**BEFORE THE SPECIAL TRIBUNAL FOR THE NGARURORO AND CLIVE RIVERS WATER CONSERVATION ORDER**
**AT NAPIER**

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|---|---|
| **IN THE MATTER** | of the Resource Management Act 1991 (the Act) |
| **AND** | |
| **IN THE MATTER** | of a Special Tribunal appointed under s202 of the Act to consider an application for a Water Conservation Order made by New Zealand Fish and Game Council, the Hawke's Bay Fish and Game Council, Ngāti Hori ki Kohupatiki, Whitewater New Zealand, Jet Boating New Zealand, and the Royal Forest and Bird Protection Society of New Zealand (the Applicants) in relation to the Water Conservation Order |
| **The Special Tribunal** | Richard Fowler QC (Chair)<br>Alec Neill<br>Dr Roger Maaka<br>Dr Ngaire Phillips<br>John McCliskie |

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# STATEMENT OF EVIDENCE OF GILLIAN MARGARET HOLMES FOR HORTICULTURE NEW ZEALAND (WATER QUALITY)

25 January 2019

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## INTRODUCTION

### Qualifications and experience

1. My full name is Gillian Margaret Holmes

2. I am employed by Jacobs New Zealand Ltd (Jacobs), an engineering and environmental consulting firm. I am contracted to provide water quality and groundwater expertise on the proposed Water Conservation Order for the Ngaruroro River and Clive River to Horticulture New Zealand (HortNZ).

3. I hold a Bachelor of Science (BSc) in Geography (2001) and a Master of Science Degree in Physical Geography (2004) from Otago University.

4. I have 14 years' experience in the field of hydrogeology and water resources. I started my career at MWH New Zealand Limited and worked for them between 2004 and 2007 and joined Sinclair Knight Merz (now Jacobs) in 2007.

5. I have previously acted as an Expert Witness in groundwater related consent hearings across New Zealand. In addition, I regularly provide expertise in the fields of hydrogeology and groundwater quality to a range of local government clients including Bay of Plenty Regional Council and other organisations such as HortNZ and New Zealand Transport Agency.

6. I have undertaken most of this technical work in relation to consent hearings to provide assessments of effects related to various activities as required by the Regional Plans and other planning documents specific to the Region in which the activities are proposed to be undertaken.

7. I am familiar with Plan Change processes through providing technical support for expert witnesses for Variation 6 of the Waikato Regional Plan, as well as supporting the expert witnesses for HortNZ on Hawkes Bay Regional Council's Tukituki River Catchment Plan Change 6. This support included working with the Hawke's Bay Regional Council (HBRC) on defining the level of stream depletion from groundwater bores near the Tukituki River, and reviewing expert evidence.

8. I am also familiar with implementing Water Conservation Orders, having spent several years completing resource consent applications for groundwater takes near the Mataura River in Southland. This work involved detailed assessment of groundwater/river connection and working closely with Environment Southland to determine the level of stream depletion from each new groundwater take as required by The Water Conservation Order (Mataura River) 1997.

**Code of Conduct**

9. While this is not a hearing before the Environment Court, I can confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses produced by the Environment Court and have prepared my evidence in accordance with those rules. My qualifications as an expert are set out above.

10. I confirm that the issues addressed in this brief of evidence are within my area of expertise.

11. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

**Purpose and scope of evidence**

12. My evidence addresses the following matters related to the Proposed Water Conservation Order for the Ngaruroro River and Clive River (WCO):

    (a) Discussion on the need for clear and concise objectives, policies and rules within planning documents to aid applicants applying for resource consents; and

    (b) Several points of clarification that I believe would be required to make the WCO clearer for applicants if the WCO is implemented. These are:

        i. The lack of definition of the term "hydraulically connected groundwater" as stated in Clause 9 c) and d), particularly given the numerous definitions currently being outlined in the Hawkes Bay Regional Resource Management Plan (RRMP) and Plan Change 9 (PC9) process. This leads to

uncertainty on which groundwater takes would be required to comply with the minimum flow requirement for the Ngaruroro River under the WCO.

