BEFORE THE ENVIRONMENT COURT
I MUA I TE KOOTI TAIAO O AOTEAROA

UNDER	the Resource Management Act 1991
IN THE MATTER	of appeals under Clause 14 of the First Schedule of the Act
BETWEEN	**TRANSPOWER NEW ZEALAND LIMITED** (ENV-2018-CHC-26)
	FONTERRA CO-OPERATIVE GROUP (ENV-2018-CHC-27)
	HORTICULTURE NEW ZEALAND (ENV-2018-CHC-28)

AFFIDAVIT OF ZANE NIGEL MOSS

TOPIC B1 - ISSUE 16

RELATING TO APPENDIX K – SURFACE WATER APPENDIX

25 February 2022

Judicial officer: Judge Borthwick

Counsel: Sally Gepp
Level 1, 189 Hardy Street,
Nelson 7010
Email: sally@sallygepp.co.nz
Telephone: 021 558 241

ARATIATIA LIVESTOCK LIMITED
(ENV-2018-CHC-29)

WILKINS FARMING CO
(ENV-2018-CHC-30)

GORE DISTRICT COUNCIL, SOUTHLAND DISTRICT COUNCIL & INVERCARGILL CITY COUNCIL
(ENV-2018-CHC-31)

DAIRYNZ LIMITED
(ENV-2018-CHC-32)

H W RICHARDSON GROUP
(ENV-2018-CHC-33)

BEEF + LAMB NEW ZEALAND
(ENV-2018-CHC-34 & 35)

DIRECTOR-GENERAL OF CONSERVATION
(ENV-2018-CHC-36)

SOUTHLAND FISH AND GAME COUNCIL
(ENV-2018-CHC-37)

MERIDIAN ENERGY LIMITED
(ENV-2018-CHC-38)

ALLIANCE GROUP LIMITED
(ENV-2018-CHC-39)

FEDERATED FARMERS OF NEW ZEALAND
(ENV-2018-CHC-40)

HERITAGE NEW ZEALAND POUHERE TAONGA
(ENV-2018-CHC-41)

STONEY CREEK STATION LIMITED
(ENV-2018-CHC-42)

THE TERRACES LIMITED
(ENV-2018-CHC-43)

CAMPBELL'S BLOCK LIMITED
(ENV-2018-CHC-44)

ROBERT GRANT
(ENV-2018-CHC-45)

SOUTHWOOD EXPORT LIMITED, KODANSHA TREEFARM NEW ZEALAND LIMITED, SOUTHLAND PLANTATION FOREST COMPANY OF NEW ZEALAND

(ENV-2018-CHC-46)

TE RUNANGA O NGAI TAHU, HOKONUI RUNAKA, WAIHOPAI RUNAKA, TE RUNANGA O AWARUA & TE RUNANGA O ORAKA APARIMA
(ENV-2018-CHC-47)

PETER CHARTRES
(ENV-2018-CHC-48)

RAYONIER NEW ZEALAND LIMITED
(ENV-2018-CHC-49)

ROYAL FOREST AND BIRD PROTECTION SOCIETY OF NEW ZEALAND
(ENV-2018-CHC-50)

Appellants

AND **SOUTHLAND REGIONAL COUNCIL**

Respondent

I, Zane Moss, of Invercargill, Manager, solemnly and sincerely affirm:

1. I am the Manager of Southland Fish and Game Council ('Fish & Game'). I am authorised by Southland Fish & Game Council to provide this affidavit.

Qualifications and experience

2. I hold the qualifications of Bachelor of Science majoring in Applied Biology (1993) and Master of Science with Honours in Wildlife Management (1997), both from Lincoln University.

3. I have been employed Fish & Game since 1997, initially as a Field Officer and subsequently as the Operations Manager. I have been employed as the Regional Manager since 2016.

4. My principal areas of expertise are freshwater and fish ecology and recreational fisheries management. I have knowledge of the responses of fish populations to freshwater abstraction and land use intensification, fish bioenergetics, instream habitat modelling and habitat suitability analyses. This evidence draws on my knowledge, including various published scientific papers and reports.

5. The Southland Fish & Game region encompasses the lower South Island, extending from the Mataura catchment west to Fiordland and south to Stewart Island. This overlaps with the area of the Southland Regional Council, commonly known as Environment Southland. I have been involved in Environment Southland led processes relating to the development of the Proposed Southland Water and Land Plan (the Proposed Plan) notified in 2016 and its predecessor, the Operative Regional Water Plan for Southland (2010) (the Operative Plan) notified in 2000. I have participated in Environment Court facilitated mediation in relation to appeals on the Proposed Plan.

6. I confirm I have read and agree to comply with the Code of Conduct of Expert Witnesses in the Environment Court Practice Note. This evidence is within my area of expertise, except where I state that I am relying on what another person has told me. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

7. I advise that I am married to Dr Jane Kitson who has provided evidence in these proceedings for Ngā Rūnanga o Ngāi Tahu. I do not consider that any conflict of interest arises out of this.

Scope of evidence

8. This affidavit provides technical evidence to support the agreed changes to Appendix K – Surface Water Appendix of the proposed Southland Water and Land Plan (Topic 1 - Issue 16).

