

BEFORE THE HEARINGS PANEL

IN THE MATTER of hearings on
submissions concerning
the Proposed One Plan
notified by the
Manawatu-Wanganui
Regional Council

**SUPPLEMENTARY EVIDENCE OF DR JOHN MARTIN QUINN
FOR THE WATER HEARING
ON BEHALF OF HORIZONS REGIONAL COUNCIL**

1. INTRODUCTION AND EXECUTIVE SUMMARY

1. I have prepared this report as supplementary evidence to my Section 42A report. It has been compiled in response to evidence received from experts on behalf of submitters. As a result of considering the expert evidence received, I have expanded the evidence in my Section 42A Report.
2. I have read, and comment on here, the technical evidence of Dr Michael Robert Scarsbrook.
 - (i) I provide evidence from six of the seven sites within Horizons' Region in the National Rivers Water Quality Network (NRWQN) to address the statement by Dr Scarsbrook that there was no evidence demonstrating relationships between periphyton biomass and nutrient concentrations in the Region. This analysis demonstrates positive relationships between nutrient concentrations and periphyton cover at these NRWQN sites.
 - (ii) I also provide a photo of sewage fungus in the Manawatu River to illustrate the effects of sewage fungus on aesthetic values in relation to my evidence on biochemical oxygen demand (BOD) in my original Section 42A report.
3. I have met with submitter experts Keith Hamill and Paul Kennedy to discuss their recommendations on water quality standards in Schedule D. I have not included any comment on this caucus as it is adequately discussed in the supplementary evidence of Dr Wilcock and Kate McArthur and in the report of Richard Thompson. I am happy to answer any questions the panel may have in relation to my attendance at this meeting.

Table 1. Issues discussed at pre-hearing meetings and caucusing

Issue discussed	With experts	Meeting notes
Water quality standards in Schedule D and application of ANZECC guidelines	Keith Hamill Paul Kennedy Dr Bob Wilcock Kate McArthur Jon Roygard Myself	

2. RESPONSE TO ISSUES RAISED BY TECHNICAL EXPERTS

4. Table 2 below summarises the issues raised by the submitter that I am responding to and outlines any resolution or explanation that is necessary.
5. I have focused on issues raised by the submitter's expert that were not covered in my original evidence or require further explanation. Where issues are raised by submitters

experts that I consider are already covered by material in my original evidence, I have attempted to minimise repetition by not commenting on the issues here. However, I am happy to address those issues in response to any questions the Panel may have.

Table 2. Summary table of matters raised by technical expert in evidence on the water provisions of the Proposed One Plan.

Matter raised by submitter's expert	Expert	Degree of agreement	Explanation/ outcome
Lack of direct evidence of a relationship between nutrient concentrations and periphyton biomass	Dr Michael Scarsbrook	Agree that this information was not provided but disagree that there is no relationship	I investigated the data on periphyton cover and nutrient concentrations at six Horizons' Region sites in the National Rivers Water Quality Network database from 1990-2006 that were summarised recently as part of a report on the whole database (Quinn and Raaphorst, 2008). This provides direct evidence of positive relationships between nutrient concentrations and periphyton cover at river sites in Horizons' Region.

6. This analysis aimed to address the question raised by Dr Scarsbrook of whether there is a relationship between periphyton cover and nutrients at the six National Rivers Water Quality Network (NRWQN) sites in Horizons' Region sampled by NIWA's Wanganui field team. To enhance the consistency of the data, the seventh NRWQN site in the Region (TU1, Whanganui at Te Maire) was not included because it is sampled by a different field party and is only wadeable at the margins (Quinn and Raaphorst, 2009). I examined the site average data for the whole period (6 data points) and the annual data for each year (17 x 6 = 102 data points). Background on the methods used for the data collection is given in Quinn and Raaphorst (2009). Relationships were investigated by correlation and graphical analysis.

7. The correlations between average dissolved reactive phosphorus (DRP) and dissolved inorganic nitrogen (DIN aka SIN) concentrations and both the average filamentous algal cover and the annual maximum filamentous algal cover for 1990-2006 at the six sites are shown in Table 1. There were positive relationships between both dissolved reactive phosphorus (DRP) and dissolved inorganic nitrogen (DIN) and the average annual and average annual maximum cover of filamentous algae ($r > 0.5$). Using the annual data increases the statistical power of the test (ie. increases n from 6 to 102) and indicates statistically significant relationships at the 95% level between annual average DRP and annual maximum filamentous percent cover, and between both DRP and DIN and annual maximum percent cover of filamentous algae plus mats (Table 1). The

relationships between annual maximum filamentous percent cover and DRP and DIN are graphed in Figure 1.