ii. The need for clarification on the Water Quality Limits, referenced in Clause 11 (Requirement to protect water quality) and outlined in Schedule 5. This clarification involves the following points:

1. What are the final limits being proposed? There is a difference between the Limits outlined in WCO V3, and those outlined in the Applicant's evidence (McArthur, 2018);

2. What data is available to assess the current state and progress against this state going forward?

3. The need for a methodology outlining compliance to these limits.

**CLARITY WITHIN PLANNING DOCUMENTS**

13. As set out above, I have led or have been involved in technical work undertaken to provide assessments of effects as required by the Regional Plans and other planning documents specific to the Region in which the activities are proposed to be undertaken.

14. I have undertaken this work across New Zealand and believe I have a good understanding of planning documents, including Regional Plans that need to be complied with for various activities.

15. As these planning documents vary between different regions in New Zealand, I believe it is important that they include clear and concise objectives, policies and rules that applicants can follow when applying for resource consents. As the WCO will be a relevant matter in relation to resource consents it is my opinion that it is important that the WCO is clear and unambiguous.

16. In my view, as currently drafted, the WCO does not provide clarity on the information and assessments that would be required to be undertaken for surface water, groundwater

and discharge consent applications. This lack of clarity will add complexity and uncertainty during the resource consent assessment process.

17. In addition, I consider that the WCO does not provide any resource management advantage over a Regional Plan. A Regional Plan that gives effect to such policy as the National Policy Statement for Freshwater Management (NPSFM, 2017) must provide clear objectives, policies and rules around managing potential effects.

18. For these reasons, I oppose the WCO as currently drafted.

19. I believe that there are several significant points of clarification and elaboration that would be required to be made to the WCO to make it clearer and more certain. I recommend these clarification points are considered and addressed by the Applicants before the WCO could be implemented. These are discussed below.

**HYDRAULICALLY CONNECTED GROUNDWATER**

20. Clauses 9 c) and d) of the WCO reference the term "hydraulically connected groundwater" when defining abstractions that require restrictions on alterations of river flow and form. The term is further used in both Schedules 2 and 3, which define hydraulically connected groundwater as waters to be protected.

21. The restrictions outlined within the WCO for hydraulically connected groundwater include assigning a minimum flow of no less than 2,400 litres per second (L/s) for the Ngaruroro River at Fernhill.

22. I agree with the inclusion of hydraulically connected groundwater within regional plans, and if the WCO were to be approved, then it would be appropriate for it to be included within this document given its importance for recharge to the surface water bodies across the Heretaunga Plains. However, I consider that a definition is required for the term, especially given the multiple discussions around this concept that have taken place during the PC9 process. These discussions have focused on the potential benefits (or lack of) to streams and rivers when groundwater abstractions are ceased due to minimum flows, as discussed in further detail below.

23. The Heretaunga Plains is an alluvial formation formed by sediments deposited by the Ngaruroro, Tukituki and Tutaekuri Rivers (Dravid and Brown, 1997), with the Heretaunga Aquifer underlying the Plains. Across the Plains, there are several rivers, streams and drains that form a complex network that interact with the underlying aquifer system.

24. The largest river in this network is the Ngaruroro River, and as the river enters the Plains, it begins losing water to the aquifer system and provides approximately two thirds of recharge to the Heretaunga Aquifer System (HBRC, 2018b). There are also springs, spring fed streams and artificial drains across the Plains that receive discharge from the aquifer.

25. Historically, there was limited information on the surface water and groundwater interactions on the Heretaunga Plains, which led to uncertainty regarding their magnitude, effect and appropriate form of management. This is particularly relevant for the most significant interaction; stream depletion because of groundwater abstraction.