9. The agreed changes were set out in a Joint Memorandum in Support of Consent Order dated 3 February 2022. The changes, including the rationale for the same, were also explained in more detail in the affidavit of Lauren Maciaszek for Environment Southland dated 2 February 2022, attached as **Appendix 2** to the Joint Memorandum.

Appendix K – Surface Water Appendix

10. Appendix K provides, among other things, a method for assessments of environmental effects for surface water takes, diversion, and use. Method 1 sets out the process for undertaking an assessment of environmental effects of surface water takes, diversion and use using generalised habitat models.

11. Appendix K - Surface Water Appendix was appealed by Fish and Game.

12. Fish and Game sought to:

    a. Amend various parts of the table for Method 1 to add additional critical value species;

    b. Amend Method 1 to replace Generalised Habitat Models with Instream Habitat Flow Incremental Methodology;

    c. Amend Methods 1 and 2 to replace the NIWA report mentioned with "an updated review reflecting the most recent international research";

    d. Amend step 3 of Method 2 to remove "with rivers with a median flow greater than 4.5 m3/s";

    e. Amend step 4 of Method 2 to remove "or a proportion of the maximum habitat if it occurs at a flow less than the Q95"; and

    f. Amend the table in Method 2 to replace "90%" habitat retention with "100%" habitat retention for high quality large adult trout – perennial fishery.

13. Through mediation the parties agreed to amend Step 2 set out in the Method 1 table of Appendix K as set out in the draft Consent Order and paragraph [58] of the affidavit of Lauren Maciaszek in relation to Topic B1 as follows.

Median flow	Surface Water Management Unit		
	Lowland	Hill/Mountain	Hill2 (Hokonui/Catlins)
0 – 300 L/s	Diadromous galaxiid	Non-diadromous galaxiid	Diadromous galaxiids (low elevation) and non-diadromous galaxiids at higher elevations
300 – 750 L/s	Trout spawning/juvenile rearing or Redfin/common bully if trout excluded	Trout spawning/juvenile rearing or non-diadromous galaxiid if trout excluded Large adult trout	Trout spawning/juvenile rearing or non-diadromous galaxiid if trout excluded Large adult trout
0.75 – 2.5 m^3/s	Trout spawning/juvenile rearing* Large adult trout	Trout spawning/juvenile rearing Large adult trout	Trout spawning/juvenile rearing Large adult trout
2.5 – 5 m^3/s	Trout spawning/juvenile rearing*	Large adult trout	Large adult trout
> 5 m^3/s	Large adult trout	Large adult trout	Large adult trout

The above table shows critical values by reference to both surface water management unit and flow range.

14. The rationale for the agreed changes is set out in the affidavit of Ms Maciaszek at paragraphs [59] – [63], including that:

    a. The agreed changes to include additional references to trout are likely to be more effective in achieving the objectives of the proposed Southland Water and Land Plan, as the inclusion of trout is expected to require more water to be retained instream where trout habitat would be affected, and therefore maintain a higher quantity of habitat; and

b. The agreed changes are taking a more conservative approach in ensuring that the health of ecosystems is prioritised above water abstraction.

15. I support Ms Maciaszek's assessment for the following reasons:

Recognition of trout spawning and juvenile rearing

a. A range of sports fish, including brown trout and rainbow trout, are found within Southland waters. Of these brown trout have the widest distribution. All trout fisheries in the Southland region are wild and self-sustaining. This means that they are reliant on the health and productivity of the freshwater habitats in which they occur.

b. Adult trout generally live in medium to larger sized rivers and lakes and are adapted to feed over the summer period to put on condition to enable spawning in the autumn or early winter in smaller spawning tributaries. Spawning tributaries, including in lowland locations in Southland, can on occasion be quite small, and trout run up them during freshes and minor floods in autumn to early winter to get as far upstream as possible.

c. Maintaining suitable spawning areas and unimpeded access to them is crucial to the on-going survival of wild stocks of trout in Southland. Tributaries that provide trout spawning and juvenile rearing (nursery) habitat provide an important contribution to the resilience of larger main stem trout fisheries.

d. As flows in trout spawning and nursery habitats drop to low levels, the area and quality of freshwater habitat also declines. This can result in a range of negative impacts on trout fishery values, including reduction in invertebrate food supply, increased competition between fish for food and / or space. As flows decrease to very low levels juvenile trout (and other fish, such as upland bullies) may experience a loss of cover and increased mortality because of predation by terrestrial predators, such as shags and herons. Predation impacts are more likely to occur in small streams where cover (turbulence in riffles and overhanging vegetation) is reduced, and juvenile trout and other small fish are vulnerable. The reduction in cover makes it easier for terrestrial predators to target fish in the remaining surface water.[1]

[1] Trotter, M. 2016 Juvenile trout survival and movement during summer low flow abstraction period in the Lindis River, Central Otago. MSc thesis, Department of Zoology, University of Otago, Dunedin.

e. When surface flow connection along a stream corridor is lost (and flow between remaining pools ceases) remaining stranded fish can experience mortality due to water quality stress, such as high-water temperature and low oxygen levels.

