BEFORE THE MANAWATU WANGANUI REGIONAL COUNCIL

IN THE MATTER OF	The Resource Management Act 1991
AND	
IN THE MATTER OF	Hearing on Submissions Concerning the Proposed Horizons Regional Council One Plan for the Manawatu Wanganui region.

STATEMENT OF EVIDENCE OF CORINA JORDAN

28th September 2009

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1. INTRODUCTION

1.1 My name is Corina Jordan

1.2 I am employed as the Environmental Officer for the Wellington Fish & Game Council. I have been employed by the Wellington Fish and Game Council between 2007 and present. I hold a Bachelor of Science degree in Genetics, and Zoology (2007), with Honours (1st class) in Natural Resource Management (2008), from Massey University.

1.3 I have three years research experience specialising in Molecular Ecology at the Allan Wilson Center (Massey University), with three published papers.

1.4 The Wellington Fish and Game region encompasses the lower North Island, extending from north of Waiouru across to Norsewood and south to Cook Straight. This largely overlaps with the Horizons and Greater Wellington Regional Council areas. Over the last two years I have become familiar with a wide range of environmental issues pertaining to the Horizons' region, including the impacts of point and non point source pollution, increasing abstraction pressures, and rural and urban water supplies, breaches in resource consents conditions, and the health of the regions wetlands, gamebird, surface water, and trout populations.

1.5 My job entails reviewing our population monitoring programmes, and undertaking population assessments; liaison with public interest groups, recreational hunters and anglers; and representing the Wellington Fish and Game Council in the statutory planning process. This involves assessing notified resource consent applications, regional policy statements and regional and district plans, for their effect on the regions game bird, trout fishery, and recreational hunting and angling values.

1.6 For the last two years I have been responsible for co-ordinating the Wellington Fish and Game Councils involvement in the Proposed One Plan. In this capacity I have attended numerous meetings and workshops with Horizons staff and other submitters.

1.7 I am familiar with trout habitat requirements, water quality and flow requirements to which these hearings relate. This evidence draws on my knowledge, various published scientific papers and reports, and expert advice from other Fish and Game technical officers and field staff.

1.8 I have read the Environmental Court's Code of Conduct for Expert Witnesses (Section 5 of the Environment Court Consolidated Practice Note 2006), and I agree to comply with it. I confirm that the issues addressed in this brief of evidence are within my area of expertise, except where I state that I am relying on what I have been told by another person.

1.9 I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

1.10 I am a member of the New Zealand Freshwater Sciences Society.

2 SCOPE OF EVIDENCE

2.1 My evidence will, from a planning and ecological perspective, cover the following matters so far as they relate to Wellington Fish and Game Council's submissions:

i. Cover the Background to New Zealand Fish and Game Councils including , statutory consideration, and the National importance of salmonids
ii. State of the resource - Population monitoring
iii. State of the resource - Outline case studies looking at the impacts on freshwater resources and recreational trout fisheries
iv. Framework for the Proposed One Plan and General themes and issues
v. Proposed One Plan provisions relating to water quality
vi. Proposed One Plan provisions relating to water quantity
vii. Proposed One Plan provisions relating to Beds of Rivers and Lake provisions

3 EXECUTIVE SUMMARY

3.1 In accordance with the directions of the Chair of the Hearing Panel the following bullet points provide an executive summary of my evidence, focusing on the conclusions arising from it in relation to the matters raised in the Wellington Fish and Game submission

3.2 Horizons Regional Council has functions and responsibilities under the Act for the maintenance of trout fishery and recreational angling values in the region and the achievement of the purposes of the Act.

3.3 Horizons Region has high trout fishery values, some nationally significant. The regions trout fisheries are at risk from point and non point source inputs of pollution, and increasing abstraction pressures, which is degrading the ecosystem integrity of freshwater resources.

3.4 Wellington Fish and Game support the approach of the POP, and the identified values, including but not limited to, contact recreation, trout fishery values, aesthetic and riparian values. We note that there is a substantial body of scientific evidence that supports the approach being taken in the One Plan.

3.5 The framework set out in the One Plan is one that when read in its entirety, provides a clear link between the stated issues through to the objectives, policies and methods including rules. This approach provides a regionally relevant translation of Schedule 3. The establishment of numerical standards give effect to the narrative within the RMA, ensuring that resources are utilised efficiently, and that the life supporting capacity of water and ecosystems are maintained, and the needs of future generations met

3.6 In general, the approach to water protection in the Proposed One Plan is innovative and, in my opinion likely to be more efficient and effective in achieving the purposes of the Act than established alternatives, including continuation of the status quo in the region.

3.7 The justification for a regulatory framework is based on the premise that without such a framework freshwater values will not be maintained or the purposes of the Act met. Evidence clearly shows that intensification of agricultural/horticultural land uses are significantly impacting on freshwater ecological integrity, including significantly impacting on the regions recreational trout fisheries and recreational angler values. The national trend towards continuing degradation of freshwater resources is applicable to the Horizons Region.

3.8 Wellington Fish and Game supports Horizons approach to controlling land use practices which impact on the Environment

3.9 In addition to the above, I have assessed the other provisions in the Proposed One Plan and drawn conclusions on possible amendments to address Wellington Fish and Games Councils submission and provided further evidence on matters on which the Wellington Fish and Game Council has submitted in support of the existing provisions.

4 BACK GROUND

New Zealand Fish and Game, Statutory Considerations, & the National Importance of Salmonids

4.1 The Acclimitisation societies, predecessor to Fish and Game, were established during the early years of New Zealands settlement (1860s). During this period colonists, many of which the move to New Zealand was an escape from oppressions and poverty, found a land of moist and temperate climate, of rich and productive forests, and clear cool rivers and streams, where station in society did not depend on ancestry or title, and the right to hunt for sustenance and sport, was open to all. In his early (1922) history of animal and plant introductions, George Thomson wrote "*They recalled the sport which was forbidden to all but a favoured few, but which they had often longed to share in – the game preserves, the deer on the mountains or in the parks, the grouse on the heather – clad hills, the pheasants in the copses and plantations, the hares and partridges in the stubbles and turnip fields, the rabbits in the hedgerows and sandy warrens, and the salmon of forbidden price in their rivers – and there rose up before their vision a land where all these desirable things might be found and enjoyed*" (McDowell, 1994). These early Acclimitisation societies saw our augmented wildlife, some of which had already been introduced, as a true recreational resource, and they aimed to provide cheap and accessible hunting and fishing for all. To essentially protect what has come to be a traditional component of New Zealands way of life

4.2 The management of our sports fish and game bird resources has been reviewed several times since the advent of the Acclimatisation Societies in the 1860's. Historically management was shared, somewhat uneasily, with the central government managing sports fisheries and gamebirds in some areas, and the societies managing the remainder. A review in the late 1980s resulted in the establishment of 12 regional Fish and Game New Zealand councils (FGNZ) and one national council, in all areas except the Taupo Fishery. Taupo alone is managed under the Department of Conservation, acting as a FGNZ council by agreement between the Crown and Ngati Tuwharetoa. Over the last 50 years the societies also shifted their focus. With increasing scientific understanding and awareness of indigenous biodiversity values and ecosystem processes, the Acclimitisation societies altered their management focus to one of habitat protection "*Look after the habitat and the fish or gamebirds will look after themselves*" has become our mantra (Harding *et al*, 2004).

4.3 Today all FGNZ councils are established and constrained by very specific legislation under the Conservation and wildlife acts to effectively "*manage, maintain and enhance the sports fish and gamebird resource in the recreational interests of anglers and hunters*". FGNZ is responsible to the minister of Conservation in carrying out their functions, but have independence from central government as Crown entities. The twelve regional councils are elected from angling and hunting licence holders, to manage sports fish and game birds. Funding comes entirely from the sale of hunting and fishing licences, so it is a user pays user says system. FGNZ currently, has a role that is similar to the Department of Conservation in respect of the latter's freshwater fisheries responsibilities, but we are responsible for different species namely sports fish.

Conservation Act (1987)

4.4 Fish & Game NZ is a statutory body established under the Conservation Act (1987): to manage, maintain, and enhance the sports fish and game bird resource in the recreational interests of anglers and hunters (s26 (a)); to assess and monitor the condition and trend of ecosystems as habitats for sports fish, and game (s26 (b)); and to represent the interests and aspirations of anglers and hunters in the statutory planning process (s26(c)).

4.5 Under the Conservation Act (1987) sports fish include Brown and Rainbow Trout, Salmon, Perch and Tench.

4.6 In the early 1980's the Acclimitisation societies pushed for the passage of the "*Wild and Scenic Rivers*" legislation as an amendment to the Water and Soil Conservation Act (1967), to offer some balance to the National Development Act, and take into account the recreational, aesthetics, ecosystem and amenity values afforded by freshwater.

Wild and Scenic Rivers Legislation

4.7 *"An Act to promote a national policy in respect of natural water, and to make better provision for the conservation, allocation, use, and quality of natural water, and for promoting soil conservation and preventing damage by flood and erosion, and for promoting and controlling multiple uses of natural water and the drainage of land, and for ensuring that adequate account is taken of the needs of primary and secondary industry, [community water supplies, all forms of water-based recreation, fisheries, and wildlife habitats, and of the preservation and protection of the wild, scenic, and other natural characteristics of rivers, streams, and lakes]"*

4.8 This legislation intended that priority should be given to conservation over other uses and its main objective was to "*...recognise and sustain the amenity values afforded by waters in their natural state*". The "*Wild and Scenic Rivers*" legislation has since been incorporated into the Resource Management Act 1991. in particular part 2 sections 5(b), section 6(a) and section 7. The RMA has enabled recognition of, and provided protection to, trout and salmon fisheries by resource managers, primarily the Regional Councils.

Resource Management Act 1991

4.9 Part 2, principles and purposes of the RMA outlines in s5 that its purpose is to "*promote the* ***sustainable management*** [own emphasis] *of natural and physical resources*". Sustainable management meaning among other things; "*safeguarding the life-supporting capacity of air,* *water, soil, and ecosystems*" (s5(b)); and "*avoiding, remedying or mitigating, any adverse effects of activities on the environment*" (s5(c)).

4.10 Furthermore, under part 2 (RMA, 1991), it is identified that all persons exercising functions and powers, under the Act, shall recognise and provide for; "have particular regard to the; "*maintenance and* ***enhancement*** [own emphasis] *of the quality of the environment*"(f), "*amenity values*"(d), the "*intrinsic values of ecosystems*"(d) and the "*protection of the habitat of trout*"(h), as establishing as a 'Matter of National Importance' under Section 7 of the Act.

4.11 Furthermore, under part 2 (RMA, 1991), it is identified that all persons exercising functions and powers, under the Act, shall recognise and provide for; "*the preservation of the natural character of… wetlands, and lakes, and rivers, and their margins*" as a Matter of National Importance (s6(a)), and have Particular Regard to the; "*the* ***efficient use*** [own emphasis] *and development of natural and physical resources*"(s7(b)), the "*maintenance and enhancement of amenity values"* (s7(c)) *the "intrinsic values of ecosystems"* (s7(d)), *"the* ***maintenance*** *and* ***enhancement*** *of the quality of the environment*" [own emphasis], and the "*protection of the habitat of trout and salmon*" (s7(h)).

4.12 Although salmonids are an introduced fish, their valued fisheries status is recognised by statute in section 26b of the conservation Act 1987 and the RMA (1991) section 7c (the maintenance and enhancement of amenity values) and 7h (protection of the habitat of trout and salmon).The inclusion of the protection of the habitat of trout and salmon (s7h) in the RMA (1991) is in recognition of the National importance of these species. Freshwater sports fisheries are of high socio economic and socio cultural importance both domestically and internationally, providing a myriad of benefits to society (Weithman, 1999; Welcomme and Naeve 2001; Arlinghaus, Mehner & Cowx 2002).

4.13 In New Zealand the introduction of brown trout (*Salmo Trutta*)was first provided by legislation in 1867, with brown trout being introduced from 1867 – 68, rainbow trout (*Oncorhynchus mykiss*) were introduced from 1878 - 1883, and salmon through the early 1900s (Viner, 1987). Trout were immediately successful, forming largely self sustaining populations, widely distributed throughout New Zealand. Owing largely to the availability of free stone gravel bottomed rivers, and cool clean waters, which provided adequate tributary or mainstem spawning for almost all river systems. Our trout fisheries are now among the most internationally recognized trout fisheries in the world, due to the relatively widespread distribution of our salmonid populations and their large size. Anglers generally consider trout greater than 2.7 kg (6 lb), which can be a well conditioned 600mm fish, to be large, while trout in excess of 4.5 kg (10 lb) are considered to be trophy fish. The large size of our fish, as well as the scenic beauty of our country remains part of the reason why New Zealand has been regarded so highly as an anglers mecca.

4.14 The standard picture of New Zealand trout fishing promoted overseas is of an angler fishing some pristine back country or headwater river, usually surrounded by native forest or tussock grassland, in hilly or mountainous country. We are lucky enough to have two such rivers in the Manawatu Whanganui Region. The Manganui o te ao River was granted protection in 1989 under a National Water Conservation Notice in recognition of its: outstanding wild and scenic characteristics, outstanding habitat for Blue Duck or Whio (*Hymenolainmus malacorhynchos*), and its outstanding recreational fishery. The upper and middle Rangitikei River, was granted protection in 1993 under a national water conservation order, in recognition of its: nationally significant trout fishery status, outstanding wild and scenic characteristics, and outstanding wildlife features.

Figure 1. Angler fly fishing in the Upper Rangitikei River

Figure 2. Underwater photo of a Large Brown Trout taken in the Upper Rangitikei River

4.15 Trout fishing in rivers is arguably the icon of sports fishing in New Zealand, and trout fishing is undertaken throughout almost all of New Zealand from our: backcountry fisheries, which accounted for 107,800 angler days or 8.4% of total angler days for the 2007/08 season; and headwater fisheries, which accounted for 33,400 angler days or 2.6% of total angler days for the 2007/08 season; to the larger main stem rivers, which accounted for 450,300 angler days or 35% of total angler days for the 2007/08 season; down to our smaller lowland rivers which support a significant amount of fishing in total, contributing 135,800 angler days or 10.6% of total angler days for the 2007/08 season (Unwin, 2009). Lake fisheries, including Lake Rotoiti, Okataina, Tarawere, and the Rotorua Lakes fisheries, also provide nationally and internationally important angling opportunity, and accounted for over 544,000 angler days over the 2007/08 season, which is 42.8% of total angler days (Unwin, 2009).

4.16 The Wellington Fish and Game region which covers the southern districts of the Horizons region, is dominated by river fisheries, with four major catchments (Ruamahanga, Hutt, Manawatu, and Rangitikei) and fifty recognized tributaries or minor catchments. As already discussed the Upper Rangitikei River is our major scenic headwater fishery, as the Manganui o te ao River falls within the Taranaki Fish and Game Region. The Rangitikei, and the Manawatu rivers comprise our larger mainstem rivers, and our smaller lowland rivers include, rivers such as the Pohangina, Mangatainoka, Makuri, Hautapu, and Mangahao rivers. The Mangatainoka, Makuri and Hautapu rivers were granted local water conservation notices in 1991, 1990, and 1989, respectively, under the Soil and Water Conservation Act 1967 in recognition of their regionally significant trout fishery values.