26. HBRC have previously managed the effects of groundwater abstraction on surface water by defining a buffer around nearby surface water bodies under Policy 3.9.33 of the RMMP. This Policy states:

> *To manage the effects of groundwater takes from unconfined or semi-confined aquifers on nearby surface water bodies in the following manner:*
>
> > *(a) Any taking of shallow groundwater within 400 m of a river, lake or wetland as measured from the edge of the bed will be treated as if it were a direct take unless the extent to which the groundwater will deplete water in the surface water body has been assessed using an appropriate scientific process in which case the effects of surface water will be assessed on that basis.*
> >
> > *(b) Any taking of shallow groundwater beyond 400 m may require an assessment of effects in the river, lake or wetland if the scale of the take, the groundwater flow direction, and the transmissivity and storativity characteristics of the aquifer indicate interaction is likely to occur; in which case it may be treated as if it were a direct take.*

27. The 400 m buffer zone along the Ngaruroro River is shown on Figure 1.

28. However, this approach is very simplistic and does not take into consideration site specific variables that may contribute to stream depletion, e.g. degree of hydraulic connection through unsaturated zones.

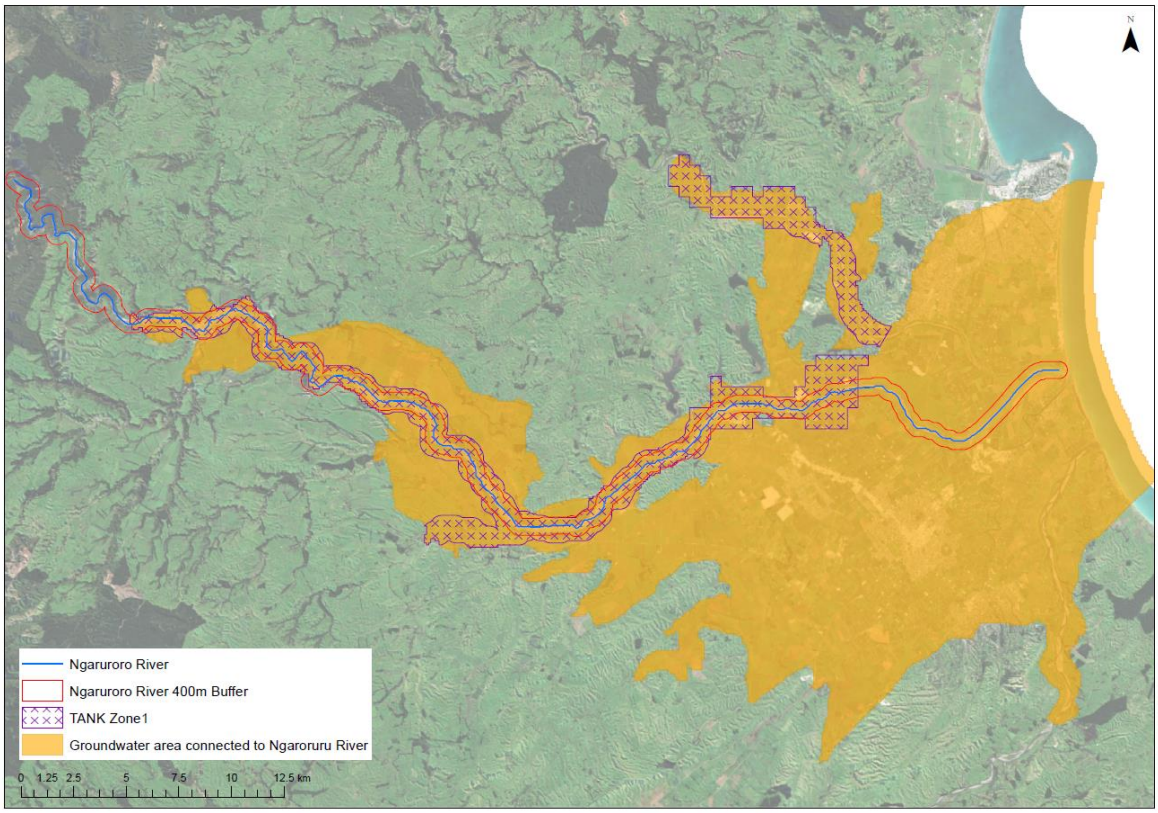


**Figure 1: Zones of Defined Hydraulically Connected Groundwater**

29. This was acknowledged by HBRC, and as part of the PC9 process for the catchments of TANK (Tuatekrui, Ahuriri, Ngaruroro and Karamu Rivers) they commissioned a series of studies to further understand the groundwater and surface water resources in these catchments.

