IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of applications for consents (APP-1995014433.02, 2005011178.01, 2016200772.00, 2017201455.00) by the TARARUA DISTRICT COUNCIL to the HORIZONS REGIONAL COUNCIL for resource consents associated with the operation of the Pahiatua Wastewater Treatment Plant, including earthworks, a discharge into Town Creek (initially), then to the Mangatainoka River, a discharge to air (principally odour), and discharges to land via seepage, Julia Street, Pahiatua.

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STATEMENT OF EVIDENCE OF DR OLIVIER MICHEL NICOLAS AUSSEIL (FRESHWATER QUALITY) ON BEHALF OF TARARUA DISTRICT COUNCIL

28 April 2017

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1. INTRODUCTION

1.1 My name is Olivier Michel Nicolas Ausseil (pronounced "O-Say").

1.2 I am Principal Scientist – Water Quality at Aquanet Consulting Ltd, a water quality and ecology consultancy based in Palmerston North and Wellington.

1.3 My evidence is given in relation to the application for resource consents for the discharges from the Pahiatua Wastewater Treatment Plant (WWTP) lodged by Tararua District Council (TDC).

2. QUALIFICATIONS AND EXPERIENCE

2.1 I have the following qualifications and experience relevant to my evidence.

2.2 I hold a PhD of Environmental Biosciences, Chemistry and Health from the University of Provence, France. I also hold a Master of Science Degree of Agronomical Engineering from the National Higher Agronomical School of Montpellier, France, and a DEA (equivalent Masters Degree) in Freshwater Environmental Sciences from the University of Montpellier II, France.

2.3 I have over 14 years' experience in New Zealand as a scientist working in local government and as a private consultant working for regional councils and local authorities, central government and government agencies, and the private sector. Prior to that, I worked as a Research Engineer between 1998 and 2001 for the French Atomic Energy Commissariat during my PhD studies.

2.4 Prior to forming Aquanet Consulting Ltd, I was employed by the Regional Planning Group of Horizons from July 2002 to June 2007, where I held the positions of Project Scientist, Environmental Scientist- Water Quality, and Senior Scientist - Water Quality.

2.5 My responsibilities at Horizons included leading the water quality and aquatic biodiversity monitoring and research programme, providing technical support to policy development and reporting on resource consent applications. I was the primary author of three technical reports underpinning the river classification, river values framework and water quality standards in the notified version of the Proposed One Plan for the Manawatu-Wanganui Region.

2.6 Since July 2007, I have been Principal Scientist at Aquanet Consulting Limited. In this position, I have been engaged by 17 different regional, district or city councils, the Ministry for the Environment, a number of iwi/hapū, the Department of Conservation, Fish and Game New Zealand, and various private companies/corporations to provide a variety of technical and scientific services in relation to water quality and aquatic ecology.

2.7 I am a certified Commissioner under the Ministry for the Environment "Making Good Decisions" programme. I was a Hearing Commissioner appointed by Horizons to hear New Zealand Defence Force's consent applications to discharge treated wastewater from the Waiouru wastewater treatment plant to the Waitangi Stream, in June 2011 and February 2012.

2.8 I have worked as a technical advisor on behalf of the consenting authority, the applicant and/or submitters on well over 150 resource consent applications, compliance assessments and/or prosecution cases for a wide range of activities.

2.9 My work routinely involves providing assessment of effects on water quality and/or aquatic ecology, recommending or assessing compliance with, resource consent conditions, and designing or implementing water quality/aquatic ecology monitoring programmes. I have designed and implemented a large number of monitoring programmes both at the scale of a specific activity and at a wider catchment or regional scale. As part of my previous role at Horizons I redesigned the state of the environment water quality monitoring programme. I also undertook a detailed review of Environment Southland's water quality monitoring programme in 2010 and of Environment Bay of Plenty's in 2012.

2.10 I am currently the Project Manager for the development of the National Environmental Monitoring Standards (NEMS) for discrete water quality monitoring. This particular Standard encompasses all sampling and field measurement procedures, laboratory methods as well as data management and quality control for water quality monitoring in rivers, lakes, groundwater and coastal waters.

2.11 I have authored or co-authored numerous catchment- or region-wide water quality reports for Greater Wellington Regional Council (whole region), Hawke's Bay Regional Council on 7 catchments (2008 and 2016), and for Environment Canterbury on the Hurunui catchment and Pegasus Bay.

2.12 I have authored various reports making recommendations for water quality limits for regional plan change processes, for Horizons Regional Council, Hawke's Bay Regional Council and Greater Wellington Regional Council. I am currently involved in the Gisborne District Freshwater Plan on behalf of the Mangatu/Wi Pere Trusts, and in the Waikato Regional Plan Change 1 on behalf of the Five Waikato River Iwi.

2.13 With regards to municipal wastewater treatment plants I have worked as a technical advisor on behalf of consenting authorities, applicants and submitters on over 35 resource consent applications for discharges of treated domestic wastewater to land and/or water, from both medium-sized towns and small communities.

2.14 I am a member of the New Zealand Freshwater Sciences Society and the Resource Management Act Law Association (RMLA).

