Native Fish:

Development and Application of the River Values Assessment System (RiVAS and RiVAS+) Method to the Gisborne District Council Region

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Land Environment & People

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Executive Summary

The first application of the River Values Assessment System (RiVAS and RiVAS+) was made to the native fisheries value in Gisborne District. A modified approach involving national (to develop the system) and local (to fully implement it) expertise applied RiVAS and RiVAS+. The method was applied to differentiate native fish sites of national significance from those of regional significance or local significance. Of 13 rivers or river clusters evaluated four were considered of national significance, namely Awatere, Coastal 1, Waiapu and Wharekahika; the remainder are of regional significance. Data were modelled by Cawthron Institute based on a variety of databases including the NZFFDB and FENZ; the expert panel then checked the modelling results and adjusted where appropriate based on local knowledge. The RiVAS+ methodology was also applied (its first application to native fisheries) to assess future potential value. Of the 13 clusters, 10 altered their sum total score, all in a positive direction. The Uawa River shifted most but still remains regionally important. In total, 10 rivers were identified as having potential to improve river conditions in a way that would enhance native fishlife value. The interventions most frequently identified for enhancing native fishlife value (with the number of times it was identified across all rivers given in brackets) were: Enhance Water Quality – reduce sediment input (8), and Enhance Water Quality – remove/fence out stock (4).

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Introduction

1.1 Purpose

This report[1] presents the development, and an application, of the River Values Assessment System for existing value (RiVAS) and for potential value (RiVAS+) to native fisheries in rivers of the Gisborne District, undertaken in March 2012. Workshops were held in Richmond and online iterations occurred during much of 2011 to develop and apply the method. This Gisborne District native fisheries report needs to be read in conjunction with the method report (see Hughey et al. 2010).

1.2 Preparatory step: Establish an expert panel and identify peer reviewers

The National Expert Panel which developed the method for native fisheries was Joanne Clapcott, Eric Goodwin, Dave West, Martin Rutledge and Neil Deans assisted by Ken Hughey. Clapcott and West, aided by Jane Goodman, assembled the raw data for Gisborne. An Expert Panel of Rebecca Lander – DoC, John Lucas – DoC, Dennis Crone - Water Conservation Team Leader GDC, Paul Murphy - Senior Water Conservator GDC, Murray Palmer – Nga Mahi Te Taiao (for the RiVAS application component), assisted by Ken Hughey met on 14th March 2012 in Gisborne to 'refine' the raw data in RiVAS in light of local knowledge, and to undertake the RiVAS+ part of the process.

Credentials of the Expert Panel and peer reviewers are provided in Appendix 1.

1 The authors wish to acknowledge the earlier work and inputs made by Dr Mike Joy from Massey University to thinking about how to rank the native fisheries value. Subsequent peer reviews by Shelley McMurtrie from EOS Ecology and John Leathwick of NIWA led ultimately to the revised approach presented in this report.

Chapter 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, river segments/catchments and fish distribution information

River value context for native fishlife in Gisborne District

Sixteen native freshwater fish species and several marine wanderers inhabit freshwater ecosystems in the Gisborne District for all or part of their life-cycle. Eight of the 16 species are listed in the Department of Conservation's threat ranking system as 'at risk-in decline'.

Lamprey (*Geotria australis*) and Giant bully (*Gobiomorhus gobioides*), included in the 16 species, are not listed on the New Zealand Freshwater Fish database as being present in the Gisborne District. However it is likely that they do inhabit the District's waterways, at least in low numbers. It should be noted that compared to other regions/districts in New Zealand, Gisborne and East Cape freshwater ecosystems are under-surveyed.

Of the 16 species, 15 are known to migrate between freshwater and marine ecosystems to complete their life-cycle. Cran's bully (*Gobiomorphus basalis*) is the only native non-migratory species found in the Gisborne District. However, there is still some debate around the taxonomy of Cran's bully and their distribution, so it is possible that records of Cran's bully from the Gisborne District are mis-identifications.

The majority of the 16 species are distributed throughout the Gisborne District, however Giant kokopu (*Galaxias argenteus*) and Shortjaw kokopu (*Galaxias postvectis*) have only been recorded from waterways on the East Cape where bush cover is still present. Redfin bully (*Gobiomorphus huttoni*) and Torrentfish (*Cheimarrichthys fosteri*) are also more common in East Cape waterways than those that drain into Poverty Bay.

River value categories

There are two distinct categories of native fish in New Zealand's rivers and streams; migratory (i.e., diadromous) and non-migratory species. New Zealand's native fish fauna is predominantly migratory and this is true for the Gisborne District where 15 of the 16 native freshwater species migrate between fresh water and the sea to complete part of their lifecycle.

Due to differences in the lifecycles of migratory and non-migratory species, the distribution of these two categories of native fish can respond differently to both natural gradients and anthropogenic impacts. For example, because migratory species typically require access to the sea, their diversity and abundance is strongly influenced by elevation and distance inland (Jowett & Richardson 1996). For non-migratory species that do not require access to the sea, elevation and distance are far less likely to have an impact on the diversity and abundance of these species. Instream barriers (both natural and man-made, physical and chemical) that stop fish from migrating to and from the sea can also have a significant impact on the distribution of migratory species and yet may have a minimal impact on the distribution of non-migratory species.

Despite these differences the expert panel decided that a different approach to migratory and non-migratory species in the overall assessment will not usually be needed. This is because the fish fauna of the Gisborne District is dominated by migratory species - both migratory and non-migratory species can be found at the same locations and potential instream barriers can also limit the dispersal of non-migratory species.

River segments/catchments

Although the adult habitat of many native fish species occur in particular river segments (e.g., lowland or upper reaches), native fish habitat in rivers is usually driven by catchment scale characteristics (e.g., elevation, distance inland, proportion of indigenous forest cover); therefore a catchment scale approach is warranted. The predominance of migratory fish in New Zealand also warrant the use of a catchment scale approach rather than river segments in isolation as many fish species require access both up and downstream of the entire catchment. We have developed the method so that it can be applied at multiple scales, essentially built around the concept of catchment order, complemented by data sourced from a range of different applications but especially from the Freshwater Ecosystems of New Zealand (see http://www.doc.govt.nz/conservation/land-and-freshwater/freshwater/freshwater-ecosystems-of-new-zealand/).

The 13 management units for the Gisborne region were identified by recording the rivers listed in the report "Freshwater biodiversity in the East Coast Hawkes Bay Conservancy of the Department of Conservation" (Froude, 2003) and also including rivers that have been brought to the attention of Water Conservation staff as having value for native fish, e.g., a cluster of coastal streams in the north. The list of rivers, ordered geographically from north to south (Figure 1), was taken by Cawthron Institute and clustered by catchment, with coastal rivers being clustered with other like coastal rivers as for an assessment of native birdlife for the Gisborne region (Bull et al. 2012).