30. Wilding (2018) completed a comprehensive review of the entire stream network of the Heretaunga Plains and identified all significant river losses and spring locations. Overall, this study identified 64 locations where the flow is either losing or gaining.

31. This information was then incorporated into a groundwater model developed for the Heretaunga Plains (HBRC, 2018a). This model was constructed to allow technically defensible groundwater allocation limits to be established. The model

covers the area of the Heretaunga Plains and surrounding river valleys that are considered to contain aquifers in hydraulic connection with the Heretaunga Aquifer.

32. Specific objectives of the groundwater model were defined during the modelling process, as well as through consultation with interested parties. These included:

    (a) Ability to evaluate the impact of stresses (such as abstraction from individual wells or groups of takes) on groundwater levels and individual stream flows, accounting for seasonal effects, for historical and future scenarios; and

    (b) Ability to evaluate the effectiveness of various management strategies on stream flow and groundwater levels (e.g. pumping bans, artificial recharge, stream augmentation) along with security of supply

33. Historical scenarios were undertaken on the calibrated groundwater model, as outlined in HBRC (2018b), which estimated the impact of current and past groundwater abstraction on the aquifer and river flows. The results of these scenarios indicated that under historical abstraction, river losses increased, resulting in decreased river flows.

34. In addition, it was determined that all groundwater abstractions in the Ngaruroro River catchment would be contributing, in some degree, to streamflow depletion. This area is shown on Figure 1.

35. As such, all groundwater abstraction could be defined as being from hydraulically connected groundwater and under the current wording of the WCO, they would be subject to minimum flow restrictions.

36. However, I believe this definition of hydraulically connected groundwater is too broad and doesn't take into consideration any of the factors such as the lag effect from restricting groundwater abstraction. The lag effect relates to the delay in a response in surface water following the cessation of abstraction due to distance between groundwater bore and surface water body and intervening aquifer units and parameters.

37. This lag effect is observed within the Ngaruroro River, with the maximum flow depletion observed in April, while the maximum groundwater abstraction occurs in January (HBRC, 2018b).

38. HBRC (2018b) undertook several mitigation scenarios to assess the feasibility of various management options across the Heretaunga Plains. One of the mitigations scenarios involved identifying the benefit of introducing pumping bans for groundwater bores classified as stream depleting using minimum flows within rivers and identifying different stream depletion management zones.

39. The results indicated that:

    (a) Pumping bans do improve river and stream flows, but the effect is relatively minor as it only related to bores located within 400 m of rivers as outlined in RMMP;

    (b) Even if all the abstraction on the Heretaunga Plains ceased, it would take several months for the aquifer to recover fully, and consequently river flows to recover, thus providing limited increases in flow during the lowest flow periods; and

    (c) Redefining a zone of potential stream depletion (definition as Zone 1, shown on Figure 1) resulted in more stream flow recovery compared to the existing scenario, i.e. 400 m buffer around rivers.

40. Based on these results, HBRC are now recommending defining Zone 1 as stream depleting takes under PC9 as discussed in the TANK meeting #36 minutes. Zone 1 was further discussed during this meeting, with the Zone defined as covering:

    (a) Takes identified during modelling that have >90% stream depletion after 7 days of pumping; and

    (b) Takes located within a 400 m buffer around the Ngaruroro River, where there is a lower confidence in model results.

