BEFORE THE SPECIAL TRIBUNAL

No.

In the matter of	The Resource Management Act 1991
And	
In the matter of	an application to amend the Water Conservation (Kawarau) Order 1997 by The New Zealand & Otago Fish & Game Councils

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EVIDENCE OF GREGORY IAN RYDER

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1. Introduction

1.1 My full name is Gregory Ian Ryder. I am a water quality scientist and aquatic ecologist and hold BSc. (1st Class Honours) (1984) and PhD. (1989) degrees in Zoology from the University of Otago.

1.2 I am a member of the following professional societies:

(a) New Zealand Freshwater Society;

(b) New Zealand Water and Wastes Association; and

(c) Royal Society of New Zealand.

1.3 I am a Director of Ryder Consulting Limited, an environmental consulting business with offices in Dunedin, Christchurch and Tauranga. Prior to this I held positions at the Otago Regional Council and the University of Otago.

1.4 For approximately 22 years, I have been associated with a wide variety of studies on freshwater ecology and water quality throughout New Zealand. I have been project manager for major studies on New Zealand river ecosystems. Regional councils and government departments have engaged me to peer review environmental studies and resource consent applications, and I have held the position of an independent commissioner on a number of major resource consent hearings associated with marine farms, water abstractions, wastewater discharges, irrigation and hydro development.

1.5 In 1995 I designed, and for a number of years ran, Environment Southland's State of Environment freshwater monitoring programme and my company continues to be involved with this programme. Ryder Consulting also currently undertakes Otago Regional Council's annual State of the Environment freshwater biological monitoring programme and have previously been engaged by West Coast Regional Council to analyse and prepare a report on its state of the environment monitoring data. I have assisted both Environment Southland and Otago Regional Council in developing their respective regional water plans and was the principle author in developing water quality standards for Southland's draft regional water plan which have received relatively few challenges in the submission process.

1.6 I have considerable experience with hydro-electric power schemes and have been contracted by owners, regional councils and government departments to provide ecological assessments on a number of existing and proposed power schemes including the Arnold, Branch, Clutha, Coleridge, Gowan, Hawea, Matahina, Mataura Falls, Mokau, Monowai, Paerau, Wahapo, Waihopai, Waikato, Waipori, Wairau and Waitaki schemes.

1.7 In particular, I have been associated with ecological surveys of a number lakes/reservoirs controlled by hydro generation or irrigation including Hawea (Otago), Loganburn (Otago), Mahinerangi (Otago), Matahina (Bay of Plenty), Monowai (Southland), Wahapo (Westland), as well as having undertaken reviews of lakes Dunstan (Otago), Coleridge (Canterbury), the Waikato River lakes, and Rotorangi (Taranaki).

1.8 I am broadly familiar with other irrigation, drinking water and hydro storage reservoirs in Otago including the Clutha River dams, Conroys Dam, Falls Dam, Lake Onslow and most of Dunedin City's drinking water reservoirs.

1.9 I undertook a site inspection of the Nevis River valley and gorge on 12 September 2008 together Pioneer Generation staff and advisors. The inspection involved a vehicle trip into the valley followed by a helicopter flight through the gorge sections.

1.10 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note (31 March 2005). I have read and agree to comply with that Code. Except where I state that I am relying upon the specified evidence of another person, my evidence in this statement 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 which I express.

2. Scope of evidence

2.1 Pioneer Generation Ltd has engaged me to:

(a) review the aquatic ecological work undertaken by Mr Ross Dungey;

(b) assess the appropriateness of the methodologies he used in evaluating the aquatic ecology of the Nevis River catchment;

(c) comment on the status and significance of the Nevis River fisheries based on my experience with other river systems;

(d) comment on the potential effects of a hydro-electric power scheme on the aquatic values of the Nevis River catchment.

3. Review of information collected by Mr Ross Dungey

3.1 I have viewed the evidence of Mr Dungey and have discussed with him his work in relation to the Nevis River fisheries on a number of occasions. I have assessed his work under several general criteria namely methodologies employed, seasonality of sampling, frequency of sampling and time scale - whether the studies adequately describe the existing environment with respect to river ecology and whether they adequately addresses potential issues associated with a possible hydro-electric power scheme in the Nevis Valley.