2.15 I was the co-recipient of the New Zealand Resource Management Law Association 2016 Chapman Tripp Project Award for an ongoing consultation process associated with the re-consenting of wastewater treatment plant and community water supplies in the Ruapehu District.

2.16 I confirm that I have read the 'Code of Conduct' for expert witnesses contained in the Environment Court Practice Note 2014. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

BACKGROUND AND ROLE

2.17 I was engaged by Tararua District Council in December 2014 to review the assessment of effects of the Pahiatua Wastewater Treatment Plant (WWTP) discharge on water quality and freshwater ecology prepared by Dr Neale Hudson (Opus, 2014). My review is summarised in a technical memo dated 17th December 2014, included in the application bundle. In this assessment, I also provided an assessment against the RMA S107(1) narrative water quality standards, the NPSFM Attribute States for periphyton, ammonia and nitrate, and the One Plan Schedule E water quality targets.

2.18 The original application involved the use of the water intake gallery located on the true right bank of the Mangatainoka River. This discharge location raised some issues with regards to monitoring and monitoring locations. I participated in technical discussions with Ms Maree Patterson, Horizons' Senior Water Quality Scientist to resolve issues related to monitoring the effects of the Pahiatua WWTP discharge. In March 2017 I co-signed, with Ms Patterson a memo discussing the current level of effects and options regarding monitoring. Although it is not now proposed to use the intake gallery as the discharge structure, discussions regarding the current level of effects and degree of monitoring required in the future are entirely relevant to the consideration of this application. The memo is attached as Appendix B of this evidence.

2.19 I participated in the three pre-hearings held in relation to Pahiatua and Eketahuna WWTPs. One aspect that struck me during this process was the degree of confusion that running a joint process for two different WWTPs seemed to cause in relation to the effects of the two discharges on water quality and ecology. In my opinion, the situation for the Pahiatua WWTP is very different from that at Eketahuna.

2.20 I also contributed to the responses to the two S92 requests for further information provided in December 2015 and April 2017.

2.21 I have visited the Pahiatua WWTP on several occasions over the last three years, including looking at potential monitoring sites' characteristics and accessibility. Through my work in the region over the last 15 years, I am very familiar with Manawatu catchment and the Mangatainoka River and their recreational and ecological values.

2.22 I have read Mr Patterson's S42A report and have responded to issues raised by Mr Patterson. I have also read, and relied on, the evidence prepared by Mr John Crawford in relation to the WWTP treatment process and performance and by Mr Roger McGibbon in relation to wetland design.

3. SCOPE OF EVIDENCE

3.1 My evidence addresses the following matters:

(a) River values and water quality targets;

(b) An analysis of the current effects of the discharge, based on existing water quality and ecological data;

(c) An assessment of the potential future effects of the discharge, on the basis of the proposed changes to the current discharge quality and location;

(d) A response to Mr Patterson's S42A report;

(e) Recommendations relative to consent conditions.

3.2 As indicated above, I have carefully read Mr Patterson's s42A report and, where I substantively agree with his evidence, have directly referred to specific sections of his report to avoid duplication.

4. SUMMARY OF EVIDENCE

4.1 The current effects of the Pahiatua WWTP discharge on the Mangatainoka River's water quality and ecology can be summarised as follows:

(a) The discharge is currently to Town Creek, a small, but permanently flowing tributary of the Mangatainoka River. Although there is only very limited information, I expect the effects on Town Creek to be significant, and I support the shifting of the discharge point out of Town Creek;

(b) The current monitoring sites are upstream and downstream of the confluence between Town Creek and the Mangatainoka River, thus monitoring results incorporate the effects of both town Creek and the WWTP discharge. It is also possible that some, limited,

attenuation of contaminants from the discharge occurs within Town Creek. Shifting the discharge to the new proposed discharge point will enable a more direct measurement of the actual effects of the discharge. Suitable monitoring sites are available upstream and downstream of the new proposed discharge point for both water quality and ecological monitoring.

(c) The discharge currently causes a small, but statistically significant, increase in ammoniacal nitrogen concentration, but well below One Plan targets. The risk of ammonia toxicity on aquatic life can be considered as low;

(d) There are no statistically significant increases in *E. coli* concentrations downstream of the discharge; however, the proportion of samples exceeding the One Plan targets increases slightly.

(e) The One Plan target relative to DRP is exceeded both upstream and downstream of the discharge. The discharge causes a moderate, but statistically significant, increase in DRP concentration in the Mangatainoka River, and has the potential cause a material, but not major, increase in DRP concentrations under low flow conditions.

