

**BEFORE THE ASHBURTON DISTRICT COUNCIL
AND THE CANTERBURY REGIONAL COUNCIL**

IN THE MATTER OF the Resource Management Act 1991

AND

IN THE MATTER OF applications made by Ashburton
Community Water Trust for
resource consents to establish,
operate and maintain hydro
electric power stations and
ancillary activities.

STATEMENT OF EVIDENCE BY RICHARD MARK ALLIBONE

1. INTRODUCTION

- 1.1 My name is Richard Mark Allibone, a senior ecological consultant at Golder Associates (NZ) Ltd. I have been in practice as a freshwater and terrestrial scientist and manager for 13 years.
- 1.2 I have previously been employed as the National Services Manager for the Queen Elizabeth the Second National Trust (QEII); Species Protection Officer at the Biodiversity Recovery Unit of the Department of Conservation; Fisheries Scientist and Post Doctoral Fellow at the National Institute of Water and Atmospheric Research (NIWA) and a Freshwater Fisheries Specialist for the Department of Conservation in the Nelson/Marlborough and Otago Conservancies.
- 1.3 I have a BSc (Geology and Zoology), an MSc (Zoology) and a PhD (Zoology) from the University of Otago.
- 1.4 I have previously reviewed hydro-electric power scheme consent applications for the Electricity Ashburton's hydro scheme on the Rakaia River for TrustPower Limited, Meridian Energy Ltd's North Bank Tunnel Concept (NBTC) on behalf of Environment Canterbury; and Contact Energy Ltd's Roxburgh, Clyde and Lake Hawea operations on behalf of the Department of Conservation. I was also part of the Department of Conservation team assessing application for resource consents for TrustPower Ltd's Waipori hydro electric power scheme. In addition, I was a fisheries technical expert for the Department of Conservation during the assessment and negotiations with Meridian Energy with regard to Project Aqua. As a senior member of the freshwater staff at the Department of Conservation I also gave advice to Conservancy staff with regard to the reviewing of the assessment of effects of other proposed hydro electric schemes.
- 1.5 For the Electricity Ashburton hydro electric scheme on the Rakaia River I reviewed the consent application with regard to the effects of the scheme on the Highbank Power Station tailrace salmon barrier and effects of the operation on the upstream salmon migration on behalf of TrustPower Limited.
- 1.6 As a reviewer of the NBTC consent application I reviewed all aspects of the fisheries evidence which covered effects on native fish, trout and salmon and salmon angling. I also reviewed the assessment of effects on fish and fisheries for the Hunter Downs Irrigation Scheme for Environment Canterbury.
- 1.7 I have been a contributing author to two books and 24 peer reviewed papers and reports.

1.8 I have read, and agree to comply with, the Code of Conduct for Environment Court witnesses and have prepared my evidence in accordance with those rules.

2. BACKGROUND

2.1 Ashburton Community Water Trust (ACWT) have applied for resource consents to establish, operate and maintain a hydro electric power generation scheme that draws water from the Rakaia River.

2.2 The scheme will convey up to 40 m³/s water from the Rakaia River through a canal, the Highbank Canal, and two (or three) drop structures with power generators at each drop structure. The water would then discharge into the existing Highbank Power Station tailrace. This part of the scheme is essentially the same as the Electricity Ashburton (EA) scheme in terms of structures and sites. Water discharged into the Highbank upper tailrace and water discharged from Highbank Power Station itself would then be drawn into a new canal, the Terrace Canal, at a rate of up to 40 m³/s. Water in excess of 40 m³/s in the upper Highbank tailrace would continue to be discharged via the Highbank tailrace.

2.3 I have been commissioned by TrustPower to assess the potential effects of the discharge consent on the salmon barrier at the Highbank Power Station. My evidence will address the following:

- A brief description of the salmon migration in the Rakaia River;
- A description of the existing salmon barrier and bypass system;
- The effects of ACWT's discharge to the Highbank tailrace;
- The effects of tailrace widening; and
- Recommended consent conditions

3.0 SALMON MIGRATION IN THE RAKAIA RIVER

3.1 Adult Chinook salmon migrate upstream from the sea to the upper reaches of the Rakaia River each year to reach spawning habitats in the upper river tributaries. The migration season runs from December through to May with the peak migration period being February and March (Unwin & Glova 2000). The salmon runs are highly variable and have been shown to vary from 2700 fish to 16700 fish (Unwin & Glova 2000). In the last two years Terry (2008) reported the estimated salmon runs in the Rakaia River to be 3963 salmon (2007) and 7712 salmon (2008).