3.2 I have concluded that in my opinion the approach and methodologies employed by Mr Dungey are robust and extensive, given the difficult environment he has to work in. I note that his work is still ongoing in that his studies were working to a more extended time frame than that imposed on him by this WCO application. In that regard, there is further work that would be of benefit in determining the overall effects of hydro-electric power scheme, and this work would typically be completed prior to any resource consent application process associated with a specific proposal.

3.3 The primary focus of the Nevis River catchment studies has been in relation to the trout fishery, with a lesser focus on the galaxiid fishery. Other aspects of the aquatic ecosystem, including benthic communities (macroinvertebrates and periphyton), have received less attention, and where they have been assessed it is mainly in relation to their potential effect on the trout fishery. Given that sport fisheries and angling appear to be the primary aquatic and recreational issues associated with the WCO application, I consider that this is a reasonable approach.

3.4 Such an approach is in my experience fairly typical of that adopted when the effects of hydro-electric proposals are focused on the angling amenity. More detailed analysis of other aspects of the ecosystem may be required and these can be appropriately addressed via the resource consent application process.

3.5 There is no evidence to suggest that other aspects of the aquatic ecosystem have required a more rigorous assessment than that undertaken by Mr Dungey and I am not aware of any information to suggest that rare or uncommon assemblages exist in any part of the catchment including the area that would potentially be inundated by a hydro reservoir. In any case, more detailed assessments would probably be required as part of any consenting process and it is appropriate that further assessments can be made at that stage.

4. Existing fisheries values

4.1 Mr Dungey's surveys have identified five species of fish in the Nevis catchment with varying levels of amenity, ecological and conservation interest. The species identified are longfin eel (*Anguilla dieffinbachii*), gollum galaxias (*Galaxias gollumoides*), brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*). I briefly comment on each of these species below.

4.2 The longfin eel fishery of the Nevis River catchment appears to be small and of little significance when compared to the wider eel fishery of the Clutha River catchment. Mr Dungey informs me that only one eel has been found in surveys of the Nevis catchment and that individual was caught in the lower reaches of the Nevis River towards the Kawarau River confluence.

4.3 The creation of a hydro-electric dam would all but eliminate eels from upstream of the dam unless allowances were made for upstream passage of migrant juvenile eels (elvers) and passage for downstream migrating adult eels. Eel passage is a common issue faced throughout the country in relation to dams. Eel migration is already severely restricted in the Clutha catchment by the presence of three large hydro dams (Roxburgh, Dunstan and Hawea), and while measures are gradually being take to address passage at these dams, it will be some time before the benefits of improved passage are known. Notwithstanding the existing situation, the Nevis catchment appears to offer at best moderate habitat potential given the limited access to the upper catchment and the very cold winters limiting growth potential. The altitude of the upper Nevis Valley is approximately 600-700 metres and is getting towards the upper end of the altitude scale for longfin eel (Table 1). The apparent absence of eels in this part of the catchment suggests to me that my assessment of the catchment offering only moderate habitat potential for eels is a conservative one.

Table 1. Minimum (min.), mean, maximum (max.), median and standard deviation (SD) of altitude and distance inland where longfin and shortfin eels are found. Source McDowall and Taylor 2000, based on the New Zealand Freshwater Fisheries Database.

Species	Altitude (m asl)					Distance inland (km)				
	Min.	Mean	Max.	Median	SD	Min.	Mean	Max.	Median	SD
Longfin eel	0	119.4	1150	100	135.6	0	47.7	314	26	53.3
Shortfin eel	0	55.8	835	30	76.7	0	42.6	292	16	52.0

