

**IN THE MATTER**

**of the Resource Management  
Act 1991**

**AND**

**IN THE MATTER**

**of an application by Majac Trust  
seeking a variation to the Buller  
Water Conservation Order 2001**

**EVIDENCE OF MARTIN RUTLEDGE**

**Introduction**

1. My name is Martin John Rutledge, I have been employed by the Department of Conservation since March 1988. Since December 2001 I have held the position of Freshwater Technical Support Officer for Nelson Marlborough Conservancy. Prior to that I worked for Canterbury Conservancy as Technical Support Officer Marine and Freshwater. I have also held positions in Recreation Planning and Fish and Game Management within the Department. My work for the Department primarily involves giving technical advice on the conservation of freshwater fish and their habitats.
2. Prior to working for the Department I worked for several years as a Freshwater Fisheries Consultant and Fisheries Technician for MAF Fisheries (now NIWA). I hold the degree of BSc.(Hons.) in Zoology from the University of Canterbury where I majored in Freshwater Ecology. I am familiar with and have conducted studies and research on a range of New Zealand freshwater ecosystems, the habitat, food and other ecological requirements of New Zealand native fish, salmonids and invertebrates and published internal reports and articles in New Zealand and overseas journals.
3. I have presented evidence on behalf of the Department of Conservation at hearings involving major projects impacting on freshwater ecosystems. In 2001, I appeared on behalf of the Director General of Conservation in support of an

application by Fish and Game New Zealand for a Water Conservation Order for the Rangitata River. I had no involvement with the original application for a Water Conservation Order for the Buller River System.

4. I am familiar with and have carried out field work in both the Nelson Lakes and also in the Gowan River and some of its tributaries. In the context of my evidence today which focuses on the topic of eels, my research work has included diet studies of shortfinned eels in Waikato lake systems. In the recent past it has included the capture and tagging of large longfinned eels from Lake Rotoiti as part of a pilot study examining eel movement in the lake. I have also encountered and observed large longfinned eels in both lakes Rotoiti and Rotoroa as part of snorkel diving surveys of weed beds in the lakes.

### **Summary of Evidence**

5. My evidence today focuses on how crucial unimpeded eel access is, through the migration pathway provided by Gowan River, in order to sustain the nationally important eel fishery values in Lake Rotoroa.
6. I will set out how the proposal by Majac Trust to vary the flow protection regime set out for the Gowan in the WCO may adversely affect the eel fishery values in Lake Rotoroa by affecting eel migration success and survival.
7. I will then comment on what is required to ensure that the Gowan River's contribution as a migration pathway to this nationally important eel fishery is protected. I acknowledge that some of the detail in those comments is more relevant to a resource consent hearing. I do, however, consider they demonstrate a problem with the variation sought by the applicant in relation to the protection of the Lake Rotoroa eel fishery and how it can be addressed. In that context these comments provide the basis for the Director General seeking a specific provision relating to passage.
8. First though, I would like to provide the Tribunal with some background and context in terms of the biology and status of the New Zealand longfinned eel and reiterate the importance of the eel habitat provided within Lake Rotoroa.