- 3.2 The majority of migrating salmon swim up the Rakaia River to tributaries such as Glenarriffe Stream and Hydra Waters. At these upper river tributaries the adult fish spawn and die.
- 3.3 The migrating salmon follow two types of cues when undertaking their upstream migration. The fish always attempt to move in an upstream direction and there is a strong behavioural aversion to downstream movement. The odour of the individual fish's natal stream is also a strong attractant to salmon as they return to their natal stream for spawning. Therefore fish will always attempt to swim upstream and will also home in on waterways that have their natal stream odour.
- 3.4 Each year salmon are attracted to the Highbank tailrace outflow as the tailrace can represent a significant flow of water up which they can swim. The numbers of salmon are highly variable and depend on the water flow from Highbank and the size of the salmon run. It should however, be noted that the Highbank Power Station discharge is water that has been abstracted from the Rangitata River. The tailrace outflow therefore does not provide odour cues for the Rakaia salmon and movement up the tailrace could be considered as salmon straying from their natal river, something that 2-3% of salmon naturally do (Unwin & Glova 2000).
- 3.5 An assessment of the numbers of salmon attracted to the Highbank tailrace discharge by Unwin & Glova (2000) concluded that the attractiveness of the tailrace increased with the flow discharged. Importantly this attractiveness is not a linear relationship, but as flow increases the attractiveness increases exponentially. Unwin & Glova (2000) concluded that entrainment of salmon in the tailrace would double with every additional 3 m³/s water being discharged.

4.0 THE Highbank Tailrace Salmon Barrier

- 4.1 Salmon are attracted up the Highbank tailrace when the power station is operating and discharging water. However, it is important to note that currently when Highbank Power Station is not operating there is no water available in the tailrace for fish. Therefore, when Highbank Power Station does not operate the dry tailrace is a complete barrier to salmon entrainment in the tailrace and their migration proceeds naturally upstream in the Rakaia River. Mr Lees has provided an outline of the current Highbank operations and this shows that operations in the peak salmon migration season are now limited due to the Rangitata Diversion Race water being used for irrigation for most of the salmon migration season.
- 4.2 The tailrace at Highbank Power Station has two distinct sections: the section from the power house downstream for approximately 500 m is a formed canal (Figure 1); the lower 500 m is a modified disconnected minor braid of the Rakaia River. The

lower section is lined with willow trees and is more winding than the upper section (Figure 2).

- 4.3 The salmon passage barrier has been constructed at the downstream end of the formed canal. At this point a section of concrete-lined channel has been created and a salmon passage barrier consisting of seven panels with vertical bars has been built (Figure 3).
- 4.4 The barrier has been constructed as a series of panels with vertical bars that are set at an angle to the flow and spaced 50 mm apart. Each panel can be individually lifted to allow cleaning of debris that accumulates on the bars. The panels are also designed to "pop" at the bottom if the water pressure on the panel becomes too great. This occurs when debris has built up on the panel and has begun to block the water flow through the barrier. The panels do not "pop" under the consented tailrace discharge flows when clean of debris. The "popping" of individual panels prevents wholesale failure of the barrier in the event of rapid debris build up between cleaning events.
- 4.5 A salmon bypass channel (Figure 4) has been constructed that discharges its flow into the tailrace immediately downstream of the concrete formed channel area at the salmon barrier. This bypass channel allows salmon that encounter the barrier to continue to migrate in an upstream direction and rejoin the Rakaia River. TrustPower currently holds a consent that allows the flow in the bypass channel to be maintained by undertaking river works to achieve a connection with the Rakaia River and maintain appropriate water levels in the bypass for salmon passage. Flowing water is maintained in the bypass channel when Highbank is operating during the salmon migration season.
- 4.6 Downstream of the salmon passage barrier and concrete section the winding natural minor braid channel has been graded to fill in the previously existing pool habitat. The lower tail race section is therefore now a continuous run section. The removal of the pool habitat has been designed to discourage salmon from resting in the lower tailrace during flow recessions, thus preventing salmon becoming stranded in residual pools.
- 4.7 The salmon passage barrier was constructed in 2006 and has operated for two salmon migration seasons (2006/2007, 2007/2008).
- 4.8 During the first season of the barrier's operation, monitoring of the barrier and salmon in the tailrace was undertaken by TrustPower staff. For the 2006/2007 salmon season Fish & Game (North Canterbury), (Terry 2007) reported a run of approximately 3963 salmon however, at the Highbank Power Station only seven

