Attachment 8:

Technical Evidence:

8A:

Evidence of Dr Peter Wilson;

BEFORE THE COMMISSIONERS APPOINTED BY

ENVIRONMENT SOUTHLAND

Application APP-20191339

UNDER	the Resource Management Act 1991
IN THE MATTER	of a resource consent application to take water from and discharge water and treated wastewater to the Mataura River and to use an existing weir and associated damming and diversion of water
APPLICANT	Alliance Group Limited

STATEMENT OF EVIDENCE OF DR PETER STANLEY WILSON

FOR ENVIRONMENT SOUTHLAND

Dated this 9th day of November 2020

INTRODUCTION

Current Position

1. My name is Dr Peter Stanley Wilson. I am a Senior Water Quality Scientist at 4Sight Consulting, a position I started on 18 February 2019. Before this role, I held the position of Coastal Water Quality Scientist at the Waikato Regional Council for four years. In these roles, my responsibilities have been based on environmental science, research, and resource management with a focus on sediment and water quality.

Qualifications and Experience

2. I hold a Bachelor of Science degree in chemistry and a Master of Science with Honours degree in chemistry, both from the University of Waikato. I also hold a PhD in marine biogeochemistry from Auckland University of Technology.

3. I have over 10 years' experience assessing sediment and water quality. My previous work experience includes assessing environmental effects of aquaculture; tracking the source of faecal contaminants in freshwater and estuarine environments; and designing, implementing, and reporting on regional state of the environment sediment and water quality monitoring programmes. I have provided technical advice to resource consent staff on a range of activities and discharges including marine farms, wastewater treatment plants, and marinas. I have routinely assessed activities against the requirements of the Resource Management Act 1991, National Policy Statement for Freshwater Management, New Zealand Coastal Policy Statement 2010 (NZCPS), National Environmental Standards, and regional plans.

4. I have also prepared and presented ecological evidence previously for council hearings and the Environment Court.

Code of Conduct

5. I have read the Environment Court's Code of Conduct for Expert Witnesses 2014, and I agree to comply with it. I confirm that the issues addressed in this brief of evidence are within my area of expertise, except where I state I am relying on what I have been told by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

6. I have been asked by Environment Southland to review the water quality aspects of the resource consent application and associated technical reports for the water takes and wastewater discharge from the Alliance Mataura Meat Processing Plant ("**the Plant**") into the Mataura River.

7. I have prepared this statement of evidence based on a technical review report I co-authored for Environment Southland on the potential effects of the water takes and wastewater discharge from the Plant on water quality and ecology aspects (herein,

"**4Sight Technical Review**"[1]). I prepared a summary of the potential water quality and ecology effects in a memo to Environment Southland, dated 7 November 2019, which was made available on the Environment Southland website along with the consent application documents.[2] I also prepared a letter for Environment Southland that summarised its state of the environment monitoring data that was relevant for putting the potential effects of the discharge from the Plant in context of the wider environment (herein, "**SOE Summary**"[3]).

8. I have reviewed the application documents, including the following documents in preparing my evidence for this hearing:

   a. Assessment of Environmental Effects prepared by Alliance ("**AEE**");

   b. Assessment of effects report by Freshwater Solutions ("**Freshwater Solutions report**")[4];

   c. Quantitative microbial risk assessment report by Streamlined Environmental ("**QMRA Report**")[5];

   d. **Mixing Zone report** by Streamlined Environmental[6]; and

   e. Draft Environmental Management Plan – July 2020 ("**EMP**")[7].

9. A site visit is planned for Monday 30 November to inspect the discharge from the Plant and the nearby receiving environment.

10. In this statement of evidence, I outline my review of the resource consent application and associated technical reports with regard to the potential water quality effects and respond to relevant points raised by submitters.

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[1] Wilson, P., Bennett, K., 2019. Technical review – Mataura Processing Plant resource consent applications: Water quality and ecology. 4Sight Consulting technical report prepared for Environment Southland. 21 p. Attachment 7 of s42A report.

[2] Available from https://www.es.govt.nz/environment/consents/notified-consents/2019/alliance-group-limited-mataura-meat-processing-plant

[3] Wilson, P., 2019. Technical Review – Mataura Processing Plant: SOE Data Analysis. Memo prepared for Alex Erceg, Environment Southland, 14 October 2020. Attachment 7 of s42A report.

[4] Montgomerie, R., Carter, N., Fitzpatrick, M., 2019. Assessment of the effects of Alliance Mataura's discharges and water take on Mataura River and Toetoes Estuary. Freshwater Solutions technical report prepared for Alliance Group Ltd. Resource consent application Appendix 2.

[5] Dada, C. A., 2019. Quantitative microbial risk assessment of the Mataura Plant's wastewater discharge. Streamlined Environmental technical report AES1704 prepared for Alliance Group Ltd. Resource consent application Appendix 3.

[6] Dada, C. A., 2019. Determination of mixing zone of treated wastewater from Alliance Mataura discharged into the Mataura River: a mixing modelling approach using contaminant tracers. Streamlined Environmental technical report AES1803 prepared for Alliance Group Ltd. Resource consent application Appendix 4.

[7] McKegg, S., 2020. Draft Environmental Management Plan: Alliance Mataura (July 2020). Prepared for Alliance Mataura by Freshwater Solutions. 17 p.

11. A discussion of the wastewater treatment upgrade options and the potential effects of the water take and discharge on freshwater ecology is addressed in the evidence of other experts for Environment Southland (Alice Andrew and Keren Bennett).

BACKGROUND

12. Alliance owns and operates the Plant on the riverbank of the Mataura River in the Mataura township, which is approximately 44 km upstream from the Toetoes Estuary.

13. Alliance is applying for replacement resource consents with a consent term of 35 years for the Plant for the following activities:

    a. Take up to 21,200 m^3 water per day from the Mataura River for cooling water;

    b. Take up to 8,000 m^3 water per day from the Mataura River for meat processing and truck washing;

    c. Discharge of 21,200m^3 of condenser cooling water into the Mataura River; and

    d. Discharge of up to 8,000 m^3 per day of treated meat works wastewater into the Mataura River;

    e. Use an existing weir and hydro race structure, and associated damming and diversion of water[8].

14. In this evidence, I address the potential effects on the Mataura River from the discharges noted in 13 c. and d. above.

15. The Freshwater Solutions Report identifies the following potential and, in some cases, actual effects from the discharges on the receiving water quality to be:[9]

    a. Ammoniacal-N (ammonia) toxicity;

    b. Increased nutrient concentrations;

    c. Increased bacteria concentrations;

    d. Reduced dissolved oxygen (DO) concentrations;

    e. Altered colour and clarity; and

    f. Generation of foams and scums.

16. I agree with this list, however, I would also add that the discharge of the cooling water has the potential to increase the water temperature, which Freshwater Solutions have addressed in their report.

FAECAL BACTERIA

17. *Escherichia coli* (*E. coli*) is measured as a common indicator of the many potential pathogens (e.g., bacteria, viruses, and protozoa) in the water that could make the

[8] Resource consents for land and water permits for this activity were applied for under a separate application to the others titled 'Use of Mataura River weir to dam and divert water'.
[9] Freshwater Solutions Report, at p 21.

water unsuitable for recreational use (e.g., swimming) and is used in a range of statutory instruments.

18. There are three sources of guideline values for *E. coli* that are relevant to assess the suitability of the water for recreational use in this location in the Mataura River:

    a. Recreational water quality guidelines[10]: 550 CFU/100 mL (single sample - action level; concentrations higher than this indicate that the water is highly likely to be unsuitable for recreational use);

    b. National Policy Statement for Freshwater Management 2020 ("**NPS FM**"): categorise the water into one of five categories (A–E); and

    c. Regional Water Plan / PSWLP: 130 *E. coli* per 100 mL for "Popular Bathing Sites" and within 1 km immediately upstream of these sites[11].

19. The Mataura River is known to have degraded water quality with regard to *E. coli*. *E. coli* concentrations upstream of the Plant are typically elevated (median *E. coli* concentration between December 2017 and May 2018 of 355 CFU/100 mL) and fall under the poorest NPS FM category, E. The narrative for this category is: "*For more than 30% of the time, the estimated risk is ≥50 in 1000 (>5% risk). The predicted average infection rate is >7%.*"[12] The monitoring results similarly exceed both the recreational water quality guideline and the PSWLP popular bathing site guideline.

20. Analysis of monitoring data in the Freshwater Solutions Report, the QMRA Report, and the 4Sight Technical Review each identify that *E. coli* concentrations in the Mataura River increase significantly downstream of the discharge.[13] After reasonable mixing, the median *E. coli* concentration between December 2017 and May 2018 was about seven times greater downstream (2,600 CFU/100 mL) of the discharge than it was upstream (355 CFU/100 mL).[14]

21. Table 1 shows a summary of monthly *E. coli* sampling results collected by Environment Southland over 12 months from September 2018 to August 2019. The results below indicate that upstream of the Plant, concentrations exceeded 260 CFU/100mL on 58% and 25% of occasions in the Mataura River and Waikaka Stream at Gore and 100% of occasions downstream of the Plant. Following the approach described in the NPS FM (2020) Clause 3.27, such results would trigger daily sampling during the defined bathing period. Concentrations exceeded 540 CFU/100mL on 17% and 8% of occasions in the Mataura River and Waikaka Stream at Gore and 92% of occasions downstream of the Plant. While *E. coli* concentrations exceed 540 CFU/100mL, regional council

[10] Formally known as: Ministry for the Environment and Ministry of Health, 2003. Microbiological water quality guidelines for marine and freshwater recreational areas. Accessible from: https://www.mfe.govt.nz/publications/fresh-water/microbiological-water-quality-guidelines-marine-and-freshwater-0

[11] Regional Water Plan: Appendix G, Surface water bodies Classified as "Mataura 3". Proposed Southland Water and Land Plan: Appendix C, Surface water bodies Classified as "Mataura 3".

[12] NPSFM, at p 40.

[13] Freshwater Solutions Report, at p 50; 4Sight Ecology Report, at p 4.

[14] 4Sight Technical Review, Table 4, page 4.

must "*take all practicable steps to notify the public and keep the public informed that the site is unsuitable for primary contact, until further sampling shows a result of 540 E. coli per 100 mL or less.*"[15] Based on this information, it is likely that signage would be required at the Mataura Bridge bathing beach throughout most of the bathing season.

Table 1: Monthly measurements of *E. coli* (CFU/100 mL) between September 2018 and August 2019 (12 months) at three SOE locations near the Plant.

Site	Results >260 (%)	Results >540 (%)
Mataura River at Gore	7 (58%)	2 (17%)
Waikaka Stream at Gore	3 (25%)	1 (8%)
Mataura River 200m d/s Mataura Bridge	12 (100%)	11 (92%)

22. After the installation of UV treatment, it is anticipated that *E. coli* concentrations downstream of the plant would be similar to those measured at the upstream sites. Table 2 shows the estimated *E. coli* concentrations in the Mataura River downstream of the discharge for scenarios including UV treatment and UV and biological treatment under a range of river flows. The data suggest that, after installing UV treatment (Year 5–15 in the table), *E. coli* concentrations downstream are likely to be similar or slightly higher than upstream concentrations. After the installation of UV and biological treatment (Year 15+), there is potential for the discharge to improve the quality of the Mataura River in its current state (decrease levels of *E. coli*) due to the low concentration of *E. coli* in the wastewater discharge.

[15] NPS FM, at 3.27(6).