3. CONCLUSION

8. Together, these data show that there is direct evidence of relationships between nutrient concentrations and algal percent cover at sites in Horizons' Region.

Table 3. Pearson Product-Moment Correlation coefficients between concentrations of dissolved reactive phosphorus (DRP) dissolved inorganic nitrogen (DIN) and algal cover for Horizons' Region NRWQN data 1990-2006. * and ** indicate statistically significant at $P < 0.10$ and $P < 0.05$, respectively.

	Average filamentous algal cover (1990-2006) (n = 6)	Average annual maximum filamentous algal cover (1990-2006) (n = 6)	Annual maximum filamentous algae cover (n = 102)	Annual maximum cover of filamentous + mat algae cover (n = 102)
DRP	0.66	0.73*	0.37**	0.37**
DIN	0.60	0.54	0.17	0.20**

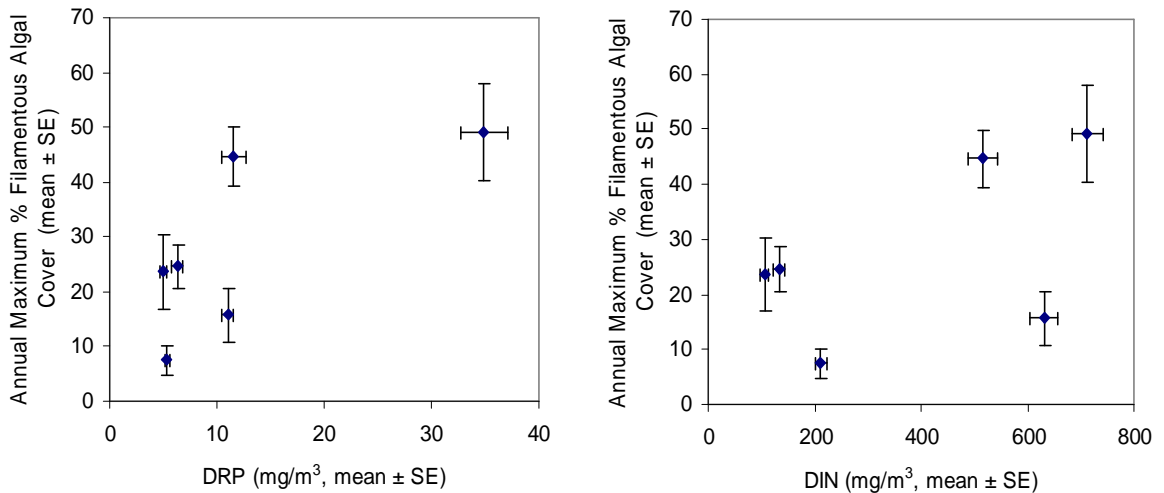


Figure 1: Relationships between annual maximum percent cover by filamentous algae and concentrations of dissolved reactive phosphorus (DRP) and dissolved inorganic nitrogen (DIN) at six NRWQN sites in Horizons' Region between 1990 and 2006.

9. Photographs of sewage fungus: Horizons staff requested that I present a photograph of sewage fungus as supplementary information to my evidence on scBOD₅ controls to prevent sewage fungus proliferation.

10. Figure 2 shows sewage fungus in the Manawatu River, at the end of Akers Rd downstream of the Palmerston North City and Longburn Dairy Factory discharges on 14 January 1984, prior to the reduction of BOD load in the “Manawatu River clean-up” of the 1980s. This demonstrates that sewage fungus degrades stream aesthetics significantly.



Figure 2. Sewage fungus in the Manawatu River below Palmerston North, January 1984. Note pencil in lower photograph for scale (photo J. Quinn).

4. REFERENCE

Quinn, J.M.; Raaphorst, E. 2009: Trends in nuisance periphyton at New Zealand National River Water Quality Network sites 1990-2006. NIWA Client Report: HAM2008-194, 22 p.

Dr John Quinn
November 2009