(f) The One Plan SIN target is exceeded upstream and downstream of the discharge. The discharge does not cause a statistically detectable increase in SIN concentrations, and does not have the potential to cause more than a minor increase in in-stream SIN concentrations or loads, even during periods of low flows.;

(g) With regards to periphyton:

  (i) There is a measurable, but mild, effect on periphyton biomass when comparing immediately upstream and downstream of the discharge;

  (ii) Both the upstream and downstream sites are within "Band B" of the NPSFM, indicating "*occasional blooms reflecting low nutrient enrichment and/ or alteration of the natural flow regime or habitat*"

  (iii) There is no clear evidence of an increase in periphyton cover between upstream and downstream of the discharge in the last 5 years;

  (iv) Interestingly, the Pahiatua at Town Bridge site, located 1.5 km upstream of the discharge point presents significantly more periphyton growth the sites upstream or downstream of the discharge. This is in spite of an increase in DRP concentrations (SIN remaining similar) between Town Bridge and upstream of the discharge.

(v) In my assessment, the One Plan target relative to periphyton biomass is met overall upstream of the discharge and met or very marginally (depending on the assessment method used) exceeded downstream of the discharge.

4.2 The discharge does not appear to cause any more than minor effects on macroinvertebrate communities. The RMA S107(1)(g) narrative standard and the One Plan QMCI change targets are currently met.

4.3 With regards to the causes of the current, mild increase in periphyton biomass, and the future (i.e. post-commissioning of the upgrade) effects of the discharge:

(a) SIN concentrations are always elevated in the Mangatainoka River, well above periphyton growth requirements, including during low river flows. As a result, P-limited conditions dominate in the Mangatainoka River under all flow conditions;

(b) It is likely that the mild increase in periphyton growth measured downstream of the discharge, compared with upstream is caused by the phosphorus content of the discharge. The nitrogen content is unlikely to cause any material increase in periphyton growth, given the nitrogen saturated conditions upstream of the discharge, and the very small incremental increase caused by the discharge.

(c) The proposed upgrades are intended to significantly (by a factor 3) reduce DRP concentrations in the discharge. This is expected to reduce the effects of the discharge on periphyton growth. Once the proposed effluent standard is met, the potential increase in DRP concentrations during low flows will be of limited ecological relevance.

(d) Monitoring will address any remaining uncertainty with regards to the effects of the discharge on periphyton growth.

4.4 I expect that a well functioning UV plant will reduce *E. coli* concentrations in the effluent to a point where effects on in-river *E. coli* concentrations in of no material concern.

5. RIVER VALUES AND WATER QUALITY TARGETS

5.1 In paragraphs 14 to 20, Mr Patterson provides a summary of the river values identified in the One Plan in relation to the Mangatainoka River. I agree with Mr Patterson's assessment and I do not repeat it here.

5.2 Appendix 1 of Mr Patterson's evidence presents the One Plan (Schedule E) water quality targets applicable to the Lower Mangatainoka water management sub-zone, in which the discharge is located. Again, I agree with Mr Patterson's assessment, and do not repeat it in my evidence.

5.3 In his evidence, Mr Patterson discusses compliance with the One Plan periphyton targets. I do not agree with the assessment method used by Mr Patterson (95th percentile of the data), and also note that there are discrepancies between the assessment method used by Mr Patterson, and the way the One Plan periphyton targets have been applied in recent resource consents (e.g. Feilding WWTP), or are proposed to be applied in consent conditions (even the conditions proposed by Horizons differ between Pahiatua and Eketahuna WWTPs). I discuss this further in my evidence.

5.4 It is important to note that, from a technical point of view different Schedule E targets were defined for different reasons. In particular:

(a) Some of the targets are only defined as "State of the Environment" targets and are not directly applicable to point source discharges. This is, for example, the case for MCI and deposited sediment;

(b) Some of the targets directly relate to (i.e. are a measure of) the state of a given river value. For example, visual water clarity and periphyton cover directly relates to the aesthetic and recreational values of the river. Likewise, MCI provides a direct measure of the river's life-supporting capacity, and the change in QMCI provides a direct measure of the degree of effects of a specific activity on life supporting capacity;

(c) By contrast, other targets, such as DRP, SIN, $ScBOD_5$ or POM targets do not directly relate to effects on river values, rather they are a sub-set of controlling factors to other factors (such as periphyton growth), which can directly affect river values. Specifically, it means that, from a technical point of view, in-stream nutrient (DRP and SIN) can be considered subsidiary to the periphyton and macroinvertebrate targets.

5.5 The above comment has relevance to the decision to apply different targets in different contexts, including in resource consent conditions.

6. CURRENT EFFECTS

6.1 The discharge is currently to Town Creek, a small, but permanently flowing tributary of the Mangatainoka River. Although there is only very limited information, I expect the effects on Town Creek to be significant, and I support the shifting of the discharge point out of Town Creek.

6.2 The current in-river monitoring sites are located in the Mangatainoka River upstream and downstream of the confluence with Town Creek, thus monitoring results relate to effects on the Mangatainoka River and incorporate the effects of both town Creek and the WWTP discharge. It is

also possible that some, limited, attenuation of contaminants from the discharge occurs within Town Creek. Shifting the discharge to the new proposed discharge point will enable a more direct measurement of the actual effects of the discharge. As detailed in the 12 April 2017 S92 response, I am of the view that suitable monitoring sites are available upstream and downstream of the new proposed discharge point for both water quality and ecological monitoring.