salmon were recorded in the tailrace above the barrier. For the 2007/2008 salmon season monitoring of the barrier was undertaken by TrustPower staff and Golder. Terry (2008) reported a run of 7712 salmon, and at Highbank an estimate 43 salmon were entrained in the upper tailrace, the majority of which were small (probably "jack" or male) salmon that were capable of passing between the salmon barrier bars (Golder 2008).

- 4.9 In previous years (prior to the instalment of the fish screen) when the Rakaia River has had large salmon runs it has been reported that several hundred salmon have become entrained in the Highbank Power Station tailrace and in the 1950s commercial harvesting of salmon occurred in the tailrace (Unwin & Glova 2000). In comparison with previous years, the number of salmon entrained in the tailrace in the 2006/07 2007/08 years, following the installation of the fish screen, represents a major improvement and has demonstrated the salmon passage barrier is very effective at preventing salmon becoming trapped and/or stranded in the tailrace.

5. EFFECTS ON THE ASHBURTON COMMUNITY WATER TRUST DISCHARGE

- 5.1 The applicant wishes to discharge up to 40 m³/s of water from the Highbank Canal to the Highbank tailrace and to divert up to 40 m³/s from the Highbank tailrace to the Terrace Canal. The 40 m³/s discharge into the Highbank tailrace will comprise that available to ACWT under its combined take permit and assumed in Mr Borrie's evidence to be 23 m³/s (although the consented take for ACWT will be 40 m³/s) and any additional water that can be sourced from EA (up to 17 m³/s). Additional water for the Terrace Canal diversion may be taken from the Highbank Power Station (up to 40 m³/s).
- 5.2 ACWT (Mr Neal Borrie second brief of evidence) have modelled the likely abstractions from the Rakaia River by ACWT and EA and using historic discharge records from Highbank Station modelled the likely flows to be discharged via the Highbank tailrace to the Rakaia River. Mr Borrie in Sections 38 – 48 of his evidence presents the flow modelling results for the discharge of water at Highbank via the tailrace. With the EA and ACWT hydro-electric schemes operating and the Terrace Canal taking water up to 40 m³/s, the discharge of water at Highbank is substantially reduced (Mr Borrie Figure 15, Section 45).
- 5.3 I concur with Mr Borrie's conclusion that the reduction in the discharge at Highbank will reduce the attractiveness of the tailrace to Chinook salmon. It is notable in the model presented by Mr Borrie that the discharge in the key salmon run months of

from January to April that flows are very low compared to current monthly mean flows.

- 5.4 An additional effect that has not been assessed by the applicant is the change in odour cues in the Highbank tailrace. Currently the discharge contains no water from the Rakaia River and the lack of appropriate natal stream odours in the Highbank tailrace discharge may be discouraging Rakaia River salmon from entering the tailrace. The discharge of EA and ACWT scheme water into the tailrace will for the first time provide odour cues appropriate for Rakaia River salmon seeking their natal streams. In my opinion this effect at best will not change the attractiveness of the tailrace but at worst (and in my view, the more likely outcome) this will increase the attractiveness of the tailrace to salmon natal to the Rakaia River.

