BEFORE THE HEARING PANEL

AT HAMILTON

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the Proposed Waikato Regional Plan Change 1 Waikato and Waipā River Catchments
AND	
IN THE MATTER	of Variation 1 to the Proposed Waikato Regional Plan Change 1 Waikato and Waipā River Catchments

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STATEMENT OF SUPPLEMENTARY EVIDENCE OF KATHRYN JANE MCARTHUR FOR THE DIRECTOR-GENERAL OF CONSERVATION

WRC RESPONSE TO HEARING PANEL QUESTIONS – 5 JULY 2019

19 July 2019

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INTRODUCTION

1. My full name is Kathryn Jane McArthur.

2. I have been engaged by the Director-General of Conservation to provide evidence on freshwater management, water quality and ecosystem health, with a particular focus on streams and rivers, for the hearing on proposed Plan Change 1 for the Waikato and Waipā Rivers (PC1).

3. I am the Practice Leader – Water, at The Catalyst Group, an environmental consultancy based in Palmerston North.

QUALIFICATIONS AND EXPERIENCE

4. My qualifications and experience are set out in my Evidence in Chief dated 15 February 2019.

CODE OF CONDUCT

5. I have read the Environment Court "Code of conduct for expert witnesses", and I agree to abide by it. I have prepared this Statement in accordance with that Code. I confirm that my evidence is within my area of expertise. I have not omitted to consider any material facts known to me that alter or detract from the opinions I express in this Statement. I have acknowledged the material used or relied on in forming my opinions and in the preparation of this Statement.

SCOPE OF EVIDENCE

6. The scope of my supplementary evidence is in response to the memo from Waikato Regional Council (WRC) to questions from the hearing panel including:

    a. Water quality monitoring – rivers and streams; and

    b. Mapping and protection of īnanga spawning habitats.

WATER QUALITY MONITORING IN THE PC1 CATCHMENTS

Physico-chemical water quality monitoring

7. In my opinion the Waikato Regional Council physico-chemical water quality monitoring of rivers and streams in the PC1 sub-catchments is generally adequate with respect to the distribution of monitoring sites. I note the recent inclusion of an additional ten sites to ensure each of the PC1 sub-catchments is monitored. This will be useful to measure the performance of the Plan with respect to physico-chemical water quality.

8. However, there are some relevant physico-chemical parameters that are not currently included in monitoring that should be (i.e., dissolved oxygen, temperature, pH and sediment) and some receiving environments that are not monitored which require inclusion (e.g., Waikato Estuary, particularly sediment and nutrient characteristics, and wetlands[1]). Additional ecological parameters for river and stream monitoring are discussed separately below.

9. Suspended and deposited sediment are not directly monitored in the current WRC water quality network, despite sediment being one of the four key contaminants to be addressed by PC1 and a key driver of ecological condition regionally (Pingram et al. 2019). Water clarity is measured (where accessible) as a surrogate[2] of suspended sediment, however this does not directly contribute to measuring or understanding any changes in sediment load that may be achieved through the proposed PC1 methods (e.g., those related to the management of riparian setbacks, stock access and critical source areas). I understand from paragraph 102 of the WRC response memo that turbidity is also monitored, although this is not listed in the section on water quality monitoring at the beginning of the memo.

10. In my opinion, it would be useful to include a measure of suspended sediment (TSS or a similar parameter) to enable the calculation of current sub-catchment sediment loads and changes in sediment load

[1] Block 3 evidence in chief of Dr Robertson, parargraphs 38 and 39, paragraphs 44 to 51, and paragraphs 56 to 59.

[2] Although I note water clarity is a direct measure of the effect of sediment on some values such as recreational and cultural use and is linked to ecological values through assessing the ability of fish to 'sight-feed' in water. Water clarity should continue to be included in the monitoring network to assess effects on these values.

over time carried by the rivers and streams in the PC1 catchments. This would also allow for calibration and validation of sediment load estimates from models such as those examined by Hughes (2015), which underpin the modelling of the PC1 approach. As well as a direct measure of sediment within rivers and streams (and a measure of the sediment available for deposition within these systems), the ability to measure sediment load is critical to understanding the transport and delivery of sediment to sensitive downstream receiving environments such as the Waikato Estuary, lakes and wetlands.