Table 2: Estimates of *E. coli* concentrations in the Mataura River downstream of the discharge for a range of scenarios including UV and UV + biological treatment, and a range of river flows. Prepared by Dr Chris Dada.[16]

Post-consent period	Scenarios	WW discharge	Conc discharge (95th Perc)	Flow in river m3/d			River Conc U/S (95th Perc)	Resulting River Conc D/S (95th Perc)	Change in concentration as a result of the discharge	Effect of discharge on receiving water E.coli
				annual median	summer median	minimum				
		m3/d	CFU/100mL	m3/d	m3/d	m3/d	CFU/100mL	CFU/100mL	CFU/100mL	
Year 0-5	WW discharge +Annual median riverflow	8,000	1,400,000	6,912,000	2,764,800	864,000	5,401	7,013	+1612	Major effect
	WW discharge +Annual minimum riverflow							18,195	+12794	Major effect
	WW discharge +Summer median riverflow	8,000	1,865,000	6,912,000	2,764,800	864,000	8,201	13,558	+5357	Major effect
	WW discharge +Summer minimum riverflow							25,236	+17035	Major effect
Year 5-15	WW discharge +Annual median riverflow	8,000	10,000	6,912,000	2,764,800	864,000	5,401	5,406	+5	Minor effect
	WW discharge +Annual minimum riverflow							5,443	+42	Minor effect
	WW discharge +Summer median riverflow	8,000	10,000	6,912,000	2,764,800	864,000	8,201	8,206	+5	Minor effect
	WW discharge +Summer minimum riverflow							8,218	+17	Minor effect
Year 15+	WW discharge +Annual median riverflow	8,000	1,000	6,912,000	2,764,800	864,000	5,401	5,388	-13	Minor improvement
	WW discharge +Annual minimum riverflow							5,361	-40	Minor improvement
	WW discharge +Summer median riverflow	8,000	1,000	6,912,000	2,764,800	864,000	8,201	8,180	-21	Minor improvement
	WW discharge +Summer minimum riverflow							8,135	-66	Minor improvement

Annual median, summer median and minimum Mataura River flows correspond to 80 m^3, 32 m^3/s and 10 m^3 respectively (i.e. 6912000, 2764800 and 86400 m3/d)

23. Because of the high *E. coli* concentrations measured in the discharge and after reasonable mixing with the Mataura River, the Applicant conducted testing of pathogens in the water to better understand the potential health risks associated with the wastewater discharge (Quantitative Microbial Risk Assessment - QRMA). A prior study by Environmental Science and Research Limited (ESR) for Environment Southland identified that the levels of *Campylobacter* spp. (one of the key pathogens) in the Mataura River were lower than concentrations of *E. coli* indicated.[17] That is, the study found that the health risk to recreational users in the Mataura River was lower than the indicator faecal bacteria, *E. coli*, inferred.[18] The study also suggests that "*Alliance Mataura contribute*[s] *a relatively small proportion of the overall Campylobacter risk*"[19]. Overall, it is likely that the health risk to recreational users is lower than the elevated *E. coli* concentrations indicate.

24. I understand that the Plant's wastewater treatment system is currently not designed to specifically remove pathogens from the wastewater. Consequently, the majority of pathogens generated on site will be discharged into the Mataura River. Because of this, I consider the effects of the discharge in its current state to have a significant adverse

[16] Prepared by Dr Chris Dada. Provided to 4Sight and others via email by Doyle Richardson on 15 October 2020.

[17] Cressey, P., et al., 2017. Mataura Quantitative Microbial Risk Assessment (QMRA). Environmental Science and Research Limited (ESR) technical report CSC17010 prepared for Environment Southland. 33 p.

[18] I note that the study collected samples on one day only and measured relatively low concentrations of *E. coli* in their samples when compared to monitoring by the Applicant upstream of the Plant (Table 2, page 14). *E. coli* concentrations in the ESR samples ranged from 300–1,100 CFU/100 mL whereas the *E. coli* concentrations measured upstream of the Plant between 2017 and 2018 ranged from 30–5,500 CFU/100 mL.

[19] Above n 17, page 30.

effect on *E. coli* levels in the Mataura River. I recommend that the wastewater treatment process is upgraded to include UV treatment as soon as possible, rather than in five years as it is proposed in the application. After the installation of UV and biological treatment, it is possible that the discharge may have low levels of *E. coli* such that, with the Mataura River's current water quality (i.e., excluding catchment improvements), it might dilute (improve) *E. coli* from upstream sources.

NITROGEN

25. Three forms (species) of nitrogen were measured by the applicant upstream and downstream of the discharge point: nitrate, nitrite, and total ammoniacal nitrogen (herein referred to as ammonia). Each species contributes to the total nitrogen load and, at high concentrations can cause nuisance algal growth and it can even be toxic to aquatic species. This section focuses on the two species of potentially greatest effect in the discharge, nitrate and ammonia.[20]

26. Total nitrogen in the discharge is not currently measured by the applicant; however, limits on the concentration of total nitrogen in the discharge and total annual load after the installation of a biological treatment system is proposed in 15 years. Inclusion of total nitrogen in the Plant's routine monitoring is recommended and Alliance have proposed to include this in their draft EMP. Reductions in total nitrogen loads will be important as a contribution to the cumulative improvement in water quality in the Mataura River and Toetoes Estuary downstream of the plant. Effects of the discharge from the Plant on the Toetoes Estuary is discussed later in this evidence from paragraph 45 and in Keren Bennett's evidence.

Nitrate

27. Nitrate concentrations are slightly higher downstream from the discharge point than they are upstream (mean concentration 0.02 g/m^3 higher).[21] The concentrations of nitrate in every sample upstream of the Plant exceeded the ANZG (2018) ecosystem health guideline value.

28. With regard to toxicity, concentrations of nitrate both upstream and downstream of the discharge are below the chronic toxicity guideline value of 2.4 g/m^3 for slightly to moderately disturbed systems (95% protection).[22]

29. The Applicant has proposed a biological treatment system upgrade in 15 years that will reduce the levels of nitrate in the discharge. There is no current limit on the concentration of nitrate that can be discharged from the Plant, however, after the upgrade, the applicant proposes total and dissolved inorganic nitrogen limits (both

[20] The discharge was determined to have no significant effect on nitrite concentrations in the Mataura River so has been omitted for simplicity. More details in the 4Sight Technical Review, page 6.
[21] 4Sight Technical Review, page 6.
[22] Hickey, C.W. (2013). Updating nitrate toxicity effects on freshwater aquatic species. NIWA Report HAM2013-009 prepared for Ministry of Building, Innovation and Employment: Funded by Envirolink. 31 p.

include nitrate).[23] There are no measurements of nitrate/nitrite or total nitrogen in the wastewater so it is difficult to determine the exact reduction that is anticipated. However, the AEE states that, after installation of the biological treatment, total nitrogen concentrations are anticipated to be reduced by about 68% and the annual nitrogen load by 50%.[24]

30. Overall, the discharge from the Plant has a very small effect on the concentrations of nitrate in the Mataura River after mixing.

Ammonia

31. The discharge from the Plant increases the concentration of ammonia in the Mataura River by 60% downstream of the discharge.[25]

32. At high concentrations, ammonia can be toxic to aquatic species. Depending on the concentration, the effects can range from behaviour modification to death. The toxicity of ammonia is a factor primarily of pH, but also water temperature. The reason for this is that the measurement of ammonia includes both NH_3 (ammonia) and NH_4^+ (ammonium) and the associated toxicity is primarily due to NH_3. The ratio of these two components in solution is dependent on pH and temperature.

33. At pH 8.0, the PSWLP ammonia standard is 0.9 g/m^3. This value sits within Attribute State band 'C' of the NPS-FM, which has the narrative "80% species protection level: Starts impacting regularly on the 20% most sensitive species (reduced survival of most sensitive species)." In my assessment, I adjusted all ammonia concentrations to pH 8.0.

34. Ammonia concentrations downstream of the discharge are within the PSWLP standard.[26] This represents a low toxicity risk to most aquatic species. There is, however, a statistically significant increase in the mean ammonia concentration downstream of the discharge by about 2.2 times.[27] Ammonia concentrations in the mixing zone will have higher ammonia concentrations, which may pose some risk to aquatic species close to the discharge.

35. These potential toxicity effects have been acknowledged in the AEE: "*the Amm-N*[28] *concentration in the discharge has the potential to cause adverse effects in the mixing zone through chronic and acute toxicity, as well as result in non-toxic effects such as adversely affecting fish migration in the mixing zone*."[29]

36. The applicant has proposed a biological treatment system upgrade in 15 years that will reduce the levels of ammonia in the discharge. Once the system is installed, the

[23] AEE page 59, EMP, page 7.
[24] AEE, page 43.
[25] Median concentration upstream = 0.03 g/m^3; median concentration downstream = 0.05 g/m^3.
[26] 4Sight Technical Review, page 7.
[27] 4Sight Technical Review, page 7.
[28] Amm-N used in the AEE and ammonia used in the 4Sight Ecology Report and my evidence refer to the same components.
[29] AEE, page 26.

applicant proposes ammonia limits in the discharge of 5 g/m^3 for a 12-month rolling mean and 10 g/m^3 for the 95th percentile.[30] This would be a substantial reduction from the current discharge limits of up to 50 g/m^3 per day (but typically <30 g/m^3). As a result of the proposed treatment system upgrade, concentrations downstream of the Plant should be closer to upstream concentrations. Reductions in ammonia will be important for reducing the total nutrient load in the Mataura River and downstream Toetoes Estuary. It will also reduce the risk of acute toxicity to aquatic organisms in the mixing zone. There is no current evidence of significant issues occurring to aquatic organisms in the mixing zone due to ammonia, however, this is difficult to assess without targeted studies. Further comment on this is included in Keren Bennett's evidence.

37. Overall, I consider the effects of the discharge on ammonia concentrations in the Mataura River to be moderate to high (i.e., a measurable and ecologically meaningful adverse effect). I recommend that the timeframes for the upgrade to the biological treatment system be reduced from the proposed 15 years. After the wastewater upgrade, I anticipate the effects to decrease to low.

PHOSPHORUS

38. Measurements of two forms (species) of phosphorous were carried out by the Applicant upstream and downstream of the discharge point: total phosphorus and dissolved reactive phosphorus (DRP). DRP is one component of total phosphorus that is readily bio-available and elevated levels of phosphorus contribute to eutrophication (nutrient enrichment), which may result in nuisance algal growth.

39. The AEE notes that phosphorus concentrations in the green waste stream were comparatively high to the non-green waste stream.[31] To reduce phosphorus concentrations in this waste stream, Alliance included an additional alkali dissolved air flotation treatment step.

Total Phosphorus

40. During the monitoring period, total phosphorus concentrations varied widely. The highest measurement was 47 times greater than the ANZG (2018) ecosystem health guideline value[32] both upstream and downstream of the discharge. Typically, total phosphorus concentrations follow a similar pattern to suspended sediment concentrations because a large proportion of total phosphorus is sediment-bound; that is, following heavy rainfall, both suspended sediment and total phosphorus concentrations are typically elevated.

41. The average total phosphorus concentration between 2012 and 2019 was 35% higher downstream from the discharge than it was upstream.[33] The proposed biological

[30] AEE, page 58.
[31] AEE, page 22.
[32] ANZG (2018) ecosystem health guideline value for rivers classified as Cold Dry Hill = 0.009 g/m^3.
[33] 4Sight Technical Review, page 9.

treatment system will slightly reduce the total phosphorus concentration limits in the discharge from a rolling 12-month median of 5.5 g/m^3 to a rolling 12-month median of 5 g/m^3.[34] Although this is a small decrease to the limit, the proposed limit could allow for the Plant to discharge about 20% more phosphorus than the median discharge from March 2018 to March 2019, based on the available monitoring data.[35]

42. Despite the levels of phosphorus being elevated, there are no obvious signs of nutrient enrichment (eutrophication) such as clear patterns of increased nuisance algal growth downstream from the plant. Reductions of phosphorus to ANZG (2018) guideline levels would, however, be beneficial to improve water quality, cumulative downstream nutrient enrichment effects and overall ecosystem health. Furthermore, estuaries such as the Toetoes Estuary are nitrogen limited due to the abundance of phosphorus in oceanic waters such that reductions in river-borne phosphorus are likely to provide limited improvement in the estuary in the absence of reductions of nitrogen loading.