f. Instream riffles and shallow runs are important for providing habitat for juvenile trout, which prefer higher water velocities, and other small fish and macroinvertebrates. It is often the riffle habitat that is most reduced by severe levels of flow reduction.[2]

Recognition of large adult trout in rivers with median flows <2.5m³/s

a. Trout are often classified based on their body length: small (<250mm), medium (250-400mm) and large (>400mm).

b. Small streams (defined as 'rivers' in the Resource Management Act 1991) that provide fishing opportunities for medium - large trout are highly desirable to anglers, particularly fly anglers. There are many small streams in Southland with monitored median flows less than 2.5m³/s, which provide habitat for large trout and are recognised trout fisheries. For example, Hamilton Burn (median flow – 1.015m³/s), Waihopai Stream (median flow – 1.22m³/s), Orauea Stream (median flow – 1.907m³/s), Otautau Stream (median flow – 1.977m³/s), Waimatuku Stream (median flow – 1.516m³), Otapiri Stream (median flow – 1.015m³/s).[3] In addition, there are many similar examples in Southland where flows are not monitored, for example the Meadow Burn and Brightwater Spring.

c. The effects of flow reduction on adult trout, particularly during low flow periods, are well recognised. For example:

    i. During periods of low flow stress adult trout may become restricted to perennial reaches of smaller streams, particularly where there are deeper pools and other cover such as undercut banks;

    ii. Effects of extreme low flows can result in long term impacts on trout population structure. Reaches of streams that are annually dried to isolated pools and

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[2] Hayes, J., Hay, J., Gabrielsson, R., Goodwin, E., Jellyman, P., Booker, D., Thompson, M. 2018. Review of the rationale for assessing fish flow requirements and setting ecological flow and allocation limits for them in New Zealand - with particular reference to trout. Nelson: Cawthron Institute.

[3] Environment Southland online flow data - https://envdata.es.govt.nz/index.aspx?c=flow&tab=hydro – Accessed on Monday, 21 February 2022.

dewatered bed are likely to function as population sinks, where breeding effort and recruitment potential is lost;

iii. Prolonged low flow events in streams can increase water temperatures resulting in fish stress, reduced trout growth rates and condition.[4] This is because flow is a primary determinate of the area and quality of instream habitat for both fish and their food.

It is my opinion that agreed changes better represent the trout values associated with small – medium sized rivers in Southland. These support both significant trout spawning and nursery values and adult trout fishery values. Recognition of these trout values when considering water abstraction is warranted.

16. Typical instream habitat models take account of a range of freshwater fish species, each with its own unique life history, habits, and flow requirements. Flow management must reconcile these different flow requirements to provide protection for a range of fish species. Jowett and Hayes (2004) suggest identifying the critical instream values (fish species) and managing for those values. Critical values may include rare or endangered fish species or highly valued sport fish with high flow requirements, under the assumption *"that by providing sufficient flow to sustain the most flow sensitive, important value (species, life stage, or recreational activity), the other significant values will also be sustained"*.[5]

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[4] Hayes, J., and R. Young. 2001. Effects of low flow on trout and salmon in relation to the Regional Water Plan: Otago. Cawthron Institute Report.
[5] Jowett I.G., Hayes, J.W. 2004. Review of methods for setting water quantity conditions in the Environment Southland draft Regional Water Plan. Prepared for Southland Regional Council. NIWA Client Report HAM2004-018.

17. Most recent habitat modelling exercises in New Zealand use the most sensitive fish species as the benchmark for setting minimum flows, assuming that all other species' habitat will be provided for. Native fish flow requirements have often been modelled to be less than those for trout, except some fast-water species, such as torrent fish. When applied in minimum flow setting exercises, higher flow retention has been recommended for trout, particularly adult trout. In simple terms, wider identification of trout as critical instream values in the Method 1 of Appendix K also means a more conservative level of provision for the health of most native fish species when setting minimum flows. In my opinion, this is advantageous for native fish species.

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Zane Moss

Affirmed at Invercargill)

This 25th day of February 2022)

Before me)

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A ~~Solicito~~r / Deputy Registrar of the High Court of New Zealand /

~~Justice of the Peace~~

Martin Cupit
Deputy Registrar
Gore District Court

References

Hayes, J., Hay, J., Gabrielsson, R., Goodwin, E., Jellyman, P., Booker, D., Thompson, M. 2018. Review of the rationale for assessing fish flow requirements and setting ecological flow and allocation limits for them in New Zealand - with particular reference to trout. Nelson: Cawthron Institute.

Hayes, J., and R. Young. 2001. Effects of low flow on trout and salmon in relation to the Regional Water Plan: Otago. Cawthron Institute Report.

Jowett I.G., and Hayes, J.W. 2004. Review of methods for setting water quantity conditions in the Environment Southland draft Regional Water Plan. Prepared for Southland Regional Council. NIWA Client Report HAM2004-018.

Trotter, M. 2016. Juvenile trout survival and movement during summer low flow abstraction period in the Lindis River, Central Otago. MSc thesis, Department of Zoology, University of Otago, Dunedin.