11. Dissolved oxygen is continuously monitored by WRC at two sites in the mainstem of the Waikato River. The NPS-FM requires a minimum of dissolved oxygen monitoring below point source discharges. Whilst the WRC memo identifies that two more river FMUs require continuous dissolved oxygen monitoring[3], the TLG recommendations[4] identified the need for more monitoring of dissolved oxygen in **all** rivers [emphasis added], not only at sites downstream of point source discharges.

12. All of the water quality experts considered dissolved oxygen an important attribute and measure of the value (presumably ecosystem health, although this is not explicit in the JWS, Table 1). Furthermore, in considering dissolved oxygen as a potential attribute for Table 3.11-1 (JWS Attachment 6) the experts recommended prioritised implementation of dissolved oxygen monitoring for areas known to be affected by low dissolved oxygen (DO), such as "*areas of flood control infrastructure that exacerbates DO issues through the (unconsented) discharge of low DO waters from drainage impoundments, and small streams affected by nuisance submerged macrophyte growth.*"

13. In my opinion, and that of some other experts, continuous monitoring of dissolved oxygen (as opposed to spot measures which do not pick up the daily minima) is needed as a method in PC1. In my view it is essential that adequate ongoing funding is provided for monitoring this critical measure of ecosystem health. Such monitoring could be prioritised by site-specific risk (as suggested above) and timed to coincide with periods of greatest dissolved oxygen stress (i.e., summer

[3] Paragraph 16 of the response to questions memo from WRC to the Hearing Panel dated 5 July 2019.
[4] Summarised in Table 1 of Scarsbrook (2016) Water Quality Attributes for Healthy Rivers: Wai Ora Plan Change. Report No. HR/TLG/2016-2017/2.1A

period 1 November to 30 April as prescribed in the NPS-FM attribute table). Dissolved oxygen sondes could be deployed on a rotational basis across high-risk sites in the PC1 catchments during these times.

14. Temperature and pH are usually concurrently measured alongside dissolved oxygen and other physico-chemical parameters, given the relationship between water temperature and dissolved oxygen saturation and the toxicity of ammonia to pH and temperature. Continuous temperature is an important physico-chemical water quality parameter in its own right and should be included in any water quality monitoring network, as a minimum where other continuous measurement equipment is deployed. Again, the experts agreed that temperature was an important attribute (Table 1, JWS) and the TLG recommended the development of a temperature attribute for the PC1 catchments. I agree that it would be useful for continuous temperature (and pH) to be monitored.

15. In summary, I recommend additional physio-chemical water quality monitoring and accounting of suspended sediment, a wider programme of continuous monitoring of dissolved oxygen, continuous temperature and pH are included to measure the effectiveness of PC1.

Ecological monitoring

16. Currently the focus on the four contaminants in PC1 does not adequately capture ecological attributes associated with values such as ecosystem health or mahinga kai[5]. This is particularly the case with respect to the tributary streams[6]. However, WRC monitor a wide range of ecological indicators (including macroinvertebrates, fish and aquatic plants/periphyton) and their stressors/drivers through the regional ecological monitoring of streams (REMS) network. This network has a probabilistic (randomised) design, which enables good estimates to be made of the ecological condition and the condition of ecological drivers by stream length in perennial, non-tidal, and wadeable streams on developed land. Currently the results are reported by stream length at the regional scale, but WRC staff have provided PC1 catchment

[5] Block 1 evidence in chief of Kathryn McArthur, paragraphs 24, 70, 74, 85 and 87, and Block 1 rebuttal evidence of Kathryn McArthur, paragraph 9.
[6] Block 1 evidence in chief of Kathryn McArthur, paragraph 92.

specific information as requested by the experts, to support the JWS process with respect to macroinvertebrates and deposited sediment. Presumably other parameters monitored through the REMS network can also be reported at the same scale.

17. The REMS network is ideal for monitoring ecological condition and the drivers of condition in the wadeable streams of the PC1 catchments as a whole. Accounting and reporting on changes over time can also be undertaken for the parameters measured in the REMS network. In my opinion the REMS network lends itself well to monitoring and reporting on ecological health across the wadeable streams of the PC1 catchments and should be utilised for measuring the Plan's success in providing for ecosystem health as a value over time.

