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| **IN THE MATTER** | of the Resource Management Act 1991 |
| **AND** | |
| **IN THE MATTER** | of **PROPOSED CHANGE 1** to the **GREATER WELLINGTON REGIONAL POLICY STATEMENT** |

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**STATEMENT OF EVIDENCE OF AMI COUGHLAN ON BEHALF OF THE WELLINGTON FISH AND GAME COUNCIL**

**HEARING STREAM 5 – TE MANA O TE WAI AND FRESHWATER**

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## 1. INTRODUCTION

1.1 My full name is Ami Coughlan.

### Qualifications and experience

1.2 I have the following qualifications:

(a) Bachelor of Environmental Science from Massey University.

(b) Master of Science, Ecology with Distinction from Massey University.

1.3 My MSc thesis, which I completed in 2022, was titled *Risk assessment and mitigations of the potential impacts of trout predation on New Zealand's indigenous fish species*.

1.4 I am employed by the Wellington Fish and Game Council ("Fish and Game") as a Resource Officer. I have held that role since December 2018. As a Resource Officer, I am responsible for:

(a) Managing the Fish and Game's response to policy, planning, and environmental issues affecting sports fish and/or gamebird values.

(b) Co-ordinating with the regional Fish and Game Council regarding regional planning and consenting processes relating to resource projects and to the National Fish and Game Council as required.

(c) Monitoring RMA resource consent applications, preparing submissions in response to planning processes, and advocating for habitat management and access in relation to sports fish and game birds.

**Purpose and scope of evidence**

1.5 The purpose of my evidence is to provide some context for amendments sought by Fish and Game to Proposed Change 1 which are addressed in Ms Campbell's evidence. My evidence is structured as follows:

(a) Habitat, freshwater species, and freshwater species interaction (Section 2).

(b) In-stream and out-of-stream factors affecting species interaction (Section 3).

(c) Management strategies for species interaction (Section 4).

(d) Tying together the threads of habitat protection and species interaction (Section 5).

(e) Protecting the habitat of trout and salmon and indigenous species (Section 6).

**Expert Witness Code of Conduct**

1.6 I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note dated 1 January 2023. I have complied with the Code of Conduct in preparing this evidence and agree to comply with it while giving oral evidence. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

## 2. HABITAT, FRESHWATER SPECIES, AND FRESHWATER SPECIES INTERACTION

2.1 People appear to think of habitat and species as separate concepts. For example, the National Policy Statement for Freshwater Management (**NPS-FM**) directs the protection of habitat (with caveats) in Policies 9 and 10 and action on species interaction, via fish passage, in section 3.26. However, these concepts are integrated, each thread impacting, and being impacted by, the others.

2.2 The concept of habitat defines the location or home of an organism and is the reason behind creating legal protections for places or species inhabitating a particular area in order to prevent or halt species loss (Wallace, 2007). Species interactions within this habitat can be important in determining the diversity of the local ecosystem (Bairey et al., 2016).

2.3 Species can exist and persist where a set of abiotic and biotic factors allow them too (Wiens, 2011). Habitat and species interactions are intertwined, whereas climate (and environment) predominantly determines where species can survive. Within favourable environments, complex species interactions affect both individual performance and population dynamics (Louthan et al., 2015). Species interactions are mediated by environment and resource availability, but also by the presence, actions, and behaviours of other species (Bairey et al., 2016).

2.4 Generally, when discussing the impacts of trout on native fish species in New Zealand, the concurrent introduction of trout with large scale land use have made attributing decline to specific stressors difficult. There is a need to consider the requirements for a highly valued trout fishery within the context of an increasingly threatened native fish fauna, and to prioritise where impacts of trout are likely to be greatest to focus management actions.

2.5 The majority of New Zealand freshwater fish species are endemic and suffer population fragmentation (Joy & Death, 2013., Moffat et al., 2020), with many species locally extinct over much of their pre-European range (Canning, 2018). That outcome is largely attributed to loss of habitat, eutrophication, sedimentation, hydrological changes, and introduced species (Foote et al., 2015, Joy et al., 2019).

2.6 Because of this, protection of the freshwater environment is an important aspect of increasing the abundance and distribution of native species. Degraded environments, as well as being potentially harmful to the species themselves, can increase negative impacts of interspecies interactions,  as constricting and homogenising river habits via flood management schemes, substrate sediment infill, or water abstractions can increase the vulnerability of native fish to the impacts of predators (David et al., 2019; Gluckman et al, 2017; Speirs, 2001).