6.0 THE EFFECTS OF WIDENING AND REALIGNMENT OF THE TAILRACE

- 6.1 To accommodate the addition of up to 40 m³/s of water in the Highbank tailrace it is expected that the tailrace will have to be widened (Mr Woods, evidence in chief). At times when the Terrace Canal is not operating or there is an emergency shutdown it is possible that this 40 m³/s and the discharge from Highbank Power Station will be discharged via the Highbank tailrace to the Rakaia River. On a "worst case" scenario, this could be up to 80 m³/s. This will also require the construction of an auxiliary spillway to spill water to protect the salmon barrier. This will require construction work at the end of the formed tailrace and the junction of the bypass and tailrace.
- 6.2 Any new construction needs to avoid creating any salmon resting habitat immediately downstream of the barrier in the lower tailrace. Currently the concrete section of tailrace downstream of the barrier provides very poor resting habitat and encourages salmon to move up the bypass and back to the Rakaia River. This smooth tailrace bed needs to be maintained across the whole width of the tailrace.
- 6.3 During the construction of the auxiliary spillway the bypass channel confluence with the tailrace should be reinstated to ensure the bypass flow enters the tailrace as close to the screen as possible and that the flow sweeps across the channel as close to the salmon barrier as possible so that salmon are attracted to the bypass.
- 6.4 Downstream of the salmon barrier in the lower tailrace section the tailrace has been graded to form a continuous run. The lack of pools prevents salmon from becoming stranded during declining flows and again discourages salmon from resting in the tailrace.

- 6.5 Any widening of the lower tailrace and the proposed realignment (Mr Woods' evidence) needs to maintain this pool-free habitat to continue discouraging salmon from resting in the lower tailrace. The removal of riparian vegetation will also be required during widening. Currently the lower tailrace is a relatively stable channel and this plays an important part in maintaining the run habitat and preventing bank scour and pool formation. Any widening of the lower tailrace needs to ensure scouring does not lead to pools forming in the tailrace and will require ongoing maintenance to ensure that it remains a pool free habitat.
- 6.6 In the event of an emergency shutdown when up to 80 m³/s may be discharged into the lower tailrace scouring may occur in this race. This could create new pool habitat and provide resting areas for salmon to subsequently become stranded in. Such an event is not associated with the day to day operations of the proposed hydro electric scheme but is a rare event that could occur.
- 6.7 The potential scouring effect can be managed relatively simply with the applicant carrying out post-emergency discharge surveys of the lower tailrace to detect scouring. Any scour holes can then be filled and the lower tailrace regraded to maintain the desired run habitat.
- 6.8 In addition to the reduced discharges from the Highbank tailrace the current tailrace will be widen to accommodate the large discharge events when EA and Highbank Power Stations discharge. This will provide an additional benefit for the avoidance salmon entrainment. For any given discharge volume the water depth will be reduced which will in turn reduce the attractiveness of the tailrace and increase the attractiveness of the salmon bypass hence encourage salmon to use the bypass and return to the Rakaia River.

7.0 CONSENT CONDITIONS RECOMMENDED

- 7.1 The effects of the ACWT at Highbank will be to reduce the discharge and reduce the potential for salmon entrainment. However, discharges from Highbank will continue and the salmon barrier will still be required to ensure entrainment of adult salmon does not occur. With appropriate consent conditions this can be achieved.
- 7.2 I would recommend that for the consent (CRC072640) to discharge up to 40 cubic metres per second of water and contaminants to the Rakaia River via the Highbank Power Station Tailrace includes the following proposed conditions relating to the salmon passage barrier and bypass:

To maintain the tailrace channel:

- 2(g) *Where any discharge from the emergency spillway to the unformed Highbank tailrace results in any geomorphological modification (including to the salmon bypass channel) that leads to an increased incidence of salmon entrainment in the tailrace, the consent holder shall re-grade or reinstate the channels to mitigate the increased incidence of salmon entrainment.*
- 2(h) *For the purpose of condition (2)(g) the consent holder shall monitor the performance of the Highbank Power Station formed tailrace and salmon barrier no less than weekly after there is an overflow or emergency discharge during the salmon migration season, being 1 December to 31 May. A report detailing the incidents of the manual reinstatement of the salmon bypass or lower tailrace following such reinstatements, where required, shall be provided to the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, by 31 May each year. These reports are also to be simultaneously served on TrustPower Ltd.*
- 6 *The salmon barrier shall be inspected weekly and the Consent Holder shall undertake any necessary cleaning and maintenance works within seven days of that inspection, unless urgent maintenance or repair work is required in which case that shall take place as soon as possible.*