18. Narrative and/or numeric targets can be set for ecological condition (e.g., using macroinvertebrates as indicators) and for the drivers/stressors of ecosystem health (e.g., deposited sediment) to measure the maintenance or improvement of ecosystem health across the PC1 catchments. For example, the REMS network results have been used to estimate that 53% of wadeable stream length in the PC1 catchments is in poor ecological condition with respect to macroinvertebrates (QMCI <4; JWS, Attachment 7). A target could be set for X%[7] of streams to exceed the threshold for poor ecological condition over the 80-year timeframe for achieving the Vision and Strategy, with timebound targets for improvement within that timeframe (e.g., 10 and 20 year targets).

19. In my opinion it is unfortunate that the WRC REMS network information has not been considered earlier in the PC1 process to better utilise the high-quality, empirical results and predictions of ecological condition within the Plan's framework. However, I understand that this dataset has only recently been collated to a standard that facilitates robust empirical analysis (e.g., Pingram et al. 2019).

20. An area of ecological importance that is not adequately captured by the REMS network or routine WRC monitoring is nuisance periphyton and submerged macrophytes. Although REMS measures periphyton cover

[7] Note: the JWS Attachment 7 recommends an 80-year target of 0% of stream length in poor ecological condition with respect to macroinvertebrates for the wadeable streams of the PC1 catchments.

annually and presence/absence observations are made monthly during routine water quality sampling, this data is not adequate to report against the NPS-FM periphyton attribute, or the WRP policy relating to periphyton cover (Policy 6(d)).

21. The TLG recommended a need for surveillance and monitoring of periphyton and submerged nuisance macrophytes in rivers and the experts considered a risk-management approach to prioritise sites where nuisance periphyton may be an issue in the PC1 catchments (JWS, Attachment 9). Although nuisance periphyton is not an issue for many of the PC1 sub-catchments due to the soft substrate of these sites, there are some sub-catchments which have hard-substrates and may be at risk of nuisance periphyton growth and subsequent adverse effects on recreational, cultural and ecological values[8]. Other soft-substrate sub-catchments are adversely affected by nuisance submerged macrophytes (Pingram et al. 2019).

22. Monthly monitoring of periphyton biomass and/or cover in wadeable streams is not reliant on low flow conditions as suggested in the WRC memo at paragraph 18. When flows are too high for wading or the substrate is obscured by elevated sediment during high flow events it is usual practice to enter a nil result for periphyton cover for that sampling observation (Biggs and Kilroy 2000; Kilroy et al. 2008). Other regional councils (e.g., Greater Wellington, Horizons, Hawkes Bay, Canterbury, Northland, Nelson, Tasman, Southland) commonly monitor periphyton biomass and/or cover in hard-substrate wadeable streams within their State of the Environment monitoring networks. There is no reason why WRC cannot undertake similar monitoring at sites in sub-catchments where there is a risk of nuisance periphyton growth.

23. I recommend adopting the percent periphyton weighted composite cover (periWCC) method proposed by Matheson et al. (2012 and 2016) as the method for monitoring periphyton in the PC1 catchments. This method captures both filamentous and mat periphyton cover within one index and there are national guidelines relating to ecological condition[9], which can be used to assess nuisance effects (see Table 1 below,

[8] As detailed in the Block 1 evidence in chief of Kathryn McArthur, paragraph 90.
[9] Block 1 evidence in chief of Kathryn mcArthur, paragraph 126.

originally presented as Table 2 in my Block 1 evidence in chief). Monitoring periphyton cover is more cost and time-effective for councils as there are no laboratory analysis costs associated with monitoring and results are available as soon as data is collated. The Ministry for the Environment have produced a draft guide to monitoring periphyton under the NPS-FM[10] which includes the ability to gather information on periphyton using a periphyton cover assessment method[11].

Table 1: Matheson et al. (2012) provisional guidelines for periphyton weighted composite cover percentage (periWCC) for classes of ecological condition in New Zealand rivers.