4.17 New Zealands trout fisherys are recognized both internationally and domestically, attracting both local and foreign tourism. At the New Zealand Eco Tourism Conference held in Nelson this year (2009) the Associate Minister of Tourism opened the conference stating that "*tourism generates 20 billion dollars for our economy, 18% of our export earnings*" (Dr Colman, 2009). "*It equates to 9.2% of our GDP and accounts for 1 in 10 jobs*"(Dr Coleman, 2009). He stated that tourism driven by both international visitors and domestic travel "*is big business and a serious industry in NZ*", "*it stimulates regional growth, supports our international connectedness and influences our international reputation*". Domestic tourism has increased by"*6.2% to 8.1 billion dollars in the year to December 2008*", and that "*nature based visitors spent $5 billion on their New Zealand trip – that is 61% of our international visitor expenditure*". He stated that NZ is an "*aspirational destination and visitors wanted to immerse themselves in New Zealand's landscapes, culture and experiences*" (Dr Colman, 2009). Trout fishing based tourism is a significant component of these figures, providing the highest rate of income per capita, with the recreational tourist angler spending more on their fishing holiday than any other tourist venture (Tourism New Zealand *pers comm.*, 2009). Figures taken from the National Angling survey undertaken by Martin Unwin of NIWA, show total fishing license sales of 98, 620 for the 2007/08 season, of which overseas anglers accounted for 12.7% (excluding the Lake Taupo fishery). Per capita license sales appear to have increased slightly since the 2001/02 survey. Total angler effort for the 2007/08 season was estimated to be over 1, 271, 300 angler days, of which 68,900 angler days (5.4%) was expended by overseas visitors. Total effort by New Zealand residents differed little from the corresponding figure for the previous two surveys. In acknowledgment of the importance of New Zealand's rivers and their recreational value the associate minister for tourism stated that " *New Zealand's rivers are assets that support tourism and recreational opportunities"*, and that "*promoting and protecting our natural environment makes dollars and sense*" (Dr Colman ,2009).

4.18 Unfortunately, New Zealand's larger rivers, including our iconic headwater fisheries, are coming under increasing pressure from developers including hydroelectricity companies. Our main stem rivers and smaller lowland rivers, which are often the ordinary "*close to home*" fishing sites for many anglers, are coming under increasing pressure from agriculture and horticultural activities, flood protection activities causing ongoing disturbance and channelisation, deforestation, wetland reclamation, urbanization, hydropower generation, water abstraction, and waste disposal. These impacts have altered our freshwater ecosystems profoundly, probably more than terrestrial ecosystems (Cowx, 2002). As a result the majority of freshwater ecosystems are impacted and the fisheries heavily modified or degraded (Cowx & Gerdeaux, 2004). These impacts have affected our trout fisheries disproportionately, due to the relatively high water quality and quantity requirements of salmonids. and as a consequence the sustainability of our lowland fisheries is becoming increasingly challenged. The Horizons region is no exception.

5 STATE OF THE RESOURCE – WELLINGTON FISH AND GAMES TROUT FISHERIES

5.1 In fulfilment of Fish and Game's statutory requirements, in relation to sports fish, under s26c of the Conservation Act (1987), Wellington Fish and Game sets out in our Annual Operational Plan a programme for monitoring and assessing our regions trout fishery populations. Project 1111 "*Sports Fish Monitoring*" requires Wellington Fish and Game undertake annual drift dive and spawning surveys of our regions main trout fishery rivers, which provides information on population change and recruitment. This information is used to inform regulation setting and resource management purposes, to ensure that the regions trout fisheries are sustainably managed and maintained.

5.2 Drift dive information dates back to 1979, in this region, with regular assessment of the Upper Rangitikei, Hutt, and Waikanae, Rivers. The Makuri, middle and lower Rangitikei, Mangatainoka, Hautapu, Oroua, and Ohau rivers, in the Horizons region, have historically only been dived periodically. In 2004 our sports fish monitoring program was revised, so that 13 rivers, and 43 sites were included in our annual drift dive assessment plan. The Hutt, Upper Rangitikei and Waikane Rivers were still assessed independently, but information from the other rivers was collated to provide a cumulative assessment on the sustainability of the regions trout fisheries. With the complete change in Wellington Fish and Game staff in 2008, our Sportsfish monitoring program was again revised, to include more rivers and a greater number of sites, complemented by habitat mapping.

5.3 Overall, in 2009, 19 rivers, and 53 sites, were dived. A further three transects were attempted in an extra two rivers, but because of extremely low flows (Upper Makakahi), and poor visibility (lower Makakahi, Manawatu at Raikaitai) had to be abandoned. The total dived for the 2009 year includes 6 more rivers, and an extra 10 new drift dive sites, than the last 4 years. These new rivers and drift dive sites have been included as the freshwater resources are coming under increasing pressure from development, intensification of agriculture and horticulture, abstraction, and point source pollution.

Methods

5.4 Drift diving is the most common technique for assessing the abundance of trout in New Zealand rivers and is described in Teirney and Jowett (1990). Sites are chosen which represent the geological diversity of the river, generally upland, middle, and lowland representative reaches are included. The length of each reach is determined by the number of pool/riffle and runs present, and is generally a function of the width of the active channel. Sites generally include 3 character replicates. Divers, properly equipped, form a straight line, spaced evenly across the river at right angles to the river's banks and float with the current looking for trout as they go. Diving generally starts at the beginning of a pool and ends at the beginning of a riffle. The number of small (10 - 20cm), median (20 – 40cm) and large (>40cm) rainbow and brown trout are recorded, and expressed as number of trout, in each category, per kilometre.

5.5 Drift dive counts are considered to generally be underestimates of the total trout population (Teirney & Jowett 1990; Young & Hayes 2001). The degree of underestimation varies from river to river and is probably dependent on the amount of physical cover that is available. However, the proportion of trout that are detected by divers appears to remain relatively constant over time within river reaches (Young & Hayes 2001).

Results

5.6 Drift Dive results over the last 5 years show a significant decline in the Wellington Fish and Game regions trout fisheries ($F = 7.42$, $P = 0.07$) (Fig. 3). With rivers, such as the Mangatainoka and Makakahi, driving this downward trend, both of which were granted

Local Water Conservation Notices due to their Regionally Significant trout fishery value. The Mangatainoka River (Fig. 4), has dropped from ~ 31 trout per km in 1981, and ~ 96 trout per km in 1987 to current levels of 7 trout per km in 2009 ($F = 7.52$, $df = 1,9$, $P = 0.02$), while the Makakahi has dropped from 10 trout /km in 2006 to 2 trout/km in 2009 ($R^2 = 0.99$, $F = 243$, $dF = 1,2$, $P = 0.004$)

5.7 However, not all our rivers are declining. Rivers such as the, Pohangina ($F = 0.06$, $df = 1,5$, $P = 0.81$, $R^2 = 0.01$,), and Makuri ($F = 2.88$, $df = 1,4$, $P = 0.16$ $R^2 = 0.27$,), remain stable, showing no significant upward or downward trends over time.

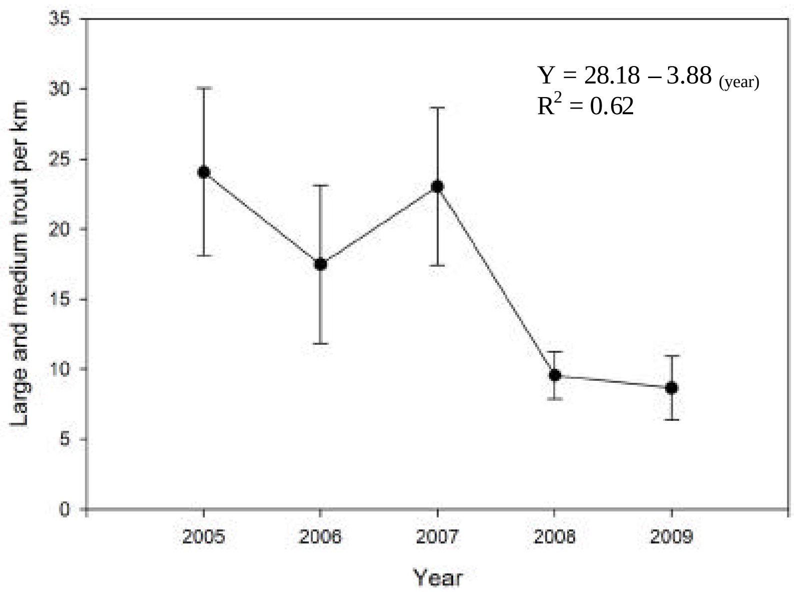

Figure 3. Trout abundance for the Wellington Fish and Game Region, over time, as assessed by drift diving

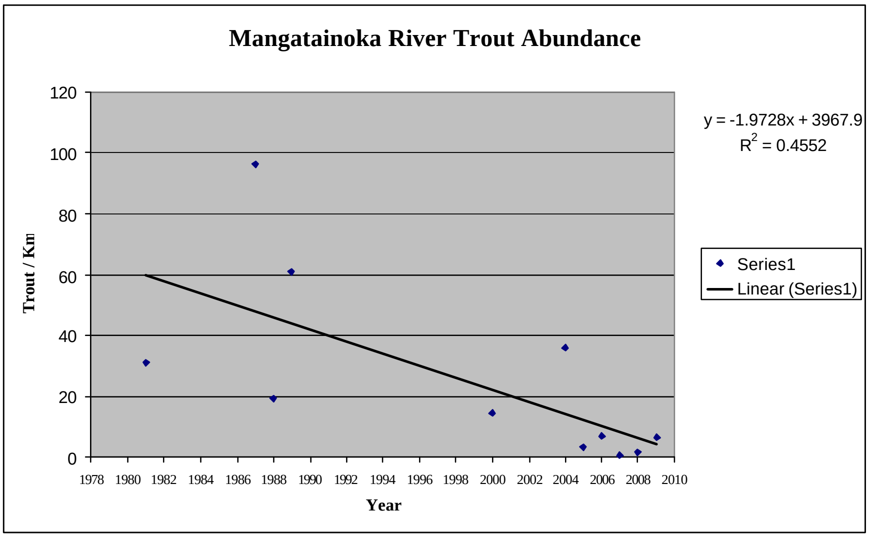

Figure 4. Mangatainoka River trout abundance, over time, as assessed by drift diving

5.8 Trout abundance in rivers such as the lower Rangitikei, and Manawatu, cannot be assessed by Drift Diving due to poor visibility. Cawthron is currently trialing new technology which may, in the future, enable turbid rivers to be assessed by sonar.

5.9 Results from the National Angling Survey show that angler use in the Rangitikei is remaining stable (~6060 for 2007/08 season, and ~5710 for the 1994/95 season) (Unwin, 2009), and angler use in the Manawatu also appears stable (~14220 angler days for the 2007/08 season, and ~11970 angler days for the 1994/95 season), with 90% of those angler days upstream from Palmerston North (Unwin, 2009), due to decreasing water quality downstream.

Conclusion

5.10 Wellington Fish and Games trout fisheries are under threat, with many rivers showing declines in trout abundance. Our once trophy fisheries which were protected under local water conservation notices are now struggling. Poor water quality from point and non point source pollution, low flows due to high abstraction volumes in some catchments, and the degradation of trout spawning habitat is significantly adversely impacting on the sustainability of our recreational fisheries and adversely impacting on our anglers recreational, intrinsic and amenity values.

A. CASE STUDY – STATE OF THE RESOURCE – RANGITIKEI RIVER

Water Quality

Included in Horizons Proposed One Plan in the "*Outstanding*" trout fishery class is the Upper and middle Rangitikei, and the Manganui o te Ao Rivers and their tributaries. Theses sections of both these rivers, and their tributaries, are protected by National Water Conservation Orders in recognition of their nationally outstanding trout fishery and aesthetic values. The Manganui o te Ao falls within the Taranaki Fish and Game region, while the Rangitikei is managed by Wellington Fish and Game. The lower Rangitkei River is classified as "*Regionally Significant*" and the coastal Rangitikei is classified "*other*" in the Proposed One Plan.

The Rangitikei is Wellington Fish and Games largest river, it flows 240km from its source in the Kaimanawa Mountains to the Tasman Sea, and attracts anglers from all over New Zealand as well as overseas. The Rangitikei headwater sports fishery has been rated one of the best backcountry fisheries in both New Zealand and the world (Taylor, 2001; Strickland and Hayes 2003). The entire Rangitikei River provides a diverse array of angling experiences, and angler opportunities for self sustaining populations of both Brown (*Salmo Trutta*) and Rainbow Trout (*Salmo gairdneri*). The Rangitikei offers extensive areas of fishable water throughout its length. Easy access was characteristic of the middle and lower reaches (from Mangohane to Vinegar Hill), which are the most popular with over ~3690 angler visits for the 2007/08 season (Unwin, 2009).

Although the Rangitikei passes through pastoral country, spectacular scrub covered bluffs, sheer papa cliffs, and gorges create a dramatic setting. Anglers surveyed for satisfaction rated the Rangitikei 5 out of 5 due to its scenic beauty, relative solitude, and its angling opportunities. As a result picnicking, camping, and swimming were also popular recorded pastimes.

Over the 2007/08 season the Rangitikei River attracted a total of ~6060 recorded angler days (Unwin, 2009). Within the Rangitikei catchment the recognized trout fisheries are the Rangitikei River mainstem, Otamateanui Stream (headwater tributary), Mangamaire River (headwater tributary), Whakarekou River and its two main tributaries the Maropea and Mangatera, the Hautapu River and the Kawahtau River and one of its tributaries, the Pourangaki.

Water quality in the Rangitikei River declines as you travel downstream, due to inputs of sediment and non point source pollution from agricultural land use, and point source inputs of pollution from treated sewage and meat-work discharges.

The convergence of the Hautapu River, which is degraded by the Taihapi STP discharge, and agricultural land use, along with the input of treated sewage from the Mangaweka STP contribute to the decline in the health of the middle Rangitikei river (McArthur, 2009). Five point source discharges of treated sewage into the lower Rangitikei River tributaries, along with inputs of treated sewage directly into the Rangitikei Mainstem from the Bulls STP, and Ohakea STP, along with Riverlands Manawatu meatworks discharge, causes significant degradation in the Coastal Rangitikei management zone (McArthur, 2009).

Wellington Fish and Game, along with Peter Taylor of Horizons flew the Rangitikei River in March 2009, following complaints from local anglers on the poor state of the river. Excessive algal blooms were photographed.