6.3 Appendix A to this evidence provides an update of in-stream data analysis. A summary of the data analysis methodology, graphs and a short factual summary are provided in Appendix A. The paragraphs below provide a summary of the effects of the discharge on the basis of monitoring data available.

6.4 Statistically significant increases in ammoniacal nitrogen concentrations were only detected in some of the flow bins (all flows, and <20th FEP). Total ammoniacal nitrogen concentrations were always well below the One Plan targets, both upstream and downstream of the Pahiatua WWTP discharge (Appendix 1, Section 1.3.1 and Figure 2), indicating a low risk of toxic effects from ammonia on aquatic life both upstream and downstream of the discharge.

6.5 With regards to the NPSFM (2014) Attribute State for Ammonia, both upstream downstream sites were in Band A during the whole monitoring period when considering median concentrations (Appendix A, Figure 3, upper). However, with regards to maximum concentrations (Appendix A, Figure 3, lower), the early part of the monitoring period was different from the latter part. The downstream site was in Band D, then Band C in 2011-2012, while the upstream site was in Band B. Since early 2013 however, both sites have remained in Band A.

6.6 Interrogating the data further, it appears that the above was due to two high ammoniacal nitrogen concentrations reported for the downstream site in 2011, on 8 March (1.8 g/m^3) and 8 June (1.4 g/m^3). Ammoniacal nitrogen concentration in the effluent on 8 March 2011 was 0.129 g/m^3, i.e. less than one tenth of the concentration reported in the Mangatainoka River. The discharge therefore cannot have caused the reported increase in ammoniacal nitrogen concentration in the river on that date. There is no effluent quality data for 8 June 2011, however the closest sample, dated 14 June 2011 had an ammoniacal nitrogen concentration of 1.8 mg/l, which is only marginally above the in-river concentration reported on 8 June. Again, the role of the discharge on the apparent in-river increase is very doubtful.

6.7 There were no statistically significant reductions in water clarity The One Plan target of a no more than 20% reduction in visual clarity was exceeded 6 times since 2010, out of 31 observations, or 19% of samples (Appendix A, Figure 12). It should be noted that increases of more than 20% were

measured in 3 out of 31 occasions, indicating that measurement errors may be responsible for some of the apparent exceedances. There were no statistically significant increases in TSS or POM concentrations between upstream and downstream of the discharge, indicating that the discharge seems unlikely to have a more than minor role on visual water clarity, or organic matter deposition.

6.8 No statistically significant differences in *E. coli* concentrations were identified between upstream and downstream in any of the flow bins. However, there was a small decrease in the proportion of samples not meeting the One Plan targets (from 94% upstream to 89% downstream when considering the 550/100 ml target, and from 77% to 73% when considering the 260/100 ml target) and a drop in the overall NPSFM grading downstream of the discharge from A to B considering median concentrations and from C to D considering 95th percentile concentrations (Appendix A, Section 1.3.6 and Figures 9 and 10).

6.9 SIN[1]: The One Plan SIN target (i.e. an annual average concentration of 0.444 g/m^3 at flows below the 20th FEP) was exceeded by a factor of approximately 2 at both the upstream and downstream sites in the Mangatainoka River (Appendix A, Section 1.3.3 and Figure 6). No statistically significant differences were detected between the upstream and downstream sites.

6.10 An analysis of SIN loads, from the discharge and in-river was provided in the 12 April 2017 S92 response for further information. This analysis indicated that:

(a) The discharge does not have the potential to raise the annual average SIN concentration by more than a very minor amount (0.002 g/m^3, or 0.6% of the One Plan target);

(b) Even under low river flow conditions, the discharge does not have the potential to raise the SIN concentrations by more than a relatively minor (0.010 g/m^3) and not ecologically relevant amount, especially in the context of elevated background SIN concentrations (0.535 g/m^3 at low flows)

(c) The current SIN load from the Pahiatua WWTP is estimated at 1.34 T/yr. This represents 0.2% of the in-stream load in the Mangatainoka River and 0.06% of the in-stream load in the Manawatu River upstream of the Manawatu Gorge;

6.11 DRP: The One Plan DRP target (i.e. an annual average concentration of 0.010 g/m^3 at flows below the 20th FEP) was exceeded overall at both the upstream and downstream sites in the Mangatainoka River, although by a

[1] Soluble Inorganic Nitrogen. This is the sum of nitrate-, nitrite- and ammoniacal nitrogen, and is generally considered as the nitrogen fraction directly available for plant/algae growth.

greater amount (c. 2times the target) at the downstream site than at the upstream site (c. 1.4 times the target) (Appendix A, Section 1.3.4 and Figure 7). There were statistically significant differences between upstream and downstream, but only in the "all flows" and "<20th FEP" flow bins. There was no material measured increase under base flow (<median flow bin) or low flow (< half median flow bin) conditions. This is somewhat surprising as the effects of point source discharges are typically greater during periods of low river flows.