Fish distribution information

NIWA's New Zealand Freshwater Fish Database (NZFFD) provides a wealth of information on the presence and distribution of freshwater fish in New Zealand's rivers and streams with approximately 32,000 records. The Gisborne District rivers and streams have approximately 400 records (around 1% of the total records), which is relatively few in the New Zealand context (Goodman, pers. comm., March 2012). This information has not been collected evenly from all of the region's rivers and streams.

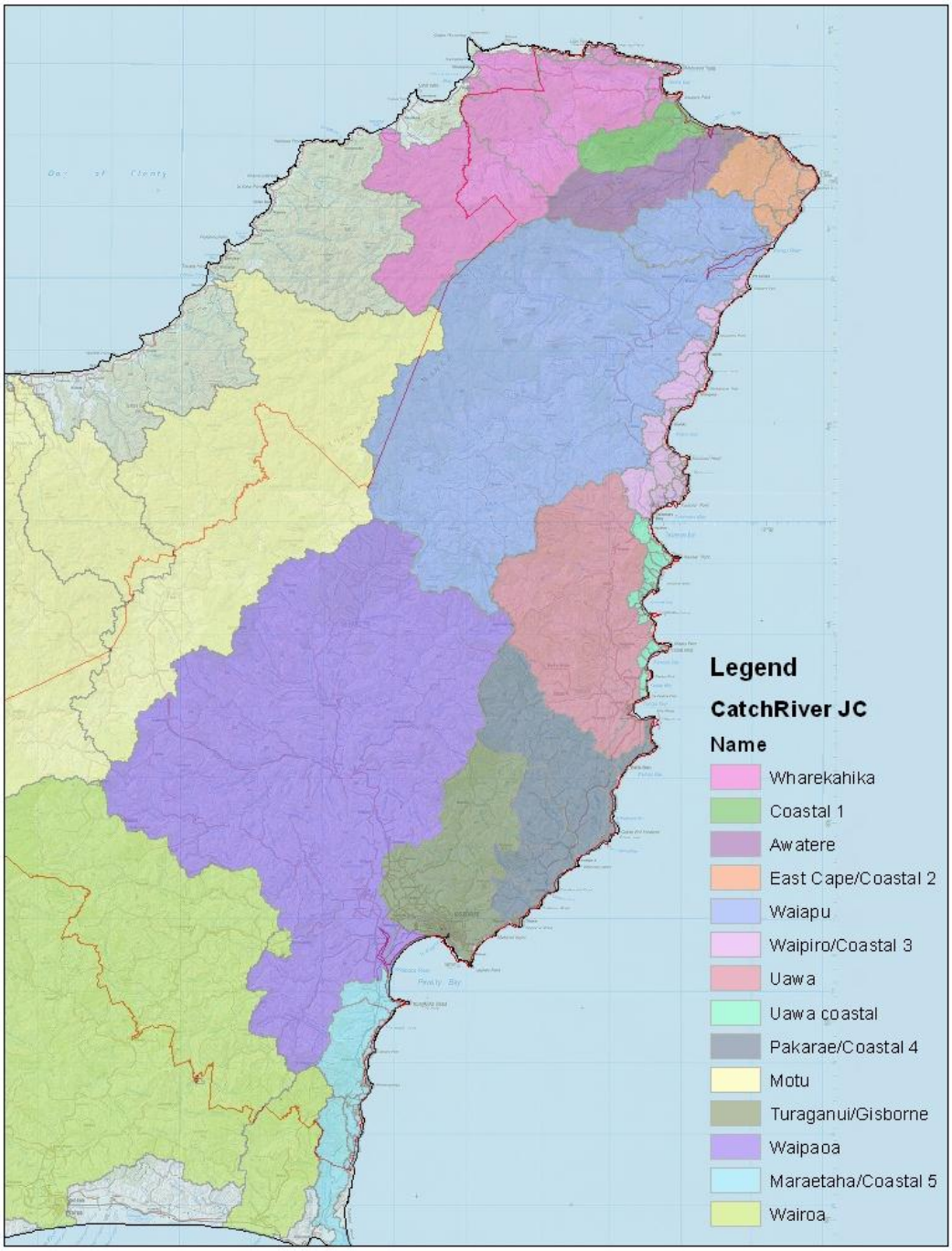
Comparing and ranking of rivers using only NZFFD data, where some rivers have many records and some rivers have none, is therefore not appropriate as they cannot be objectively assessed and there will always be a bias towards rivers and streams that have been sampled more frequently (i.e., there is more chance of recording a threatened species in a river that has been fished than a river that has not).

To help overcome the spatial variability of fish information, and to complement existing data in the NZFFD, source data from the FENZ and other databases was incorporated into this assessment process. The predictive modelling effectively fills in the gaps for rivers where there are few or no fishing records in the NZFFD. The model provides very accurate probabilities of the occurrence for each fish species in all of the district's rivers and streams and can be used to give an objective, consistent and accurate assessment of where fish will be present.

An additional threatened species score for each river was calculated from the NZFFDB presence per catchment, by applying a weighting to each threatened species based on their threat status listed in Allibone et al. (2009).

Existing data in the NZFFD, along with data from FENZ and threatened species scores, were used to evaluate and rank the fish communities for the different river catchments in the region.

Figure 1
River clusters for native fish in Gisborne District



Other Considerations

When applying this method in the Gisborne District, it wasn't considered appropriate to treat migratory and non-migratory species separately, however, in some regions it might be, especially when the non-migratory species have extremely high conservation interest (e.g., much of the east coast of the South Island). However, at this stage, it was considered that rivers with these species would gain recognition by attributes that also take into account the threatened status of a species.

Records in NIWA's NZFFD span a significant period of time (e.g., in the Gisborne District there are records from the 1960s). NZFFD records older than 10-20 years may no longer represent the actual fish communities in the river fished. A cut-off time period was discussed by the Expert Panel but it decided to use Expert Panel discretion in determining whether older NZFFD records were still relevant (i.e., compare them to more recent NZFFD records if available and/or consider the effects of any landuse changes over time). If older NZFFD records were not considered to be still relevant they were not used in this process.

Lakes, wetlands and estuaries can all have significant native fish values, and while in many cases they are intricately linked with river and stream ecosystems, differences in habitat and some differences in the species likely to occur within that habitat (e.g., estuaries are often populated by a mixture of both freshwater and marine species) mean that it would be inappropriate to assess these habitat types alongside rivers. Therefore a separate evaluation for each different habitat (e.g., lakes, wetlands and estuaries) is required.

Outcomes

Treat all native freshwater fish the same (no separate categories for migratory and non-migratory species).

Assess freshwater fish communities at the whole catchment scale or the sub-catchment scale in the case of large rivers.