Figure 5 Aerial Photos of the Rangitikei River at Utiku, just downstream from Hautapu confluence, algal blooms evident (March 2009)

Figure 6. Aerial Photos of algal blooms in the Rangitikei River at Mangaweka (March 2009)

Figure 7. On the left - Aerial Photo taken downstream from Mangaweka at Soldiers Road showing algal blooms. On the right - Aerial Photo of the Rangitikei River at Ohingaiti showing algal blooms (March 2009)

Figure 8. Aerial Photo taken of the Rangitikei River, at the confluence with the Makohine stream. The Makohine stream (trout spawning stream) showing high sediment levels, macrophyte and algal growths, Rangitikei showing algal bloom (March 2009)

Excessive algal growths are caused by elevated levels of phosphorus and nitrogen, warm temperatures, and light. Algal blooms impact on both the health of the trout fishery, and recreational enjoyment of the angler. Periphyton growths can reduce over night dissolved oxygen levels which can impact on trout growth, reproductive rates, health and survival (Hay *et al*, 2006). Macroinvertebrate communities are altered to taxa that are less preferred as food items for trout, so again trout growth, health and sustainability are adversely affected.

Recreational angling is impacted by changes in trout population including population declines, declines in individual trout size, and health. Angling also becomes difficult as lines get caught in the algae and footing is precarious. Cyanobacteria blooms are detrimental to an anglers health and often kill domestic animals. Anglers recreational amenity and intrinsic values are compromised.

As detailed in Dr Roygards, and Ms McArthrus officers evidence both point and non point sources of pollution are significantly adversely impacting on the health of the Rangitikei River, directly and indirectly via tributaries. Point source inputs cause significant increases in DRP, SIN, and Ecoli levels.

In August this year (2009) Wellington Fish and Game officially complained about the state of the Riverlands Manawatu discharge, stating:

"Riverlands Manawatu has consistently breached its resource consent conditions pertaining to the volume and quality of wastewater discharged into the Rangitikei River. High levels of suspended solids, dissolved reactive phosphorous, ammoniacal nitrogen, and Ecoli, have characterised these breaches. Periphyton growths immediately downstream from the discharge have been well in excess of standards for recreational or amenity values, and macroinvertebrate studies have shown degraded water quality with shifts in EPT taxa from pollution sensitive to tolerant taxa. On top of this, plant upgrades of the wastewater treatment plant, to address these issues, have not been undertaken within specified time frames, as originally set out in their 2003 Consent application.

Nutrient and contaminant enrichment can cause significant adverse impacts on the life supporting capacity of freshwater resources. High levels of suspended solids, nutrients, and associated increases in biological oxygen demand, adversely impact on aquatic communities, including trout populations and habitat. Discharges of this nature also degrade the amenity and recreational values of water systems, and can cause a health hazard to river users including fisherman" (Jordan, 2009).

Currently land use within the Rangitikei catchment is predominantly sheep and beef (66%) with Dairy the second most common (20%) (M^cArthur, 2009). Of 95 dairy discharge consent 3 of those are still to water (M^cArthur, 2009). Changes in land use with increases in intensive agriculture will continue to degrade the health of the Rangitikei River further, impacting on Nature based businesses within the catchment, on the life supporting capacity of the resource, the sustainability of the trout fishery, and the intrinsic and amenity values of recreational users.

Angling video will be shown during the hearing

Water Quantity

The Tongariro Power Development (TPD), owned by Genesis Energy, is a major abstractor of water from the headwaters of the Rangitikei River. In 1978, the then New Zealand Electricity Department, dammed the Moawhango River in its headwaters near Waiouru. The Dam reduced the mean annual flow at Moawhango village from $14.5m^2/s$ to $5.3m^3/s$ (63.1% reduction), and the mean annual flow was reduced from $3.7m^3/s$ to $0.9m^3/s$ (75.6% reduction) (Tonkin and Taylor, 1999). This is the largest abstraction in the region and is approximately 2.2 times greater than the combined maximum consented daily rate for water abstraction by agriculture (Roygard, 2009). Rainbow trout prior to the diversion, were the most abundant sports fish in the river and while persisting in the Moawhango below Aorangi Stream confluence for much of the 1980's have now been significantly diminished.

At Kakariki in the Rangitikei the influence of the TPD abstraction is reported as a 11% reduction in the mean flow, 16% for low flows, and 0.4% for flood flows (Henderson, 2003). In addition water is abstracted for the purposes of agriculture, industry and water supplies. Approximately 75% of the catchments total abstraction from both ground and surface water is taken from below Onepuhi in the lower part of the Rangitikei River (Horizons Regional Council, 2004).

Water abstraction can adversely impact on trout populations by increasing the length and severity of low flows during the critical summer months. Low flows can reduce available habitat, and cause water temperatures to increase, all of which can limit trout growth, reduce disease resistance, and reproduction, and cause fatalities. Low flows exacerbate poor water quality and cause increases in excessive periphyton growths. Reductions in flow variability and channel forming flows, cause sediment levels to rise and potential reductions in habitat diversity.

Natural Character

The maintenance of the Natural Character of rivers and their margins is of National Importance under part 2 section 6(a) of the RMA (1991). The "*Natural character*" of an environment, as discussed during the Proposed One Plan hearings on Living Heritage, "*is that dimension of its character which is an expression of nature*" (Anstey, paragraph 47, pg 19, 2009).

Natural character includes the morphological components of the environment that sustain healthy ecosystems. In the case of trout the important morphological components of natural character, include, but are not limited to: habitat diversity including, the presence of riffle habitat to support healthy macroinvertebrate communities, leading into cool deep pools with riparian shading; suitable gravels to support spawning, juvenile rearing, and adult trout requirements; instream woody debris; and adequate flows and flow variability to sustain the health of the system eg limit excessive periphyton growths, maintain instream morphological diversity, and flood plain connection, and reduce sedimentation issues.

The Natural Character of the Rangitikei River is impacted by gravel extractions and river management practices. Historically a braided river, the Rangitikei is now predominately a single thread channel river. Research by Jane Richardson and Dr Ian Fuller (2008) into the channel planform change indicate that the lower Rangitikei River underwent a transition from a multi channeled river to a predominantly single thread wandering river, with associated reductions in morphological complexity between 1949 and 1983 in response to intensive river management. Bank protection measures, along with gravel extractions, instigated under the Rangitikei River Scheme have had a considerable impact on channel shape, enhanced channel floodplain disconnection, and exacerbated sediment deficits (Richardson & Fuller, 2008).

The first Rangitikei River Scheme was established in 1952 to control flooding and erosion caused by the Rangitikei River, (Horizons Regional Council, 2000). The Rangitikei River Scheme review No2 1983 found that channel confinement, and gravel extractions, were causing degradation, and were leading to undermining and failure of tree bank protection. The 1983 review concluded that the 300 – 400m wide channel specified by schemes reviews 1 and 2 was too narrow. The central fairway was to be widened to 500m, rip rap instead of tree protection was to be used for preventing bank erosion, gravel extractions was to be limited to areas of aggradation, and a riparian zone was delineated by the Consolidation Scheme (Richardson & Fuller, 2008). The last major review of the Rangitikei Scheme occurred in 1994. The current scheme covers 63 km of the Rangitikei River and runs from Rewa to the sea. Flooding is controlled by just over 21km of stop banking (Blackwood, 2009). Bank protection works include over ~20km of tree bank protection, and over ~150,000 tonnes of rock work (Richardson & Fuller, 2008).

Research findings by Richardson and Fuller found a clear directional change in river morphology from a multi thread braided channel, with high morphological diversity eg pools, runs, riffles, backwaters, vegetated beaches, and bars, to a more uniform single threaded channel. Active channel width was reduced by ~75% at the Bulls bridge site, 78% at the Flock House site, and 50% at the Kahariki site, from 1955 to 2007 (Richardson & Fuller, 2008). Results are discussed further in Dr Ian Fullers Evidence, but it is his expert opinion that the Rangitikei River is in a state of dynamic instability, and that river management practices will need to be reviewed to take into account the Natural Character of the river to ensure that river management is both environmentally and economically sustainable.

River channel morphological changes can have implications for the ecology of the river corridors. Disconnection of the floodplain and channel alters the disturbance regime and affects the ecological processes of succession (Ward *et al*, 2001). Morphological changes have altered the morphological diversity of the river, and likely impacted on aquatic and riparian populations, altering available habitat, food webs, physical instream and physiochemical processes, and species diversity (Hanrahan 2007; Jellyman and McIntosh, 2008). It is likely that the wider, shallower, multi channeled river that existed in 1949 provided a greater area of suitable habitat for trout than the single narrow channel that has prevailed since 1983 (Richardson & Fuller, 2008).

The Rangitikei River is considered a valuable source of gravel for roading and construction (Horizons Regional Council, 2000). The majority of the Rangitikei Rivers gravel is supplied from the Kawhatau River (Richardson & Fuller, 2008). Annual average gravel supply rates are estimated to be in the vicinity of 20,000 – 30,000m^3/yr^{-1}, which is significantly lower than the ~120,000 – 240,000 m^3/yr^{-1} that has been removed annually since 1961 (Horizons Regional Council, 2000).

Over extraction of gravel is resulting in degradation of the river bed in the Rangitikei River, potentially jeopardizing the Rangitikei River Control Scheme (Horizons Regional Council, 2000). Bed lowering of up to 0.5m between 1977 and 1990 has been reported for a 28km section of the Rangitikei River from 4km downstream of the Bulls Bridge to 15km upstream of the Kakariki Bridge (Horizons Regional Council, 2000). Though as the gradient flattens during the last 15km, gravel aggradation and siltation occurs (as discussed by Mr Blackwood, paragraph 80, pg 17, 2009).

Over extraction of gravel causes undermining of edge protection, increases erosion, and threatens stop-banks (Blackwood, 2009). It causes entrenchment of the active channel which exacerbates the process of degradation. Gravel extractions, if not appropriately managed result in reductions in the morphological diversity of instream habitat. Broad shallow runs are created for potentially extensive distances. The length of the channel can be reduced due to a loss of sinuosity. Pool /riffle components, which are essential for sustaining a healthy trout fishery are reduced. Machinery crossings cause sediment release which can be significant depending on the location and number of crossings, also if extraction occurs in the wetted channel large volumes of sediment can be released which would smother aquatic environments, alter macroinvertebrate communities and adversely impact both directly and indirectly trout populations. Over extraction or environmentally insensitive gravel extraction results in a loss of Natural Character and threatens the rivers life supporting capacity.

Figure 9. Gravel extraction at Kakariki, showing degradation to the Rivers Natural Character including morphological diversity. Riffle and pool habitat suitable for sustaining trout has been degraded. Flows are now spread across the channel creating a shallow broad expanse of river which is unsuitable for sustaining a healthy ecosystem (March 2009)

Figure 10. Gravel Extraction at Kakariki (March 2009)

Figure 11. Gravel extraction in the wet in the Kawhatu river at the Rangitikei Confluence. The Kawhatu is included in the middle Rangitikei Water Conservation Order to be protected for its outstanding recreational trout fishery. Operators were working outside of their consent. The Natural character of the river was degraded, trout migration was impaired, sediment released into the active channel was significant, and work was occurring during our trout spawning period. Any spawning through this site would have been destroyed and the high sediment loads could have significantly adversely impacted on hatching rates (21st of August 2009)

As noted by Mr Blackwood "*gravel management aimed at avoiding bed degradation is an essential component to maintain the integrity of our flood protection structures*" (Blackwood, paragraph 50, pg 11, 2009), and the "*total gravel extracted from the river system must not exceed the total gravel supplied to the river. Failure to observe this principal is likely to see a progressive decline in river bed levels, with the attendant undermining of riverbanks and structures*" (Blackwood, paragraph 118, pg 28, 2009)

The operations team of Horizons are currently reviewing river management practices in the Rangitikei River to confirm or revise current design, with particular regard to scheme affordability (Blackwood, 2009). It is the opinion of Dr Ian Fuller that the river is in a state of dynamic instability and both Dr Fuller and Mr Williams believe that future river management will need to look at the natural character of the river in order to inform flood protection management which is both environmentally and economically sustainable.

B. CASE STUDY – STATE OF THE RESOURCE – MANAWATU RIVER

Water Quality and Quantity

The Manawatu River is 235 km long and flows from the eastern side of the Ruahine and Tararua Ranges, west through the Manawatu Gorge to the Tasman Sea. The river drains a total catchment area of 5944 km^2, much of which has been developed from native forest to pasture, resulting in sparse riparian cover. The upper reaches of the Manawatu catchment support mainly hill country sheep and beef production, while the more gently rolling or flat land gives rise to intensive dairy farming.

Water quality is a major issue in the Manawatu River (McArthur, 2004), which is rated as one of the most polluted rivers in New Zealand. Water quality the upper catchment is classed as '*moderately nutrient enriched*' but significantly degrades rapidly downstream (Fowler, & Henderson, 1999). The sources of this enrichment are diffuse nutrient runoff from agricultural land use (80% of DRP and 98% of SIN are non point sourced) (McArthur, 2009), urban sewage discharges and industrial wastewater discharges (McArthur, 2009). The water quality of the Manawatu is exacerbated during low flows by high rates of water abstraction, particularly in the upper catchment (Hurndell, 2009). Stock have access to a large proportion of the waterways and in conjunction with the lack of riparian cover cause direct adverse impacts on water quality through nutrient and sediment inputs in addition to direct streambank and bed erosion, which impact on adult trout and trout spawning habitats. Periphyton and cyanobacteria proliferations are common, Ecoli standards breach safe contact recreation guidelines during low and high flows, and macroinvertebrate health is significantly compromised (McArthur, 2009). Surveys of fish communities of the upper Manawatu tributaries found lower altitude sites are degraded with generally low to medium fish abundance when compared to the national average (Hamer & Lewis, 2004), with the near absence of migratory native fish (McArthur, 2009).

The Manawatu River is easily the most used fishery by anglers in the Wellington Fish and Game Region, rating higher than the Hutt, Ruamahanga and Rangitikei Rivers (Unwin, 2009). It supports a year round population of brown and rainbow trout, and offers exceptional close to home angling opportunity, with over 14220 angler visits recorded in the 2007/2008 National Angling Survey (Unwin, 2009). About 90% of those angler days are upstream of Palmerston North. Nationally it ranks 10th of all rivers fished excluding those inflowing to Lake Taupo.

Below the Tiraumea confluence the Proposed One Plan classifies the middle and lower Manawatu River as "*locally significant*". Progressive degradation of the Manawatu River, from point source and non point source discharges of pollutants, and high sediment loads, reduce its attraction to anglers, and impact on the trout fishery, as it travels down to the coast. Surveys by Barker and Forlong in 1985 (Barker & Forlong, 1985) found that over 50% of anglers who fished the Manawatu River, attributed "*poor water quality to adversely affected their fishing experience*". Since then the quality of the Manawatu River has continued to decline, and anglers recreational and amenity values with it. A survey by Taylor and Stancliff (2005) found that Wellington anglers considered "*pollution/poor water quality, and nuisance algae*" the most important factors contributing to them having a negative trout fishing experience below the gorge .

