of *river*^ *bed*^ that is not covered by flowing *water*^ at the time of extraction. (d) The activity must comply with the general *conditions*^ listed in Section 17.3. (e) The activity must not take place in any *rare habitat**, *threatened habitat** or *at-risk habitat**.	
17-17 Other gravel extraction	Except as regulated by Rules 17-3 and 17-16, the excavation or other disturbance of the *bed*^ of a *river*^ or *lake*^ for the purpose of extracting gravel and other *bed*^ material, pursuant to s13(1) RMA and including any ancillary: (a) damming or diversion of *water*^ pursuant to s14(2) RMA (b) *discharge*^ of *water*^ or sediment into *water*^ or onto or into *land*^ pursuant to ss15(1) or 15(2A) RMA (c) deposition of substances in or on the *bed*^ of the *river*^ or *lake*^ pursuant to s13(1) (d) *discharges*^ to air pursuant to s15(2A) RMA.	**Discretionary**	(a) The activity must not take place in any *rare habitat**, *threatened habitat** or *at-risk habitat**.	
17-18 Other minor *bed*^ disturbances	Except as regulated by other *rules*^ in this chapter, the excavation, drilling, tunnelling or other disturbance of the *bed*^ of a *river*^ pursuant to s13(1) RMA and any ancillary: (a) damming or diversion of *water*^ pursuant to s14(2) RMA (b) *discharge*^ of *water*^ or sediment into *water*^ or onto or into *land*^ pursuant to ss15(1) or 15(2A) RMA (c) deposition of substances in or on the *bed*^ of the *river*^ or *lake*^ pursuant to s13(1). **Advice Note:** For the avoidance of doubt, this *rule*^ does not include gravel extraction.	**Permitted**	(a) The activity must not take place in a *river*^ regulated under Rule 17-3. (b) The activity must comply with the general *conditions*^ listed in Section 17.3. (c) The activity must not take place in any *rare habitat**, *threatened habitat** or *at-risk habitat**.	
17-19 Plants	Except as regulated by other *rules*^ in this chapter, the introduction, planting, removal or destruction of a plant in or on the *bed*^ of a *river*^ or *lake*^ pursuant to s13(1) or s13(2) RMA, and any ancillary: (a) excavation, drilling, tunnelling or other disturbance of the *bed*^ of a *river*^ or *lake*^ pursuant to s13(1) RMA (b) damming or diversion of *water*^ pursuant to s14(2) RMA (c) *discharge*^ of *water*^ or sediment into *water*^ or onto or into *land*^ pursuant to ss15(1) or 15(2A) RMA (d) deposition of substances in or on the *bed*^ of the *river*^ or *lake*^ pursuant to s13(1).	**Permitted**	(a) A pest plant, as listed in the Regional Pest Plant Management Strategy, must not be introduced or planted. (b) The activity must not involve the planting of a tree or shrub in a reach of a *river*^ with a Schedule B Value of Flood Control and Drainage, as regulated by Rule 17-15. (c) The activity must not involve the removal or destruction of plants in Lake Papaitonga, Pukepuke Lagoon or Lake Horowhenua except for a radius of 500 m from the Lake Horowhenua outlet weir (which is permitted by this *rule*^). (d) The activity must comply with the general *conditions*^ listed in Section 17.3. (e) The activity must not take place in any *rare habitat**, *threatened habitat** or *at-risk habitat**.	

Rule Guide:

Gravel extraction that cannot meet the conditions set out in Rule 17-17 is a discretionary activity under Rule 17-23.

The discharge of contaminants into water or into or onto land, other than contaminants specifically identified in the rules, is regulated by the rules in Chapter 14.

Activities undertaken in *rare habitats**, *threatened habitats** or *at-risk habitats** are regulated under Rules 13-8 and 13-9.

17.8 Rules - Activities Within Rivers with a Schedule B Value of Flood Control and Drainage

Rule	Activity	Classification	Conditions/Standards/Terms	Control/Discretion Non-Notification
Rule 17-14 **Activities undertaken by or on behalf of the Regional Council in *rivers*^ with a Schedule B Value of Flood Control and Drainage**	The following activities within a reach of a *river*^ with a Schedule B Value of Flood Control and Drainage, where they are undertaken by or on behalf of the Regional Council: (a) the erection, placement, or extension of any *structure*^ in, on, under or over the *bed*^ of a *river*^ pursuant to 13(1) RMA (b) the excavation, drilling, tunnelling or other disturbance (including gravel extraction) of the *bed*^ of a *river*^ pursuant to s13(1) RMA (c) any damming or diversion of *water*^ pursuant to s14(2) RMA (d) any *discharge*^ or deposition of plants, removed *bed*^ material, rock, shingle, earth, *cleanfill material**, *water*^ or sediment into *water*^ or onto or into *land*^ pursuant to ss13(1), 15(1) or 15(2A) RMA (e) the damage, destruction, disturbance or removal of plants or parts of plants pursuant to s13(2) RMA.	**Permitted**	(a) The activity must be undertaken in accordance with the Environmental Code of Practice for River Works (Horizons Regional Council, June 2010). (b) The activity must not involve: (i) an activity prohibited under Rule 17-1 (ii) an activity regulated under Rule 17-3, except to the extent that the activities may be carried out in specified Sites of Significance - Aquatic and Sites of Significance - Cultural in accordance with (a).	
17-15 **Activities affecting Schedule B Value of Flood Control and Drainage**	Except as regulated by Rule 17-6, the following activities pursuant to ss 9(2) and 13(1) RMA in, on or under an *artificial watercourse** or a reach of a *river*^ with a Schedule B Value of Flood Control and Drainage or adjacent *land*^ as defined in (j) to (m): (a) the planting of a tree or shrub (b) the erection, placement or extension of any building or other *structure*^ (including accessways) (c) the erection, placement or extension of a fence perpendicular to a *river*^ or *artificial watercourse** (d) the erection, placement or extension of a fence greater than 1.2 m high parallel to a *river*^ or *artificial watercourse** (e) the deposition of any rock, shingle, earth, debris or other *cleanfill material** (f) any excavation, drilling, tunnelling or other disturbance likely to undermine the functional integrity of a stopbank or *river*^ control *structure*^ (g) any *land disturbance** that impedes access required for *maintenance** of a *river*^ or drainage scheme (h) the *upgrade**, reconstruction, alteration, extension, removal or demolition of any *structure*^ that is maintained by the Regional Council for the purposes of flood control or erosion protection or drainage and any ancillary: (i) excavation, drilling, tunneling or other disturbance of the *river*^ or *lake*^ *bed*^ pursuant to s13(1) RMA (ii) damming or diversion of *water*^ pursuant to s14(2) RMA (iii) *discharge*^ of *water*^ or sediment into *water*^ or onto or into *land*^ pursuant to ss15(1) or 15(2A) RMA (iv) deposition of substances in or on the *bed*^ of the *river*^ or *lake*^ pursuant to s13(1) (v) *land disturbance** pursuant to s9(2) RMA where the activities listed in (a) to (h) are	**Discretionary**		

Rule	Activity	Classification	Conditions/Standards/Terms	Control/Discretion Non-Notification
	undertaken in any of the following areas: (i) within the *bed*^ of a *river*^ or within an *artificial watercourse** (j) on a stopbank (k) on any strip of *land*^ between an *artificial watercourse** or *bed*^ of a *river*^ and 8 m inland of the landward toe of a stopbank (l) for areas without stopbanks, anywhere within 10 m of an *artificial watercourse** or the *bed*^ of a *river*^ (l) Only *land*^ use activities described under (f) and (g) are controlled under this *rule*^ on *land*^ described under (j) and (k) on and adjacent to the Manawatu River secondary stopbank located between Ruahine Street at Fitzroy Bend and Ruamahanga Crescent. The other listed *land*^ use activities are not controlled in that area. This *rule*^ does not apply to activities undertaken by or on behalf of the Regional Council.			

Rule Guide:

The discharge of contaminants into water or into or onto land, other than contaminants specifically identified in the rules, is regulated by the rules in Chapter 14.

17.11 Rules - Activities that do not Comply with Permitted Activity, Controlled Activity or Restricted Discretionary Activity Rules and all other s13(1) RMA Activities Not Covered by this Chapter

Rule	Activity	Classification	Conditions/Standards/Terms	Control/Discretion Non-Notification
17-22 **Activities that do not comply with *permitted activity*^ *rule*^ general *conditions*^**	Any activity that does not comply with Rule 17-5 condition (a), Rule 17-6 condition (a), Rule 17-7 condition (g), Rule 17-9 condition (c), Rule 17-10 condition (j), Rule 17-11 condition (e), Rule 17-12 condition (d), Rule 17-16 condition (d), Rule 17-18 condition (b), Rule 17-19 condition (d), including any ancillary: (a) excavation, drilling tunnelling or other disturbance of the *bed*^ pursuant to s13(1) RMA (b) damming or diversion of *water*^ pursuant to s14(2) RMA (c) *discharge*^ of *water*^ or sediment into *water*^ or onto or into *land*^ pursuant to ss15(1) or 15(2A) RMA (d) deposition of substances in or on the *bed*^ of the *river*^ or *lake*^ pursuant to s13(1).	**Restricted Discretionary**	The activity must comply with all other conditions, standards and terms of the applicable *permitted activity*^ *rule*^.	Discretion is restricted to: (a) measures to avoid, remedy or mitigate the effects^ of the activity in relation to any non-compliance with the matters listed in Section 17.3 (b) duration of consent (c) review of consent *conditions*^ (d) compliance monitoring
17-23 Activities that do not comply with *permitted activity*^, *controlled activity*^ or *restricted discretionary activity*^ *rules*^ and all other s13(1) RMA activities not covered by this chapter	Any activity that does not comply with one or more *conditions*^, standards or terms of a *permitted activity*^, *controlled activity*^ or *restricted discretionary activity*^ *rule*^ in this chapter, but which is not expressly classified as a *discretionary activity*^, *non-complying activity*^ or *prohibited activity*^ or is a s13(1) RMA activity not covered by this chapter, including any ancillary: (a) excavation, drilling, tunnelling or other disturbance of the *bed*^ pursuant to s13(1) RMA (b) damming or diversion of *water*^ pursuant to s14(2) RMA (c) *discharge*^ of *water*^ or sediment into *water*^ or onto or into *land*^ pursuant to ss15(1) or 15(2A) RMA (d) deposition of substances in or on the *bed*^ of the *river*^ or *lake*^ pursuant to s13(1).	**Discretionary**		

Rule Guide:

The discharge of contaminants into water or into or onto land, other than contaminants specifically identified in the rules, is regulated by the rules in Chapter 14.

Waikato Regional Council

4.3.4.4 Discretionary Activity Rule – Bed Disturbance Activities

Any river or lake bed disturbance activity, including:

1. Excavation, drilling, tunneling, or
2. The introduction of any plant or part of any plant in, on or under the bed, or
3. Deposition of any substance in, on or under the bed, or
4. Reclamation or drainage of the bed, or
5. The clearance of vegetation in, on or under the bed:

that is not otherwise provided for by, or does not comply with, a permitted or controlled activity rule within this Regional Plan is a **discretionary activity** (requiring resource consent).

Bay of Plenty Regional Land and Water Plan

Rule 71 **Discretionary – Activity in the Beds of Streams, Rivers and Lakes**

Unless provided for by another rule in this regional plan, the:

1 Use, erection, reconstruction, placement, alteration, extension, removal, or demolition of any structure or part of any structure in, on, under, or over the bed of a stream, river or lake,

2 Excavation, drilling, tunnelling or other disturbances to the bed of a stream, river or lake,

3 Introduction of planting of any plant or any part of any plant in, on, or under the bed of a stream, river or lake,

4 Disturbance, removal, damage or destruction of any plant or any part of any plant in, on, or under the bed of a stream, river or lake,

5 Deposition of any substance in, on, or under the bed of a stream, river or lake,

6 Reclamation or drainage of the bed of a stream, river or lake,

Is a discretionary activity.

ECAN

The Minister for Canterbury Earthquake Recovery has made amendments to the following using section 27(1)(a) of the Canterbury Earthquake Recovery Act 2011:

Christchurch City Plan (District Plan);
Natural Resources Regional Plan (NRRP); and the
Proposed Land and Water Regional Plan (pLWRP)

These amendments will alter the requirements for resource consent when undertaking earthquake-related land repairs. Changes to the District Plan, NRRP, and pLWRP are aimed at reducing requirements for resource consent when repairing land with increased liquefaction vulnerability while managing any negative environmental effects. These provisions apply to 'flat land' located within the greater Christchurch area. For repair works on the Port Hills or Banks Peninsula, existing provisions in the Christchurch City Plan, the Banks Peninsula District Plan and Regional Plans apply. The amendments have now been publicly notified in The Press and apply immediately.
Date it takes effect: Friday 5 September 2014

Natural Resources Regional Plan

As a result of the Canterbury Land & Water Regional Plan (LWRP) being made **partially operative on 13 August 2015 and 15 October 2015,** some parts of the NRRP are now inoperative. The parts of the NRRP that **remain operative** are:

- Chapter 1 - Overview
- Chapter 2 – Ngāi Tahu and the management of natural resources
- Chapter 3 – Air quality
- Chapter 5 - Water quantity
- Chapter 6 – Activities in the beds of lakes and rivers

Please note that while Chapters 5 and 6 of the NRRP are still operative, all rules within these chapters are to be treated as inoperative with the exception of rules that relate to the damming of water, or the taking or using of surface water.

6.6 Regional Rules

Rule BLR5 Excavation, drilling, tunnelling, depositing, reclamation, drainage or disturbance in, on, under or over the bed

Activity	Conditions
1. The excavating, drilling, tunnelling, depositing, reclamation, drainage or disturbance (but not including excavation of materials for the erection, reconstruction, placement, use, alteration, extension, demolition or removal of a structure classified by Rules BLR2, BLR3, BLR4 or BLR7) in, on, over or under the bed of a lake or river, is: (a) a **permitted activity** provided the activity complies with all the conditions of this rule; (b) a **discretionary activity** where Condition 1 is not complied with; (c) a **prohibited activity** where Condition 12 is not complied with; or (d) a **restricted discretionary activity** where any other condition is not complied with. This rule does not apply to activities in artificial lakes and detention and retention lakes classified by Rule BLR1.	1. The activity shall not be undertaken in, on, or under the beds of any high naturalness lakes listed in Table WQN19 of Schedule WQN5 in Chapter 5 or Schedule BLR6; 2. No part of the activity shall occur within surface water or at or below the water table. 3. The activity shall not involve the disturbance or removal of any rocks with a diameter greater than 500 millimetres on any axis. 4. The activity shall not include the deposition of any substance, other than bed material, on the bed. 5. The activity shall not be, or result in, the reclamation of the bed. 6. The volume excavated by any person or on behalf of any person, organisation or corporation: (a) in the bed of any river or lake shall not exceed 20 cubic metres per week and not more than 50 cubic metres in any 12 consecutive months or, (b) between 1 February and 31 August, in the beds listed in Schedule BLR2, shall not exceed 50 cubic metres per month and not more than 250 cubic metres in any 12 consecutive months period; or, (c) between 1 February and 31 August, in the beds listed in Schedule BLR3, shall not exceed 100 cubic metres per month and not more than 500 cubic metres in any 12 consecutive months period. 7. Any excavation undertaken in accordance with Condition 6 above will include the removal of excavated material (other than surplus or reject material) from the bed within ten days of that material being excavated. 8. The Customer Service Centre of Environment Canterbury shall be notified before any excavation of more than 50 cubic metres in any four weeks is undertaken in accordance with Conditions 6(b) or (c) of this rule. This notification must state, the location of the excavation site, the quantity of material to be excavated, the approximate dates when the activity is to be undertaken and a contact phone number of the person undertaking the activity. 9. To avoid destabilising any lawfully established structure in, on, under or over the bed of a lake or river the activity shall: (a) be undertaken at a distance greater than 50 metres from any lawfully established dam, weir, culvert crossing, bridge, surface water intake plant or network utility pole or pylon and 150 metres from any lawfully established water level recorder; and (b) not be undertaken within 5 metres of any existing flood control structures or to a depth exceeding 1 metre. 10. The activity, or any associated equipment, materials or debris shall not obstruct or alter the passage of water in a manner that causes: (a) any more than minor increase in the risk or potential for flooding of surrounding lands;

<table>
<tr><td>Where Rule Applies:

This rule does not apply to all areas/situations in the Canterbury region - see Table BLR3: Index of rules.</td><td>(b) any more than minor destabilising of lawfully established flood control structures or flood control vegetation or any other lawfully established structures in, on, or under or over the bed of a lake or river;
(c) any more than minor increase in erosion of the river or lake bed; or
(d) drainage of water from the bed or diversion of flows within the bed.
11. No vegetation used for flood control or bank stabilisation shall be disturbed, removed, damaged or destroyed, except by or on behalf of the person or agency responsible for maintaining that vegetation for flood control purposes.
12. No plant species identified in Schedule BLR1 shall be planted or introduced.
13. The activity and any associated equipment, materials or debris shall not obstruct or alter the navigation of the bed or water body in a manner that has the potential to cause injury to any person.
14. The activity shall not include any refuelling of machinery or vehicles on the bed.
15. Upon completion of the activity:
(a) all reject surplus or unused bed material stored in the bed shall be spread out;
(b) any excavated areas shall be left with battered slopes not exceeding a 3:1 slope angle (3 horizontal to 1 vertical) and any flow channels disturbed during the activity shall be reinstated; and
(c) all equipment and temporary structures associated with the activity shall be removed from the bed.
16. The activity shall not occur within any section of the water body that is backed up by the tide.</td></tr>
<tr><td></td><td>Restriction of Discretion</td></tr>
<tr><td></td><td>Where the activity is classified as a restricted discretionary activity, Environment Canterbury has restricted its discretion to the following matters:
1. Effects on the stability and integrity of lawfully established structures.
2. The volume of bed material to be extracted or deposited.
3. The depth of excavation.
4. Effects on the risk of flooding, including:
(a) effects on upstream and downstream flood carrying capacity; and
(b) the cumulative impact in conjunction with other similar activities in the catchment.
5. Effects on sediment load and transport, including cumulative effects in conjunction with other similar activities in the catchment.
6. Effects on the stability of bed or banks, including any increased risk of erosion and any cumulative impacts in conjunction with other similar activities in the catchment.
7. Effects of the activity, including management of vehicles and materials, on the integrity and effectiveness of flood control works or flood control vegetation.
8. Effects on other activities, including commercial and recreational activities, on or over the bed or on land adjacent to the bed.
9. Effects on water quality and aquatic life.
10. Effects on the habitat of trout and salmon.
11. Effects on indigenous vegetation and habitat for indigenous fauna, including: disturbance or loss of fish passage, spawning habitat or nesting and breeding habitat for indigenous birds.
12. Effects on natural character and braided river systems.
13. Any impacts on heritage sites or sites of significance to Ngāi Tahu.
14. Effects arising from the extent of excavation.
15. Financial contributions or bonds as specified in Part 6.13 of this chapter.</td></tr>
</table>

For information only:

1. Persons exercising this rule should be aware that permission may need to be obtained at their own expense from the legal owner or administering body of the bed and of the resource and/or the owner of land via which access to the riverbed is obtained.
2. The activity must comply with the water quality rules in NRRP Chapter 4 Water Quality.
3. Any deposition or excavation may also need to meet requirements of rules or seek resource consent under the relevant District Plan or City Plan.
4. The storage of hazardous substances, including fuel and oil, is addressed by NRRP Chapter 4 Water Quality.