## **Background on eels**

- 9.** At the time of the earlier hearings for the Buller Water Conservation Order, Dr John Hayes and others gave evidence on the significance of the native fishery values supported by the freshwater habitats of the Buller River system. This included the value of the eel populations and eel habitat in the Nelson Lakes. The Planning Tribunal accepted that the Lakes supported nationally important eel fisheries.
- 10.** Key reasons for recognising the national importance of the Nelson lakes eel fisheries were the significant national decline in the population of New Zealand longfinned eels (“longfin” for short) and the importance of the lakes as a refuge from commercial and recreational fishing of these eels. Thus the lakes provide a nationally important reserve breeding stock for the New Zealand longfin population. The shortfinned eel, which is the other common freshwater eel found in New Zealand, has populations occurring in Australia, Tasmania and some Pacific Islands. The longfin, however, occurs in New Zealand only. That is, it is endemic to this country and New Zealand has the one and only world stock of the species.
- 11.** Since the original Water Conservation Order was established, concern for the viability of stocks of the longfin has increased rather than abated. The species has now been formally listed by Hitchmough (2002) as “threatened in gradual decline”, as a result of fishing pressure and habitat loss. There is a predicted decline of 5-30% in the total population in the next 10 years due to existing threats, and the decline is predicted to continue beyond 10 years. In this respect, the threatened status of the longfin reflects what is happening to stocks of freshwater eels worldwide. Stocks of several of the world’s fifteen species (which like the longfin all belong to the family Anguillidae) are collapsing at an alarming rate.
- 12.** These freshwater eels all have a lifecycle similar to the longfin. The adults live in freshwater, then, after many years undergo a bodily transformation, leave freshwater in early autumn, enter the ocean and travel thousands of kilometres to spawn in the deep oceans and die. During this fascinating and impressive migration the eels don’t feed at all but rely on their stores of fat to sustain them.

This pattern of migration with adults leaving the freshwater environment to undertake their spawning at sea with the young eels returning to freshwater to complete the cycle is referred to as “catadromy”.

13. Longfins are believed to spawn somewhere east of Tonga (Jellyman 2005 in press). After hatching from eggs the eel develops into a leptocephalous stage living in the ocean plankton and then gradually over about 2 years finds its way back to freshwater entering streams as tiny transparent glass eels.
14. Once in freshwater the tiny eels (“elvers”) feed and grow, moving upstream populating suitable habitats. Elvers can move large distances inland, and are known for the impressive upstream mass migrations they undertake in summer-autumn. Because of their small size and elongate shape they can climb many obstacles in their path such as waterfalls and even attempt to climb up the faces of dams and weirs in their way through thin films of water.
15. This same basic life history cycle shared by all species of freshwater eel makes them vulnerable to similar factors and it is not surprising, therefore, that so many species are considered threatened species. For example an article in “The Telegraph” in February last year read:

*“Eels could be on the slippery slope to extinction, according to scientists who say European populations are at just one per cent of their 1980 levels. The latest estimates of eel stocks found that the American variety is faring little better. “There are almost no eels left in the Great Lakes,” Dr Willem Dekker, of the Netherlands Institute for Fisheries Research in Ijmuiden, told New Scientist magazine. The fish are threatened by the trade in the Far Eastern delicacy of “glass” eels - the first stage in development after larvae - and dam building, which prevents elvers swimming up rivers to mature into eels”.*

16. With respect to the status of the longfin eel I think this extract from a December 2003 Press Release from NIWA, quoting Dr Don Jellyman, provides the Tribunal with a useful summary of the conservation issues related to the longfin :

*“Freshwater fisheries principal scientist Don Jellyman from the National Institute of Water & Atmospheric Research (NIWA) said there is increasing evidence to show that current levels of commercial fishing and habitat loss could seriously affect the sustainability of our longfinned eel fishery.”*

*“Our concerns for the longfin eel are based on a number of factors, including the very low numbers of juvenile longfins in some catchments,*

*their slow growth rates, the significant declines in catch per unit effort, and the reduction of or loss of access to waterways because of hydrodams. The number of populations dominated by males, especially in the lower half of the South Island, which supports the largest longfin eel fishery in the country, is also of particular concern.”*