Use NZFFD data, along with FENZ and threatened species scores, to evaluate and rank the fish communities in the different river catchments.

Step 2: Identify attributes

Attributes which describe the native fish values were based on generally accepted variables with implications for the intrinsic values of the native fisheries of rivers. Attributes were decided on by the expert panel. A number of additional attributes were considered but not included because of their degree of overlap with the primary attributes selected.

Attributes encompass only one of the four well-beings defined in the Local Government Act (i.e., environmental). Social (e.g., whitebaiting activity – see Booth et al. in prep.), economic (e.g., commercial fishing), and cultural (e.g., traditional fisheries) are also relevant for native fish and further discussion is needed on how this might be addressed, or if iwi values for rivers should be expressed separately to all others (Tipa 2010).

Two primary sources of 'hard' data drive most of the attributes, namely the Freshwater Ecosytems of New Zealand (FENZ) (see: http://www.doc.govt.nz/conservation/land-and-freshwater/freshwater/freshwater-ecosystems-of-new-zealand/), and the New Zealand Freshwater Fisheries Database (NZFFD) (see: http://www.niwa.co.nz/our-services/online-services/freshwater-fish-database).

The FENZ is described by the Department of Conservation (http://www.doc.govt.nz/conservation/land-and-freshwater/freshwater/freshwater-ecosystems-of-new-zealand/) as "… a large set of spatial data layers and supporting information on New Zealand's rivers, lakes and wetlands. It contains data gathered from a wide variety of sources. It can be used to objectively map and quantify various aspects of New Zealand's freshwater, providing:

- Comprehensive descriptions of the physical environment and biological character.
- Classifications that group together rivers and streams, lakes and wetlands having similar ecological character.
- Estimates of human pressures and impacts on biodiversity status.
- Rankings of biodiversity value that indicate a minimum set of sites that would provide representative protection of a full range of freshwater ecosystems while taking account of both human pressures and connectivity."

The NZFFD is described by NIWA (http://www.niwa.co.nz/our-services/online-services/freshwater-fish-database) as recording "the occurrence of fish in fresh waters of New Zealand, including major offshore islands. Data stored include the site location, the species present, their abundance and size, as well as information such as the fishing method used and a physical description of the site. The latter includes an assessment of the habitat type, substrate type, available fish cover, catchment vegetation, riparian vegetation, water widths and depths, and some water quality measures. Data, which are recorded in the field on pre-printed forms (see a sample record), are contributed voluntarily by NIWA, fish and game councils, the Department of Conservation, regional councils, environment consultants, universities, and interested individuals. Access to the data requires registration and users are encouraged to contribute data".

Outcome

A list of all attributes selected is provided in Appendix 2. Attributes considered but not selected are also listed.

Step 3: Select and describe primary attributes

From the list of attributes outlined in Step 2, primary attributes were selected to represent key variables affecting the native fish values of rivers. Selection was based on:

1. The need for pragmatism – 10 attributes were identified but these were considered to be the most important and to describe most of the variation around relative importance.
2. Expert panel members' opinions about the contribution of attributes to an understanding of the native fishery.
3. Keeping the amount of overlap between attributes to a minimum (one reason for not selecting some attributes was the amount of overlap with selected attributes).

Outcome

Appendix 2 identifies the 10 primary attributes (in bold) and describes them, with emphasis on explanation of the attribute's validity and reliability as a representative measure of native fish river value.

Step 4: Identify indicators

One indicator for each primary attribute was identified, using SMARTA criteria (see Hughey et al. 2010), based on:

1. Existing data from GIS (e.g., land use and catchment order data from the River Environment Classification (Snelder et al. 2002)), NIWA's NZFFD, the FENZ source data (Leathwick et al. 2008), and documentation on instream structures (barriers) in the Gisborne District (Armstrong, 2008)
2. Expert Panel judgment.

Appendix 3 shows the assessment of each indicator against the SMARTA criteria.

No primary attributes were dropped, although for some indicators it was recognised that there was a lack of hard data that would limit an objective approach during the assessment process. However, it was deemed that even a subjective assessment of these indicators would add value to the overall assessment and river ranking process.

Outcome

Indicators are listed in Appendix 2 and assessed against SMARTA criteria in Appendix 3.

Step 5: Determine indicator thresholds

Thresholds were applied to each indicator in an attempt to determine high, medium and low relative significance. Thresholds for each indicator were defined by real data for virtually all indicators of Primary Attributes, or largely by Expert Panel judgment (e.g., Primary Attribute 5: Key population of threatened species ('Stronghold')). The threshold 'cut offs' were based on expert opinion and further work is likely required to justify the relationships between these 'cut offs' and 'hard' data.

In most cases thresholds were determined to allow for three (and occasionally a fourth) different thresholds (high (3), medium (2), low (1) and occasionally no importance (0)).

Outcome

Thresholds are identified in Appendix 2.

Step 6: Apply indicators and indicator thresholds

Most indicators were assessed using objective data and in these cases data were kept in their original format (e.g., Primary Attribute 4: Number of Declining Species) to assist the Expert Panel when evaluating the data, and to help achieve a transparent process.

Some indicators (for Primary Attribute 5: Key population of threatened species ('Stronghold')) were assessed by the Expert Panel opinion due to a lack of available hard data. While this was a subjective process and is not ideal, this indicator and attribute was deemed important enough that a subjective assessment was better than no assessment at all.

Outcome

Applications of the thresholds are given in Appendix 4.

Step 7: Weight the primary attributes

The 10 primary attributes were considered to make an equal contribution to native fish life as a whole. The decision was reached to keep weightings equal.

Outcome

Equal weighting.

Step 8: Determine river significance

Step 8a: Rank rivers

A spreadsheet was used to sum the indicator threshold scores for each river. The spreadsheet for a selection of rivers is set out in Appendix 4. Since we had chosen to equally weight the primary attributes, we did not have to first multiply the threshold scores by the weights.

Step 8b: Identify river significance

Using the ranked list from Step 8a, the Expert Panel examined the rivers, and their attribute scores. The following criteria were applied:

National significance:
Criterion 1: Total score of all indicator columns is 24 or more; or
Criterion 2: Declining species score 3.
Regional significance:
Rivers that are not of local or of national significance.
Local significance:
Criterion 1: Total score of all indicator columns is 15 or less, and declining species score is 1 or less then local.

Translation of these functions to rivers is shown in Appendix 4.

Outcome

A list of rivers ranked by a scoring system from highest to lowest, which represents an initial significance ranking list. See Appendix 4.
Rivers identified as significant at the national, regional and local level. See Appendix 4.