43. Although opportunities for further phosphorus reduction would be supported, I consider that reduction of *E. coli* and nitrogen to be a higher priority over that of total phosphorus. Overall, I consider the effect of the discharge on total phosphorus in the Mataura River to be moderate to low.

Dissolved Reactive Phosphorus

44. The results for DRP were similar to those of total phosphorus in that measured concentrations varied widely and were 40% higher downstream than they were upstream of the Plant.[36] The applicant does not propose any decrease to limits of DRP even after the proposed installation of a biological treatment system. Further reductions in DRP in the discharge would likely require an additional treatment system or process. In the same manner as total phosphorus, I consider that reduction of *E. coli* and nitrogen to be a higher priority over that of DRP. However, as for all discharged contaminants, I support opportunities for further DRP reduction. That said, I consider the effect of the discharge on DRP in the Mataura River to be moderate to low.

NUTRIENT LOADS TO THE TOETOES ESTUARY AND CUMULATIVE EFFECTS

45. The Toetoes Estuary is approximately 60 km downstream from the Plant. It is a Ramsar site, which means it is recognised internationally as a wetland of high ecological value and importance.[37]

46. Nutrient loading to the Toetoes Estuary and cumulative effects from the discharge are closely linked in the Freshwater Solutions report as the discharge nutrient loads are reported in the context of catchment-wide nutrient loads. I consider this to be an appropriate approach.

[34] AEE, page 59.
[35] See Appendix A for table comparing current and proposed consent limits and typical discharge concentrations.
[36] 4Sight Technical Review, page 10.
[37] https://www.wetlandtrust.org.nz/get-involved/ramsar-wetlands/awarua-waituna-lagoon/

47. The report describes the effects of its nutrient discharge as likely to have little effect overall when considering that it contributes around 1% of the nutrient load from the entire catchment (1.1–1.7% total nitrogen; 0.7–1.1% total phosphorus). The Mataura catchment, however, has known elevated nutrient levels, is very large (5,400 km^2), and primarily comprises rural (high intensity) land use. Therefore, 1% of the overall catchment's nutrient load is still a substantial load, is disproportionate to the contaminant contribution of the other catchment land uses and activities, and is arguably not negligible as it is described in the executive summary[38].

48. The Freshwater Solutions Report states that "*even a marked reduction of the discharge total nitrogen and total phosphorus loads would have little, if any, detectable effect on the nutrient status of the Toetoes Estuary*."[39] Measurable ecological improvement is only likely to be achieved in the Mataura River and Toetoes Estuary if the quality of all discharges to the river are improved. Furthermore, estuaries are nitrogen-limited, that is, there is typically an abundance of phosphorus in estuarine systems and elevations of nitrogen is the most likely nutrient to result in the growth of nuisance algae and the presentation of other eutrophication-related issues.

49. Currently, there is no specific removal of nitrogen from the wastewater stream and, therefore, the majority of nitrogen generated on-site is discharged to the river. Proposed wastewater treatment upgrades to a biological treatment system in 15 years is estimated to reduce total annual nitrogen loads by around 50%.[40] After installation of the biological treatment system, Alliance propose to set an annual total nitrogen load limit of 25 tonnes (~0.8% of catchment total nitrogen load), which is a significant reduction on the proposed annual limit of 60 tonnes up until the treatment is implemented.[41] An annual total nitrogen load of up to 25 tonnes is a more appropriate limit to see overall reductions in nutrients from the catchment into the Toetoes Estuary.

50. The need for improvements to Mataura River water quality is supported by the findings from broad-scale intertidal habitat mapping of the Toetoes Estuary by Stephens (2018)[42] that were also presented in the Freshwater Solutions report. Specifically, the findings from the habitat mapping showed that "*although large sections of the lower estuary remain in good condition, sheltered upper estuary embayments have developed stable nuisance macroalgal growth with poorly oxygenated sediments since 2013*." The report also states that "*excessive nutrient inputs are the primary driver of the eutrophication* [nutrient enrichment] *symptoms*" and that "*the estuary is in a "MODERATE" but declining condition in relation to eutrophication*." These findings highlight the adverse effects of elevated nutrient levels on the Toetoes Estuary.

[38] Freshwater Solutions Report, page v.
[39] Freshwater Solutions Report, page 44.
[40] AEE, page 43.
[41] AEE, page 59.
[42] Stevens, L.M. 2018. Fortrose (Toetoes) Estuary 2018: Broad Scale Habitat Mapping. Report prepared by Wriggle Coastal Management for Environment Southland. 50p.

51. Overall, I consider the effects, including cumulative effects, of the discharge on the Toetoes Estuary to be moderate. After installation of the biological treatment system, I anticipate the effects to reduce to be moderate to low.

TOTAL SUSPENDED SOLIDS, OIL, AND GREASE

52. The PSWLP Receiving Water Quality Standards for Surface waterbodies Classified as Mataura 3 states that "*Any discharge is to be substantially free from suspended solids, grease and oil.*" There is no formal definition of substantially free. Environment Southland commissioned a legal analysis that concluded, "[s]*ome guidance may be taken from the concentrations accepted by the Planning Tribunal under the Water and Soil Conservation Act 1967. These cases indicated that concentrations of 30g/m^3 and 150g/m^3 of suspended solids, and a concentration of 75g/m^3 of grease and oil, in a discharge would still be considered "substantially free*".[43]

53. The discharge has a median total suspended solids concentration of 67 g/m^3 and median oil and grease concentration of 13 g/m^3.[44] Based on the cases cited by the advice above, this is likely to fall within the range of 'substantially free'.

54. Overall, there has been an increase in the TSS concentration of 2 g/m^3 per year between 2012 and 2019.[45] If the median TSS concentration continues to increase at this rate, the median TSS concentration will exceed 100 g/m^3 by 2031.

55. There is a 27% increase in TSS concentration downstream from the Plant.[46] Elevated concentrations downstream from the Plant may also arise from the increased mixing from the Mataura Falls and the discharges from the cooling and processing water. Because of such elevation in TSS downstream of the discharge, it is questionable whether the discharge is substantially free from a water quality perspective.

56. The proposed upgrade of the wastewater treatment to include a biological treatment system is estimated to reduce the TSS concentration in the discharge to a rolling 12-month median of 20 g/m³ and 95th percentile of 40 g/m³.[47] This is a substantial reduction from the current discharge limit of a maximum of 200g/m³ and consistently maintained at <100 g/m³ that is likely to be similar to upstream concentrations and will assist with reducing the total sediment loading in the Mataura River.

57. Overall, I consider the effects of the discharge on TSS, oil, and grease to be low to moderate. After the installation of a biological treatment system, I anticipate that the discharge would have a low effect on TSS, oil, and grease downstream of the discharge and be much more likely to be 'substantially free' from a water quality perspective.

[43] Doesburg, M., Langford, A. Memorandum: Interpretation of "substantially free". 2 December 2019.
[44] 4Sight Technical Review, Figure 7, page 13.
[45] Freshwater Solutions report Table 5, p 9. 4Sight Ecology Report, page 12.
[46] 4Sight Technical Review, page 12.
[47] AEE p 58.

GENERATION OF FOAMS AND SCUMS

58. The Freshwater Solutions Reports concludes that the discharge does not result in the generation of conspicuous foams or scums or change in clarity.[48] Based on the information presented in the AEE and Freshwater Solutions report, I generally agree with this conclusion. I note, however, that scums and foams have been seen downstream of the discharge, for example, during a site visit by Ian Mayhew on 28 October 2020, but he advised he also observed scums and foams in the river upstream of the discharge such that source was not clear. I understand he was advised that Alliance have investigated this issue and consider that the scums and foaming are not attributable to their discharge.

DISSOLVED OXYGEN

59. The contaminants and organic matter discharged from the Plant have the potential to decrease dissolved oxygen levels in the Mataura River. Dissolved oxygen is essential for aquatic animals to breathe.

60. Results from consent monitoring conducted between 2012 and 2019 and from high-frequency measurements between 25 January 2019 and 19 March 2019 revealed that dissolved oxygen concentrations were statistically significantly lower downstream than they were upstream by 0.75 mg/L on average.[49] The high-frequency data were not available to Freshwater Solutions at the time of their reporting.

61. The Freshwater Solutions report states that: "*dissolved oxygen concentrations were above the SWLP standard (5 g/m^3) and met the NPS (2017) numeric attribute state A.*"[50] They consider that, although the discharge does decrease the dissolved oxygen concentrations downstream of the discharge, it does not adversely affect the water quality as the dissolved oxygen levels are still within the guideline values. I agree with this conclusion.

62. It is possible that water is oxygenated between the upstream and downstream sites due to mixing and aerosolization by the Mataura Falls and that the actual effect of the discharge on dissolved oxygen is greater than the monitoring indicates. This would require further target sampling to confirm.

63. Regardless, the concentration of dissolved oxygen in the water downstream of the Plant is within the guideline value and so I consider the effect of the discharge to be low.

pH

64. The pH of the Mataura River is affected by the wastewater discharge from the Plant. There is a statistically significant decrease from a mean pH upstream of 7.39 to a mean pH downstream of 7.45 (i.e., more basic / less acidic).[51] The decrease in pH

[48] Freshwater Solutions Report, pages 45–46.
[49] 4Sight Technical Review, page 16.
[50] Freshwater Solutions Report, page 61.
[51] 4Sight Technical Review, page 16.

downstream of the Plant's discharge means that a greater proportion of the samples are within the ANZG (2018) pH range for ecosystem health. In this regard, the discharge provides a small improvement in the water quality of the Mataura River. I agree with the Freshwater Solutions report that the discharge does not adversely affect the pH of the Mataura River.[52] I consider the effects of the discharge on pH to be low.

SULPHIDE

65. Sulphides have the characteristic odour of rotten eggs and can be toxic to aquatic organisms at elevated concentrations. Consent conditions state that the discharge may not exceed 5 g/m^3 and should be consistently below 2 g/m^3. In the monitoring dataset from 2012 to 2019, all results were well below the 5 g/m^3 limit. One result in November 2019 had a concentration of 2.1 g/m^3 but typically, results were less than 1.5 g/m^3. This indicates a very low risk of adverse effects from sulphides in the discharge on the Mataura River.

66. The applicant has proposed removing the requirement to monitor sulphides in the discharge and, in my opinion, I agree with removing this monitoring requirement based on the monitoring data to date.

WATER TEMPERATURE

67. Up to 21,200 m^3 water per day is extracted from the Mataura River and run through condensers and heat exchangers to cool large on-site chillers and freezers at the Plant. I understand that no contaminants are introduced into this water prior to discharging back to the river. However, the discharge has the potential to adversely affect the Mataura River by increasing the water temperature. Water temperature measurements are conducted upstream and downstream of the discharge to monitor this.

68. Results from consent monitoring conducted between 2012 and 2019 and from high-frequency measurements between 25 January 2019 and 19 March 2019 revealed that there was no ecologically meaningful change in water temperature downstream of the discharge point.[53] This is in agreement with the findings in the Freshwater Solutions report.[54]

69. Again, it is possible that water is cooled due to mixing and aerosolization through the hydro race discharge, and then mixed with water traversing the Mataura Falls, and that in the absence of these processes the effect of the discharge on the water temperature may be greater. Regardless, these features exist and the effects of the discharge on water temperature appear to be low.

70. Overall, I consider the effects of the discharge on temperature to be negligible.

[52] Freshwater Solutions Report, page 61.
[53] 4Sight Technical Review, page 14.
[54] Freshwater Solutions Report, page 54.

ENVIRONMENTAL MONITORING PLAN

71. Alliance produced a draft EMP in July 2020, which was provided following a pre-hearing meeting. The purpose of the EMP is to describe the approach and methods that would be used to fulfil the requirements of the proposed consent conditions 17 and 18.

72. Proposed consent condition 18(b) proposes to collect representative weekly samples from the treated wastewater discharge. I agree with the timing and list of parameters, which include: *E. coli*, temperature, pH, total Kjeldahl nitrogen, ammoniacal nitrogen, dissolved inorganic nitrogen, total nitrogen, total suspended solids, total phosphorus, dissolved reactive phosphorus, and carbonaceous BOD_5.