The consent holder shall be responsible for:

- (a) *any re-grading and reinstatement of the unformed lower Highbank tailrace including any re-connection to an active branch of the Rakaia River; and*
- (b) *any modifications to the salmon screen and / or salmon bypass channel necessary to give effect to this consent, or as advised by Environment Canterbury in response to any issues raised as a consequence of the consent holders monitoring responses in relation to the above, and as pursuant to s.128 of the Resource Management Act.*

To monitor salmon entrainment:

The consent holder shall monitor the performance of the Highbank Power Station tailrace salmon barrier on a no less than weekly basis whenever the consent holder is discharging water to the Highbank tailrace for that period of the entire salmon migration season, being 1 December to 31 May. A report detailing the incidents of the salmon barrier screens popping, the manual reinstatement following each incident, and any incidents of maintaining the connection of the fish bypass channel to the Rakaia River shall be provided to the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, by 31 May each year. These reports are also to be simultaneously served on TrustPower Ltd.

To maintain the salmon bypass:

9. *The consent holder shall ensure that the braid of the Rakaia River diverted to connect with the Highbank tailrace fish bypass channel from the Highbank tailrace salmon barrier is maintained in good working order at all times to ensure migrating fish will be able to move upstream.*

- 10 *A record shall be kept of the incidence of salmon entrained in the bypass channel and the North Canterbury Fish and Game Council shall be notified on each occasion that Condition 9 below is triggered. Records of salmon entrapment shall be forwarded to Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, at the end of by 31 June each year, or as requested. This report is also to be simultaneously served on TrustPower Ltd.*
- 12 *The consent holder shall be responsible for any re-grading and reinstatement of the salmon bypass channel including any re-connection to an active braid of the Rakaia River.*

7.3 I would recommend that for the consent (CRC072645) relating to the construction and maintenance of the salmon barrier that to ensure the barrier is operative the following conditions:

- 1 *Prior to the commencement of operational discharges from the Rakaia Terrace Hydro Scheme, the consent holder shall construct, place and maintain barrier structures at approximate map references NZMS 260 K36:065-385, NZMS 260 K36:087-358 and NZMS 260 L36:158-280:*
- (a) *Each barrier structure shall effectively exclude mature migrating salmon from entering the tailrace or discharge canal, and shall be designed, constructed and maintained in accordance with the recommendations of a suitably qualified aquatic ecologist, and a chartered professional engineer (my emphasis)*
- (b) *The consent holder shall form and maintain a bypass channel that ensures that salmon attracted to the Highbank Power Station salmon barrier are able to return to a main flowing channel of the Rakaia River.*
- (c) *Within three years of the commencement of this consent the consent holder shall provide the Canterbury Regional Council Compliance Manager with a report, prepared by a suitably qualified person, detailing the extent to which the systems referred to in condition (2) are meeting the objectives of this condition.*
- 7 *The works shall not prevent the passage of fish within natural river braids, or cause the stranding of fish in pools or channels.*
- 9 *The consent holder shall ensure that the braid of the Rakaia River diverted to connect with the bypass channel from the Highbank tailrace salmon barrier (under consent CRC011249) is maintained in good working order at all times to ensure migrating salmon are able to move upstream.*
- 11 *In the event that the consent holder or persons acting for them observes a minimum of 50 adult salmon that have become entrained in the Highbank Power Station tailrace channel or the Highbank emergency spillway above the salmon barrier, the consent holder or persons acting for them shall, as far as is practicable, be responsible for salvage, and release into an active channel of the Rakaia River.*
- 12 *Monitoring of salmon entrainment shall be undertaken not less than weekly:*
- (a) *every year for the three years following the commencement of the scheme; and thereafter*
- (b) *for one migration season every four years post commissioning of the scheme for the term of this consent, for the entirety of the Salmon migrating season, being 1 December to 31 May.*
- 13 *This monitoring referred to in Condition (12) is to determine whether there is an adverse effect on salmon entrainment in the Highbank Power Station tailrace*

channel as a result of the discharge that is more than minor. These annual monitoring reports are to be forwarded to Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, by 30 June each year, or as requested. The report on any incidents of entrainment of salmon in the Highbank tailrace shall be simultaneously served on TrustPower Ltd.