Step 9: Outline other factors relevant to the assessment of significance

Perhaps the most telling issue concerns the availability of relevant and up-to-date data which is of a resolution high enough to objectively assess and rank all rivers and streams in the region. This, along with the lack of hard data to assess impacts such as low flows and instream barriers on the native fish fauna, makes an objective assessment of the native fish values of all rivers and streams in the Gisborne District problematic at best.

Outcome

Complement existing data on freshwater fish distribution with data from predictive models and use subjective indicators where no hard data is available.

Chapter 3
Application of the RiVAS+ Methodology

Step 10: Identify rivers and interventions

Rivers for potential state assessment

The 13 river clusters identified in the RiVAS assessment (see Appendix 4) were used as the basis for the RiVAS+ analysis.

No new river reaches were added that represent rivers with potential value for native fishlife 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. Enhance access		
	a. Helicopter access	
	b. Vehicle access	
	c. Boat access	
	d. 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 (or similar – includes small weirs and pump stations)	
	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 (and/or achieve other outcomes0		
	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, storm water in urban environments)	
	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)		

Appendix 5 lists the Gisborne District river sections used for the RiVAS+ assessment.
Table 1 and Appendix 5 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 5.

Then the Panel considered the net effect of these interventions upon the value of the river to native fishlife. 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 fishlife 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 fishlife, 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).

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 5 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 13 clusters, 10 altered their sum total score, all in a positive direction. The Uawa River shifted most (by 2.5 points, from 20 to 22.5), but still remains regionally important. The main reason for the large change relates to fencing of inanga spawning sites to raise the score of this indicator from 1 (current) to 3.

All other rivers recorded small shifts in value, with no consequential change in their river importance classification.

In total, 10 rivers were identified as having potential to improve river conditions in a way that would enhance native fishlife value. The interventions most frequently identified for enhancing native fishlife value (with the number of times it was identified across all rivers given in brackets) were:

1. 7d, Enhance Water Quality – reduce sediment input (8)
2. 7a, Enhance Water Quality – remove/fence out stock (4)
3. 4a/b, Remove or mitigate fish barriers – (a) culverts (1); (b) dams (weirs in GDC) (1).

Outcomes

Appendix 5 and Appendix 6 provide a list of rivers ranked by their potential increase in value for native fishlife, with possible interventions identified for each river.

Step 14: Review assessment process and identify future information requirements

There is a real lack of NZFFD data for the region. Targeted sampling of key waterways should occur, including gathering MCI data where possible.

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Appendix 1
Credentials of the Expert Panel members

The Expert Panel comprised six members. Their credentials are:

Dr Joanne Clapcott is a freshwater ecologist with Cawthron Institute and specialises in the ecological function of steam ecosystems and the development of robust stream health indicators. Joanne has over 10 years of experience in freshwater science and works extensively with central and local governments in New Zealand to improve the management of freshwater environments. Joanne has experience with national native fish datasets and spatial analyses to characterise the relationship between fish communities, land use and environmental variability.

Eric Goodwin is a scientific data analyst with Cawthron Institute. Eric has statistical and spatial analysis expertise which he uses to develop broad-scale models of environmental data to inform coastal and freshwater management. Recently, Eric has worked with regional and national datasets to examine spatial patterns in fish and other freshwater biota, predict stream health, and model contaminant dispersal patterns in and around coastal developments.

Dr David West did his MSc researching freshwater fish communities in pasture and native forest sites in the Waikato rivers, then worked for NIWA doing research on native fish tolerances to environmental conditions, e.g. temperature, sediment, pH. He moved to DOC where he applied freshwater information to management, got a scholarship from Scion and Landcare Research to do a PhD at Waikato University on effects of point source discharges on freshwater fish resident in discharge plumes into the Waikato River. Worked as a PostDoc in Canada researching effects of mines on aquatic communities using slimey sculpin as a indicator fish species. Now back in New Zealand as a Scientifc Advisor for the Freshwater Section of DOC Science and technical doing everything from developing methods to remove exotic fish from streams to developing & supporting the use of geospatial models such as FENZ.

Rebecca Lander is the Freshwater Technical Support Officer for the East Coast Bay of Plenty Conservancy of the Department of Conservation, and has become familiar with waterways and freshwater issues in the Gisborne region over the past three years. She has also spent five years working as a DOC Biodiversity Ranger and has a BSc (Hons) in Ecology and Environmental Management.

Jane Goodman has an MSc (Hons) in freshwater ecology. She is currently employed by the Department of Conservation as a Freshwater Technical Support Officer (TSO) based in Hamilton and is the leader of the Large Galaxiid Recovery Group. In a previous role Jane worked for the Department of Conservation in Gisborne for 6 years as a Freshwater TSO.

John Lucas is employed as a Programme Manager Biodiversity for the Department of Conservation, Gisborne/Whakatane Area office. He has worked in Gisborne for 15 years, employed initially with Eastern Fish and Game then the Department of Conservation as a technical support officer.

Dennis Crone is Team Leader Water Conservation at GDC. This team is responsible for processing consents for activities in water bodies. This provides opportunity to be familiar with rivers and streams throughout the district. His background is in Agricultural Science and recently as a soil conservator with GDC after positions within MAF as a Senior Policy Analyst and area manager of MAF Technology. Knowledge in regard to native fisheries in the district is from observation and interest rather than an academic background.

Paul Murphy is a Senior Water Conservator at GDC. He has 7 years experience in the Water Resources Section of the Gisborne District Council managing water issues throughout the Gisborne Region.

Murray Palmer is a member of the Freshwater Advisory Group for the development of the Gisborne District Council Freshwater Management Plan and is director at Nga Mahi Te Taiao, an independent

resource management consultancy. Murray has Bachelors degree from Massey University with majors in Philosophy and Environmental Science, a Post-graduate Diploma in Resource and Environmental Planning, and is currently completing a Post-graduate Diploma in Maori Resource and Environmental Management. In the field of freshwater ecology and management, Murray has produced research reports and planning documents for Māori Trusts, marae and environmental consultants. His present research focus is around land use impacts on freshwater biological condition in Te Tairawhiti. Murray also has experience as an environmental educator and is currently contracted to the Ministry of Education and the Department of Conservation to deliver freshwater science education to schools and communities.

The panel was assisted by **Ken Hughey** (Professor of Environmental Management, Lincoln University). Ken was formerly employed by the Department of Conservation and one area of responsibility was native fisheries management in Canterbury and on the Chatham Islands. Ken has been largely responsible for managing the development of the River Values Assessment System (RiVAS).