41. I agree with using the HBRC Zone 1 for identifying stream depleting groundwater effects as it is based on the latest scientific information and takes into consideration lag effects of groundwater takes (i.e. groundwater abstraction located

at a distance to the river are not restricted by minimum flows).

42. It is not clear from the technical work submitted by the Applicant that any assessment of what would constitute "hydraulically connected groundwater" has been undertaken. I believe that the Applicants should undertake this technical assessment and provide a definition and map of what they consider to be the "hydraulically connected groundwater" for inclusion within the WCO.

**SCHEDULE 5 WATER QUALITY LIMITS**

43. Clause 11 of the WCO outlines the requirements to protect water quality within the Ngaruroro and Clive Rivers. These requirements involve not allowing a resource consent to be granted or rule within a plan authorising the discharge of contaminants onto land or into water that would cause the limits outlined in Schedule 5 to be exceeded.

44. I agree, in principle, with the use of water quality limits to protect water quality within rivers and streams. However, the limits need to be clearly defined with adequate baseline data for determining the "base case" of water quality, and a clear compliance methodology outlined.

45. For reasons outlined below, the Water Quality Limits currently outlined in the WCO are not clearly defined, with many questions regarding the base case data and what method of compliance will be used.

46. Firstly, there is confusion around what limits the Applicants are proposing for the WCO. Limits have been outlined in Version 3 of the WCO as circulated, however within the Applicants Stage 2 hearing evidence, changes to these limits are discussed (McArthur, 2018).

47. As the changes to limits within McArthur (2018) were not presented in a table replicating Schedule 5, I have attempted to present what I understand the proposed changes to be, as shown in Table 1.

48. Proposed changes to the limits include:

    (a) Alignment of some parameter to those currently being proposed within the PC9 (TANK) process;

(b) Changes in units for the limits (which has led to at least one error, i.e. the limit proposed for dissolved reactive phosphorus is stated as 0.08 mg/L rather than 0.008 mg/L);

(c) Changes to limits to those directly derived for the National Objectives Framework (NOF) bands for those parameters included within the NPSFM;

(d) Introducing new parameters with limits, including periphyton biomass and deposited fine sediment.

49. To provide clarity on these proposed changes, I would recommend that the Applicant present the changes in the form of Schedule 5 so that the proposed limits can be easily reviewed.

50. Based on my understanding of the proposed changes to the limits (as outlined in Table 1), I support the changes to using NOF bands for the parameters included within the NPSFM (2017) as intensive work has been undertaken to determine the thresholds for these bands.

51. However, it should be noted that in the case of dissolved oxygen (DO), the NOF limit has been set based on daily or 7-day mean statistics. It is my understanding that the current monitoring data for DO on the Ngaruroro River (undertaken by NIWA) is completed monthly, which would make assessing the monitored data to these statistics difficult.

52. DO changes daily, and even within a 24-hour period, due to changes in temperature and biomass photosynthesis. As such, the monthly sample currently collected will only provide a snapshot of what DO levels were at the time of collection, not necessarily a true reflection of the current state of the river.

53. As such, I recommend that the Applicant clarifies how DO compliance will be undertaken with the current monitoring being collected. This point is further covered in paragraph 58 of my evidence.

