Before the Southland Regional Council

APP – 20191339

Under	the Resource Management Act 1991 (**RMA**)
In the matter of	An application for replacement water and discharge permits for cooling and processing purposes at the Mataura Processing Plant
Applicant	Alliance Group Limited (**Alliance**)

Statement of evidence of Mark James for Alliance Group Limited

16th November 2020

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QUALIFICATIONS AND EXPERIENCE

1 My full name is Mark Richard James.

2 I am an aquatic ecologist holding the following degrees, BSc Victoria University, Wellington; BSc (Hons) Victoria University, Wellington and PhD (Aquatic Biology), University of Otago, Dunedin.

3 I have a background in basic and applied research in marine and freshwater ecology and biology with over 40 years' experience including research, consulting and management of science organisations.

4 Following two years with the Institute of Nuclear Sciences, Department of Scientific & Industrial Research (DSIR) I was employed in 1982 by the Taupo Research Laboratory, DSIR, then moved to Christchurch in 1992 as a scientist with the National Institute of Water & Atmospheric Research (NIWA). In 1994 I was appointed as a Project Director and led large multi-disciplinary Foundation for Research, Science & Technology (FRST) funded programmes including "Lake Ecosystems" and “Sustainability of coastal ecosystems”. In 2000 I moved to Hamilton to take up the position of Regional Manager with NIWA and in 2002 was appointed as NIWA’s Director Operations. In 2008 I retired from this position taking up a brief position as Chief Scientist for Environmental Information before leaving NIWA in late 2008 and setting up as an independent environmental consultant and ecotour operator.

5 Since 1982 I have been involved in research on the ecology of freshwater and marine systems. These studies aimed to gain a better understanding of ecological processes in lakes, rivers, coastal and open ocean systems. I have worked in New Zealand, Finland, Denmark, Australia and in Antarctica. My research has been published in over 45 papers in scientific journals and books. These publications have included scientific papers in international journals and book chapters on the ecology of freshwater and marine invertebrates, freshwater management, coastal sustainability as well as the effects of sediments, lake level management, and other anthropogenic activities on aquatic ecosystems.

6 During my 41 years' experience I have been involved with Regional Councils, government departments and industry in establishing guidelines for ecological assessments, providing descriptions of freshwater and marine communities and assessments of potential ecological effects for a wide range of projects throughout New Zealand.

7 I have been involved in the preparation work for the Alliance consent application since 2017 which has included:

- Providing advice and liaison with stakeholders;
- Reviewing previous reports on the ecology of the Mataura River and Alliance operations and scoping new work required for consents;
- Reviewing reports on new ecological studies carried out;
- Assessment of the effects of the Alliance Mataura treated wastewater discharge on the receiving environment; and
- Preparation of a report on proposed monitoring.

8 I have visited the Alliance Mataura processing plant and the Mataura River on a number of occasions. I have also been involved in the Southland Statutory Planning Process (SSPP) and have taken part in a number of caucusing meetings with other science experts as directed by the judge hearing appeals on the 2018 Southland Water and Land Plan (SWLP).

9 In preparing this evidence I have reviewed published and unpublished reports and in particular the following which have been used in this assessment:

- The reports and statements of evidence of other experts giving evidence relevant to my area of expertise, including:
  - (i) Description of the receiving environment (Freshwater Solutions 2018);
  - (ii) Assessment of the effects of Alliance Mataura's discharges and water take on Mataura River and Toetoes Estuary (Freshwater Solutions 2019);
  - (iii) Quantitative microbial risk assessment for the discharge of treated meat processing factory wastewater into the Mataura River (Streamlined Environmental 2018);
  - (iv) Determination of mixing zone of treated wastewater from Alliance Mataura discharged into the Mataura River: a mixing modelling approach using contaminant tracing (Streamlined Environmental 2019); and

(v) Evidence in chief for Mr Richard Montgomerie, Mr Azan Khan and Dr Chris Dada.

- The Section 42A Officers' Report and associated review documents and evidence.
- Submissions by Fish and Game Southland, Hokonui Runanga and Department of Conservation.

10 I have read and agree to comply with the Code of Conduct for Expert Witnesses (Environment Court Practice Note 2014). This evidence is within my area of expertise except where I state that I am relying on facts or information provided by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

SCOPE OF EVIDENCE

11 My evidence addresses the following matters:

- An assessment of the actual and potential effects of the current and future discharge and current water take on the aquatic environment;
- Identification of relevant aquatic guidelines and appropriate standards;
- An assessment of the effects of the proposed activities with reference to those targets and standards;
- An assessment of proposed mitigation to meet appropriate water quality standards where necessary; and
- An outline of a proposed monitoring plan.

12 Evidence describing the general features of the Mataura River and characteristics of the existing discharge and receiving environment is provided by Mr Montgomerie. Dr Dada addresses microbial contaminants.

EXECUTIVE SUMMARY

13 The Alliance Mataura Plant (the Plant) is located on the Mataura River at Mataura approximately 44 km upstream of the Toetoes Estuary. Alliance has lodged applications for the replacement of treated wastewater discharge, cooling water discharge and water take resource consents for the Plant. My

evidence assesses the effects of the current and ongoing discharges. In relation to an application to use an existing weir and hydro race structure to dam and divert water Alliance is relying on information that formed the hydro consent application and are carrying over appropriate conditions from that consent.

14 The processing season typically starts in October and ends in September with a short 'off season' between late September and mid-late October. Changes to the type of stock processed since the 2012 season and other changes to the processing and treatment systems have resulted in a significant reduction in water use and contaminant loads from the plant to the receiving environment (Mr Richardson and Mr Montgomerie's evidence provides details of these changes). The advent of *Micoplasma bovis* and a general increase in processing space requirements from suppliers has increased the number of cattle being processed in the last two seasons which resulted in an increase in the total nutrient and total suspended solid loads, and biological oxygen demand (BOD) compared with previous years.

15 Overall Alliance achieved a very high (near 100%) compliance with its treated wastewater discharge consent limits. The monitoring results however, show that ammoniacal-N and *E.coli* levels are significantly elevated downstream of the Plant.

16 The point of complete mixing has been estimated as approximately 100 m downstream from the discharge.

17 There is no apparent effect of the discharge on river temperature or dissolved oxygen at the Mataura Bridge Site. The only time the river water temperature (both upstream and downstream of the discharge) exceeded the upper lethal temperature limit for the mayfly *Deleatidium* sp. (23 °C) was in the summer of 2018 and it came close to the limit upstream in March 2019.

18 Monitoring of continuous dissolved oxygen (DO) conducted 1.2 km upstream and 13 km downstream of the discharge indicated the National Policy Statement for Freshwater Management (NPS-FM) attribute state was B both upstream and downstream for the 7-day minimum and 1-day minimum respectively in Jan 2018. In summer 2019 the DO attributes were A upstream and B downstream. Contemporaneous DO sampling results in summer 2019 immediately upstream and downstream of the discharge were very similar indicating changes with the site 13 km downstream could be due to factors

other than the discharge at a time when the river was stressed due to elevated temperature.

19 Monitoring confirms that the discharge does not adversely affect pH, turbidity, colour or clarity. Nor does it result in the generation of conspicuous foams or scums. At times the discharge may contribute to a small increase in TSS downstream of the Plant in combination with the effect of the energy from the Mataura Falls resuspending fine material and the discharge. However any such increase does not appear to cause any ecological effects.

20 BOD concentrations were below the guideline of <2 g/m^3 for avoiding nuisance heterotrophic growths and effects on aquatic biota. The formation of conspicuous heterotrophic growths immediately downstream of the discharge due to BOD has not been observed.

21 Monitoring shows that there is a change in ammoniacal-N from a NPS-FM attribute state A upstream to B downstream. This represents a change from a 99% species protection level to a 95% species protection level, i.e., at the downstream site 5% of the most ammoniacal-N sensitive species may be occasionally affected. The species that could be impacted at attribute state B are exclusively freshwater mussels, which do not occur in the Mataura River immediately upstream or downstream of the discharge or in similar habitats elsewhere. The more sensitive species found in this part of the Mataura fall within the top 20% of sensitive species and are equally protected by the attribute state B as they are attribute state A.

22 With regard to enrichment, mean annual dissolved reactive phosphorus concentrations at biological monitoring sites upstream and downstream of the discharge were in the C Band. There is no bottom line for this attribute state in the 2020 NPS-FM but the levels would be below those defined as "degraded" in the recent expert caucusing for the proposed Southland Water and Land Plan (pSWLP). There are no attribute states defined for DIN in the 2020 NPS-FM but levels would be below those defined as "degraded" in the Freshwater Science and Technology Advisory Group (STAG) report and accepted by the expert caucusing for the pSWLP.

23 The lack of nuisance algal growths in the periphyton surveys undertaken since 2013 indicates the discharge is unlikely to be stimulating nuisance algal growths despite the apparent high concentrations. 2019 was an exception as high temperatures and long accrual periods did result in some high levels upstream and downstream.

24 The enriched and degrading state of the Toetoes Estuary reflects the cumulative effect of nutrients from the whole Mataura River catchment. The total nitrogen discharge contribution to the Toetoes Estuary load from the Alliance discharge is 1.1–1.7%. The majority of total nitrogen load entering Toetoes Estuary is derived from other catchment inputs, particularly diffuse sources. Even a marked reduction in the total nitrogen and total phosphorus loads in the Alliance discharge would have little, if any, detectable effect on the nutrient status of Toetoes Estuary. However, along with all other sources that contribute nutrients to the catchment, Alliance will need to proportionally reduce the amount of total nitrogen it discharges over time as part of catchment wide initiatives to improve water quality. Nitrogen is the major issue with the estuary and eutrophication thus the focus is on nitrogen for improvement rather than phosphorus. This is agreed in paragraph 42 of Dr Wilson's evidence.

