

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 to the Waikato
Regional Plan

EVIDENCE - RESPONDING TO HEARINGS PANEL QUESTIONS TO COUNCIL

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INTRODUCTION

1. My name is Michael Robert Scarsbrook. I am the Science Manager with Waikato Regional Council, a position I have held since November 2018. I hold the degree of PhD in Zoology from the University of Otago (1996).
2. I have worked in various freshwater research and development roles for 24 years. Most of my career has been focussed on land use effects on freshwaters and I have experience and expertise in state of the environment reporting. I've held science and science management roles at the National Institute of Water and Atmospheric Research (1995-2008), DairyNZ (2008-16), Fonterra (2016-18) and Waikato Regional Council (2018-). I was a member of the Healthy Rivers - Wai Ora Technical Leaders Group (TLG). My current role at Waikato Regional Council involves management of three science teams (Water, Land & Soil, and Coastal).
3. I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014, and agree to comply with it. Except where I state that I am relying upon the specified evidence of another person, 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 or detract from the opinions which I express.

PURPOSE

4. The purpose of this supplementary evidence is to provide responses to the following questions from the Hearings Panel to Council dated 19 February 2019:

QUESTION 5: Table 3.11.1 Numerical values

QUESTION 13: Nitrogen Load to Come

QUESTION 5: Table 3.11-1 Numerical values

5. The Panel has asked the following question:
As above, a number of submissions seek that water quality data derived at times of high river flows be excluded from consideration when determining compliance with/achievement of the numerical values in the Table. The section 42A report addresses these submissions from a policy perspective, but taking flows above three times median as a possible trigger point, what is the sensitivity of the Table 3.11.1

values to inclusion or exclusion of data when flows are greater than three times median.

Also with respect to Table 3.11.1, can the table please be augmented with columns stating current measured water quality based on the most recent data available and the relevant water quality band in terms of the National Objectives Framework (as per the NPSFM 2014) where applicable for the Panel's reference."

RESPONSE

6. My colleagues Mr B Vant and Mr B Jenkins and I have worked together to provide this response to the Panel's question. Our first step was to review the information on current state (2010–14) that was included as Appendix 1 of section D.4 of the Section 32 Evaluation Report. Over the past two years we have become aware of some minor errors and potentially ambiguous interpretations of the information in that Appendix. As a result, we have drafted a revised version of the 2010–14 current state table; included here as Attachment 1.

7. The main features of this revision are as follows:
 - (a) A small number of typographic errors that were introduced when the current state table in the Section 32 report was drafted have been corrected.
 - (b) A small number of errors in the Regional Council database have been corrected.
 - (c) The fact that the ammonia concentrations shown in the current state table in the Section 32 report have been adjusted to pH 8 as specified in the National Objectives Framework is now explicitly stated. Furthermore, a minor error in the adjustment table used by the TLG has been corrected in line with the table provided in the Ministry for the Environment's *Guide to Attributes in Appendix 2 of the National Policy Statement for Freshwater Management* that was published in 2018.
 - (d) The fact that the *E. coli* dataset used to determine the current state included results from 2009 as well as from 2010–14 is now explicitly stated.
 - (e) Recognising the direction provided in the 2017 amendments to the National Policy Statement for Freshwater Management, where possible, 60 sample results were analysed to obtain the estimate of the 95th percentile *E. coli* concentration. Where the number of monitoring results available during 2009–14 was less than 60 – as is the case for most of the monitored sites on streams other than the Waikato River itself – we indicate this in the revised table.
 - (f) The fact that in developing the current state table in the Section 32 report, the TLG decided to follow the longstanding Regional Council protocol of excluding all water

clarity measurements that were made in the upper 10 percent of river flows is now explicitly stated.

8. We then proceeded to determine the sensitivity of the gap between the current state (2010–14) and the targets in Table 3.11.1 to the possible exclusion of monitoring results obtained when river flows exceeded three times the median value¹. That is, we considered the likely effects of including or excluding results collected at high river flows on future assessments of the compliance of the observed water quality with the current PC1 targets (as shown in Table 3.11.1).
9. Figure 1 and Table 2 below summarize the results of this assessment. For each monitoring site in Table 3.11.1, we calculated the gap between the revised value of the current state (2010–14) obtained using water quality results obtained at all flows and (1) the short-term, and (2) the 80-year target. We then repeated the calculations only using water quality results from 2010–14 that were obtained at flows lower than three times the median value.
10. For each attribute at each sampling site, the ratio of the “gap with data excluded” to “gap with data included” was calculated. Figure 1 shows the boxplots of these ratios for each attribute for both the short-term and the 80 year targets. Table 2 lists the average values of the gaps for each attribute, together with the ratio of these averages in each case.

¹ Flow records were available for locations at or reasonably-near the sites. See section 2.6 *Flow records* in Vant (2018) *Waikato Regional Council technical report 2018/30* for details.