6.12 The analysis of DRP loads from the discharge and in-river indicated that:

(a) The discharge does not have the potential to raise the annual average DRP concentration by more than a relatively minor amount (0.0007 g/m^3, or 7% of the One Plan target);

(b) However, under low flow conditions, the discharge does have the potential to raise the DRP concentrations by up to 0.004 g/m^3. Whilst not major, this potential increase is not negligible and represents 23% of the upstream/background DRP concentration of 0.017 g/m^3 during low flows. It is important to bear in mind however that these estimates are theoretical only and are not apparent in the actual monitoring data.

(c) The current DRP load from the Pahiatua WWTP is estimated at 0.399 T/yr.

6.13 With regards to the analysis of the Periphyton biomass data available:

(a) The dataset available spans a period of 8 years (December 2008 to September 2016). Monitoring was undertaken monthly; however, a number of monthly samples were not collected due to a number of reasons, including high river flows. This raises the question of whether observations made on tense dates should be taken into account or ignored;

(b) The principle of undertaking monthly periphyton sampling is to build, over time, a base of data representative of a range of river conditions. Periphyton biomass is known to be low when the rivers are in flood, due to physical removal of the biomass. A 3 times median flow is commonly used as a flow threshold in relation to periphyton biomass (Biggs, 2000). The One Plan uses a flow threshold of 20th FEP. The risk with ignoring the "high river flow" observations is that it introduces a bias in the dataset, by discarding valuable information (i.e. that the biomass was most likely very low at the time sampling should have been undertaken). The alternative is to assume, on these monitoring occasions, a biomass consistent with expectations or monitoring information. This distinction is particularly relevant when considering compliance with frameworks (such as the NPSFM Attribute State) or

consent conditions (such as the condition suggested by Horizons officers for the Eketahuna WWTP) that explicitly require monthly measurements.

(c) I note that he above question, of whether "high flows" observations should be discarded or not, and how they should be treated in data analysis is not resolved at the national scale, but it is my understanding that this will be addressed in the National Environmental Monitoring Standard (NEMS) for periphyton, due in late 2017.

(d) To provide a complete picture, I have analysed the dataset in two different ways:

(i) Ignoring high flow observations;

(ii) Assuming a periphyton biomass of 1 mg/m^2 when flows in the river were greater than the 20th FEP;

(iii) In both cases, I have only considered "paired" observations, i.e. when data were available for both sites on the same day, to enable direct upstream/downstream comparison.

6.14 During the 2008-2016 monitoring period:

(a) The One Plan target was exceeded twice at the upstream site during the monitoring period, with a third sample being exactly on the target of 120 mg/m^2, and a fourth just below at 115 mg/m^2;

(b) The One Plan target was exceeded 5 times at the downstream site, with a sixth sample just below at 115 mg/m^2;

6.15 It is notable that no exceedances of the One Plan target has occurred since 2015, i.e. when the clarifier/filter were installed at the plant.

6.16 Depending on whether the "high flow" observations are included or excluded, the overall proportions of samples meeting the One Plan target are:

(a) With high flow observations included (94 paired observations): 98% upstream and 95% downstream;

(b) With high flow observations excluded (86 paired observations): 98% upstream and 94% downstream.

6.17 When assessing against the provisions of the NPSFM, both the upstream and downstream sites are in the B Band, indicating "*occasional blooms reflecting low nutrient enrichment and/ or alteration of the natural flow regime or habitat*". Band B is based on the same numerical threshold as the One plan target (120 mg/m^2), and meeting the One Plan target is, in my opinion, generally consistent with meeting NPSFM Band B.

6.18 The above points confirm the conclusion reached in 2014 both in the Opus report and by myself, i.e. that there is an apparent mild increase in periphyton growth downstream of the discharge and that the proportion of samples meeting the One Plan target decrease slightly (from 98% upstream to 95% downstream).

6.19 Table 14 of Mr Patterson provides a summary of periphyton data available at other sites in the Mangatainoka catchment. It is interesting to note that the site with the highest periphyton biomass is the Pahiatua at Town Bridge site, located a short distance (1.5km) upstream of the Pahiatua discharge. Median and 95th percentile biomass and number of samples exceeding the One Plan target are all greater than either upstream or downstream of the Pahiatua discharge, or than at the SH2 site, located a further 3km downstream.

6.20 At paragraph 82, Mr Patterson emits the hypothesis that the apparent reduction in periphyton biomass between the Town Bridge and the Upstream of Pahiatua WWTP discharge sites is due to assimilation/attenuation of nutrients in that reach of river. However, this is not supported by the nutrient concentration data summarised in his tables 8 and 9, which show essentially similar SIN concentrations at these two sites, and in fact an increase (not a decrease as might have occurred as a result of nutrient assimilation/attenuation) in DRP concentrations between Town Bridge and Upstream of Pahiatua WWTP discharge.

6.21 In my view, the apparent differences in periphyton biomass between the two sites are more likely associated with uncertainty in periphyton biomass measurement, and inherent variability between sites (shading, substrate stability and size, groundwater inputs, etc.). This illustrates the need to consider periphyton data with a degree of caution.

6.22 Now turning to the issue of assessing compliance with the One Plan targets and defining adequate consent conditions, there appears to be a variety of methods and recommendations in front of the Panel, both in relation to the Eketahuna and Pahiatua WWTPs.