Appendix 2
Assessment criteria for native fish (Steps 2-4)

ATTRIBUTE CLUSTERS	ATTRIBUTE (primary attributes in bold)	DESCRIPTION OF PRIMARY ATTRIBUTES	INDICATORS	INDICATOR SIGNIFICANCE THRESHOLDS	DATA SOURCES and SPECIFIC APPLICATION to GDC (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	
Numbers	**1. Abundance of fish (Fish)**	Compilation of the named species using the reach rated by relative abundance	Continuous variable (estimated total fish abundance) for each area – natural breaks in data at a regional scale to inform scores	3 = high estimated abundance of native species; 2 = moderate estimated abundance of native species; 1 = low estimated abundance of native species	NZFFD for species diversity and then expert input on relative abundance of each. Note that for some areas, including GDC there is a limited number of records. Specifically, based on the average abundance of native fish (22 species): • use “native abundance" spread sheet in GDC NZFFD data.xls • Range in values: min = 0, max = 236, mean = 31 • For each GDC13 sum (total spp/total reach length sampled) • REPORT: 1. Average number native fish AND 2. Regional score 1,2,3
	2. Inanga spawning site (Spawning)	Known or surmised areas of whitebait spawning	Raw data	Raw number of spawning sites per river: 3 = 2+ known sites; 2= 1 spawning sites;	DoC Regional Inanga Spawning records (Obj.) added to by Expert Panel opinion (Subj.). Specifically: DOC spawning records

ATTRIBUTE CLUSTERS	ATTRIBUTE (primary attributes in bold)	DESCRIPTION OF PRIMARY ATTRIBUTES	INDICATORS	INDICATOR SIGNIFICANCE THRESHOLDS	DATA SOURCES and SPECIFIC APPLICATION to GDC (and reliability)
				1= likely but not known; 0 = unlikely. (Note expert panel adjustment possible – record why)	• Plot location of 8 sites – use "jc" spread sheet in GDC inanga spawning.xls • Score 0 = no known spawning sites, 1 = likely spawning but not known (expert panel to assess whether 0 or 1), 2 = 1 spawning sites, 3 = 2+ spawning sites • REPORT: 1. Number of sites AND 2. Defined score 0,1,2,3
Scarcity, Diversity, Benefits	Fish community	Biogeographic and/or regional recruitment contexts. Expected fish species diversity vs. found show healthy fish communities. Consider guilds.	Unknown		Mined from other attributes (Obj.) plus expert opinion (Subj.)
	3. Diadromous predictions (Diadromous)	FENZ provides the ability to predict which diadromous species will occur in particular locations/reaches. This data can	Continuous variable (sum probability of occurrence) for each 3rd order catchment (length-based aggregation), and natural breaks at national scale to inform scores	3= relatively high probability of occurrence 2= moderate probability of occurrence 1= relatively low probability of occurrence	FENZ (Obj.) and then to EP for reconsideration. Predictive feature. Specifically: • Use national analysis [use sum of the probability of occurrence of 15 spp length weighted at the 3rd order group should be viewed at the national scale to inform natural breaks and assign 1,2,3] • Length weighted aggregation (e.g. sum (probability)/total stream length) to inform GDC13

ATTRIBUTE CLUSTERS	ATTRIBUTE (primary attributes in bold)	DESCRIPTION OF PRIMARY ATTRIBUTES	INDICATORS	INDICATOR SIGNIFICANCE THRESHOLDS	DATA SOURCES and SPECIFIC APPLICATION to GDC (and reliability)
		be used to capture diversity, richness etc			score • REPORT: 1. Average national score AND 2. Regional score 1,2,3
	4. Number of Critical, Endangered or Vulnerable fish spp. (Declining species)	Provides a snapshot of the importance of the river for species 'at risk' (includes declining, recovering, relict, naturally uncommon – for NZ = 17 described species (Allibone et al. 2010))	Named species and their conservation status	3= 7 (or more) declining or 1 or more nationally endangered spp; 2= 4 (or more) declining or 1 or more nationally vulnerable; 1 = 1 (or more) declining spp; 0 = No Threatened or At risk-declining spp.	NZFFD (Obj.). EP to consider as yet undescribed species, and related issues. Specifically: • use '"native abundance" spread sheet in GDC NZFFD data.xls. This is the sum number of unique species labelled as declining (n = 9; NO critical, endangered or vulnerable in GDC) • Score 0 = none declining, 1 = 1 or more declining, 2 = 4 or more declining and/or 1+ vulnerable, 3 = 7 or more declining and/or 1+ vulnerable • REPORT: 1. Number declining species AND 2. Defined score 0, 1,2,3
	Number of Declining fish species	Similar to above	Named species 5 spp	Similar to birdlife and related to defined conservation status	NZFFD & FENZ Predicted (Obj.)
	5. Key population Threatened species	Provides a measure of relative importance of	Named species and relative regional or national proportions of populations	3 = One (or more) population(s) considered to be of national importance;	NZFFD (and recovery Plans (Obj.) and Expert Opinion (Subj.). Use NZFFD. Scan and rank order by species.

ATTRIBUTE CLUSTERS	ATTRIBUTE (primary attributes in bold)	DESCRIPTION OF PRIMARY ATTRIBUTES	INDICATORS	INDICATOR SIGNIFICANCE THRESHOLDS	DATA SOURCES and SPECIFIC APPLICATION to GDC (and reliability)
	(Stronghold)	rivers as strongholds for populations of 'threatened or at risk' species in New Zealand. Multiple criteria used in recovery plans including scientific, so make it EP Same list as above.	thought to be there in 5% classes. Populations key to the ongoing 'survival' of the species. Get EP to consider: 1. If basically only region with the fish then 5 sites 2. Max 3 otherwise	2 = More than one population(s) considered to be of regional importance; 1 = At least one population of an at risk species of regional stronghold importance recorded in the catchment; 0 = No stronghold populations of threatened species recorded in the catchment.	Specifically: • Plot location of sites (DoC) • Score cluster 0 = no strongholds, 1 = at least 1 population stronghold at risk of regional importance, 2 = 2+ populations of regional importance, 3 = 1+ population of national importance • REPORT: 1. Number of sites AND 2. Defined score 0,1,2,3
Water quantity & quality)	**6. Flow regime integrity (Flow)**	Water abstraction is one pressure that affects the integrity of natural flow regimes. The greater the abstraction the lesser the integrity. This is	Continuous variable and 1-3 score for each 3rd order catchment (score first then aggregate – length based); natural breaks at national level to inform average regional scores Water allocation pressure spatial layer	3 = relatively no water abstraction pressure; 2 = moderate water abstraction pressure; 1 = relatively high water abstraction pressure.	RC abstraction database (Obj.). Proposed National Environmental Standards on Ecological Flows: a. For all NZREACH segments where SegFlow <= 5 cumecsWhen SegProLowFlow = 1 score 3 When SegProLowFlow >0.9 score 2 >>>0 records When SegProLowFlow <0.9 score 1 >>>677 records b. For all NZREACH segments where SegFlow > 5 cumecs When SegProLowFlow = 1 score 3 When SegProLowFlow >0.8 score 2 >>>0 records When SegProLowFlow <0.8 score 1 >>> 669 records