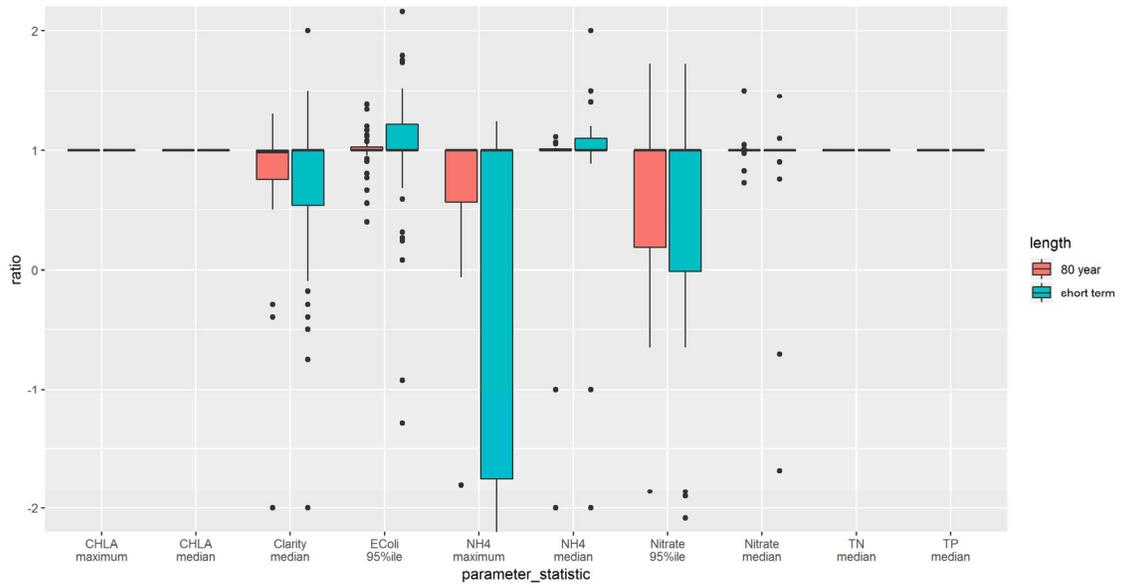


Figure 1: Boxplots of the ratio of the {gap between current state with high flow data excluded and future target} to the {gap between current state with high flow data included and future target} for each water quality attribute. Boxplots for the ratios for both short-term and 80 year targets are shown. A small number of extreme outliers lie outside the y-axis range and are not shown.

Table 2: Average values of the gaps between the current state and the future water quality targets, based on data from 2010–14 that either included or excluded water quality results obtained at river flows greater than three times the median flow. For each pair of results, the ratio of the averages is a measure of the extent to which excluding high flow results reduces the size of the gap between the current and future water quality. Abbreviations as in Table 1, “Max”, maximum.

	Short-term targets			80-year targets		
	Including	Excluding	Ratio	Including	Excluding	Ratio
Med Chla (mg/m ³)	0.1	0.1	1.0	1.9	1.9	1.0
Max Chla (mg/m ³)	0.1	0.1	1.0	2.3	2.3	1.0
Med total N (mg/m ³)	15	15	1.0	143	143	1.0
Med total P (mg/m ³)	1	1	1.0	13	13	1.0
Med nitrate (mg/L)	0.012	-0.007	-0.6	0.118	0.099	0.8
95%ile nitrate (mg/L)	0.135	0.045	0.3	0.360	0.270	0.8
Med ammonia (mg/L)	0.001	0.001	1.0	0.008	0.008	1.0
Max ammonia (mg/L)	0.003	-0.002	-0.7	0.032	0.027	0.8
95%ile <i>E. coli</i> (/100 mL)	234	210	0.9	2253	2229	1.0
Clarity (m)	-0.11*	-0.07	0.6	-0.45*	-0.41	0.9

*for this assessment, all values of black disc were considered (i.e. the standard approach of ignoring clarity measurements made in the upper 10 percent of flows was not used)

11. Several points can be made about this assessment, as follows:

- (a) Overall, 5–7 % of the sampling occasions in 2010–14 occurred when river flows were greater than three times the median value.
- (b) In many cases, removing water quality results associated with high river flows had little or no effect on the average size of the gap between the future targets and the current state (Table 2).
- (c) For the nine sites on the main-stem of the Waikato River, this was simply due to the fact that none of the sampling occasions during 2010–14 occurred at flows greater than three times the median flow. As a result, the “including high flows” and “excluding high flows” datasets for Waikato River sites during 2010–14 were identical. And since the chlorophyll *a*, total N and total P attributes only apply to sites on the main-stem of the Waikato River, the first four rows in Table 2 show no effect of flow.
- (d) High flow concentrations of nitrate had a reasonably-large effect on compliance with the short-term targets (both median and 95 percentile). That is, excluding the high flow nitrate concentrations substantially reduced the gap between the current state and the short-term targets. Indeed, the average gap between the current state and the short-term target for median nitrate was actually negative (and therefore so too was the value of the corresponding ratio in Table 2). At several sites, high flow concentrations of nitrate were often high, markedly affecting the median and 95-percentile

concentrations for those sites (and thus affecting the average size of the gap for all sites).