Despite the poor water quality, Fish and Game still actively promote the lower Manawatu Fishery down to Foxton Beach, noting in our Lower Manawatu River Fishery pamphlet (2006) that there are populations of "*Brown and Rainbow trout* *throughout, with perch around Palmerston North and downstream*". The lower and coastal Manawatu river offers tidal angling opportunity for sea run brown trout, which are common along the West Coast of New Zealand. Recent accounts by local anglers have reported good angling opportunity from Tokomaru down to the Opiki Bridge, with up to eight pound river run brown trout caught (Steve Brown, Manawatu Freshwater Anglers Club, *pers comm*, 2009.). Downstream from the Opiki bridge however, the angling recreational value decreases due to excessive '*growths of weed which choke the water, and pollution*" (Steve Brown, Manawatu Freshwater Anglers Club, *pers com*, 2009). During our annual gamebird count on the lower Manawatu River this year it was noted by our senior Officer Mr Steve Pilkington that "*the state of the water downstream from Opiki was disgusting. There were 3 dead cows in the river and on its banks, excessive growths of instream weed, the smell of the water was highly offensive, and the colour a deep turbid brown*" (Steve Pilkington, Wellington Fish and Game Field Officer, *pers comm*., 2009).

Figure 12. Lower Manawatu River below Opiki, showing high instream sediment levels and bank slumping and erosion (February 2009)

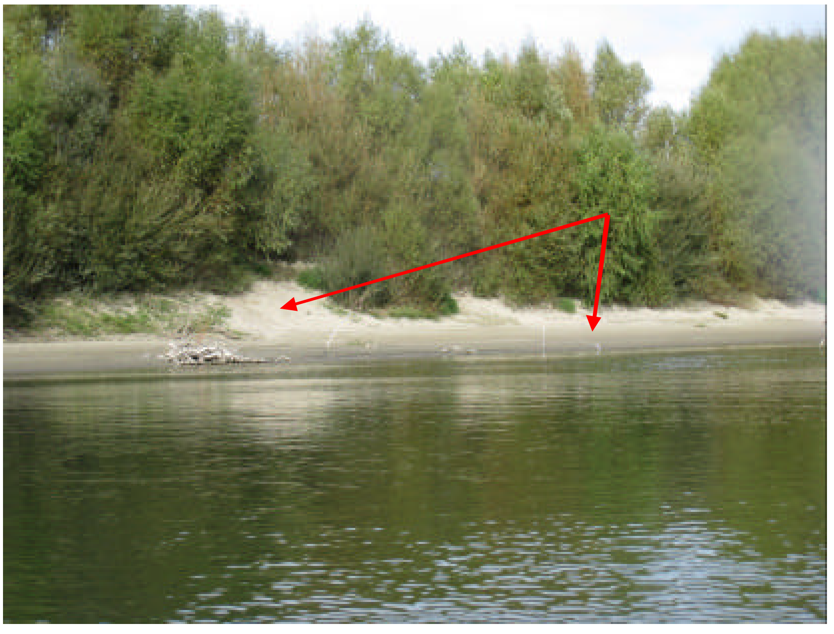

Figure 13. Manawatu River, below Opiki, showing a stock fence erected in the water

Figure 14. Lower Manawatu River, below Opiki, Stock grazing to the water causing bank erosion and inputs of waste (February 2009)

Figure 15. Photo taken further down stream from previous photo. Dead calf on the bank of the Lower Manawatu River (February 2009)

Figure 16. Dead cow on the banks of the Lower Manawatu River, it looks to have died struggling to get out of the water. Water quality significantly degraded

In establishing the Regional Policy Statement (1998), and the Manawatu Catchment Water Quality Regional Plan (1998), Horizons committed itself to improving the quality of the Manawatu River. Objective 11 (RPS) is to '*maintain and* ***<u>enhance</u>*** *surface water quality*', policy 11.1 "*to promote water quality in all rivers to be at least suitable for contact recreation*", and policy 11.3 (RPS) '*promoting discharges to land rather than water'*.

These policies and plans have failed to adequately address the state of the River. The Manawatu Catchment Water Quality Regional Plan (1998), specified water quality standards that were linked to water quality objectives, and then set timeframes by which they were to be achieved (Phosphorus and Nitrate), these have not been met.

Standards set by the MCWQRP to achieve this objective, and reflected in consent conditions, have been regularly breached by District Councils Wastewater Treatment Plant discharges to surface water. The Horowhenua District Council, in regard to the Shannon Wastewater Treatment Plant discharges breached clarity, TSS, $ScBOD_5$, DO, NH^4-N, and DRP standards, and on October the 27th 2007 the council allowed 5.1 million litres of partially treated sewage to be pumped into the Manawatu River.

At the resource consent hearing this year Wellington Fish and Game noted that "*Territorial authorities, under Part 4 of the RMA (1991) (s31(e)), must also, control any actual or potential effects of activities in relation to the surface water of rivers and lakes. Therefore the HDC had a responsibility under the RMA, as well as under their previous consent, to maintain the plant to a standard which resulted in the best quality water with regard to the receiving environment*" (Hearing Evidence Ms Jordan , 2009). Wellington Fish and Game stated their concern that "*HDC only addressed the issue of short-circuiting in the treatment plant in July of this year, and that the significant issue of stormwater infiltration and illegal connections had* *not currently been addressed*" (Hearing evidence Ms Jordan, 2009). Plant upgrades are proposed to partially address these issues, but the council will still be discharging treated wastewater to the Manawatu River.

C. CASE STUDY – STATE OF THE RESOURCE – MANGATAINOKA RIVER

One of the Regions most highly valued trout fisheries, the Mangatainoka flows from the eastern Tararua Ranges in a north/ north east direction to join the Tiraumea just upstream from its confluence with the Manawatu River. The Mangatainoka River is ~70km long and has a catchment area of ~415km^2. Once extensively covered by native forest (Rimu, Rata, Matai, Totara, Tawa, and Kowhai) and scrub, now only ~18% remain. The Mangatainoka catchment is now predominately pasture with Sheep and beef as the main catchment land use (51%), followed by Dairy (28%) (M^{c}Arthur, 2009). The Mangatainoka River is significantly impacted by non point and point source pollution, high abstraction, and historic river management.

Greater than 99% of SIN, and at high flows 84% of DRP is sourced from non point source pollution. Point source inputs of treated sewage from the two municipal waster discharges, Eketahuna STP (via the Makakahi) and Pahiatua STP combined with treated waste discharges from Fonterra Pahiatua and DB breweries, also make significant contributions to resource degradation, especially during low flows when they contribute the majority of DRP inputs. Both E.coli levels, and excessive periphyton growths, including cyanobacteria blooms increase as you move down the catchment, along with macroinvertebrate health. Over both the 2007/08 and 2008/09 summers extensive cyanobacteria blooms caused the Mangatainoka River at the Mangatainoka Reserve to be closed for recreational and amenity uses (McArthur, 2009).

Abstractions include both agricultural and town supply, with Eketahuna (via the Makakahi River), Pahiatua, and Pleckville taking for their rural supplies, and Fonterra and DB breweries taking for industrial uses. The combination of point and non point source pollution exacerbated by high abstraction rates are having a significant detrimental impact on instream ecosystems including the Regionally Significant Trout fishery.

The Mangatainoka River was granted a Local Water Conservation Notice in 1991 under the Soil and Conservation Act 1967, in recognition of its regionally significant trout fishery values. Thought to be moderately remote from home, anglers rated the river a 4 out of 5, for ease of access, the large extent of fishable water, the quality and quantity of trout, solitude, and scenic value. Picnicking, swimming, and camping were also favored activities undertaken by our anglers. The Mangatainoka was rated as the third highest angling use river, after the Rangitikei and Manawatu Rivers over the 1994/95 angling season with ~ 3040 angler days (Unwin, 2009). Today the Managatainoka is still rated as our third highest utilized angling river though angler days have dropped (~ 1990 angler days over the 2007/08 season) (Unwin, 2009). Anglers still enjoy its scenic beauty, and solitude, however they have to work a little harder to catch that fish, with trout numbers declining rapidly over the last few years.

The variability in the fishery and possible causes were noted in Mr Peter Taylor's hearing evidence for the Local Water Conservation Notice proceedings (1991), He stated that "*floods and fragile spawning conditions largely cause the observed variation in trout numbers, and prolific algal growths and flood control works (particularly in the past) suppress the fishery from time to time and in certain reaches*". He goes on to state that "*many tributary streams have been severely modified by channel straightening, have large cobbles replacing what were suitable spawning gravels, silt deposition, nutrient enrichment or suffer from stock trampling*" (Taylor, section 5.2, 1991). It seems the situation is only getting worse, with results from our last drift dive counts of the trout population showing declines in the population from ~ 31 trout per km in 1981, and ~ 96 trout per km in 1987 to current levels of 7 trout per km in 2009 (DF = 1,9, F = 7.52, P = 0.02)

The declines in trout population are attributed to the degradation of the resource including high inputs of both point and non point sources of pollution, and high rates of abstraction, causing excessive periphyton growths, lower DO levels, increased temperatures, and significant declines in macroinvertebrate health. These impacts, along with degradation of spawning habitats, and historic river works which reduced the Natural Character of the river, contribute to declines in the health and sustainability of the Mangatainoka trout fishery. Historic high angler use may also have contributed to the current low numbers, though trout fisheries are renowned for jumping back rapidly with a successful spawning season. Over the last few years the daily bag limit has been set at 2 with a maximum size restriction, although many anglers prefer to catch and release.

Figure 17. Grade control structure in the Mangatainoka River (December 2005)

Figure 18. Cross blading in the Mangatainoka River . Gravel has been pushed to the true right bank edge, filling in any pools. Cross blading across the entire river has created a broad shallow expanse of river, and reduced morphological diversity. Adult trout holding water has been lost (December 2005)

Figure 19. Marks of a stock feed pad directly adjacent to the Mangatainoka River. Effluent is clearly obvious in the indentations and on the bank

CASE STUDY – STATE OF THE RESOURCE – MAKAKAHI RIVER

The Makakahi River provides important Rainbow (*Salmo gairdneri)* and Brown trout (*Salmo Trutta*) habitat and contributes to the regionally significant Mangatainoka fishery. In recognition of it's regionally significant status it was awarded Local Water Conservation Notice in 1991. The Makakahi River sustains a year round fishery providing excellent angling opportunity. It also provides essential spawning and nursery habitat for trout recruitment to both the local fishery and the Mangatainoka fishery.

Habitat mapping and drift diving surveys of the Makakahi River were undertaken by Wellington Fish and Game Officers on the 4 February 2009. Four sections were surveyed including an upper site at Kaiparoro Road, two middle sites at Falkner, and Waiwaka roads and a lower site at Hendersons Road.

Surveying of the upper section showed extremely low flows, to the point where contiguous passage was virtually non existent. Water temperatures were extremely elevated, in excess of 24^{o}C. No trout of any size class were found, and it was observed that numerous native fish deaths had occurred, with at least 15 dead bullies (*Gobiomorphus* sp.) and one dead eel (*Anguilla* sp.) approximately 0.5m long, recorded.

Figure 20. Upper Makakahi site along showing extremely low flows and loss of contiguous passage. Surface waters peculate through the gravels at some sites.

Figure 21. Makakahi River along Kaiparoro Road. Showing extremely low water levels, and instream macrophyte growth, (February 2009)

The Department of Conservation notes that the Makakahi River provides important habitat for native fish species. Species present include threatened species, including the shortjaw kokopu *(Galaxias postvectis)* which is identified as a high priority species in the Wellington Conservation Management Strategy, longfinned eel *(Anguilla dieffenbachia*), identified as medium priority, lamprey *(Geotria australis)* also identified as of medium priority, and koura (*Paranephrops spp.*). Other native fish species are also present, including unidentified bully and upland bully

Visual observations of invertebrate populations consisted mainly of water boatmen and some caddisflies, there was minimal riparian cover, and periphyton and macrophyte growths were noted. Overall this is indicative of poor water quality.

The two middle sections of the Makakahi River, which constitute historic drift dive sites, were dived and while no trout were seen at the Falkner Road site, one dead eel, approximately 30cm long, was recorded. Numerous native galaxids were sighted along a 500 m section of the Waiwaka site and only two large brown trout. Habitat in these middle sections comprised a mixture of deep pools, and pool riffle run habitat with boulders and gravel beds covered in sediment.

Figure 22. Falkner Road drift dive site, showing good riparian cover. The bed was covered in a fine layer of periphyton. Levels of deposited sediment were increasing as we moved down the Makakahi Stream (~80% periphyton cover) (February 2009).

Figure 23. Lower end of Waiwaka Road drift dive site, Makakahi Stream. Two large brown trout were seen at this site. Visual clarity was reducing as we moved down the Makakahi Stream. Periphyton and macrophyte growth increasing, deposited sediment covers gravels. Good riparian cover (February 2009).

The lower section at Hendersons Road, was undivable due to extensive macrophyte bed growths and reduced visual clarity, which was recorded as <1m

The catchment is impacted by both non point and point source pollution. As discussed in Ms McArthurs' evidence discharge from the Eketahuna STP is a significant contributor of DRP to the river at both high and low flows. Non point source inputs of contaminants contribute significantly to both DRP, and SIN at high and low flows. Macroinvertebrate community health is assessed as "*poor*" (McArthur, 2009). Poor water quality is exasperated by high abstraction, with the Eketahuna water supply being one of the highest abstractors.

Wellington Fish and Game in their hearing evidence for Resource Consent 101169 by Tararua District Council relating to the Eketahuna Water Supply Scheme noted that "*Territorial authorities have a statutory mandate to ensure natural resources are used in an efficient manner and that any actual or potential effects of activities on the environment, in relation to the surface water of rivers and lakes are controlled (RMA 1991, part 4, s31e).*" Furthermore WFG stated that they were of the opinion that "*Tararua District Council had not fulfilled it's obligation to ensure the efficient use of the Makakahi freshwater resource*". Of particular concern was the estimated unaccounted losses or takes from the system. TDC put these losses at 100-180 m^3/day (TDC, 2008). However, information from Good Earth Matters put losses from the system at 265 m^3/day, while the Horizons water quality scientist stated losses to be 819.4 m^3/day. These losses constitute an unacceptable cost to the environment, increasing the duration and extent of low flow conditions in the Makakahi River, and associated adverse impacts on instream values.

The contribution of point and non point source pollution along with high abstraction rates is significantly impacting on the life supporting capacity of the Makakahi Stream, and causing significant (R^2 = 0.99, F = 243, df = 1,2, P = 0.004) degradation of the trout fishery and its recreational value. It is the opinion of Wellington Fish and Game that inadequate implementation and enforcement of the Local Water Conservation Notice by Horizons has resulted in deterioration of this regionally significant trout fishery.

D. CASE STUDY – STATE OF THE RESOURCE – IMPACTS OF LAND USE ON TROUT SPAWNING HABITATS

Trout populations living in rivers normally migrate upstream into smaller headwater tributaries to spawn (McDowell, 1990). In the Wellington Fish and Game region migration is generally around April/May depending on flow conditions, with peak spawning occurring June/July. Spawning takes place in swift flows over relatively stable gravels (up to 5cm in diameter) on a uniform area of bed. The female excavates a trough (also known as a '*redd*') laying eggs ~15cm deep in the gravels of the streambed often at the tail of a pool. The female lays up to 2,000 – 3,000 eggs during the spawning season, which accounts for the rapid reinstatement of some trout fisheries, following troughs in trout abundance. Approximately 1 – 6 egg pockets are contained per redd. The male fertilisers the eggs, and the female then excavates upstream. The dislodged material covers the eggs and if there is suitable area available this excavation can form another egg pocket.