17. Dr Jellyman and research scientists collaborating with him, as well as a range of other scientists, have published many papers which set out the detailed research findings regarding the causal factors contributing to the decline in longfin populations. If required I can provide the Tribunal with a selection of research papers which cover the range of factors affecting longfin survival such as those quoted in the press release.
18. More recently, Dr Jellyman (Jellyman 2005 in press) and others have recognised the role played by ocean currents and the general quality of conditions in the ocean in influencing the survival rates of larval eels and the return rates to freshwater. Thus, changes in ocean current patterns and productivity induced by climate change are another factor of potential concern for eel recruitment. However the role of such factors is as yet poorly understood.
19. It was lack of understanding in the 1940's which led New Zealand trout fishery managers to actively encourage anglers to "kill eels on sight" in the belief that they were harming trout fisheries. Subsequent research by Burnett (1952) showed that, in fact, eels acting as top predator in the food chain, benefited trout anglers in keeping trout numbers down to a level that resulted in larger numbers of good sized trout being available to catch.
20. In terms of their ecological role as top predators in New Zealand freshwater systems the decline in abundance of large longfins could result in changes in the structure in fish communities and food webs, another cause for concern. For example McDowall (1990) cites a Rakaia River longfin with 22 torrentfish, 2 quinnat salmon smolts and 2 blue gilled bullies in its stomach, demonstrating their broad predatory tastes and "consumptive power" in shaping fish communities.
21. Returning to the factors contributing to the decline of longfins mentioned above, eels also have what could be described as a general "image problem". This is because they are slimy, resemble snakes, are hard to kill and night active, which somewhat understandably seems to set off some sort of primeval human response of fear. The result is that humans have generally not highly regarded them as a

species to protect, often leading to their destruction and undoubtedly compounding their fate.

- 22.** It is not hard to see then why the longfin has reached the point of being designated a threatened species. The continuing population decline has made the value of the protected eel populations in Lakes Rotoroa and Rotoiti assume even greater significance since the the Water Conservation Order was established. Indeed, these populations could legitimately now be regarded as being of international importance given that the species occurs nowhere else on the planet.
- 23.** In that respect there are other attributes of the longfin that need to be recognised in an international context. These include it being the world's largest freshwater eel, with weights of up to 24 kilograms reliably reported. An interesting feature of the longfin's biology is that it is only the female eels which reach these very large sizes with the largest males reaching around a relatively puny 2-3kg.
- 24.** Unconfirmed reports of much larger eels exist, such as that of Graham (1956) who reported eels of 59 kg . This account is probably much more in the realm of legend than fact. Certainly there are plenty of "legendary" tales of huge eels living in the local creeks and rivers of New Zealand. Thus, while there are attitudinal elements of fear and disdain there is also a certain amount of attachment to the longfin because of its conspicuous large size and habits. It has acquired the status of something of an icon freshwater fish in New Zealand.
- 25.** I am not qualified to speak on behalf of the local tangatawhenua in regard to their specific views on the matters under consideration today, however, in general terms it is well known that Maori regard eel or tuna as a taonga or treasure. They have many lores, traditions and mythologies associated with eels and their great importance as food source.
- 26.** Illustrating their importance more than 160 Maori names for eels have been recorded, reflecting the diversity of local traditions and the significance attached to variations in size, shape, colour, taste, behaviour and habitat. Maori also developed ingenious fishing technologies to take eel at many life cycle stages. Examples include hinaki (eel pots) , pa-tuna (eel weirs), toi (eel bobbing without hooks), korapa (hand netting), rapu tuna (feeling with hands and feet then catching with hands), rama tuna (by torch light) patu tuna (eel striking), mata rau (spearing) and koumu (eel trenches). During the annual tunaheke (eel migration) channels were dug into stream banks and lake shores, trapping vast numbers of

eels on their way to the oceanic breeding grounds. The returning elvers (baby eels) were taken by placing bundles of bracken fern at the top of falls or at known congregation points during their upstream movement (Best, 1929).

27. With respect to local pakeha eel legends, in the Marlborough Express February 1963 the following was reported:

*“An experienced Nelson skin diver was bed-ridden for two days with the bends after fleeing from monster eels 100ft below the surface of Lake Rotoiti. The diver who was searching for a propeller, was approached by a huge eel and was preparing to defend himself with a knife when three other eels approached. Although he had seen eels of 40lb caught on a line in the lake these were bigger than that. I would estimate they were about 80lb he said.”*

28. Dr Jellyman’s (Jellyman 1995) eel studies in the lake could not confirm this size, with the largest eel recorded in Lake Rotoiti being just 7kg or about 16lb and 1.2metres long. Nor is it likely that Lake Rotoroa harbours eels of a size too different from this.