6.10.5.5 Rule BLR5 Excavation, drilling, tunnelling, depositing, reclamation, drainage or disturbance in, on, under or over the bed

Excavation, drilling, tunnelling, depositing, reclamation, drainage or disturbance within the bed is restricted under section 13 of the RMA. These activities within the bed have the potential to impact on rates of erosion, river channel alignment and structure stability. However, the significance of this impact will depend on numerous activity and site-specific elements. The purpose of the rule is to remove the requirement, under section 13 of the RMA, to get resource consent for those activities which will have no more than a minor adverse effect on the environment (provided the conditions of the rule are met).

Rule BLR5 specifically provides for gravel extraction by including conditions for the excavation of bed material. The rule does not provide for excavation in relation to erection, placement, maintenance or modification of structures. These activities are addressed by Rules BLR2, BLR3, BLR4 and BLR7. The volumes of excavated material **permitted** under this rule are limited to account for the potential cumulative effects of numerous extraction activities within the river reach or catchment. For volumes in excess of the permitted limits the varying rates of gravel supply and excavation within specific river reaches need to be assessed through the resource consent application process.

Reclamation, drainage and deposition (other than the deposition of bed material) are addressed by Rule BLR5 as restricted discretionary activities. This is because the potential effects of these activities on the instream environment, other values and uses are likely to be more than minor and need to be assessed on a case-by-case basis.

In general, **restricted discretionary** activity status is appropriate for activities covered by this rule that do not comply with conditions, as the likely adverse effects can be reasonably specified.

Canterbury Land and Water Regional Plan

RULES

Note: The recommendations of the Hearing Commissioners on submissions to the Canterbury Land & Water Regional Plan have been **formally adopted** by Council.
The Plan was made **partially operative** on 1 September 2015 and 1 December 2015.

At its meetings on 13 August 2015 and 15 October 2015, the Environment Canterbury Council resolved to make the Land & Water Regional Plan operative, with the exception of the following rules:

- Rules 5.123 – 5.127 (Take and Use Surface Water)
- Rules 5.154 – 5.158 (Dams and Damming)

On 9 April 2016 the Minister for Canterbury Earthquake Recovery amended the Canterbury Land and Water Regional Plan (LWRP) and the proposed Canterbury Air Regional Plan (pCARP) under section 27(1)(a) of the Canterbury Earthquake Recovery Act 2011 (CER Act). The amendments enable the ongoing operation of Burwood Landfill for the disposal of earthquake waste through to 2021.

Changes were previously made to the Canterbury Land and Water Regional Plan under Action 46 of the Land Use Recovery Plan to enable the continued operation of the landfill within the existing landfill footprint. However, following further assessment of resource consent requirements and consultation with the community in relation to those applications, it was identified that further changes to regional planning documents were necessary. These further changes are the subject of the Minister's amendments on 9 April 2016.

5.147
Sections 124A to 124C of the Resource Management Act 1991 do not apply to resource consents to extract gravel from the bed of a lake or river in Canterbury.

5.148
The extraction of gravel from the bed of a lake or river including the deposition of substances on the bed and excavation or other disturbance of the bed of a lake or river is a **permitted activity**, provided the following conditions are met:

1. The activity is not undertaken in, on, or under the bed of any river or lake listed as a high naturalness waterbody in Sections 6 to 15; and
2. No part of the activity occurs within flowing water; and
3. The activity does not include the deposition of any substance, other than bed material, on the bed; and
4. The volume excavated by any person or on behalf of any person, organisation or corporation: (a) in the bed of any river or lake does not exceed 5 m3 in any 12 consecutive months; or (b) between 1 February and 31 August, in the beds listed in Schedule 14, does not exceed 5 m3 per month and not more than 10 m^3 in any 12 consecutive months period; or (c) between 1 February and 31 August, in the beds listed in Schedule 15, does not exceed 10 m3 per month and not more than 20 m^3 in any 12 consecutive months period; and
5. Any excavated material (other than surplus or reject material) is removed from the bed within 10 days of the material being excavated; and

6. Unless undertaken by the network utility operator responsible for the structure, the activity is undertaken more than 50 m from any lawfully established dam, weir, culvert crossing, bridge, surface water intake plant or network utility pole or pylon, more than 150 m from any lawfully established water level recorder and more than 5 m of any existing defences against water; and
7. The activity and any associated equipment, materials or debris does not obstruct or alter access to or the navigation of the lake or river; and
8. The activity does not include screening or any other processing of the gravel within the bed of the lake or river; and
9. The activity is not undertaken in an inanga or salmon spawning site listed in Schedule 17; and
10. Excavation shall not occur within 100 metres of birds which are nesting or rearing their young in the bed of the river.

5.149
The extraction of gravel, including the ancillary deposition of substances on the bed and excavation or other disturbance of the bed that complies with all the conditions in Rule 5.148, except with respect to the volume limits in condition 4 of Rule 5.148, is a **permitted activity**, provided the following condition is met:
1. The extraction of gravel is undertaken by or on behalf of the CRC in conformance with the current version of the Canterbury Regional Gravel Management Strategy prepared to give effect to Policy 10.3.4 of the Canterbury Regional Policy Statement.

5.150
Any extraction of gravel from the bed of a lake or river where one or more of the conditions for Rule 5.148 or 5.149 are not met is a **discretionary activity**.

5.151
Notwithstanding any other rule in this Plan, temporary structures and diversions associated with undertaking activities in Rules 5.147 to 5.150 or in relation to artificial watercourses are **permitted activities**, provided the following conditions are met:
1. The activity is not undertaken in an inanga or salmon spawning site listed in Schedule 17; and
2. The temporary structure and diversion is in place for not more than 4 weeks in any 12 month period.

5.152
Temporary discharges to water or to land in circumstances where a contaminant may enter water associated with undertaking activities in Rules 5.147 to 5.150 or in relation to artificial watercourses are **permitted activities**, provided the following conditions are met:
1. The discharge is only of sediment, organic material and water originating from within the bed of the lake or river; and
2. The discharge is not undertaken in an inanga or salmon spawning site listed in Schedule 17; and
3. The discharge is not for more than ten hours in any 24-hour period, and not more than 40 hours in total in any calendar month.

5.153
Where not classified by any other Rule in this Plan, the diversion or discharge of water and contaminants as a result of the extraction of gravel from the bed of a lake or river including the deposition of substances on the bed and excavation or other disturbance of the bed of a lake or river, is a **discretionary activity.**

Appendix D. Questionnaire circulated to Regional Councils and Responses

Environmental Management Services

Hawkes Bay Riverbed Gravel Management Study
Regional Council Benchmarking Questions
Otago Regional Council

1. How are gravel extraction permits administered in your region (eg do you as the river engineering department administer and issue the permits or does your resource consent department do this; do you hold the permits yourselves or are they held by individual extractors etc.)?

Decision-making on resource consents must take account of matters that are broader than "engineering" considerations. There must also be clear separation between regulatory and operational functions within an organisation. For these reasons ORC's consents section have the responsibility for deciding and issuing resource consents for gravel extraction.

Some resource consents are held by ORC but most are held by other organisations or individuals.

2. If you hold the gravel consents yourselves, did you prepare a resource consent application, and if so, can you supply a representative example?

Applications are usually prepared by planning consultants.

3. Within flood control scheme areas, do you use gravel extraction as a tool to maintain the flood conveyance capacity of the river, and if so how effective is this approach.

It is used in a limited way within some flood control scheme areas. There is an increasing expectation is some parts of Otago that ORC will take a more active role in managing river form (rather than capacity) using gravel extraction as a tool.

4. What is the basis to your royalty charges for gravel and is this written down in a document? For instance are you relying on RMA s36 charging and what activity costs (eg cross section monitoring) do you on-charge to extractors?

ORC charges a compliance monitoring fee. The fee is set through the Annual Plan process and is published in the Annual Plan.

5. Do you have a 'Gravel Management Plan' or an equivalent type of document that guides your activities in this area; and if so, can you supply a copy?

ORC is preparing River Morphology and Riparian Management Plans for some rivers in Otago. The rivers being targeted are those where river morphology is dynamic over short time scales and where there is high community interest in how the river and its margins should be managed. The plans are prepared in consultation with the community and stakeholders, through a series of workshops. Whilst the plans have no statutory basis they act as a guide for ORC's river management activity and help inform the Annual Plan process. The plans help ensure that community expectations around river control and gravel extraction are managed and that the respective roles of ORC and landholders are clear. They also ensure that decision-making takes account of wider community values and that rivers are not simply seen as gravel quarries.

6. How do you direct extractors to extract gravel from aggrading rivers/reaches that are further away or of poorer quality from more readily available or better quality sources?

The Plans referred to in 5 above assist as they ensure that there is consideration of community values and impacts other than just the quality of the material that is to be taken. Care needs to be taken with consent conditions that rely on discretion. Such conditions are not always lawful and can allow directions to be given that do not account for river values.

7. Do you finance gravel extraction from aggrading rivers from target rate scheme or general rate funding as opposed to relying on commercial gravel extractors? If so, is this a significant and costly activity for your schemes/rating?

ORC principally relies on commercial operators but it is likely that ORC will need to direct fund extraction in some areas in the future.

8. Are you facing 'gravel banking' by commercial extractors and if so, how are you dealing with this?

This is a legal issue that does not seem to have a clear answer.

9. Do you have any documentation or information on the different Acts that govern your river management responsibilities (eg RMA, Soil Conservation and Rivers Control Act, Crown Minerals Act, Land Drainage Act etc.)?

N/A.

10. Do you have any relevant legal opinions on gravel management that you are willing to share?

We have none.

11. Have you experienced any 'interface' issues between your gravel extraction permitting regime and District Councils' earthworks and other district plan consenting requirements?

Nothing of note.

12. Do you have any defined process or agreements with TAs in place for identifying the lateral extent on a floodplain that your gravel permitting process applies to?

No, as that has not been necessary.

13. How do you measure/monitor gravel extracted for consent compliance monitoring and gravel royalty recovery?

ORC relies on information provided by the consent holder. That information comprises the volumes extracted and in some cases cross-sections that have been surveyed by the consent holder pre and post extraction.

14. Is there any other information relating to gravel management that you think is relevant?

None.

Darryl Lew
14 April 2016

Environmental Management Services

Hawkes Bay Riverbed Gravel Management Study
Regional Council Benchmarking Questions
Environment Canterbury

1. **How are gravel extraction permits administered in your region (eg do you as the river engineering department administer and issue the permits or does your resource consent department do this; do you hold the permits yourselves or are they held by individual extractors etc.)?**

In Canterbury, gravel is administered in the following ways:

- Resource Consents,
- Gravel Authorities (Permits issued under a permitted rule of the Land and Water Regional Plan),
- Resource Consents held by the council (Permits under a resource consent held by Regional Engineer),
- Permitted baseline in the Land and Water Regional Plan.

The River Engineering Section issues and administers gravel extraction authorisations, these Gravel Authorisations are for extraction on behalf of the Regional Council where there is a known surplus of material and the removal of that material will benefit flood and erosion control schemes. A rule in the Canterbury Land and Water Regional Plan enables the issuing of gravel authorisations. These authorisations require operators to work in accordance with the Canterbury River Gravel Extraction Code of Practice (2015). The Code of Practice was written as part of the implementation of the Canterbury Regional River Gravel Management Strategy (2012) and has set maximum volumes of up to 60,000 m3 and durations up to 12 months. The Land and Water Regional Plan has restricted some areas from the issuing of Gravel Authorisations, and in these areas Resource Consents can still be applied for.

Resource consents are processed and administered by a separate section of Council. Consents may also be applied for if an applicant wishes to take more than 60,000m3 or have a longer duration than 12 months.

The River Engineering section holds both Resource Consents and Gravel Authorisations to take material for the benefit of our scheme areas.

2. If you hold the gravel consents yourselves, did you prepare a resource consent application, and if so, can you supply a representative example?

We have applied for gravel extraction consents and for Gravel Authorisations. Under current circumstances the project manager would apply for an authorisation or resource consent depending on the circumstances. A copy of the most recent Resource Consent application is attached.

3. Within flood control scheme areas, do you use gravel extraction as a tool to maintain the flood conveyance capacity of the river, and if so how effective is this approach?

We have river bed level monitoring programmes for our major river schemes, and target minimum bed levels to enable management of flood & bank erosion risk by gravel extraction. This approach has had marginal success in the past due to inability to target extraction - but the newly imposed authorisation process under the Land and Water Regional Plan will improve our ability to target gravel extraction to maintain flood capacity.

4. What is the basis to your royalty charges for gravel and is this written down in a document? For instance are you relying on RMA s36 charging and what activity costs (eg cross section monitoring) do you on-charge to extractors?

Gravel extractors who hold a resource consent or gravel authorisation are charged a gravel management fee of $0.13 per cubic metre of consented/authorised volume, and this is charged irrespective if the full allocated amount is taken or not. The gravel management fee funds all the survey and analysis work required to determine how much gravel is available for extraction and where it should be taken to gain the most benefit from extraction. The charging regime is set out in the Gravel Management Strategy and charges are approved through the Long Term Plan process. Other costs passed onto extractors include the costs of processing their applications and the monitoring of their activity.

5. Do you have a 'Gravel Management Plan' or an equivalent type of document that guides your activities in this area; and if so, can you supply a copy?

The Canterbury Regional River Gravel Management Strategy (2012), copy provided.

6. How do you direct extractors to extract gravel from aggrading rivers/reaches that are further away or of poorer quality from more readily available or better quality sources?

We direct extraction to the nearest sites where gravel is available, and the contractor makes a choice giving regard to cartage costs & suitability. Gaining access to the riverbed over private land is often a constraint that the contractor must work through. The Gravel Authorisation process discussed above is an incentive to extract from those areas because the costs associated with gaining that permission is significantly less than a resource consent.

7. Do you finance gravel extraction from aggrading rivers from target rate scheme or general rate funding as opposed to relying on commercial gravel extractors? If so, is this a significant and costly activity for your schemes/rating?

No – we rely solely on commercial extraction but recognise incentives may be needed in problem reaches of key rivers such as Blands Reach – Ashburton North Branch.

8. Are you facing 'gravel banking' by commercial extractors and if so, how are you dealing with this?

Yes – this was a problem in all rivers before the Regional Gravel Management Strategy – and remains a problem with larger & strategically located rivers such as the Ashley & Waimakariri which have long term large volume consents. The policies in the Land and Water Regional Plan are now giving stronger direction to consents officers to only issue short duration consents to ensure the gravel is taken over shorter durations (in alignment with our Gravel Management Strategy). Copy of policy 4.95A is below. The Gravel Authorisations are also ensuring gravel banking does not occur due to their short durations.

The Regional Plan now directs that sections 124A to 124C of the RMA do not apply to gravel extraction in Canterbury. This means that upon the expiry of a gravel consent, the un-used portion of the original allocation is now available for any party to apply to take, rather than the original consent holder having first priority to that resource. This incentivises extractors to take their full allocation within their consented timeframe, or else they may lose that allocation.

Copy of Policy from the Land and Water Regional Plan:
4.95A *Effective management of rivers for flood control purposes is enabled, and erosion of riverbeds, banks and structures from the effects of gravel extraction is minimised, by aligning the duration and volume limits in any resource consent granted for the extraction of gravel with those set out in the Canterbury River Regional Gravel Management Strategy.*[l]

9. Do you have any documentation or information on the different Acts that govern your river management responsibilities (eg RMA, Soil Conservation and Rivers Control Act, Crown Minerals Act, Land Drainage Act etc.)?

10. Do you have any relevant legal opinions on gravel management that you are willing to share?

11. Have you experienced any 'interface' issues between your gravel extraction permitting regime and District Councils' earthworks and other district plan consenting requirements?

Yes. Poorly defined "interface" depending on legal definition of riverbed. Some district plans trigger land use consents from both Regional & District Councils.

12. Do you have any defined process or agreements with TAs in place for identifying the lateral extent on a floodplain that your gravel permitting process applies to?
No – dealt with case by case if an issue.

13. How do you measure/monitor gravel extracted for consent compliance monitoring and gravel royalty recovery?

Every resource consent and gravel authorisation have conditions about measuring and reporting the volumes taken. Volumes must be recorded and then submitted to us on a quarterly basis. The Compliance Monitoring branch of the Council then checks these figures against activity seen on site. Larger resource consents also require bed level surveys to demonstrate extraction.

As noted above, the gravel management fee is charged on the total volume irrespective of what is actually extracted therefore the reporting of volumes taken is not important for the fee collection. The fee may be invoiced upon granting of the consent/authorisation or smaller amounts are invoiced through the duration of the consent/authorisation.

14. Is there any other information relating to gravel management that you think is relevant? No

Darryl Lew
14 April 2016

Environmental Management Services

Hawkes Bay Riverbed Gravel Management Study
Regional Council Benchmarking Questions
Greater Wellington regional Council

GWRC FP response 19 May 2016 GWRC File Ref FMGT-7-91

1. How are gravel extraction permits administered in your region (eg do you as the river engineering department administer and issue the permits or does your resource consent department do this; do you hold the permits yourselves or are they held by individual extractors etc.)?
   GWRC Flood Protection (FP) currently has resource consents to extract gravel from all rivers in which operative river schemes exist and are administered by GWRC. The volume, location and timing vary depending on the specific river. GWRC FP then issues licences to individual contractors to extract a certain volume for a specified period.

2. If you hold the gravel consents yourselves, did you prepare a resource consent application, and if so, can you supply a representative example?
   Current applications are generally a "consent suite" package which includes gravel extraction activities in addition to all other consented river management activities. GWRC are using consultants to help prepare these.

3. Within flood control scheme areas, do you use gravel extraction as a tool to maintain the flood conveyance capacity of the river, and if so how effective is this approach.
   Gravel is extracted either as a tool to manage the river alignment or to maintain flood capacity more generally. FP manages the gravel extraction in line with regular bed level surveys which identify areas of aggradation/degradation and compare it to an optimum bed envelope. This approach is very effective in areas where both the needs of GWRC and contractors align. Gravel extraction close to urban areas or close to the end use (a roading project say) work very well. In remote reaches, it is difficult to find extractors.

4. What is the basis to your royalty charges for gravel and is this written down in a document? For instance are you relying on RMA s36 charging and what activity costs (eg cross section monitoring) do you on-charge to extractors?

Licences are issued by Flood Protection to contractors extracting under GWRC's resource consents.

In the Western part of the region, licence fees are charged to reflect the reasonable costs associated with:

- Supervision and administration
- Obtaining resource consents
- A contribution to the regular cross-section surveys

In reality, these licence fees only cover a portion of the costs.

In the Wairarapa, a gravel royalty is charged in addition to a licence fee. The intent of the gravel royalty is to cover the reasonable costs listed above and also to generate a surplus which is invested back into the management of the river schemes. The royalty is charged under a licence issued in 1972 by the Commissioner of Crown Lands. The revenues vary from year to year, but at the time of writing around $90,000 is allocated to Wairarapa river schemes each year.

