BEFORE THE PROPOSED NATURAL RESOURCES PLAN HEARINGS PANEL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of water quality
AND	
IN THE MATTER	of Right of Reply evidence to matters raised during Hearing Stream 4

STATEMENT OF RIGHT OF REPLY EVIDENCE OF GRAHAM DAVID FENWICK ON BEHALF OF WELLINGTON REGIONAL COUNCIL

TECHNICAL – Water quality in regard to:
Objectives for aquatic ecosystem health and mahinga kai (Objective 025)

4 May 2018

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1. INTRODUCTION

1.1 My name is Graham David Fenwick. I am a biologist with over 40 years' experience as a practicing researcher. My academic qualifications are a BSc, MSc and PhD, all in aquatic ecology, and a post-graduate Diploma of Business Administration. I have worked for NIWA as a scientist for 19 years (since 1998) and as a biodiversity scientist involved in environmental investigations since 1974. My specialist areas are aquatic invertebrate biodiversity and the ecology of aquatic sediments. A full list of my qualifications and experience is in **Attachment A** of my primary evidence dated 12 January 2018.

1.2 In my primary evidence I was asked to provide evidence for the following specific matters:

a) Background on groundwater and groundwater ecosystems

b) National directives for protecting groundwater ecosystems

c) Appropriateness of the Wellington Regional Council's approach

2. CODE OF CONDUCT

2.1 I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note and that I agree to comply with the code. 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 to detract from the opinions which I express.

3. SCOPE

3.1 I have been asked to provide Right of Reply evidence in response to evidence presented at the hearing seeking that the narrative nitrate objective for groundwater directly connected to surface water is replaced by a numeric objective requiring ≤2.4mg/L as an annual median and ≤3.5mg/L as an annual 95th percentile.

4. RESPONSE TO HEARING EVIDENCE

4.1 I wish to provide some clarification of my views on narrative versus numerical limits for nitrate in groundwater in response to Ms Kate McArthur's evidence and to the Hearing Panel's questions on this matter.

4.2 After consideration of the evidence presented at the hearing by Ms McArthur my primary evidence remains unchanged.

4.3 The proposed Natural Resources Plan (pNRP) sets an objective for freshwater environments in Objective 25: "safeguard aquatic ecosystem health … in fresh

water bodies"[1] generally. The pNRP's specific objectives for protecting groundwater biodiversity from nitrate echo this overarching objective variously: "not cause unacceptable effects on groundwater-dependent ecosystems or on aquatic plants, invertebrate or fish communities in connected surface water bodies", and "not cause unacceptable effects on stygofauna communities or other groundwater ecosystems"[2].

4.4 I support use of these narrative objectives instead of numerical (concentration) objectives for several reasons:

(a) These narrative objectives state clearly the outcomes sought in managing its groundwater environments. Any numerical objectives are simply surrogates for these objectives.

(b) Nitrate concentrations that are safe for groundwater biodiversity and groundwater ecosystems are not known. There are no scientific data on nitrate effects on groundwater invertebrates, groundwater microbes or groundwater ecosystems overall.

(c) Limits and guideline concentrations for sustaining surface water ecosystems do exist, but application of such concentrations to groundwater ecosystems assumes that groundwater species and their ecosystems respond similarly to nitrate. However, groundwater ecosystems do differ from surface water ecosystems in some important ways. In particular, groundwater invertebrate communities are dominated by crustaceans, notably amphipods, whereas river and lake communities are mostly dominated by insects, fish and molluscs. Crustaceans differ significantly in their physiologies, behaviours and life-histories from insects, fishes and molluscs.

(d) Also, surface water ecosystems tend to be dominated by photosynthetic productivity, with organic carbon and oxygen usually abundant. Groundwater ecosystems lack photosynthetic plants, organic carbon often is scarce and dissolved oxygen concentrations are moderate to low. Biofilms replace photosynthetic plants and algae as the dominant functional group. Thus, groundwater ecosystems differ in significant ways from surface water ecosystems, further indicating that nitrate concentrations for protecting riverine and lake ecosystems may not be directly applicable.