25 While the Plant discharge is having a significant effect on the levels of *E. coli* in the receiving water downstream, observed increases in *E. coli* concentrations as a result of the treated Plant discharge did not translate to increases in the abundance of zoonotic pathogens. Neither did these increases in *E. coli* relate to increases in the individual illness risk. This is confirmed in the evidence of Dr Dada. However, Alliance will need to achieve a reduction in bacterial levels to meet the NPS-FM and SWLP requirements. The evidence of Mr Khan details how that might be achieved and the evidence of Mr Low includes suitable conditions to address this upgrade.

26 Periphyton surveys since 2013 have shown that algal cover and biomass, whilst varied between sites and among surveys, is not influenced by the discharge and can be high upstream and downstream. Significant algal cover and high periphyton biomass potentially affect the Macroinvertebrate Community Index (MCI) and Quantitative Macroinvertebrate Community Index (QMCI) scores. *Deleatidium* sp. abundance has been variable between sites and across surveys but has tended to be lower at downstream sites. Prior to the most recent surveys there had been a general increasing trend in *Deleatidium* sp. abundance at the site downstream. The decline in *Deleatidium* sp. abundance at downstream sites in February 2019 is not explained by periphyton cover and biomass or ammoniacal nitrogen concentrations but could reflect the stress of high river temperatures and in the case of the March period long accrual periods upstream and downstream also contributing to declines in macroinvertebrate indices.

27 Overall results indicate the treated wastewater discharge has not resulted in a consistent decrease in MCI and QMCI scores between upstream and downstream locations over the period 2013-2019. There is no evidence or causal links showing that observed changes are associated with the discharge.

28 The processing component of the take is approximately 8,000 m^3/day or a reasonable worse case instantaneous take of 194 L/s[1]. This represents approximately 1-2% of the 7 day MALF. The small size of the take relative to the river flow and the very minor effect of the take on minimum flow duration and flow variability will result in only negligible effects on dissolved oxygen, contaminant concentrations and river water temperature, and is not expected to alter water quality or affect fish populations.

29 The results of the benthic invertebrate community monitoring over many years indicate that the water take and the discharge do not adversely affect the benthic invertebrate community (an important food source for fish).

30 The abstraction of water from the hydro-race has the potential to entrain juvenile fish. Despite the low risk it is recommended that all the intakes that are currently fitted with 5–6 mm screen mesh be fitted with <3 mm screens to further reduce the potential for entrainment and to meet best practice standards for screening intakes.

31 As Mr Wiese's evidence states, Alliance acknowledges that it will need to reduce ammoniacal-N, total nitrogen and *E. coli* levels to assist in meeting the SWLP and NPS-FM standards and limits and to contribute to an improvement in water quality in the catchment as a whole. To address this Alliance has proposed installing a UV plant within 5 years to decrease *E.coli* levels and within 15 years will make a significant investment in further improvements to wastewater treatment that will significantly decrease ammoniacal-N and total nitrogen (TN) concentrations and loads. These upgrades are detailed in the evidence of Mr Khan.

32 A comprehensive monitoring programme is proposed that will address the limits set in the conditions of consent in the discharge and monitor key parameters of water quality upstream and downstream to ensure and demonstrate that the discharge is not affecting river health. The conditions

[1] Alliance utilises 18 river water intake pumps across the site. Based on how the pumps are used across the plant, as described in the S92 Response dated 9 August 2019, it is estimated that a worst-case instantaneous take would be 194 L/s.

attached to the evidence of Mr Low and the EMP attached to my evidence include these monitoring requirements.

EFFECTS OF THE CURRENT DISCHARGE

33 The actual and potential effects of the current discharge on the receiving environment, that were assessed, included:

- Increased ammoniacal-N levels which can cause toxicity effects on biota in the river;
- Reduced dissolved oxygen levels that can impact directly on invertebrates and fish;
- Increases in nitrogen and phosphorus which can increase the risk of nuisance algae and eutrophication of the river and estuary;
- Reduced water clarity and an assessment of whether the discharge results in the generation of conspicuous foams and scums which can affect aesthetics, recreation and ecological values; and
- Increased microbial contamination that can impact on aquatic health, recreation and cultural values, and consumption of fish and shellfish.

34 The potential effects were identified through analysis of the available discharge and receiving environment data, expert advice, published and unpublished reports, and through consultation with Alliance's project team, Southland Regional Council (SRC) and the stakeholders' Technical Working Party (TWP). In preparing this evidence I have also had regard to the matters raised in submissions made on the application.

35 Water quality and biological communities in the receiving environment of the Mataura River, prior to and following the proposed wastewater treatment upgrade, were assessed against standards and targets derived from the following:

- 2018 SWLP;
- National Policy Statement for Freshwater Management (NPS-FM) (2017);
- NPS-FM 2020;
- Resource Management Act 1991,
- Where appropriate ANZECC guidelines; and

- Discussions on determining indicators of water quality degradation undertaken as part of the expert science caucusing for the Environment Court appeals on the SWLP.

36 The targets were selected after a careful evaluation of the receiving environment, expert advice, and the assessment of the effects. The rationale for the selection of each of the water quality and biological standards and limits is summarised below.

Current discharge

37 The following summary is based on Freshwater Solutions' reports (2018 and 2019) and while some parts are duplicating evidence presented by Mr Montgomerie they are repeated here for completeness.

38 Changes to the wastewater treatment process contributed to reductions in phosphorus concentrations in the discharge in the 2000s, significant reductions in BOD, sulphide and further reductions in DRP in 2012. There have been some further changes since 2012 that have also reduced some contaminants.

39 Overall Alliance has achieved a very high compliance with its treated wastewater discharge consent limits. One or two BOD concentration non-compliances were recorded each year between October 2012 and 12 March 2019 (nine in total) and four non-compliances for TSS not being consistently maintained. The ammoniacal-nitrogen limit of 'consistently maintain' < 30 g/m^3 was not met in one five-week period between January 2015 and February 2015. A batch of non-compliances occurred in March and April 2019 (five for BOD concentration, one for TSS and two for ammonia) and three for BOD concentration in January 2020. Investigations have been completed for all these events and corrective actions implemented where applicable. It should be noted that there has been 100% compliance with the BOD load limit over these times. Full details of the level of various contaminants in the discharge are provided in the evidence of Mr Montgomerie.

40 As described in the evidence presented and reported by Dr Dada there are very high concentrations of *E.coli* of up to 10^7 CFU/100mL in the discharge, but the levels of the representative pathogens, which are known to cause illness, were very low and more variable.

The effects of the current discharge on water quality

Water Quality Standards and Guidelines

41 In this section of my evidence I provide some background and context to the various freshwater quality standards and guidelines to which I refer in my evidence. The reason for doing so is that there are several sets of standards and guidelines that are referred to in New Zealand, and it can be confusing to know which ones to refer to, and why.

42 **Appendix 1** attached contains the various "formal" sources of freshwater quality standards and guidelines for various attributes that I refer to in my evidence. **Table 1** contains the attributes a group of expert ecologists (including myself) agreed could be used in Southland as interim indicators of water quality degradation in freshwater bodies. These attributes were developed in the context of the Environment Court's consideration of the Proposed Southland Water and Land Plan, but as yet the Court has made no findings on how these interim indicators should be used.

Table 1. Attributes for clearly "degraded" rivers agreed to in expert caucusing for the SWLP Topic A (JWS November 2019) for applicable indicators.

Attribute		
Ammoniacal nitrogen (mg/L)	**More Stringent** >0.03 (annual median) >0.05 (annual maximum)	**Less Stringent** >1.0 (annual median) >2.20 (annual maximum)
	Upland	**Lowland**
Dissolved inorganic nitrogen (mg/L) - median	>0.5	>1.0
Dissolved reactive phosphorus (mg/L)	>0.01	>0.018
Periphyton – chlorophyll *a* (mg/m^2) (92^{nd} percentile over at least 3 years monthly sampling)	>120	>200
Periphyton - % weighted composite cover (92^{nd} percentile over at least 3 years monthly sampling)	>40	>55
Macroinvertebrate Community Index (MCI)	<100	<90

Suspended sediment (turbidity) NTU/FMU	>2	>2
E.coli	> 130 (annual median) >1200 (95th percentile) >540 (exceed >20%) >260 (exceed >34%)	> 130 (annual median) >1200 (95th percentile) >540 (exceed >20%) >260 (exceed >34%)

43 A number of points need to be made about the various attribute standards and guidelines that are available:

- The identification of appropriate water quality standards across a variety of attributes can be challenging and sometimes contentious. This is for a number of reasons including:

  (i) Natural variability in biotic and abiotic features of different freshwater bodies and freshwater body types, making "one size fits all" standards problematic;

  (ii) A lack of agreement about the condition or state the standard or guideline is designed to achieve. For example, is the purpose to sustain existing biodiversity; to maintain viable populations of particular species; to improve or enhance particular populations (potentially at the expense of other populations); to protect all biodiversity from further decline; or to guard against potential future risks to aquatic species?

  (iii) Inadequate data. For many areas and for many species we have limited useful information.

- Because of the challenges I mention above, the development of appropriate guidelines and standards is a constant work in progress.

- No single guideline or standard addresses all attributes of interest. For example, a key attribute that is "missing" from all of the operative standards, including the 2020 NPS-FM, is dissolved inorganic nitrogen (DIN). DIN is a key nutrient form of nitrogen and elevated concentrations *may* give rise to excessive periphyton growth.

- The status of the various guidelines and standards needs to be considered with care. Some are operative and have status under the RMA. Some are draft or proposed and may be subject to amendment and have limited weight in RMA decision-making. This is addressed further in the planning evidence of John Kyle.