5. Do you have a 'Gravel Management Plan' or an equivalent type of document that guides your activities in this area; and if so, can you supply a copy?
   We have engaged a consultant (Laddie Kuta) on a secondment basis to assist us with our gravel analysis process and to develop a gravel strategy.

6. How do you direct extractors to extract gravel from aggrading rivers/reaches that are further away or of poorer quality from more readily available or better quality sources?
   This is difficult. Generally there has to be a commercial need to extract and it is hard to make contractors use sources that are not viable for their operation. Haulage costs are generally the most significant cost. Where we charge royalties (Wairarapa rivers) the royalty charge is waived as incentive to attract extraction, however in comparison to haulage costs from a commercially unfavourable site the waiver of royalties is basically insignificant. Some larger contractors have land-based extraction options available.

7. Do you finance gravel extraction from aggrading rivers from target rate scheme or general rate funding as opposed to relying on commercial gravel extractors? If so, is this a significant and costly activity for your schemes/rating?
   To date GWRC has not funded gravel extraction but this is a possibility. There are significant budget and river management issues to consider.

8. Are you facing 'gravel banking' by commercial extractors and if so, how are you dealing with this?
   No. This problem is not an issue as there is generally far more material available than is licenced. We sometimes have issues with smaller contractor's obtaining licences and then not winning the roading contract (for E.g). We try and minimise this by continual monitoring

of the licence holders and talking to them if there has been little or no extraction. We also issue shorter term licences.

9. Do you have any documentation or information on the different Acts that govern your river management responsibilities (eg RMA, Soil Conservation and Rivers Control Act, Crown Minerals Act, Land Drainage Act etc.)?
   RMA, SCRCA, LGA mainly. Functions of Regional Councils (catchment boards) defined in all three, we are empowered to set up schemes and carry out works under the SCRCA but everything we physically "do" must be permitted or consented under the RMA.
   We also use Floodplain Management Plans and Asset Management Plans to help define the focus of our activities.

10. Do you have any relevant legal opinions on gravel management that you are willing to share?
    This is a very broad question but if you have something particular in mind then we'd be happy to look into it.

11. Have you experienced any 'interface' issues between your gravel extraction permitting regime and District Councils' earthworks and other district plan consenting requirements?
    Generally not in regard to gravel extraction. However, there is potential competition for extractors. If we make things too difficult or unattractive then many operators might move from our river based extraction to land based DC aligned areas.

12. Do you have any defined process or agreements with TAs in place for identifying the lateral extent on a floodplain that your gravel permitting process applies to?
    River Corridors are defined in most District Plans in our Region and gravel extraction/river management activities are permitted by TA planning instruments. River corridors are defined through the FDFMP process.

13. How do you measure/monitor gravel extracted for consent compliance monitoring and gravel royalty recovery?
    Extraction volumes are self-recorded, and contractors are expected to submit extraction volumes as they extract. We regularly monitor and audit extraction operations to ensure correct volumes are being recorded.

14. Is there any other information relating to gravel management that you think is relevant?
    We are increasingly finding that we're not able to consider gravel volumes/levels in isolation and must consider them in relation to overall river management (eg. how design channels and buffers work). We are addressing this through Floodplain Management Plans currently in development and review, and through our Gravel Strategy. Check back with us in six months to see how we're getting on.

Environmental Management Services

Hawkes Bay Riverbed Gravel Management Study
Regional Council Benchmarking Questions
Horizons Regional Council Response

1. How are gravel extraction permits administered in your region (eg do you as the river engineering department administer and issue the permits or does your resource consent department do this; do you hold the permits yourselves or are they held by individual extractors etc.)?
   Gravel extraction is managed using the consent process and administered by our resource consent department. For some river schemes we internally hold 'global' consents for all gravel extraction and manage the extraction locations with contractors. In other schemes gravel extraction consents are held both by individual contractors and by ourselves for different reaches of the river.

2. If you hold the gravel consents yourselves, did you prepare a resource consent application, and if so, can you supply a representative example?
   Yes resource consent applications are made for river operations gravel extraction. An example is attached to this email.

3. Within flood control scheme areas, do you use gravel extraction as a tool to maintain the flood conveyance capacity of the river, and if so how effective is this approach.
   Yes we do. Gravel extraction is used effectively as both a tool to maintain flood conveyance and to influence channel alignment

4. What is the basis to your royalty charges for gravel and is this written down in a document? For instance are you relying on RMA s36 charging and what activity costs (eg cross section monitoring) do you on-charge to extractors?

We charge RMA Section 36 fees on all consented gravel extraction. These fees are calculated from the reported volumes of gravel extracted and the fee is specified in Horizons' Long Term Plan and Annual Plans (e.g. currently $0.41/m3 extracted). These charges allow for research into sustainable gravel allocation, e.g. tracking of gravel volumes and the movement of gravel through river systems. Section 36 charges are payable by all resource consent holders and contribute (30%) to the Council's costs for its surface water, ground water and gravel resource research and monitoring programmes. All consent holders (incl. Horizons) report on the volumes they extract monthly and are charged from these volumes. For the Horizons consents, we usually pass the charge on to the contractor who extracts and utilises the gravel.

We have two further (rarely used) charges related to gravel extraction for consent holders in specific reaches. One type is specified in consent conditions of two consents and was set up during the consent process to offset the environmental effects of the extraction (the revenue goes into river restoration works via a trust). The other type was related to extractions from the degradation reach of the Rangitikei River. This charge is considered a financial contribution under Section 108 of the RMA to mitigate adverse effects on flood protection and erosion control works. The charge is set in Horizons' annual plan.

5. Do you have a 'Gravel Management Plan' or an equivalent type of document that guides your activities in this area; and if so, can you supply a copy? The One Plan, Horizons' consolidated regional policy statement and regional plan, provides a policy and regulatory framework for gravel management. Chapter 17, Activities in artificial watercourse, beds of rivers and lakes, and damming, is the principle chapter. Policy 17-3, Gravel extraction, includes reach-specific gravel extraction limits (in Table 17.1). Rules 17-6 and 17-7 are specifically focused on managing the effects of gravel extraction; if the extraction is proposed in a rare, threatened or at risk habitat it would be regulated by Rules 13-8 or 13-9. Extraction carried out in flood control and drainage scheme reaches identified in the One Plan[1] is permitted, if carried out by or on behalf of Horizons in accordance with the Environmental Code of Practice for River Works; any other extractor would need consent.

6. How do you direct extractors to extract gravel from aggrading rivers/reaches that are further away or of poorer quality from more readily available or better quality sources? This is an on-going problem. We are often unable to encourage contractors to extract gravel from priority areas where distance and quality are a factor.

7. Do you finance gravel extraction from aggrading rivers from target rate scheme or general rate funding as opposed to relying on commercial gravel extractors? If so, is this a significant and costly activity for your schemes/rating? No we generally do not fund gravel extraction as a scheme activity. However, given low demand in some areas and localised aggradation this could be reviewed in the future.

8. Are you facing 'gravel banking' by commercial extractors and if so, how are you dealing with this? In the past some gravel banking has occurred and this has been solely their commercial decision and not influenced by ourselves.

9. Do you have any documentation or information on the different Acts that govern your river management responsibilities (eg RMA, Soil Conservation and Rivers Control Act, Crown Minerals Act, Land Drainage Act etc.)?

[1] Which do not include the schemes that came into existence since the One Plan was notified.

10. Do you have any relevant legal opinions on gravel management that you are willing to share?

Have you experienced any 'interface' issues between your gravel extraction permitting regime and District Councils' earthworks and other district plan consenting requirements? No I am unaware of any in river issues here. We have had an instance where gravel extraction from a river berm area required a district council consent. Horizons does make submissions on proposed District Plan provisions regulating gravel extraction, in particular if they are likely to contradict or duplicate One Plan provisions.

11. Do you have any defined process or agreements with TAs in place for identifying the lateral extent on a floodplain that your gravel permitting process applies to?
    Not that I am aware of.

12. How do you measure/monitor gravel extracted for consent compliance monitoring and gravel royalty recovery?
    This is largely managed on an honesty system with contactors forwarding returns either directly to our consents monitoring department for their own consents or to the river operations department for gravel takes managed under Horizons consents.

13. Is there any other information relating to gravel management that you think is relevant? The latest gravel mining trends operated by large gravel extractors on private land is limiting the ability of river operations to effectively, and cost efficiently, utilise gravel extraction for channel management.

Darryl Lew
14 April 2016

Environmental Management Services

Hawkes Bay Riverbed Gravel Management Study
Regional Council Benchmarking Questions

1. How are gravel extraction permits administered in your region (eg do you as the river engineering department administer and issue the permits or does your resource consent department do this; do you hold the permits yourselves or are they held by individual extractors etc.)?

   There are three options for gaining permission to excavate gravel from rivers in the Bay of Plenty:

   - ***As a permitted activity under the operative Regional Gravel Management Plan (any member of the public can extract 100 m3 per site per annum).***
   - ***By obtaining a gravel allocation to undertake gravel extraction on behalf of the Regional Council (through a permitted activity, no time or quantity restrictions apply within the river schemes).***
   - ***Under resource consent.***

   For a few rivers, the Rivers & Drainage Section of the Bay of Plenty Regional Council (BOPRC) hold consents on-behalf of the Rivers Schemes to enable gravel to be removed for river control purposes. For these rivers a permit can be issued to allow extraction under the BOPRC consent.

   Gravel extraction consents are also held by external contractors and local iwi. Council's Consents Section issue the consents while the Rivers & Drainage Section determines the extraction locations and quantities permitted.

2. If you hold the gravel consents yourselves, did you prepare a resource consent application, and if so, can you supply a representative example?

   Copy of resource consent 61321 attached. Issue date was 2009. Copy of application can be supplied on request (this is an old application and more recent ones may be obtained from other Councils).

3. Within flood control scheme areas, do you use gravel extraction as a tool to maintain the flood conveyance capacity of the river, and if so how effective is this approach.

   Yes gravel extraction is used by BOPRC as an effective tool to maintain the flood conveyance capacity as well as the integrity and dynamics of the rivers. Excavation sites have proven to result in cleaner beaches that allow gravel to migrate through the river systems more effectively.

   Some rivers have a mean bed level envelope to manage bed levels within a minimum and maximum level.

4. What is the basis to your royalty charges for gravel and is this written down in a document? For instance are you relying on RMA s36 charging and what activity costs (eg cross section monitoring) do you on-charge to extractors?

   Gravel management fees are in accordance with section 36 of the RMA and are set out in under the relevant resource consents. The charges cover administration, monitoring (cross section survey) and supervising of gravel extraction. The current fee is $0.90/m3 and is charged on monthly returns supplied by the contractors etc.

5. Do you have a 'Gravel Management Plan' or an equivalent type of document that guides your activities in this area; and if so, can you supply a copy?

   BOPRC has had an operative Regional River Gravel Management Plan since 2001 which governs the extraction of gravel from rivers and stream with the Bay of Plenty excluding extraction in the coastal marine area.

   The plan can be view on Council's website: http://www.boprc.govt.nz/knowledge-centre/plans/regional-river-gravel-management-plan/.

6. How do you direct extractors to extract gravel from aggrading rivers/reaches that are further away or of poorer quality from more readily available or better quality sources?

   Gravel allocations are considered, issued and managed through the Rivers & Drainage Section at BOPRC.

   Obtaining a gravel allocation allows the extractors to operate as a permitted activity under the Gravel Plan and/or resource consent.

   The Natural Environmental Regional Monitoring Network (NERMN) Report on River and Stream Channel Monitoring provides Council with:

   - ***Data to identify the quantity of gravel available for extraction and the present extraction rates.***
   - ***Data to allow setting maximum annual extraction rates based on river control and river maintenance criteria.***
   - ***Data which Council can meet its statutory obligations and effectively manage the region's resources.***

7. Do you finance gravel extraction from aggrading rivers from target rate scheme or general rate funding as opposed to relying on commercial gravel extractors? If so, is this a significant and costly activity for your schemes/rating?

   No extraction is carried out under funding from rates (target or general).

8. Are you facing 'gravel banking' by commercial extractors and if so, how are you dealing with this?

   No, gravel banking is not an issue at present. Feedback received from contractors is that the quality of gravel excavated from waterways in the Eastern BOP is of mixed quality and only suitable for certain products. The overriding factor for contractors is the proximity to work suits i.e. transport costs.

9. Do you have any documentation or information on the different Acts that govern your river management responsibilities (eg RMA, Soil Conservation and Rivers Control Act, Crown Minerals Act, Land Drainage Act etc.)?

   The principal statue which the environmental effects of gravel excavations are managed is the RMA. Other relevant statues are the Soil Conservation and Rivers Control Act 1941 under which BOPRC undertakes flood control works, and the Crown Minerals Act 1991 which governs the excavation of gravel from Crown owed riverbeds. This is set out under the Statutory Framework of the Regional Gravel Management Plan.

10. Do you have any relevant legal opinions on gravel management that you are willing to share?

    Legal opinion was obtained around using Rule 3 from the Water and Land Plan in issuing allocations. Can be shared once approval obtained.

11. Have you experienced any 'interface' issues between your gravel extraction permitting regime and District Councils' earthworks and other district plan consenting requirements?

    This is something Council staff are mindful of when issuing allocations under permitted rules but no problems have arisen to-date.

12. Do you have any defined process or agreements with TAs in place for identifying the lateral extent on a floodplain that your gravel permitting process applies to?
    No

13. How do you measure/monitor gravel extracted for consent compliance monitoring and gravel royalty recovery?

    Cross section surveys and monthly returns received by extractors.

14. Is there any other information relating to gravel management that you think is relevant?

- ***Gravel Management Guidelines http://www.boprc.govt.nz/knowledge-centre/our-library/guideline-publications/***

- ***NERMN River and Stream Channel Monitoring Programme 1990-2010 (Engineering staff are currently preparing the next review).***

- ***Regional Water and Land Plan http://www.boprc.govt.nz/knowledge-centre/plans/regional-water-and-land-plan/***

Darryl Lew
14 April 2016

Appendix E. Proposal from NIWA to MBIE

2016 Contestable Fund

Research Programmes Template (full proposal)

Proposal Glossary

Word/acronym/ abbreviation/te reo Māori	**Full description/translation**
Abrasion	Process by which gravel particles reduce in size or break into smaller particles as they are transported down a river.
Aggregate	Aggregate is the collective term for gravel, sand and stone.
Allocation	The volume of gravel that may be taken by resource consent holders/written authorisation holders as defined by the conditions of their consent.
Bar	A deposit of sediment (sand/gravel) within a river channel.
Bedload	Particles of aggregate carried by the natural flow of a waterway on or immediately above its bed.
Channel form	The shape of a river channel including its width and depth, whether it is single thread or braided and the presence and size of features such as bars, riffles and pools.
Delft3D	Open source 2D and 3D hydraulic and morphological modelling software.
Ecosystem	A system formed by all plants, animals and micro-organisms in a particular area interacting with the non-living physical environment as a functional unit.
GCD software	Geomorphic Change Detection software. Software package developed to map and analyse change occurring between repeat topographic surveys.
GIS	Geographic Information System. Software designed to manage, analyse and present/map spatial and geographic data.
Good management practice	An umbrella term to describe industry led programmes promoting practice changes to improve industry performance against particular or agreed objectives.
GRATE	Gravel Routing And Textural Evolution model: 1D morphological modelling software developed by NIWA with specific functionality for modelling of gravel bed and braided rivers.
Gravel	Includes all coarse and fine materials sourced primarily from river deposits.
Gravel/sand transition	The location on some rivers where the river substrate changes from gravel to sand, usually associated with a reduction in slope.
Hapū	Sub-tribe.
Hydraulic model	Numerical model of water depth and flow velocities in a river.
IPENZ Rivers Group	A technical group, affiliated to the Institute of Professional Engineers New Zealand, comprising river engineers and managers.
Iwi	Tribe.
Kaitiaki	Guardian.
Kaitiakitanga	The exercise of guardianship.
LiDAR	Light Detection And Ranging. Aerial laser scanning technology widely used to survey topography.
Lithology	Physical characteristic of the rock type of individual gravel grains.
MMS	Mobile Mapping System. Mobile laser scanning system using similar technology to LiDAR but at a smaller scale and lower cost.
Morphological model	Model of river flow coupled with sediment transport to simulate evolution of channel bed levels and substrate size.
NPS-FM	National Policy Statement – Freshwater Management

NSC	National Science Challenge.
Over-extraction or over-allocation	A situation where either: values associated with current gravel resource use cannot be sustained to a minimum standard if all resource consents are fully exercised; and/or the total allocation exceeds the total available volume if all consents are fully exercised.
Riffle	A small rapid within a river or stream where water is flowing over shallow rocks.
Riparian	Relating to the bank of streams, rivers and lakes – riparian vegetation is vegetation found on the banks of a river, stream or lake.
Shear-stress	Streamwise force exerted by flowing water on to the river bed which drives bedload transport.
Step-length	The average distance travelled by gravel particles while entrained during a flood.
Substrate	River bed material (i.e. gravel).
Te Kūwaha	NIWA's Centre for Māori Environmental Research.
Topo-bathy LiDAR	A green-laser airborne LiDAR system capable of surveying shallow underwater topography as well as dry-ground topography in a single pass.

Statements

Executive Summary

The goal of this research is to facilitate sustainable extraction of gravel aggregate from New Zealand (NZ) rivers, supporting decision makers by using excellent science to reduce uncertainty relating to gravel supply rates and the effects of extraction.

The key research aims are:

1) Developing methods to reliably quantify the supply of gravel from upstream at any point on a gravel-bed river.
2) Developing more reliable numerical morphological models to quantify the spatial and temporal effects of gravel extraction on river bed levels, river morphology, and downstream gravel transfer.
3) Applying these models to explore the broad scale, long term consequences of common, generic gravel extraction scenarios on bed levels and gravel delivery to the coast.
4) Quantifying effects of gravel extraction on riverine physical habitat and ecosystems.
5) Supporting Māori engagement in decision making processes relating to gravel extraction by ensuring regulators and industry are aware of Māori values relating to gravel extraction and ensuring Māori have an understanding of the potential environmental effects of gravel extraction.
6) Developing guidelines and tools for all stakeholders to enable sustainable gravel extraction.

The benefits to NZ will be to support economic growth by allowing access to gravel to meet community and industry needs, whilst protecting environmental values and providing for the cultural and spiritual values of rivers. Better understanding of the sustainable supply of gravel will ensure gravel is not ‘over-extracted’, potentially leading to an increase in river-channel and coastal erosion, and that gravel is not ‘under-extracted’, potentially leading to a reduction in flood protection. Better understanding of the ecological effects of gravel extraction, such as changes in habitat for fish, invertebrates and wading river birds, will ensure extraction is planned and managed in a more ecologically sustainable manner.