4.4 In terms of the non-migratory galaxiid population of *Galaxias Gollumoides*, Mr Dungey has determined that potential reservoirs associated with a hydro scheme would flood only a minor proportion of its known distribution, with galaxiids having being found in several metres of one stream that enters the Nevis on the true right bank opposite the Nevis Burn. In general, the area of inundation is thought to have low habitat suitability due to the likely predation pressure exerted on this species by trout. Trout are known to have significantly reduced the geographical extent of a number of native fish species, particularly small non-migratory species (Townsend & Crowl 1991). Indeed it could be argued that the presence of the existing trout fishery has probably had an adverse effect on the distribution and abundance of the local native galaxiid fishery. I note that Dr Young, in his evidence to the Hurunui WCO hearing stated, in relation to a trout growth model, "*That said the model has under-predicted the size of a few large resident trout in the Nevis River, Central Otago, where a downstream falls apparently prevents upstream migration. A possible explanation is that these fish supplement their diet with fish –*

probably resident galaxiids which are known to occur in the Nevis catchment' (Young 2009).

4.5 Creating a reservoir for hydro generation would potentially inundate the lower reaches of several tributaries of the Nevis River. Some of these tributaries are known to support non-migratory populations in their mid and upper reaches and flooding of the lower reaches would not compromise habitat currently occupied by these populations. I understand that no galaxiids have been recorded from the residual river or discharge zones, as identified in the evidence of Mr Dungey, and are probably rare in this section of the catchment. Further, no natural barriers to upstream trout migration (e.g., waterfalls) would be inundated (thus allowing trout access further upstream).

4.6 In any event, it is possible to create artificial barriers to prevent upstream migration of predatory trout and koaro. I am aware of such barriers being deployed on tributaries within the Lake Mahinerangi catchment, which supports several populations of non-migratory galaxiid, as well as trout and koaro populations. This catchment has similar physical characteristics to the Nevis catchment, with tributaries set in steep sided valleys.

4.7 A report prepared on the Nevis Valley galaxiid population by the Department of Conservation (Neilson 2008) largely confirms my assessment of existing and potential risks to this species in the Nevis catchment and also acknowledges that the potential effect of loss of predatory barriers can be avoided by engineering new barriers.

4.8 The various trout surveys undertaken by Mr Dungey since the summer of 2002-03 are by far the most comprehensive of any aquatic ecological work done in the catchment and arguably are more comprehensive than most assessments of other salmonid fisheries in Otago. The range of methods he has employed, including aerial reconnaissance of adult fish and spawning sites, drift dive surveys, electric fishing and bank side observations are standard approaches to defining population structure and fish tagging is probably the only other additional method that would contribute useful information. I understand that radio tagging of fish was a preferred method of Mr Dungey's to better understand trout movement throughout the Nevis

River system, but a request for permission from Fish & Game to employ tagging methodology was turned down.

4.9 An additional microchemistry study utilising trout otoliths was an agreed study approach between Fish & Game and Pioneer Generation, but has met with mixed equivocal results making data interpretation difficult, and I consider it unwise to place too much emphasis on the data produced from this study. Mr Dungey provides more detail on the otolith study.

4.10 The results from Mr Dungey's various studies indicate that the Nevis River trout fishery is characterised by a relatively low density of 'takeable' fish, with densities considerably lower than other comparable rivers. Recruitment appears to be limited, probably as a result of the extremely harsh climate conditions (very cold prolonged winter season) which will affect fish condition factor, spawning success and fish food (macroinvertebrate and possibly smaller fish) production. There is also the strong likelihood that recruitment from downstream sources (i.e., the Karawau River catchment) is extremely limited. This latter conclusion, reached by Mr Dungey, has important implications with respect to the potential ecological effects of a hydro-electric scheme in the Nevis Valley.

4.11 Mr Dungey notes the relative absence of mid-sized fish, which would typically make up a large proportion of the fish observed during drift dives in most New Zealand rivers - an observation I would concur with.

4.12 The trout appear to be slow growing and subject to angling pressure as noted by the damage to large adult fish caught by Mr Dungey.

4.13 The data presented by Mr Dungey on the trout population of the Nevis River catchment appears compelling to me and I have concluded that this fishery is a low productivity one very much at the mercy of the local climate, angling pressure, food availability and dependent on local recruitment.