- The purpose of each guideline or standard also needs to be considered. For example, the focus of the attribute tables in the previous NPS-FM (made operative in 2014, amended in 2017, and now inoperative), and those of the recently released 2020 NPS-FM, is on water quality in an FMU and they are generally not written as standards to apply to point source discharges. By contrast the Receiving Water Quality Standards – Appendix E of the pSWLP (which largely repeats the provisions of the operative regional plan) are expressly addressed to the effects of discharges following reasonable mixing and do not consider water quality in the FMU context.
- The ANZECC (2000) and MfE (2003) Guidelines, while in some respects now overtaken by more recent standards, are helpful in that they operate as *triggers* to undertake a more detailed site-specific assessment of effects. This approach recognises that for many attributes it is not the level or concentration *per se* that constitutes an adverse effect. Rather it is the potential or likelihood of that level or concentration giving rise to a significant adverse effect. DIN is an example of this.[2]
- There are no guidelines or standards for treated wastewater. Rather, the guidelines or standards that are available (such as Appendix E in the pSWLP) are receiving water standards and apply downstream of the point of discharge, after allowance of sufficient distance for the discharge to be reasonably mixed.

44 Having noted the above matters I now set out the process I have followed in selecting what I consider to be the most appropriate standard for each of the identified attributes:

- I have favoured those standards where I consider the weight of scientific consensus supports their adoption. Generally, those standards are the ones referred to in **Table 1**. There is one notable exception though. In my opinion there should be a separation of upland and lowland for large rivers, such as the Mataura, which traverse from

[2] Elevated concentrations of DIN in the water column are generally only an issue if they are promoting too much periphyton growth. Whether or not this occurs is partly a function of DIN concentrations, but will also be influenced by a host of other factors, some of which may be more significant than DIN concentrations (such as bed composition). That said, DIN contributes to the mass loading of nitrogen in a catchment, and excessive volumes of nitrogen in a catchment like the Mataura clearly causes issues as that nitrogen settles in the lower reaches and estuary as discussed in Richard Montgomerie's evidence.

pristine upland tributaries down to lowland areas which are farmed and have been modified over time.

- Where those standards have been developed in relation to FMU water quality I have applied them as if they apply to the subject discharge after reasonable mixing. That is a conservative approach as it does not make allowance for variability (reduction) in water quality that might reasonably be expected downstream of a major point source discharge while still allowing FMU standards to be met at representative monitoring points.
- I have not considered it necessary to adopt a more stringent standard for any attribute on account of any particular sensitivity in the receiving environment. There is no evidence that any such sensitivities are present.
- On the other hand I have not adjusted the most appropriate standard to make it less stringent, even though such an approach could be taken for the likes of DIN – where there is generally no evidence from the in-river monitoring that DIN in the discharge is promoting excessive periphyton growth downstream.

45 On the basis of these considerations the most appropriate standards for each attribute have been selected, and these are shown shaded in yellow in **Appendix 1** and in **Table 1**.

46 Finally (but importantly) I make the observation that regardless of what standards might reasonably be expected of the Alliance Mataura discharge, there is likely to be very little, if any, observable improvement in the health of the river's biota unless and until major improvements in discharge quality, and particularly in nutrient concentrations and mass loads, are made *throughout* the catchment.

Mixing

47 To define the mixing zone, Streamlined Environmental Ltd constructed a hydrodynamic mixing model and simulated the mixing of *E.coli*, assuming there was no die-off in the short distance of interest in the river (200-1000m downstream of the discharge point). The discharge does not instantly mix across the river but forms an effluent plume from the outfall which runs close to the true right bank until it becomes fully mixed across the river. No further dilution was found at a point 100 m downstream and thus it can be assumed

that the discharge is fully mixed by the time it reaches this point. A similar result was found when using other analytes during the simulation.

Temperature

48 The 2013 National Objective Framework for temperature, dissolved oxygen (DO) and pH provides attribute states for temperatures to protect ecosystem health with <18°C being attribute state A (where no thermal stress occurs), and attribute state B <20°C (minor stress). River water temperatures greater than 24°C have been shown to be stressful to a range of invertebrate taxa and fish species and temperatures around 24–27°C potentially result in some sensitive invertebrates, particularly some insects, being severely stressed and some fish eliminated, if such temperatures persist.

49 For the lower Mataura River the pSWLP has a limit where the daily maximum temperature shall not be increased as a result of a discharge by more than 3°C when the natural temperature is 16°C or less and by more than 1°C when temperature is above 16°C.

50 There is no risk of the Alliance discharge adversely affecting water temperature in the Mataura River, given the nature of the water usage, and that it is a diversion of a small part of the flow. The river temperature ranged between 2.3-23.2 ^{o}C with a median of 11.2 ^{o}C. There was no detectable difference in water temperatures upstream versus downstream of the discharge, and therefore the temperature change limits in the SWLP are never exceeded. The temperature at which some biota are sensitive to high temperatures is 24^{o}C and the river has occasionally exceeded this at both upstream and downstream sites.

pH

51 pH can affect a number of chemical processes including shell formation by molluscs and the toxicity due to un-ionised ammoniacal-N (NH_3) which needs to be adjusted for pH. There were no significant differences between upstream and downstream pH levels and no evidence of effects on biota.

Dissolved oxygen

52 Low DO levels can reduce benthic invertebrate community diversity and abundance and cause stress in fish, potentially leading to mortality, depending on the tolerance levels of the taxa present. The NPS-FM recognises the merits in setting DO concentration limits rather than saturation

limits and for this reason concentration limits have been adopted for setting compliance limits to manage the biological effects of DO for the Mataura River. DO concentrations can fluctuate widely in lowland rivers draining agricultural catchments, such as the lower Mataura River, and the current consent limit requires concentrations below the discharge to be >5 g/m^3.

53 Attribute states and limits in the 2020 NPS-FM have identified a 1-day minimum threshold to avoid acute levels for sensitive species and longer term 7-day minimum levels to avoid significant chronic impacts. Attribute state A results in no stress on aquatic biota and B occasional minor stress. Considering the species present in the Mataura River attribute state B is considered appropriate and thus a 7-day mean minimum in summer of >7.0 g/m^3 and 1-day minimum >5.0 g/m^3 is used in the assessment of effects of the discharge and for setting limits.

54 Continuous DO results from 13 km downstream of the discharge at Chalmers Road, between 2013 and 2017 indicated the attribute state was B or better. Continuous DO results 1.2 km upstream and 13 km downstream of the discharge at Chalmers Road in January 2018 indicated that for both locations the NPS-FM attribute state was B for both the 7-day minimum and 1-day minimum. Continuous DO results in February and March 2019 indicated the attribute state was A at both the two upstream sites and B for both at the two downstream sites. However, the two sites are 13 km apart and observations in other rivers often find DO reduces downstream because of bacterial activity and oxygen consumption.

55 DO data collected weekly upstream in the hydro-race and downstream of the discharge at the Bridge site between 2012 and 2019 shows that the median oxygen levels were 10.5 mg/L upstream and 10.9 mg/L downstream while the minimum was 8.3 and 8.0 mg/L respectively. Thus, levels are above 8 mg/L and there is no evidence of changes that would impact on biota. This also supports the conclusion that differences at the Chalmers Road site are due to river processes/inputs other than the discharge.

Clarity and colour

56 Colour and clarity affect aesthetic values and some species are sensitive to increased turbidity and reduced clarity. For example, banded kokopu are known to avoid waters with >20-25 NTU while other fish species can tolerate levels up to 160 NTU. The NTU in the 2017 NPS-FM has been replaced in the 2020 NPS-FM by visual clarity (m).

57 The Mataura River upstream and downstream of the discharge does meet the black disc distance threshold of >1.78 m in the A Band of the 2020 NPS-FM. The maximum reduction between downstream and upstream over the period 2012-17 was 20%.

58 Measurements of colour (hue and brightness) using the Munsell test in 2017-18 showed only marginal differences downstream compared with upstream. Thus, we can conclude there is not a conspicuous change or exceedances of the threshold for reductions in clarity due to the discharge. It is also possible that slight changes at times could be due to activity around the Mataura Falls which naturally causes resuspension of solids.

Foams and scums

59 Like clarity and colour, generation of foams or scums can affect aesthetic values.

60 Section 107 of the RMA requires that a discharge cannot be granted consent, if after reasonable mixing, there is 'production of any conspicuous oil, or grease films, scums or foams of floatable or suspended materials'. The recreational use of the Mataura River within the mixing zone is limited but there is a reasonable amount of contact recreation that occurs at the downstream bridge. As such the target for foams and scums, is therefore 'no conspicuous foams and scums beyond the mixing zone at the compliance point (site at 350 m)'. It is important that the Falls just above the discharge are taken into account here as this can at times generate foams immediately upstream of the discharge.

61 A register was kept of conspicuous foams and scums during the 2017/18 processing season and this showed that scums were observed upstream, normally just below the Falls, and on only two occasions out of 14 occasions originated at or below the discharge. One of the two cases below the discharge was when the plant was not operating. Overall, the discharge does not result in conspicuous foams or scums.

Biological oxygen demand

62 BOD concentrations upstream and downstream of the discharge were below the guideline of <2 g/m^3 for avoiding nuisance heterotrophic growths (MFE 1992). Thus, effects on aquatic biota, or the formation of heterotrophic growths, downstream of the discharge due to biological oxygen demand would not be anticipated. A small amount of sewage fungus was observed

at Site D1, with the aid of an underwater viewer, during the March 2019 periphyton and benthic invertebrate survey, but this was not assessed as being conspicuous. Sewage fungus was observed in 2014 but 4 occasions were upstream of the discharge and on 5 occasions were downstream.