ATTRIBUTE CLUSTERS	ATTRIBUTE (primary attributes in bold)	DESCRIPTION OF PRIMARY ATTRIBUTES	INDICATORS	INDICATOR SIGNIFICANCE THRESHOLDS	DATA SOURCES and SPECIFIC APPLICATION to GDC (and reliability)
		just one indicator of integrity.	based on data up to and including 2006 which looks at the proportion of consented water takes in relation to mean annual low flow (most recent layer not used because calculations based on mean flow); scores based on adherence to Proposed National Environmental Standards on Ecological Flows. Note – EP to update to evaluate whether takes are active.		[When SegProLowFlow = 1 >>>20583 records] c. Averaged values for 3rd order catchment Complemented by EP – existing use, timing of use, length of use. Specifically: • Use national analysis [Using water allocation scores (SegPFlw123). Proportion of low flow remaining after allocated takes is viewed in relation to proposed NEF standards. For example, score 1 when flow <= 5 cumecs and flow remaining is <0.9 low flow. Assign NES standards to national data set. View length-weighted aggregation at 3rd order group and assign scores based on natural breaks] • Length weighted aggregation (e.g. sum (probability)/total stream length) to inform GDC13 score • REPORT: 1. Mean national score AND 2. Regional score 1,2,3
	7. Water Quality (WQ)	Water quality can be measured in multiple ways and not all parameters can be included in	Adopted a 'minimum operator' approach () a. If sediment cover <20% = pass; if NO3N < 1.7 = pass; if MCI > 100 = pass b. If 0 or 1	3 = best water quality; 2 = average water quality; 1= worst water quality.	a. Fine sediment cover spatial layer and sediment guidelines; b. NO3N spatial layer and nitrate toxicity guidelines; c. MCI spatial layer and MCI recommended guidelines Specifically: • Using water quality score (wq2). Includes assessment of predicted MCI, nitrate and sediment values viewed in

ATTRIBUTE CLUSTERS	ATTRIBUTE (primary attributes in bold)	DESCRIPTION OF PRIMARY ATTRIBUTES	INDICATORS	INDICATOR SIGNIFICANCE THRESHOLDS	DATA SOURCES and SPECIFIC APPLICATION to GDC (and reliability)
		an evaluation index. To this end it was decided to consider sediment, N toxicity and MCI and to use a decision support tool to determine indicator significance. Temperature was not included because all streams have less than 20°C in the predicted mean summer temperature spatial layer in FENZ	components passed = 1, worst water quality; if 2 passed = 2, average water quality; if 3 passed = 3, best water quality Ultimately a continuous variable and 1-3 score for each 3rd order catchment (score first then aggregate – length based); regional breaks to inform scores then aggregated to area (length-based)		relation to 'healthy water' guidelines. For example, score 3 = MCI > 100, sediment < 20% and nitrate < 1.7 ppm • Length-weighted aggregation (e.g. sum(score*length)/sum(length)) at GDC13 level • REPORT: 1. Average regional score AND 2. Regional score 1,2,3
Natural environment	**8. Introduced fauna (Fauna)**	Presence of introduced	Maximum probability of **9** introduced fish	3 = little or no presence or impact from	FENZ base layer exotic, informed by Expert Panel opinion (Subj.).

ATTRIBUTE CLUSTERS	ATTRIBUTE (primary attributes in bold)	DESCRIPTION OF PRIMARY ATTRIBUTES	INDICATORS	INDICATOR SIGNIFICANCE THRESHOLDS	DATA SOURCES and SPECIFIC APPLICATION to GDC (and reliability)
		fauna (introduced fish)	species for a given segment, then length-weighted aggregation: then national natural breaks to inform score; area average to inform regional score Same as attribute 3	introduced fauna ; 2 = moderate level presence of introduced fauna likely having a moderate, but survivable, population level impact on native fish; 1 = Dominating presence of life threatening introduced fauna having/or likely to be having a severe population level impact on native fish.	Specifically: • Use national 3PLU analysis [Sum of regional probabilities length weighted to 3rd order, viewed at a national scale using natural breaks to inform scores] • Length weighted aggregation (e.g. sum (probability)/total stream length) to inform GDC13 score • REPORT: 1. Average national score AND 2. Regional score 1,2,3
	9. Physical Barriers	'Human made' structures that fully or partially prevent up- and/or down-stream fish movements	Location of barrier and calculated proportion of stream length within 20km of river length affected upstream of barrier. 20% and <20km = 1; <20% and >20km = 2; ==3	3 = no barriers known; 2 = barrier(s) present but having minimal impact on the fish fauna (e.g., <20% of stream length 20km to coast above a barrier); 1 = barrier(s) having some impact on the fish fauna (e.g., >20% of stream length 20km to	Regional Council databases. FENZ base layers (Obj.). EP local knowledge. Specifically: • Plot location of 41 barriers – use "jc" spreadsheet in S:\New_S\Projects\FRST\FVO\GisborneFreshWater\GDC Fish passage barriers.xls • Plot nz-mainland-dam-centreline • Spatial analysis to inform scores 1 = barriers effect >20% of stream length within 20km of coastline (stream length), 2 = barriers effect <20% stream length within 20km of coastline, 3 = no barriers

ATTRIBUTE CLUSTERS	ATTRIBUTE (primary attributes in bold)	DESCRIPTION OF PRIMARY ATTRIBUTES	INDICATORS	INDICATOR SIGNIFICANCE THRESHOLDS	DATA SOURCES and SPECIFIC APPLICATION to GDC (and reliability)
				coast above a barrier).	• REPORT: 1. Proportion of zone affected AND 2. Defined score 1,2,3
	Channelisation	Acts as descriptor of in-river channel condition which is a driver of habitat condition for native fish.	Proportion of river length within 20km of coast with an immediate (i.e., adjacent) embankment/ channelization effect.	3= <5%; virtually no artificial structures or channelization; 2= 5-30%; a moderate level of channelisation etc; 1= >30%; a small proportion remains in a natural channel form; 0= Totally channelised, isolated etc.	Embankment feature (Obj)
	10. Functioning riparian zone (Riparian shading)	An evaluation of the value of the riparian margin contribution to native fish habitat	Riparian shade in FENZ reflects riparian vegetation composition (potential food source and habitat availability for fish) and shading of channel (temperature control of habitat). Continuous shade variable aggregated (length based) then scored.	3= High shade (>60%) maintains temperature and provides food sources; 2= 20%-60% shade provides some structure and function; 1= <20% shade suggests poor fish habitat.	FENZ base layer (Obj.), informed then by EP (Subj.). Specifically: • Use SegRipShade • Length-weighted aggregation (e.g. Sum (SegRipShade * stream length)/ Sum(stream length)) at GDC13 level • Score 1 = <20%, 2 = 20-60%, 3 =>60% • REPORT: 1. Average riparian cover AND 2. Defined score 1,2,3