In recognition of the kaitiaki responsibilities of iwi and hapū, this research involves deliberate engagement with and input from Māori. It makes use of existing relationships with Māori and has been designed around a two-way flow of information; encouraging Māori to examine their values relating to gravel extraction and share these with other stakeholders, and providing Māori with greater understanding of broader potential effects of gravel extraction to support kaitiakitanga. This research also involves deliberate engagement with the gravel extraction industry and with regional councils to achieve a mutually beneficial management framework and ensure consistency with regional policy statements, proposed or operative regional plans that manage rivers, and the National Policy Statement for Freshwater Management.

This research will make use of leading-edge technology, including mobile topographical mapping systems and bathymetric LiDAR, and collaboration with international experts to develop a more reliable approach to quantify the supply of gravel from any point in any river. The research team comprises NZ’s leaders in morphological modelling, and will expand this capability in the course of the research. The research draws on national expertise in the field of braided river ecology to quantify the effects of gravel extraction on river biota.

Public Statement

River gravel is an important source of aggregate for roading and construction. Regulatory authorities, e.g., regional councils, currently issue consents for gravel extraction under the Resource Management Act in consultation with iwi. However, it is difficult to determine the sustainable volume of gravel that can be taken from a river due to uncertainties regarding gravel delivery from up-river, the effects of extraction operations on river-channel stability, ecosystems and cultural values, and also on gravel delivery to coasts vulnerable to erosion.

Our research aims to ensure sustainable gravel extraction by:

1. Improving methods to quantify how much gravel is available at any point on a river;
2. Improving models that predict effects of gravel extraction on river bed levels and transport rates;
3. Modelling the effects of typical gravel extraction scenarios on river bed levels and rates of gravel transfer, and related effects on channel flood capacity and erosion;
4. Improving understanding of the effects of gravel extraction on river birds, invertebrates and fish;
5. Gathering information on Māori values relating to gravel extraction;
6. Sharing the results with key stakeholders, including the gravel extraction industry, regional councils and iwi.

Our research will consult with these stakeholders to foster a shared understanding of the processes and issues around gravel extraction. The findings will enable gravel extraction to be targeted to where environmental, cultural, and economic benefits are optimised. The research will, for the first time in NZ, use bathymetric LiDAR and mobile laser systems for surveying channel topography and gravel volumes.

Impact Criteria

Benefit/s to New Zealand

Aggregate resources are a critical component of NZ's economy (transport and construction sectors), contributing more than $400M in value in 2011 (~ ⅓ of the total value of NZ's commodity production [1]). River gravel is an important source of aggregate as it is often close to market, easy to extract, and offers well graded material. The Resource Management Act and existing guidelines for managing impacts [e.g., 2] provide a structure for managing river gravel extraction, but decision making is hindered by significant uncertainty around sustainable extraction rates. Key uncertainties lie with the natural re-supply rates of river gravel from up-river and the potential impacts of gravel extraction on river ecosystems [3, 4], river and coastal erosion, and cultural values. This uncertainty leads regional councils to limit extraction consents to conservative volumes and short durations, which increases commercial risk to industry and costs to end-users [5], and creates the 'flipside' risk that extraction essential to maintain flood protection may not attract an operator [6].

Our research delivers strongly on the Investment Plan [7] by providing improved understanding, methods, guidelines and tools to enable sustainable and efficient use of the natural aggregate resource, hence reducing costs and increasing sustainability of the construction and transport industries. In addition to this direct economic benefit, the reduction of river and coastal erosion and flood risks will reduce costs from hazard events. Intangible environmental benefits will arise from provision of better tools to monitor and manage regional gravel resources, and the ability to set objectives for riverine values and define confident limits on gravel use in planning instruments, in keeping with the NPS-FM [8].

Ngati Kahungunu and Ngāi Tahu representatives both identified that Māori have a feeling of "helplessness in terms of having any influence on extraction" [9, 10] as well as concern regarding the impacts of gravel extraction, specifically on mahinga kai and taonga species but also from the *Taiapo* perspective of environmental guardianship. They also highlighted that there is a need for iwi to better understand the ecological and social impacts of gravel extraction as they currently struggle to make informed responses when they are asked to input into the consenting process. The proposed research will capture tangata whenua values in guidelines, reducing the negative cultural impacts of extraction, and empower Māori to better exercise their rights and responsibilities of kaitiakitanga by better and more confidently engaging in extraction consenting decisions.

The tools and understanding created by this research will have wider benefits through their capability to assist river channel management around multiple issues (e.g., flood conveyance, river-flow and sediment load alteration associated with upstream water-use and storage schemes, effects of climate change, and downstream effects of catastrophic natural events such as earthquakes). The work will also provide international benefits through improved and transferrable knowledge and tools for river gravel management. It aligns with Programme 3 of the Biological Heritage NSC because it evaluates the ecological impacts of gravel extraction in sensitive braided river systems.

Implementation Pathway/s

Key end-users/stakeholders associated with this research are the gravel extraction industry, local government, and Māori. The research will benefit these users by providing greater certainty in three key aspects: knowing how much gravel is delivered to extraction reaches; predicting long-term downstream impacts of extraction on river bed levels and gravel transfers; and effects of extraction operations on in-river biota and cultural values. This will be delivered to our end-users by way of improved methods, modelling tools, guidelines, and knowledge sharing.

Our implementation plan centres on early and targeted engagement with end-users by creation of a steering group involving regional council river managers, iwi representatives and representatives of the extraction industry. Input from the steering group will ensure the research is appropriately designed and targeted and the results are disseminated in the most useful way. This dissemination will include articles in industry newsletters, presentations to industry and local government workshops, presentations at hui, journal publications, and technical training seminars on models and GIS tools. A key mechanism for focussed knowledge transfer will be a good management practice guidance manual for industry, councils and iwi that will be published on NIWA, Aggregate & Quarry Association, and regional council websites. We will also transfer knowledge by engaging directly with regional councils and hapū during case-studies.

The research team has very strong existing relationships with regional council river managers through previous projects to address specific gravel management questions (Canterbury, Hawke's Bay, Waikato, Horizons-Manawatu) as well as through interaction via forums such as the River Managers Special Interest Group and IPENZ Rivers Group. The need for this research and its initial scope were developed in close collaboration with these contacts, so it is closely aligned to their needs. Their inputs will be essential to realise the benefits of this research and we have commitments of their "total support" for this research, including in-kind contributions through staff time and sharing data [11, 12]. We have also discussed the proposal with contacts in the gravel extraction industry (Aggregate and Quarry Association, Fulton Hogan) who are supportive of this research, particularly with respect to providing longer term certainty regarding gravel availability [5].

Our relationships with iwi are at an early stage but during discussions regarding this proposal they have confirmed that research into river gravel extraction would be valuable for Māori [9, 10], highlighted their areas of concern, and signalled their interest in "moving forward together with NIWA" on this research [13].

Vision Mātauranga outcomes will be achieved by engaging with iwi throughout the project: early, to identify values, during, via use of iwi teams to collect field data, and at the end, by communicating findings and including Māori values in guidance documents. To implement this, we will draw on NIWA's Centre for Māori Environmental Research, Te Kūwaha, who have very strong linkages throughout NZ and well established processes to engage with iwi. Also, an annual multi-stakeholder session will strengthen a collaborative management approach for the aggregate extraction research.

Impact Plan

The steps to deliver impacts benefits include: (1) Engaging with key stakeholders, including with the aggregate industry, regional councils, and iwi; (2) Developing new knowledge, methods and tools; (3) Applying these to case-study situations in collaboration with end-users; (4) Making data analysis tools (e.g., Geomorphic Change Detection (GCD) software to analyse river-channel surveys) and modelling tools (to predict long-term/downstream effects) available in the public domain, and running training in their use; and (5) Communicating results via guidelines, presentations, scientific papers, and workshops.

Early engagement with stakeholders will ensure focus on priority issues and values. In Year 1 workshops with extractors and councils, and hui with iwi, will share the research aims and get input on potential extraction scenarios, study reaches, issues of concern, and most effective delivery and presentation of results to promote uptake. In Years 2 and 3 we will provide regular progress updates to keep stakeholders engaged and informed and arrange active iwi participation in field data collection. Year 4 will focus on communicating the findings, improving tools for stakeholder use, and training. We will put significant effort into enhancing a toolkit (on GCD) to process remotely sensed data of river channels to monitor gravel stocks and transfers. This will be timely as several regional councils are in the process of switching from the traditional ground-surveyed, cross-section based approach of monitoring river bed-levels to use of remote-sensing (e.g., LiDAR) and are commissioning repeat surveys. Moreover, they will benefit from application of topo-bathy LiDAR, which we will use for the first time in NZ in this project.

The training workshops on methods application and modelling are a key implementation step, as full realisation of the impacts will occur beyond the research contract and will depend substantially on uptake by technical staff at regional councils and in the consulting domain.

Two years after contract completion we anticipate that:

- Modelling tools are being applied on a site-by-site basis to predict environmental effects of aggregate mining, and guidelines are being used to manage environmental effects.
- Cultural impacts are considered in all consenting decisions, and Iwi are engaged in the consenting process on an informed basis.

Five years after:

- Regional authorities are applying the methods and tools developed to process monitoring data, confidently set limits on sustainable extraction rates, and improve/update regional plans.
- Consents for river gravel extraction will be being issued for longer terms, enabling the industry to benefit economically from surety of supply of riverine aggregate.

Ten years after:

- Developments requiring aggregate are completed at less cost owing to surety of riverine supply.
- The physical and biological environments of river channels, and the stability of coastlines sensitive to supplies of river gravel, have not been significantly affected by aggregate mining.

Realisation of the benefits relies on uptake of the research by councils, iwi, extractors and consultants. By creating a formal project steering group and involving stakeholders throughout the project we mitigate the risk that they could become dis-engaged or that the developed tools will not meet their needs. Technical risk is addressed under Research Plan.

Excellence

Science

Reliable measurement of gravel load is essential for determining sustainable limits on river gravel extraction, yet a general method to do this has so far eluded the international science/engineering community. Gravel transport occurs during floods so the challenges for direct measurement are daunting, while estimation by bedload formula is notoriously uncertain. Finding a solution is a key priority flagged at recent international workshops.

Our primary research aim faces this challenge by developing a new field-based approach to measure gravel transport rates at the flood-event scale that is based on surveying morphological change. By using the latest remote-sensing technologies, we aim to resolve the size of trans-flood erosion and deposition patches and from these extract transport rate. Once proven, the method will be available for broad application internationally.

A key hypothesis is that we will find a relationship between patch size and how far gravel moves during floods (the 'step-length'). This could fail during very large floods when the change we survey only captures the net change from several accretion/erosion cycles. We will check this by using a 2D morphological model to undertake numerical experiments with large floods. Risk of incorrect model behaviour will be mitigated by calibrating the model to our field measurements during smaller floods. A further check on method reliability will be by working in study reaches with a zero-transport downstream boundary, so by measuring net reach volume change we can independently measure reach gravel inflow.

Having reliable measures of gravel transport rate at one location will enable calibration of morphological models (which use bedload transport formulae and so must be calibrated). This will "open the door" to using such models to predict downstream effects of extraction operations on river bed-level, form, and gravel delivery downstream, enabling assessment of effects on flooding, erosion, riverine physical habitat and ecosystems, and cultural values.

Thus our secondary research aims are to enable such predictions of effects based upon the use of numerical models by improving model capability and collecting field data about how extraction-induced effects on river morphology impact on other values.

For model capability enhancement, we will address sand-gravel mixtures, abrasion, and cross-channel shear stress and grainsize variation. We will then use the improved models to simulate a series of typical extraction scenarios.

For habitat and ecological effects we will compile evidence of effects and identify resilience by collecting new field data on geomorphic, ecological, and cultural effects at example extraction sites. The geomorphic data will be used to assess how extraction influences changes in physical habitat. The ecological campaign will capture spatial and temporal biotic responses to these physical changes. We will take a Māori-led approach to assess cultural values relating to gravel extraction. This will be the first time that physical, ecological, and cultural impacts of riverine extraction will have been studied together. The risks of inconclusive results will be mitigated by selecting study reaches with strong extraction 'signals' and monitoring for 1-2 years to capture natural restoration by floods and freshes.

Team

FIRST NAME	LAST NAME	ORGANISATION	ROLE/S	Yr 1 FTE	Yr2 FTE	Yr3 FTE	Yr 4 FTE
Alan	Grey	NIWA	Contact person	0.02	0.01	0.01	0.01
Jo	Hoyle	NIWA	Science leader	0.45	0.50	0.64	0.63
Murray	Hicks	NIWA	Key researcher	0.25	0.08	0.11	0.16
Richard	Measures	NIWA	Key researcher	0.30	0.25	0.46	0.52
Jeremy	Walsh	NIWA	Key researcher	0.27	0.15	0.16	0.21
Michelle	Greenwood	NIWA	Key researcher	0.18	0.19	0.18	0.24
New	Scientist	NIWA	Early career researcher	0.16	0.24	0.26	0.16
Jochen	Bind	NIWA	Key individual	0.25	0.33	0.38	0.15
Mandy	Home	NIWA	Other	0.09	0.06	0.05	0.04
Jon	Tunnicliffe	University of Auckland	Other	0.05	0.05		
Masters	Student	University of Auckland	Student	0.5	0.5		
Damia	Vericat	University of Lleida, Spain	Other	0.25	0.25	0.05	0.05
Joe	Wheaton	Utah State University,	Other			0.2	0.1
Dimitri	Lague	University of Rennes,	Other		0.25	0.25	0.1
Mark	Sanders	Ryder Consulting	Other	0.15	0.15		

Our team will use NZ's leading experts in sediment transport and modelling in gravel-bed rivers, draw in experts on riverbed ecology and riverine cultural values, and call in top international experts on gravel-bed river surveying.

Science Leader Dr Jo Hoyle is an emerging leader in the new field of eco-geomorphology. She has experience with river channel surveys, hydraulic modelling, and the connections between channel form and processes and in-stream biota, as well as practical experience as a river asset manager and strong links to the IPENZ Rivers Group. Key researcher Dr Murray Hicks, who will support the Science Leader, led a team that pioneered use of aerial digital photogrammetry and LiDAR to survey change in large braided rivers [14, 15]. Murray leads NIWA's Core-funded Sustainable Water Allocation Programme, which collaborated with an international consortium to survey and model the Rees River, Otago [16, 17]. He has published widely on gravel-bed rivers and has advised regional councils on gravel budgets and aggregate extraction. In 2013 he received the IPENZ Arch Campbell Award for services to river engineering in New Zealand.

Key researcher Richard Measures is a 1D-3D river hydraulic and morphological modeller, an active contributor to the international open-source model Delft3D ("2012 Delft3D Developer of the Year" award), and applied NIWA's GRATE (Gravel Routing And Textural Evolution) 1D morphological model to assist ECan and HBRC [18, 19] with gravel extraction planning including training HBRC staff in model use. Key researcher Jeremy Walsh develops the code for the GRATE model. Key researcher Dr Michelle Greenwood, a river ecologist specialising in disturbance events, is another emerging leader who has expertise in braided, gravel-bed river ecosystems, and will investigate the effects of extraction on river biota.

Key individual Mandy Home will lead the Māori engagement aspects. Mandy is from Ngāi Tahu and is a member of NIWA's Te Kūwaha team, which has extensive experience with iwi engagement. Key individual Jo Bind, an expert in geospatial analysis, also manages NIWA's new Mobile Mapping System (MMS), which will be a key instrument for collecting the high resolution topographic data required for this project. Dr Mark Sanders (sub-contractor) brings a background in wading river birds of NZ gravel-bed rivers. The University of Auckland (sub-contractor) contributes a Master's student and co-supervisor Dr Jon Tunnicliffe, who has experience in gravel extraction issues in Hawke's Bay.

We have commitments from three exciting international collaborators, each world-leaders in their fields. Dr Dimitri Lague is the scientific director of the green-laser, topo-bathy airborne LiDAR instrument that we will be sourcing from France for this research [20]. Dr Damia Vericat, a previous collaborator [21], currently leads a project aimed at coupling channel morphodynamics and ecological diversity in Spanish rivers suffering major alterations due to gravel extraction [22] and has begun developing the concept of gravel transport step-length estimation off maps of morphological change [T8]. Dr Joe Wheaton brings experience in river restoration, monitoring and modelling riverine habitats, and is co-developer of the GCD software [24, 25] that we plan to further develop in relation to gravel extraction during this project.

Resources

Our research requires rapid, accurate (±10 cm) and high resolution (> 1 pt/m^2) repeat surveys of channel topography to map erosion and deposition from flood events and to capture changes in in-stream physical habitat. For this we intend using two leading-edge technologies: a mobile mapping system (MMS) and topo-bathy LiDAR. Use of these underpins the proposed morphological approach to quantifying gravel transport, which would be impossible or prohibitively expensive otherwise.

NIWA is currently purchasing a 'LiDAR USA Scanlook 2.0' MMS, a miniaturised LiDAR scanner integrated with GPS and an inertial reference unit (IRU). It is ideally suited to rapid surveying of the dry parts of river banks and beds between floods; its small size and weight allowing deployment on a range of platforms (e.g., 4WD vehicle, backpack or jetboat mounted for surveying smaller areas or drone/helicopter). The scanner's array of 32 lasers are spread across a 40 degree field of view, which minimises shadowing effects caused by vegetation and other physical obstacles. It achieves resolution and accuracy higher than aerial LiDAR, which sets the accuracy benchmark for our study requirements but is also more expensive to deploy. The novel use of MMS technology for river bed surveying in this project will develop robust operating and data processing procedures enabling greater uptake of this powerful tool for river bed monitoring in New Zealand and internationally.

The Universities of Rennes and Nantes (France) purchased an 'Optech Titan' topo-bathy LiDAR in 2015. Deployed from a plane or helicopter, the instrument uses a green laser to survey submerged (down to 5-10 m depth) and dry-land topography at very high resolution and precision (20 pts/m^2, ±10 cm vertical accuracy) and competitive cost compared to existing techniques (e.g., sonar). With such an instrument, it is now possible to rapidly obtain a complete description of fluvial environments (topography, bathymetry, vegetation cover) over wide areas (> 100 km^2) in a single pass. Only a few topo-bathy LiDAR instruments are available in the world, and none in NZ. Our collaborator Dr Dimitri Lague is the scientific director of this instrument and has expressed his willingness to work with the research team to operate it in NZ for this project (as well as for other deployments currently under discussion) [20]. The Rennes/Nantes instrument, with Dr Lague's involvement, offers the huge advantage that it can be used at relatively low cost, since the main operational costs are restricted to flight hours (a light aircraft can be used) and post-processing costs. Its use in our project will be the first deployment of a topo-bathy LiDAR in NZ rivers. Over the next decade, we see this becoming the technology of choice for river channel and gravel management surveys, and so this project will play a key role in introducing it and developing its use to NZ river management. Since this will not be available until early 2018, we utilise our MMS until then.

Other special NIWA resources to be used include a remote-control mini-jetboat and a quadcopter drone (for securing aerial imagery, MMS deployment). In the unlikely event of MMS or topo-bathy LiDAR breakdown, we will use structure-from-motion based photogrammetry-derived dry river-bed topography using imagery collected with NIWA's camera-equipped drone.