Nutrients

63 Dissolved inorganic nitrogen (DIN, ammoniacal-N, nitrite- and nitrate-N) and DRP can cause nuisance algal growths in some rivers while total phosphorus (TP) and total nitrogen (TN) loads can result in eutrophication effects such as nuisance macrophyte and macroalgal growths in the lower reaches of rivers and estuaries. Although nitrogen is generally considered the most common limiting nutrient in estuaries, limitation due to either nutrient or co-limitation can occur in rivers and thus both nitrogen and phosphorus need to be considered in assessing nutrient concentrations and loadings.

64 The current pSWLP does not include any limits for DIN (ammoniacal-N, nitrate-N and nitrite-N) and DRP. However, it is likely that overarching limits will be set for Southland's Fresh Water Management Units (FMUs) as more work is completed to give effect to the NPS-FM and the proposed Regional Water and Land Plan. In fact, potential limits are currently being discussed as part of the Southland Statutory Plan Process (SSPP) and it is likely that there will be a requirement to at least meet the bottom line for DIN and DRP proposed in the Freshwater Science and Technical Advisory Group (STAG) report (STAG 2019). The bottom lines for DIN and DRP, which were recommended in the STAG report and generally accepted by scientists who took part in caucusing as part of Topic A for the pSWLP, is for a median and 95th%iles of 1.0 and 2.05 mg/L for DIN and 0.018 and 0.054 mg/L for DRP (D Band in 2020 NPS-FM, also see JWS 2019).

65 The median concentrations of DIN upstream were 0.93 mg/L and 0.91 mg/L (U1 and U2) and downstream 0.90 and 0.92 mg/L(D1 and D2) in the 2018-19 period. The 95th%iles were 1.35 and 1.41 mg/L upstream and 1.35 mg/L at both downstream sites. Thus, there was no meaningful difference between upstream and downstream and both would fall into attribute state C and below the concentrations that would be defined as "clearly degraded".

66 For DRP the median levels were 0.0095 mg/L and 0.010 mg/L at upstream sites and 0.010 at both downstream sites in 2017-18. The 95th%iles were 0.024 mg/L and 0.020 at upstream sites and 0.016 and 0.015 at downstream sites. Thus, both upstream and downstream were on the attribute state B/C

border for medians and for 95th%iles were on the border of attribute state A/B for upstream and in attribute state A downstream. There is no evidence that the discharge is increasing the DRP levels downstream of the discharge when compared with upstream.

67 The lack of nuisance algal growths in the periphyton surveys undertaken from 2013-2018 indicate the discharge is unlikely to be stimulating nuisance algal growths, despite the relatively high nutrient concentrations. Higher levels were observed upstream and downstream in 2019. This means that either DIN or DRP concentrations need to be higher than the guidelines to produce growths or other factors are controlling periphyton growth in the river. It should be noted that in March 2019 periphyton was at or close to nuisance levels upstream and downstream but this could be attributable to the long accrual period at low flows and warm temperatures at the time. Accrual period is a major driver of periphyton biomass.

68 The enriched and potentially degrading state of the Toetoes Estuary with increasing areas of excessive nuisance macroalgae reflects the cumulative effect of nutrients, and specifically nitrogen, from the whole Mataura River catchment. The total nitrogen discharge contribution to the Toetoes Estuary load from the Alliance discharge is estimated to be 1.1–1.7% and the estimated total phosphorus discharge contribution is 0.7–1.3% with the vast majority of TN and TP load entering Toetoes Estuary being derived from other catchment inputs, particularly diffuse sources such as agriculture.

69 Given the enriched and potentially degrading state of the Estuary it is apparent that catchment-wide nutrient controls are likely to be required to arrest the risk of decline in water quality of the Estuary. Even a marked reduction of TN load in the Alliance discharge would have little, if any, detectable effect on the nutrient status of Toetoes Estuary in the absence of similar reductions in inputs from other contributing sources. However, Alliance will need to reduce its nitrogen levels over time in line with whatever Freshwater Management Unit (FMU) wide initiatives the community settles on to improve water quality.

Ammoniacal-N toxicity

70 Elevated ammoniacal-N levels have the potential to be toxic to a range of aquatic organisms. The toxic component of ammoniacal-N is the un-ionised NH_3 with toxicity being adjusted for pH and temperature conditions at the time. Ammonia toxicity is covered in the current NPS-FM but not directly in

the pSWLP. However, there is a requirement in Appendix E of the pSWLP for the lower Mataura that "there must not be any destruction of natural aquatic life by reason of a concentration of toxic substances". Ammoniacal-N is a contaminant of concern in the discharge from the Mataura Alliance Plant.

71 The limits set in the NPS-FM take pH and temperature into account and set attribute states for different concentrations to provide various levels of protection. Attribute state A is set to provide protection for 99% of species that have been assessed for toxicity and attribute state B is set to protect of 95% of species. The concentrations (adjusted for pH and temperature) are <0.03 and <0.05 for annual median and annual maximum for attribute state A and 0.03-0.24 and 0.05-0.40 mg/L respectively for attribute state B.

72 The median concentration in the undiluted discharge over the last monitoring period was 15 g/m^3 with a 95th%ile of 29 mg/L thus there is potential for toxic effects on biota downstream. Annual median concentrations of ammoniacal-N upstream of 0.02-0.03 g/m^3 would always meet attribute state A while downstream concentration was consistently higher (0.05 mg/L) and would just fall into attribute state B on all occasions.

73 The change from ammoniacal nitrogen NPS-FM attribute state A upstream, to B downstream, is a change from a 99% species protection level to a 95% species protection level, i.e., at attribute state B 5% of the most ammoniacal-N sensitive species may be occasionally affected. Such species are exclusively freshwater mussels, which do not occur in the Mataura River immediately upstream or downstream of the discharge, most probably due to the lack of suitable fine sand substrate. Those species that are more ammoniacal-N sensitive and that do occur in the Mataura River in the vicinity of the discharge are the mayfly *Deleatidium sp*. and the snail *Potamopyrgus antipodarum*, but these fall within the top 20% of sensitive species and are thus protected by the attribute B state.

74 As discussed above the downstream sites are only just in attribute state B and the present levels would be expected to protect the species found in this part of Mataura River and species that would be expected to occur. It should also be noted that the 2020 NPS-FM has raised the national bottom line to the bottom of B Band (instead of the bottom of C Band) and this would be met with the current and future concentrations after mixing. Thus, it can be concluded that while levels are higher downstream than upstream, they are

unlikely to have an acute or chronic effect on the biota. The biota present is what expected in this type of river habitat and there is no evidence of a toxic influence.

Nitrate toxicity

75 Nitrate can be toxic to aquatic life, causing stress in a range of aquatic species, with high levels resulting in inhibited growth and effects on immune systems. The lower Mataura River receives significant nitrate inputs from the surrounding catchment but nitrate levels are still below the levels that would cause nitrate toxicity. The bottom line for DIN (ammoniacal-N and nitrate-nitrite-N) set in the STAG report (STAG 2019) and the JWS (2019) was 1.0 mg/L. Meeting this requirement would also meet attribute state A for nitrate toxicity in the NPS-FM (2020) and would not be an issue for the discharge.

Effects on microbial risks

76 The following assessment summarises the microbial reports prepared for Alliance and evidence presented by Dr Dada.

77 Bacteria have the potential to cause human health issues directly through contact recreation and indirectly through contamination of fish and shellfish.

78 *E. coli* is an indicator of human health risk associated with microbial contamination and contact recreation. The Mataura Bridge is one of the bathing sites included in Appendix G of the SWLP and the lower Mataura River is popular for a range of recreational purposes, including those that require contact with the water and the prospect that some water will be ingested.

79 The 2020 NPS-FM defines five bands for the attribute for human health for recreation. The Attribute States for rivers and lakes for *E. coli* are percent exceedances over 540 and 260 *E.coli*/100 ml, median concentration and the 95th percentile. It is generally accepted that attribute state D and E would be considered "degraded". For these attribute band medians must be > 130 *E.coli*/100 ml and 95th%ile of >1200 *E.coli*/100 ml respectively.

80 For Mataura 3 (which includes the area around Mataura township) the SWLP sets a standard where *E.coli* shall not exceed 1000 *E.coli*/100 ml, except within 1 km upstream of "Popular bathing sites" where the concentration shall not exceed 130 *E.coli*/100 ml.

81 Analysis of monitoring data for the Mataura River indicates that levels of *E.coli* would mean the river would be classified in the red or attribute state E for most sites, regardless of whether they are upstream or downstream of the discharge. This can be attributed to the 190 km long Mataura River and its tributaries having various point and diffuse sources of microbial contamination including from industries, sewage treatment plants and increased levels of dairying.

82 However, the proportion of samples that exceed the NPS-FM water standards increase between sites upstream and downstream of the discharge. For example. exceedances of the 540 cfu/100 ml increased from 35% (upstream) to 77% (downstream). Thus the discharge is having a significant effect on levels of *E.coli* at least at the compliance site downstream. It should also be noted that there is a clear link for very high levels upstream and downstream of the discharge point with high flows, suggesting overland flow is a major contributor to very high values in the river generally.

83 While the Plant discharge is having a significant effect on the levels of *E. coli* in the receiving water downstream, observed increases in *E. coli* concentrations as a result of the treated Plant discharge did not translate to an abundance of zoonotic pathogens. Neither did these increases in *E. coli* relate to the individual illness risk based on a comprehensive quantitative microbial risk assessment (QMRA) carried out by Streamlined Environmental Ltd and discussed in the evidence of Dr Dada. Monitoring showed that the pathogens *Campylobacte*r and *Salmonella* were in very low numbers and *E.coli* 0157:H7, a pathogen of concern, was rare. However, regardless of the actual health risk, Alliance will need to reduce bacterial levels to meet the NPS-FM *E. coli* requirements (see later in my evidence).