6.23 As I explained in my evidence in relation to the Eketahuna WWTP, the issue of how compliance with the One Plan biomass target should be assessed was the subject of extensive debate and expert caucusing during the Feilding WWTP council-level and Environment Court hearings. The Court accepted that these targets were not applicable as absolute numbers, and, imposed a consent condition based on no more than 1 exceedance out of 12 consecutive monthly samples (roughly equivalent to 8% of samples). This was based on a joint recommendation from myself and Mr Brown, noting that there was competing evidence both at the council-level and Environment Court hearing suggesting that the One Plan targets should be imposed as absolute standards.

6.24 I am of the view that the approach taken for Feilding is consistent with the intent of the One Plan target, and I have recommended it in a number of recent consent processes in the Horizons Region. It is also generally consistent with the intent of the NPSFM (2014) attribute state for periphyton biomass, which is to allow one exceedance in each "normal" year[2] although the assessment period is different (12 months in the Feilding approach, instead of 36 months in the NPSFM).

6.25 In relation to the Eketahuna WWTP hearing, Horizons Officers suggested a condition directly aligned with the NPSFM framework, allowing no more than 8% of samples to exceed 120 mg/m^2 on the basis of monthly samples taken over a period of at least 36 months. This roughly corresponds to no more than 3 exceedances (in fact 2.88) out of 36 consecutive months. The NPSFM Attribute State is based on the most recent expert advice[3], noting that one of the key authors, Dr Barry Biggs, also advised the development of the One Plan periphyton targets. During the Eketahuna hearing, I expressed the view that this approach was not very different from the approach taken for Feilding and offered the distinct advantage of enabling consistency with the NPSFM framework.

6.26 The set of consent conditions put forward by Ms Morton for the Pahiatua WWTP includes a condition requiring no "more than 5% of sampling occasions, on the basis of monthly measurements taken over a period of at least 24 months". This is again a different approach, but significantly more stringent than the above two approaches. It corresponds to 1.2 exceedances in 24 months, or 1.8 exceedances in 36 months. A second exceedance would only be allowable after 3 years and four months (40 months).

6.27 Mr Patterson has used a calculation based on the 95th percentile of the data to assess compliance. I note that this is different from the consent condition based on 5% of samples over a 24 months period. Due to the relatively small number of observations, the calculation of the 95th percentile is likely to be skewed by a small number of high observations, and in any case will depend on the percentile calculation method. In my view, for consent compliance purposes, it is vastly preferable to rely on a set number or proportion of allowable exceedances, and allow compliance to be assessed on a rolling basis, so compliance assessments are able to account for any improvements made during the life of the consent.

6.28 I remain of the opinion that the approach taken for Feilding, or a slightly modified version[4] of Ms Morton's version of proposed conditions for

[2] Snelder T., Biggs B., Kilroy C. and Booker D. (2013) National Objective Framework for Periphyton. Prepared for the Ministry for the Environment. November 2013.
[3] Snelder T., Biggs B., Kilroy C. and Booker D. (2013) National Objective Framework for Periphyton. Prepared for the Ministry for the Environment. November 2013.
[4] I would suggest that the condition could be clarified by clearly setting out the allowable number of exceedances per fixed number of samples, and allow compliance on a rolling basis over the last 12 or 36 samples. The condition will also need to clarify how the "high flow" observations should be dealt with.

Eketahuna (8% of samples over 36 months) are adequate and consistent with recent consents granted in this region and/or the NPSFM.

6.29 Currently, none of the four monitoring sites on the middle and lower Mangatainoka River would fully meet the condition proposed by Ms Morton for Pahiatua. The site upstream of the Pahiatua WWTP would have been non-compliant between June 2013 and September 2014. The other three sites (Town Bridge, downstream of the discharge and SH2) would not currently meet this proposed condition most of the time.

6.30 Currently the upstream of Pahiatua WWTP site would meet both the "1 out of 12" and "3 out of 36" conditions. The downstream site would have exceeded the "1 out of 12" condition occasionally, when more than one exceedance occurred within a 12 month period (in 2011/2012 and 2014). Similarly, a "3 out of 36" condition would have been exceeded for a short period of time in 2014. This means that some limited improvement would be required in order to meet either of this condition at the downstream site on the basis of historical data. I note however that the downstream site has met both conditions since the installation of the clarifier and filter in 2015.

6.31 With regards to periphyton cover, a total of 98 monthly observations are available between December 2008 and January 2017 (figure 20, Appendix A):

(a) the One Plan target relative to long filamentous cover was exceeded occasionally upstream (twice) and quite regularly downstream (7 times) in the early part of the monitoring period (2008-2010); however, since 2011, the One Plan target was exceeded the same number of times (three times) at each site and there does not seem to be any pattern of increase between upstream and downstream of the discharge;

(b) The One Plan target relative to cover by diatom or cyanobacteria thick mat was exceeded once at the upstream site and always met at the downstream site.