73. Similarly, proposed consent condition 18(c) proposes to analyse representative weekly samples of receiving water quality upstream and downstream of the point of discharge, when a discharge is occurring. I agree with the approach and list of parameters, which include: *E. coli*, temperature, pH, dissolved oxygen concentration and saturation, nitrate-nitrite nitrogen, total Kjeldahl nitrogen, ammoniacal nitrogen, dissolved inorganic nitrogen, total nitrogen, total suspended solids, total phosphorus, dissolved reactive phosphorus, and carbonaceous BOD_5.

74. I have prepared a table, presented in Appendix A, comparing the proposed consent limits prior to the wastewater treatment upgrades, summaries of the most recent 12-months of discharge monitoring data, and proposed limits after the installation of UV and biological treatment. The proposed limits were sourced from the AEE[55] and draft EMP[56]. There were a few key differences between the limits proposed and the AEE and the draft EMP, which I discuss below.

75. Load limits were omitted in the EMP for all parameters except $cBOD_5$. In my opinion, the approach in the EMP is appropriate as concentration limits are simpler to assess for compliance and long-term monitoring. Measures of discharge volume are still essential so that loads can be calculated when necessary.

76. An important point to note regarding concentration limits is that the total loading is dependent on the volume of the discharge. The median daily discharge volume between March 2018 and March 2019 was 5,400 m^3/day. If the Plant were to discharge up to their maximum proposed discharge volume of 8,000 m^3/day each day, the contaminant loading could be up to 48% higher. This is an unlikely scenario, but an important point to consider. I understand that this is addressed in the evidence of Alice Andrew.

77. The $cBOD_5$ limit of 3,500 kg/day is not proposed to be reduced following the wastewater treatment upgrades despite the concentration limit generally decreasing. It is not clear whether no reduction in $cBOD_5$ load limit is anticipated or whether this should be decreased proportionally to the concentration limit.

[55] AEE, Table 10, page 58.
[56] EMP, Tables 1–2, pages 6–7.

78. Total Kjeldahl nitrogen limits were reduced in the EMP from a maximum of 200 g/m^3 and a consistently maintained 100 g/m^3 in the AEE to a 12-month median and 95th percentile of 60 and 80 g/m^3, respectively. In my opinion, the limits presented in the EMP are appropriate as they are consistent with the other limits (median and 95th percentile) and are the lower of the two.

79. The EMP proposes no limit for total Kjeldahl nitrogen (organic nitrogen + ammoniacal nitrogen) after the installation of UV and biological treatment. In my opinion, this is an appropriate approach because the Applicant proposes monitoring total nitrogen and dissolved inorganic nitrogen (nitrate-nitrite nitrogen, and ammoniacal nitrogen), which are a more comprehensive suite of nitrogen measurements than total Kjeldahl nitrogen.

80. The proposed limits for total suspended solids is twice as high in the draft EMP and proposed consent conditions (40 g/m^3 median, 80 g/m^3 95th %ile) than it is in the AEE (Table 10, page 58; 20 g/m^3 median, 40 g/m^3 95th %ile). In my opinion, the lower values proposed in the AEE are preferable as they are most similar to upstream concentrations and, therefore, most likely to fulfil the requirement of 'substantially free'.[57]

81. The EMP describes the proposed sampling approach for the wastewater discharge and includes the collection of composite water quality samples over 8 hours and rotation of sampling days each week from Monday through to Thursday. Similarly, the monitoring in the Mataura River upstream and downstream of the discharge is proposed to be undertaken weekly and the sampling day will be rotated from Monday through to Thursday. I agree with such approaches and anticipate that they will maximise the likelihood of collecting samples that are representative of the discharge and receiving environment.

RESPONSE TO SUBMITTERS

82. I have read the submissions and respond to those that refer specifically to water quality and raise topics that are related to those covered in my evidence; that is, the submissions from the Department of Conservation and Fish & Game New Zealand – Southland Region.

83. The Department of Conservation and Fish & Game New Zealand – Southland Region both raise concerns in their submissions regarding the concentrations and loads of contaminants being discharged by the Plant, most notably total nitrogen, ammoniacal nitrogen, and *E. coli*. The submissions describe the effects of increases of these contaminants downstream of the discharge on the Toetoes/Fortrose Estuary, to threatened species in the vicinity, and to human health. The submissions acknowledge that the proposed upgrades will reduce these contaminants but raise concerns that the improvements will not come into effect until 2043. I agree with these statements

[57] 4Sight Technical Review, page 12.

and note that in my evidence I have also recommended that timeframes for the proposed upgrades are reduced.[58]

CONCLUSIONS

84. Overall, the discharge from the Plant has been shown to increase concentrations of total nitrogen, ammoniacal nitrogen, and *E. coli* in the Mataura River. In my opinion, the current state of the discharge has moderate to high level of effects on these parameters. After UV and biological treatment has been installed, I anticipate that the contribution of contaminants in the discharge will be similar to that of current upstream water quality in the Mataura River. I acknowledge that upstream water quality is the Mataura River is degraded, and that catchment-wide improvement is required to improve water quality. Such improvement will likely be driven by Environment Southland's implementation of the National Policy Statement for Freshwater Management. Further improvements to the Plant discharge, beyond those already proposed, may be necessary in the context of the objectives and limits set for the catchment through this process.

Faecal bacteria

85. On average, the concentration of *E. coli* is seven times higher downstream of the discharge than it is upstream. I consider the current discharge to have significant adverse effects on *E. coli* levels in the Mataura River. After the installation of UV treatment, it is anticipated that the effect will reduce substantially. After the further addition of biological treatment, it is possible that the discharge may dilute *E. coli* (improve water quality) in the Mataura River from upstream sources.

Nitrate

86. Nitrate concentrations are slightly higher downstream from the discharge than they are upstream. Concentrations of nitrate both upstream and downstream of the discharge are well below levels that could potentially be toxic to aquatic organisms. After the installation of biological treatment, I anticipate the concentration of nitrate will be even less.

Ammonia

87. Ammonia concentrations are 60% higher downstream of the discharge than upstream. After reasonable mixing, ammonia concentrations are within the PSWLP standard, which represents a low toxicity risk to aquatic species. It is possible that ammonia concentrations within the mixing zone, particularly near the discharge point, are at levels that exceed the toxicity guideline and could pose some risk to aquatic organisms. After the installation of biological treatment, I anticipate that this potential effect will reduce substantially.

[58] This EIC, para 37.

Phosphorus

88. On average total phosphorus concentrations were 35% higher and dissolved reactive phosphorus concentrations were 40% higher downstream of the discharge than they were upstream. The proposed wastewater treatment upgrades do not propose any substantial reduction in phosphorus being discharged and the proposed limits could allow for the Plant to discharge about 20% more phosphorus than the median discharge from March 2018 to March 2019, based on the available monitoring data. Despite these elevated levels, there are no obvious signs of nutrient enrichment (eutrophication) such as clear patterns of increased nuisance algal growth downstream in the Mataura River.

Nutrient loads and cumulative effects

89. The discharge from the Plant is estimated to contribute 1–2% of the total nitrogen and phosphorus loads to the Toetoes Estuary. The Toetoes Estuary has identified eutrophication issues and its state is declining. The Mataura catchment has known elevated nutrient levels, is very large (5,400 km^2), and primarily comprises rural (high intensity) land use. Therefore, 1–2% of the overall catchment's nutrient load is a substantial load, is disproportionate to the contaminant contribution of the other catchment land uses and activities, and is arguably not negligible as it is described in the executive summary of the Freshwater Solutions report. Installation of biological treatment is estimated to reduce total annual nitrogen loads by around 50%.

90. I consider the effects of the current discharge on nutrient loading and cumulative effects to be moderate. After the installation of biological treatment, I anticipate that the effect will reduce substantially.

TSS, oil, and grease

91. TSS concentrations are 27% higher downstream of the discharge than they are upstream. Elevated concentrations downstream from the Plant may also arise from the increased mixing from the Mataura Falls. Because of such elevation in TSS downstream of the discharge, it is questionable whether the discharge is substantially free from a water quality perspective. However, there do not appear to be adverse ecological effects as a result of the TSS increase. Based on the cases cited by the legal advice sought by Environment Southland, the concentrations of TSS, oil, and grease appear to fall within the definition of 'substantially free'. After the installation of a biological treatment system, I anticipate that the discharge would have a low effect on TSS downstream of the discharge and be more likely to be 'substantially free' from a water quality perspective.

Generation of foams and scums

92. The Freshwater Solutions Reports concludes that the discharge does not result in the generation of conspicuous foams or scums or change in clarity. Foams and scums are visible on occasion both upstream and downstream of the discharge. No evidence suggests the discharge increases the frequency or size of foams and scums. Based on

this information, I conclude that the discharge doesn't appear to give rise to foams and scums.

Dissolved oxygen

93. The concentration of dissolved oxygen is slightly lower downstream of the discharge. Dissolved oxygen was, however, always within the SWLP standard and meets the NPS FM (2020) numeric attribute state A. Based on this, I consider the effects of the discharge on dissolved oxygen in the Mataura River to be low.

pH

94. The pH in the Mataura River is decreased (more basic / less acidic) downstream of the discharge. Such decreases result in a greater number of measurements being within the ANZG (2018) pH range for ecosystem health. In this regard, the discharge provides a small improvement in water quality.

Sulphides

95. Sulphides measured in the discharge have been well below the maximum allowed concentration. Typically, sulphide concentrations are less than 1.5 g/m^3 and indicate a very low risk of adverse effects from sulphide in the discharge on the Mataura River.

Water temperature

96. There is no ecologically meaningful change in water temperature downstream of the discharge point.

EMP

97. Alliance produced a draft EMP in July 2020 following a pre-hearing meeting. In general, I agree with the approaches described in the plan relating to monitoring water quality of the discharge and receiving environment.

98. There were some differences between proposed consent limits presented in the AEE and the EMP. For each difference, I suggest the lower concentration is the most appropriate. Load limits were excluded from the EMP for all parameters except $cBOD_5$. I think this is appropriate because, in my opinion, concentration limits are simpler to assess for compliance and long-term monitoring. Measures of discharge volume are still essential so that loads can be calculated when necessary. It should be noted, however, that if the Plant were to regularly discharge up to its full consented volume of 8,000 m^3/day, it may still be compliant with concentration limits but be contributing higher contaminant loads than at its typical discharge of around 5,400 m^3/day.

_____

Dr Peter Wilson

APPENDIX A: COMPARISON OF PROPOSED DISCHARGE LIMITS PRE AND POST TREATMENT UPGRADES

Table A1: Current and proposed discharge limits from the AEE (Table 10, page 58) and the EMP (Tables 1–2, pages 6–7). Typical discharge was calculated from the most recent 12 months of data (March 2018–March 2019) that were available.