The ecological effects of the current discharge on biota

84 The potential adverse ecological effects in the receiving environment, associated with the Plant discharges, are as follows:

- Proliferation of nuisance algal growths including thick mats of periphyton (e.g., *Phormidium*) and filamentous green algae;
- Reduced benthic invertebrate community health; and
- Reduced fish abundance, diversity and health.

85 Surveys of the biota in the Mataura River upstream and downstream of the discharge from the Alliance Plant have been carried out annually by Freshwater Solutions Ltd and the results are described in detail in the evidence of Mr Montgomerie. Surveys included two sites upstream and two sites downstream and describe the general habitat as well as the periphyton and macroinvertebrate communities.

Periphyton

86 Nuisance growths include sewage fungus, periphyton algae, and macrophtyes (large aquatic plants). Periphyton refers to the complex of algae, cyanobacteria and heterotrophic microbes found on hard substrates in rivers and streams. Periphyton also forms the base of the food web in these rivers and is a primary source of food for a range of macroinvertebrates and ultimately fish.

87 The discharge location and elevated nutrient concentrations in the discharge and receiving environment have the potential to elevate water and sediment nutrient levels. Excessive periphyton algal growth can cause detrimental effects on ecological, cultural, recreational and aesthetic values. Large biomass of periphyton can also alter pH and DO levels and affect habitat for a range of aquatic biota.

88 The SWLP defines standards for stream periphyton cover (as a percentage of the stream bed) to support instream values affected by periphyton in the Southland Region. There are no standards set for the lower Mataura River at Mataura (Mataura 3) but it could be argued that the river should meet the standards for a 'Lowland hard bed' river which has the following guidelines:

- Biomass shall not exceed 35 g/m^2 for either filamentous algae or diatoms and cyanobacteria.
- Chlorophyll-a shall not exceed 120 mg/m^2 for filamentous algae and 200 mg/m^2 for diatoms and cyanobacteria.

89 There are four attribute states (A to D) defined in the periphyton attribute of the national objectives framework (NOF) in the current NPS-FM. Chl-*a* (in mg/m^2) provides an estimate of periphyton algal biomass and is the periphyton attribute unit for protecting ecosystem health. The bottom line is defined as levels not exceeding 200 mg/m^2 in more than 8% of samples for a minimum of 3 years. Attribute state A is described as having rare blooms, B occasional blooms and C periodic blooms.

90 Periphyton surveys since 2012 have shown that algal cover and biomass, whilst varied between sites and among surveys, showed no effect from the discharge for cover of nuisance mats or cyanobacteria and filamentous algae. Surveys have shown that following long accrual periods nuisance levels can build up. Levels were high and exceeded the bottom line for both downstream sites in 2012 but up until 2018 have consistently been in attribute state B of <120 mg/m^2 and at times in attribute state A. This decrease, may in part, have been attributed to the reduction in the discharge of phosphorus since 2012.

91 Levels of periphyton remained in attribute state B in January and February 2019 but were increasing and in March 2019 one site upstream and two sites downstream were in attribute state C or even exceeded the bottom line of 200 mg/m^2 in the case of the site furthest downstream. These high levels of periphyton were attributed to the long accrual period during a dry and warm period prior to sampling which gives periphyton an opportunity to develop to high, potential nuisance levels. At that time, it is likely levels could have been affecting macroinvertebrate communities but both upstream and downstream periphyton would be expected to have dropped once there was an increase in flows or floods in the river.

Macroinvertebrates

92 The benthic macroinvertebrate community consists of a range of taxa including snails, bivalves, chironomid larvae, worms, caddisflies, and mayflies. The community in the lower Mataura River reflects the location, land use and modification throughout the catchment. The discharge from the Alliance Plant and inputs from other sources will potentially affect habitat sensitive taxa, such as mayflies, which are highly valued food for fish. There is also the potential for the discharge to result in adverse effects directly through toxicity (e.g., ammoniacal-N toxicity effects), as discussed earlier.

93 The 2020 NPS-FM requires action plans be put in place where the Macroinvertebrate Community index (MCI) is below 90 and the Quantitative Macroinvertebrate Community Index (QMCI) is below 4.5. No standards are set for Mataura 3 in the SWLP but for lowland hard bed rivers the receiving water standards for MCI and SQMCI scores of 90 and >4.5 respectively.

94 In his evidence Mr Montgomerie provides data on macroinvertebrate populations (number of taxa, abundance, EPT, MCI and QMCI) at upstream and downstream sites under the current discharge. In summary:

- The number of taxa present, abundance, and percent EPT (Ephemeroptera - mayflies, Plecoptera - stoneflies and Trichoptera - caddis flies) has been variable both upstream and downstream of the discharge and there is no clear difference that can be linked to the discharge;
- The numbers of the high value mayfly *Deleatidium* has tended to be lower downstream but until recently (2019) has been increasing;
- The decline in *Deleatidium* sp. abundance at downstream sites in February 2019 is not explained by periphyton cover and biomass or ammoniacal-N concentrations but could reflect high river temperatures at the time and an increase in overall stress that occurred some weeks later. A similar thing is likely to have happened at upstream sites as well in March 2019;
- There is no apparent effect of the discharge on river temperature or dissolved oxygen that would have affected macroinvertebrates at the Mataura Bridge Site;
- MCI scores were similar upstream and downstream of the Plant between 2012-2019 and remained within the 'fair' stream health range for all sites. Scores have been above the SWLP (2018) guideline of MCI >90 at the sites downstream of the discharge, on most sampling occasions up until 2017. In the most recent surveys (2017-2019) all sites upstream and downstream, except the site furthest downstream, were < 90 and would not have met the bottom line;
- QMCI scores have been variable across years largely as a result of differences in the relative abundance of *Deleatidium*, QMCI scores have typically been higher at the upstream site just above the discharge while QMCI scores for the other site upstream and downstream sites have generally been within a similar range. The low QMCI score in March 2019 was reflective of the stressful conditions in the river upstream and downstream of the discharge at the time of the survey.
- Overall results indicate the treated wastewater discharge has not resulted in a consistent decrease in MCI and QMCI scores between upstream and downstream locations over the period between 2012 and 2019. There is no evidence or causal links that can be associated with

the discharge for the February 2019 survey and the March 2019 declines that occurred both upstream and downstream.

The effects of the current discharge on fish

95 The Mataura River near the Alliance Plant supports long and shortfin eel, common and upland bully, Gollum, southern and alpine galaxias, giant kokopu, and lamprey (kanakana). The area is also significant for its brown trout population.

96 The discharge has the potential to have direct effects (e.g., through ammoniacal-N toxicity) on fish diversity and abundance within the mixing zone and the lower Mataura River downstream of the discharge. It can also have indirect effects through altered food sources (e.g., benthic invertebrate community composition).

97 The lower Mataura River is a migratory pathway for a range of species with eels (tuna) and kanakana being the obligate diadromous species that need to have passage through to complete their lifecycles. Elevated ammoniacal-N concentrations within the discharge have the potential to affect their migration if they are forced to spend too much time in the discharge plume before it is sufficiently mixed.

98 The SWLP sets ‘avoiding rendering fish unsuitable for human consumption’ as a target for lowland rivers.

99 There are no known persistent pollutants in the Mataura discharge and therefore adverse effects from the discharge on fish health or the consumption of fish are not expected.

100 The main concerns with fish populations themselves are potential effects of discharges on food resources and potentially ammoniacal-N toxicity. As described above there is no evidence that the macroinvertebrate community has been impacted by the discharge. In fact, the macroinvertebrate community has improved in recent years, including below the discharge.

101 The change from attribute state A to B downstream will only affect the most sensitive species, which in the case of what was used to define the attribute state are only freshwater mussel species, which do not occur in the habitats present below the discharge.

102 Various galaxiids and elvers have been found to be able to tolerate relatively high ammoniacal-N and would be protected by attribute state B at downstream sites, which is set to protect 95% of species. The issue with kanakana is dealt with below under submissions.

CHANGES IN WATER QUALITY WITH PROPOSED NEW TREATMENT

103 The Mataura River has been classified as a degraded river based on the levels of *E.coli* and DIN (dissolved inorganic nitrogen – ammoniacal-N, nitrate-N and nitrite-N) (JWS November 2019). As discussed earlier I have applied these as the minimum level of protection to avoid degradation in the Mataura River below the discharge.

104 While levels of *E.coli* would struggle much of the time to meet the limits in the NPS-FM and SWLP upstream, there is also a significant increase in exceedances downstream due to the discharge. A comprehensive QMRA and analyses of microbial components in the discharge showed that the increase in *E.coli* did not correlate with risk from pathogens. Despite this I am advised that Alliance will be implementing new ultra-violet treatment that will significantly reduce the levels of *E.coli*. This is addressed in the evidence of Mr Khan.

105 A discharge limit with a median of 1,000 cfu/100 ml (95%ile of 10,000 cfu/100 ml) at Year 5 and a 95th%ile of 1,000 cfu/100 ml at Year 15 (compared with 95th%ile discharge levels between 240,000 and 2,400,000 cfu/100 ml between 2004 and 2018), has been recommended for post-upgrade by Alliance, a concentration that I consider appropriate. The addition of UV treatment is planned for within 5 years from consent being granted and at 15 years for further upgrades, and will ensure that these limits are met and the discharge improved.