Appendix 3
Assessment of indicators by SMARTA criteria

Indicator	Specific	Measurable	Achievable	Relevant	Timely	Already in use
1. Abundance of fish (Fish)	Yes	NZFFD and EP estimates	Data available although limited in some areas; complemented by EP	Abundance has a link to relative importance	Data available + some EP input	To a limited extent although not universally applied
2. Inanga spawning site (Spawning)	Yes	DoC records; Surveyed identified sites or suspected sites	Data available although limited in some areas; complemented by EP	Known spawning important for native fisheries conservation	Data available + some EP input	Yes
3. Diadromous predictions (Diadromous)	Yes	FENZ predictive modelling	Based on existing FENZ modelling	High diversity means high importance	Data available + some EP input	Yes, but not widely implemented, yet
4. Number of Critical, Endangered or Vulnerable fish spp. (Declining species)	Yes	List of known species - NZFFD	Data available although limited in some areas; complemented by EP	High number links to high importance	Data available + some EP input	Yes
5. Key population Threatened species (Stronghold)	Yes	Expert knowledge; species recovery plans	Relevant experts available with local knowledge	Key sites important for conservation	Data available + some EP input	To a limited extent although not universally applied
6. Flow regime integrity (Flow)	Yes	RC abstraction database	Data available	Flow integrity important for native fish	Data available + some EP input	Yes
7. Water Quality (WQ)	Yes	Combination of sediment, NO3N and MCI	Data available although limited in some areas;	Many species require high water quality	Data available + some EP input	Yes, although not in this form

Indicator	Specific	Measurable	Achievable	Relevant	Timely	Already in use
			complemented by EP			
8. Introduced fauna (Fauna)	Yes	FENZ base layer	Based on existing FENZ data	Low impact of invasives improves importance	Data available + some EP input	Yes
9. Physical Barriers	Yes	RC database and FENZ layer	Data available	A low number of barriers raises importance	Data available + some EP input	Yes
10. Functioning riparian zone (Riparian shading)	Yes	FENZ base layer	Based on existing FENZ modelling	Intact riparian zones relate to higher levels of importance	Data available + some EP input	To a limited extent although not universally applied

Appendix 4
Significance assessment calculations for native fishlife (Steps 1 and 5-8)

	1 Fish Score		2 Spawning Score		3 Diadromous Score		4 Declining Species Score		5 Stronghold Score		6 Flow Score		7 WQ Score			8 Introduced Fauna Score		9 Physical Barrier Score		10 Riparian Shading Score				
	Average number native fish	Regional score	Number of whitebait sites	Defined score	Average national score	Regional score	Number declining species	Defined score	Number of stronghold sites	Defined score	Average national score	Regional score	Average regional score	Regional score	Expert panel	Average national score	Regional score	Proportion of zone affected	Defined score	Average riparian cover	Defined score	Sum	Importance	Comments
Awatere	4941	1	1	2	2.2	2	7	3	GK, SJK	3	3.0	3	2.5	2	3	3.0	3	0.00	3	0.52	2	25	National	Giant kokopu probably also SJK – significant because there are very few populations on the East Coast of New Zealand, probably heading towards going locally extinct due to reduced recruitment
Coastal 1	6520	1	1	2	2.5	2	9	3	GK, SJK	3	3.0	3	2.6	3	3	2.9	3	0.00	3	0.59	3	26	National	Giant kokopu probably also SJK – as above
East Cape/ Coastal 2	11278	1	0	0	2.9	3	3	1	BK	2	3.0	3	2.6	3	3	2.6	3	0.00	3	0.71	3	22	Regional	Good populations of Banded kokopu
Maraetaha/ Coastal 5	5608	1	1	1	2.1	2	3	1	LFE	1	3.0	3	2.0	1	2	2.3	2	0.00	3	0.58	3	19	Regional	Ranked all sites at least as regional importance – the East Cape and Poverty Bay Streams are regional and potentially could say national strongholds for longfin eels, still good numbers around throughout catchments
Motu	13314	1	1	1	1.8	1	5	2	SJK, LFE	3	3.0	3	2.8	3	2	2.5	2	0.00	3	0.56	2	20	Regional	Old records or SJK, pretty sure there is no fishing for longfin eel – one of only a handful of rivers in NZ
Pakarae/ Coastal 4	6482	1	0	0	2.3	2	2	1	LFE	1	3.0	3	1.6	1	2	2.8	3	0.01	2	0.49	2	17	Regional	Longfin eel
Turanganui/ Gisborne	5255	1	1	1	2.4	2	3	1	LFE	1	2.8	2	1.5	1	2	2.7	2	0.04	2	0.54	2	16	Regional	Longfin eel
Uawa	22584	2	1	1	2.2	2	4	2	LFE	1	3.0	3	2.1	1	2	2.8	3	0.01	2	0.55	2	20	Regional	Longfin eel
Waiapu	35644	2	0	0	1.7	1	7	3	LFE	1	3.0	3	2.6	3	2	3.0	2	0.00	3	0.50	2	19	National	Longfin eel
Waipaoa	59885	3	1	2	1.7	1	6	2	LFE, K	3	2.9	1	2.1	1	1	2.9	2	0.03	2	0.51	2	19	Regional	Stronghold for longfin eel – could say either regional or national importance, The Te Arai (waterworks bush) has a good population of koaro, one of very few streams (only one I saw) that flows in to Poverty Bay with koaro
Waipiro/ Coastal 3	5570	1	0	0	2.2	2	3	1	LFE	1	3.0	3	2.8	3	3	2.8	3	0.00	3	0.64	3	20	Regional	Longfin eel
Wairoa	58545	3	2	2	1.4	1	5	2	LFE	1	2.9	2	2.4	2	2	2.6	2	0.00	3	0.53	2	20	Regional	Longfin eel
Wharekahika	27755	2	3	3	2.3	2	8	3	GK, SJK	3	3.0	3	2.8	3	3	2.9	3	0.01	3	0.51	3	28	National	Giant kokopu probably also SJK – significant because there are very few populations on the East Coast of New Zealand, probably heading towards going locally extinct due to reduced recruitment