- (e) However, there was substantially less effect of high flow concentrations on compliance with the long-term targets for nitrate (where the gaps were generally larger).
 - (f) Note that the targets for future water clarity are mostly larger numbers than the current values, so the gaps between current state and the targets were negative.
12. A related matter is whether the original assignment of bands using the current state information may have resulted in different bands – and thus different future water quality targets – if a “high flows excluded” dataset had instead been used. Without a rigorous numerical analysis of this, all we can say is “possibly”. However, we consider that such an approach would have been contrary to the principles behind the development of the NOF bands in the first place.
13. For example, the NOF targets for total P, total N and phytoplankton chlorophyll *a* were all based on a consideration of the conditions found in many New Zealand lakes of widely-varying water quality. The conditions observed in these lakes are likely to have been affected by the high loads of N and P that entered them during floods.² This means that the numerical values of the targets for total N, total P and chlorophyll *a* in Table 3.11.1 implicitly assume that the nutrient loads from the catchments that are carried by flood flows have not been discounted (and will not be discounted in the future).
14. The Hearing Panel also asked to see a version of Table 3.11.1 that includes information on the currently-available data. Tables 3A and 3B below combine the current state results obtained using data from 2014–18 (using the revised protocols described above), with the short term and 80-year targets in Table 3.11.1.

² For example, 40 percent of the annual load of phosphorus that entered Lake Rotorua via the Ngongataha Stream in 1996 was delivered to the lake on just three days of high flow: see Hoare, RA 1982. Nitrogen and phosphorus in the Ngongataha Stream. *New Zealand journal of marine and freshwater research* 16: 339–349.

Table 3A: Short-term and 80-year targets from Table 3.11.1, plus current state values for 2014–18 (including NOF bands). Chlorophyll a, total nitrogen and total phosphorus at the main-stem Waikato River sites.

	Median chlorophyll (mg/m ³)			Maximum chlorophyll (mg/m ³)			Median total nitrogen (mg/m ³)			Median total phosphorus (mg/m ³)		
	current	short term	80 year	current	short term	80 year	current	short term	80 year	current	short term	80 year
Upper Waikato River FMU												
Waikato River Ohaaki Br	1.5 (A)	1.5	1.5	1.5 (A)	13	13	127 (A)	134	134	10 (A)	10	10
Waikato River Ohakuri Tailrace Br	4 (B)	3.2	3.2	25 (B)	11	11	216 (A)	206	160	18 (B)	17	17
Waikato River Whakamaru Tailrace			5			25	266 (A)	260	160	22 (C)	20	20
Waikato River Waipapa Tailrace	5 (B)	4.1	4.1	18 (B)	25	25	350 (B)	318	160	26 (C)	25	20
Middle Waikato River FMU												
Waikato River Narrows Boat Ramp	5 (B)	5.5	5	83 (D)	23	23	515 (C)	404	350	29 (C)	28	20
Waikato River Horotiu Br	5.5 (C)	6.1	5	24 (B)	23	23	535 (C)	432	350	35 (C)	34	20
Lower Waikato River FMU												
Waikato River Huntly-Tainui Br	5.5 (C)	5.9	5	20 (B)	19	19	720 (C)	562	350	43 (C)	43	20
Waikato River Mercer Br	7.5 (C)	10	5	37 (C)	30	25	740 (C)	631	350	48 (C)	49	20
Waikato River Tuakau Br	9 (C)	11.3	5	45 (C)	37	25	720 (C)	571	350	50 (C)	50	20

Table 3B: Short-term and 80-year targets from Table 3.11.1, plus current state values for 2014–18 (including NOF bands). Nitrate, ammonia, *E. coli* and clarity at all sites. Note that the current state data for the two NIWA sites on the Waipa River is for 2013–17: values shown in italics. Abbreviations and units as in Tables 1 and 2; “Cu” current state; “Sh”, short term; “80”, 80 year.