**Table 1: Schedule 5 Version 3 Limits and Limits Proposed by McArthur (2018)**

| Indicator | Version 3 WCO Limits (Schedule 5) – Lower Ngaruroro River at Chesterhope | Proposed New Limit - Ngaruroro River at Chesterhope (McArthur, 2018) |
|---|---|---|
| Dissolved inorganic nitrogen (DIN) (Total oxidised nitrogen (nitrate + nitrite) + ammoniacal N) | Annual average concentration shall not exceed 100 mg/$m^3$ | <0.1 mg/L median at all flows (further analysis of current state needed) |
| Ammonia (adjusted) | Shall not exceed 100 mg/$m^3$ (unadjusted for pH and temperature) | Recommend change in WCO limit to reflect A NOF band:<br>Annual median shall be less than or equal to 0.03 mg/L, and<br>Annual maximum shall be less than or equal to 0.05 mg/L<br>(Compliance with the numeric attribute states should be undertaken after pH adjustment). |
| Dissolved reactive phosphorus (DRP) | Annual average concentration shall not exceed 8 mg/$m^3$ | <0.08 mg/L median at all flows (further analysis of current state needed) |
| E. Coli | E Coli shall not exceed 260/100 ml when river flows are less than median<br>or 550/100 ml when flows are less than the 20$^{th}$ exceedance percentile | Recommend change in WCO limit to reflect A NOF band: There shall be less than 5% over 540 cfu/100 ml, and<br>There shall be less than 20% over 260 cfu/100ml, and<br>The median concentration shall be less than 130 cfu/100 ml, and<br>95$^{th}$ percentile of E Coli shall be less than 540 cfu/100ml |
| Dissolved oxygen (DO) concentration (continuous) | NA | Recommend change in WCO limit to reflect A NOF band: 7-day mean minimum greater than or equal to 8.0 mg/L, and<br>1 day minimum greater than or equal to 7.5 mg/L. |

| Indicator | Version 3 WCO Limits (Schedule 5) – Lower Ngaruroro River at Chesterhope | Proposed New Limit - Ngaruroro River at Chesterhope (McArthur, 2018) |
|---|---|---|
| DO % Saturation | Daily (24-hour) minimum DO shall not drop below 80% of saturation | Daily (24-hour) minimum DO shall not drop below 80% of saturation |
| Temperature | The 95$^{th}$ percentile of samples shall not exceed 21degrees C | <21 degrees C using Cox-Rutherford Index from continuous measurements, hottest 5 consecutive days, all flows |
| Clarity | Shall exceed 1.6 m at flows less than median | Shall exceed 1.6 m at all flows |
| Macroinvertebrate Community Index (MCI) | Long-term (continuous) running average shall exceed 100 | 5-year median shall exceed 100 |
| Periphyton weighted composite cover (periWCC) | Annual maximum shall be less than 20% | Unsure if a change is suggested: McArthur (2018) states that further consideration needed as Chesterhope site exceeds the WCO value in some years. |
| Cyanobacteria mat cover | Shall be less than 20% | Annual maximum shall be less than 20% |
| Periphyton biomass | NA | <120/m$^2$, maximum 8% exceedance 3 years monthly observations |
| Deposited fine sediment (%) | NA | <20% or within 10% of reference condition<br>Also:<br>Additional deposited fine sediment measures related to reference condition are needed to protect sites with currently low deposited sediment, where an increase to just below 20% would be a significant adverse change. |

54. Clarification is also required around the base case for several of the attributes proposed for Schedule 5. Table 1 outlines four parameters (DIN, DRP, temperature and periphyton) where it has been stated that further analysis of the current state is required. I understand that this information will be circulated to experts prior to caucusing, so I cannot comment on this further at this time, other than to note the importance of clearly defining a base case to avoid exceedances due to natural (climatic) variation.

55. One such example has been noted within McArthur (2018) for periphyton. Figure 2 replicates the graph from McArthur (2018) which shows that for the Ngaruroro River at Chesterhope Bridge, the annual maximum periphyton weighted composite cover percentage (%WCC) regularly exceeds the proposed limit of less than 20%.

56. This variation has been identified as potentially being the result of between-year variability in flood frequency. These flood events scour the river bed and remove periphyton. These events need to be taken into consideration during compliance of the proposed limits, as discussed further in paragraph 58.