29. Dr Jellyman’s studies did, however, show the great age of eels in Lake Rotoiti – with a maximum age for a female longfin of 106 recorded- making it the oldest record age for an eel anywhere in the world. The average age of eels was found to be 56 years, with an estimated average age for female eels at sexual maturity of 96 years. The study also showed that the eels were very slow growing just 9mm per year because of the low water temperature and oligotrophic (low nutrient) nature of the lake.

30. The diet of eels within Lake Rotoiti consisted of about 80% juvenile trout, and the other 20% comprised bullies and unidentified material (Jellyman, 1996). With respect to the eels in Lake Rotoroa – there is no reason to expect that the longfin population would not have the same attributes as the eels in Rotoiti. My own observations snorkelling during daylight hours in Lakes Rotoroa and Rotoiti were of similar numbers of large eels in both lakes, in the order of about 1 metre long slowly cruising around the weedbeds presumably looking for food. These eels would occasionally show some interest in me or my colleague snorkelling or diving but generally kept to themselves.

### **Eel populations in Lake Rotoroa and the role of the Gowan River**

31. Dr Hayes’s earlier evidence at the WCO hearings set out for the Planning Tribunal the importance of the eel habitat in lakes Rotoroa and Rotoiti in the national context. Notably it was emphasized that all North Island lakes and 73%

of the South Island lakes occurring within National Parks are all variously modified by hydro schemes with resultant recruitment and downstream passage problems for eels. Thus, the vital attributes of lakes Rotoroa and Rotoiti as eel habitat were their refuge from fishing **and** the fact that safe unimpeded passage for eels (and other migratory fish) was available- i.e. between the lakes and the sea via the Buller River system, which currently is not obstructed by major hydrodams or other structures.

**32.** I don't propose to further elaborate on the significance of the lakes themselves as the nationally important, physical providers, of safe (no fishing allowed) habitat for the threatened longfin eel. Indeed, the WCO already recognises this. However, it is the continuation of this vital connectivity and safe eel passage between Lake Rotoroa and the sea that needs to be assessed in light of the Majac proposal.

**33.** The Gowan River is the only route to the sea for the large out-migrating adult eels heading out to sea to spawn. Likewise, the Gowan River is the only route back into the lake for the small elvers migrating upstream to Lake Rotoroa in search of suitable habitat.

**34.** Clearly, if either the safe passage or survival rates of out-migrating adult eels or the returning elvers is compromised then the nationally important eel population in the lake will not be adequately sustained.

**35.** This connectivity is not specifically addressed in the current WCO. I consider the existing flow regime and restrictions in the WCO which apply to the Gowan do ensure the connectivity is achieved.

### **Potential Impacts of proposed Gowan hydro scheme on Lake Rotoroa eels**

**36.** As mentioned earlier the adverse effects of hydro schemes on eel populations are well recognised in New Zealand and elsewhere in the world. When catadromous fish species such as eels attempt to migrate downstream to reach spawning grounds, they are inevitably entrained at water intakes associated with hydro-dams and get chopped up by the turbine blades. Elongate fish like eels are most

affected and small turbines cause the most damage. Research shows that mortality of fish in turbines is directly related to the size of the turbine and size of the fish. Various New Zealand reports indicate that turbine mortality rates of large out-migrating longfins is near to 100%. Mutilated eels are commonly found below hydroelectric dams during the autumn migration period (Boubee *et al.* 2001).