5. Possible ecological effects of a hydro-electric power scheme

5.1 Any ecological effects associated with a hydro-electric power scheme would be highly dependent on the size and location of scheme structures, particularly the location and size of a storage reservoir and head pond. It is my understanding that Pioneer have no final scheme design at this stage, but rather a range of possible options that would be subject to further investigation. One option is a small intake reservoir extending from a dam approximately 800m downstream of the Nevis Burn confluence to just below Nevis Crossing, with a tunnel or pipe intake leading to a sloped penstock and powerhouse located approximately 4.5 km upstream from confluence with the Kawarau River.

5.2 A second option is also a small intake reservoir extending from a dam situated approximately 800m downstream of the Nevis Burn confluence to just below Nevis Crossing, but with an additional, larger storage dam situated just downstream of Nevis Crossing with a reservoir extending upstream to around the mouth of Schoolhouse Creek. This would inundate approximately 4-5 km of the Nevis River and the bottom ends of some of its tributaries.

5.3 Obviously, final scheme design will have a significant influence on the possible environmental effects. In general I have considered the worst case potential effects associated with an additional larger storage dam.

6. River inundation and formation of a still-water environment

6.1 Inundation of a river reach to form a reservoir will no doubt alter local aquatic ecology as already discussed by Mr Dungey. Physical, chemical and biological changes to the local aquatic environment are likely as I describe below.

6.2 Water quality

6.3 Water quality within a Nevis Valley reservoir may differ from that typically found in the river now, but the extent of change will depend on the physical characteristics of the reservoir (its morphology), the water quality of the inflows, climate (ambient temperature, solar radiation and wind) and how outflows are managed. Future land use will also affect water quality, particularly nutrient and sediment inputs. Currently, land in the Nevis Valley is grazed by sheep and cattle, but at low densities (a reflection of the low productivity climate), and while there is very little water quality data available for the river, I would expect water quality to be good, with relatively low nutrient concentrations and oxygen demanding substances. This situation could be further improved in the future by destocking throughout the catchment, which I understand is a possibility via the tenure review process, and by physically excluding stock from land immediately surrounding the reservoir.

6.4 Wind has a strong influence on lakes and reservoirs. It can mix the water and resuspend bottom sediments - particularly in shallow lakes. Hicks (2005) predicts that wind waves would re-suspend fine sediment from the shallower margins of a Nevis Valley reservoir, particularly while it is drawn down. He determined that a substantial area of the lake bed would be disturbed during a strong wind event. Consequently, the reservoir and its discharge would be turbid during and following wind events, resulting in a reduction in average water clarity in the lower river during such occasions. The frequency of such events is unknown but the valley is elevated and strong winds are not uncommon (R. Dungey, pers. comm.). More turbid water can inhibit algae and macrophyte growth by reducing the amount of light available.

6.5 The largely shallow nature of the reservoir and possible significant wind disturbance means that stratification[1] of the reservoir is unlikely or at best partial stratification may occur in deeper water towards the dam face. Again, such a situation arising would be dependent on how the scheme is operated (including operating range, seasonal operating range and position of the intake). Stratification is largely an undesirable phenomena in lakes and reservoirs as the water quality and resulting ecological effects resulting from significant stratification are typically adverse in nature.

6.6 The growth of aquatic macrophytes also has strong interactions with lake water quality. A collapse in the coverage of aquatic macrophytes has been observed in many shallow lakes around New Zealand - always with a corresponding decline in water quality.

[1] Thermal stratification of lakes is a change in the temperature at different depths in the lake resulting in the incomplete mixing of the layers.

6.7 Reservoir ecology

6.8 A reservoir associated with a hydro scheme in the Nevis Valley will develop an ecology of its own different in character from that of the river it replaces. The largely still-water environment will provide habitat for an assemblage of macroinvertebrates suited to soft-bottomed habitats and possibly macrophyte communities. The assemblage is likely to differ little from that observed in other high altitude lakes and reservoirs throughout Otago and be dominated by chironomid larvae, snails, worms, small crustacea (ostracods) and larvae of some other insects species such as cased trichopterans and damselfly larvae, depending on the extent of macrophyte beds.