After about 28 - 42 days the eggs hatch into alevins, which are 20 mm in length. The alevins remain in the gravels for a further 14 – 21 days to absorb the yolk sac attached to their stomachs. Incubation and emergenge are temperature dependent. Successful egg incubation, and alevin development relies on cool water temperatures, adequate dissolved oxygen (>80% saturation), good percolation of water through the spawning gravels, at an adequate velocity (for oxygen delivery and removal of metabolic wastes) and a lack of sedimentation (McDowall 1990). The preferred temperature range for brown trout spawning is 3-20°C, with an optimum temperature of 10°C, and for hatching a preferred range of 2-11°C with a maximum of 20°C (NIWA, 2005). Too much fine material or sediment can stop the flow of water through the gravels, smothering the eggs, and suffocating the alevins. This is also a critical time when streambed disturbance is likely to have a detrimental effect on juvenile development and recruitment

The critical habitat requirements for successful spawning are:

- Headwater tributaries with reasonably stable winter flows
- Suitably sized gravels with little sediment deposition on the bed
- Low water temperatures
- Clean, sediment free water
- High oxygenation
- Undisturbed streambed

Salmon and trout fry and fingerling migration is significantly higher during freshes and high flows and occurs mostly during the night, and more so during moonless nights (Unwin, 1986; Davis and Unwin, 1989; Fox *et al.*, 2003). The majority of migrating juvenile salmon are encountered in the top 0.5 m of the water column (Glova and Boubée, 2002). Trout fry have a strong preference for bank side movement and keep to the edges of the main channels, near to the banks of the streams and rivers (Unwin, 1986; Hopkins and Unwin, 1987; Fox *et al.*, 2003; Unwin & Taylor, 2007). Fry feeding on small insects living in the streambed grow to fingerlings (~100mm) in the first year and generally live in shallower rocky margins of rivers. As they grow into adult fish, 2 – 3 years and 25 – 50cm in length, they move into water where depth provides them with protective cover or they seek out overhanging banks and vegetation in which to hide.

Figure 24. Spawning redd obvious in gravels of the Kahuterawa Stream. Approximately 100% periphyton cover (with the exception of the spawning redd in which periphyton has been dislodged), growths of filamentous algae (July 2009).

The following case studies indicate the impact of agricultural land use on trout spawning habitat.

As part of our statutory mandate under s26c of the Conservation Act (1987), Wellington Fish and Game undertakes spawning surveys to access the state of the regions trout fisheries.

Surveys in the Mangatainoka and tributaries showed that the Mangamaire, Makotukutuku, an unnamed tributary (on the Nireaha Plain), Mangaraupiu and Hukanui Streams all had good to fair spawning activity. Surveys in the Mangatainoka have shown extensive use with historic counts of up to 24 and 42 redds counted in some of the mainstem sites (Taylor, 1989). Although, degradation of spawning habitat has been noted, due to a lack of riparian vegetation, and stock access to a large proportion of many of the streams, causing bank collapse and degradation in water quality (Taylor, 1989). Degradation of spawning habitat is likely to be one of the key factors contributing to the significant decline in the Mangatainoka Fishery.

Spawning surveys in the Makuri Stream River, identified the reach of the Makuri River from the gorge to its confluence with the Makuri-iti River as being very good trout spawning habitat with large numbers of spawning redds identified (12 – 20). Though again evidence of bank slumping and collapse along the banks of the Makuri mainstem were noted. Spawning surveys in the Makuri-iti identified it as fair in regards to spawning redds but lacking in riparian vegetation with a high degree of bank collapse.

A report to Fonterra (2005) entitled "*Manawatu Catchment Trout Spawning Habitat Enhancement*" stated that the "*Makuri River from the upstream end of the gorge to the headwaters would benefit significantly from stock exclusion*" (Taylor, 2005). The report goes on to state that "*it is good trout spawning habitat with some bankside and streambed disturbance from stock access. The stable flow regime, high proportion of suitable gravel beds and lower degree of sinuosity when compared to smaller spawning streams make it an ideal candidate for fencing and for the second stage of a spawning habitat enhancement programme*". Such a project would have significant spawning and advocacy benefits.

Figure .20. Makuri Stream showing lack of riparian fencing, full stock access, and bank erosion (2005).

In the Manawatu Catchment the highest numbers of juvenile trout found in surveys of the upper Manawatu tributaries were in the Tamaki, Oruakeretaki, Raparapawai and Mangaatua Rivers. All of these rivers are impacted by agricultural land use. The Oruakeretaki, Raparapawai, and Tamaki Rivers have been identified by horizons as some of the priority rivers for implementation of the FARMS strategy due to high non point source inputs of pollution, which impact on their life supporting capacity. Water quality issues are exasperated by high rates of abstraction., with the entire upper Manawatu Catchment being fully allocated, and a number of its tributaries eg Raparapawai over allocated. Water quality in the Tamaki is further degraded by the Dannevirke STP discharge.

The East Tamaki River (headwaters of the Tamaki) rates as one of the highest spawning tributary of the Manawatu Catchment. It provides excellent habitat, in regards to gravels, bed stability, and flows, though as with the other streams running through agricultural land it suffers from stock disturbance, and lack of riparian habitat. Water quality degrades as the East Tamaki flows downstream to join the Tamaki River. In early July Fish & Game officers undertook a spawning survey of the East Tamaki as far as the first riparian fence. The catchment is predominately sheep and beef with few land owners. There were more than 20 spawning redds identified and many adult fish. However the stream banks show signs of slumping from stock trampling and faecal matter was evident on the dry areas of streambed. The areas open to stock access exhibited lower numbers of spawning redds. In the report to Fonterra (Taylor, 2005) it was also stated that a "*fencing programme would likely enhance the spawning habitat further*".

Figure 21. East Tamaki River showing bank slumping, erosion, and lack of riparian fencing and habitat

The impacts of agricultural land use on our trout spawning and fishery rivers needs to be urgently addressed. The protection of Wellington Fish and Games trout spawning habitats is essential to the sustainability of our trout fisheries.

6. FRAMEWORK FOR THE PROPOSED ONE PLAN & GENERAL THEMES

Introductory statement

6.1 Firstly, I would note that if any matter raised in Wellington Fish and Games submission or further submission is not discussed in my evidence, then it should be inferred that I support the recommendations in the section 42A officers reports.

6.2 To assist the Committee, I have attached as Appendix 1 a summary table of Wellington Fish and Games submissions and further submissions, whether the officers recommendation is to accept or reject these submissions, and my comments in regards to Wellington Fish and Game final position on these matters.

Support for the Proposed One Plan Framework

6.3 The s42a officers reports should act as serious wake up call for all of us. The information contained within these reports shows an alarming state of deterioration in some of our freshwater resources, and consequently their biodiversity values. The reports highlight the information used by Horizons to identify the current state of the regions water resources, and they show without doubt that poor water quality, and increasing abstraction pressures, along with Hill Country erosion (covered in the Land Chapters) are assuredly the most important environmental issues this region faces. Horizons has taken a good hard honest look at itself, and the land use practices within the region, and they have identified that the current Policies and Plans are failing to adequately address these issues.

6.4 Land use change, with the intensification of agriculture, land erosion, point and non point sources of pollution, and increasing rates of water allocation, are all contributing to the decline in freshwater vertebrate species. As discussed in the Evidence of Dr Joy, temporal analysis of trout distribution over the past 37 years, showed significant declines in trout presence, the steepest being over the last decade. This finding is supported by Wellington Fish and Games trout population monitoring, which shows that regional trout population numbers are trending downwards, with the greatest declines over the last 5 years.

6.5 Further investigation of these temporal trends, by Dr Joy, showed that trout absence or presence was strongly correlated to pastoral use, with strong negative relationships between trout presence and increasing proportions of pasture within a catchment ie increasing pasture covered was associated with declining trout populations. A strong positive relationship was found between trout presence and the proportion of catchment in native cover.

6.6 Further evidence of the degradation of surface water within the region is given by Associate Professor Death. Research carried out by his students and by himself, show that many streams and rivers within the region have low water quality and that these low water quality sites are more abundant in urban and intensively farmed agricultural areas.

6.7 Based on solid science and backed by general community support Horizons has developed a new framework for their Regional Policy statement and Plans. In recognition of the dynamic interlinked ecosystem processes functioning within the regions environment, Horizons has adopted an internationally endorsed, integrated catchment management approach. As discussed in the evidence of Associate Proffessor Death, "*adopting a catchment management framework is consistent with much of modern thinking on the best mechanisms for managing waterbodies*" (Death, paragraph 19, pg 11, 2009). This approach aims to address the four primary causes of environmental degradation in the region. Values are attributed to Management zones and reaches, and numerical water quality and quantity standards are established by which to protect those values.

6.8 In giving effect to legislative directive, and in recognition of the regional importance of our trout fisheries, Horizons included within the values framework of the plan, all known trout fishery rivers. Spawning habitats were identified, and our recreational trout fishery sites were classified as: Outstanding (I) for those rivers protected by National Water Conservation Notices; Regionally Significant (II) for those rivers protected by Local Water Conservation Notices, or offering similar levels of exceptional angling opportunity; or Other (I) for our locally significant fisheries. Wellington Fish and Game support the identified trout fishery and spawning habitat information contained within the Proposed One Plan, and confirm it as accurate.

6.9 Wellington Fish and Game support the approach of the POP, and the identified values, including but not limited to, contact recreation, trout fishery values, aesthetic and riparian values.

6.10 There is a substantial body of scientific evidence that supports the approach being taken in the One Plan as discussed in the Dr Roygards s42a officers report. The framework set out in the One Plan is one that when read in its entirety, provides a clear link between the stated issues through to the objectives, policies and methods including rules. This approach provides a regionally relevant translation of Schedule 3. The establishment of numerical standards give effect to the narrative within the RMA, ensuring that resources are utilised efficiently, and that the life supporting capacity of water and ecosystems are maintained, and the needs of future generations met.

<u>Recommendation to the Hearing Panel</u>

6.11 In general, the approach to water protection in the Proposed One Plan is innovative and, in my opinion likely to be more efficient and effective in achieving the purposes of the Act than established alternatives, including continuation of the status quo in the region.

6.12 Wellington Fish and Game supports the Proposed One Plan Framework including the establishment of: Management zones, sub zones; and values, including the establishment of a Contact Recreational value for all natural water bodies, the identification of Rivers to be protected for their aesthetic values, the classification of our trout fisheries, the identification of our trout spawning habitats; and associated water quality and quantity standards. We ask that those provisions in the plan relating to this framework, the values, and links between values and standards, be retained in their entirety. We ask that the hearing panel accept the recommendations in the Planning report of Clare Barton in relation to these matters.

6.13 Wellington Fish and Games only concern with the approach of Horizons, in regards to establishing the link between the values and the standards at higher policy levels, is that these standards may not be given effect as rules. As stated in the evidence of Associate Professor Death "*Guidelines can be ignored or enforced inconsistently depending on the perspective of those judging them, whereas rules provide certainty to all involved*", and ensure that activities do not continue to degrade the life supporting capacity of surface waters or their values. Wellington Fish and Game Council requests that a clear regulatory link is made between the water quality standards and the rules.

6.14 The standards should also be referred to under the AER section of the Proposed One Plan to ensure that Horizons monitors the implementation/effectiveness of the Plan against these established standards. In catchments where current water quality does not meet the standards, interim standards and timeframes for meeting them should be established so that Horizons can monitor progress towards the obtainment of the Proposed One Plans Objectives and Policies in reference to maintaining or enhancing surface water quality, and quantity to protect the identified values of these waterways.

6.15 Wellington Fish and Game Council requests that a specific Anticipated Environmental result (AER) is included which addresses the implementation of Issue 6-3, Policy 6-27 and the proposed Policy 6-27b, and method 6-9, in regards to the establishment, maintenance or enhancement of Natural Character, in relation to River management Schemes. Refer to the evidence of Dr Fuller, Mr Williams, and Associate Professor Death. The integration of consideration of a rivers Natural Character into river management practices / schemes is likely to provid both ecological and economic benefits, and ensure water bodies and their margins are managed sustainably.

6.16 As discussed in Associate Professor Deaths evidence, Horizons need to assess the effectiveness of meeting the Proposed One Plan objectives and standards against the ecological integrity of the regions freshwater environments. In this regard Wellington Fish and Game recommends the establishment of a formal process by which Horizons meets annually with key stakeholders including the Wellington Fish and Game Council, the Department of Conservation, Forest and Bird, and Massey University to assess the effectiveness of the standards and objectives of the POP in meeting the AER and maintaining or improving ecological integrity within the regions freshwater environments. Wellington Fish and Game recommends that this formal process be included in the Policy 6-1 provisions, or alternative which meets this intent. As stated in Associate Professor Deaths evidence "*This would be a mechanism for facilitating an adaptive management strategy for the Proposed One Plan that appears inherent in the sentiment of the Proposed One Plan but appears to lack a specific mechanism*".

6.17 Recommendation WTR 6 supported. The establishment of water management zones is one of the most enlightening advances this Plan makes. The approach to catchment based management that it signals is logical, relevant, and manageable, the essence of "*integrated management*" and above all captures the sense of belonging that the respective community's find important

6.18 Wellington Fish and Game is concerned with the recommended amendment to the reference of "*<u>waterways</u>*" as notified, to "*<u>waterbodies</u>*". in the Proposed One Plan water chapters. Wellington Fish and Game does not support this alteration as the term "*<u>waterbodies</u>*" does not encompass those aspects of freshwater systems which need to be protected, to provide for the sustainability of freshwater ecosystems. As discussed in the evidence of Associate Professor Death, and discussed in my evidence, the health of the water body and its riparian margin are critical to maintaining a diverse and healthy ecosystem. Riparian habitat is essential for providing both terrestrial inputs of insects to sustain trout populations, and maintaining trout habitat.

6.19 As discussed in the evidence of Mr Williams, the physical processes and ecological relationships of aquatic and terrestrial habitats form an inter – dependent and interconnected system, with riparian habitats affecting channel form and energy supply webs. The management of rivers cannot be considered without the management of their riparian zones which are essential components of river systems. The RMA refers to "*<u>rivers and their margins</u>*" which encompasses those characters which Wellington Fish and Game seek to protect. We ask that the wording be changed to reflect the intent of the RMA. We ask that reference to "*<u>waterbodies</u>*" without reference to "*<u>their margins</u>*" be declined, and instead the terms "*<u>and their margins</u>*" be included in any reference to either "*<u>waterbody</u>*" or "*<u>Waterways</u>*".