	Median nitrate			95%ile nitrate			Median ammonia			Maximum ammonia			95%ile <i>E. coli</i>			Median clarity		
	Cu	Sh	80	Cu	Sh	80	Cu	Sh	80	Cu	Sh	80	Cu	Sh	80	Cu	Sh	80
Upper Waikato FMU																		
Waikato River Ohaaki Br	0.039 (A)	0.039	0.039	0.081 (A)	0.062	0.062	0.003 (A)	0.002	0.002	0.011 (A)	0.013	0.013	120 (A)	70	70	4.89 (A)	3.8	3.8
Waikato River Ohakuri Tailrace Br	0.099 (A)	0.084	0.084	0.24 (A)	0.172	0.172	0.003 (A)	0.003	0.003	0.011 (A)	0.017	0.017	20 (A)	15	15	2.51 (B)	3.4	3.4
Waikato River Whakamaru Tailrace	0.132 (A)	0.101	0.101	0.308 (A)	0.23	0.23	0.003 (A)	0.003	0.003	0.011 (A)	0.01	0.01	95 (A)	60	60	2.4 (B)	2	3
Waikato River Waipapa Tailrace	0.215 (A)	0.164	0.164	0.375 (A)	0.32	0.32	0.006 (A)	0.007	0.007	0.016 (A)	0.017	0.017	710 (> MAS)	162	162	2.16 (B)	2	3
Pueto Stm Broadlands Rd Br	0.495 (A)	0.45	0.45	0.745 (A)	0.53	0.53	0.003 (A)	0.003	0.003	0.008 (A)	0.009	0.009	78 (A)	92	92	1.75 (B)	1.8	3
Torepatutahi Stm Vaile Rd Br	0.535 (A)	0.5	0.5	1.11 (A)	0.8	0.8	0.003 (A)	0.002	0.002	0.009 (A)	0.011	0.011	310 (B)	216	216			
Waiotapu Stm Homestead Rd Br	1.4 (B)	1.257	1	1.972 (B)	1.563	1.5	0.121 (B)	0.112	0.03	0.195 (B)	0.176	0.05	1500 (> MAS)	281	281			
Mangakara Stm (Reporoa) SH5	1.36 (B)	1.27	1	1.895 (B)	1.59	1.5	0.011 (A)	0.008	0.008	0.021 (A)	0.062	0.05	1600 (> MAS)	1584	540	0.81 (D)	0.9	1
Kawaunui Stm SH5 Br	2.7 (C)	2.58	2.4	3.5 (B)	2.85	1.5	0.005 (A)	0.006	0.006	0.037 (A)	0.079	0.05	2100 (> MAS)	2335	540	1.32 (C)	1.4	1.6
Waiotapu Stm Campbell Rd Br	0.92 (A)	0.915	0.915	1.056 (A)	1.1	1.1	0.332 (C)	0.291	0.24	0.375 (B)	0.315	0.05	125 (A)	18		1.15 (C)	1.2	1.6
Otamakokore Stm Hossack Rd	0.92 (A)	0.74	0.74	2.03 (B)	1.19	1.19	0.007 (A)	0.006	0.006	0.053 (B)	0.024	0.024	1900 (> MAS)	680	540	1.15 (C)	1.2	1.6
Whirinaki Stm Corbett Rd	0.8 (A)	0.77	0.77	1.015 (A)	0.87	0.87	0.002 (A)	0.002	0.002	0.01 (A)	0.012	0.012	370 (B)	98	98		2.7	3
Tahunaatara Stm Ohakuri Rd	0.65 (A)	0.555	0.555	1.155 (A)	0.83	0.83	0.003 (A)	0.003	0.003	0.029 (A)	0.015	0.015	6000 (> MAS)	783	540	1.15 (C)	1.3	1.6
Mangaharakeke Stm SH30 (Off Jct SH1)	0.61 (A)	0.525	0.525	1.065 (A)	0.75	0.75	0.003 (A)	0.003		0.02 (A)	0.015	0.015	2050 (> MAS)	684	540	0.85 (D)	1.1	1.6
Waipapa Stm (Mokai) Tirohanga Rd Br	1.345 (B)	1.189	1	1.755 (B)	1.5	1.5	0.003 (A)	0.003	0.003	0.005 (A)	0.005	0.005	500 (B)	1147	540	1.24 (C)	1.2	1.6
Mangakino Stm Sandel Rd	0.72 (A)	0.65	0.65	1.03 (A)	0.86	0.86	0.002 (A)	0.003	0.003	0.006 (A)	0.012	0.012	1800 (> MAS)	251	251	1.92 (B)	1.8	3
Whakauru Stm SH1 Br	0.71 (A)	0.26	0.26	1.36 (A)	0.45	0.45	0.006 (A)	0.003	0.003	0.018 (A)	0.033	0.033	3100 (> MAS)	2106	540	0.59 (D)	0.8	1
Mangamingi Stm Paraonui Rd Br	2.65 (C)	2.76	2.4	3.35 (B)	3.12	1.5	0.145 (B)	0.091	0.03	0.386 (B)	0.296	0.05	4650 (> MAS)	2151	540	0.81 (D)	0.8	1
Pokaiwhenua Stm Arapuni - Putaruru Rd	2 (B)	1.68	1	2.7 (B)	2.04	1.5	0.005 (A)	0.002	0.002	0.042 (A)	0.02	0.02	2650 (> MAS)	1363	540	1.13 (C)	1.3	1.6