106 To improve the health of the river and the Toetoes Estuary requires reductions in nutrient concentrations and loads throughout the catchment. DIN levels are either the same or only slightly different upstream and downstream at present and the contribution of the load to the Estuary is less than 1.7% for nitrogen of the total catchment inputs. Despite these very small contributions Alliance acknowledges levels in the discharge for DIN, and in particular ammoniacal-N, need to reduce as part of catchment wide efforts to improve water quality. To achieve this Alliance will be installing a new treatment plant to meet higher standards within 15 years of consent being

granted. The standards to be met pre- and post-upgrade have been determined by and are reported in Mr Khan's evidence, and are shown in **Table 2** below.

Table 2. Standards that shall not be exceeded pre and post upgrade. Medians and 95th%iles are for 12 month rolling periods. Note the E.coli limit is after the improved treatment by 15 years. An interim improvement is discussed in paragraph 104.

Parameter	**Limit pre upgrade**	**Limit post upgrade**
Ammoniacal Nitrogen	Maximum of 50 g/m^3 and consistently maintained at <30 g/m^3	Median of 5 g/m^3 and 95th%ile of <10 g/m^3
cBOD5 Load	Maximum of 3,500 kg/day	Maximum of 3,500 kg/day
cBOD5	Maximum of 300 g/m^3	Median of 50 g/m^3 and 95th%ile of 100 g/m^3
Total Suspended Solids	Maximum of 200g/m^3 and consistently maintained at <100 g/m^3	Median of 40g/m^3 and 95th%ile of 80 g/m^3
Total Kieldahl nitrogen (TN post upgrade)	Median of 60 g/m^3 and 95th %ile of 80 g/m^3	Median of 20 g/m^3 and 95th %ile of 40 g/m^3
Total Phosphorous	Median of 5 g/m^3 95th%ile of 10 g/m^3	Median of 5 g/m^3 95th%ile of 10 g/m^3
Dissolved Reactive Phosphorus	Median of 0.5 g/m^3 and 95th%ile of 1.5 g/m^3	Median of 0.5 g/m^3 and 95th%ile of 1.5 g/m^3
Dissolved Inorganic Nitrogen	Median of 40 g/m^3 and 95th%ile of 60 g/m^3	Median of 20 g/m^3 and 95th%ile of 35 g/m^3
E.coli	N/A	95 th%ile of 1000 cfu/100 ml

Implications of limits for the receiving environment

107 Because there are a number of other inputs from upstream for the parameters in **Table 2** Alliance cannot control the concentrations in the receiving environment, except for their own contribution. Thus, I do not consider limits should be placed on the receiving environment.

108 The planned improvements through treatment upgrades will significantly improve the quality of the discharge from the Alliance Plant as demonstrated above in **Table 2**. Dilution rates and apportionment of flows were used to predict what the improvements will mean for the receiving waters and whether they are enough to meet the appropriate limits and outcomes downstream, as discussed earlier in my evidence. The predictions for

differences in concentrations downstream compared with upstream are shown in **Table 3**.

109 **Table 3** shows that during minimum flows in the river in summer with the minimum dilution the lowest dilution corresponds to an increase in key parameters. The increase is greater if the 95th%ile discharge concentration is applied. However, this would be worst case, would only be for very brief periods and would still protect the communities present in these habitats from ammoniacal-N toxicity. It should also be noted that the present discharge levels with a median for ammoniacal-N of 15 g/m^3 results in a median downstream of 0.05 g/m^3. The proposed limit post-treatment upgrade is 5 g/m^3 thus the levels in the river would be expected to be significantly better than predicted most of the time. For the other parameters (DIN and DRP) the downstream effects of eutrophication, for example, in the estuary will depend on the overall load (as applied in the NPS-FM) not instantaneous concentrations.

Table 3. Concentrations downstream compared with upstream following treatment upgrades and required limits in the NPS-FM and SWLP.

Parameter g/m^3	Upstream (Median)	Downstream with minimum dilution	Downstream with minimum dilution and 95%ile future discharge	Downstream with median dilution	NPS-FM attribute state median	95th%ile
Ammoniacal-N	0.030	0.076	0.197	0.038	B 0.03-0.24	B 0.05-0.40 (maximum)
DIN	0.900	1.078	1.483	0.931	C 0.5-1.0	C 1.10-2.05
DRP	0.010	0.016	0.036	0.012	C 0.010-0.018	C 0.03-0.05

110 The median dilution or 50th percentile for the year, which is most relevant to the median in the NPS-FM, shows that the difference downstream is only very slight and would not be detectable or ecologically meaningful and would not change the attribute state. Thus, the proposed limits in the discharge would protect the communities present. This will be confirmed through the proposed monitoring upstream and downstream of the discharge. It should also be noted that if median levels upstream were to be reduced through catchment wide efforts to 0.5 g/m^3 then downstream would be 0.517, i.e only slightly higher.

RECOMMENDATIONS FOR MONITORING

111 To ensure that Alliance is able to detect if its discharge was to give rise to unanticipated adverse effects, I recommend a comprehensive monitoring programme be implemented. My recommendations are summarised below and a complete Environmental Monitoring Plan (EMP) is attached to my evidence. The proposed limits are shown in **Table 2** above.

Discharge Monitoring

112 Recommendations for monitoring of the discharge include:

a. The discharge to be sampled daily for volume and weekly for other parameters at the discharge lines prior to discharge into the Mataura River. During the recreation period (November- April) black disc measurements should be taken above and below the discharge at sites U2 and D1 at the same time as discharge measurements.

b. Composite and grab samples to be collected, preserved and analysed according to required standards and with analyses undertaken by an IANZ registered laboratory.

c. Samples to be analysed for:

- Enumeration of *E. coli*
- Temperature
- pH
- Conductivity
- Dissolved oxygen
- Turbidity
- Total Kjeldahl nitrogen
- Ammoniacal nitrogen
- Dissolved inorganic nitrogen
- Total nitrogen
- Total suspended solids
- Total phosphorous
- Dissolved reactive phosphorus
- Carbonaceous BOD_5

Microbial monitoring

113 As discussed earlier while *E.coli* is the basis for microbial limits in the SWLP and NPS-FM there is growing acceptance that *E.coli* is not always a good

indicator of the microbial risk associated with discharges. In this case it has been shown that there is a very poor relationship between elevated *E. coli* concentrations and pathogen concentrations of concern in the wastewater. Thus, monitoring for microbial risk should not be based solely on the levels of *E. coli* concentrations in the discharge, and indeed in this instance, where we know that there is a poor relationship between *E. coli* levels and the levels of those pathogens that are likely to make people unwell, the monitoring of actual pathogens of concern for human health is more important than the monitoring of *E. coli*.

114 As has been recommended in the evidence of Dr Dada the monitoring of *E.coli* should be supplemented by direct zoonotic pathogen monitoring of the discharge once every two months. The results of this monitoring should be reviewed following a suitable period after the new UV treatment has been commissioned.

Monitoring of receiving waters

Water Sampling and Analysis

115 Recommendations for monitoring of the receiving environment include:

a. Sampling of riffle habitat at two sites upstream of the discharge and two sites downstream during the summer/autumn low-flow period;

b. Representative weekly samples of receiving water quality both upstream and downstream of the point of discharge while a discharge is occurring for the following parameters:

- Enumerate *E. coli*
- Temperature
- pH
- Conductivity
- Dissolved oxygen concentration and saturation
- Nitrate nitrogen
- Total Kjeldahl nitrogen
- Ammoniacal nitrogen
- Dissolved inorganic nitrogen (nitrate-nitrite-ammoniacal N)
- Total nitrogen
- Total suspended solids
- Total phosphorous

- Dissolved reactive phosphorous
- Carbonaceous BOD_5
- Foams, scums and odour

116 I do not consider it appropriate to set limits for the receiving environment for the reasons discussed earlier in my evidence. I am confident the limits set for the discharge post-upgrade will ensure the appropriate health of the downstream river environment is maintained.

Biological Sampling and Analysis

117 Ecological monitoring is required to understand the effects of the discharge on the periphyton and benthic invertebrate communities of the Mataura River. To do this requires monitoring at points above and below the point of the discharge so that differences between those points can be identified, an assessment of the ecological meaning of those differences undertaken, and a determination made as to whether any adverse changes of significance between upstream and downstream sites can be attributed to the Alliance discharge.

118 Recommendations for monitoring of the biota in the receiving environment to demonstrate that the discharge is not having an effect on the habitat and health of periphyton and macroinvertebrate communities include:

a. Assessment of the aquatic and riparian habitat including:

- Channel width (m) and water depth (m).
- Streambed substrate (percent boulder, cobble, gravel, sand/silt).
- Streambed compaction and embeddedness.
- Organic matter content (percent logs, branches, leaves and detritus).
- Channel shade (%).
- Stream bank erosion (%).
- Habitat score.

b. Surveys at the same sites as at present (U1, U2, D1 and D2) to be undertaken annually during the late summer/autumn low flow period;

c. Measurements and observations should include:

- Visual assessment of periphyton cover at points along a transect

- Five replicate samples at each site for analyses of ash-free dry wight and chlorophyll *a*
- Sediment cover
- Visual inspection of heterotrophic growths
- Five replicate benthic grab samples from each site following protocols for hard-bottom rivers
- Macroinvertebrate analyses to include community composition, taxa numbers, abundance, MCI, QMCI, *Deleatidium* abundance, EPT numbers and percentage.

Fish communities

119 Fish health monitoring surveys should be carried out at the same time as the biological surveys above. The methodology is to be based on the observational component of the Fish Health Profile developed by Richardson (1998).

120 Surveys should include the following:

a. Fish surveys should be carried out at two sites, one site upstream and one site downstream of the discharge using appropriate nets.

b. All fish captured are to be identified and the following measurements taken:

- Length.
- Weight.
- External examination and assessment of eyes, fins, opercula, gills, and examination for lesions
- A condition score (CON) should be calculated which is a measure of the weight of the fish relative to its length (Richardson 1998).