6.20 The intent of Objective 6-1 is supported. However, the inclusion of the date "*2030*" is not supported. Life that is found in surface waters of the region need to be protected now, and not at some established time in the future. As discussed in my evidence and the evidence of

Dr Joy and Associate Professor Death, ecosystem values within the region are already compromised to the extent that their life supporting capacity is diminished, as seen by the degradation in macroinvertebrate communities and vertebrate communities, including the regions recreational trout fisheries. If action is not taken now to protect the regions freshwater ecosystems, then their values may be degraded to the extent that current freshwater vertebrate communities cannot be sustained. Part 2, principles and purposes of the RMA outlines in s5 that its purpose is to "*promote the* ***sustainable management*** [own emphasis] *of natural and physical resources*". Sustainable management meaning among other things; "*safeguarding the life-supporting capacity of air, water, soil, and ecosystems*" (s5(b)). Wellington Fish and Game requests that the recommended inclusion of "*2030*" be declined.

6.21 If the intent is that water quality standards are to be met by "*2030*" then that needs to be stated. Even if that is the intent the inclusion of "*2030*" is still opposed. The Manawatu Catchment Water Quality Regional Plan (1998), specified water quality standards that were linked to water quality objectives, and then set timeframes by which they were to be achieved, these standards and timeframes have been ignored, which indicates that this approach is flawed. If times are specified by which standards are to be met in the future, then interim standards and time lines need to be established by which to measure progress towards the achievement of the objective.

6.22 Policy 6.1 supported (as discussed in paragraph 6.12). We ask that Ms Bartons recommendations be accepted in their entirety

Recommendations - Appropriateness of including regulatory methods in the Plan

6.23 A number of submitters have challenged the establishment of regulatory methods to control some farming practices in the Proposed One Plan. The issues of voluntary vs regulatory methods to control farming activities and the concerns of landowners are addressed in Mr Botha's evidence. Mr Botha goes on to support the approach of the Proposed One Plan.

6.24 The justification for a regulatory framework is based on the premise that without such a framework freshwater values will not be maintained or the purposes of the Act met. Evidence clearly shows that intensification of agricultural/horticultural land uses are significantly impacting on freshwater ecological integrity, including significantly impacting on the regions recreational trout fisheries and recreational angler values. The national trend towards continuing degradation of freshwater resources is applicable to the Horizons Region.

6.25 Wellington Fish and Game supports Horizons approach to controlling land use practices which impact on the Environment. We ask that those provisions within the Proposed One Plan be accepted, including but not limited to, Policy 6-1, 6-7, 6-12, 6-15, 6-16, 6-18, and Chapters 13 and 15.

6.26 Having considered the above general matters I now turn to specific water quality, quantity and habitat provisions within the Regional Policy Statement section of the Proposed One Plan, and Rule Chapters, on which the Wellington Fish and Game Council submitted

7. WATER QUALITY PROVISIONS OF THE PROPOSED ONE PLAN

Water Quality Requirements of Trout

7.1 Salmonids have high water quality and quantity requirements. The four major parameters for the protection of adult trout are water temperature, dissolved oxygen, water clarity/turbidity and food (Hay *et al* 2006). Because of their high water quality and flow requirements the Ministry for the Environment included trout in their analysis of potential indicators for freshwater (Froude, 1998).

7.2 Most salmonids are sit-and-wait predators that forage essentially on drifting prey. The abundance of which varies considerably between seasons, from day to day , and during the course of the day (Giroux *et al* 2000).

7.3 Research has shown that trout prefer to feed on taxa that inhabit high water quality streams (e.g., Ephemoptera, Plecoptera and Trichoptera (EPT)), with large Trichoptera being the most highly preferred macroinvertebrate food item (Egglishaw 1967; Bisson 1978; Peddley and Jones 1978; Neveu 1981). These taxa are pollution sensitive and are found in the highest densities in riffle habitat (Shearer et al 2002; Blakely and Harding 2005).

7.4 Adult caddisflies and Hydrobiosidae are typically the most preferred Trichoptera. These species generally have a low level of sclerotisation and inorganic material associated with them (cf stony cased caddisflies) which may account for their preference (Dedual and Collier 1995). Furthermore, adult caddisflies have a high fat content (Elliott 1991). Ephemeroptera are the next most highly selected invertebrate group (Dedual and Collier 1995). Caddisfly larva and mayfly nymphs were the main prey of brown and rainbow trout in the Mohaka system, with inputs of terrestrial insects increasing in importance in summer and stonefly nymphs in winter (McLennan and MacMillan 1984).

7.5 The presence and abundance of drifting adult aquatic insects on any given day is dependent on environmental conditions such as water volume, temperature, changes in light intensity, sedimentation and periphyton levels (Shearer *et al* 2002). Agricultural development of catchments is often associated with nutrient enrichment leading to progressive downstream increases in benthic algae, and a decrease in Ephemeroptera, Plecoptera and Trichoptera (EPT) scores and consequent changes in invertebrate community structure, which adversely impacts on the health and sustainability of trout populations (Fig. 4)

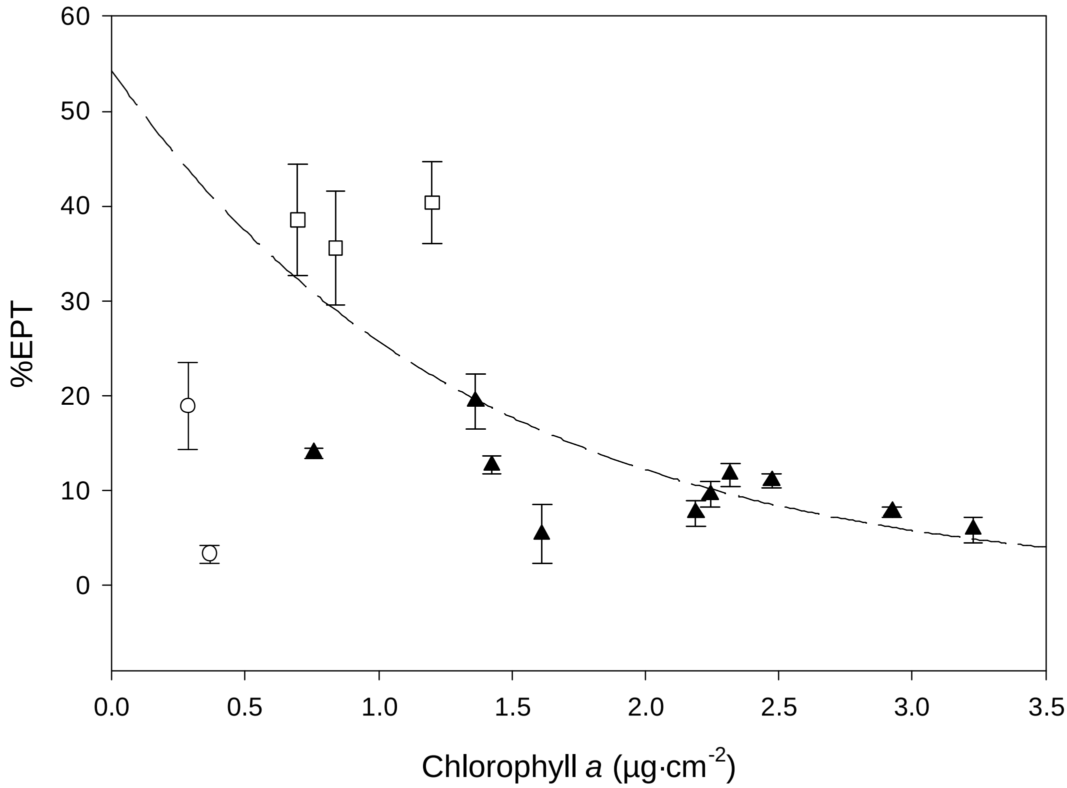

Figure 22. Drifting EPT caught in the Tongariro River as a function of periphyton biomass (From Death 2008).

7.6 Hay and colleagues (2006) suggests that maintaining a MCI above 120 (indicative of clean water) for "*Regionally Significant Trout Fisheries*", or above 100 (indicative of possible mild pollution) for "*Other Trout Fisheries*" should be appropriate.

7.7 Research has shown that the drift of the common mayfly *Deleatidium spp* (Ephemeroptera) is negatively related to chlorophyll a concentration (Shearer, 2003), which means that ability of trout to feed on drifting Deleatidium is reduced when periphyton levels are high.

7.8 High levels of heavy metals have been found to have lethal effects on several freshwater invertebrates in New Zealand (Hickey and Clements 1998), including the cased caddis *Olinga feredayi*, the common mayfly *Deleatidium spp*, and the amphipod *Paracalliope fluviatilis* (Hickey 2000). Limiting toxicants to the 99% protection level as indicated in the ANZECC guidelines is recommended.

7.9 Nutrient enrichment (due to increases in DRP and SIN) cause increases in periphyton growth (discussed in Kate McArthur's Officers report), which can result in decreases in Dissolved Oxygen (DO) as the biological oxygen demand increases (BOD_5). Dissolved Oxygen is essential for trout, which require higher levels (DO >80% saturation, >6mg/L and >9mg/L when spawning) than most other freshwater fish (Hay *et al*, 2006). As DO levels drop toward 5mg/L, growth rates, reproductive rates, health, and survival of trout are adversely affected (Hay *et al*, 2006). Dissolved Oxygen levels are also affected by temperature. Dissolved oxygen levels of 80% saturation, may not be sufficient if temperature guidelines are exceeded (NIWA, 2005).

7.10 Since trout are visual predators and drift feeding is the predominant foraging behaviour in most rivers (especially those of moderate to steep gradient), Increasing algal growth and decreasing water clarity will adversely affect the ability of trout to “sight feed” on high quality drifting macro-invertebrates such as EPT taxa (mayflies, stoneflies and caddisflies), as it will reduce their ability to detect and intercept drifting prey (Gregory & Northcote 1993). The strength of this effect depends on trout size and prey size, but will start to have an effect once water clarity drops below 4 m (Hayes, 2007). Generally maintaining clarity levels of 3.5m - 5m, as measured by black disk, are required to maintain reaction distances of drift feeding trout at appropriate levels (Hay *et al*, 2006).

7.11 High nitrogen levels in the form of both ammonia and nitrate are also, detrimental to trout populations. Research has shown that high ammonia levels (2.55mg/L at pH7.52, and 1.44mg/L at pH8) kill salmonids eggs and increase adult mortality (USEPA, 1999). Maintaining concentrations of Ammonia below 10µg-N/L and Nitrogen levels low enough to reduce the likelihood of periphyton proliferation should be enough to avoid toxic effects on Salmonids (USEPA, 1999).

7.12 Dissolved Reactive Phosphorous (DRP) is most likely to indirectly affect trout, in combination with nitrogen by promoting proliferation of algae. Ensuring levels are maintained to reduce periphyton proliferation should be sufficient to protect trout fisheries.

7.13 Deposited sediment can also clog interstices of streambed substrates leading to a reduction in water exchange with surface waters and causing the interstitial layer to become oxygen depleted. Silt accumulation and these associated factors generally bring about a change in invertebrate communities, with a loss of stonefly and mayfly species, and an increase in densities of animals such as chironomids and oligochaetes (Suren, 2005), which adversely impact on trout feeding and hence the health and sustainability of trout fisheries. Mayfly nymphs and caddis larvae are adversely impacted by high sediment levels as they preferentially graze unsilted rather than silted periphyton.(Suren, 2005; Waters, 1995).

7.14 High deposited sediment levels also adversely impact on trout spawning success by smothering the gravels, or interstitial spaces, and reducing the flow of water, and consequently dissolved oxygen to the eggs or alevins, and the removal of metabolic wastes

7.15 The main concerns with water temperature are the effects of high temperatures on aquatic life. Laboratory studies looking at the impacts of high temperatures on trout, have found that brown trout ceased feeding once temperatures climbed above 19 °C and that they would die if temperatures climbed above 25 °C for a sustained period (Elliott 1994). Trout deaths have been reported in New Zealand rivers when water temperatures have equaled or exceeded 26°C (Jowett 1997). Similarly, 50 % of *Deleatidum* mayflies will die after 4 days in water at 22.6 °C (Quinn *et al*. 1994). However, the thermal range for developing embryos, is much narrower. The preferred range for brown trout spawning is 3-20°C, with an optimum temperature of 10°C, and for hatching a preferred range of 2-11°C with a maximum of 20°C (Death, 2002; NIWA, 2005).

Recommendation to the hearing panel – Schedule D

7.16 As stated in the evidence of Associate Professor Death "*the development of specific numerical standards for evaluating POP objectives is a positive and effective way of improving water management*". Wellington Fish and Game shares this sentiment. We support the schedule D standards. These standards are a key component of the Proposed One Plan as they provide the basis for decision making in relation to matters on which the Regional Council has obligations under the Act.

7.17 Evidence given by myself and Associate Professor Death support the established water quality numerical standards, with the exception of the replacement of the QMCI standard with the MCI standard. The establishment of numerical standards which aim to protect the life supporting capacity of the resource, and maintain or enhance ecosystem integrity, recreational, and amenity values, gives effect to the narrative within the Act. Further matters in relation to the attainment of these standards have been discussed under section 6 paragraphs 6.13, 6.14, & 6.15.

7.18 Maintaining Dissolved Oxygen levels equal to or greater than 80% saturation is recommended to maintain the health and sustainability of trout fisheries, especially during the spawning season, as discussed under section 7.9 above. Wellington Fish and Game notes that for some of our trout spawning streams, eg the Raparapawai, Oruakeretaki, Tamaki, lower Kumeti, and Mangaterai Streams, water quality standards are reduced, including a lower DO saturation standard (70%). However, we also note that the officers have recommended spawning season water quality standards to alleviate our concerns. These recommendations are supported, and we asked for them to be retained.

7.19 As discussed in the evidence of Dr Joy, myself, and Associate Professor Death, deposited sediment is a significant contributor to the degraded state of some of the regions water ways. Elevated levels of deposited sediment impact on macroinvertebrate communities and the health and sustainability of the regions trout fishery. While the Proposed One Plan establishes non regulatory Whole Farm Plans to deal with the issue of land use practices, and hill country erosion, no numerical deposited standards are established. This is seen as serious weakness within the Proposed One Plan. The Wellington Fish and Game Councils recommends the inclusion of deposited sediment standards within schedule D, which can be determined in consultation with relevant Ecological experts.

7.20 As discussed by Associate Professor Death, in regard to the establishment of a MCI vs QMCI standard. Wellington Fish and Game supports the Proposed One Plan notified provision.

7.21 We ask that the Officers recommendations to retain schedule D, be accepted along with the numerical standards as discussed above.

8. WATER QUALITY PROVISIONS OF THE POP – CHAPTER 6 & 13

8.1 As stated in section 6.2, under Issue 6-1 of the Proposed One Plan, the "*quality of most rivers and lakes in the Region has declined to the point that ecological values are compromised and contact recreation such as swimming is considered unsafe*" (POP section

6.2 Significant Resource Management Issues, Issue 6-, pg6-6). Point source discharges of treated wastewater are one of the primary causes for deteriorating water quality in the region, along with Non point source discharges, and hill country erosion (Horizons Proposed One Plan, 2007).

