

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 R. ZELDIS
FOR THE WATER HEARING
ON BEHALF OF HORIZONS REGIONAL COUNCIL**

1. PART ONE: 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 and on further consideration of my original evidence, I have revised some of my recommendations as they appeared in my Section 42A Report. These revised recommendations are presented here.
2. This evidence is in three parts:
Part One: This Introduction and Executive Summary.
Part Two: Issues raised by submitter's expert and my response, including any revised recommendations as a result.
Part Three: Corrections to my original evidence.
3. I have read, and comment on here, the technical evidence of the following expert:
 - Mr Keith Hamill on behalf of Palmerston North City Council.

2. EXECUTIVE SUMMARY OF SUPPLEMENTARY EVIDENCE AND REVISED RECOMMENDATIONS

4. After consideration of the technical expert evidence, I would like to clarify some matters raised by the submitter's expert and I have revised some of my recommendations as presented in my Section 42A Report.
5. I would like to add three paragraphs to my original evidence that are relevant to:
 - (a) The potential for seasonality of nuisance macroalgal growth in estuaries;
 - (b) A revised recommendation for the Schedule H Estuary Water Management Sub-zone standard for macroalgal percent cover;
 - (c) A revised recommendation on the Seawater Management Zone algal biomass (chlorophyll a) standard in Schedule H.

3. PART TWO: RESPONSE TO ISSUES RAISED BY TECHNICAL EXPERTS

6. Table 2 below summarises the issue raised by the submitter that I am responding to and outlines any resolution or explanation that is necessary.
7. I have focused on issues raised by submitter's expert that are not covered in my original evidence or require further explanation. Where issues are raised by the submitter's expert that I consider are already covered by material in my original evidence I have

attempted to minimise repetition by not commenting on it here. However, I am happy to address those issues in response to any questions the Panel may have.

8. In response to paragraph 5.40 of the evidence of Keith Hamill on behalf of Palmerston North City Council (summarised in Table 1 below) I would like to add the following in addition to my original evidence (following on from paragraph 22 in the executive summary and repeated after paragraph 59 in the body of my evidence):

As noted, should geomorphic changes occur which create intertidal habitat (which appears to have happened in Manawatu Estuary), it is possible that macroalgal growth will appear more commonly. It is likely that such growth would decrease in winter, under light limitation, as occurs in Avon-Heathcote Estuary, Christchurch. In this case, nutrients (both dissolved reactive phosphorus (DRP) and soluble inorganic nitrogen (SIN)) will be transported more conservatively through the estuary to the sea. However, this may be a relatively brief part of the annual cycle.

Table 1. 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
Winter growth limitation (macroalgae)	Keith Hamill Paragraph # 5.40	Agree in part	It is likely that macroalgal growth, as occurs in Manawatu Estuary, will be light-limited in winter. In this case nutrients (both DRP and SIN) will be transported more conservatively through the estuary to the sea. However, this may be a relatively brief part of the annual cycle.

4. PART THREE: CORRECTIONS TO ORIGINAL S42A REPORT

9. I would like to replace paragraphs 38 and 39 of my S42A report with the following paragraphs, which include my revised recommendations for percent macroalgae cover in the Estuary Water Management Sub-zones and the chlorophyll *a* standard in the Seawater Management Zone of Schedule H:

38. Standards as applied for periphyton in freshwater are not appropriate in the estuarine context. I recommend removal of the periphyton standards (both % cover and chlorophyll *a* /m²) from the Estuary Sub-zones proposed in Schedule H, and a higher chlorophyll *a* /m³ standard for Seawater Management Zones. To account for nuisance macroalgal growth in the

Estuarine Sub-zones, **I recommend that a standard of no more than 5% of randomly selected but previously uncovered shore area by macroalgae be set as a standard in Schedule H.**

39. A higher chlorophyll *a* (chl-*a*) concentration standard than 1 mg/m³ in the Seawater Management Zone is recommended (based on data from other New Zealand coastal sites). No chl-*a* data exist for the Seawater Management Zone in Horizons' Region, although anecdotal observations of visible 'surf algae' in the Region have been made. Overseas studies show that in wastewater-affected coastal regions, surface blooms of phytoplankton became visible to the eye at levels above 5 mg/m³ and modelling has shown that eutrophic conditions can form at nutrient concentrations similar to or less than those in the Horizons Seawater Management Zone; it is possible that blooms are already forming as a result of local estuarine nutrient input. **Taking a precautionary approach and considering that spatial extent and chl-*a* levels in these blooms are unknown, a standard of no more than 3 mg/m³ is recommended, which should be determined as an annual average of monitoring data.**
10. I would also like to replace paragraph 71 and add the two following paragraphs to my original evidence in support of the recommended changes to macroalgal cover and chlorophyll *a*:

Replaces paragraph 71

Periphyton standards as applied to the freshwater systems are not appropriate in the estuarine/coastal context, and marine filamentous algae, macroalgae, and phytoplankton should be considered instead. It is suggested that monitoring be put in place to detect change in filamentous and macroalgal cover, which at present appears to be low in most places. A focus on the Manawatu Estuary in this regard is recommended, given the importance of the estuary as a Ramsar site and its apparent geomorphic and macroalgal changes noted in McBride *et al.* (1992) (see point 56 of my original S42A report). There is presently almost no algal cover for most of the estuaries. If they suddenly start producing macroalgae, this should be an alarm flag. Therefore, it is recommended that a standard of no more than 5% of randomly selected but previously uncovered shore area by macroalgae be set as a standard.

New paragraph 72

The proposed chlorophyll a (chl-a) concentration standard of 1 mg/m³ in the Seawater Management Zone is too low for an appropriate phytoplankton threshold and I recommend a higher standard. No chl-a data exist for the Seawater Management Zone in Horizons' Region, but it can be predicted that levels will regularly be higher than 1 mg/m³, based on data from other New Zealand coastal sites (all author's unpublished data), i.e. the mean of six years of chl-a monitoring in the outer Firth of Thames was about 2 mg/m³, with occasional 'spikes' greater than 4 mg/m³. These values increase toward the head of the Firth (mean of about 4 mg/m³). The mean of seven years of data from mid-Pelorus Sound was about 1.5 mg/m³, with seasonal maxima regularly above 2 mg/m³ and annual means from inner Golden Bay and Tasman Bay were about 2 mg/m³ and 1.5 mg/m³, respectively.

New paragraph 73

These values can be put in context of other studies: surface blooms of phytoplankton became visible to the eye at levels above 5 mg/m³ in the wastewater-impacted Santa Monica Bay near Los Angeles (Eppley *et al.*, 1977). In prognostic modeling studies of Port Phillip Bay, Melbourne (Harris *et al.*, 1996), highly eutrophic conditions evolved when nutrient levels were doubled or trebled over historical values (to levels similar to or less than in Horizons' Seawater Management Zone sampling) and chl-a levels reached 15 mg/m³. Given the high concentrations of nutrients in Horizons' coastal sampling and anecdotal observations of visible 'surf algae' in the Region (K. McArthur, Horizons Regional Council *pers. comm.* May 2009), it is possible that blooms are already forming as a result of local estuarine nutrient input to the Seawater Management Zone. However, the chl-a levels associated with these blooms are unknown, as are their spatial extents; nor is there knowledge of long-term average chl-a levels. Based on this it is recommended that a cautionary approach be taken, accounting for known New Zealand coastal chl-a levels and levels known to generate visible blooms. A standard of no more than 3 mg/m³ is recommended, which should be determined as an annual average of monitoring data.

5. SUMMARY OF REVISED RECOMMENDATIONS

11. I recommend that macroalgal cover of no more than 5% coverage of randomly selected but previously uncovered shore area be set as a standard.
12. I recommend a chlorophyll-a standard in the Seawater Management Zone of no more than 3 mg/m³, determined as an annual average.

6. REFERENCES

Eppley, R.W., Harrison, W.G., Chisholm, S.W. and Stewart, E. (1977). Particulate organic matter in surface waters off Southern California and its relationship to phytoplankton. *Journal of Marine Research* 35: 671-696.

Harris, G., Batley, G., Fox, D., Hall, D., Jernakoff, P., Molloy, R., Murray, A., Newell, J., Parslow, G., Skyring, G., and Walker, S. (1996). Port Phillip Bay Environmental Study Final Report. CSIRO, Canberra, Australia. 239 p.

McBride G.B., Quinn J.M., Smith R.K. (1992). Manawatu River Estuary: A review of water quality issues. Consultancy Report No. 6038/1 April 1992. Client: Manawatu-Wanganui Regional Council.