Little Waipa Stm Arapuni - Putaruru Rd	1.945 (B)	1.522	1	2.8 (B)	2.04	1.5	0.005 (A)	0.002	0.002	0.131 (B)	0.085	0.05	2000 (> MAS)	1377	540	1.81 (B)	1.5	1.6
Middle Waikato FMU																		
Waikato River Narrows Boat Ramp	0.3 (A)	0.235	0.235	0.605 (A)	0.5	0.5	0.008 (A)	0.009	0.009	0.024 (A)	0.018	0.018	1500 (> MAS)	340	260	1.92 (B)	1.7	1.7
Waikato River Horotiu Br	0.32 (A)	0.26	0.26	0.655 (A)	0.53	0.53	0.005 (A)	0.007	0.007	0.019 (A)	0.029	0.029	1750 (> MAS)	774	540	1.5 (C)	1.4	1.6
Karapiro Stm Hickey Rd Bridge	0.68 (A)	0.52	0.52	1.78 (B)	1.689	1.5	0.009 (A)	0.008	0.008	0.057 (B)	0.031	0.031	10500 (> MAS)	4518	540	0.84 (D)	0.9	1
Mangawhero Stm Cambridge-Ohaupo	1.96 (B)	1.99	1	2.75 (B)	2.49	1.5	0.045 (B)	0.041	0.03	0.097 (B)	0.072	0.05	3000 (> MAS)	2920	540	0.24 (D)	0.3	1
Mangaonua Stm Hoeka Rd	1.46 (B)	1.455	1	2.1 (B)	1.878	1.5	0.031 (B)	0.036	0.03	0.058 (B)	0.051	0.05	7250 (> MAS)	6372	540	1.06 (C)	1	1
Mangaone Stm Annebrooke Rd Br	2.4 (B)	2.58	2.4	3 (B)	2.94	1.5	0.009 (A)	0.009	0.009	0.024 (A)	0.02	0.02	2050 (> MAS)	2052	540	1.18 (C)	0.9	1
Mangakotukutuku Stm Peacockes Rd	0.85 (A)	0.8	0.8	1.745 (B)	1.788	1.5	0.082 (B)	0.077	0.03	0.169 (B)	0.132	0.05	20000 (> MAS)	1139 4	540	0.5 (D)	0.5	1
Waitawhiriwhiri Stm Edgecumbe Street	0.86 (A)	0.88	0.88	1.175 (A)	1.24	1.24	0.24 (B)	0.256	0.24	0.362 (B)	0.318	0.05	13000 (> MAS)	5922	540	0.41 (D)	0.4	1
Kirikiroa Stm Tauhara Dr	0.765 (A)	0.815	0.815	2.2 (B)	1.572	1.5	0.097 (B)	0.096	0.03	0.228 (B)	0.183	0.05	9900 (> MAS)	2124	540	0.42 (D)	0.5	1
Lower Waikato FMU																		
Waikato River Huntly-Tainui Br	0.43 (A)	0.365	0.365	1.05 (A)	0.9	0.9	0.005 (A)	0.005	0.005	0.02 (A)	0.015	0.015	3350 (> MAS)	1944	540	1.02 (C)	0.9	1
Waikato River Mercer Br	0.425 (A)	0.365	0.365	1.045 (A)	0.87	0.87	0.003 (A)	0.003	0.003	0.018 (A)	0.01	0.01	2650 (> MAS)	1494	540	0.43 (D)		
Waikato River Tuakau Br	0.415 (A)	0.325	0.325	1.01 (A)	0.88	0.88	0.003 (A)	0.003	0.003	0.016 (A)	0.008	0.008	2250 (> MAS)	1584	540	0.66 (D)	0.7	1
Komakorau Stm Henry Rd	1.4 (B)	1.279	1	4.25 (C)	4.4	3.5	0.273 (C)	0.25	0.24	0.443 (C)	0.419	0.4	5200 (> MAS)	3474	540	0.15 (D)	0.3	1
Mangawara Stm Rutherford Rd Br	0.89 (A)	0.765	0.765	4.55 (C)	2.76	1.5	0.145 (B)	0.103	0.03	0.216 (B)	0.172	0.05	5800 (> MAS)	4955	540	0.23 (D)	0.3	1
Awaroa Stm (Rotowaro) Sansons Br @ Rotowaro-Huntly Rd	0.525 (A)	0.7	0.7	1.065 (A)	1.19	1.19	0.032 (B)	0.021	0.021	0.193 (B)	0.089	0.05	1150 (> MAS)	1800	540	1.02 (C)	0.8	1
Matahuru Stm Waiterimu Road Below Confluence	0.77 (A)	0.715	0.715	1.835 (B)	1.689	1.5	0.028 (A)	0.016	0.016	0.086 (B)	0.059	0.05	12300 (> MAS)	6147	540	0.35 (D)	0.4	1
Whangape Stm Rangiriri-Glen Murray Rd	0.022 (A)	0.004	0.004	0.89 (A)	0.69	0.69	0.006 (A)	0.006	0.006	0.199 (B)	0.134	0.05	825 (> MAS)	584	540	0.15 (D)	0.3	1
Waerenga Stm SH2 Maramarua	0.86 (A)	0.82	0.82	1.335 (A)	1.41	1.41	0.006 (A)	0.005	0.005	0.02 (A)	0.022	0.022	5850 (> MAS)	5098	540	0.9 (D)	0.9	1
Whangamarino River Jefferies Rd Br	0.645 (A)	0.625	0.625	2.2 (B)	1.842	1.5	0.017 (A)	0.012	0.012	0.062 (B)	0.147	0.05	6950 (> MAS)	4712	540	0.33 (D)	0.6	1
Mangatangi River SH2 Maramarua	0.225 (A)	0.11	0.11	1.175 (A)	1.12	1.12	0.008 (A)	0.005	0.005	0.038 (A)	0.038	0.038	2500 (> MAS)	5567	540	0.48 (D)	0.5	1
Mangatawhiri River Lyons Rd Buckingham Br	0.052 (A)	0.013	0.013	0.49 (A)	0.37	0.37	0.003 (A)	0.003	0.003	0.012 (A)	0.011	0.011	1150 (> MAS)	5108	540	1.84 (B)	1.6	1.6