8.2 Poor water quality is a concern to many people, and disposal of wastes into water, and discharges of non point source contaminants, is becoming more and more unacceptable to the regional community. Poor water quality detracts from an anglers tangible and intangible amenity values, as well as posing a health hazard. Discharges of Point and nonpoint sources of pollution to the regions streams and rivers have the potential to substantially alter conditions in the river causing ecosystem instability, reducing species diversity, and adversely impacting on the sustainability of trout populations. The impacts of non point and point source inputs of pollutants on freshwater ecosystems, including the regions recreational trout fisheries, have been discussed in my evidence and the evidence given by Wellington Fish and Games' Council experts.

8.3 As outlined in Mr Carlyons evidence (2009), few rivers are now safe to drink from directly. The middle and lower reaches of many rivers are unsafe to swim in because of bacterial contamination, or are unpleasant to swim in because of excessive periphyton growth. Cyanobacteria growths, which can be toxic to people and animals, have been recorded at an increasing number of sites in the Region including the upper Manawatu, Mangatainoka, and Ohau Rivers. The lower reaches of many rivers have high concentrations of bacteria, nitrates, phosphates and sediment.

Recommendations to the hearing panel

8.4 Issue 6.1 supported and we ask that the recommendations of Ms Clare Barton be accepted

8.5 Objective 6-2 is supported and we ask that the recommendations of Ms Barton be accepted

8.6 Policy 6-3 supported and we ask that the recommendations of Ms Barton be accepted

8.7 Policy 6-4 is opposed. The intent of this policy as indicated by its title "*Enhancement where water quality standards are not met*" was designed to ensure that water bodies which had water quality that did not meet relevant water quality standards would be enhanced. The inclusion of the word" *maintained*" derogates from that intent. We asked that the inclusion of the term "*maintained*" be declined

8.8 Policy 6-5 supported and we ask the Ms Bartons' recommendations be accepted

8.9 Policy 6-7 is supported and we ask that the recommendations of Ms Barton be accepted. Regulatory vs non regulatory control of farming activities are discussed under section 6

8.10 Table 13.1 recommendation 78 is supported. As discussed in the case studies, intensification of agriculture is significantly impacting on the health and sustainability of our trout fisheries. The identification of catchments where non point source inputs are the predominant pollutants are supported. Out of the 36 sites identified 50% impact on essential trout spawning habitat, 27.8% impact on "*regionally significant*" trout fisheries including the Mangatainoka and Makakahi (which have local water conservation notices), and 16.7% impact on our "*other*" trout fisheries.

8.11 Table 13.2 recommendation WTR 49 partially supported. Wellington Fish and Game supports the regulatory approach of Horizons, and we ask that it be retained. Support for the regulation of agriculture and horticulture is discussed under section 6 of my evidence. Issues of contention as detailed in Wellington Fish and Game Councils original submission "*Fish and Game does not believe limited technologies is an acceptable reason to allow continuing or worsening serious pollution of water. We do support given the magnitude of the change involved a reasonable period of adjustment – beyond which, if the standard cannot be met, then the adverse effects of the contributing activities be avoided, remedied, or mitigated so that the standard is met*".

8.12 "*This message is not being given by the leaching run off values in table 13.2, instead the message is that it is acceptable to be no better off in 20years times, than we are now. This is a serious weak link against everything else this plan is attempting to achieve and risks jeopardising all other progress toward improved water quality, to go 20 years without improvement forecast is far to generous. The longer term targets, both values to be achieved and the time within which that achievement is expected, must signal some urgency to drive farm planning and research. Clothier et al (2007) state that the adoption of best management practices on dairy farms will achieve a kg-N/year loading improvement, in river of about 18.3% there is no reason that we know of as to why current best management practices cannot be put in place within 5 years*".

Decision sought
Revise Table 13.2 so that the leaching/run off values

- *Address DRP issues*
- *Address all LUC*
- *Do not allow an increase over current values*
- *Base target values after 5 years on what can be achieved using current best management practices*
- *After 15 years, will achieve the SIN standards set in Table D17*

8.13 Rule 13.1 recommendation WTR 81 opposed. Although Wellington Fish and Game appreciates that water takes and restrictions are covered in other rules, we are of the opinion that rule 13-1 should still refer to those restrictions. The retention of the original wording provides clarity to farmers and ensures that efficient water use and restrictions to protect instream values are included in the FARMS consenting process. Wellington Fish and Game requests that the original wording, that referred to abstractions, and restrictions in protected river, as notified be accepted

9. WATER QUANTITY PROVISIONS OF THE PROPOSED ONE PLAN

Water Quantity Requirements of Trout

9.1 Salmonids are among the most flow demanding fish species in New Zealand, due to their large size, drift feeding behaviour, and high water quality requirements.

9.2 Changes to river flows resulting from the abstraction of water have the potential to substantially alter conditions in the river, making it less suitable as adult, juvenile, and spawning, trout habitat.

9.3 The '100 Rivers' study showed that the percentage of adult trout drift feeding habitat at the mean annual low flow (MALF) and the percentage of food producing habitat at the median flow were important factors affecting trout population abundance in New Zealand rivers (Jowett 1992).

9.4 As the Mean Annual Low Flow (MALF) point is passed, trout habitat decreases exponentially through the reduction in supply of invertebrate food (both quantity and quality), reduction in available habitat, and contiguous passage, increased water temperatures, increased periphyton proliferations, and lower dissolved oxygen levels, along with decreases in the dilution of contaminants (Jowett, 1997). Stream size, channel morphology, presence of cover and the duration and severity of the low flow event relative to natural flow patterns will all determine how dramatic the effects will be on trout populations (Jowett, 1997).

9.5 Reductions in available habitat, and migration potential can result in trout becoming restricted to shallow pools, which often become too warm, stagnant, or crowded to sustain normal fish populations and growth rates (Hay *et al*, 2006). The productivity of a trout population will suffer as water temperature approaches and exceeds 19°C, with mortality being reported to occur in NZ rivers at water temperatures of around 26°C (Jowett, 1997), though behavioural changes may occur sooner, with feeding stopping at around 20°C (Jowett, 1997). The thermal range for developing embryos, however, is much narrower. For brown trout spawning there is a preferred range of 3-20°C, with an optimum temperature of 10°C, and for hatching a preferred range of 2-11°C with a maximum of 20°C (NIWA, 2005).

9.6 As discussed in section seven, periphyton biomass can build up to high levels during extended periods of low flow (Elliott, 2000). Periphyton proliferation may reduce invertebrate diversity by smothering habitats, and increase diurnal variations in dissolved oxygen and pH, which can increase the potential for ammonia toxicity (Elliott, 2000, Quinn 2000, Allan 2004). All of these changes can lead to a shift in community composition from less tolerant, larger collector/browser mayflies, caddisflies and stoneflies to being dominated by more tolerant, smaller filter-feeding caddisflies, chironomids, collector/browser beetles, snails and oligochaete worms (Elliott, 2000). This may mean that invertebrate food for trout is less available or/ and of lower quality.

9.7 Decline in abundance of large, drifting invertebrates due to periphyton proliferation at low flow may further reduce drift rates, impacting on trout feeding ability. The consequences of reduced invertebrate drift rate at low flow, due to the reduced water velocity, on salmonid food requirements will be magnified by an interaction with elevated water temperature, as energy requirements of salmonids increase with water temperature (Hay *et al*, 2006, James et al., 2008).

9.8 Potential reductions in dissolved oxygen levels in relation to reduced flows and potential increases in periphyton growths could significantly increase trout mortality rates (Deans & Richardson, 1999). The dissolved oxygen requirements of salmonids are higher than for most other freshwater fishes' (Jowett, 1997), as discussed in section 7. Dissolved oxygen should be at least 80% saturation, however this will not be sufficient if temperature guidelines are exceeded (NIWA, 2005).

9.9 The cumulative effects of surface water abstractions from river catchments have the potential to artificially increase the length and severity of low flow periods, particularly over the dry summer months, and can result in reductions in flow variability especially during critical periods, which can have a significant impact on the flora and fauna of freshwater ecosystems (Puckridge *et al*, 1998, Dewson et al., 2007).

9.10 Increased flow variability is associated with a more pronounced pool/riffle structure, and high flow or flushing flows, result in the reinstatement of habitat for a wide range of benthic organisms, assist in the removal of periphyton proliferations, reduce levels of nutrient enrichment and pollution, and increase median flow rates (Puckridge *et al*, 1998, Death 2008), all of which maintain the health of freshwater ecosystems.

9.11 It has been suggested that allowing natural hydrological variability, as far as possible, should be a part of freshwater management, and is in keeping with the protection of ecosystem processes (Poff *et al*., 1997, Puckridge *at al*, 1998).

Recommendations to the hearing panel - Schedule B

9.12 Wellington Fish and Game support the establishment of numerical core allocation and minimum flow standards, and the regulatory implementation of these standards as discussed in section six. This process is compatible with National direction, and essential in the face of increasing land use intensification and agricultural demand for water. Without the establishment of such standards, and regulatory control, abstractors would soon find they have no surety of supply during critical periods, and the ecological integrity of our freshwater ecosystems would be compromised to the point where life supporting capacity would not be sustained.

9.13 We ask that minimum flow standards set at 90% of MALF be accepted, or those standards which give effect to National Water Conservation Orders and Local Water Conservation Notices, and those waters with Aesthetic values

9.14 We ask that established core allocations be accepted

9.15 Wellington Fish and Game has concerns, as discussed in the evidence of Associate Professor Death, at the setting of lower minimum flow standards. Impacts on the health and sustainability of trout populations have been discussed in my evidence. Wellington Fish and Game recommends that minimum flow standards below 90% of MALF be declined.

9.16 As discussed in the evidence of Associate Professor Death, the maintenance of hydrological variability is essential for sustaining the health and integrity of freshwater ecosystems. Wellington Fish and Game support those provisions within the Proposed One Plan that relative to the maintenance of hydrological variability

10. WATER QUANTITY PROVISIONS OF THE POP – CHAPTER 6 & 15

Recommendations to the hearing panel

10.1 As discussed in my evidence and the evidence of Associate Professor Death, the maintenance of hydrological variability is essential for the health and sustainability of freshwater systems. Section 6.1.4 Water Quality is supported and we ask that the recommendations of Ms Clare Barton be accepted

10.2 Issue 6-2 supported, and we ask that the recommendations of Ms Barton be accepted. The impacts of increasing abstraction of freshwater ecosystems has been discussed in my evidence and the evidence given by Associate Professor Death

10.3 Objective 6-3 is supported and we ask that the recommendations of Ms Barton be accepted. The inclusion of "*or enhanced*" gives effect to those provisions within the Act

10.4 Policy 6-12 partially supported. Recommended wording changes of provision (c) opposed. The recommended wording in the final paragraph, degrades the intent of this policy from one where efficient use of the resource is given effect, to one where those provisions of the RMA are ignored. As discussed in the evidence of Mr Carlyon, and myself, a number of Territorial Authorities (TAs) do not ensure that their operations result in an efficient use of freshwater resources. Losses from these systems, along with the allowance of illegal connections, constitute a significant adverse cost to freshwater environments. Territorial authorities have a statutory mandate to ensure natural resources are used in an efficient manner and that any actual or potential effects of activities on the environment, in relation to the surface water of rivers and lakes are controlled (RMA 1991, part 4, s31e). Wellington Fish and Game supports the wording of policy 6-12 as notified and recommends that this wording be retained.

10.5 Policy 6-14 opposed. The inclusion of "*including harvesting during periods of high flow in a water body*" is unnecessary. WFG does support water harvesting, but care to ensure adequate hydrological variability to maintain the natural character of water bodies and protect their life supporting capacity needs to be considered – as discussed by Dr Fuller, Mr Williams and Associate Professor Death. Wellington Fish and Game supports the original wording as notified or amendments to the recommended wording which address our concerns regarding the maintenance of hydrological variability to provide for ecological integrity.

10.6 Policy 6.18 recommendation WRT 40 supported in part. The importance of maintaining hydrological variability, and flushing flows is discussed in the evidence of Dr Fuller and Associate Professor Death.

10.7 Policy 6.25 recommendation WRT 47 is opposed. Groundwater takes that impact on surface water bodies should have the same regulations including minimum flow restrictions and core allocation limits as surface water takes. We ask that the recommended wording be declined, and that the original wording as notified be accepted. Or alternatively only groundwater takes that have low or negligible impacts on surface water be exempt from surface water standards.

10.8 Policy 15.1 recommendation WTR 112 is opposed. Wellington Fish and Game asks that the original wording as notified, which referrer to Chapter 7 (Natural Character), be retained. As discussed by myself, Dr Ian Fuller, Mr Williams, and Associate Professor Death, flows regimes impact on the Natural Character of waterbodies and their margins, and so the maintenance of appropriate flow regimes should be considered in association with the Natural Character of waterbodies and their margins.

10.9 Rule 15.5 and Rule 15.7 recommendation WTR 124 and WTR 126 is opposed. Wellington Fish and Game does not support the deletion of clause (a) nor the deletion of Rule 15-7. The importance of National Water Conservation Notices is addressed in Mr Johnstons' evidence. Wellington Fish and Game is awaiting further direction from the New Zealand Environmental defence society in regards to Local Water Conservation Notices.

10.10 Rule 15.11 recommendation WTR131 opposed. Wellington Fish and Game does not support any diversions that involve a natural water course. Diversions of natural water courses result in the cumulative degradation of Natural Character, and have the potential to significantly impact on trout fishery values.

11. NATURAL CHARACTER & BEDS OF RIVERS AND LAKES PROPOSED ONE PLAN PROVISIONS

Trout Habitat Requirements

11.1 The favourite habitat for trout is generally larger streams in mountain areas with submerged rocks, undercut banks, and overhanging vegetation. However, trout occupy a variety of habitats from mountain streams to lowland rivers, and lakes, in New Zealand.

11.2 Information on habitat preferences for brown trout indicate that they prefer areas with gravel or coarser substrate, water depths greater than 0.6 m and water velocity between 0.3 - 0.6 m^3/s (Hayes & Jowett 1994). Similarly, studies on a variety of stream invertebrates that are commonly included in trout diets have shown that these invertebrates generally prefer areas with a substrate dominated by gravels, cobbles, and boulders, water depths between 0.1 - 0.8 m, and water velocities between 0.6 – 0.9 m^3/s (Waters 1976).

11.3 Naturally meandering channels are typified by having complex morphologies that produce eddies and areas of low velocity, which are key characteristics of any productive instream habitat. Diversity of depth, flow and substrate size through pool, riffle and run components, are essential in supporting trout throughout their life cycles.

11.4 The interchange between riffles and pools often provide the best spawning sites (Wesche 1985), providing good percolation of water through the spawning gravels, adequate velocity (for oxygen delivery and removal of metabolic wastes), and high levels of dissolved oxygen, all of which are essential for successful egg incubation (McDowall 1990).

11.5 Areas of low velocity act as refugia for many invertebrates during times of high flow. Pools also, provide deep cool water which are essential habitat for adult trout, providing space, shelter and food. They also act as essential areas of refuge during periods of low flow.