2.7 In practice, habitat protection often takes the form of action in areas such as:

(a) Reducing contaminants (including nutrients, sediments, pesticides, heavy metal etc) being discharged to water;

(b) water quality;

(c) environmental flows; and

(d) natural / physical stream characteristics such as it's meandering nature, flow profile or riparian habitat.

2.8 Interactions between trout and native fish species are likely to be species-specific. The frequency and extent of interactions between the species, and the population dynamics and behaviour of native species, will alter the likelihood and severity of impacts. The ability of all species to withstand floods and drought, and the availability of food and habitat, will also influence the resilience of native fish to trout predation (McIntosh et al., 2010; Joy & Death, 2013).

2.9 Predation seems likely the main trout-induced stressor on native fish (McDowall, 2003; Townsend & Crowl, 1991). Piscivorous predation is the act of one fish eating a fish of another species. This will negatively impact the consumed individual, however, whether it has a negative impact on the population of the species depends on a variety of other factors, including the abundance, distribution, and life strategies of that prey species.

2.10 Competition for food and space will likely have a negative impact on different native fish species in differing environments, however, where food and habitat resources are plentiful competition is unlikely to have deleterious impacts on native populations (Jones & Closs, 2018; Richardson &Taylor, 2002; Woodford, 2009). It should be noted that even where food and habitat is plentiful, the presence of trout could still contribute to changes in the behaviour of native fish species such as limiting time spent drift feeding or foraging for food in the open and spending more time in refuge habitats (McIntosh et al., 1992; Davis, 2003).

2.11 If looking at predation impacts on extremely vulnerable / endangered native fish species, then any impacts will potentially affect a population. This could be predation by trout, larger bodied native species such as tuna/eel species, koaro, kokopu etc (Whitehead et al., 2002), as well as by piscivorous birds, who remain an apex predator of freshwater fish (McIntosh and Townsend, 1995). Humans can also greatly impact species populations directly via fishing and harvesting (Haggerty, 2007; Jellyman, 2012).

## 3. IN-STREAM AND OUT-OF-STREAM FACTORS AFFECTING SPECIES INTERACTIONS

3.1 Multiple factors contribute to the persistence of indigenous fish populations within New Zealand, of which species interactions are a subset. Environmental factors such as river flow and form, availability of mesohabitat and food resources, the presence and connectivity of source and sink populations, and trout size influence those interactions and have major implications for the likelihood of those interactions being deleterious to the native species population. I address the relevant factors below.

### River flow and form

3.2 Riverine environments with unstable, natural river flows and form, high levels of habitat heterogeneity, riparian vegetation adding natural food inputs, and plentiful interstitial substrate spaces will sustain diverse freshwater fish populations and communities, including larger bodied native or introduced predator freshwater fish species (Jones & Closs, 2018; Richardson & Taylor, 2002; Woodford, 2009, Smith, 2014).

### Mesohabitat and food resources

3.3 Where the location and circumstances do not provide good habitat or food resources, species interactions are likely to become more deleterious to populations. Lack of water in rivers forces species into closer proximity to each other, limited food resources increases the chances of fish occupying the same habitat and seeking the same foods, and this increased proximity and lack of food options will increase predation by larger fish species on smaller fish, and also expose all freshwater fauna to predation via birds (David et al., 2019; Gluckman et al, 2017; Speirs, 2001).

### Source and sink populations

3.4 Local extirpation can be prevented by recruitment into the local (sink) population from a connected highly productive (source) site; source populations can form in a favourable area (Goodman, 2002; Allibone et al., 2010). Increasing the health of upstream (source) populations of vulnerable species could mitigate impacts of predation on downstream (sink) populations in degraded habitats (Woodford & McIntosh, 2010). For source populations to enhance sink populations it is vital that connectivity between the populations is maintained, and the source population is monitored, as rapid species decline in the sink population can occur if the source population can no longer sustain the sink population (Joy et al., 2019, Boddy et al., 2019).