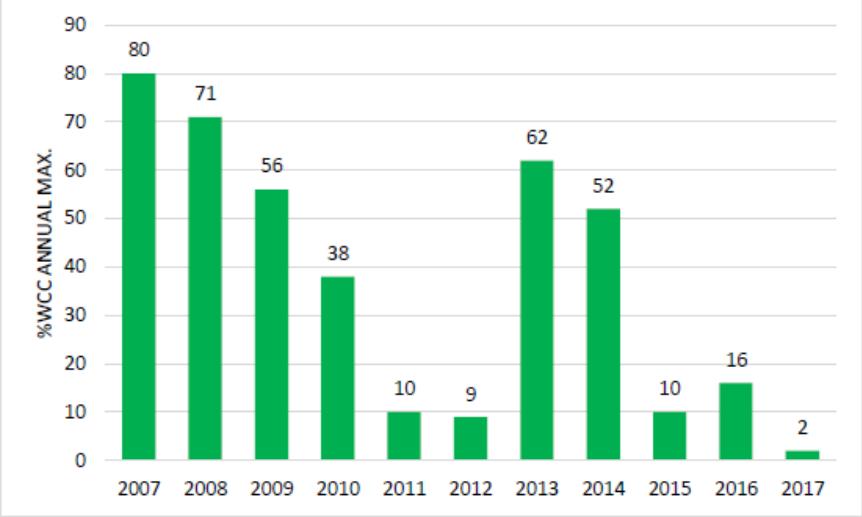


**Figure 2: Annual maximum periphyton weighted composite cover percentage (%WCC) from monthly observations between 2007 and 2017 for Ngaruroro at Chesterhope Bridge (McArthur, 2018).**

57. These exceedances and further analysis required on the base case water quality give an idea of the complexity

of using water quality limits to inform decision making on future land use discharges. The more information that is available on parameters and more data is collected and models (such as those used during the PC9 process) updated, the uncertainty associated with the parameters reduces.

58. I believe that this complexity and potential uncertainty in some of the water quality limits should be taken into consideration within the WCO, possibly through my recommendations on compliance as outlined below.

59. My final point of clarification for the water quality limits proposed for Schedule 5 relates to the methods of compliance with the limits. It is my opinion that a methodology or specifications for compliance should be included either in the WCO under Schedule 5 or outlined in a technical report referenced in the Plan. This methodology should include:

(a) Data sources for each water quality parameter;

(b) Descriptions of how statistics will be calculated, i.e. does the term median in Schedule 5 relate to a rolling median or 5-year median. This description is important given the potential for exceedance or compliance depending on the method used. For example, I have calculated a 5-year median over multiple 5-year periods as shown in Table 2. This data indicates that based on the specified Schedule 5 limit of <0.1 mg/L, the limit would be exceeded during 2009-2013 and 2010-2014, while remaining complaint for the other years;

(c) Methodology on how to deal with the known uncertainty associated with the proposed limits, and potential for changes over time (as in the case of DO outlined in paragraphs 50 and 51).

**Table 2: Calculated 5-year median for Dissolved Inorganic Nitrogen**

| 5-year period | 5-year median (mg/L) |
|---|---|
| 2013-2017 | 0.0780 |
| 2012-2016 | 0.0785 |
| 2011-2015 | 0.0895 |
| 2010-2014 | 0.106 |
| 2009-2013 | 0.106 |

**CONCLUSION**

60. In summary, I believe that, as currently drafted, the WCO does not provide clarity on the information and assessments that would be required for consent applications and does not provide any resource management advantage over a Regional Plan that provides clear objectives, policies and rules around managing potential effects, especially those Plans that give effect to such policy as NPSFM.

61. As such, I oppose the WCO as currently drafted.

62. I believe that there are several significant points of clarification that would be required to be made to the WCO to make it clearer including:

    (a) A map and definition of hydraulically connected groundwater to aid clarification of Clauses 9 c) and d);

    (b) Clarification of final parameters and water quality limits to be included within Schedule 5 of the WCO;

    (c) Confirmation of the base case water quality of several parameters in Schedule 5, i.e. DIN, DRP, temperature and periphyton;

    (d) Inclusion of a methodology or specifications for compliance, including data source for water quality parameters, descriptions of how statistics will be calculated, and a methodology of how to deal with known uncertainty associated with the proposed limits, and potential for changes over time.

**Gillian Holmes for Horticulture New Zealand**

25 January 2019

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