Whangamarino River Island Block Rd	0.138 (A)	0.075	0.075	1.01 (A)	0.7	0.7	0.028 (A)	0.011	0.011	0.148 (B)	0.054	0.05	1100 (> MAS)	655	540	0.2 (D)	0.3	1
Whakapipi Stm SH22 Br	3.9 (C)	3.39	2.4	6.1 (C)	5.12	3.5	0.006 (A)	0.006	0.006	0.02 (A)	0.081	0.05	1900 (> MAS)	1773	540	1.56 (C)	1.1	1.1
Ohaeroa Stm SH22 Br	1.655 (B)	1.473	1	2.2 (B)	1.806	1.5	0.004 (A)	0.003	0.003	0.014 (A)	0.015	0.015	1450 (> MAS)	4667	540	0.92 (D)	0.8	1
Opuatia Stm Ponganui Rd	0.785 (A)	0.74	0.74	1.12 (A)	1.06	1.06	0.006 (A)	0.005	0.005	0.015 (A)	0.016	0.016	3300 (> MAS)	2898	540	0.6 (D)	0.6	1
Awaroa River (Waiuku) Otatau Rd Br Moseley Rd	1.51 (B)	1.369	1	2.5 (B)	2.31	1.5	0.022 (A)	0.021	0.021	0.064 (B)	0.135	0.05	6500 (> MAS)	1017	540	0.41 (D)	0.4	1
Waipa River FMU																		
Waipa River Mangaokewa Rd	0.3 (A)	0.38	0.38	0.53 (A)	0.6	0.6	0.003 (A)	0.003	0.003	0.013 (A)	0.017	0.017	2400 (> MAS)	2417	540	1.82 (B)	1.5	1.6
Waipa River at Otewa	0.285 (A)	0.228	0.228	0.586 (A)	0.502	0.502	0.004 (A)	0.003	0.003	0.018 (A)	0.008	0.008	4616 (> MAS)	2036	540	1.47 (C)	2.1	2.1
Waipa River SH3 Otorohanga	0.44 (A)	0.37	0.37	1.09 (A)	1.05	1.05	0.006 (A)	0.004	0.004	0.024 (A)	0.02	0.02	4200 (> MAS)	3289	540	1.23 (C)	1.2	1.6
Waipa River Pirongia-Ngutunui Rd br	0.69 (A)	0.565	0.565	1.367 (A)	1.27	1.27	0.01 (A)	0.008	0.008	0.03 (A)	0.023	0.023	7100 (> MAS)	4441	540	0.47 (D)	0.7	1
Waipa River at Whatawhata Bridge	0.78 (A)	0.673	0.673	1.454 (A)	1.319	1.319	0.012 (A)	0.009	0.009	0.021 (A)	0.026	0.026	4899 (> MAS)	3657	540	0.56 (D)	0.6	1
Ohote Stm Whatawhata/Horotiu Rd	0.495 (A)	0.495	0.495	1.45 (A)	1.37	1.37	0.027 (A)	0.023	0.023	0.061 (B)	0.052	0.05	1850 (> MAS)	2142	540	0.6 (D)	0.6	1
Kaniwhaniwha Stm Wright Rd	0.425 (A)	0.35	0.35	0.985 (A)	0.89	0.89	0.009 (A)	0.007	0.007	0.027 (A)	0.022	0.022	4200 (> MAS)	1917	540	0.8 (D)	0.9	1
Mangapiko Bowman Rd Stm	1.71 (B)	1.369	1	3.05 (B)	2.49	1.5	0.021 (A)	0.022	0.022	0.073 (B)	0.076	0.03	9500 (> MAS)	7074	540	0.66 (D)	0.6	1
Mangaohoi Stm South Branch Maru Rd	0.197 (A)	0.23	0.23	0.39 (A)	0.39	0.39	0.003 (A)	0.003	0.003	0.007 (A)	0.008	0.008	1000 (> MAS)	943	540	1.55 (C)	1.6	1.6
Mangauika Stm Te Awamutu Borough W/S Intake	0.205 (A)	0.21	0.21	0.27 (A)	0.28	0.28	0.002 (A)	0.002	0.002	0.006 (A)	0.003	0.003	745 (> MAS)	1008	540	4.92 (A)	3.3	3.3
Puniu River Bartons Corner Rd Br	0.68 (A)	0.65	0.65	1.56 (B)	1.28	1.28	0.01 (A)	0.007	0.007	0.034 (A)	0.029	0.029	5600 (> MAS)	2790	540	0.7 (D)	0.9	1
Mangatutu Stm Walker Rd Br	0.35 (A)	0.38	0.38	1.04 (A)	0.88	0.88	0.003 (A)	0.003	0.003	0.024 (A)	0.012	0.012	7000 (> MAS)	738	540	1.57 (C)	1.5	1.6
Waitomo Stm SH31 Otorohanga	0.58 (A)	0.52	0.52	0.87 (A)	0.83	0.83	0.011 (A)	0.008	0.008	0.042 (A)	0.025	0.025	5350 (> MAS)	1453	540	0.52 (D)	0.6	1
Mangapu River Otorohanga	0.81 (A)	0.86	0.86	1.468 (A)	1.36	1.36	0.013 (A)	0.015	0.015	0.044 (A)	0.057	0.05	6750 (> MAS)	4284	540	0.56 (D)	0.7	1
Waitomo Stm Tumutumu Rd	0.615 (A)	0.63	0.63	0.755 (A)	0.8	0.8	0.004 (A)	0.004	0.004	0.029 (A)	0.013	0.013	2400 (> MAS)	2241	540	0.95 (D)	1.1	1.6
Mangaokewa Stm Lawrence Street Br	0.61 (A)	0.53	0.53	1.03 (A)	0.98	0.98	0.006 (A)	0.004	0.004	0.052 (B)	0.013	0.013	14000 (> MAS)	6224	540	0.83 (D)	1.4	1.6