**Trout size**

3.5 Most studies agree trout do not become piscivorous until they are ~150 mm FL (Klemetsen et al., 2003, Mittelback & Persson, 1998). Prey selection and capture by trout is restricted by the gape and gill raker sizing of trout, and large or abundant prey are preferred as they offer greater energy return for foraging effort; the size of the prey increases as the trout size does (Bannon & Ringler, 1986; Montori et al., 2006). Post the onset of piscivory, fish make up <10% of the diet of brown trout, while invertebrates remain the main prey sources, particularly in the middle to upper reaches of New Zealand rivers: the amount of fish consumed by trout increases with trout body size and prevalence of small bodied prey, mediated by availability of refuge for the prey (Crowl et al., 1992; Shearer & Hayes, 2019).

3.6 Therefore, it is vital that management of species interactions is location and fish community specific and nuanced to the wider environment.

**Flow**

3.7 Low flows in riverine environments and destruction of wetlands can be induced by water abstraction with significant negative impacts on all freshwater fauna (McDowall, 1984; McEwan & Joy, 2014; Howard, 2014; Xu, 2018). Native generalist fish populations dominate unregulated rivers; therefore, patterns of floods and flushes that come with undisturbed river flow regimes are vital for allowing healthy cohabitation of species and increased biodiversity (Boddy et al., 2019; Woodford & McIntosh, 2010).

**Habitat**

3.8 Complicated and unstable riverine environments promote species coexistence via providing habitat, refuge, and optimal microhabitats for a variety of species throughout differing life stages (Jones & Closs, 2018; Woodford, 2009; Boddy & McIntosh, 2017). Water level reduction and channelisation removes edge and backwater habitats needed for juvenile spawning and rearing habitats and can be especially problematic in small streams where non-diadromous high-country fish can be found (Allibone et al., 2010).

### Sediment and substrate size

3.9 Larger substrate supports greater diversity where the interstitial spaces have not been infilled with sediment, as the spaces between substrate creates microhabitats used preferentially by several native species and many macroinvertebrates (Joy & Death, 2013). Fewer interstitial spaces make the biota of the waterway more vulnerable to disturbance (Allibone, 2002). Silt and sand dominated sites have the lowest macroinvertebrate diversity and abundance (Jowett & Richardson, 1989; Quinn & Hickey, 1990), and a lack of abundant, large, healthy macroinvertebrates may increase predation risk for small fish of any species. Heavy siltation can eliminate fish spawning habitat (Hickford & Schiel, 2011; Warburton, 2015). Certain native freshwater fish species, particularly vulnerable non-diadromous species (lowland longjaw and alpine galaxiids), can only burrow into or inhabit reaches with large, loosely consolidated substrate with minimal sediment (Dunn & Brien, 2006; Boddy & McIntosh, 2017).

### Nutrients and pollutants

3.10 Sediment, nitrogen, phosphorus, pesticides, and heavy metals can negatively impact riparian and waterway habitat and ecology (Joy, 2009, Allan, 2004). Water soluble metals can disrupt the ability of fish to forage, migrate, and recognise and respond appropriately to predation risk (Greig et al., 2010, Yui et al., 2017). Nitrogen and phosphorus can contribute to excessive algal growth which traps sediment, eliminates interstitial spaces, and leads to dissolved oxygen depletion during nocturnal periods leading to injury or death of local aquatic fauna (Ausseil & Clark, 2007; Death et al., 2018).

### Connectivity

3.11 The prevalence of diadromy in the freshwater fish species of New Zealand indicates that access between marine and freshwater habitats may be the most important habitat attribute for fish community and increased biodiversity (Franklin & Gee, 2019; Jowett & Richardson, 2003; Joy & Death, 2001). Fish passage barriers at low elevation potentially negatively impact fish communities more than those further from the sea (Baker, 2003; Joy & Death, 2001), restricting upstream access to those few species with the ability to pass the barrier, and may also prevent movement of fish seeking refuge from high flow events (David, 2003). However, barriers to prevent access to threatened non diadromous species by trout, salmon, or other species likely to negatively impact that population may be an effective management tool in the mitigation toolbox.

### Riparian vegetation

3.12 Fish species richness and abundance declines in pasture sites and improves in scrub and native forested streams (Joy et al., 2019; Larned, 2020). Riparian vegetation shades and cools waterways, reduces algal growth, contributes allochthonous[1] inputs including terrestrial invertebrates, stabilises banks, and increases habitat diversity via root structures and woody debris (Canning, 2018; Montori et al., 2006; Smokorowski & Pratt, 2007, West et al., 2005). Streams with added food inputs could decrease competitive and predatory interactions (David, 2003; Montori et al., 2006). Riparian trees should extend as far up the headwaters and cover as much of the catchment as is practical to have the largest impact on stream health (Niyogi et al., 2007; Orchard, 2017).