Parameter	**Pre-Upgrade Limit**	**Typical Discharge***	**Post-Upgrade Limit (UV + biological treatment)**
Total Nitrogen	60 tonnes per year	Not measured (missing measures of nitrate and nitrite)	20 g/m^3 (12-month median) 40 g/m^3 (12-month 95th %ile) 25 tonnes per year [excluded from EMP]
Total Ammoniacal Nitrogen	50 g/m^3 (maximum) 30 g/m^3 (consistently maintained)	14 g/m^3 (12-month median) 26 g/m^3 (12-month 95th %ile)	5 g/m^3 (12-month median) 10 g/m^3 (12-month 95th %ile)
Total Kjeldahl Nitrogen	EMP: 60 g/m^3 (12-month median) 80 g/m^3 (12-month 95th %ile) AEE: 200 g/m^3 (maximum) 100 g/m^3 (consistently maintained)	40 g/m^3 (12-month median) 64 g/m^3 (12-month 95th %ile)	No limit
Dissolved Inorganic Nitrogen	40 g/m^3 (12-month median) 64 g/m^3 (12-month 95th %ile) [from EMP – excluded in AEE]	Not measured (missing measures of nitrate and nitrite)	20 g/m^3 (12-month median) 35 g/m^3 (12-month 95th %ile)
Total Phosphorus	5.5 g/m^3 (12-month rolling median) 10 g/m^3 (12-month 95th %ile)	4.0 g/m^3 (12-month median) 6.2 g/m^3 (12-month 95th %ile)	5 g/m^3 (12-month median) 10 g/m^3 (12-month 95th %ile)
Dissolved Reactive Phosphorus	EMP: 0.5 g/m^3 (12-month median) 1.5 g/m^3 (12-month 95th %ile) AEE: 14.4 kg per day (*5.3 tonnes per year*)	0.29 g/m^3 (12-month median) 0.89 g/m^3 (12-month 95th %ile) 1.6 kg per day	EMP: 0.5 g/m^3 (12-month median) 1.5 g/m^3 (12-month 95th %ile) AEE: 14.4 kg per day (*5.3 tonnes per year*)
Total Suspended Solids	200 g/m^3 (maximum) 100 g/m^3 (consistently maintained)	75 g/m^3 (12-month median) 180 g/m^3 (12-month 95th %ile)	20 g/m^3 (12-month median) 40 g/m^3 (12-month 95th %ile) [note the proposed consent conditions and draft EMP have higher limits of 40 and 80 g/m^3]
cBOD$_5$	300 g/m^3 (maximum) 3,500 kg per day	190 g/m^3 (12-month median) 300 g/m^3 (12-month 95th %ile) 1,027 kg per day	50 g/m^3 (12-month median) 100 g/m^3 (12-month 95th %ile) 3,500 kg per day
E. coli	No limit	690,000 CFU/100mL (12-month median) 2,400,000 CFU/100mL (12-month 95th %ile)	1,000 CFU/100mL (12-month 95th %ile)

* Loadings were estimated using median concentrations and discharge volumes.

8B:

Evidence of Ms Keren Bennett;

BEFORE THE COMMISSIONERS APPOINTED BY

SOUTHLAND REGIONAL COUNCIL

Application APP-20191339

UNDER	the Resource Management Act 1991
IN THE MATTER	of a resource consent application to take water from and discharge water and treated wastewater to the Mataura River and to use an existing weir and associated damming and diversion of water
APPLICANT	Alliance Group Limited

STATEMENT OF EVIDENCE OF KEREN VERONICA BENNETT

FOR SOUTHLAND REGIONAL COUNCIL

Dated this 9th day of November 2020

INTRODUCTION

Current Position

1. My name is Keren Veronica Bennett. I am a Principal Ecology Consultant at 4Sight Consulting Limited (4Sight) and have been in this role for more than six years. Previously I was employed as a consultant freshwater ecologist at Bioresearches Group Limited. In total I have over 23 years' experience as a consultant ecologist.

Qualifications and Experience

2. I hold the qualifications of Bachelor of Science in Zoology from the University of Auckland and a Post Graduate Diploma, in Wildlife Management from the University of Otago. I ama member of the New Zealand Freshwater Sciences Society.

3. My experience over the last 23 years has largely focused on assessments of ecological features and values and management of ecological effects associated with development, particularly in freshwater systems throughout New Zealand.

4. I have routinely assessed activities against the requirements of the Resource Management Act 1991, National Policy Statement for Freshwater Management, National Environmental Standards, and regional plans. I have also previously prepared and presented ecological evidence for council hearings and the Environment Court.

Code of Conduct

5. I have read the Environment Court's Code of Conduct for Expert Witnesses 2014, and I agree to comply with it. I confirm that the issues addressed in this brief of evidence are within my area of expertise, except where I state I am relying on what I have been told by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

6. I was commissioned by Environment Southland (Southland Regional Council) to review the ecological aspects of the resource consent application and associated technical reports for the water takes and wastewater discharge from the Alliance Mataura Meat Processing Plant ("**the Plant**") into the Mataura River ("**the Plant Application**"). In addition, I was asked to review the resource consent application for the use of the Mataura River weir to dam and divert water to enable the water takes ("**the Weir Application**").

7. I have prepared this statement of evidence based on a technical review report I co-authored for Environment Southland on the potential effects of the water takes and wastewater discharge from the Plant on water quality and ecology aspects (herein, "**4Sight Technical Review**"[1]).

[1] Wilson, P., Bennett, K., 2020. Technical review – Mataura Processing Plant resource consent applications. 4Sight Consulting technical report prepared for Environment Southland. 21 p.

8. I have reviewed both the application and assessment of environmental effects (AEE) reports, including the following documents in preparing my evidence for this hearing:

    a. Assessment of effects report by Freshwater Solutions ("**Freshwater Solutions report**")[2].

    b. An additional memorandum on the Weir and Fish Passage provided by the Applicant on 14 October 2020.

9. A site visit is planned for Monday 30 November, prior to the hearing, to inspect the discharge from the Plant and the nearby receiving environment.

10. This statement of evidence I will:

    a. Outline my review of the resource consent applications and associated technical reports regarding the potential ecological effects on the Mataura River and downstream environments;

    b. Outline matters of consideration relating to the potential ecological effects;

    c. Comment, as relevant, on ecological issues raised by submitters; and

    d. Comment on relevant consent conditions proposed by the Applicant.

11. A discussion of the wastewater treatment upgrade options and the potential effects of the water take and discharge on water quality is addressed in the evidence of other experts for Environment Southland (Alice Andrew and Dr Pete Wilson).

BACKGROUND

12. Alliance owns and operates the Plant on the riverbank of the Mataura River in the Mataura township, which is approximately 44 km upstream from the Toetoes Estuary.

13. Alliance is applying for resource consents with a consent term of 35 years for the Plant for the following activities:

    a. Discharge of up to 8,000 m^3 per day of treated meat works wastewater into the Mataura River;

    b. Discharge of condenser cooling water into the Mataura River;

    c. Take up to 21,200 m^3 water per day from the Mataura River for cooling water;

    d. Take up to 8,000 m^3 water per day from the Mataura River for meat processing and truck washing; and

[2] Montgomerie, R., Carter, N., Fitzpatrick, M., 2019. Assessment of the effects of Alliance Mataura's discharges and water take on Mataura River and Toetoes Estuary. Freshwater Solutions technical report prepared for Alliance Group Ltd. Resource consent application Appendix 2.

e. Use of an existing weir and hydro race structure and associated damming and diversion of water[3].

14. Alliance has made a separate Weir Application to provide certainty that the weir can be used over the same consented period as the Plant water takes and discharges.

15. The Plant application and associated Freshwater Solutions report identified the key potential biological effects of the Mataura Plant abstraction and discharges as:

    a. Potential entrainment of freshwater fish into pump intakes;

    b. Proliferation of nuisance algal growths due to nutrient enrichment;

    c. Reduced benthic invertebrate community health due to effects of the wastewater discharges on water quality; and

    d. Reduced fish abundance, diversity and health.

16. I agree with the key potential biological effects of the proposed water abstraction and wastewater discharge as identified in the application.

17. The Weir application identifies the potential effects of the weir as:

    a. Effects on fish, including upstream and downstream migration of fish;

    b. Effects on natural character;

    c. Effects on recreation; and

    d. Effects on cultural values.

18. I agree with the range of key potential effects of the weir identified by the applicant; however, I have focused my review on potential effects on migratory fish.

WATER ABSTRACTION AND WASTEWATER DISCHARGE

Entrainment of Fish

19. Of the 18 pumps taking water for the Plant, 11 are located within the hydro-race and are currently screened with an aperture size of 5 mm – 6 mm. The remaining pumps are located within a channel between the hydro-race and the plant and are screened with a passive screen with a 1.5 mm bar spacing. Due to high water velocity through the hydro-race and across the screen faces, the potential for entrainment of small fish is assessed in the application as low. Nevertheless, the Applicant is proposing to replace the 5–6 mm screens with 2–3 mm screens to further reduce the risk of entrainment of small fish.

[3] Resource consents for land and water permits for this activity were applied for under a separate application to the others titled 'Use of Mataura River weir to dam and divert water'.

20. I support the reduction in intake screen size for all pump intakes as it is in line with currently available best practice guidelines[4].

21. A condition of consent has been proposed requiring the proposed reduction in screen size. However, the condition currently indicates that the screens would be replaced within two years of any consent commencing. The extended implementation period was raised as a concern by Fish and Game in their submission to the application[5]. It is unclear from the application why a two-year period has been specified, and reasons why this relatively simple measure could not be implemented within a reasonable, but shorter, period (say 6 months or 1 year).

Algal Proliferation

22. The Mataura River is characterised in the Plant application as "having long periods of low flow interspersed with high magnitude but low frequency flood events". The Applicant conducted surveys of periphyton (algal) cover above and below the discharge from 2012 – 2019 that returned no indication of significant increases in algal growth or cover because of the discharge. Periphyton biomass and chlorophyll-a concentrations were found to be variable over time with no clear patterns between levels upstream and downstream of the Plant. The analysis in the Freshwater Solutions report determined that algal communities in the river surrounding the discharge were predominantly reflective of the length of the accrual period, and during periods of stable low flows can reach levels at all sites that are likely to have an adverse effect on benthic invertebrate communities.

23. Where increases in algal biomass were attributed to the discharge, they were in the period prior to the end of sheep and lamb processing.

24. The Mataura River above the plant is subject to a high nutrient (nitrogen and phosphorus) load, at levels that can result in nuisance levels of algal growth. The Applicant's survey results indicate that while the nutrient levels in the discharge are not resulting in notable increases to periphyton cover below the discharge, the discharge contributes to the cumulative nutrient load impacting the overall ecological health of the lower Mataura River and Toetoes (Fortrose) Estuary.

25. The Toetoes Estuary, 60 km downstream of the Plant, forms part of the larger Awarua Waituna Ramsar site, meaning it is recognised internationally as a wetland of high ecological value and importance[6]. Degradation of the Estuary as a result of excessive nutrient loads within the Mataura Catchment has been recorded by Stephens (2018)[7], with the finding that "*the estuary is in a "MODERATE" but declining condition in relation to eutrophication*." Ecological improvement in the Estuary will rely on catchment wide reductions in nutrient load, and the improved treatment systems

[4] NIWA (2007). Fish screening: good practice guidelines for Canterbury. NIWA client report: CHC2007-092. October 2007.
[5] Submission from J. Smyth, Fish & Game NZ - Southland Region, dated 21 November 2019
[6] https://www.wetlandtrust.org.nz/get-involved/ramsar-wetlands/awarua-waituna-lagoon/
[7] Stevens, L.M. 2018. Fortrose (Toetoes) Estuary 2018: Broad Scale Habitat Mapping. Report prepared by Wriggle Coastal Management for Environment Southland. 50p.

proposed by Alliance would contribute to this. However, under the current timeline proposed, such improvement would not begin for 15 years.

Benthic Invertebrate Community Health

26. The Applicant's surveys and analysis of benthic macroinvertebrate indices from sites above and below the discharge between 2012–2019 found communities reflective of the catchment-wide inputs to the river. The Freshwater Solutions report indicated that benthic communities at all sites were in 'fair' to 'poor' health, with no clear evidence that the discharge was adversely impacting community diversity within the river.

27. The most recent reported results (February and March 2019) indicated a reduced abundance of the mayfly *Deleatidium* below the discharge, despite a general increase in *Deleatidium* abundance that occurred since the processing of sheep and lamb ceased at the Plant. *Deleatidium*, as an 'indicator species', is a taxon sensitive to ammonia and other water quality reductions. A decline in *Deleatidium* abundance below and then ultimately above the discharge in early 2019 was attributed to elevated river temperatures and excessive algal growth in the river following a long period of low flow, high-stress conditions.

28. Of interest was that the impacts of these conditions were observed below the discharge before also being observed above the discharge. This may indicate that effects of some chemical stressors, such as elevated ammonia concentrations, resulting from the discharge, may be exacerbated or expressed during low flow conditions.