37. An additional risk factor to consider is that where the screens are small meshed (e.g. 30mm at Aniwhenua Power Station), eels are impinged (get sucked on to the face of the screen and are held there by water pressure) and suffocated (Mitchell 1995). Providing effective screening to allow the safe downstream passage for adult longfins is problematic. It is important to remember that each female longfin migrating out of lake Rotoroa may contain several million eggs
38. The same applies to the potential loss of the much smaller upstream migrating elvers which could also become entrained in the intake system of a hydro scheme. These eels once in the canal would be prevented from reaching Lake Rotoroa and if they did happen to reach maturity in the canal could not safely negotiate the turbines to get out to sea to spawn.
39. As mentioned earlier upstream migrating elvers have an extraordinary ability to climb wetted surfaces, unfortunately this climbing ability also puts them at risk of becoming entrained at the bottom end of a hydro scheme. The large volume of water being discharged in the tailrace will be a considerable attraction to them and they will attempt to climb in. If either they are able to enter any infrastructure and /or become unduly delayed in finding the Gowan river residual flow, then this would also compromise the recruitment of eels into Lake Rotoroa.
40. I would now like to consider the issues and risks to eels at intake and outlet structures in more detail and go on to suggest how those risks can be addressed.

#### **Eel entrainment and screening issues at the intake**

41. Under the variation to the Order proposed by Majac the flow regimes in the Gowan will be altered, with a proposed minimum flow of 9 cumecs and a maximum take of 28 cumecs.

- 42.** In my opinion the minimum flow proposed should provide adequate flows for downstream migrating adult eels and upstream migrating elvers.
- 43.** Having said that I do have concerns with the issue of eel entrainment.
- 44.** Also I need to stress my opinion relates to eels. I am not in any way implying that such a minimum flow would also adequately meet the flow needs of adult trout or other elements of the aquatic fauna such as invertebrates.
- 45.** The variation to the order sought by Majac would allow for significant variations in flow from the present situation. It could result in takes ranging from 33%-67% of the river flow. That is a very substantial increase on what is currently allowed.
- 46.** As the proportion of the natural river flow diverted into an intake increases, so does the number of fish potentially diverted. In other words, there is an increased risk of adverse effects on fish populations as the diversion flow increases.
- 47.** To illustrate the effect of fish losses into unscreened intakes, I note that losses of fish into the Rangitata Diversion Race (an unscreened intake diversion of about 40 cumecs adjacent to the bank) , were estimated at 288,000 salmon juveniles, 4000 eels, 400 bullies, 400 galaxiids, 2600 torrentfish and 2500 trout in the 1988-89 irrigation season (Unwin et. al. 2005). This did not take into account smaller juvenile size classes and fish larvae. Thus, potentially huge losses of fish can arise.
- 48.** While the next section of my evidence could apply to any waterbody, it may be of more use if I move from the general and consider the issue in terms of the Majac proposal. With respect to the proposed scheme it is intended to have an intake structure and screen situated along the true right river bank and parallel with the river flow. As they move upstream or downstream, fish often follow the river bank to make use of the cover they can find there. It is likely, therefore, that the concentration of fish exposed to a bank intake will be higher than that expected if fish numbers were simply proportional to the flow volume diverted.

- 49.** Certainly, I would expect longfin eels to be hugging the river bank as they are a very strong cover seeking species at all sizes: from large downstream migrating adults leaving the lake (say 600-1200mm); to the much smaller eels (say from 100 -600mm) which may be permanently living in the river itself in the vicinity of the intake or passing by the intake (potentially in large numbers) as they move on upstream into the lake. I make this point to emphasize that in my opinion there is no doubt that eels of all sizes will be regularly encountering the intake structure. Accordingly the entrainment risk is very high given that some will be of small size, the volume of water entering the intake is large and the attraction of bank cover to eels.
- 50.** Another feature of eel behaviour to consider is their bottom dwelling habit (like most other native fish). This means that screens would need to be effective over the full depth of the water column. I note that the screen design proposed in Mr Swan's evidence achieves this.
- 51.** As earlier discussed, impingement of large adult eels on screens at other hydro installations is a recognised problem and is increased when the much smaller and less powerful young eels (or other small native fish or trout fry) are present. The key issue here is the speed of the water at the face of the screen, often referred to as the approach velocity. The slower the water the less the risk of eels or other fish being impinged. The evidence of Mr Swan has not provided information on what the likely approach velocity would be with the respect to the 28 metre long screen section shown on the design drawings.
- 52.** Directly related to the issue of approach velocity is that of maintaining the screen clean to avoid accelerated velocities between patches of debris accumulated on the screen. I imagine that there will be reasonable amounts of debris drifting down the Gowan, particularly weed from Lake Rotoroa which has broken off during rough weather. There will also be leaves, twigs and other woody debris along with algae sloughed off riverbed stones. While not known to be present in the Gowan or Lake Rotoroa as yet, the possibility of a rock snot (*Didymosphenia*) infestation cannot, unfortunately, be discounted in the future. Thus screen cleaning devices would need to take into account the need to deal with the possibility of Didymo clogging screens.