### Temperature

3.13 Heated discharges, water abstraction, and removal of riparian shading alters the thermal regime of a waterway and limits the abundance and distribution of aquatic invertebrates via their thermal tolerances, and as macrophytes and algae become more abundant, macroinvertebrate size, abundance and quality as food resource for fish decreases (Quinn et al., 1994; Piggott et al., 2015). Water temperature affects fish behaviours, growth rates, survival, and abundance (Ausseil & Clark, 2007, Richardson et al., 1994). Any temperature outside of the preferred temperature range of each species will override any top-down control by fish despite any abundance of predators (Hayes et al., 2019; Young et al., 2010). Most native fish species have lethal temperatures at higher ranges than that of trout (Richardson et al., 1994). Warmer water temperatures in waterways where trout may be larger may help assist cohabitation with more thermally tolerant species, however, this needs to be weighed carefully with the sublethal population impact on the native species and the impacts on macroinvertebrate food resources. Shading streams with riparian vegetation is the most effective method of reducing water temperature in streams narrower than 10 m (Richardson & Jowett, 2005).

3.14 Efforts which improve the quality and extent of native fish habitat will not only help improve native fish resilience to trout predation, but also to any other disturbances they face. Concerns have been raised regarding whether improving habitat will benefit trout and cause more predation impacts on native species. However, it is well documented that waterbodies with a dynamic range of form and flow and bed instability appear to promote coexistence by reducing trout

[1] Allochthonous inputs relates to organic materials added or imported into a waterbody from outside of that waterbody, including from terrestrial environments.

population densities and biotic interactions (McIntosh, 2000; Leprieur et al., 2006). Native fish species may be less affected by disturbances than introduced species, thus protections of habitats which allow for disturbance and other location specific managements should encourage healthy and abundant native fish populations and coexistence with trout.

## 4. MANAGEMENT STRATEGIES FOR SPECIES INTERACTION

4.1 Table 1 demonstrates a range of management strategies which can moderate the impact, frequency, or likelihood of species interactions.

Table 1: Actionable management strategies to mediate and mitigate impact of trout predation on native fish species.

| **Mitigation** | **Actions** | **Rationale** |
|---|---|---|
| Flow variability | Provide for a less disturbed flow regime, reduce water abstraction for any use, and allow a return to a less constrained cycle of drought and flood. | Streamflow is a major variable affecting abundance and distribution of freshwater species. Trout are linked to significant negative impacts on native species in stable streams. Flood flow peaks and droughts assists cohabitation with native species and native species spawning and recruitment. |
| Stream morphology and size | Provide for the full variety and variability of stream processes to positively influence biological diversity by providing for species specific habitat and life history needs. Discourage and find alternatives to channelisation and water abstraction where possible. | Habitat heterogeneity allows cohabitation of many species, including trout and native fish species across differing life stages. Edgewater habitats increases recruitment potential to bolster populations. Dynamic river structure vital for fish species. |
| Sediment and substrate size | Provide for reduced sediment and a range of substrate sizes, minimise sediment | Interstitial space provides habitat, access to food, and refuge for many native fish species and is thus necessary for multi-species |

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| | inputs into waterways, and allow riparian overhanging structures and wood inputs. | communities. Sediment infills substrate, reduces waterway depth, and homogenizes habitat, which may preclude cohabitation. |
| Nutrients and pollutants | Provide for minimised inputs of nutrients and pollutants from any source. | Nutrient inputs can infill waterways and interstitial spaces with aquatic flora and cause hypoxic conditions overnight. Metal and chemical pollutants impair fish species greatly decreasing predator avoidance ability. |
| Source and sink populations | Tools: Correctly identify source vs sink populations and connectivity between them, maintain source populations and work to bolster recruitment for sink populations. Ensure fish abundance alone isn’t the metric for population health, analyse age groups and site fecundity. | Sink populations of species lose more individuals than they create, and therefore must be bolstered by immigration from healthier populations (source populations). Sink populations are highly vulnerable to extirpation from any threat, including trout or other predator. Source populations may sustain other populations in the face of pressures. |
| Marine - freshwater connectivity | Provide for increased marine - freshwater connectivity in both upstream and downstream directions and remove fish passage barriers where possible | The high incidence of diadromy in freshwater fish indicates the importance of access between marine and freshwater environments in replenishing freshwater communities in the face of biological and environmental pressures. |
| Riparian vegetation | Provide for appropriate riparian vegetation extending throughout as much as the catchment as is practicable. | Many fish species require robust riparian vegetation, inputs of food and woody debris as shelter can sustain inter-species cohabitation as well as partially mitigate other environmental impacts. |
| Temperature | Provide for temperature fluctuations, reduce or | Water temperature outside any species' preferred range overrides |