11.6 Natural streams usually support well vegetated riparian margins, and instream plant communities of algae and/or macrophytes. Both riparian and instream vegetation are important components of stream ecosystems and often provide food for invertebrates, shelter for fish (including trout), birds, and spawning sites for galaxiid fish. Both instream and riparian cover are also important for spawning adult, and newly hatched trout (Wesche 1985). Clearing riparian vegetation degrades instream habitat by removed a potentially important energy source and reducing physical habitat.

11.7 The interconnections between waterbodies are important for maintaining the resilience of the system. Smaller streams provide spawning and rearing habitat, while the main river sections provide good habitat for adult trout. Habitat with larger interstitial spaces, protective cover, or that is less impacted by floods will act as refuges during periods of high flow, while diversity of spawning habitats makes it unlikely that a flood or other disturbance will affect all recruitment areas. Free passage among the different waterbodies is required to maintain the resilience of the system

Impacts of River Management on Trout Habitat

11.12 River realignment works including gravel extractions and redistributions have both short term and long term impacts on aquatic environments. In the short term, sediment disturbances have the potential to adversely affect fish and micro/macro-invertebrate habitats in the stream, and displace or smother plant life. In addition high concentrations of suspended solids in the stream following disruption impede successful egg incubation, reduce visual clarity, and lower dissolved Oxygen levels, which can be lethal to trout.

11.13 In the long term, river straightening reduces the quality and quantity of available trout habitat. By creating a uniform, fast flowing, trapezoidal shaped channel, river works reduce the sinuosity of the river, and the heterogeneity of pool, riffle and run habitats, essential to the maintenance of healthy trout populations.

11.14 By altering the heterogeneity of pool, riffle, and run habitats, variable flow is reduced. These variable flows are essential in supporting trout by providing a mixture of environments suitable for spawning, and the development of juveniles through to mature adults. Also, the removal of over-bends, by river realignment works, decreases the number of pools, which are essential for trout space, feeding and cover. These pools are especially important during periods of low flow, as they offer cooler deeper waters for trout to shelter within.

11.15 Trout migration is also impacted by reducing channel heterogeneity, and increasing sediment loads (McDowell, 1990). Although adult trout have established territories within suitable habitats, they undertake upstream and downstream migrations annually for spawning (McDowall 1990). If long lengths of a river do not provide resting sites during this migration, due to a lack of habitat diversity and increased water velocity, they effectively become barriers to spawning migration and thereby adversely impact on the reproductive capacity of the population. The importance of instream migration (McDowall 1990) is often overlooked as a consideration for trout habitat.

11.16 Extensive flood protection works also impact on the feeding ability of trout. Drifting invertebrates are the major food source for adult trout in New Zealand Rivers. International evidence has found the average downstream drift distance for invertebrates is in the vicinity of 10m; therefore if an impacted or disturbed channel length is longer than the drift distance, drift from an unstressed upstream source may not be sufficient to sustain a locally viable fishery in that section of the channel (Gore 1985).

11.17 Traditional ‘resectioning’ (Cross blading) involves extracting/moving gravel to deepen or widen the main channel to increase its inbank flood carrying capacity and is often done in conjunction with channel realignment and bank protection. Resectioning has been shown to have significant adverse environmental impacts on instream habitat, including sediment release, reducing channel heterogeneity, and disrupting the natural benthos. In some instances, resectioning, promotes continual instability, and can increase the potential for the river to avulse (leave its channel and enter the floodplain).

11.18 Gravel extractions also can cause serious adverse environmental impacts. Evidence from rivers in Southland and Marlborough show significant habitat loss (Hudson 1997) which is supported in the international literature (Church 1992). Gravel extractions in the Wairarapa are changing channel morphology. Over extraction, in the dry is reducing the bed level, creating a shallow, wide, uniform channel, devoid of pools and riffles. Removal of the pool/riffle system, that is an integral feature of an aquatic ecosystem, and the direct and frequent disturbance of trout habitat by way of major gravel extractions, renders waterways unsuitable for angling amenity or fisheries values, thus destroying some elements of natural character in the process.

Overview of Impacts of River Engineering

- Shortened stretch of river reducing physical trout habitat
- Reduction in the quality of trout habitat by creating a uniform fast flowing, trapezoidal shaped channel, not in keeping with upstream or downstream geomorphology (Loss of flow variability by altering pool/ riffle/ run ratios);
- Sedimentation
    - smother natural benthos;
    - reduce water clarity and increase turbidity;
    - decrease dissolved O_2;
    - cause changes to benthic fauna;
    - Reduces resistance to disease;
    - Reduces growth rates;
    - Impairs spawning, and successful egg and alevin development; and
    - Can be lethal to fish
    - Reduction in the “the numbers and diversity of invertebrates or fish species by destroying suitable habitat or removal of food sources”;

11.19 Trout are especially sensitive to habitat change. They require cold well oxygenated water with low sedimentation levels, especially during the trout spawning period, where cold, well oxygenated water and gravels, and minimal sedimentation are essential to spawning success and alevin survival. Abundant pools (riffle pool components) are also vitally important as they not only offer adult trout habitat, and angling opportunity, they also provide essential resting sites for trout during migration.

Natural Character

11.20 The maintenance of the Natural Character of rivers and their margins is of National Importance under part 2 section 6(a) of the RMA (1991). The "*Natural character*" of an environment, as discussed during the Proposed One Plan hearings on Living Heritage, "*is that dimension of its character which is an expression of nature*" (Anstey, paragraph 47, pg 19, 2009), and includes ecological structure and processes including geomorphic, hydrologic, energetic, physio/chemical, trophic, biotic, ecologic, and extrinsic factors (anthropomorphic).

11.21 The ecological description of Natural Character was identified and protected in the *MoWD v Marlborough Sounds Planning Authority* judgment where ecological processes were considered as being part of the areas Natural Character. Underlying ecological processes are inherent qualities to landscapes in addition to overt visual features.

11.22 Judicial protection has not just extended to natural character of unmodified landscapes. In the *Southland Airport case* the character of the modified or cultural landscape was deemed to have value and deserve protection. The judge declined the application in favour of the appellants amenity and enjoyment values including tranquillity. In *Brook Weatherwell Johnson v Tasman District Council* the judge ruled that a modified hill overlooking Motupipi estuary had Natural Character worthy of protection. The judgement considered the wider landscape context and determined that development could be detrimental to the ecology of the adjacent estuary.

11.23 Natural Character includes habitat connectivity, resilience to disturbance and community class complexity. Natural character may also reflect ecosystem health, thereby making it measurable by considering changes in physical, chemical and biological indicators. Change in ecological character is defined as the impairments or imbalance of any of those processes and functions which maintain the freshwater environment and its products, attributes and values. These processes need to be either protected or enhanced to maintain the viability of these ecosystems in the face of pollution and human encroachment.

11.24 Natural character includes the morphological components of the environment that sustain healthy ecosystems. In the case of trout the important morphological components of natural character, include, but are not limited to: riparian habitat; instream habitat diversity including, the presence of riffle habitat to support healthy macroinvertebrate communities, leading into cool deep pools with riparian shading; suitable gravels to support spawning, juvenile rearing, and adult trout requirements; instream woody debris; and adequate flows and flow variability to sustain the health of the system eg limit excessive periphyton growths, maintain instream morphological diversity, and flood plain connection, and reduce sedimentation issues.

Recommendations Chapter 6 Beds of Rivers and Lakes & Chapter 16

11.25 Issue 6-3 is opposed. As discussed under Section Six the term "*waterbody*" is not supported, and we request that reference to either a "*waterbody*" or "*waterway*" be followed by "*and their margins*". We request that the inclusion of "*which while having beneficial effects in terms of flood mitigation*" into Issue 6-3 be declined. As discussed my evidence, the evidence of Mr Blackwood, Dr Ian Fuller, and Mr Gary Williams, gravel extractions can have significant adverse effects on the natural character of freshwater systems but also on flood protection. We ask that issue 6-3 be amended to read:

The demand for flood and erosion control to protect many types of land use has led to significant modification of the Regions water~~bodies~~ ways and their margins. Structures required to be located within the beds of rivers and lakes, including bridges, culverts, water intake and discharge pipes and hydroelectricity structures, also affect the natural character of water~~bodies~~ ways and their margins. These types of uses and developments, in conjunction with gravel extraction ~~which while having beneficial effects in terms of flood mitigation~~, have modified, and continue to modify the physical characteristics and ecology of may of the Regions water~~bodies~~ ways and their margins.

11.26 Objective 6-4 recommendation WTR 18 is opposed. Flood and erosion protection by Regional Councils are enabled by the Soil conservation and Rivers Control Act 1941 "*An Act to make provision for the conservation of soil resources and for the prevention of damage by erosion, and to make better provision with respect to the protection of property from damage by floods*". However, amendments to this Act state that "*nothing in this Act shall derogate from .. or the Resource Management Act 1991*" (s10a). This ensures that the adverse effects of fulfilling these responsibilities are avoided, remedied, or mitigated, that the life supporting capacity of resources is safeguarded (s5), and the natural character of rivers and their margins is protected as nationally important (s6)

Under part 2 (s6) of the Resource Management Act 1991 Regional Councils need to recognise and provide for:

- as a "*matter of national importance*" the preservation of the Natural Character [own emphasis] of wetlands, and lakes and rivers and their margins (s6); and
- "*have particular regard to*" the maintenance and enhancement [own emphasis] of: amenity values (s7c); Intrinsic values of ecosystems (s7d); Maintenance and enhancement of the quality of the environment (s7f); the protection of the habitat of trout and salmon (s7h).

11.27 These matters are discussed more fully in Mr Williams evidence. Wording of objective 6-4 as currently recommended does not reflect the preamble in 6.1.5, it does not tie in with issue 6-3, nor does it have regard to the natural character of rivers and their margins. We ask that the objective be amended to include reference to:

- *The maintenance of their life supporting capacity*
- *The recognition and maintenance of their ecosystem values; and*
- *The maintenance or enhancement of Natural Character*

To give effect to those provisions within the RMA

11.28 Policy 6-27 recommendation WTR 50 opposed. Wellington Fish and Game Council is concerned that the links between chapter 6 and 7 in so far as they relate to the maintenance or enhancement of Natural Character are weak. For natural Character to be maintained or enhanced it first has to be identified. Following consultation with Mr Williams, Dr Fuller, and Associate Professor Death, Wellington Fish and Game Council recommends either amending Policy 6-27 or including a new Policy 6-27b to address these concerns in regard to the identification, maintenance or enhancement of natural character. Amend wording as follows:

In considering matters relating to the preservation, restoration or rehabilitation of the natural character of rivers and their margins particular regard will be given to :

- *the natural 'style' and dynamic processes of the river in terms of its natural meander pattern, characteristic bed style and width, quality and quantity of bed habitat and connectivity with its flood plain at the appropriate geomorphological scale (whole river, water management zone, and reach):*
- *the desirability of an integrated approach to flood and erosion hazard management , including the preservation, restoration or rehabilitation of natural character:*
- *appropriate science-based research and planning mechanisms (including management plans) to support decision making in these matters.*

Policy 6-27b could then tie into the amended methods, and Anticipated environmental result (AER) in regards to the maintenance or enhancement of natural character.

11.29 As discussed in the evidence of Dr Fuller, Mr Williams, and Associate Professor Death, establishing the Natural Character of the river or reach, and managing the river for its Natural Character may in fact prove a more economic and sustainable mechanism of flood control

11.30 Policy 6-28 recommendation WTR 51 opposed. Wording as notified supported

11.31 Policy 6-29 recommendation WTR 52 opposed. It is the opinion that policy 6-29 degrades the intent of Policy 6-27 and the proposed new Policy 6-27b. Wellington Fish and Game requests that recommendation WTR 52 is declined, and that either this policy is omitted from the Plan or amended to retain the intent of Policy 6-27 and proposed Policy 6-27b.

11.32 Policy 6-32 recommendation WTR 55 opposed. Table 6.4 of the Proposed One Plan "*Average Annual allocatable volumes of gravel*" specifies that ~ 190,000m^3/yr^{-1} of gravel can be taken from the Rangitikei River. Considering supply rates have been calculated at 61,700m3/yr from 1977 to 1990, 64,400m3/yr for between 1990 and pre 2004, and that supply rates cannot be estimated from pre post 2004 (Blackwood, paragraph 250, pg 55), this allocation estimation seems rather high. As documented by Mr Blackwells officers report (2009) historic gravel extractions in both the Rangitikei and Manawatu Rivers have progressed at an unsustainable rate causing significant degradation of river bed reaches.

11.33 Cross sectional survey data appears patchy for the Manawatu River, where assessments of bed load were determined from 96 cross sections surveyed from 1991 onwards, of which some sites were only surveyed twice. Taking into account the potential significant adverse environmental impacts and the significant potential adverse impacts on flood protection, Wellington Fish and Game recommends that table 6.4 is declined. We understand that gravel extraction is an integral component of river management but feel that these volumes cannot be justified. Allocation of gravel resources should be based on cross sectional survey data which identifies sediment loads, and establishes sustainable extraction volumes, which may fluctuate over time (Discussed by Mr Williams).

11.34 Following consultation with Horizons amended wording for method 6-9 was agreed. Wellington Fish and Game Council support the officers recommendation in relation to the methods and asked that they be accepted.

11.35 Table 16.1 recommendation WTR 138 partially supported. Wording under "*trout spawning*" clause (q) supported. New wording under "*Trout fishery*" (x) supported. Table 16.1 condition (c) and (d) under Life supporting capacity conditions which apply to all water bodies is opposed. Recommended wording as follows to address issues in regards to cumulative adverse impacts on Natural Character, as discussed in Associate Professor Deaths', Mr Williams, and Dr Fullers expert evidence, and deposited and suspended sediment issues as addressed in Associate Professor Deaths', Mr Williams, Dr Fuller, and Dr Joys' evidence:

- Any discharge of sediment directly caused by the activity shall not be undertaken for more than 5 days, and for more than 12 hours in total
- Any discharge of sediment under (c) shall not, after reasonable mixing, cause any conspicuous change in the colour of water in the receiving water body or any change in horizontal visibility of greater than 20%, more than 4 hours after completion of the activity
- The activity shall not result in any permanent straightening or channelling of a river.
- The Natural Character of the waterbody and its margins shall not be impacted

11.36 Rule 16.1 recommendation WTR 161 is supported. The upper and middle Rangitikei and Manganui o te Ao rivers and their tributaries are Protected under National Water Conservation Orders due to their nationally significant trout fishery, scenic, and biodiversity values. The importance of National Water Conservation Orders and their statutory standing is discussed earlier in my evidence and further in the evidence of Mr Johnson. Under National Conservation Orders Damming is expressly prohibited

11.37 Rule 16.2 recommendation WTR 142 opposed. Wellington Fish and Game is awaiting further direction from the New Zealand Environmental Defence Society on these matters.

11.38 Rule 16.2A recommendation opposed. Include the Mangatainoka in regards to wet gravel extraction.

11.39 Rule 16.13 recommendation supported. However, it is my opinion that issues surround the establishment of current levels of Natural Character, and the maintenance or enhancement of Natural Character need to be addressed under chapter 6. This is discussed further in the expert evidence of Associate Professor Death, Dr Fuller, and Mr Williams.

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