Methods

Research Aim 1

Research Aim 1 is to develop a new 'morphological' approach to measure gravel transport rates based around high-resolution surveys of erosion and deposition caused by high-flow events. We will work at study reaches in a large braided river (Waimakariri, Canterbury) and a semi-braided river (Ngaruroro, Hawke's Bay). These rivers have been selected because they have gravel/sand transitions at their downstream ends plus extensive historical channel-survey datasets and extraction records - so their transport rates are already known with certainty [26, 27]. In each study reach we will:

1. Use either topo-bathy LiDAR or a combination of a MMS with boat- and image-based bathymetry mapping to survey changes in topography following a series of flood events [15, 28, 29].
2. Map and compute volumes of erosion and deposition following each flood event using GCD software, which separates real erosion/deposition from 'noise' created by survey error. Until the topo-bathy LiDAR arrives in 2018, higher survey error in wetted channels will be mitigated by focussing on erosion patches, which tend to be thicker and hence are easier to detect above survey error.
3. Measure average gravel 'step-length' (distance travelled) during different sized flood events using radio-tagged tracer particles.
4. Correlate observed step-length with size characteristics of erosion and deposition patches to create a step-length predictor (so that in future applications of the method patch size characteristics from mapped geomorphic change can proxy for step-length).
5. Combine step-lengths with erosion/deposition patch volumes to compute event gravel transport rate.
6. Set up a 2D morphological model (DELFT3D) of the study reach and, once calibrated off the field measurements of erosion and deposition, use this to numerically investigate the relationship between step-length and erosion/deposition patch dimensions. This step has been included as the model can simulate floods of any size, mitigating the risk that following large floods the effect of multiple erosion/deposition cycles may increase uncertainty associated with field measurements of erosion/deposition volumes.
7. Disaggregating the event-averaged gravel transport results into an instantaneous gravel bedload vs water discharge rating, and using this to calculate the long-term gravel transport rate through the study reach.
8. Validating the latter off the long-term average gravel transport rate determined independently from historical river surveys, extraction records, and observed zero gravel flux past the gravel-sand transition.

We will implement the new gravel transport rate approach as an extension to collaborator Joe Wheaton's GCD Arc-GIS module. This will include automated extraction of erosion patch volumes and length statistics, as well as a calculation of net change in reach gravel volume and its uncertainty. Including the new techniques in the GCD software provides fit-for-purpose tools directly relevant to gravel-extraction management which can be easily applied by consultants, regional council river engineers, or industry.

Research Aim 2

We will develop more reliable modelling tools by making significant improvements to existing numerical morphological modelling tools for predicting the effect of extraction on river bed-levels, substrate size grading, and downstream delivery of sand and gravel. This will involve:

1. Using the open source Delft3D morphological model in 2D mode (high resolution, computationally intense, suited to reach-scale modelling over individual flood time-

scales) to parameterise 1D models (low resolution but able to simulate decadal to century scale channel evolution over 100+ km of river), particularly for incorporating spatially-distributed shear stress and bed-material grainsize, which are key controlling factors for gravel transport (to be undertaken in the Waimakariri River, using the DELFT3D model built for Research Aim 1).

2. Validating cobble abrasion algorithms in NIWA's 1D GRATE model with field data on cobble size and lithology collected from a mixed lithology river (middle Tukituki River, which has a mixture of gravel lithologies of varying robustness, provides a long reach without new gravel sources, and already has an early-version GRATE model set up).
3. Co-supervising field- and modelling-based student studies to assess the effect of substrate manipulation on gravel mobility and channel form, such as 'bar-skimming' (selective extraction of coarser cobbles) and 'bar ripping' (mechanically breaking-up the bed-surface armour layer).
4. Capturing these improvements and effects of extraction operations into the GRATE model.
5. Writing updated technical and user manuals for the GRATE model and providing training courses on its use.

Research Aim 3

The improved GRATE and Delft3D models will be applied to several typical situations to characterise and quantify the effects of gravel extraction on riverbed levels, substrate size, and gravel exports downstream (e.g., to erosion-sensitive coasts), and river channel physical habitat (i.e., inundation, depth, substrate size, velocity, frequency of bed disturbance by floods). The typical situations will include: i) over- and under-extraction (short- and long-term, localised and widespread); ii) climate change effects on gravel supply and continuity of transfer; iii) episodic increases in supply from large storms and earthquakes; and iv) cumulative effects of extraction operations such as bar ripping and skimming. With i), an example question is the extent to which a temporary (say 10 year) phase of extraction 50 km upstream from the coast would diffuse downstream over time, thus smoothing-out the impact on the coastal sediment budget over a longer period. Typical situations and case-example rivers will be selected with input from the regional councils' River Managers Group.

Research Aim 4

Investigating the effects of extraction operations on river channel biota will involve:

1. Collating information from past studies and from stakeholder observations and records (e.g., extraction industry, DOC, regional councils, Fish & Game, iwi).
2. Identifying key process-links (e.g., altered riverbed topography promotes weed growth, changes in the frequency of invertebrate disturbance by floods, inhibited fish passage).
3. Undertaking controlled experiments (with un-extracted/extracted, upstream/downstream paired reaches) to measure the scale of effects of extraction works on physical habitat and biota responses and to determine the rate-of-recovery of physical habitat in extraction reaches through the natural work of floods and freshes – which will identify the physical resilience of channels to extraction operations.

The experiments will require: repeat morphological surveys using the same survey techniques detailed in Research Aim 1; Delft3D model setups for each survey, with physical habitat in relation to discharge being mapped in regard to habitat suitability (depth-velocity-substrate combinations), distribution of habitat units (riffles, runs, pools), and island characteristics (number, distance to bank – as a measure of river-bird vulnerability to predators). Biota responses will include repeat surveys of periphyton, invertebrates, birds, fish, and vegetation. Specific focus will be placed on key Mahinga Kai, linking with Research

Aim 5. The monitoring will span at least one full year to capture both extraction operations and floods/freshes.

Research Aim 5

Assessing the effects of extraction operations on Māori values will involve: i) gathering information kanohi-ki-te-kanohi (face-to-face) at hui; ii) employing a variation on the COMAR methodology to assess relationships between extraction-related channel changes and Māori values [30]. This work will be integrated into the field studies in Research Aim 4 to maximise use of resources and to deliver holistic understanding of effects. Specifically, iwi assessment teams will survey the control and extraction-impacted reaches at the same time as the surveys of physical habitat change and river channel biota, with the iwi surveys also repeated through a year to assess how rapidly cultural values may be restored naturally by floods and freshes.

Involving iwi in this way at both our key study sites in Canterbury and Hawke's Bay will build upon recent work by Hawke's Bay and Canterbury regional councils to promote engagement on decision making regarding gravel extraction. During discussions with iwi representatives they have highlighted particular hapū and marae which are most impacted by gravel extraction and who would be most valuable to involve in this data collection.

The broader results of the study will be shared face-to-face at hui towards the end of the research programme and included in publically available guidance documentation where appropriate.

Research Aim 6

Stakeholder engagement and effective communication of research outputs is essential in order to achieve maximum benefit. Key users of the research will be industry, iwi, regional council river engineers and consents staff, and consultants. We will ensure stakeholders are engaged and that the research meets their needs and is communicated in an effective way by:

1. Creating a steering group at the start of the program which will meet at least annually to help ensure the research stays focussed on stakeholders needs.
2. Holding workshops early in the research programme to increase understanding and co-develop issues of concern and specific scenarios to assess in Research Aim 3.
3. Producing a guidance manual for all stakeholders to explain the potential issues and risks associated with gravel extraction and how to avoid or mitigate them.
4. Holding workshops to present initial research results, share and seek feedback on draft guidelines, and provide training on the tools, including the use of numerical models and use of the enhanced GCD tool (particularly focussed for councils).

Research Plan (Methodology)

For Research Aim 1 (to develop a reliable method of measuring gravel transport rate), we have chosen to pursue our 'morphological' approach because: (i) rapid, sufficiently-accurate field surveys to provide the required data are now achievable with modern remote-sensing technology, (ii) analysis tools for rapidly processing such large datasets (e.g., GCD Arc-GIS plugin) have matured, (iii) there are promising indications of a relationship between erosion/deposition patch-size characteristics and transport rate in existing datasets our team has helped collect [23], (iv) locating the study reaches above gravel/sand transition points enables an independent measure of gravel transport rate, and (v) the method should be able to be taken-up by others, providing they can access the survey technology. To that end our vision is that regional councils in New Zealand (and international equivalents) will, over the next decade, embrace technology such as topo-bathy LiDAR and the opportunities that it enables in the course of regular river surveys.

Risk of failure of preferred survey equipment during our project is mitigated by having fall-back options (e.g., MMS for topo-bathy LiDAR, structure-from-motion photogrammetry for MMS). Team members are experienced in all of these techniques.

We will use 2D modelling to replicate the RA1 field observations (e.g., with a model we can easily measure gravel transport distance using 'digital tracers', map erosion/deposition patch distributions, and tally gravel transport rates). This will enable us to test hypotheses further, particularly to assess how well the approach applies during large floods when gravel slugs may move multiple steps.

For RA2, our strategy is to use field-calibrated high-resolution 2D numerical models to create expedient parameterisation routines that overcome the shortcomings of 1D models which, nonetheless, still remain the only practical tool for predicting the effects of extraction over large river distances and decade-century time-scales.

With RA3, we will use modelling tools to answer frequently-asked questions around gravel-extraction sustainability particularly in regard to effects on riverbed levels and continuity of gravel transfer, using case-example situations from collaborating regional councils.

With RA4 and RA5, we will use a paired-reach approach (adjacent treated/untreated reaches) to show the effect of extraction operations on riverbed physical habitat, biota, and cultural values. We will monitor over at least a year to ensure that effects of extraction can be placed in perspective to natural riverbed disturbance by high flows, which will demonstrate the level of extraction activity that may be sustainable on a year-by-year basis. With RA5, our strategy is to engage with iwi so that the research is focussed on their values and concerns, and then work together to collect data that informs them on how gravel extraction could affect their values.

RA6 will involve a steering group of council, industry and iwi representatives throughout the programme to ensure that the research priorities align with their priorities. Workshops early in the research programme will co-develop issues of concern and specific scenarios to assess, and closing workshops will convey results, discuss guidance advice, and provide training on tools.

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Appendix F. NZTA and Hawkes Bay Territory Authorities' Aggregate Specifications

TNZ M/4: 2006

SPECIFICATION FOR BASECOURSE AGGREGATE

1. SCOPE

This specification sets out requirements for basecourse aggregate for use on state highways and other heavily trafficked roadways.

2. GENERAL

All sampling and testing shall be performed by an IANZ Accredited laboratory for the performance of the relevant test as shown in Figure 1.

All basecourse aggregate which does not comply with the requirements of this specification shall be either: tested as agreed by the Transit New Zealand's Engineering Policy Manager for consideration as a regional basecourse aggregate for inclusion in Table 4 or rejected.

The basecourse aggregate shall be classified as either M/4 or one of the regional basecourse aggregates detailed in Table 4. Additional guidance on the use of regional basecourse aggregates is provided in the appendices to the Notes for this specification.

3. SOURCE PROPERTIES

The basecourse aggregate shall be broken or crushed from either: waterworn gravel; quarried rock or from other sources accepted as a regional basecourse aggregate detailed in Table 4. Source material shall consist of hard, sound material of uniform quality, free from soft or disintegrated stone or other deleterious material.

3.1 Testing Source Properties General

Source properties of the aggregate shall be assessed by the testing specified in Clause 3.3 on samples of aggregate from current production, which are representative of the processing method.

If the aggregate source or processing method is changed then the source properties shall be tested immediately and the Engineer informed. Acceptance of basecourse aggregate from the varied process shall be at the discretion of the engineer until the source properties are shown by test to comply with this specification.

The source property tests shall be performed at periods not exceeding two years unless a comparative petrographic examination of the current aggregate and a sample from the material successfully tested two years earlier shows that there has been no significant change in the material.

If a petrographic examination is used as described above the source properties shall be tested at least once every four years.

The petrographic examination must be performed by persons who are qualified by education and experience to employ techniques for the recognition of the characteristic properties of aggregates and minerals. The examination shall follow the guidelines given in ASTM C 295 *Standard Practice For Petrographic Examination of Aggregate For Concrete*.

When testing source properties a sample of the aggregate suitable for petrographic examination shall be stored for a minimum of two years by the IANZ Accredited laboratory performing the test.

The Engineer may require some or all of the source property tests to be performed in addition to the testing frequencies stated above. Should the test results show that the material complies with this specification, testing will be at the Principal's cost, otherwise testing will be at the cost of the Contractor.

3.2 Source Property Tests and Sampling

Source properties shall be sampled and tested at a rate of at least one sample for every 10,000m^3 of source material.

3.3 Source Property Tests

3.3.1 Crushing Resistance

When tested in accordance with NZS 4407 : 1991, Test 3.10, *The Crushing Resistance Test*, under a load of 130 kN less than 10% fines passing 2.36 mm sieve size shall be produced.

3.3.2 Weathering Quality Index

The aggregate shall have a quality index of AA, AB, AC, BA, BB or CA when tested according to NZS 4407 : 1991, Test 3.11 *Weathering Quality Index Test.*

3.3.3 California Bearing Ratio

The sample shall be:

(a) compacted in accordance with NZS 4402 : 1986, Test 4.1.3 *New Zealand Vibrating Hammer Compaction Test at Optimum Water Content* and;

(b) tested in accordance with NZS 4407 : 1991, Test 3.15 *The California Bearing Ratio Test* (without a surcharge for at least 4 days). The soaked CBR of the basecourse aggregate shall not be less than 80%.

4. PRODUCTION PROPERTIES

Production properties of the aggregate shall be assessed by the testing specified in Clause 4.2 on representative samples of the crushed aggregate.

Representative samples of aggregate may be taken from conveyor belt, bin, stockpile or truck. Representative samples of the aggregate shall be obtained in accordance with NZS 4407 : 1991.

4.1 Production Property Test Sampling

Stored aggregate shall be subdivided into lots so that aggregates of visible difference are sampled and tested separately. The rate of obtaining samples from lots shall be as in the Table 1.

Table 1: Minimum sampling rate for production property tests

Lot Size		Number of Samples
From	To	
1 m^3	400m^3	2
400m^3	1500m^3	3
1500m^3	4000m^3	4

Where the lot size exceeds 4000m^3 additional testing shall be at the rate of one sample for every 1000m^3.

The Engineer may require some or all of the production property tests to be performed in addition to the testing frequencies stated above. Should the test results show that the aggregate complies with this specification, testing will be at the Principal's cost, otherwise testing will be at the cost of the Contractor.

4.2 Production Property Tests

4.2.1 Quality of Fines

The basecourse aggregate shall comply with either Sand Equivalent or Clay Index or Plasticity Index requirement stated below.

4.2.1.1 Sand Equivalent

The sand equivalent shall not be less than 40 when the aggregate is tested according to NZS 4407 : 1991, Test 3.6 *Sand Equivalent Test*.

4.2.1.2 Clay Index

The clay index of the fraction of basecourse passing the 75µm sieve shall not be greater than 3 when the aggregate is tested according to NZS 4407 : 1991, Test 3.5 *Clay Index Test*.

4.2.1.3 Plasticity Index

The plasticity index of the fraction of basecourse passing the 425µm sieve shall not be greater than 5 when the aggregate is tested according to NZS 4407 : 1991, Test 3.4 *Plasticity Index Test*.

4.2.2 Broken Face Content

The aggregate broken face content in each of the three aggregate fractions between the 37.5mm and 4.75mm sieves shall not be less than 70% by weight and shall have two or more broken faces, when tested according to NZS 4407 : 1991, Test 3.14 *Broken Face Test*.

4.2.3 Particle Size Distribution

The particle-size distribution of the aggregate shall conform with the envelope limits defined in both Tables 2 and 3 below, when the aggregate is tested according to NZS 4407 : 1991, Test 3.8.1 *Wet Sieving Test*.

If testing has been performed to show that the dry sieving method is not significantly different to the wet sieving method at 95% confidence limit for the same aggregate then dry sieving method may be used.

Table 2: Particle Size Distribution Envelope Limits for an Individual Sample

Test Sieve Aperture	Maximum and Minimum Allowable Percentage Weight Passing	
	AP40 (Max size 40mm)	AP20 (Max size 20mm)
37.5mm	100	-
19mm	66 - 81	100
9.5mm	43 - 57	55 - 75
4.75mm	28 - 43	33 - 55
2.36mm	19 - 33	22 - 42
1.18mm	12 - 25	14 - 31
600µm	7 - 19	8 - 23
300µm	3 - 14	5 - 16
150µm	0 - 10	0 - 12
75µm	0 - 7	0 - 8

Table 3: Particle Size Distribution Shape Control

Fractions	Maximum and Minimum Allowable Percentage Weight Of Material Within the Given Fraction	
	AP40 (Max size 40mm)	AP20 (Max size 20mm)
19mm - 4.75mm	28 - 48	-
9.5mm - 2.36mm	14 - 34	20 - 46
4.75mm - 1.18mm	7 - 27	9 - 34
2.36mm - 600µm	6 - 22	6 - 26
1.18mm - 300µm	5 - 19	3 - 21
600µm - 150µm	2 - 14	2 - 17

5. REGIONAL BASECOURSES AGGREGATES

For the regional basecourse aggregates the M/4 criteria shall apply except for deviations as stated in Table 4.

The regional basecourse aggregates may only be used in the region detailed if specified in Table 4 or as approved by the Engineer. The use and source of regional materials must be clearly identified in the Contractor's tender. A methodology for dealing with any special considerations must also be included in the tender.

6. COMPLIANCE

The Contractor shall supply proof of compliance before basecourse aggregate is supplied.

7. BASIS OF MEASUREMENT AND PAYMENT

The basis of payment shall be on the final compacted volume of the basecourse aggregate in place with the method of measurement as defined in the contract documents.