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| | remove anthropogenic sources of thermal pollutants into waterways, ensure water abstraction does not interfere with the riverine ecosystem. | any biological interactions by changing all species behaviours (including feeding and breeding), and negative impacts of these unfavourable conditions will increase any impact of predation. |
| Trout size | Large trout (>150mm FL) in deep, stable rivers may pose a threat to threatened native fish if any such are inhabiting the same waterbody. Therefore, removal of large trout may avoid species interactions. Barriers to prevent trout from moving into vulnerable native fish populations should be left in place while required for the health of that population. | Trout can become piscivorous once over 150mm FL. After this size, fish remain a small portion of trout diet (<10%, on average), and this proportion is governed primarily by the abundance of small fish and the availability of refuge for the prey. Non-diadromous species with highly fragmented and impacted habitats need to be protected from introductions of any large piscivorous fish, including trout. |

4.2 Interventions should be possible where needed. Those interventions will be determined by the needs of each specified location. Conflicts between the needs of the waterbody and the fauna inhabiting it and human needs may complicate how intervention is undertaken, however, these should still fall within the realm of achievable. Widespread removal of trout will likely not be practical due to their widespread and migratory nature, nor would it be financially or socially acceptable (Chadderton, 2001). However, there will be sites, particularly in some small headwater streams and tributaries where trout should be removed as part of a suite of management tools to bolster vulnerable native fish populations.

4.3 While some highly vulnerable species populations may require exclusion of predators such as large trout or koaro to ensure their survival, attempted eradications may not achieve enhanced biodiversity outcomes, and may have unanticipated negative ecological impacts on the food web. A holistic focus on ecosystem health of the designated area (and then the wider catchment and connections) is strongly recommended for any management program.

4.4 Any species interaction management actions should be undertaken as a collaborative, matauranga and science-based event with iwi, relevant council bodies, the Department of Conservation, and Fish and Game councils.

## 5. TYING TOGETHER THE THREADS OF HABITAT PROTECTION AND SPECIES INTERACTION

5.1 The three threads of habitat protection, species interactions, and fish passage are artificially separated by humans in an attempt to make sense of the world around us. While this can be helpful, particularly when ensuring policy captures all aspects needed to protect the environment, it can be profoundly unhelpful if it leads to perceptions whereby species interactions are not seen within the much vaster impacts of environmental and biological factors.

5.2 Where waterbodies contain small or fragmented populations of threatened freshwater fish species, who are thus more vulnerable to impacts of any kind, managing species interactions will be more urgent than in other locations.

5.3 The extent of any deleterious impact of trout predation on indigenous fish populations will inevitably depend on numerous factors, including the production rates of other prey fish and macroinvertebrates and the local trout population density, which are all, in turn, affected more generally by primary production, allochthonous input rates, nutrients, sediment, available habitats, migratory connectivity – barriers and passage, water temperature, and the hydrological regime. The interaction of each factor in determining the impact of trout on native fish populations would be notoriously difficult to predict. Monitoring fish populations at high-risk locations and adaptively responding to any low or declining populations through the identification and adoption of multiple mitigations would likely provide the most robust approach going forward.

## 6. PROTECTING THE HABITAT OF TROUT AND SALMON AND INDIGENOUS SPECIES

6.1 Healthy, abundant, protected habitat is key for healthy freshwater fish species. Where the risk from species interaction is low it is very likely that actions to improve habitat for trout and salmon will benefit native species. After all, in this situation they inhabit the same river and benefit from the same river resources. Habitat interventions, as discussed previously, provide for increased in-stream habitat diversity, food resources, river flow and disturbance, and aim to reduce nutrient, sediment, and pollutant inputs, and minimise overgrowths of macrophytes and algae, which will help provide optimal conditions to increase aquatic invertebrate and vertebrate diversity and abundance.