- 53.** Thus, some form of screen cleaning device that can operate effectively under a high potential debris load is an essential component in providing effective fish screening for eels and other fish. I note that no screen cleaning device is proposed by Majac at the intake. Thus it appears that maintaining a clean screen is one of the major operational issues yet to be addressed by Majac.
- 54.** It goes without saying to note that the larger the flow of water diverted from a river the more difficult and expensive it is to effectively screen. This is even more so if the highest screening effectiveness standards must be met, to meet the test of protecting the nationally important eel population in Lake Rotoroa. In my view the goal (with respect to the issue of eels) should be to very closely approach 100% effectiveness in screening all size classes of eels from entering the intake, thus the screen mesh will need to be fine.
- 55.** Before I make suggestions as to what screen specifications I think could provide the necessary level of protection for longfin, it is relevant to also consider the potential screening requirements of other fish species present.
- 56.** The range and size of other fish species who's screening needs must be taken into account appear to include brown trout (*Salmo trutta*)- from fry to adults (25-600 mm) upland bullies (*Gobiomorphus breviceps*)-from fry to adults(5-65mm) and possibly dwarf galaxias (*Galaxias divergens*) (6-70mm) and koaro (*Galaxias brevipinnis*) ( 7-100mm), (McDowall and Suren 1995). These latter two species have been recorded from Gowan tributaries so it is possible that populations also exist in the Gowan River mainstem. Also with respect to koaro it is possible that koaro live in Lake Rotoroa and its tributaries. Any koaro spawning that occurs in these habitats will generate passively drifting fry which will rear in the lake plankton and could potentially drift out of Lake Rotoroa into the Gowan.
- 57.** The body width dimension is the key one to consider in selecting an appropriate mesh size to provide effective screening. Approximate sizes for excluding the smallest lifecycle stage of fish would be: galaxiid and bully fry 1mm, trout fry 3mm, elvers 1.5mm. This assumes that these fish would be approaching the screen at 90 degrees, however, the screens would be roughly parallel to the current. Thus, as the fish are being swept past the screens, the fishes' body alignment would be more cross wise than head on so that a mesh size larger than that indicated may

still be effective in screening. As a general guide, through screen velocity (approach velocity) of less than 0.15 m/s has been proposed for other screen installations to address impingement risks to weak swimming fry such as that of salmonids. Half a metre per second has been suggested as suitable for adult eels (Boubee, 2003.).