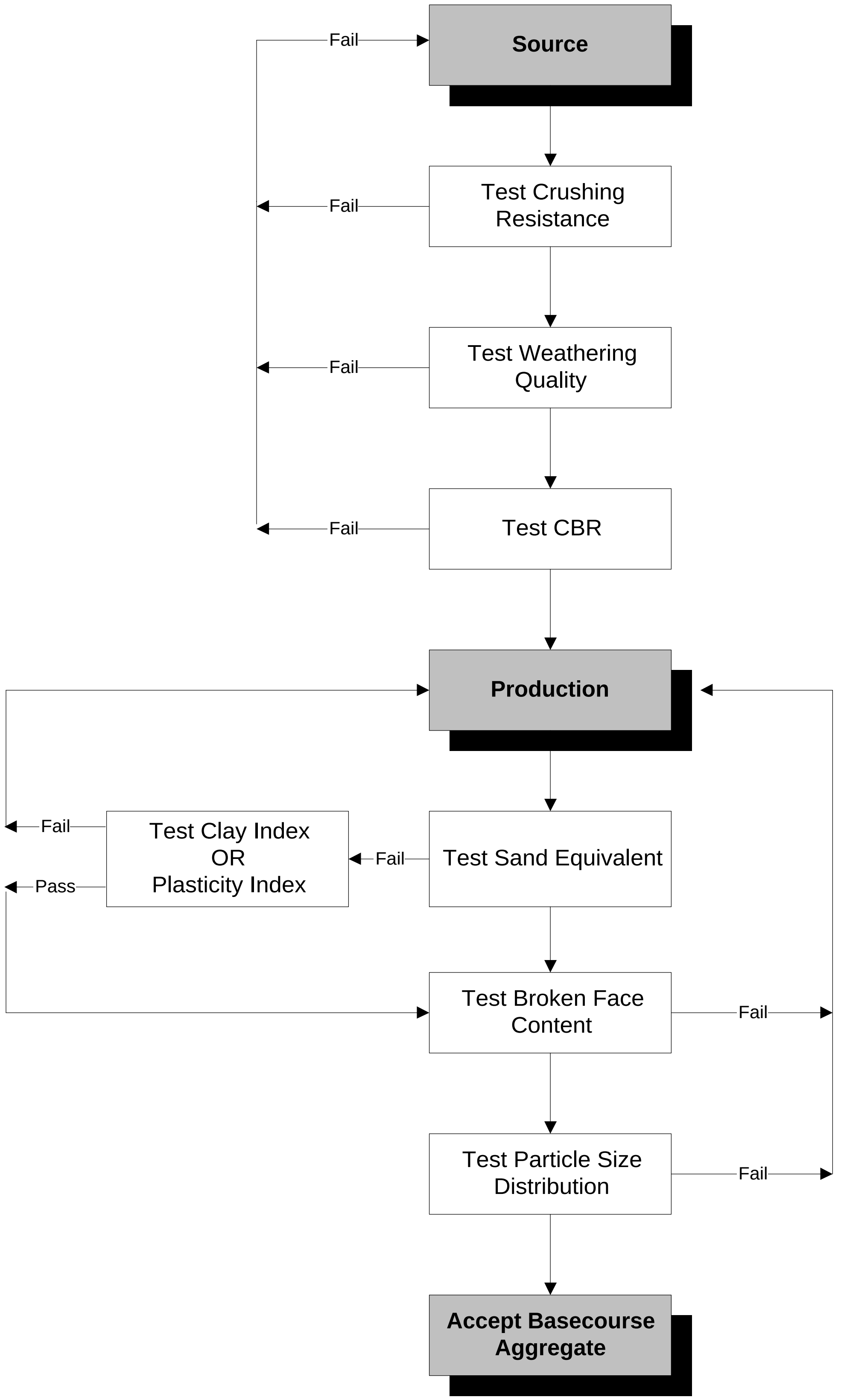


Figure 1 : Flow Chart for Basecourse Aggregate Tests

Table 4: Regional Basecourses

NZS 4407:1991 TEST NAME	TEST NO	TNZ M/4		NAPIER RIVER GRAVEL	
WEATHERING QUALITY INDEX	3.11	AA,AB,BA,BB,CA			
CRUSHING RESISTANCE	3.1	NOT LESS THAN 130kN			
CALIFORNIA BEARING RATIO	3.15	NOT LESS THAN 80%			
BROKEN FACE CONTENT GREATER THAN TWO	3.14				
SIEVE SIZE					
19mm - 37.5mm		NOT LESS THAN 70%		NOT LESS THAN 50%	
9.5mm - 19.0mm		NOT LESS THAN 70%		NOT LESS THAN 50%	
4.75mm - 9.5mm		NOT LESS THAN 70%		NOT LESS THAN 50%	
QUALITY OF FINES					
SAND EQUIVALENT OR	3.6	NOT LESS THAN 40		NOT LESS THAN 35	
CLAY INDEX OR	3.5	NOT GREATER THAN 3		IF SAND EQUIVALENT IS LESS THAN 35	
PLASTICITY INDEX	3.4	NOT GREATER THAN 5		IF SAND EQUIVALENT IS LESS THAN 35	
WET SIEVING TEST	3.8.1				
TEST SIEVE APERTURE		AP40	AP20	AP40	AP20
37.5mm		100	—		
26.5mm		—	—	78 - 100	
19mm		66 - 81	100		
9.5mm		43 - 57	55 - 75		
4.75mm		28 - 43	33 - 55		
2.36mm		19 - 33	22 - 42		
1.18mm		12 - 25	14 - 31	13 - 25	
600µm		7 - 19	8 - 23	10 - 19	
300µm		3 - 14	5 - 16	7 - 14	
150µm		0 - 10	0 - 12	5 - 11	
75µm		0 - 7	0 - 8	3 - 8	
PARTICLE SIZE DISTRIBUTION SHAPE					
FRACTIONS		AP40	AP20	AP40	AP20
19.0mm - 4.75mm		28 - 48	—		
9.5mm - 2.36mm		14 - 34	20 - 46		
4.75mm - 1.18mm		7 - 27	9 - 34		
2.36mm - 600µm		6 - 22	6 - 26	6 - 20	
1.18mm - 300µm		3 - 19	3 - 21	5 - 15	
600µm - 150µm		2 - 14	2 - 17	2 - 12	
TRAFFIC LOADING LIMIT					

NZS 4407:1991 TEST NAME	TEST NO	ROTORUA 1 RHYOLITE		ROTORUA 2 PART CRUSHED RIVER GRAVEL	
WEATHERING QUALITY INDEX	3.11				
CRUSHING RESISTANCE	3.1	NOT LESS THAN 60 kN			
CALIFORNIA BEARING RATIO	3.15				
BROKEN FACE CONTENT GREATER THAN TWO	3.14				
SIEVE SIZE					
19mm - 37.5mm		N/A		NOT LESS THAN 40%	
9.5mm - 19.0mm		N/A		NOT LESS THAN 40%	
4.75mm - 9.5mm		N/A		NOT LESS THAN 40%	
QUALITY OF FINES					
SAND EQUIVALENT OR	3.6			NOT LESS THAN 45	
CLAY INDEX OR	3.5			IF SAND EQUIVALENT IS LESS THAN 45	
PLASTICITY INDEX	3.4			IF SAND EQUIVALENT IS LESS THAN 45	
WET SIEVING TEST	3.8.1				
TEST SIEVE APERTURE		AP40	AP20	AP40	AP20
37.5mm					
26.5mm					
19mm					
9.5mm					
4.75mm					
2.36mm					
1.18mm					
600µm					
300µm					
150µm					
75µm					
PARTICLE SIZE DISTRIBUTION SHAPE CONTROL					
FRACTIONS		AP40	AP20	AP40	AP20
19.0mm - 4.75mm					
9.5mm - 2.36mm					
4.75mm - 1.18mm					
2.36mm - 600µm					
1.18mm - 300µm					
600µm - 150µm					
TRAFFIC LOADING LIMIT		LESS THAN 1 x 10^6 ESA			

NZS 4407:1991 TEST NAME	TEST NO	WANGANUI SHELL ROCK	TARANAKI ANDESITE – 65kN
WEATHERING QUALITY INDEX	3.11		
CRUSHING RESISTANCE	3.1	NOT LESS THAN 50 kN	NOT LESS THAN 65 kN
CALIFORNIA BEARING RATIO	3.15	NOT LESS THAN 120%	
BROKEN FACE CONTENT GREATER THAN TWO	3.14		
SIEVE SIZE			
19mm - 37.5mm 9.5mm - 19.0mm 4.75mm - 9.5mm		N/A N/A N/A	
QUALITY OF FINES			
SAND EQUIVALENT OR	3.6		
CLAY INDEX OR	3.5		
PLASTICITY INDEX	3.4		
WET SIEVING TEST	3.8.1		
TEST SIEVE APERTURE		AP40 AP20	AP40 AP20
37.5mm 26.5mm 19mm 9.5mm 4.75mm 2.36mm 1.18mm 600µm 300µm 150µm 75µm		N/A N/A N/A N/A 70 MAX N/A 50 MAX N/A N/A N/A 10 MAX	
PARTICLE SIZE DISTRIBUTION SHAPE			
FRACTIONS		AP40 AP20	AP40 AP20
19.0mm - 4.75mm 9.5mm - 2.36mm 4.75mm - 1.18mm 2.36mm - 600µm 1.18mm - 300µm 600µm - 150µm		N/A N/A N/A N/A N/A N/A	
TRAFFIC LOADING LIMIT			LESS THAN 2 x 10^5 ESA

NZS 4407:1991 TEST NAME	TEST NO	TARANAKI ANDESITE –85kN	TARANAKI ANDESITE–100kN
WEATHERING QUALITY INDEX	3.11		
CRUSHING RESISTANCE	3.1	NOT LESS THAN 85 kN	NOT LESS THAN 100 kN
CALIFORNIA BEARING RATIO	3.15		
BROKEN FACE CONTENT GREATER THAN TWO	3.14		
SIEVE SIZE			
19mm - 37.5mm 9.5mm - 19.0mm 4.75mm - 9.5mm			
QUALITY OF FINES			
SAND EQUIVALENT OR	3.6		
CLAY INDEX OR	3.5		
PLASTICITY INDEX	3.4		
WET SIEVING TEST	3.8.1		
TEST SIEVE APERTURE		AP40 AP20	AP40 AP20
37.5mm 26.5mm 19mm 9.5mm 4.75mm 2.36mm 1.18mm 600μm 300μm 150μm 75μm			
PARTICLE SIZE DISTRIBUTION SHAPE			
FRACTIONS		AP40 AP20	AP40 AP20
19.0mm - 4.75mm 9.5mm - 2.36mm 4.75mm - 1.18mm 2.36mm - 600μm 1.18mm - 300μm 600μm - 150μm			
TRAFFIC LOADING LIMIT		LESS THAN 1 x 10^6 ESA	

NZS 4407:1991 TEST NAME	TEST NO	WELLINGTON 1 GREYWACKE	
WEATHERING QUALITY INDEX	3.11		
CRUSHING RESISTANCE	3.1		
CALIFORNIA BEARING RATIO	3.15		
BROKEN FACE CONTENT GREATER THAN TWO	3.14		
SIEVE SIZE			
19mm - 37.5mm 9.5mm - 19.0mm 4.75mm - 9.5mm		NOT LESS THAN 60% NOT LESS THAN 60% NOT LESS THAN 60%	
QUALITY OF FINES			
SAND EQUIVALENT OR	3.6	NOT LESS THAN 30	
CLAY INDEX OR	3.5	IF SAND EQUIVALENT IS LESS THAN 30	
PLASTICITY INDEX	3.4	IF SAND EQUIVALENT IS LESS THAN 30	
WET SIEVING TEST	3.8.1		
TEST SIEVE APERTURE		AP40 AP20	
37.5mm 26.5mm 19mm 9.5mm 4.75mm 2.36mm 1.18mm 600µm 300µm 150µm 75µm		100 - 95 58 - 85 30 - 65 15 - 45 10 - 35 8 - 25 5 - 20 3 - 15 0 - 10 0 - 8	
PARTICLE SIZE DISTRIBUTION SHAPE CONTROL			
FRACTIONS		AP40 AP20	
19.0mm - 4.75mm 9.5mm - 2.36mm 4.75mm - 1.18mm 2.36mm - 600µm 1.18mm - 300µm 600µm - 150µm			
TRAFFIC LOADING LIMIT			

RCC – Recycled Crushed Concrete

NZS 4407: 1991 TEST NAME	TEST NO	RCC BASECOURSE	
[2,3]DEFINITION	**RCC** is **Recycled Crushed Concrete** composed of rock fragments coated with cement with or without sands and/or filler, produced in a controlled manner to close tolerances of grading and minimum foreign material content. RCC fragments shall consist of clean, hard, durable, angular fragments of concrete. A basecourse is the upper 150 mm layer in the pavement, while the sub-base is below the basecourse layer. Subbases shall conform to the requirements of TNZ M/3 notes, the Foreign Material Contents listed below and the project specific specification. Variation to the following limits are possible should the material meet the requirements of TNZ M22, accepted by Transit New Zealand. **It must be approved for use by the appropriate Regional Council.**		
[2]FOREIGN MATERIAL	The percentages of foreign materials shall be determined by RTA Test Method T276. The percentages of foreign materials shall not exceed the following percentages by mass: Type 1 Materials: Glass, brick, stone, ceramics and asphalt < 3%; Type II Materials: Plaster, clay lumps and other friable material: < 1%; Type III Materials: Rubber, Plastic, Bitumen, Paper, Wood and other vegetable or decomposable matter: < 0.5% No Type II or III materials may be retained on the 37.5mm or above sieves for RCC Basecourse materials. In no circumstances shall the RCC product contain any asbestos or asbestos fibre. Testing for foreign materials shall be at the minimum sampling rate for production property tests		
WEATHERING QUALITY INDEX	3.11	(N/A)	
CRUSHING RESISTANCE	3.1	NOT LESS THAN 130kN	
CALIFORNIA BEARING RATIO	3.15	NOT LESS THAN 80%	
BROKEN FACE CONTENT GREATER THAN 2	3.14		
SIEVE SIZE			
19mm - 37.5mm 9.5mm - 19.0mm 4.75mm - 9.5mm		NOT LESS THAN 70% NOT LESS THAN 70% NOT LESS THAN 70%	
QUALITY OF FINES			
SAND EQUIVALENT OR	3.6	(N/A)	
CLAY INDEX[2] OR	3.5	(N/A)	
PLASTICITY INDEX[2]	3.4	NOT GREATER THAN 5	
WET SIEVING TEST	3.8.1		
TEST SIEVE APERTURE		AP40	
75mm 63mm 37.5mm 19mm 9.5mm 4.75mm 2.36mm 1.18mm		100 100 98 - 100 76 - 94 57 - 75 38 - 58 27 - 47 19 - 39	

NZS 4407: 1991 TEST NAME	TEST NO	RCC BASECOURSE	
600µm 300µm 150µm 75µm		12 - 32 6 - 26 0 - 22 0 - 14	
RCC – Recycled Crushed Concrete – continued: **PARTICLE SIZE DISTRIBUTION SHAPE**			
FRACTIONS		AP40	
37.5mm - 9.5mm 19.0mm - 4.75mm 9.5mm - 2.36mm 4.75mm - 1.18mm 2.36mm - 600µm 1.18mm - 300µm 600µm - 150µm		 27 - 47 17 - 41 8 - 30 6 - 24 5 - 21 3 - 19	
TRAFFIC LOADING LIMIT			

Please note: N/A = Not Applicable and test is not required
1. RCC is generally non plastic as cement dust reacts with any plastic fines present.
2. These requirements for RCC were based on the Transport South Australia's Pavement Material Specification Part 215.
3. RCC shows comparable performance to high quality M4 aggregate as proven at Transit New Zealand accelerated pavement testing facility CAPTIF.

Special Considerations

Stockpiles of RCC should be separated (a minimum distance) from water courses because of the alkaline nature of RCC leachate.

Where RCC aggregates are used in granular basecourse applications in conjunction with subdrains, the following procedures are recommended to reduce the likelihood of leachate precipitates clogging the drainage system:

- Wash the processed RCC aggregates to remove dust from the coarse particles.
- Ensure that any geotextile fabric surrounding the drainage trenches (containing the subdrains) does not intersect the drainage path from the base course, ie do not fully wrap drains (to avoid potential plugging with fines).

The pH value of the RCC aggregate can exceed a pH value of 11. This can be corrosive to galvanized or aluminum pipes placed in direct contact with the RCC. Galvanized or aluminum pipes shall not be used in RCC pavements.

NZS 4407: 1991 TEST NAME	TEST NO	GLENBROOK MELTER SLAG
DEFINITION	Glenbrook Melter Slag is a co-product of the iron making operation at NZ Steel, Glenbrook. The material is processed by "SteelServ" to produce an AP40 aggregate complying to the standard TNZ M4 requirements. **It must be approved for use by the appropriate Regional Council.**	
CHEMICAL ANALYSIS	To ensure a consistent product, the acceptable ranges of the individual relative proportions of slag are: Min % / Max % Cao 10 20 Fe 0 10 SiO2 9 15 Al2O3 15 21 MnO 0.5 1.7 MgO 11 15 TiO2 27 42 Cr2O3 0.2 0.6 V2O5 0.1 0.5 Note: The Fe content is removed from the slag during the crushing process The non-ferrous component of every production batch of sub-base and base course Slag shall be analysed in a IANZ accredited laboratory for its chemical properties and at an interval of six months or 10,000m3 of production (whichever occurs first), for the source properties, so as to assure Transit New Zealand that the Slag remains within the parameters specified.	
POTENTIAL EXPANSION OF AGGREGATES FROM HYDRATION REACTIONS (preformed as a Source Test)	EN 1744-1:1998	Not Greater than 0.5% at seven days
WEATHERING QUALITY INDEX	3.11	>BB
CRUSHING RESISTANCE	3.1	NOT LESS THAN 130kN
OTHER	As per TNZ M4	
TRAFFIC LOADING LIMIT		

Special Considerations

Stockpiles should be separated (a minimum distance) from water courses because of the alkaline nature of leachate.

Steel Slag aggreate are known to potentially clog geotextile fabric wraped drains, the reduced amount of free lime in Melter Slag should reduce this risk. Where Melter Slag aggregates are used in granular basecourse applications in conjunction with subdrains, the following procedures required :

- Ensure that any geotextile fabric surrounding the drainage trenches (containing the subdrains) does not intersect the drainage path from the base course ie do not fully wrap drains (to avoid potential plugging with fines).

The pH value of the melter slag aggregate generally ranges from approximately 8 to 10 in laboratory testing and 7.5-8 in the field; however leachate from blast furnance and steel slags are often in these ranges and can exceed a pH value of 11. This can be corrosive to galvanized or aluminum pipes placed in direct contact with the slag. With this in mind galvanized or aluminum pipes shall not be used in melter slag aggregate pavements.

While melter slags have reportedly good test results in terms of potential to swell. The use of Slag aggregate next to structures (such as bridge abutments) is not permitted.

AGGREGATE / RECLAIMED GLASS BLENDED BASECOURSE

DEFINITION

Overseas experience suggests that appropriately processed reclaimed glass is well suited for use as a basecourse aggregate. Adding glass to aggregate, in suitable proportions, provides a number of environmental benefits without compromising the mechanical properties of the aggregate.

This extension of the M/4 specification allows up to 5% reclaimed glass (by mass) to be blended with natural or recycled aggregate for road base construction. The aggregate / reclaimed glass (cullet) blend must comply with the requirements of the M/4 specification except for the variations and additions provided in this table.

Up to 5% reclaimed glass can also be added to subbase aggregate in accordance with the relevant requirements of the M/4 specification.

Proportions of cullet in excess of 5% may be used at the discretion of the Transit New Zealand Engineering Policy Manager, provided that the requirements of the M/22 specification have been satisfied. Such applications are likely to be restricted to relatively low traffic volume projects and the material may be subject to higher standards with respect to contamination limits.

CULLET PROPERTIES

Reclaimed Glass Source	The cullet can originate from a number of glass products, viz: waste food and beverage containers, drinking glasses, window glass, or plain ceramic or china dinnerware. Reclaimed glass from hazardous waste containers, light bulbs, vehicle windscreens, fluorescent tubes or cathode ray tubes shall not be used.
Grading	The cullet shall be crushed to achieve the following gradation: (NZS 4407:1991 Test 3.8.1)
Contamination Limit	Debris, such as paper, foil, plastic, metal, cork, food residue, organic matter, etc can have a significant influence on the performance of the aggregate / glass material. The cullet shall not contain more than 5% debris, as determined using the procedure described in RTA Test Method T267 (where “reclaimed glass” is substituted for “recycled concrete”).
Cleanliness	The cullet shall be washed to ensure that undesirable odours are eliminated.