Attachment 1 Revised table of current state values (2010–14).

Attachment 1: Current state water quality variables for the Waikato and Waipa River catchment, 2010–14, as revised by Waikato Regional Council staff, March 2019. Note that where possible, *E. coli* results obtained in 2009 were included to help ensure a sample size of 60; even so, in many cases the sample size was lower than this (in the range 22–39): these values are shown in brackets. Note also that water clarity results obtained at river flows higher than the 90-percentile flow were ignored. Note ammonia is pH-adjusted to pH 8 as specified in the National Objectives Framework and the ammonia maximum is the average of 5 annual maxima. “Med”, median; “Max”, maximum; “95%ile”, 95-percentile; “N”, nitrogen; “P”, phosphorus.

	Med Chla	Max Chla	Med total N	Med total P	Med nitrate	95%ile nitrate	Med ammonia	Max ammonia	95%ile <i>E. coli</i>	Med clarity
	(mg/m ³)	(mg/m ³)	(mg/m ³)	(mg/m ³)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(/100 mL)	(m)
Upper Waikato FMU										
Waikato River Ohaaki Br	1.5	13	134	10	0.039	0.076	0.002	0.013	80	3.80
Waikato River Ohakuri Tailrace Br	3.1	11	216	17	0.086	0.177	0.003	0.017	16	2.25
Waikato River Whakamaru Tailrace			271	20	0.101	0.251	0.003	0.010	60	1.87
Waikato River Waipapa Tailrace	4.0	25	336	25	0.164	0.320	0.007	0.016	140	1.86
Pueto Stm Broadlands Rd Br			540	93	0.450	0.536	0.003	0.009	(92)	1.64
Torepatutahi Stm Vaile Rd Br			625	96	0.500	0.825	0.002	0.011	(215)	
Waiotapu Stm Homestead Rd Br			1860	100	1.285	1.665	0.121	0.190	(280)	
Mangakara Stm (Reporoa) SH5			1580	74	1.300	1.675	0.008	0.063	(1700)	0.86
Kawaunui Stm SH5 Br			2990	82	2.600	3.100	0.006	0.083	(2535)	1.33
Waiotapu Stm Campbell Rd Br			1955	72	0.915	1.135	0.301	0.349	(18)	1.17
Otamakokore Stm Hossack Rd			990	144	0.740	1.360	0.006	0.025	(696)	1.10
Whirinaki Stm Corbett Rd			810	62	0.770	0.885	0.002	0.013	(98)	
Tahunaatara Stm Ohakuri Rd			780	44	0.555	0.845	0.003	0.015	(810)	1.25
Mangaharakeke Stm SH30			685	48	0.525	0.795	0.003	0.015	(700)	1.02
Waipapa Stm (Mokai) Tirohanga Rd			1355	95	1.210	1.555	0.003	0.005	(1215)	1.11
Mangakino Stm Sandel Rd			760	47	0.650	0.875	0.003	0.012	(250)	1.63
Whakauru Stm SH1 Br			470	42	0.260	0.461	0.003	0.033	(2280)	0.75
Mangamingi Stm Paraonui Rd			3495	325	2.800	3.400	0.098	0.323	(2330)	0.82
Pokaiwhenua Stm Arapuni - Putaruru			2010	106	1.755	2.200	0.002	0.020	(1455)	1.26
Little Waipa Stm Arapuni - Putaruru			1780	68	1.580	2.150	0.002	0.089	(1470)	1.53
Middle Waikato FMU										
Waikato River Narrows Boat Ramp	5.5	23	410	28	0.235	0.545	0.010	0.018	265	1.60
Waikato River Horotiu Br	6.0	23	441	36	0.260	0.550	0.007	0.029	650	1.35
Karapiro Stm Hickey Rd Bridge			860	86	0.520	1.760	0.008	0.031	(4960)	0.93
Mangawhero Stm Cambridge-Ohaupo			2930	163	2.100	2.720	0.042	0.074	(3185)	0.26
Mangaonua Stm Hoeka Rd			1905	52	1.505	2.100	0.037	0.051	(7020)	0.91