Fish Communities

29. The Mataura River below the Plant to the Toetoes Estuary is known to provide habitat for a diverse range of native fish as well as exotic sports fish including trout and salmon. The Mataura Falls near the Plant are a natural barrier for the upstream movement of some fish species.

30. One survey of fish communities was undertaken by the Applicant in the period between 2012 and 2019, completed in late February 2019. The survey was undertaken by Freshwater Solutions using electric fishing and a single night deployment of fyke nets at sites above and below the discharge and Falls. The methodology appears generally in line with standard assessment methods, although there is little further detail of methodology in the Freshwater Solutions report. The area of run and riffle habitat fished at each site was provided and fyke nets appeared to target pool habitats where larger eels are more likely, predominantly in localities downstream of the discharge and the Falls.

31. That survey determined that a limited range of fish species were recorded from the river immediately surrounding the Plant, the most commonly recorded being shortfin eel and upland bully. Elvers (juvenile eels) and a juvenile lamprey were recorded upstream of the discharge and weir, indicating some degree of ongoing recruitment. No indicators of a direct impact of the discharge on freshwater fish or fish health, based

on fish condition, were evident from the single survey undertaken, however in my opinion further surveys would be required to provide a more representative sample and assist in determining any long-term trends.

32. Chemical contaminants such as ammonia can have toxic effects for aquatic biota, including freshwater fish. While ammonia concentrations in the river below the mixing zone (250 metres from the discharge point) were within the range unlikely to result in toxic effects for aquatic biota, there may be localised areas of elevated ammonia concentrations within the mixing zone as a result of high levels in the discharge[8], particularly during low flow periods. This was acknowledged in the Freshwater Solutions report. It is accepted that such areas would likely be localised, prior to full mixing and there are no indications that the discharge is limiting fish migration through the area.

33. There is the potential for localised toxic levels of ammonia within the mixing zone near the discharge point and prior to full dilution that may limit aquatic biota utilising the area. However, there is no mention in the documents provided to indicate any lethal toxic effects on fish have previously been observed or recorded from the area.

34. The proposed upgrade to the plant will reduce the levels of ammonia in the wastewater discharge, to the point that concentrations in the river downstream of the Plant should be closer to ambient/upstream concentrations. Such reductions will also reduce the risk of acute toxicity to aquatic organisms in the mixing zone, particularly under low flow conditions.

Summary

35. Overall, since the plant ceased processing sheep and lambs, I agree with the Applicant's assertion that there are no gross indicators of adverse impacts on aquatic communities that can be attributed to the wastewater discharge, based on the assessments undertaken to date.

36. As outlined by Dr Wilson's evidence, ammonia concentrations are elevated below the Plant because of the discharge and, in conjunction with other nutrients, the discharge contributes to the cumulative effects on the wider Mataura River and Toetoes Estuary.

37. The Plant application[9] notes that improvements in water quality will be required in the Mataura catchment under the National Policy Statement for Freshwater Management 2014[10] ("**NPS FM**") and the installation of a biological treatment system would significantly reduce ammonia and other nitrogen outputs from the Plant. The Applicant is proposing to upgrade the plant to install the biological treatment system within 15 years of any consent being granted.

[8] Current median discharge concentrations of 15 g/m^3 (5%-ile – 95%-ile: 5.9 – 29 g/m^3)
[9] Plant Application page 43; Freshwater Solutions report page 62
[10] This has now been superseded by the NPS FM 2020, with similar goals to improve degraded water quality

38. While there are no gross indicators of adverse effects of the discharge on the freshwater fauna of the Mataura River, the discharge contributes to cumulative degradation of the River water quality and the Toetoes Estuary.

39. Given the national (NPS FM) and regional (operative and proposed Regional Plan) objectives to improve water quality, and the cultural and ecological values of the Mataura River and the Toetoes Estuary receiving environments, I am of the opinion that the 15-year timeframe anticipated for the treatment plant upgrade should be reviewed and reduced to the extent practicable to achieve the anticipated benefits of contaminant load reductions in a more timely manner.

40. Should the Plant application be approved, the Applicant has proposed an Environmental Monitoring Plan be developed to outline the requirements and methods for monitoring of the discharge and the Mataura River receiving environment. The Environmental Monitoring Plan would include monitoring of the water quality and physical and biological features of the river, including periphyton and benthic invertebrate communities. A draft Environmental Monitoring Plan (**EMP**) has recently been provided which indicates the scope of monitoring proposed[11].

41. The proposed condition also makes reference to a fish health monitoring survey[12]. The application has identified no adverse effects on fish as a result of the discharge or water takes, and discharges no persistent pollutants that may affect consumptive values of fish, so no tissue sampling is proposed in the draft EMP. This is considered appropriate and is supported as unnecessary. Instead annual monitoring using fyke nests at two sites (one upstream, one downstream) is proposed for a visual assessment of fish condition, and calculation of a condition score based on fish length and weight. This method is generally supported, with the recommendation that the downstream fish health monitoring site be located in relatively close proximity to the discharge and mixing zone to capture the health of fish living near the discharge.

42. Given the above, the overall intent of the Environmental Monitoring Plan is generally supported, should the application be approved.

WEIR APPLICATION

43. The Weir application provided little information on the weir, other than that it is u-shaped and believed to have been constructed in the 1920s or 1930s. The weir dams and diverts water into a channel along the western bank of the Mataura River beside the Plant, with the channel known as the 'hydro race'. The Plant water intakes and hydro scheme turbine operate within this race. A similar race and associated hydro scheme are present on the eastern bank of the river. That scheme is operated by Mataura Industrial Estate (MIE) under a separate set of consents.

[11] Freshwater Solutions (2020a) Environmental Management Plan, Alliance Mataura (draft). Prepared for Alliance Mataura, July 2020

[12] Plant Application, Appendix A; proposed conditions 17 and 18

44. After receiving the 4Sight Technical Review, Alliance has since provided additional information on the weir in a memo, intended to address the queries raised in that review[13] (the **Alliance memo**).

45. Neither the Weir Application nor the Plant Application provide detail on the features of the weir. No information on the weir height, shape, face slope or materials is detailed in either application. The recent Alliance memo provided further context, including additional photographs and description of how the design maintains flow over the weir. The weir is described as a broad crested weir, constructed of concrete, with square edges. The photographs provided in the memo and attachments indicate consistent laminar flows over the lower lying 71m 'apex' of the central weir under typical flow conditions, causing turbulent flow across the downstream face of the weir. Aerial photographs indicate that each 'arm' of the weir following the hydro races diverts river flows over a length of approximately 400 m.

46. The Freshwater Solutions Report notes that the overtopping flow below the weir as far as the Mataura Falls is constrained within a channel through the centre of the river at low flows but covers the entire bedrock lined channel at higher flows[14].

47. Freshwater fish species known to surmount the Mataura Falls downstream of the weir include migratory native species; longfin and shortfin eels, lamprey and koaro. These fish are all excellent 'climbers' as juveniles, except for lamprey that climb as adults. The exotic brown trout is also present in this part of the river. Trout migrate within the river system at times.

48. Overall, the Weir Application provides no discussion of the potential long term effects of the weir on the river through that section to the Falls, including flow changes that may have impacted opportunities for fish passage through the Falls and bedrock sections of the river between the hydro-races. As an example, the weir's flow diversion to the hydro races may have limited the range of available pathways and reduced flow variability that assists migratory fishes' ability to migrate over and above the Mataura Falls.

49. The application provides no assessment or discussion of any alternative options or means of diverting flow that have been considered, such as a reduced or remodelled weir structure. Similarly, no consideration of modifications that may improve fish passage has been made. This lack of consideration of alternatives was also raised by Aukaha in their Cultural Impact Assessment[15].

50. Potential effects on the upstream and downstream migration of fish are discussed in the Weir Application, with further information provided in the recent Alliance memo[16].

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[13] Alliance (2020) Wier and fish passage – APP-20191339. Memorandum from Doyle Richardson (Alliance) to Ian Mayhew (Consultant Planner for ES), 14 October 2020.
[14] Freshwater Solutions Report, page 87.
[15] Aukaha (2019a) Alliance – Mataura Plant – Cultural Impact Assessment. Instream Structures and Water Permits. 19 September 2019. (Attachment 3 of Alliance s.92 response dated 30 September 2019).
[16] Alliance (2020)

The weir is recognised as a fish barrier, in addition to the natural barrier created by the Mataura Falls that are a short distance below the weir. The falls are naturally diverse in features and, despite being a significant barrier to most fish species, maintain some diversity of flows and opportunities for climbing fish to surpass. In contrast, the weir is very uniform in design with laminar flows over the face. Consistent laminar flows and high velocities at the weir face limit opportunities for climbing fish to surpass the obstacle. Nonetheless, there are indicators that some upstream fish migration past the weir is occurring.

51. The Weir Application refers to the requirements of an existing resource consent associated with the hydro scheme and weir[17] for an Elver Trap and Transfer Plan to be implemented, and for a fish ladder to be maintained, to assist in the upstream migration of fish. That consent will expire in November 2026; however, the Weir Application indicates that Alliance is proposing to continue the same requirements. Maintaining the trap and transfer requirement as a condition of any consent is supported.

52. No information on the fish ladder was provided in the Weir Application and application material, however the hearing report associated with the hydro scheme application[18] indicated it is intended to provide upstream passage for salmonid species. It is unclear whether salmonids regularly pass the Mataura Falls and are able to utilise the ladder.

53. The recent Alliance memo included a copy of a fish ladder inspection report prepared by Freshwater Solutions (2020b)[19]. That report provided a description of the ladder as a pool and weir structure, photographs of the ladder, and determined it was in good physical condition and "appeared to be functioning as designed"[20] as a fish passage structure for salmonids. No specific monitoring has been undertaken to determine if salmonids (trout or salmon) are routinely bypassing the falls and weir, although there are anecdotal reports of fish using the ladder[21].

54. The proposal to maintain the fish ladder to assist salmonid migration past the weir, as a condition of any consent, is supported.

55. No comment on the ability of the fish ladder to also provide passage for native fish species was provided in the Weir Application, however the design was targeted for salmonids, and due to the difference in requirements, any benefits of the ladder for native fish are likely to be limited.

56. Effects on lamprey (kanakana) are not discussed in the application. These, along with eels, are considered taonga and important mahinga kai species by mana whenua. The

[17] AUTH.20171566-01

[18] Environment Southland. Report and Decision of Independent Hearings Commissioner Hearing held in the Council Chambers, Environment Southland, Invercargill on 3 December 2018. Independent Hearings Commissioner Dr Rob Lieffering decision on hydro scheme operation, Application No. APP-20171566.

[19] Freshwater Solutions (2020b) Mataura River Weir fish ladder inspection. Prepared for Alliance Group Limited.

[20] Freshwater Solutions (2020b) page 5.

[21] Freshwater Solutions (2020b) page 5.

Mataura Falls were particularly associated with the taking of kanakana[22]. There appears to be no assessment of effects of the weir structure on these fish, which seasonally migrate from the sea as adults to breed and return to the sea as juveniles. The Alliance memo adds comment on kanakana, referencing pre-2007 observations of adult lamprey accumulating at the base of the falls and around the hydro-electric plant then disappearing overnight[23]. Some were observed getting over the walls into the Alliance hydro race. This was interpreted as a strong indication that lamprey were not limited by the weir and were able to migrate upstream. While lamprey have excellent ability to traverse obstacles, and juveniles of lamprey (and eels) have been recorded above the weir, some features of artificial structures, such as sharp edges or 'lips', may limit success.

57. A 2007 Golder Associates report[24] appended to the Alliance memo recommended 'rounding the lip' of the diversion weir top to remove the 90^{o} angle, as a simple means of improving the ability for longfin eel elvers to climb the weir. Such a change may also assist lamprey (kanakana), which also have difficulty passing sharp (90^{o} angle) edges. It is unclear if this recommendation has been implemented. If not, a requirement to round the downstream lip of the weir is recommended as a condition of consent.