6.32 I note that there seem to be some inconsistencies between my assessment and that conducted by Mr Patterson. For example, Mr Patterson (at paragraph 80) indicates that the mats target was exceeded twice both upstream and downstream of the discharge, although my dataset (received from Horizons) indicates only one exceedance at the upstream site and none at the downstream site. I will seek clarification on these inconsistencies.

6.33 With regards to macroinvertebrate communities, there do not appear to be any material or consistent differences in any of the key indices of macroinvertebrate abundance or health between the upstream and downstream sites. Specifically, the "no more than 20% reduction in QMCI"

One Plan target is met. In my opinion, there is no evidence of the discharge causing any significant adverse effects on aquatic life in the Mangatainoka River, i.e. the discharge meets the provisions of S107(1)(g).

7. EFFECTS OF THE DISCHARGE FOLLOWING COMMISIONING OF THE UPGRADES

7.1 The assessment I conducted above indicates that:

(a) There is a reduction in the proportion of time the One Plan targets relative to *E. coli* are met, although the change between the two sites was not significant overall. The role of the discharge is unclear;

(b) There is no material increase in SIN concentration, either actual (on the basis of monitoring data or potential (on the basis of load calculations)

(c) There is a small increase in annual average DRP concentration. Under low river flow conditions, the discharge may cause a potential but not measured increase in DRP;

(d) The discharge may have contributed to changes in visual clarity of more than 20% (although measurement uncertainty is likely to have played a role);

(e) The discharge may have caused or contributed to a mild increase in periphyton growth, leading to a reduction in the proportion of samples exceeding the periphyton biomass target (although whether or not the target is met or marginally exceeded at that site is disputable).

(f) There is no evidence of more than minor effects on aquatic life from the discharge, as evidenced by the low toxicity risk from ammonia and the absence of more than minor effects on macroinvertebrate communities.

7.2 The upgrades currently being commissioned include, in addition to the secondary treatment provided by the oxidation ponds, tertiary treatment composed of chemical dosing, clarification/filtration, UV disinfection and wetland and land passage.

7.3 I expect that a well functioning UV plant will reduce *E. coli* concentrations in the effluent to a point where effects on in-river *E. coli* concentrations in of no material concern. The UV plant was installed in 2015. Considering the data collected since 2015, there has been no increase between upstream and downstream of the discharge in the number of samples exceeding the One Plan *E.coli* targets since that time.

7.4 The clarifier and filtration unit were installed in 2015. Considering the water clarity data collected since 2015 (Appendix A, Figure 12), there has been

one measurement indicating a more than 20% decrease, and one measurement indicating an increase of more than 20%. There is no evidence of any consistent effect on visual clarity from the discharge since 2015.

7.5 With regards to the causes of the mild increase in periphyton growth and the future (i.e. post-upgrade) effects of the discharge

(a) SIN concentrations are always elevated in the Mangatainoka River, well above periphyton growth requirements, including during low river flows. As a result, SIN:DRP ratios (Appendix A, Figure 8) are elevated under all flow conditions, indicating that P-limited conditions dominate in the Mangatainoka River under all flow conditions;

(b) It is likely that the mild increase in periphyton growth measured downstream of the discharge, compared with upstream is caused by the phosphorus content of the discharge. The nitrogen content of the discharge is unlikely to cause any material increase in periphyton growth, given the nitrogen-saturated conditions upstream of the discharge, and the very small incremental increase caused by the discharge;

(c) Once fully commissioned, the upgrades are intended to significantly reduce DRP concentrations/loads in the discharge (an approximate 3-fold reduction based on a comparison of current performance vs. proposed effluent standards[5]). I expect that there will be a consequential reduction in the effects of the discharge on periphyton growth. As referred to in my paragraph 6.12 above, the DRP loads in the discharge have the potential to increase the average in-river DRP concentration by up to 0.004 g/m^{3}during periods of low river flow. This figure will reduce to less than 0.0013 g/m^3 mg/L once the proposed effluent standard is met, which is of very limited ecological relevance against a background concentration of 0.017 g/m^3.

(d) Monitoring will address any remaining uncertainty. As explained in the 12th April S92 response, I am of the opinion that adequate water quality and ecology monitoring sites are available upstream and downstream of the new proposed discharge location.

7.6 The discharge does not appear to cause any more than minor effects on macroinvertebrate communities. The RMA S107(1)(g) narrative standard and the One Plan QMCI change targets are currently met. Given the proposed improvements to the discharge treatment and quality, effects on

[5] Refer to the evidence of Mr Crawford. The current median DRP concentration is 1.4 g/m^3, and the proposed median concentration in the effluent is 0.5 g/m^3.

macroinvertebrate communities should keep on meeting the One Plan QMCI target and S107(1)(g) standard in the future.

8. RESPONSE TO S42 A REPORT

8.1 In paragraph 86, Mr Patterson explains as QMCI scores become more suppressed, it becomes increasingly difficult to cause a 20% change between upstream and downstream. Mr Patterson cites the examples of the Hunterville and Taihape consents, which include a no more than 15% change in QMCI as an in-stream standard. Although Mr Patterson does not explicitly recommend applying a no more than 15% change in QMCI limit for the Pahiatua WWTP discharge, the set of proposed conditions in Ms Morton's Appendix 1 (condition 8.l.) includes it.