1 Sp. GK = Giant Kokupu; SJK = Short Jawed Kokupu; BK = Banded Kokupu; LFE = Long Finned Eel; K= Koaro

Codes

River	Declining species present									Number
Awatere	Longfin eel	Torrentfish	Giant kokopu	Koaro	Inanga	Short jaw kokopu		Redfin bully		7
Coastal 1	Longfin eel	Torrentfish	Giant kokopu	Koaro	Inanga	Short jaw kokopu	Bluegill bully	Redfin bully	Lampray	9
East Cape/ Coastal 2	Longfin eel				Inanga			Redfin bully		3
Maraetaha/ Coastal 5	Longfin eel				Inanga			Redfin bully		3
Motu	Longfin eel	Torrentfish		Koaro		Short jaw kokopu	Bluegill bully			5
Pakaraae/ Coastal 4	Longfin eel						Bluegill bully			2
Turanganui/ Gisborne	Longfin eel				Inanga			Redfin bully		3
Uawa	Longfin eel	Torrentfish			Inanga		Bluegill bully			4
Waiapu	Longfin eel	Torrentfish	Giant kokopu	Koaro	Inanga	Short jaw kokopu		Redfin bully		7
Waipaoa	Longfin eel	Torrentfish		Koaro	Inanga		Bluegill bully	Redfin bully		6
Waipiro/ Coastal 3	Longfin eel			Koaro				Redfin bully		3
Wairoa	Longfin eel	Torrentfish		Koaro	Inanga			Redfin bully		5
Wharekahika	Longfin eel	Torrentfish	Giant kokopu	Koaro	Inanga	Short jaw kokopu	Bluegill bully	Redfin bully		8

Significance thresholds (highlighted columns)

Green	High = National
Blue	Medium = Regional
Yellow	Low = Local

Miscellaneous (highlighted rivers)

Pink	Rivers overlap with neighbouring council

Data reliability (font colour)

Black	Reliable data
Blue/Purple	Less reliable data
Red	Data checked by Expert Panel and has been adjusted

Appendix 5
Potential significance assessment calculations for native fishlife (RiVAS+) (Steps 10-13)

		1 Fish Score		2 Spawning Score		3 Diadromous Score		4 Declining Species Score		5 Stronghold Score		6 Flow Score		7 WQ Score			8 Introduced Fauna Score		9 Physical Barrier Score		10 Riparian Shading Score				
	Intervention	Average number native fish	Regional score	Number of whitebait sites	Defined score	Average national score	Regional score	Number declining species	Defined score	Number of stronghold sites	Defined score	Average national score	Regional score	Average regional score	Regional score	Expert panel	Average national score	Regional score	Proportion of zone affected	Defined score	Average riparian cover	Defined score	RiVAS sum	RiVAS+ sum	Importance
Awatere	7a, 7d	4941	1	1	3	2.2	2	7	3	GK, SJK	3	3.0	3	2.5	2	3.5	3.0	3	0.00	3	0.52	2	25	26.5	National
Coastal 1	7a	6520	1	1	3	2.5	2	9	3	GK, SJK	3	3.0	3	2.6	3	3	2.9	3	0.00	3	0.59	3	26	27	National
East Cape/ Coastal 2	7d	11278	1	0	0	2.9	3	3	1	BK	2	3.0	3	2.6	3	3.5	2.6	3	0.00	3	0.71	3	22	22.5	Regional
Maraetaha/ Coastal 5	7d	5608	1	1	1	2.1	2	3	1	LFE	1	3.0	3	2.0	1	2.5	2.3	2	0.00	3	0.58	3	19	19.5	Regional
Motu	7a	13314	1	1	1	1.8	1	5	2	SJK, LFE	3	3.0	3	2.8	3	2.5	2.5	2	0.00	3	0.56	2	20	20.5	Regional
Pakarae/ Coastal 4	7d	6482	1	0	0	2.3	2	2	1	LFE	1	3.0	3	1.6	1	2	2.8	3	0.01	2	0.49	2	17	17	Regional
Turanganui/ Gisborne	7d, 4a	5255	1	1	1	2.4	2	3	1	LFE	1	2.8	2	1.5	1	2.5	2.7	2	0.04	3	0.54	2	16	17.5	Regional
Uawa	7a, 7d	22584	2	1	3	2.2	2	4	2	LFE	1	3.0	3	2.1	1	2.5	2.8	3	0.01	2	0.55	2	20	22.5	Regional
Waiapu	7d	35644	2	0	0	1.7	1	7	3	LFE	1	3.0	3	2.6	3	2.5	3.0	2	0.00	3	0.50	2	19	19.5	National
Waipaoa	7d, 4a	59885	3	1	2	1.7	1	6	2	LFE, K	3	2.9	1	2.1	1	2	2.9	2	0.03	3	0.51	2	19	21	Regional
Waipiro/ Coastal 3		5570	1	0	0	2.2	2	3	1	LFE	1	3.0	3	2.8	3	3	2.8	3	0.00	3	0.64	3	20	20	Regional
Wairoa		58545	3	2	2	1.4	1	5	2	LFE	1	2.9	2	2.4	2	2	2.6	2	0.00	3	0.53	2	20	20	Regional
Wharekahika	7a	27755	2	3	3.5	2.3	2	8	3	GK, SJK	3	3.0	3	2.8	3	3	2.9	3	0.01	3	0.51	3	28	28.5	National

Note:

1 Sp. Codes GK = Giant Kokupu; SJK = Short Jawed Kokupu; BK = Banded Kokupu; LFE = Long Finned Eel; K= Koaro

River	Declining species present									Number
Awatere	Longfin eel	Torrentfish	Giant kokopu	Koaro	Inanga	Short jaw kokopu		Redfin bully		7
Coastal 1	Longfin eel	Torrentfish	Giant kokopu	Koaro	Inanga	Short jaw kokopu	Bluegill bully	Redfin bully	Lampray	9
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Motu	Longfin eel	Torrentfish		Koaro		Short jaw kokopu	Bluegill bully			5
Pakaraae/ Coastal 4	Longfin eel						Bluegill bully			2
Turanganui/ Gisborne	Longfin eel				Inanga			Redfin bully		3
Uawa	Longfin eel	Torrentfish			Inanga		Bluegill bully			4
Waiapu	Longfin eel	Torrentfish	Giant kokopu	Koaro	Inanga	Short jaw kokopu		Redfin bully		7
Waipaoa	Longfin eel	Torrentfish		Koaro	Inanga		Bluegill bully	Redfin bully		6
Waipiro/ Coastal 3	Longfin eel			Koaro				Redfin bully		3
Wairoa	Longfin eel	Torrentfish		Koaro	Inanga			Redfin bully		5

Wharekahika	Longfin eel	Torrentfish	Giant kokopu	Koaro	Inanga	Short jaw kokopu	Bluegill bully	Redfin bully		8

Significance thresholds (highlighted importance column)

Green	High = National
Blue	Medium = Regional
Yellow	Low = Local

Miscellaneous (highlighted rivers)

Pink	Rivers overlap with neighbouring council

Data reliability (font colour)

Black	Reliable data
Blue/Purple	Less reliable data
Red	Data checked by Expert Panel and has been adjusted

RiVAS+ (highlighted rivers and cells in 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+)