- 58.** However, with respect to the Majac proposal, no detailed information has been provided on what the specific localised flow direction or current speed may be in the vicinity of the intake screen. What has been specified, though, by Mr Swan is the intention to use horizontal bars with 25mm spacings as the fish screen.
- 59.** As discussed above besides catering for eels, screen design must also simultaneously meet the screening requirements of the other fish species in terms of mesh size and the avoidance of impingement etc. The fish species stage with the finest mesh screen requirement is upland bully fry where assuming a head on approach attitude a mesh of 1mm would be needed to exclude them. I note, however, that this species is not considered threatened and its abundance in the river is unknown, therefore, lesser performance criteria may be acceptable for this species and an increased mesh size of 2-3mm may be adequate- recognising that a non head- on approach attitude is likely to be induced by the positioning of an intake parallel to current flow.
- 60.** I think 2-3mm is also likely to be reasonably effective in screening out elvers and larger eels to a near 100% performance criterion and it should also deal effectively with the needs of trout from the fry to adult stage.
- 61.** Having said that, however, I believe that before any specific design was decided upon that this should be underpinned by an appropriately designed testing and monitoring programme to verify that the exclusion efficiencies met the requirements for eels and other species.
- 62.** The 25mm spaced horizontal bars proposed in Mr Swan's evidence will definitely not achieve the high level of screening efficiency that is appropriate to protect threatened longfin elvers and small eels up to about 45cm long, other native fish, and trout – from trout fry up to trout about 30cm long. These fish will be able to pass through the screen into the canal and ultimately through the turbines.

## **Entrainment issues at the scheme outlet**

- 63.** Dealing with potential fish entrainment at the bottom end of the scheme (the tailrace outflow) is a significant issue given the proportion of diverted flow being returned to the river in comparison with that left in the residual Gowan River. Upstream migrating elvers and koaro and other fish such as trout will be attracted to the large outflow volume and may try to enter the tailrace outflow structures, they need to be prevented from doing this and safely directed up the Gowan River.
- 64.** I have considered the evidence of Mr Swan and the design drawings relating to the tailrace and outlet structure. The information states that the final 50m of the tailrace to where it joins the river is formed using river stones embedded in concrete, with a cross section similar to the natural river bed. The description of the entry point of tailrace flows into the Gowan itself is that the water enters on the inside of a bend with the appearance of a broad fan of water similar to other tributary stream confluences.
- 65.** As it currently stands I do not think that this outlet design configuration will be effective in deterring climbing native fish from being attracted to tailrace flows and then trying to climb up the wetted surfaces on the margins of the constructed tailrace outflow channel. Likewise adult trout, although unable to climb or strong enough to swim against the assumed(no details are given) high velocity outflow, may be confused or distracted by the large flows and not move on up the natural Gowan River channel.
- 66.** I think that customised engineering solutions that deal with these issues need to be developed.
- 67.** If this is not done then increased mortality of longfin elvers is likely to occur as their climbing behaviour over wet surfaces increases their vulnerability to predators such as rats and birds as they are easily picked off the exposed surfaces. Elvers exhausted from climbing, that drop back and congregate in the waters at the confluence of the outlet and Gowan River, will also be vulnerable

to predation by trout, shags, ducks, kingfishers and larger eels (e.g see Jellyman 1977).

68. Large losses of longfin elvers would be unacceptable in the context of sustaining the nationally important eel fishery in Lake Rotoroa.
69. A combination of fine meshed screens (to stop elvers and koaro), drop structures including an overhanging lip, possibly with a trap for elvers and koaro, could offer possible satisfactory solutions. It would be highly preferable, however, for elver traps not to have to be used and solutions found so that they could find their own way up the Gowan River.
70. Notwithstanding the need to also adequately address the entrainment issues for trout and other species, I believe that at the outlet achieving near 100% performance in preventing entrainment for longfin elvers is appropriate. To ensure that this standard is achieved, the necessary research, design trials and monitoring, need to be undertaken first.

### **Conclusion**

71. As I stated at the outset, ensuring the safe passage of threatened longfin eels up and down the Gowan River is fundamental to protecting the nationally important eel fishery values in Lake Rotoroa. Logically it follows that this crucial function - should be appropriately recognised and provided for in the WCO provisions relating to the Gowan..
72. My view is that at both intake and outlet structures of any hydro scheme on the Gowan near 100% performance in preventing entrainment of longfin eels of all sizes is appropriate. Thus the careful design and testing of any fish screening and entrainment prevention measures proposed is required to ensure this performance measure can be met.
73. Thank you for the opportunity to be heard today.

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