Mangaone Stm Annebrooke Rd Br			3060	118	2.600	3.200	0.009	0.020	(2220)	0.95
Mangakotukutuku Stm Peacockes Rd			1875	415	0.800	2.350	0.082	0.141	(12600)	0.41
Waitawhiriwhiri Stm Edgcombe Street			2110	91	0.880	1.265	0.258	0.346	(6520)	0.38
Kirikiroa Stm Tauhara Dr			1490	63	0.815	1.975	0.104	0.198	(3620)	0.40
Lower Waikato FMU										
Waikato River Huntly-Tainui Br	6.0	19	585	45	0.365	1.010	0.005	0.015	2000	0.87
Waikato River Mercer Br	10.5	30	662	52	0.365	0.895	0.003	0.011	1550	
Waikato River Tuakau Br	12.0	38	595	52	0.325	0.890	0.003	0.008	1600	0.61
Komakorau Stm Henry Rd			2900	90	1.310	5.300	0.251	0.421	(3800)	0.17
Mangawara Stm Rutherford Rd Br			1890	210	0.765	3.350	0.111	0.185	(5445)	0.25
Awaroa Stm (Rotowaro) Sansons Br			990	12	0.700	1.390	0.024	0.093	(1940)	0.84
Matahuru Stm Waiterimu Road			1310	98	0.715	1.905	0.017	0.060	(6770)	0.31
Whangape Stm Rangiriri-Glen Murray Rd			2116	122	0.004	0.795	0.008	0.143	(588)	0.17
Waerenga Stm SH2 Maramarua			1115	46	0.820	1.420	0.005	0.023	(5605)	0.83
Whangamarino River Jefferies Rd Br			1085	88	0.625	2.500	0.011	0.055	(5175)	0.49
Mangatangi River SH2 Maramarua			493	72	0.110	1.290	0.006	0.038	(6125)	0.54
Mangatawhiri River Lyons Rd Buckingham Br			181	23	0.013	0.400	0.003	0.011	(5615)	1.63
Whangamarino River Island Block Rd			1831	152	0.075	0.865	0.013	0.158	(667)	0.20
Whakapipi Stm SH22 Br			3875	51	3.500	5.350	0.006	0.084	(1910)	1.10
Ohaeroa Stm SH22 Br			1825	26	1.525	1.915	0.003	0.015	(5125)	0.81
Opuatia Stm Ponganui Rd			1070	31	0.740	1.081	0.005	0.016	(3160)	0.53
Awaroa River (Waiuku) Otaua Rd Br Moseley			2095	46	1.410	2.500	0.022	0.144	(1070)	0.37
Waipa River FMU										
Waipa River Mangaokewa Rd			585	16	0.380	0.710	0.003	0.017	(2625)	1.51
Waipa River at Otewa					0.228	0.504	0.003	0.008	2203	2.13
Waipa River SH3 Otorohanga			600	22	0.370	1.150	0.004	0.020	(3595)	1.11
Waipa River Pirongia-Ngutunui Rd br			860	48	0.565	1.535	0.008	0.023	(4875)	0.63
Waipa River at Whatawhata Bridge					0.673	1.587	0.009	0.026	4003	0.63
Ohote Stm Whatawhata/Horotiu Rd			1320	76	0.495	1.385	0.023	0.054	(2320)	0.55
Kaniwhaniwha Stm Wright Rd			590	29	0.350	0.995	0.007	0.022	(2070)	0.87
Mangapiko Bowman Rd Stm			2095	240	1.410	2.650	0.022	0.078	(7800)	0.61
Mangaohoi Stm South Branch Maru Rd			365	52	0.230	0.415	0.003	0.008	(987)	1.58
Mangauika Stm Te Awamutu Borough W/S			275	8	0.210	0.286	0.002	0.003	(1060)	3.60
Puniu River Bartons Corner Rd Br			910	48	0.650	1.305	0.007	0.029	(3040)	0.94
Mangatutu Stm Walker Rd Br			510	20	0.380	0.908	0.003	0.012	(760)	1.53
Waitomo Stm SH31 Otorohanga			755	30	0.520	0.925	0.008	0.026	(1555)	0.59
Mangapu River Otorohanga			1240	60	0.860	1.428	0.016	0.064	(4700)	0.61
Waitomo Stm Tumutumu Rd			765	22	0.630	0.825	0.004	0.013	(2430)	0.95
Mangaokewa Stm Lawrence Street Br			775	36	0.525	1.060	0.005	0.014	(6855)	1.10

QUESTION 13: Nitrogen Load to Come

15. The panel has asked the following question:

To give some context to this issue, can the Panel please be provided with maps focusing on the approximate areas where dairy conversions have occurred in two time steps, say 2000-2010 and from 2010 to the most recent point in time that Council has data available (the maps supporting the s32 analysis combine all land uses in different time periods and it is difficult to identify the scale of the changes over time).

RESPONSE

16. Map yet to be provided. Council is currently working on an agreed methodology to bring together the varying sources of information for land use conversion from the different time periods and undertaking appropriate analysis and verification.

Dr Mike Scarsbrook

11 March 2019