Grading (continued):

Sieve	Percent Passing
9.5 mm	100
4.75 mm	70 – 100
2.36 mm	35 – 88
1.18 mm	15 – 45
0.30 mm	4 – 12
0.075 mm	0 - 5

The plus 4.75 mm component of the cullet must not contain more than 1% of flat or elongated particles, i.e. particles with a maximum to minimum dimension ratio greater than 5:1. The ASTM D 4791 test is appropriate (except that the test sample shall be taken as the material retained on the 4.75 mm sieve).

PRODUCTION

Concentrations of reclaimed glass within the aggregate could have a detrimental influence on the performance of the material in a basecourse layer. Therefore, the aggregate and reclaimed glass shall be mixed thoroughly to ensure that there is an even distribution of glass throughout the basecourse stockpile.

CULLET QUALITY ASSURANCE TEST FREQUENCY

Tests for compliance with grading, particle shape and contamination shall be carried out at a frequency of two tests (each) per cullet stockpile.

ADDITIONAL PRODUCTION TESTING	As per TNZ M4	
TRAFFIC LOADING LIMIT		

CHANGES TO TNZ M/4
SPECIFICATION FOR BASECOURSE AGGREGATE

The major changes in this April 2006 edition of the TNZ M/4 specification are:

- Inclusion of Aggregate / Reclaimed Glass Blended Basecourse as a regional variant. Reclaimed Glass is also allowed in subbase with this specification.

The major changes in the May 2005 edition of the TNZ M/4 specification were:

- The ability to obtain approval of alternative basecourse materials as agreed by Transit's Engineering Policy Manager.
- Inclusion of Recycled Crushed Concrete as a regional variant.
- Inclusion of Glenbrook Melter Slag as a regional variant.

The major changes in the 2003 edition of the TNZ M/4 specification were:

- The creation of 3 new regional variants on TNZ M/4 for Taranaki Andesite.
- The removal of unused regional variants, Christchurch Uncrushed River Gravel, Nelson Basalt Rock and Wellington 2 Uncrushed River Gravel
- Regional variants are only to be used where they are specifically allowed for in the contract documents.
- The addition of 2 appendices to the TNZ M/4 Notes. The two appendices are technical notes covering the use of Wanganui Shell Rock and Taranaki Andesite.
- Updating terminology from Equivalent Design Axles (EDA) to Equivalent Standard Axles (ESA) in Traffic Loading Limit.

(iv) Test certificate for Mechanical Impact Protection rating (IK)

(v) Test certificate of thermal endurance and thermal testing requirements.

If the developer chooses to install roadway lighting that varies from the above standards, they shall pay Council a capitalised maintenance charge, based on the *additional* installation, operational and maintenance costs, as compared to standard street lighting.

Additional costings shall be calculated over a 30 year life period, and in present value terms using a discount rate of 8%. (Refer to NZTA Economic Evaluation Manual).

Any road lighting that varies from the complying standard, must still be designed in accordance with AS/NZS 1158 "Lighting for roads and public spaces".

F1.10.3. Rural Roadway Lighting Design

Lighting on rural roads is provided for vehicle safety in hazardous areas such as intersections. Any new road intersecting with a Rural Arterial or Rural Collector road will require a minimum one light on the opposite side of the main road and an additional light installed on the intersecting road.

F1.11. MATERIALS

F1.11.1. Testing

All appropriate material testing shall be carried out by testing laboratories with recognised registration or quality assurance qualifications.

F1.11.2. Concrete

All concrete shall be ready mix concrete supplied from an approved ready mix plant, and conform with NZS 3109 Extruded and in-situ kerb and channel and dish channels, sumps, footpaths, residential crossings and commercial / industrial crossings, shall have a minimum 28 day compressive strength of 20 MPa.

F1.11.3. Subbase Aggregate

Usually river aggregate in HB

A variety of materials may provide satisfactory performance in the subbase layer providing the pavement layer depths are designed accordingly. The pavement design shall specify the subbase material to be used and provide soaked CBR test results confirming that the material is compatible with the design. The aggregate shall have a minimum crushing resistance of 100 KN when tested in accordance with NZS 4407: 1991 Test 3.10, and shall produce a minimum CBR of 40 when tested in accordance with NZS 4407:1991 Test 3.15 after compaction.

The minimum subbase aggregate requirements are that the material shall be able to be constructed in accordance with TNZ B/2 including compaction standards and surface shape tolerances. The maximum particle size shall be the lesser of 80 mm or 40% of the layer depth in accordance with B/2.

The TNZ M/3 "Notes on Subbase Aggregate" is useful in specifying subbase aggregates.

F1.11.4. Basecourse Aggregate

Basecourse aggregate shall comply with TNZ M/4.

Refer to Table 5 in the M/4 specification for details of the "Napier River Gravel" regional variant.

F1.11.5. Transition Layer

Any transition layer shall be included in the approved pavement design. The transition layer material may be a filter aggregate complying with TNZ F/2 or an approved geotextile filter fabric.

F1.11.6. Road Surfacing Materials

The road surfacing material shall comply with the following:

(a) Asphaltic Bitumens shall comply with TNZ M/1.

(b) Sealing Chip shall comply with TNZ M/6.

(c) Asphaltic Concrete shall comply with TNZ M/10.

(d) AS/NZS 4455: Masonry Units, Pavers, flags and segmental retaining wall units.

F1.11.7. Traffic Signs and Road Name Plates

All materials for signs shall comply with the "Standard for the Manufacture and Maintenance of Traffic Signs, Posts and Fittings" published by NZTA and the Road Safety Manufacturers Association. Further to this specification, no timber posts, plates or blades shall be used.

F1.11.8. Road Marking Paint

Road marking paint shall comply with TNZ M/7: Road Marking Paints.

F1.12. NON-PUBLIC ACCESSWAYS FOR OTHER THAN FRONT LOTS (Urban & Rural)

Non-public accessways include all roads and accessways that remain in private ownership after completion of any development other than a front allotment.

The standards described in this section apply to the length of accessway on private land. The length between the road carriageway to the road boundary is controlled by Sections F1.6.14. and F1.6.15. of this Code. These two sections include controls on the location of vehicle crossings which, in turn, affect the location of accessways.

In all cases where the access is to be used or shared by more than a single allotment or dwelling unit it shall be formed at the time of subdivision or land development. Where urban accessways could be damaged by the subsequent development of the allotments, Council may defer the requirement to complete the pavement construction for a specified period.

Minimum formed and legal widths and other relevant standards shall be as detailed on Table F-4. Further to Table F-4 the following geometric and drainage requirements shall apply:

(a) All changes in horizontal alignment shall be formed by use of circular curves.

WDC Maintenance Specification

M30: Materials

CONTENTS

WDC Maintenance Specification M30
Materials

1 GENERAL

This specification sets out the requirements for materials that apply to the WDC Standard Maintenance Specifications.

Unless otherwise stated, the latest version of all standards and specifications shall apply.

2 SAMPLING AND TESTING OF MATERIALS

The Contractor shall be responsible for all sampling and testing of materials, including costs.

All sampling and testing shall be undertaken in accordance with the relevant standards and specifications. All materials used in the Contract Works shall comply with their respective standard specifications.

All material test results shall be International Accreditation NZ (IANZ) certified for both sampling and testing. The Contractor shall submit samples, when required by the Engineer, for pre-acceptance testing. The Engineer reserves the right to obtain additional samples himself.

The Contractor shall retain the certified test results covering all materials incorporated in the works. A copy and summary of these shall be submitted to the Engineer. Batch certification of materials factory manufactured shall be retained for all materials included in the works

3 GRANULAR AGGREGATES

3.1 General

The Contractor shall be familiar with the properties of the aggregate he intends to use to ensure that it can be used and constructed to the required specification.

The Contractor shall not add materials to the aggregate subsequent to satisfactory acceptance testing without prior approval of the Engineer.

The Contractor shall nominate the intended source of aggregate material at least 7 days before construction commences and shall be responsible to ensure where applicable that resource consents exist and are complied with.

3.2 Testing

All conformance testing required will be undertaken by the Contractor, at his cost, and results made available to the Engineer on request.

The Contractor shall retain the certified test results covering all materials incorporated in the works. A copy and summary of these shall be submitted to the Engineer.

3.3 AP65 Subbase

AP65 shall consist of:

- Well graded, deleterious free, granular material.
- Maximum stone size – 65.0mm.
- 30% minimum broken faces (NZS4407:1991 'Methods of Sampling and Testing Road Aggregates' Test 3.14).
- Soaked CBR greater than 30% (NZS4407:1991 Test 3.15).
- Plasticity Index of material finer than 0.425mm sieve – less than 12 (NZS4407:1991 Test 3. 4).

3.4 1234

AP40 crushed river basecourse shall conform to the following Specification:

NZS 4407:1991 Test Name	***Test No.***	***Aggregate***
Weathering Quality Index	3.11	AA, AB, BA, BB, CA
Crushing Resistance	3.1.0	Not less than 130kN
California Bearing Ratio (CBR)	3.15	Not less than 80%
Broken Face Content > 2	3.14	
Sieve Size 19.0mm – 37.5mm 9.5mm – 19 mm 4.75mm – 9.5mm		 Not less than 50% Not less than 30% Not less than 30%
Quality of Fines Sand Equivalent or Clay Index Plasticity Index	 3.6 3.5 3.4	 Not less than 35 Not greater than 3 if Sand Equivalent less than 35 Not greater than 5 if Sand Equivalent less than 35
Wet Sieving Test Test Size Aperture 37.5mm 26.5mm 19mm 9.5mm 4.75mm 2.36mm 1.18mm 600µm 300µm 150µm 75µm	3.8.1	 AP40 78-100 13 – 25 10 – 19 7 – 14 5 -11 3 – 8
Particle Size Distribution Shape Fractions 19.0mm - 4.75mm 9.5mm – 2.36mm 4.75mm – 1.18mm 2.36mm - 600µm 1.18mm - 300µm 600µm - 150µm		 AP40 6 - 20 5 – 15 2 - 12

4 UNSEALED SURFACE AGGREGATES

4.1 General

This section covers the end product placed by the Contractor and in place at the completion of the works within the upper 100mm of the road pavement.

4.2 Proportion Of Broken Rock

In each of the three aggregate fractions between the 37.5 mm and 4.75 mm sieves, not less than 50% by weight shall have two or more broken faces.

4.3 Aggregate Strength and Quality

Strength and Quality attributes shall meet the following specification when the aggregate is tested in accordance with Test 3.10 of NZS 4407:1991.

Table 1 : Aggregate Strength And Quality

Material Description	***Crushing Resistance***	***Weathering Index***	***Sand Equivalent***
NRB M/4 (AP40)			40
PAP 40	130 kN	AA, AB, AC,	36
PAP 20		BA, BB, CA	36
AP 65			
AP 40	110 kN	AA, AB, AC,	15
AP 20		BA, BB, CA, CB	

4.4 Grading and Stone Shape

Grading attributes shall meet the following specification when the aggregate is tested in accordance with Test 3.10 of NZS 4407: 'Methods Of Sampling And Testing Road Aggregates'.

The weight of material in each fraction shall lie within the limits shown.

Table 2 : Aggregate Grading Envelope

Test Sieve Aperture	**Percentage Passing**			
	NRB M/4 (AP40)	*AP 65*	*PAP 40 AP 40*	*PAP 20 AP 20*
63.0 mm		100		
37.5 mm	100	70-85	100	
19.0 mm	66-81	46-68	63-81	100
9.5 mm	43-57	31-54	41-57	52-75
4.75 mm	28-43	20-41	26-43	31-55
2.36 mm	19-33	13-32	18-33	21-42
1.18 mm	12-25	9-23	11-25	13-31
600 micron	7-19	6-16	6-19	7-23
300 micron	3-14	3-12	3-14	5-16
150 micron	10 max	10 max	10 max	12 max
75 micron	7 max	6 max	7 max	8 max

Table 3 : Aggregate Grading Shape Control

Fractions	Percentage Of Material In Fraction			
	NRB M/4 (AP40)	*AP 65*	*PAP 40 AP 40*	*PAP 20 AP 20*
37.5 - 9.5		24-46		
19 - 4.75	28-48	15-37	27-49	
9.5 - 2.36	14-34	10-31	13-34	19-47
4.75 - 1.18	7-27	7-25	7-28	8-35
2.36 - 600	6-22	6-19	6-22	6-27
1.18 - 300	5-19	5-16	5-19	3-21
600 - 150	2-14	2-12	2-14	2-17

Material which contains stones which because of the fractured shape cause damage to vehicle tyres shall not be used in the upper 50mm of any pavement.

4.5 Clay Content

The supplied material shall have a plasticity index of between 5 and 10 with a liquid limit of between 25 and 35.

Permeability shall be in the classification of low to moderate.

The clay index of any material shall not exceed 4.5

4.6 Alternative Materials

The Contractor may propose to use alternative material which does not comply with Clauses 3.3 to 3.6 inclusive.

The Contractor shall not use an alternative material without the prior written approval of the Engineer.

The Contractor shall provide test results for the proposed material in accordance with Clause 3.2 for consideration by the Engineer.

The Engineer may require the Contractor to install a test section of the alternative material for evaluation. The test section shall not exceed 200m long by the full width of the road. The evaluation shall last for a minimum period of two (2) months from the date of completion.

The Contractor’s cost of complying with this clause shall be borne by the Contractor with the exception of the cost of the test section where the material is subsequently approved by the Engineer.

The Engineer may require the removal of the test section and reinstatement by the Contractor where the material is not accepted.

5 SEALING CHIP

Sealing chip shall be in accordance with TNZ Specification M/6 2006 Sealing Chip (including Napier variant dated Sept 1995)and amendments.

6 SAND

Sand shall consist of crushed or uncrushed gravel, stone or rock or a combination of any of these. It shall be hard, durable and clean and shall not contain any harmful materials such as iron, salt, shale or coal.

The grading of the sand shall fall within the envelope defined in the following table when tested in accordance with Test 3.8.2 of 'NZS 4407:1991.

Sieve Size	*Percentage Passing By Weight*
4.75 mm	100
2.36 mm	90-100
1.18 mm	70-100
600 micron	40-100
300 micron	5-70
150 micron	0.15

The sand equivalent shall not be less than 70 when the material is tested in accordance with Test 3.6 of 'NZS 4407:1991.

7 BALLAST

The least dimension of any stone classed as ballast shall be 125mm.

Ballast shall have a weathering quality index of AA, AB, AC, BA, BB, or CA when tested in accordance with 'NZS 4407 : Methods of Testing Road Aggregates' Test 3.11

Ballast shall have a crushing resistance greater than 130kN when tested in accordance with NZS 4407: 'Methods of Testing Road Aggregates' Test 3.10

8 PREMIXED MATERIALS

8.1 General

Premix includes all bitumen-bound materials, whether hot or cold laid, which have been mixed prior to being placed in the repair area. Bitumen stabilised aggregates are not covered by this specification.To be classified as premix as opposed to bitumen stabilised aggregate, the mix shall have a binder content greater than 2.5%.

8.2 Hotmix Materials

Asphaltic concrete shall be in accordance with TNZ Specification M/10: 2005 and P11/P 2003 together with subsequent amendments.

The following amendment is to be made to TNZ M/10
DELETE Clause 6 and replace with : 'No separate payment will be made for the supply of Asphaltic Concrete'

8.3 Other Premixed Materials

Other premix materials shall be designed to meet the service requirements detailed below:

- Upon completion of the work the material shall be sufficiently dense and bonded to ensure that it is not displaced, shoved, removed or picked up by traffic.
- Upon completion of the work and for a period not less than 12 months following, the material shall not bleed or flush.
- Any repair shall be uniformly dense and free of segregation.
- If the surface of any repair is porous then subsequent sealing of the repair may be necessary to constitute completion. The requirements of Clause 3.8c(ii) above shall then apply to the sealed surface.

At the start of the Contract the Contractor shall submit to the Engineer details of the premix materials he intends to use.

9 ASPHALTIC BITUMEN

Asphaltic bitumen shall comply with 'TNZ M/1:1995 Specification for Roading Bitumens'

The following amendment is to be made to TNZ M/1
DELETE Clause 6 and replace with: 'No separate payment will be made for the supply of Asphaltic Bitumen'.

10 CONCRETE

Concrete shall be ordinary grade concrete with the minimum specified crushing strength at 28 days when tested in accordance with 'NZS 3109: Concrete Construction'

Concrete shall be produced in accordance with 'NZS 3104: Specification For Concrete Production'.

11 MORTAR

Mortar for providing a water-tight joints in manholes or other stroemater structures shall be an approved polymer modified cementitious mortar such as Fosroc Renderoc HB, or an approved epoxy mortar such as Humebond.

Mortar shall be applied in accordance with the manufacturer's specifications to fill all voids

12 CEMENT FOR STABILISATION

Cement shall comply with the requirements of NZS 3122 'Specification for Portland and Blended Cements'

Cement shall be protected from moisture until used and shall be free from significant lumps and flow freely during application.

13 STORMWATER PIPES AND ACCESSORIES

13.1 Concrete Pipes

Precast reinforced concrete pipes shall comply with NZS 3107 'Specification For Precast Concrete Drainage And Pressure Pipes'

Pipe strength shall be Class X or as specified in the Contract Documents

Pipe joints shall be in accordance with the manufacturer's recommendations

13.2 Corrugated Steel Pipes and Flumes

Corrugated steel pipes and flumes shall comply with the requirements of NZS 4405 'Helical Lock-seam Corrugated Steel Pipes' for materials, galvanising and fabrication

13.3 HDPE Pipes

HDPE pipe shall comply with the requirements for drain pipes in 'NZS 7604: High Density Polyethylene Drain and Sewer Pipe and Fittings'.

Pipes shall be Class SN6, SN8 or SN16 as specified in the Contract documents.

13.4 Subsoil Drains

Sub-soil drainage pipe shall comply with the requirements of TNZ Specification F/2:2002 and shall be either:

<u>High density polyethylene (HDPE) pipe</u>

HDPE pipe shall comply with the requirements for drain pipes in 'NZS 7604: High Density Polyethylene Drain and Sewer Pipe and Fittings'.

Sub-soil drainage pipe shall be perforated with holes that shall not exceed $35mm^2$ in area with a maximum dimension of 6.5mm in any direction. The perforations shall be evenly spaced along the pipe length and shall exceed a total perforation area of $2000mm^2$ per one metre length of pipe

<u>Plain wall PVC pipes</u>

PVC pipes shall comply with AS/NZS 1260: PVC Pipes and Fittings for Drain, Waste and Vent Applications', Class SN4 or SN6

13.5 Manholes

Manholes shall be standard circular precast reinforced concrete 1050mm dia manholes with all manhole components able to withstand HN-HO-72 loading.

Cast iron covers and frames shall be Humes 1105, or approved equivalent.

Light duty lids and covers may be used in footpaths and berms.