6.9 Macrophytes (rooted aquatic plants) suitable for still-water environments are likely to be present in some parts of the Nevis catchment. I anticipate that they would eventually colonise a reservoir located downstream. Macrophyte beds can provide highly productive habitat for lentic invertebrate species and in turn provide cover and food for fish. However the extent of macrophyte cover would be highly dependent on the operating regime of the reservoir, and its exposure to wind, with strong winds and a more extensive operating range providing less opportunity for an extensive macrophyte community to develop. Further, the harsh climate of the Nevis catchment means that macrophytes and other biota associated with the more shallow margins of the reservoir will most likely be subject to freezing in winter and possible drying in summer (if the reservoir level drops) and so have low productivity potential.

6.10 It is possible to provide some general prediction of a Nevis Valley reservoir with other similar reservoirs in Otago. Stark (1993) surveyed the macrophyte-associated macroinvertebrate communities of seventeen hydro-electric and natural lakes/reservoirs in the South Island. The primary objective of the survey was to determine whether communities in lakes with artificially controlled levels differed significantly from those in natural lakes. Lake Onslow was one of the lakes surveyed and in my opinion provides a useful comparison with the Nevis situation given it is at a similar altitude (>684 m above sea level) and has similar catchment characteristics.

6.11 Stark (1993) found an average of 37 invertebrate taxa in the 17 lakes, the lowest number being 23 taxa (Cobb Reservoir in Nelson) with Onslow having approximately 33 taxa. Chironomid larvae (Diptera) and worms dominated the lake benthic fauna of Onslow.

6.12 Stark found no statistical difference in macroinvertebrate taxonomic richness (i.e., the number of distinct taxa found in a lake) between the samples collected from hydro-electric lakes and natural lakes, although his survey method involved assessing only one transect at each lake. Stark also found no statistical difference in macroinvertebrate densities (i.e., the number of animals per unit area of lake bed) between samples he collected from hydro-electric lakes and natural lakes.

6.13 Given all the above, I do not expect a reservoir in the Nevis catchment to be particularly productive in terms of aquatic food availability for fish. However I do expect a reservoir will afford an increase in habitat for trout, albeit different from the flowing river habitat it would replace, given the potential area it would cover. Despite potential water level fluctuations, the reservoir will provide refuge from large flood events when currently some fish are likely to be displaced downstream. A reservoir would provide some buffering to this effect. There is also the likelihood that the reservoir would provide feeding habitat for fish attracted by the fall of terrestrial insects on the water surface. Several high altitude reservoirs throughout Otago (including the Loganburn Reservoir and lake Onslow) are well known for their seasonal cicada fishing and attract significant numbers of anglers.

6.14 Some spawning habitat in the lower reaches of several tributaries may be lost as a result of inundation, but I understand from Mr Dungey's surveys that this area represents a relatively minor contribution to the overall spawning habitat in the Nevis Valley. I also understand from the work of Dr Hicks (Hicks 2005) that the tributaries would develop gravel deltas and so it is possible that some new trout spawning habitat will become established with time.

6.15 Overall I expect that a reservoir will provide a net positive contribution to trout habitat in the Nevis Valley although this is difficult to quantify without a more precise description of a hydro scheme and its operation regime. Lake Onslow is an example of a popular high altitude Otago reservoir fishery, as described by Mr Dungey. In reaching this conclusion I also acknowledge that the type of habitat will change quite substantially from that currently afforded by the river, and that the angling amenity will also change accordingly for this section of the river.

7. Creation of a physical barrier to fish migration

7.1 Mr Dungey has already described the difficulty in accessing the gorge from an angling (and researcher's) perspective. He has also described why he considers it to represent an extremely challenging barrier for upstream fish migration and I doubt whether there is much debate about this issue. In my experience, if such habitat was mooted by a power company as being suitable for upstream migrating fish, or suitable for angling, in relation to power scheme development, I expect that it would be roundly rejected by fisheries managers as being inappropriate. From my observations of the lower gorge and the additional assessments undertaken by Mr Dungey, the gorge appears to provide highly unsuitable habitat for fish passage and unsuitable water for all anglers other than those individuals seeking an extreme physical challenge.

7.2 Mr Dungey's evidence indicating a lack of fish movement during the trout spawning season and the absence of rainbow trout above the gorge, despite their abundance below it, suggests to me that the gorge is a significant barrier to upstream trout migration.