58. The Aukaha Cultural Impact Assessment[25] notes that while the weir structure is an existing structure and has been in place for a long time, it may no longer be fit for purpose. Aukaha recommend further assessments to explore how the weir could be modified to better allow natural functioning of the river while still allowing for operation of the Plant intakes and hydro race. I agree with this recommendation, including an assessment of measures that could be made to improve fish passage past the weir for species such as kanakana, koaro and eels.

Conclusion

59. In my opinion, the Weir Application provided little detail on the weir and implications for natural river functioning, however subsequent information provided in the Alliance memo added useful context. Inclusion of the conditions included in an existing resource consent associated with the hydro scheme and weir requiring an Elver Trap and Transfer Plan to be implemented, and for a fish ladder to be maintained is supported. The weir comprises a notable barrier to upstream fish migration. However, little is known of actual effects of the weir structure on populations of other migratory fish species, such as kanakana and koaro. Alternatives or amendments to the weir structure that may improve opportunities for upstream fish passage past the weir have not been adequately considered within the application. Simple measures, such as rounding of the 'lip' of the weir may improve opportunities for upstream passage of native climbing fish species. An assessment of other modifications that may improve

[22] Aukaha (2019b) Alliance – Mataura Plant – Cultural Impact Assessment. 1 August 2019. (Attachment 2 of Alliance s.92 response dated 30 September 2019).
[23] Golder Associates (2007) Assessment of hydro-electric diversion effects on fish passage. Prepared for Alliance Group Limited. Page 8
[24] Golder Associates (2007)
[25] Aukaha (2019a)

opportunities for fish passage, while maintaining the functioning of the weir should also be considered.

60. Review of the decision surrounding the damming and diversion of the river for use in the hydroelectric turbine (AUTH.20171566-01 and AUTH.20171566-02)[26] indicate that a shortened consent period was applied in order to bring the end date in line with the lapse date associated with the adjacent MIE diversion and hydro turbine. The reason for this was, largely, due to the uncertainty surrounding potential effects of the diversion of flows through the turbines on downstream migratory fish, including adult eels and juvenile lamprey. The Commissioner considered the time period appropriate to enable both consent holders (Alliance and MIE) to collect information on effects of the weir and hydro schemes on downstream fish migration. The outcomes of that assessment may impact reconsenting of the hydro scheme and/or result in changes to the race and intake setup, including options such as screening of the intakes, or modifications to the weir to better allow for both upstream and downstream fish passage. Given that this consent was only recently granted, the assessment has yet to be completed. Accordingly, there does not appear to be any additional evidence to support a substantially longer term for the weir damming and diversion.

61. Additionally, the weir applications separate the operation and use of the weir for the diversion of water to the hydro race for water takes (abstraction) from the diversion of water, using the same weir and hydro race, through the hydroelectricity turbine. It is difficult to see how they can reasonably be separated in that way, as the system is clearly linked. In my opinion, the overall use of the weir and hydro races may better be considered in conjunction with the hydro scheme during reconsenting prior to the 2026 lapse date for the two hydro schemes.

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Keren Bennett

[26] Environment Southland. Report and Decision of Independent Hearings Commissioner Hearing held in the Council Chambers, Environment Southland, Invercargill on 3 December 2018. Independent Hearings Commissioner Dr Rob Lieffering decision on hydro scheme operation, Application No. APP-20171566.

8C:

Evidence of Ms Alice Andrew;

BEFORE THE COMMISSIONER APPOINTED BY

SOUTHLAND REGIONAL COUNCIL

Application APP-20191339

UNDER	the Resource Management Act 1991
IN THE MATTER	of a resource consent application to take water from and discharge water and treated wastewater to the Mataura River and to use an existing weir and associated damming and diversion of water
APPLICANT	Alliance Group Limited

STATEMENT OF EVIDENCE OF ALICE ANDREW

FOR SOUTHLAND REGIONAL COUNCIL

Dated this 9th day of November 2020.

INTRODUCTION

Current Position

1. My name is Alice Emma Andrew. I am a Principal Environmental Consultant and Director of 4Sight Consulting Limited (4Sight). I have been in this role for more than 19 years.

Qualifications and Experience

2. I hold the qualification of Bachelor of Technology in Environmental Engineering, from Massey University, an accredited engineering degree by Engineering New Zealand and The Washington Accord.

3. My experience over the last 19 years has largely focused on assessments and management of environmental effects of domestic, commercial and industrial wastewater discharges to land and water, throughout New Zealand, particularly discharges from onsite wastewater systems throughout the Auckland region.

4. I have routinely assessed such activities against the requirements of the Resource Management Act 1991, National Policy Statement for Freshwater Management, National Environmental Standards, and regional plans. I have previously attended council hearings working as a provider of specialist input on behalf of council.

Code of Conduct

5. I have read the Environment Court's Code of Conduct for Expert Witnesses 2014, and I agree to comply with it. I confirm that the issues addressed in this brief of evidence are within my area of expertise, except where detailed engineering design knowledge of wastewater treatment systems applies or where I state I am relying on what I have been told by another person.

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

SCOPE OF EVIDENCE

7. I was commissioned by Environment Southland (Southland Regional Council) to review the proposed wastewater management options in the resource consent application and associated technical reports for the water takes and wastewater discharge from the Alliance Mataura Meat Processing Plant into the Mataura River ("**the Plant**").

8. I have prepared this statement of evidence based on a Wastewater Assessment report I authored for Environment Southland addressing wastewater treatment and disposal options proposed for the Plant (herein,

"**4Sight Technical Review - Wastewater**"[1]) and additional information provided by the Alliance Group Limited (**Alliance** or the **Applicant**).

9. I have reviewed both the application and Assessment of Environmental Effects prepared by Alliance ("**AEE**") in preparing my evidence for this hearing, including the following documents:

    a. Mataura Plant Wastewater Treatment and Disposal Alternatives Assessment report by Pattle Delamore Partners ("**PDP report**")[2].

    b. 4Sight's technical review of water quality and ecology aspects associated with the proposed discharge ("**4Sight Technical Review**")[3].

    c. Alliance Mataura Plant Wastewater Treatment and Disposal Alternatives Assessment – Re-assessment of Land Discharge Options report by Pattle Delamore Partners (**PDP Re-assessment of Land Options report**)[4]

    d. Discharge Options and Treatment Alternatives Further Assessment Technical Memorandum by Pattle Delamore Partners (**PDP Further Options Tech Memo)[5]**

10. I have not visited the site however I understand that a site visit is planned prior to the hearing to inspect the plant operations, discharge from the Plant and the nearby receiving environment.

11. This statement of evidence will:

    a. Outline my review of the resource consent applications and associated technical reports regarding the proposed flows and loads to the Mataura River.

    b. Outline matters of consideration relating to the proposed wastewater treatment and disposal options.

    c. Comment on consent conditions proposed by the Applicant.

12. A discussion of the potential effects of the water take and discharge (and damming and diversion) on water quality or ecology is addressed in the evidence of other experts for Environment Southland (Keren Bennett and Dr Pete Wilson).

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[1] Andrew, A., 2020. Technical review – Mataura Processing Plant resource consent applications. 4Sight Consulting technical report prepared for Environment Southland.
[2] Wilkinson, L., Khan, A., 2019. Alliance Mataura Plant Wastewater Treatment and Disposal Alternatives Assessment by Pattle Delamore Partners Limited prepared for Alliance Group Limited.
[3] Wilson, P., Bennett, K., 2020. Technical review – Mataura Processing Plant resource consent applications. 4Sight Consulting technical report prepared for Environment Southland.
[4] Khan. A, 2020. Alliance Mataura Plant Wastewater Treatment and Disposal Alternatives Assessment – Re-assessment of Land Discharge Options by Pattle Delamore Partners Limited.
[5] Wilkinson, L., Khan, A., 2020. Discharge Options and Treatment Alternatives Further Assessment, Technical Memorandum by Pattle Delamore Partners Limited.

13. A technical review of the detailed engineering design of the proposed wastewater treatment and land disposal options proposed is beyond the scope of my evidence, the validity of the engineering sizing calculations and design proposed in the PDP report is assumed to be sound.

BACKGROUND

14. Alliance owns and operates the Plant on the riverbank of the Mataura River in the Mataura township, which discharges treated wastewater and cooling water to the Mataura River.

15. Alliance has made applications for water takes, discharges of water and wastewater and use of the weir (and associated damming and diversion). My evidence pertains to the treatment of wastewater prior to its discharge.

16. In terms of the wastewater treatment and disposal aspects of the application being considered in my evidence, my understanding of the existing situation is summarised below:

    a. There are two waste streams generated onsite that discharge treated wastewater to the Mataura River:

        i. Green waste stream from stock yards, gut cutting and tripe processing; and

        ii. Non-green waste stream from the slaughterhouse floor, further processing, and hide wash overflow.

    b. The existing treatment system is comprised of preliminary treatment (screening), primary treatment (settling) and physio-chemical treatment via a dissolved air floatation (DAF) system.

    c. The existing discharge consent provides for a maximum daily discharge of 14,000 m^3 per day – although actual discharge rates have been shown to be substantially lower than this level.

STAGED UPGRADE TIMEFRAMES

17. Alliance has applied for resource consents with a consent term of 35 years for the Plant to discharge of up to 8,000 m^3 per day of treated meat works wastewater into the Mataura River; and to undertake a staged upgrade as follows:

    a. Year 1 to 3 – implementation of water reduction initiatives and addressing existing resilience issues.

    b. Within 5 years – implementation of an Ultraviolet Disinfection System (UV) to reduce microbial contaminants.

    c. Within 15 years – implementation of biological treatment to reduce nutrient and BOD loading.

18. The AEE states that a comprehensive assessment of the effects of the discharge on the receiving environment determined that no adverse effects trigger the need for immediate or urgent mitigation.

19. However, the 4Sight Technical Review has concluded that the river is degraded with respect to E. coli and nutrients, and that current E. coli concentrations in the discharge are shown to be having significant adverse effects on the water quality of the Mataura River. Nutrients discharged from the Plant also contributes to cumulative nutrient loads that ultimately enter the Toetoes Estuary.

20. I support the upgrading of the Plant discharge to reduce adverse effects. In my opinion the current treatment process does not meet current best practice and the proposed upgrade will move towards this.

21. Additionally, given national and regional objectives to improve water quality, and the cultural and ecological values of the Mataura River and the Toetoes Estuary receiving environments, I believe a treatment upgrade that achieves a significant reduction in nutrient and microbial contaminant loads should be adopted in a more timely manner than is currently proposed.

FLOWS AND CONTAMINANT LOADS

22. Based on raw data provided by Alliance, I have calculated the average daily flow in 2018 (for comparative purposes) as 3,782 m^3, with a maximum daily discharge of 7,475 m^3, and the calculated annual flow in 2018 as 1,085,369 m^3.

23. The application proposes to discharge up to 8,000 m^3 per day, and whilst I agree that this is appropriate given the peak discharge was 7,475 m^3 per day, without additional flow limits a discharge of 8,000 m^3 per day could theoretically equate to a maximum annual discharge of 2,296,000 m^3 (assuming 281 processing days of the year, as was the number of processing days in 2018).

24. This potential annual discharge volume (2,296,000 m^3) is approximately twice (2x) the actual 2018 annual discharge, that has formed the basis of the water quality and ecological effects on the Mataura River.

25. In my opinion, if the proposed discharge flow volumes are accepted, lower monthly average and/or monthly and annual limits should be set to ensure that the annual discharge load does not substantially increase beyond what is currently discharged.

26. In my report (4Sight Technical Review – Wastewater), based on the current flow I have suggested examples[6] of additional limits if a discharge of up to 8,000 m^3 per day were allowed.

[6] Based on 2018 flow data and rounded for convenience: to discharge up to 8,000 m^3 per day, up to 100,000 m^3 per month, and up to 1,100,00 m^3 per year.