8.2 Beyond the issues associated with departure from the Plan's targets (which the planning experts should address), I am of the opinion that there are technical issues associated with this change that must be considered.

8.3 The One Plan QMCI target was developed on the basis of a change of 1 QMCI point, which was considered at the same time ecologically relevant (as being a shift from one quality class to the next) and likely to be detected with reasonable sampling effort (e.g. 5 replicate samples). At a QMCI score of 5, 1 point corresponds to a 20% change. This was, in simple terms, the basis for the One Plan 20% change target. Further details and discussion can be found in John Stark's One evidence to the One Plan hearing[6].

8.4 At a lower QMCI score, a 20% change corresponds to a smaller nominal change. For example, for a QMCI score of 4, a 20% change corresponds to a reduction of 0.8 points (and 0.6 points at a QMCI score of 3, etc.). A 15% change corresponds to 0.6 QMCI points at a QMCI score of 4, and 0.45 points at a QMCI score of 3. Such smaller and smaller changes become increasingly unlikely to be detected statistically (due to the inter-sample variability), and are less and less likely to be ecologically relevant. As simply put by Dr Stark (2007):

"*A tighter standard would require greater sample replication in order to detect the difference with any confidence, and the smaller the difference the less ecological significance it is likely to have*"

8.5 In conclusion, I do not support the application of a 15 % QMCI change target because it would be (1) very difficult to detect with any confidence and (2) less ecological relevant than the actual One Plan target. I am also of the opinion that it is inconsistent with the technical advice the One Plan target was based on.

[6] Stark (2007). Determination of ecologically meaningful changes in QMCI. Dated 19th February 2010.

9. CONSENT CONDITIONS

9.1 In paragraph 99, Mr Patterson provides monitoring recommendations. I am in general agreement with these recommendations, with the following exception. Given the very low level of effect on macroinvertebrate communities over the last 6 years, and the likeliness that these effects will not increase in the future, requiring annual macroinvertebrate monitoring for the duration of the consent seems unnecessary. I suggest that monitoring be undertaken for the first three years to establish a baseline at the new monitoring sites. Assuming no significant issues are detected, monitoring could then be undertaken more infrequently, e.g. every 3 to 5 years for the remainder of the consent.

9.2 In paragraph 100, Mr Patterson recommends that, in terms of in-stream standards, the recent Feilding and AFFCO consents constitute a good starting point. I am familiar with these decisions, and generally agree with Mr Patterson's recommendation. I note however that the in-stream standards in Ms Morton's proposed condition 8 contain significant differences with the above decisions, in particular

(a) Condition 8 d, relative to "no more than minor effect on aquatic life". As I already explained in relation to the Eketahuna discharge, this wording is inconsistent with that of S107(1)(g), which refers to "significant adverse effects". I am unsure as to how in practice one would assess compliance with such a standard, and this would need to be clearly defined. This standard is also inconsistent with the Feilding and the AFFCO decision, where it was accepted that the S107(1)(g) narrative standard should be removed, and the 20% QMCI change target should be relied on;

(b) Condition 8i, relative to periphyton biomass. As I explain in my evidence, this wording is different from that of the Feilding decision, and from Horizons' own recommended wording for the Eketahuna WWTP.

(c) Condition 8j. prescribes that there must not be a change in NPSFM periphyton bands between upstream and downstream. In my view this is inconsistent with one of the overall guiding principles of the One Plan targets, that movement within the target is acceptable, and I recommend that the clause be removed;

(d) Condition 8.l. suggests a limit of no more than 15% change in QMCI. For the reasons set out above, I see no valid technical reason to depart from the Plan's target;

9.3 In addition, clause 8.f. sets a limit relative to Dissolved Oxygen (DO) saturation (a daily minimum of 80%). In paragraphs 75 to 77, Mr Patterson describes the results of continuous Dissolved Oxygen (DO) monitoring

undertaken by Horizons at the Mangatainoka at Town Bridge, indicating that the One Plan target of 80% saturation is not met at that site. Mr Patterson emits the hypothesis (at paragraph 104) that the discharge may exacerbate the issue, and recommends (at paragraph 99) one-off continuous DO monitoring upstream and downstream of the discharge. Given the issues at Town Bridge, it may indeed be wise to undertake such monitoring. However, it is likely that the One Plan target of 80% DO saturation will not be met either upstream or downstream of the discharge, and the consent conditions will need to make it clear how the results will be interpreted, particularly if the 80% DO saturation is indeed imposed as an in-stream standard. One alternative may be to remove clause f. but require an assessment of the effects of the discharge on in-stream DO levels on the basis of the monitoring data. I note that the Feilding conditions did not incorporate a minimum DO saturation standard.

9.4 In my experience, direct discussion between experts is the most efficient way to resolve issues or differences such as those raised above.

Dr Olivier Michel Nicolas Ausseil

28 April 2017

Appendix A: Update of the monitoring data analysis

Appendix B: Pahiatua WWTP Monitoring memo