PeriWCC	Ecological condition
<20%	Excellent
20 – 39%	Good
40 – 55%	Fair
>55%	Poor

24. I have identified in my Block 1 evidence other parameters of ecological relevance which should be monitored in the rivers of the PC1 catchments, some of which were recommended by the TLG and subsequently supported by some experts in the JWS[12], including deposited sediment, benthic cyanobacteria (which can be assessed concurrently with nuisance periphyton cover), nuisance macrophytes and toxicants, metals and metalloids. In addition, WRC monitoring of the Waikato Estuary, lakes and wetlands is also needed[13] to ensure the requirements of national policy documents (such as the NZCPS and the NPS-FM) and the Vision and Strategy are met.

[10] https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/Periphyton%20note%20draft%20technical%20guidance%20_FINAL.pdf

[11] Step 3, page 22 of MfE (2018) A draft technical guide to the periphyton attribute note, New Zealand government, Wellington. Pp. 69.

[12] These are detailed in my Block 3 evidence, paragraphs 22 to 24.

[13] As discussed in the Block 1 evidence in chief of Ms Kettles and the Block 3 evidence in chief of Drs Robertson and Stewart.

25. In summary, I recommend utilising the REMS network to measure the ecological health of wadeable streams and to set targets for the maintenance or improvement of ecosystem health and drivers of ecological condition across the wadeable streams of the PC1 catchments. I also recommend determining the risk of nuisance periphyton, submerged nuisance macrophytes and benthic cyanobacteria at river sites in the PC1 catchments, with subsequent surveillance and monitoring of periphyton in at-risk sites. Deposited sediment is also a critical driver of ecological conditions in the Waikato Region (Pingram et al. 2019) and should continue to be monitored through the REMS network, reported on and accounted for in the PC1 framework. Where there is a risk of toxicants, metals and metalloids (i.e., urban and industrial land), these should also be monitored and accounted for.

MAPPING AND PROTECTION OF ĪNANGA SPAWNING HABITAT

26. The Waikato River is one of New Zealand's largest rivers and as such has the potential to provide a proportionately large areal amount of īnanga spawning habitat nationally, although flood protection of farmland significantly reduces the area of tidal inundation of suitable habitat. Thus, the remaining available īnanga spawning habitat in the lower Waikato River (and in suitable spawning habitats associated with lakes Whangape, Waahi and Waikari; David et al. 2019) is of critical importance for the survival and recruitment of īnanga at both the regional and national levels.

27. It is my understanding that Mr McCallum-Clark has become aware of the further information WRC hold on īnanga spawning habitat (as intimated in my Block 2 evidence) since writing the WRC response memo and that he will be issuing an erratum to the panel on this matter. At the time of writing I have not seen Mr McCallum-Clark's corrected response and therefore I reserve any further comment on the issue of the protection of īnanga spawning habitat in PC1.

Kathryn Jane McArthur

19 July 2019

REFERENCES

Biggs BJF, Kilroy C 2000. Stream periphyton monitoring manual. Prepared for Ministry of the Environment. NIWA, Christchurch.

David BO, Jarvis M, Özkundakci D, Collier KJ, Hicks AS, Reid M 2019. To sea or not to sea? Multiple lines of evidence reveal the contribution of non-diadromous recruitment for supporting endemic fish populations within New Zealand's longest river. Aquatic Conservation: Marine and Freshwater Ecosystems. 2019: 1– 15. https://doi.org/10.1002/aqc.3022.

Hughes A. 2015. Waikato River suspended sediment: loads, sources & sinks. Report No. HR/TLG/2015-2016/2.4.

Kilroy C, Biggs B, Death R 2008. A periphyton monitoring plan for the Manawatu-Wanganui Region. Report prepared for Horizons Regional Council. NIWA Client Report CHC2008-03.

Matheson F, Quinn J, Hickey C 2012. Review of the New Zealand instream plant and nutrient guidelines and development of an extended decision-making framework: Phases 1 and 2 final report. Prepared for the Ministry of Science & Innovation Envirolink Fund. NIWA Client Report No: HAM2012-081.

Matheson F, Quinn JM, Unwin M 2016. Instream plant and nutrient guidelines. Review and development of an extended decision-making framework Phase 3, HAM2015-064: 118.

Pingram MA, Collier KJ, Hamer MP, David BO, Catlin AK, Smith JP 2019. Improving region-wide ecological condition of wadeable streams: risk analyses highlight key stressors for policy and management. Environmental Science and Policy 92 (170-181).