6.2 In my experience, the habitat needs for trout – particularly in terms of water quality and quantity – are often higher than the needs of indigenous species. In circumstances where anthropogenic demand for abstraction or the discharge of contaminants is significant, the habitat retained in rivers is often driven down to the absolute need of the species within. When this situation occurs, the presence of trout and management of the waterbody to meet the habitat needs of trout can lead to more healthy and resilient river habitats, benefiting both trout and native species, because the overall habitat requirements of the river are greater than if trout were not present.

6.3 There are limited places where protections of <u>habitat</u> of trout and salmon would be inconsistent with protecting the <u>habitat</u> of indigenous species. There are likely places where the <u>presence</u> of trout and salmon would be currently incompatible with allowing highly vulnerable native species to thrive and regain abundance and population health. Fish passage barriers preventing access to highly vulnerable species may help to create species and habitat reserves to protect these species.

6.4 However, solely focussing on biological interactions as a priority over environmental factors could potentially lead to removal or reduction of protections for habitat for native species, such as allocating more water takes from rivers, which will likely have a negative impact on that species, and the ecosystems they inhabit and impact.

## 7. PROVIDING FOR THE NATURAL CHARACTER AND FORM OF RIVERS

7.1 A river reach has a natural character that depends on climatic and catchment conditions and the physical and ecological conditions of that reach. This character is a dynamic expression of the processes at work, and varies in time and place, and thus the natural character of a river changes along its length from headwaters to the sea, and over time (Williams, 2013). Rivers present an ever-changing interplay between their flowing water and their margins, between surface and ground water, and between channels and flood plains (Williams, 2013).

7.2 Williams (2013) determined a high-level natural character index for western rivers in the Wellington regions by assessing: the active riverbed, the bankfull width, and the permitted floodplain width; channel sinuosity; and pool-run-riffle sequences. The natural character of these rivers has been substantially modified by river management and flood mitigation works and the ongoing management to protect people, economic, and/or social assets from flood damage.

7.3 It should be noted that ecosystems with high natural character – those which are less modified – often support diverse habitats with increased biodiversity (Gray et al, 2006, Environment Foundation, 2015).

7.4 Both wetland habitat and riparian habitats are modified and destroyed by drainage, flood control, land development and intensification (Gluckman, 2017).

7.5 Human activities have tamed rivers across much of the country, particularly through command-and-control activities such as pipes, dams, flood protection engineering and changes to the structure of riparian vegetation: these changes have had profoundly negative impacts on the freshwater ecosystem which now necessitates ongoing heavy management of the river bed and has created rivers very different to their ancestral forms and behaviours (Brierley et al, 2022). Aquatic habitat has been reduced by water takes for irrigation, hydropower impoundments, flood control, and water diversion (Gluckman, 2017).

7.6 Rivers have suffered negative effects to ecological processes and depletion or loss of sensitive species due to river channelization and flood control works (Gluckman, 2017). Rivers in the Greater Wellington region have been greatly simplified and homogenized throughout the region, inducing significant changes in their functionality and biodiversity values. An example of this is the Otaki River, where stopbank construction between 1945 and 1955 removed connected floodplain surfaces for urban and agricultural development, and by 2016 the lower Otaki reaches operate as a single channel between flood protection barriers isolated from previous channels and braided habitat. Rivers so tightly constrained act to pit society against natural river processes and functions (Brierly et al, 2022).

7.7 As pressure on water resources increase there is a need to provide for protections of water which address the overuse of the resource and the under-provision of ecosystem health so as to maintain or restore ecosystem health, as well as supporting local communities. Protecting the natural character of water has become so important that rivers in multiple countries, including New Zealand, have recently been granted the legal status of persons to add legal emphasis on such protections amid a backdrop of environmental legislation and policy which emphasizes the public use of the resources over the protection of nature itself (O'Donnell & Talbot-Jones, 2018).

7.8 Arguably, wherever possible, it is better to release Aotearoa's 'strangled rivers' in a measured, controlled way before they release themselves, with catastrophic consequences to life and infrastructure, and while re-wilding entire flood plains may be unrealistic, ecological, economic, and socio-cultural gains can be made in better accommodating a greater range of river habitats and processes (Brierly et al, 2022).

**Ami Coughlan**
**3 November 2023**

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