121 I have reviewed the proposed conditions and these provide for the array of monitoring obligations I have proposed above as being necessary.

EFFECTS OF WATER TAKE

122 The Mataura River Conservation Order 1997 protects the river's identified outstanding values from adverse effects associated with abstraction, noting that there is an exception for the weir at Mataura.

123 The processing component of the take is 8,000 m^3/day or 194 L/s. This represents 1-2 % of the 7 day MALF. The small size of the take relative to the river flow and the very minor effect of the take on minimum flow duration and flow variability will result in only negligible, if any, effects on DO, contaminant concentrations and river water temperature and is not expected to alter the water quality or affect fish.

124 The results of the benthic invertebrate community monitoring over many years and the large population of resident brown trout indicate that the water take does not adversely affect the benthic invertebrate community (an important food source for fish), fish habitat or fish migration. Overall, the take is very likely to have no detectable effects on ecological communities and responses.

125 The abstraction of water from the hydro-race has the potential to entrain juvenile fish. To reduce the risk of entrainment it is recommended that all the intakes that are currently fitted with 5–6 mm screen mesh be fitted with 3 mm screens to further reduce the potential for entrainment and to meet best practice standards for screening intakes.

SECTION 42A CONSENT OFFICERS REPORT AND 4SIGHT CONSULTING REPORT AND EVIDENCE

126 Alliance has received the Consent Officers Section 42A report and reviews and evidence from Dr Peter Wilson and Ms Keren Bennett from 4Sight Consulting. Key points, which are relevant to my area of expertise and to which I provide a response, are:

- Elevated levels of contaminants degrade the water quality of the Mataura River;
- The potential level of dilution has not been calculated so unclear what the likely water quality will be downstream;
- The significant increases in ammoniacal-nitrogen, TN and *E.coli* need to be addressed;
- Suggested improvements to intake screens, concerns around fish passage, and lack of urgency to improve nutrient reduction;

- Overall the reviewers and 42A report support the proposed treatment upgrade but are concerned about the lack of urgency.

Elevated nutrients and E.coli

127 The reviewers, their evidence and 42A report acknowledge that most contaminant levels and physical properties such as temperature, DO and pH are not substantially altered from upstream levels and are within SWLP water quality standards. There is agreement that ammoniacal-N, TN and *E.coli* are significantly increased downstream and should be the focus of improved treatment.

128 As described in my evidence, the reviewers and 42A reports note that overall the discharge has a very small effect on concentrations of nitrate in the Mataura River after mixing.

129 As noted in my evidence and the reviewers comments the current discharge substantially increases the concentration of ammoniacal-N in the Mataura River downstream of the discharge. The reviewers acknowledge that the concentrations downstream of the discharge represent a low toxicity risk to most aquatic species but are concerned about the risk close to the discharge. However, this is only a small area up to 100 m downstream and does not cover the whole river's width which allows a pathway for fish outside the plume.

130 The recent decline in Deleatidium below and then ultimately above the discharge does indicate there could be added stresses at times under extreme conditions but it should be noted that the communities upstream experienced similar reductions the following month. There is no evidence that ammonia levels were high below the discharge mixing zone at the time and would have caused the decline in Deleatidium. The new treatment proposed will reduce this risk substantially.

131 For fish passage, such as eels and kanakana, there is no evidence of effects of toxicity in this stretch of the river and they would be expected to pass through the area and if necessary can avoid the discharge plume close to the discharge (covered earlier in my evidence). The new treatment will substantially reduce levels of ammoniacal-N downstream and they will be close to levels upstream. Importantly the new treatment will reduce risk of

toxicity close to the discharge and the overall nitrogen concentrations and loads from the discharge to the downstream environments.

132 There may be an increase in phosphorus downstream at times but concentrations in the discharge are relatively low and phosphorus can be released from sediments which may in part explain higher levels further downstream at the Bridge site. There have already been substantial improvements in phosphorus treatment and reductions in levels released. The reviewers acknowledge that nitrogen and *E.coli* are a higher priority than TP or DRP.

133 The reviewers support the proposed improvement in treatment and substantial reduction in nitrogen, TSS and *E.coli*. They note that the increase in nitrogen to the river is still substantial but I would reiterate that the contribution is still negligible compared with other sources (see below for further comments on loads).

134 As is documented in the EMP and recommended Alliance will be incorporating all forms of nitrogen and phosphorus in monitoring of the discharge and receiving environment including TN. The lack of some forms of nitrogen and phosphorus was a concern noted in the reviewers report.

Loads and limits

135 Dr Wilson states in para 47 that although the nitrogen discharge is only around 1% of the nutrient load from the entire catchment "it is still a substantial load, is disproportionate to the contaminant contribution of the other catchment land uses and activities, and is arguably not negligible". I do not follow how the load is disproportionate to the rest of the catchment inputs as 1% is still 1% of the total inputs. As described in my evidence above there will be no measurable or meaningful change in the water quality downstream and in the estuary, until there is a catchment-wide reduction. The relative load is still negligible.

136 In para 74 Dr Wilson suggests there are some differences in consent limits between the AEE and the Draft EMP. In Para 74 he says load limits are omitted for all parameters except $cBOD_{5.}$ However, this only refers to the tables and Section 3.2 of the Draft EMP describes the load limits proposed for Nitrogen both pre-upgrade (Page 5) and post upgrade (Page 7). Thus, load limits as proposed in the AEE are included in the Draft EMP.

137 Mr Richardson outlines in his evidence why an annual load is more appropriate from an operational perspective than the monthly load discussed in the evidence of Ms Andrews. I consider from a science perspective that with limits on the concentrations in the discharge and discharge flows that this will protect the downstream environment from increased risk of eutrophication. It is the overall load over a period of several months that is likely to be more important to the overall health of the estuary, while the reduced concentrations will protect the river system.

Potential dilution

138 The ES reviewers noted in their report that there was no calculation of dilution and they provide estimates based on two simple approaches. This is a valid comment. We had already addressed this subsequent to the application being made by using a simple model which was based on concentrations upstream and the apportionment of flows from the discharge and the river flows (minimum and median flows), to derive the potential concentrations for the key parameters ammoniacal-N, DIN and DRP downstream, after the improved level of treatment is installed. The results of this analyses were provided to Fish & Game. Based on this work we have estimated a minimum dilution of 60x after the discharge is fully mixed (compared with estimates of 100-300x for ammonia and total phosphorus and 10-20x for DRP in the reviewers' report). The results are described earlier in my evidence and **Table 3**.

139 Dr Dada describes the changes in *E.coli* in his evidence noting that *E.coli* is not a good indicator of pathogen risk in this case. The QMRA carried out by Dr Dada provides a far more robust assessment of individual illness risk than those based on indicator *E.coli* levels alone. In their report the reviewers express concerns that there is an elevated risk still. However, work by Dr Dada concludes that the risk is less than 1% which is an acceptable level for recreational bathing and the below the NZ threshold for tolerable risk. Dr Dada discusses the microbial issues further in his evidence.

140 *E.coli* has also been added to weekly sampling in the EMP above and below the discharge, as well as zoonotic monitoring every month for the first year following the grant of consent, as recommended by the reviewers in their report.

Entrainment in intakes

141 The reviewers support the change in intake screens to meet best practice. However, the 42A report states that there is an immediate need to upgrade the fish screen rather than the proposed 2-year timeframe. As discussed in the evidence of Mr Richardson, Para 19 of Ms Bennett's evidence identifies that due to high water velocity across the water intake screens, the potential for entrainment of small fish is low. This will be part of programmed improvements and as the potential for entrainment is acknowledged as low I do not see the need for the urgency noted in the 42A report.

Fish passage

142 Potential Issues with fish passage are discussed in the main body of my evidence and above but the presence of elvers, adult eels and adult kanakana upstream and above the weir shows that they do pass through the Falls area (which would always have been a barrier) and over the weir. As the reviewer acknowledges there is the potential for higher ammoniacal-N concentrations in the mixing zone close to the plume but this is unlikely to limit fish passage through the area as discussed earlier in my evidence.

143 Potential improvements to the weir structure for the taonga species tuna and kanakana are possible, and some issues such as the sharp lip on the weir and effects on kanakana are being discussed as part of a native fish plan with Hokonui Rununga and DOC.

Urgency for upgrades

144 The 42A report and evidence of Dr Wilson state that the need to upgrade the wastewater treatment plant is more urgent than suggested in the application. The reasons given for this is the effects of ammoniacal-N toxicity and increase in nitrogen in the receiving environment.

145 In terms of ammonia Dr Wilson states that the present discharge results in levels that "represent a low toxicity risk to most aquatic species" (para 34). Dr Wilson acknowledges in para 36 that the proposed reductions will reduce the risk of acute toxicity to aquatic organisms in the mixing zone but at present the levels pose a risk in this zone. Overall he considers that effects "to be moderate to high (i.e. a measurable and ecologically meaningful adverse effect)" (Para 37).

146 The 42A report agrees with Dr Wilson that the treatment upgrade should be earlier than proposed because of the risk in the mixing zone which is important for kanakana passage. As a result Mr Mayhew recommends the improved treatment be reduced from the 15 years and full biological treatment be implemented within 5 years.

147 As described earlier in my evidence the mixing zone is a very small area, estimated as within 100 m of the discharge and the plume has been modelled and would hug the bank on the true right. Based on expert opinion (Dr Cindy Baker, NIWA) kanakana would be able to avoid the plume and can pass through on the other side if they detected stressful levels of ammoniacal-N. Based on this advice and the characteristics of the plume I do not consider this warrants the urgency stated in the 42A report. I agree that the upgrade should be carried out as soon as practical, taking into account other factors outlined in the evidence of My Wiese but the 5 years is not warranted when there is no evidence of effects on the biota.