WASTEWATER TREATMENT OPTIONS

27. Alliance engaged PDP to develop management options and outline the wastewater treatment methods and technology that could be used to reduce the loads of key parameters in the wastewater discharge. Alliance stated that they sought 'Practicable' solutions proportionate to the likely environmental risks from contaminants in the discharge.

28. PDP initially developed sixteen management options for the Plant, which included various options for the continued discharge to the Mataura River; irrigation to land; a dual discharge option to both land and water; and discharge to the local municipal plants. This option assessment was based on the premise that no adverse effects trigger the need for immediate or urgent mitigation[7]. PDP then discarded those deemed as incorporating significant risk and uncertainty, and substantial lifecycle costs. This resulted in 5 options being considered further, which all involved full or partial river discharge.

29. Whilst I agreed that such criteria for discarding options were relevant, I considered they needed to be explored and considered in the context of effects as identified in the 4Sight Technical Review. Therefore I sought further assessment of the feasibility of land disposal, a dual discharge option, disposal to the existing municipal treatment plants, and for PDP to elaborate on the reasons why a range of other alternative treatment technologies were not considered (or had been removed from consideration).

30. PDP prepared the Re-assessment of Land Disposal Options report and Further Options Tech Memo in response to this request. From their findings, I agree that options for land disposal (full or partial) are limited and may be deemed not the best practicable option for the following reasons:

    a. Soils in the vicinity of the processing plant are unsuitable to allow sustainable wastewater irrigation, and there is a lack of suitable land available for the establishment of a comprehensive land discharge scheme.

    b. For the land that could be utilised, other factors such as long conveyance distances and a high risk of runoff render the options impracticable.

    c. Due to the fact that the Plant processes during winter and winter processing rates are high, winter irrigation requires the use of large storage facilities which increases risk in relation to management of nutrient levels in the stored treated wastewater, and odour.

    d. The option of discharging (as trade waste) to the two treatment plants (Gore and Mataura) is unlikely to provide a long-term reduction in

[7] The AEE states that a comprehensive assessment of the effects of the discharge on the receiving environment determined that no adverse effects trigger the need for immediate or urgent mitigation.

contaminant load to the river as those treatment plants cannot provide any greater level of treatment and it would therefore effectively just be shifting the problem.

31. PDP's reassessment of alternative treatment technology options considered a range of treatment upgrade options that are commonly utilised in the meat industry as well as for the dairy industry, that are simple to operate and provide for the highest levels of resilience.

32. Newer untested technologies were not considered appropriate, based on the risk that they may be unreliable. Whilst I agree that the most appropriate option should be based on a proven ability to provide good levels of treatment and resilience to handling peak wastewater loads, I also believe that Alliance should keep a watching brief on newer technologies that may allow them to reduce or remove the discharge to the river, and that flexibility should be provided in the consent conditions to reflect this.

SUMMARY

33. In my opinion, the current treatment system is not best practice for treating wastewater and an upgrade is appropriate.

34. PDPs investigations demonstrated that:

    a. Removing the direct discharge to the Mataura River via a land-based discharge is currently not the best practicable option;

    b. Discharge to other treatment plants (Gore and Mataura) are unlikely to provide a long-term reduction in contaminant load to the river, and

    c. Newer technologies, untested in the meat or dairy industry in New Zealand carry the risk of being unreliable.

35. On the basis that this discharge to the river continues, then I consider that the proposed upgrade to the treatment system (comprising an activated sludge lagoon and clarifier system to reduce nutrient loads, with further tertiary treatment to reduce bacterial loads to appropriate levels, following the existing DAF system) is appropriate to move towards best practice and achieve a significant reduction in nutrient and microbial contaminant loads, subject to the following:

    a. A maximum daily limit, monthly average, and monthly and annual limits each be set to ensure that the annual discharge load does not substantially increase beyond what is currently discharged.

    b. The timeframe for the treatment plant upgrade be reduced to achieve the identified benefits in a more timely manner.

    c. Further investigation and consideration into technologies that could reduce or remove the need to discharge to the river should be undertaken,

and flexibility should be provided in the consent conditions to reflect this if a staged upgrade is approved.

Alice Andrew

8D:

Evidence of Dr Marion Poore;

BEFORE THE COMMISSIONERS APPOINTED BY

SOUTHLAND REGIONAL COUNCIL

Application APP-20191339

UNDER	the Resource Management Act 1991
IN THE MATTER	of a resource consent application to take water from and discharge water and treated wastewater to the Mataura River and to use an existing weir and associated damming and diversion of water
APPLICANT	Alliance Group Limited

STATEMENT OF EVIDENCE OF MARION ROSALIND POORE

FOR SOUTHLAND REGIONAL COUNCIL

Dated this 9th day of November 2020

INTRODUCTION

Current Position

1. My name is Marion Rosalind Poore. I am a public health physician currently employed by the Ministry of Health as a Chief Clinical Advisor for the Covid-19 Health System Response Directorate. I undertake a small amount of work as an independent contractor.

Qualifications and Experience

2. I have been a registered medical practitioner since 1979 and qualified as a specialist in Public Health Medicine in 2004.

3. I am a member of the NZ College of Public Health Medicine - which is concerned with the health of populations, the factors that may cause disease and the implementation of evidence-based interventions for preventing disease and ill health.

4. I have extensive experience as a public health practitioner having worked as a Medical Officer of Health for Southern DHB in the Otago and Southland Health Districts between 2004 - 2019. This includes managing outbreaks of infectious disease, health risk assessment of environmental situations, advising on human health risk related to environmental contamination including water.

Code of Conduct

5. I have read the Environment Court's Code of Conduct for Expert Witnesses 2014, and I agree to comply with it. I confirm that the issues addressed in this brief of evidence are within my area of expertise, except where I state I am relying on what I have been told by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

6. I was commissioned by Environment Southland (Southland Regional Council) to review the public health aspects of the resource consent application and associated technical reports for the water takes and wastewater discharge from the Alliance Mataura Meat Processing Plant ("**the Plant**") into the Mataura River ("**the Plant Application**").

7. I have prepared this statement of evidence based on a technical review report I authored for Environment Southland on the potential effects of the water takes and wastewater discharge from the Plant on public health[1].

[1]. Public Health review of the Alliance Meatworks Ltd Assessment of Environmental Effects for their Consent application to continue operating the Mataura Meat Processing Plant at Mataura. 1 November 2020

8. I have reviewed both the application and assessment of environmental effects (AEE) reports, including the following documents in preparing my evidence for this hearing:

   a. Assessment of effects report by Freshwater Solutions ("**Freshwater Solutions report**")[2].

   b. Quantitative Microbial Risk Assessment[3] ("**QRMA"**).

9. A site visit is planned prior to the hearing to inspect the discharge from the Plant and the nearby receiving environment.

10. This statement of evidence will:

   a. Outline my conclusions in respect of public health risk;

   b. Make recommendations on the timeframes for the proposed upgrades and other matters to be considered through consent conditions.

11. A discussion of the wastewater treatment upgrade options and the potential effects of the water take and discharge on water quality is addressed in the evidence of other experts for Environment Southland.

BACKGROUND

12. Alliance owns and operates the Plant on the riverbank of the Mataura River in the Mataura township.

13. Alliance is applying for resource consents with a consent term of 35 years for the Plant for the following activities:

   a. Discharge of up to 8,000 m^3 per day of treated meat works wastewater into the Mataura River;

   b. Discharge of condenser cooling water into the Mataura River;

   c. Take up to 21,200 m^3 water per day from the Mataura River for cooling water;

   d. Take up to 8,000 m^3 water per day from the Mataura River for meat processing and truck washing; and

   e. Use of an existing weir and hydro race structure and associated damming and diversion of water[4].

[2] Montgomerie, R., Carter, N., Fitzpatrick, M., 2019. Assessment of the effects of Alliance Mataura's discharges and water take on Mataura River and Toetoes Estuary. Freshwater Solutions technical report prepared for Alliance Group Ltd. Resource consent application Appendix 2.

[3] Dada AC,(2019) Quantitative Microbial Risk Assessment for the discharge of treated meat processing factory wastewater into the Mataura River. Report AES 1704

[4] Resource consents for land and water permits for this activity were applied for under a separate application to the others titled 'Use of Mataura River weir to dam and divert water'.

14. The Applicant proposes the following discharge quality improvements:

    a. The installation of 'Equipment to disinfect the process wastewater discharged from the site in order to inactivate pathogens' within five years of the commencement of the consent (proposed Condition 8); and

    b. A further Wastewater Treatment Plan Upgrade, with specific discharge limits (primarily associated with BOD, suspended sediment and nutrients), within 15 years of the commencement of the consent (proposed Conditions 9 to 15).

15. The AEE is supported by a range of technical assessments. Of relevance to this public health review is the QMRA. A key conclusion of this report is that while '*E. coli concentrations increase significantly following discharge of the Alliance Plant wastewater it is concluded that the current wastewater treatment applied at [the] Alliance Plant is sufficient to reduce health risks associated with swimming below the discharge to levels below 'the NZ threshold for tolerable risk', even at [a] maximum discharge of 14,400 m^3/d* [5].

16. My assessment is provided in my report and I do not repeat it here, other than to reiterate my conclusions and recommendations below.

ASSESSMENT CONCLUSIONS

17. The discharge of animal wastewater from the Mataura Plant contributes a significant level of microbial contamination in the Mataura river. This is of a level that it creates a significant risk to the health of those who may use the water for swimming or contact recreation below the plant.

18. The QMRA report concludes there is a low health risk associated with the discharge, due to the low levels of pathogens in the discharge. In my opinion, this conclusion should be treated with caution as:

    a) One or more bacterial pathogens were found in all samples of wastewater and protozoan parasites were found in some samples;

    b) The sampling programme was conducted between December and March only, when evidence from notifiable disease reporting shows that some pathogen loads are likely to peak during spring;

    c) The QMRA technique is complex and very few such studies on animal wastewater and impacts on human health have been completed.

19. While establishing causal relationships between waterborne microorganisms and human illness can be challenging because of multiple pathways and underreporting of gastrointestinal infections, and technical issues around detecting pathogens in water, this does not mean that risks to health do not exist. The identification of any bacterial pathogen from a fresh water body is significant from a public health risk perspective.

[5] Dada AC,(2019) Quantitative Microbial Risk Assessment for the discharge of treated meat processing factory wastewater into the Mataura River. Report AES 1704. P 9

20. A precautionary approach is necessary to improve understanding of three emerging risks to public health associated with animal wastewater being discharged into the Mataura River. These include emerging pathogenic zoonotic organisms such as viruses, the role of organic compounds in the ecosystem, and the impact of microplastics in the ecosystem.

21. In my opinion, the best way to manage the public health risk associated with animal wastewater being discharged to the Mataura River is to reduce the contaminant levels being discharged. The proposals to install a UV plant and to upgrade the wastewater treatment plant to remove nitrogen and other contaminants will help reduce the microbial contamination from the wastewater discharge.

22. Degradation of freshwater bodies is an environmental issue of great concern to New Zealanders, and the discharge of animal waste from the Mataura Plant is a longstanding source of contamination into the Mataura River. A precautionary approach to addressing the public health risks would be to complete the installation of the UV plant and upgrade to the wastewater treatment plan in a more timely manner than is proposed.

RECOMMENDATIONS

23. To ensure that public health risk is effectively managed using a precautionary approach, I recommend the following:

    a) Complete the proposed plant upgrades as soon as possible. From a public health perspective, this particularly relates to the proposed UV plant although there will also be considerable benefit from the wastewater treatment plan upgrade. These will contribute to improved water quality and bring associated community, cultural and environment benefits to improving the health of the local community.

    b) Regular monitoring of *E. coli* levels above and below the discharge point should be undertaken.

    c) An assessment of the nature of the virus load, emerging organic compounds and microplastics in the discharge should be undertaken.

    d) Consider a shorter consent term, and/or the ability to review discharge standards, to ensure that the consent keeps pace with increasing knowledge on the discharge and changing community expectations for public health risk.

Dr Marion Poore