7.3 If it is accepted that the lower Nevis River gorge does not provide significant upstream passage for trout, it is then appropriate to consider what other aquatic ecological and angling values are necessary to be maintained in the gorge section. I address this issue in Section 8 of my evidence.

7.4 I agree with Mr Dungey that downstream migration/passage can still occur with a hydro scheme in place. Safe passage through turbines is always an issue with hydro dams and this is dependent on a range of factors including turbine design and station head. While large fish can experience very high levels of mortality, smaller fish have a greater chance of survival after passage through turbines. For example, the survival of juvenile rainbow trout (69-90mm in length) passing through a turbine at the Hinemaiaia HEPS in the North Island was found to be very high (79% after 96 hours) (Maclean & Dedual 2004).

7.5 In any event, I am confident that downstream passage for fish can be provided via the incorporation of appropriate design features for a hydro-electric scheme, should it be determined to be necessary.

8. Altering the downstream flow of the river

8.1 Hydro schemes typically result in alteration to downstream river flows. This is a consequence of the desire by owners to operate the scheme in as efficient manner as possible to ensure their asset capitalises on generation potential.

8.2 In the case of the Nevis River, the section of river where flows would most likely be affected by a hydro scheme is contained in a confined, very steep, rocky, relatively inaccessible gorge, as already described principally in the evidence of Mr Dungey. Flows in this section of the river should be sufficient to sustain the local aquatic ecosystem. I do not consider it necessary to consider flow effects in the Kawarau River at and below the confluence with the Nevis River given the dominance of the Kawarau flow relative to the Nevis.

8.3 Mr Dungey considers that lesser flows in this section of the river would provide some benefit to local instream habitat by reducing water velocities and increasing the proportion of pool habitat, and in doing so, increasing the type of habitat preferred by trout. I concur with this assessment but note that a more stable flow regime, albeit more favourable for the physical habitat requirements of trout, may result in the development of greater periphyton biomass and so alter the benthic community. Arguably, such a potential change can produce both positive and negatives effects. For example, stable flows below dam outlets, while increasing periphyton biomass, also increases abundance of filter-feeding invertebrates (e.g., net-spinning caddisflies like *Aoteapsyche*) which are targeted by drift feeding trout. If periphyton biomass becomes excessive, it can be controlled by controlled flushing flow releases. The extent to which this may be required in the Nevis River is uncertain given the low productivity catchment and steep gradient gorge.

8.4 I note that Fish & Game has sought two minimum flows for the lower gorge section of the Nevis River; a 4 cumec flow at Nevis Crossing and a 5.1 cumec flow at Wentworth Station, which is located towards the very bottom of the catchment. It is my understanding that the minimum flows sought have been based on the results of an IFIM study of the River undertaken on behalf of the Otago Regional Council (Jowett 2004). That study considered that adult brown trout habitat is maximised at 5 cumecs and food producing habitat is maximised at 6.2 cumecs. Fish & Game were advised by its experts (Olsen & Hayes 2006) that for a highly valued fishery retention of 90% of the habitat available at MALF (mean annual low flow) is appropriate. By applying "a margin of error" to the IFIM outputs, an approach I have not seen used before in setting low flows in a regional context, Fish & Game considered the MALF as an appropriate minimum flow to protect the habitat of the fishery.

8.5 I am somewhat confused by Fish & Game's request for these particular minimum flows given the comment in the Olsen & Hayes (2005) report at page 11, "*Applying a 90% habitat retention rule in the Nevis River would mean that the minimum flow would be set at 2.8 m^3/s at Nevis Crossing (4.3 m^3/s at Wentworth) (i.e., 2.8 m^3/s would be retain 90% of the habitat for adult brown trout at the MALF).*". These flow values seem to me to be considerably lower than the values subsequently sought by Fish & Game using the findings in the Olsen & Hayes report as some form of justification for flow setting.