(e) Presently used limits and guidelines for surface water ecosystems were developed based on individual invertebrate species' responses to chronic exposures of up to 60 days. These experimental exposure durations are

[1] Wellington Regional Council. 2015. Proposed Natural Resources Plan. http://www.gw.govt.nz/proposed natural resources plan/, p. 42.
[2] Ibid. p. 43.

less than the lifespans of many invertebrates, especially those inhabiting groundwaters. Thus, the science underlying these limits rarely examines whole of life effects on a species, and nothing about inter-generational effects of such exposures.

(f) Of the 40 species for which useful toxic concentrations are known, only 13 were invertebrates[3]. Of these, seven were crustaceans, and these did not include representatives of any New Zealand stygofauna families.

(g) Dr Chris Hickey, New Zealand's leading aquatic toxicologist and author of the updated ANZECC nitrate guideline concentrations, acknowledged that the science underlying present guideline concentrations is inadequate for groundwater species (pers. comm. 2018).

(h) I note that the science underlying guideline concentrations continues to improve and the ANZECC guideline concentrations for nitrate-nitrogen decreased from 2000 to 2016 (i.e., earlier research results under-estimated toxic effects). This suggests that, as we learn more about species and ecosystem sensitivities to this substance, including possible interactive effects, present-day guideline concentrations may be further reduced.

(i) There is much more to learn about nitrate toxicity effects on freshwater organisms. Only recently has understanding of the ameliorating effects of water hardness on nitrate become known. A very recent research paper demonstrated that reduced dissolved oxygen concentrations increased the sensitivity of New Zealand freshwater crayfish to reduced forms of nitrate (nitrite and ammonia)[4]. The generally lower dissolved oxygen concentrations in groundwater the potential for this effect to be important to stygofauna.

(j) The proposed narrative objectives accommodate revisions of guidelines and new information. Their link to the Technical Report[5] provides guidance on nitrate concentrations considered to provide sufficient protection at that time. I note that the updated ANZECC guidelines are slightly more

[3] Hickey CW. 2016. Guidelines for the protection of aquatic ecosystems, toxicant trigger values: nitrate – freshwater. Australian and New Zealand guidelines for fresh and marine water quality. Draft August 2016. Council of Australian Governments Standing Council on Environment and Water, Canberra, ACT, Australia. 26 pp.

[4] Broughton RJ, Marsden ID, Hill JV, Glover CN. 2018. Interactive effects of hypoxia and dissolved nutrients on the physiology and biochemistry of the freshwater crayfish, Paranephrops zealandicus. Marine and Freshwater Research. https://doi.org/10.1071/MF17262

[5] Greenfield S, Milne J, Perrie A, Oliver M, Tidswell S, Crisp P. 2014. Aquatic ecosystem health and contact recreation outcomes in the draft Natural Resources Plan: Technical guidance document. Greater Wellington Regional Council, Report GW/ESCI-T-greenfield14/91. 52 pp. http://www.gw.govt.nz/assets/Plans--Publications/Regional-Plan-Review/Proposed-Plan/Proposed-Natural-Resources-Plan-for-the-Wellington-Region-July-2015.pdf

conservative[6] than those identified in the Technical Report.

5. CONCLUSIONS

5.1 In conclusion, I continue to support the narrative objectives in Table 3.6 of Objective O25 as opposed to a numeric objective for the reasons outlined above. I note that the technical guidance document provides useful guidance with regard to the interpretation of the narrative nitrate objective.

[6] Hickey CW. 2016. Guidelines for the protection of aquatic ecosystems, toxicant trigger values: nitrate – freshwater. Australian and New Zealand guidelines for fresh and marine water quality. Draft August 2016. Council of Australian Governments Standing Council on Environment and Water, Canberra, ACT, Australia. 26 pp.