14 TIMBER

14.1 General

All sawn timber shall be No 1 Framing Grade Radiata Pine in accordance with NZS 3631 'New Zealand National Timber Grading Rules'.

All natural round timber shall be Radiata Pine or Douglas Fir and shall comply with the requirements of NZS 3605: ' Timber Piles And Poles For Use In Buildings'.

14.2 Preservation Treatment

All permanent timber shall be treated to current requirements of the NZ Timber Preservation Council (NZTPC) for the particular end use as shown in the following table.

Specification	*NZTPA Hazard Class*	*Typical End Use*
Low Decay Hazard Protected from weather, insect resistant	H1.1	Interior lining
Low Decay Hazard Protected from weather but with a risk of moisture exposure	H1.2	Wall framing
Moderate Decay Hazard Above ground, exposed to the weather	H3.1	Weatherboards, exterior trim
Moderate Decay Hazard Above ground, exposed to or protracted from the weather but some risk to moisture exposure	H3.2	Structural decking, fencing
High Decay Hazard Ground Contact	H4	Fenceposts, agricultural posts, landscaping timber
Severe Decay Hazard Ground contact and high risk end use	H5	Piles, retaining walls, transmission poles
Marine Use	H6	Marine piles and timber

15 TOPSOIL AND SEED

Under normal circumstances, existing topsoil can be re-used for reinstatement of berms, verges etc.

Where required, imported topsoil shall be a dark brown friable loose loam containing a high percentage of humus and shall be free of any stones, weeds or other debris.

All topsoiled surfaces shall be re-seeded by spreading the seed mix on the finished surface at a rate of 12.0g/m^2, seed mix as follows:

- One third Brown Top (Agrostis Capillaris);
- One third White Clover (Trifolium Repens);
- One third Sheep's Burnet (Sanguisorba minoe spp Muricata).

Other seed mixes may be used with the Engineer's prior approval

<table>
<tr><th colspan="10">Aggregate Standards used in the Hawkes Bay Region</th></tr>
<tr><th rowspan="2">Authority</th><th rowspan="2">Aggregate Specification</th><th rowspan="2">Other Specification</th><th rowspan="2">Details</th><th colspan="4">Aggregate Strength and Quality</th><th rowspan="2">Sources</th><th rowspan="2">Alternative Materials/Comments</th></tr>
<tr><th>Crushing Resistance (a)</th><th>Weathering Index (b)</th><th>Sand Equivalent (c)</th><th>CBR (d)</th></tr>
<tr><td>NZTA</td><td>TNZ M/4: 2006</td><td>-</td><td>-</td><td>Not less than 130kN</td><td>AA, AB, BA, BB, CA</td><td>Not less than 40 (Napier Gravel = not less than 35)</td><td>Not less than 80%</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">NCC</td><td>TNZ M/4</td><td>-</td><td>"Napier River Gravel"</td><td>Not less than 130kN</td><td>AA, AB, BA, BB, CA</td><td>Not less than 35</td><td>Not less than 80%</td><td rowspan="2">HB river aggregates</td><td rowspan="2">N/A</td></tr>
<tr><td>TNZ M/3 Notes on Subbase</td><td>-</td><td>Subbase Aggregate: usually river aggregate in HB</td><td>Not less than 100kN</td><td>-</td><td>-</td><td>Not less than 40</td></tr>
<tr><td>HDC</td><td>TNZ M/4</td><td>-</td><td>-</td><td>Not less than 130kN</td><td>AA, AB, BA, BB, CA</td><td>Not less than 35</td><td>Not less than 80%</td><td>contractors individual quarries and river gravel sources</td><td>HDC engage contractor. Contracts stipulate aggregate must comply with NZT M/4 aggregate specifications. Contractors to provide evidence of aggregate compliance testing</td></tr>
<tr><td rowspan="2">WDC</td><td rowspan="2">WDC specifications</td><td rowspan="2">"40mm Red"</td><td>AP40 Crushed River Basecourse for some sealed pavements (AP65 Subbase)</td><td>Not less than 130kN</td><td>AA, AB, BA, BB, CA</td><td>not less than 35</td><td>Not less than 80%</td><td rowspan="2">contractors individual quarries and river gravel sources</td><td rowspan="2">Not all sealed pavement aggregates have to comply with NZT M/4, as alternative materials can be used.
Contractor may propose to use alternative materials which do not comply with WDC specifications. Needs prior approval from WDC Engineer; provide test results; and may need to install a test section of road.</td></tr>
<tr><td>AP40 Crushed River Basecourse for unsealed and some sealed pavements (AP65 Subbase)</td><td>110kN</td><td>AA, AB, AC</td><td>15</td><td>-</td></tr>
<tr><td rowspan="2">CHBDC</td><td>TNZ M/4 (sealed roads)</td><td>-</td><td>AP40 Crushed River Basecourse for sealed pavements (AP65 Subbase)</td><td>Not less than 130kN</td><td>AA, AB, BA, BB, CA</td><td>not less than 35</td><td>Not less than 80%</td><td>contractors individual quarries and river gravel sources</td><td>For re-sealing, CHBDC engage contractor and stipulate aggregate must comply with NZT M/4 aggregate specifications</td></tr>
<tr><td>no specifications for unsealed roads</td><td>red metal and rotten rock</td><td>AP40 and AP65 red metal and rotten rock mix for unsealed pavements and subbase</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

a. NZS 4407: 1991, Test 3.10 The Crushing Resistance Test
b. NZS 4407: 1991, Test 3.11 Weathering Quality Index Test
c. NZS 4407: 1991, Test 3.6 Sand Equivalent Test

d. tested in accordance with NZS 4407: 1991, Test 3.15 (California Bearing Ratio Test) and NZS 4402: 1986, Test 4.1.3 (New Zealand Vibrating Hammer Compaction Test at Optimum Water Content

H

APPENDIX H

Sediment Supply Context (HBRC Regional Assets Section)

Sediment supply context

Introduction
The interaction between sediment supply from the region's rivers has been studied in detail in the comprehensive report *"Hawke's Bay: Environmental Change, Shoreline Erosion & Management Issues by Dr. Paul Komar, Consulting Oceanographer, November 2005".* In particular section 7 of that report covers beach sediment sources, losses and sediment budgets. This work includes the results of model studies by Gibb (2003) and Tonkin and Taylor (2005) and represents current knowledge on the subject of sediment supply and coastal interaction. The following discussion includes the salient points from the Komar report. In addition NIWA completed for HBRC a morphological model of the Ngaruroro River *"Modelling Gravel Transport, Extraction and Bed Level Change in the Ngaruroro River; Richard Measures, October 2012"* and a similar model is under development for the Tukituki River from which similarities between the two rivers can be made and conclusions made relating to the effects of sediment supply to the coast.
Background
The shore of Hawke's Bay extends along the east coast of New Zealand's North Island, from the Mahia Peninsula in the north to beyond Cape Kidnappers in the south. The coast of Hawke Bay is characterized by alternating stretches of rocky shores and embayments that contain its principal beaches. The rocky portions — the Mahia Peninsula, the high cliffs north of Tangoio, Bluff Hill within the city of Napier, and Cape Kidnappers at the south — all represent prominent headlands that limit or entirely prevent the passage of beach sediments around them, confining the sand and gravel to within the individual embayments. For study purposes the bay is divided into a northern cell called the Bay View Littoral Cell (Tangoio to the Napier Port) and a southern cell called the Haumoana Littoral Cell (Napier Port to Cape Kidnappers).
The beaches of are composed of mixtures of gravel and sand. The pebbles and cobbles are derived from the erosion of Mesozoic rocks found within the Kaweka Mountain Range, a greywacke that originated in the deep ocean as deposits of fine-grained silt but were later metamorphosed by heat and pressure during mountain building, yielding the most resistant rocks in the Range. The gravel barrier beach that formed along the present day shoreline was largely formed from landward movement of gravels lain down on the seafloor during since the last marine transgression during the Holocene period.
A century ago four large rivers transported gravels to the plains, with some gravels reaching the coast. In 1931 the tectonic uplift produced by the Hawke's Bay earthquake raised the lower reaches of the Tutaekuri, Ngaruroro and Esk Rivers, trapping the gravel so that now those rivers only deliver sand to the Bay's shores. In contrast, with its watershed having subsided at the time of the earthquake, only the Tukituki River now represents a significant source of gravel and sand to the ocean beaches, reaching the coast. The erosion of Cape Kidnappers also supplies some greywacke gravel to the beach system.
As more intensive development and settlement of the plains took place so did the need to provide flood protection. Over the years the plains rivers have been restricted from meandering wherever and confined to a manageable channel through construction of stopbanks and channel works to provide the high standard of flood protection expected by the population that currently live and work on the plains.

Effects on coastal sediment supply of river management activity.

a. **Gravel beach raking**. Field tests, laboratory tests and morphological modelling have been carried out to determine the effects of the beach raking. All confirm that beach raking (to break up the armour layer) is effective. The model results clearly show that beach raking can increase model transport rates by up to 100%. The effects on transport rate could be less than modelled if the mixing of the bed surface substrate is less thorough in reality than that assumed in the model. (*R. Measures, Oct. 2012*). Two important conclusions can be drawn from this study. Firstly, it is clear that where beach raking is carried out there are lowered bed levels in the raked reaches and increased bed levels downstream of them. Secondly the increased transport rate with raking, results in increased supply to the coast and thus helps offset the loss of supply to the coast through extraction.

b. **Gravel extraction**. The effects of gravel extraction on the propagation of gravel downstream to the coastal reach were investigated in the morphological modelling. For the Ngaruroro the model showed that extraction had relatively little effect on bedload transport rate. Extraction changes the distribution of gravel deposition resulting in slight steepening or flattening of the bed gradients in the reach. No gravel is transported within 1.8 km of the coast.

   For the Tukituki River a similar result to the Ngaruroro modelling is obtained except that gravel does get transported to the coast even with extraction that has occurred in the past. The relationship between gravel transport to the coast and the amount of gravel that ends up on the barrier beach is currently unknown. It is assumed that if more gravel reached the coast then more gravel would be available to help form the barrier beach (mixed sand and gravel); but then gravel transport along the shore or onto the barrier beach is also a function of the wave energy, which is independent of the gravel supply. To put this another way, a 100 percent increase in gravel reaching the coast from the river, is unlikely to increase the barrier beach by an equivalent amount and the actual quantum is not known at this stage.

   One aspect of the HBRC's modelling of the Tukituki River gravel extraction is that extraction from the upper and middle reaches has had no effect on the bed levels and transport rates in the lower reaches.

   For the Tutaekuri and Esk rivers, no detailed geomorphological modelling investigation has been carried out to date. However similar observations can be made regarding the effects of extraction on coastal sediment supply. Some further comment is included later in this discussion.

Rivers contributing gravel to the coast.

As outlined by Komar (*Komar, Nov. 2015*) in the Haumoana Littoral Cell it is only the Tukituki River that supplies significant volumes of coarse-grained sediment to the coast. The Tutaekuri and Ngaruroro only yield fine sand and mud, not gravel. For the Bay View Littoral Cell only a very small amount (if any) of gravel is supplied to the coast and gravel extraction is likewise minimal. Any negative affect is more than compensated by the contribution from the Westshore re-nourishment scheme.

Komar (*Komar, Nov. 2015*) tabulates the sediment budget (sources and sinks) carried out by other researchers over the years for the two littoral cells. These give an estimate of the net gains and losses and are balance by the abrasion losses.

Sources (Credits)	**Best Estimate Annual rates m3/year**
Tukituki River	28,000
Cape Kidnappers	18,000
Total	46,000

Losses (Debits)	
Awatoto extraction	-47,8000
Pacific Beach extraction	-12,800
Gravel abrasion	-30,400
Total	-91,000
Balance of beach sediment	
South of Tukituki River	-48,800
North of Tukituki River	3,800
Net Balance	-45,000

Treating separately the gravel balance in the area north of the Tukituki River and to the south of the Tukituki River shows that there is a considerable credit of 62,400 m3/year that moves into the northern part of the cell.

South of Tukituki Littoral Cell Sources (Credits)	**Best Estimate Annual Rates m3/year**
Cape Kidnappers erosion	18,000
Losses (Debits)	
Longshore transport north	-62,400
Gravel Abrasion	-4,400
Balance of Beach Sediment	
Net Balance	-48,800

Since Komar’s 2005 report, HBRC have ceased extraction from Pacific Beach ; the consent for commercial extraction from Awatoto has expired and the indications are that it will not be renewed. This then means that there will be another 60,600 m3/year together with the 3,800 m3/year accretion, giving a net sediment balance of 64,400 m3/year. This represents a significantly greater degree of beach accretion available from 2017 onwards, north of the Tukituki River mouth.

Littoral Cell North of Tukituki, no extraction. Sources (Credits)	**Best Estimate Annual Rates m3/year**
From southern sub-cell	62,400
Tukituki River	28,000
Total	90,400
Losses (Debits)	
Gravel Abrasion	-26,000
Balance of Beach Sediment	
Net Balance	64,400

The coastal credit from the Tukituki River represents 31% of the total credit as part of the balanced sediment budget and this amount could be much reduced and not change the

beach from an accreting phase to an eroding phase. For the southern sub-cell, Komar (section 7-13) concluded that the contribution of the Tukituki River as a sediment source was not included in the sediment budget, but that the possibility cannot be ruled out entirely.
For the Bay View Littoral Cell the situation is somewhat simpler with respect to gravel extraction which has all but ceased due to the Esk River channel degradation since the mid 1970's. Average transport rates to the coast over the past decade are 3,500 m3/year, with little if any gravel. Komar has used a transport rate of 2000 m3/year representing the decades prior to 2005. There is no significant change to the sediment budget with the latter rate. The beach from just south of the Esk River to Tangoio is in an erosion phase.

Bay View Littoral Cell Sources (Credits)	**Best Estimate Annual Rates m3/year**
Esk River	2000
Beach nourishment	10000
Total	12000
Losses (Debits)	
Gravel Abrasion	-27000
Total	-27000
Balance of Beach Sediment	
Net Balance	-15000

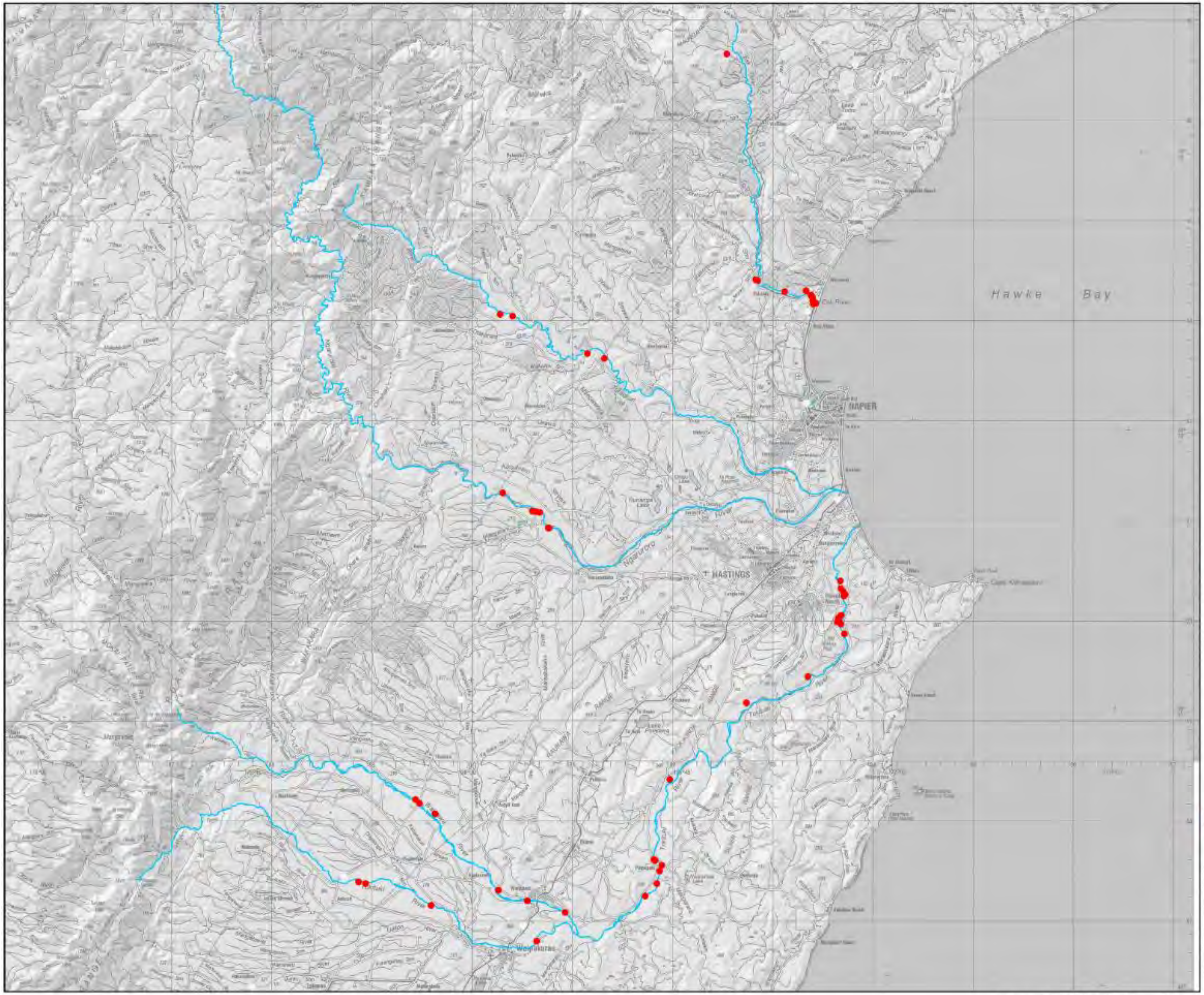
Summing up

As seen in the tables above there are relatively small amounts of sediment supply to the coast from the river systems. In the Ngaruroro River gravels are not present in the lower 1.8 km of the river system, therefore removing gravels from the mid reaches of this river will have no material effect on gravel supply to the coast. For the Tukituki River it provides approximately 31% of the gravel supply to the Haumoana Littoral Cell coastal budget north of the river and probably zero or insignificant supply south of the river. This supply is only affected by extraction in the lower reach. Preliminary modelling results indicate that extraction reduces the sediment transport rate to the coast by about 16%. On the other hand beach raking increases the sediment transport to the coast by up to 100% (similar to the Ngaruroro). The net effect is that as long as beach raking is carried out along with extraction (based on past extraction rates) the sediment transport rate to the coast is increased or at least unaffected.
The effect of extraction from the lower reach on how much gravel then accretes on the beach is not able to be quantified at present.

Ir Gary Clode
Regional Assets Manager
Hawke's Bay Regional Council
May 2017

APPENDIX H

Location of Consented Water Takes with Tukituki River



Legend

● WT_GravelExtractionConsent_Selection

Consent - Gravel Extraction

Water Take Consents

NORTH

1:350,000 (A3 Landscape)

HAWKE'S BAY
REGIONAL COUNCIL

DATA FROM: Information obtained from the Hawke's Bay Regional Council's Geographic Information Systems Database.

DISCLAIMER
The Hawke's Bay Regional Council cannot guarantee that the data shown on this map is 100% accurate.