- 14 The consent holder shall monitor the performance of the Highbank Power Station Tailrace salmon barrier and associated by pass channel not less than weekly at all times when the consent holder is discharging water to the Highbank tailrace for the period of the entire salmon migration season, being 1 December to 31 May. A report detailing the performance or incidents of the salmon barriers popping shall be provided to the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, by 30 June each year. The report is to be simultaneously served on TrustPower Ltd.
- 15 The Highbank Power Station salmon barrier shall be inspected no less than weekly and the Consent Holder shall undertake any repairs, cleaning and/or maintenance works necessary to maintain the integrity and function of the barrier within seven days of that inspection, unless urgent maintenance or repair work is required in which case that shall take place as soon as possible.
- 17 The consent holder shall be responsible for:
 - (a) any re-grading and reinstatement of the unformed lower Highbank tailrace including any re-connection to an active branch of the Rakaia River; and
 - (b) any modifications to the Highbank Power Station salmon barrier and / or the associated fish bypass channel necessary to give effect to this consent, or as advised by Environment Canterbury in response to any issues raised as a consequence of the consent holders monitoring responses in relation to the above, and as pursuant to s.128 of the Resource Management Act.

7.5 With respect to Consent CRC072645 I would note the currently proposed consent conditions are confusing with respect to the use of fish barriers and screens at the ACWT intake and discharge points and the salmon barrier at the Highbank tailrace. I would recommend that the Highbank salmon screen is recognised with distinct consent conditions from the ACWT intake and discharge barriers and screens to provide more clarity for the consent conditions.

7.4 I would also recommend the addition of the follow consent condition for Consent CRC072645:

Prior to construction works being completed on the Highbank tailrace auxillary spillway, the consent holder is to ensure that the bypass flow enters the tailrace as close to the Highbank Salmon barrier as possible. These works shall be undertaken and be concluded in a period that does not coincide with Salmon migration season, being that period between 1 December to 31 May.

7.5 Finally I would note that some of the consent conditions above include reporting dates for compliance reports on salmon entrainment to Environment Canterbury that are 31 May, 30 June or 31 June. I would recommend later reporting dates for these compliance reports as the salmon season can run until the end of May and

the 31 May report deadline is difficult to comply with. I would also note that the 31 June is an impossible reporting date as June has only 30 days. To allow the reports to include information on the size of salmon runs and to complete an analysis of the salmon barrier's effectiveness I would recommend reporting dates of 1 September.

8.0 CONCLUSION

- 8.1 It is my opinion that if the salmon barrier, emergency spillway, bypass channel and tailrace are maintained appropriately by ACWT, then the effects on salmon migration should be minor and will reduce the potential for the attraction of salmon to the Highbank tailrace.
- 8.2 The proposed consent conditions as proposed (with amended dates) for the discharge at Highbank tailrace and maintenance of the salmon barrier, address issues associated with the salmon barrier appropriately.

Richard Allibone

September 2008

References

- Golder Associates Ltd. 2008: Annual Chinook salmon monitoring report: Highbank Power Station. Report prepared for TrustPower Limited.
- Terry, S. 2007: 2006-2007 Salmon Management Report North Canterbury Region. Unpublished Report, Fish & Game North Canterbury.
- Terry, S. 2008: 2007-2008 Salmon Management Report North Canterbury Region. Unpublished Report, Fish & Game North Canterbury.
- Unwin, M.J., & Glova, G.J. 2000: The impacts of discharges from the Highbank tailrace on the Rakaia River salmon fishery. NIWA client report CHC00/09.



Figure 1: Highbank power station and upper tailrace canal.



Figure 2: The lower tailrace section.



Figure 3: Salmon barrier (in a raised position) and concrete lined channel.



Figure 4: The bypass channel, with the salmon barrier in the background.