8.6 An additional concern I have with the approach used by Fish & Game is the way these minimum flow requirements have been applied to a section of the river that has quite different physical characteristics to the sections from where the IFIM recommendations were derived. That is, the IFIM study was undertaken within the relatively gentle gradient sections of the river around and upstream of Nevis Crossing (mean gradient 0.43%), and applied to the largely steep gorge section of the lower river (mean gradient 3.8%).

8.7 This observation is acknowledged by Olsen & Hayes (2005) on page 11 of their report to Fish & Game where they state: "*The above estimates of flow requirements are likely to overestimate flow needs of trout and invertebrates in the steeper gorge sections – where flow* *is faster, however, there are no IFIM data available for these reaches.*".

8.8 Mr Dungey has shown in Figure 8 of his evidence that, even in a relatively quiescent section of the gorge that permitted physical measurements to be taken, flows above approximately 3.5 cumecs produced velocities across the wetted channel that were less favourable for adult and yearling brown trout.

8.9 Therefore I question the appropriateness of the minimum flow recommendations of Fish & Game as they relate to the steep gorge sections that would be potentially affected by a hydro scheme in the Nevis Valley. Obviously, flows in the lower section of the gorge (at Wentworth Station) are unlikely to be affected by minimum flows as this reach is well downstream of any influence from the scheme. Furthermore, river flows upstream of the influence of a hydro scheme's reservoir would not be affected by its operation.

9. Conclusion

9.1 A hydro-electric power scheme on the Nevis River has potential to alter the physical characteristics of sections of the Nevis River, particularly from downstream of the Schoolhouse Creek confluence (if a large reservoir were to form part of the scheme) and the gorge section downstream of Nevis Crossing.

9.2 The existing aquatic ecosystem and potential effects on the fisheries of the Nevis catchment associated with hydro-electric development have in my opinion been adequately addressed by Mr Dungey, who has conducted a range of surveys over a number of years.

9.3 While changes to the trout fishery are likely as a result of a potential scheme, it is my opinion that these would not be detrimental to the existing population and there is an ability through appropriate scheme design to mitigate potential adverse effects associated with water quality, downstream passage and lower river (gorge) habitat. Based on the information I have viewed, I do not consider that upstream passage is necessary to sustain the existing fisheries of the Nevis River.

9.4 I concur with Mr Dungey that there is no indication that the trout fishery has changed materially since the Kawarau WCO was gazetted in 1997.

9.5 Potential effects to the galaxiid population in the catchment are also able to mitigated through the creation of artificial barriers, should these be necessary.

9.6 It is important to note that my assessment of the potential effects of a hydro-electric scheme is based on a likely worst case scenario involving the creation of a large storage reservoir. Pioneer Generation has indicated (largely through the evidence of Mr Mulvihill) that alternative scheme options exist that do not include a large storage reservoir. Consequently, such options can be viewed as having a much lower potential effect on the existing aquatic environment than what I have considered above.

10. References

10.1 Hicks, D.M. 2005. Sedimentation effects associated with a proposed hydro-scheme on the Nevis River. Prepared for Pioneer Generation. NIWA Client Report CHC2005-009.

10.2 Jowett. I.G. 2004. Flow requirements for fish in Luggate Creek, Arrow River, Nevis River, Stony Creek, Sutton Stream, Trotters Creek and Waiwera River. No. HAM2004-081.

10.3 Maclean, G. and Dedual, M. 2004. Hinemaiaia trout passage trials. Prepared by Taupo Fishery Area, Department of Conservation on behalf of TrustPower.

10.4 Neilson, J.M. 2008. Gollum galaxias (*Galaxias gollumoides*) in the Nevis Valley. File Note SAR 06-10-01. Department of Conservation.

10.5 Stark, J.D. 1993. A survey of macroinvertebrate communities in seventeen South island lakes. Prepared for ECNZ. Cawthron Institute.

10.6 Townsend, C.R. and Crowl, T.A. 1991. Fragmented population structure in a native New Zealand fish: an effect of introduced brown trout? Oikos 651: 347-354.

10.7 Young, R.G. 2009. Statement of evidence of Roger Graeme Young on behalf of New Zealand and North Canterbury Fish & Game Councils. Minister For The Environment Special Tribunal. 6 March 2009.

Gregory Ian Ryder

6 May 2009