148 The contribution to nutrient loads in a degraded receiving environment is also presented as a reason for urgency. As discussed above under loads Dr Wilson states "it is still a substantial load, is disproportionate to the contaminant contribution of the other catchment land uses and activities, and is arguably not negligible". I would again stress that we would not see any measurable or meaningful change in the catchment loads and quality of the downstream environment and estuary until there is a catchment wide reduction. This is likely to be at the scale of at least a decade and thus again I do not agree, as stated in the 42A report, that there is "a moderate effect" which justifies the urgency of 5 years for the full biological treatment to be implemented.

149 I would also note that I am one of the experts assisting the Environment Court dealing with water quality aspects of the proposed SWLP. As discussed earlier in my evidence the various experts engaged by the parties to the appeals on the pSWLP have defined what we consider is clearly degraded water quality in the Southland context, and we will shortly be dealing with Appendix E of the pSWLP which sets receiving water quality standards intended to apply to the effects of discharges. While I cannot predetermine the outcome of the Environment Court's processes, in my opinion it is unlikely that the result will include thresholds for the Mataura FMU that will differ from

the thresholds I have discussed in my evidence. There are also review conditions in the in the application. Thus I consider delays in the regional planning process do not need to limit the consent term applied to the current discharge application by Alliance.

SUBMISSIONS

Fish and Game Southland

150 Fish and Game Southland (**Fish and Game**) has lodged a submission opposing the applications. The importance of the Mataura River above and below the Falls as habitat for wild fowl and a nationally significant self-sustaining brown trout fishery is acknowledged.

151 Along with all other parties that contribute nutrients to the catchment, Alliance will need to proportionally reduce the amount of total nitrogen and phosphorus it discharges over time as part of catchment wide initiatives to improve water quality.

152 The key areas of concern expressed by Fish and Game in their submission were:

- Lack of reference to periphyton limits;
- A question as to why no receiving environment limits are proposed for periphyton, total nitrogen (TN), dissolved inorganic nitrogen (DIN), ammoniacal-N, total phosphorus (TP), dissolved reactive phosphorus (DRP), biological oxygen demand (BOD), water clarity, and faecal coliforms;
- Whether in-river water quality for TN and DIN downstream will comply or be improved above the NPS-FM “bottom line” before and after the upgrade;
- Whether the NPS-FM bottom line for nitrate and ammoniacal-N toxicity and dissolved oxygen (DO) are appropriate and whether the downstream water will comply with or be improved before and after the upgraded treatment plant is operational;
- Concerns about delays of 15 years before an improvement in TN and ammoniacal-N;

- No improvement is planned for TP; and
- Whether DO should be measured further downstream than the compliance point.

These issues are addressed in the following section.

Periphyton

153 Fish and Game submit that the draft consent conditions do not include any reference to periphyton and associated limits or provide for compliance with the national bottom line set out in the NPS-FM. The bottom line in the NPS-FM for periphyton is 200 mg/m^2. As I outlined earlier in this evidence, periphyton at upstream and downstream sites was low in the summers of 2016-2018 and < 120 mg/m^2 (i.e in attribute state A and B). Periphyton concentrations were significantly higher in the summer of 2019 but only the second downstream site was over 200 mg/m^2. The bottom line in the current NPS-FM applies to monthly data over 3 years and allows one exceedance per year. Accordingly, I consider that the discharge does not exceed the bottom line in the NPS-FM at present and does not result in significant periphyton growth, thus limits in the conditions are unnecessary. It should also be noted that the attribute states in the NPS-FM are to be applied at the FMU scale not point source.

154 As described in the evidence of Mr Richardson and Mr Khan, Alliance has already significantly reduced the DRP in the discharge and will be making significant improvements and reductions to DIN discharged. Importantly it should be acknowledged that Alliance can only control its own discharges to the Mataura River. The discharge contributes only a fraction of DRP and DIN within the river and any monitoring could be skewed by an upstream influence, meaning that Alliance could be held accountable for conditions in the river that it cannot feasibly control. Thus, putting a downstream limit on the Alliance discharge when the majority of the DRP and DIN inputs are from elsewhere in the catchment is not appropriate.

Water quality in the receiving environment

155 Alliance proposes to measure a wide range of water quality parameters in the discharge and receiving environment. Mixing and dilution have been assessed and the mixing model shows the discharge is fully mixed 100 m

downstream of the discharge point. At the point of full mixing dilution by at least 60x occurs under the worst-case during summer low flows conditions.

Nitrogen

156 The submission asks for detail on why no limit is put on nitrogen in the receiving waters. Alliance will be monitoring ammoniacal-N, DIN and TN in the discharge and limits have been set in conditions for each of these forms of nitrogen (see **Table 2**). The main reason for not having an instream limit is that, as stated above, Alliance can only control its own input to the river thus putting a limit on the receiving environment without taking into account upstream inputs is not appropriate.

157 At present the DIN is the same upstream and downstream of the discharge and both are under the proposed bottom line of 1 g/m^3 , which is included in the STAG report (STAG 2019) and JWS (2019) (although the levels are close to this). Following the wastewater treatment upgrade the proposed limits for DIN are a 12-month rolling median of 20 g/m^3 and 95^{th}%ile of 35 g/m^3. TN limits are a median of 20 g/m^3 and a 95^{th}%ile of 40 g/m^3. **Table 3** in my evidence shows that with the minimum dilution of 60x would indicate that there would be no significant or detectable increase in DIN in the river downstream after mixing. Post-upgrade the discharge DIN will be improved from what it is now thus the concentration and loads from the discharge will in reality be reduced from what we see now.

158 The reduction in ammoniacal-N and DIN levels following improved wastewater treatment will significantly reduce the inputs of TN to the Mataura River and in turn, the Toetoes Estuary. However, on their own these reductions will not be detectable because of the negligible contribution deriving from the Alliance Plant discharge compared with other inputs. In short, the contribution made by the Alliance discharge in this respect is very small when compared with the current amounts of TN already within the river system.

159 The submission by Fish and Game questioned whether the bottom line for nitrate-N and ammoniacal-N toxicity is sufficient to protect ecosystem health. A bottom line for DIN of 1 mg/m^3 corresponds to the annual median for attribute state A for nitrate toxicity and thus ensures maximum protection as discussed above. The bottom line for ammonia toxicity is an annual median of 0.24 mg/L and maximum of 0.40 mg/L. I have discussed ammoniacal-N toxicity in my evidence above but it is important to reiterate that the change

from attribute state A upstream, to B downstream of a discharge, is a change from a 99% species protection level to a 95% species protection level. However, the 5% most sensitive species are exclusively freshwater mussels, which do not occur in the Mataura River immediately upstream or downstream. Those ammoniacal nitrogen sensitive species that do occur in the Mataura River in the vicinity of the discharge are *Deleatidium sp*. and *Potamopyrgus antipodarum* which will still be protected downstream with the present discharge, a situation that will be further improved when the new treatment plant is operative.

160 Alliance will be implementing new technology and new reduced limits on ammoniacal-N in the discharge which will significantly reduce the increase in ammoniacal-N downstream and ensure that the median and 95th%ile are at a level that would protect the most sensitive species.

Phosphorus

161 The issues above for DIN also apply to DRP. The DRP measured upstream and downstream (mean 0.011 mg/L upstream and 0.010 mg/L downstream) are in the C Band in the 2020 NPS-FM. If a bottom line was to be applied (D Band median of 0.018 mg/L) then it would be met with the present discharge.

162 Alliance made significant improvements to its treatment of phosphorus in 2012 targeting DRP which dropped from an average daily DRP load of 88kg/day in 2004/05 to 2.3 kg/day in 2018/19. This also reduced TP and it is not necessary to make further improvements especially when the overall contribution to the TP inputs to the estuary is negligible (1%) and bottom lines as a result of the discharge for DRP will be met. There are no plans in place which would increase the DRP concentrations in the discharge.

163 The proposed discharge limit for DRP is a median of 0.5 g/m^3 and 5 g/m^3 for TP. As shown in **Table 2** under median conditions it is predicted that the levels downstream will be virtually the same as upstream and above the proposed bottom line, and this is consistent with what we see now.

Dissolved oxygen

164 Fish and Game has reservations whether the bottom line is appropriate for the lower Mataura River. The bottom limit in the NPS-FM is an absolute minimum of 5 mg/L (7 day mean minimum) for below point source discharges. The minimum DO measured routinely upstream and downstream of the discharge are 8.3 and 8.0 mg/L, respectively. Data

sondes deployed in January 2018 and March 2019 upstream and downstream of the discharge to continuously measure DO over short periods showed a 7-day minimum of 7.6 and 7.1 respectively and 1-day minimum of 6.8 and 5.9, which would place this site in attribute state B and thus well above the bottom line. A data sonde deployed at Chalmers Rd, 13 km downstream of the discharge, in January 2018 and Feb-Mar 2019 also showed a 7-day minimum of 7.1 mg/L.

165 Fish and Game has reservations whether the DO should be measured downstream at Chalmers Rd as there are indications of a DO 'sag' effect whereby DO levels further down in the Mataura River are lower than upstream near the discharge point. As demonstrated above the results are the same no matter where the sampling point is. It should also be noted that deployment of a sonde at Chalmers Rd will continue and there are other inputs which could affect DO processes downstream of the discharge. Reductions in DO are not uncommon downstream as oxygen is consumed through heterotrophic activity.

E.coli

166 No limits are proposed for *E.coli* in the receiving environment for the same reasons outlined above for nutrients and in particular that concentrations above the discharge are already elevated and are not a result of the Alliance discharge. Data for the Mataura River above and below the discharge show that exceedance of the bathing water standards was common throughout the Mataura River with the river being classified according to the NPS-FM as E (red) for most sites. As discussed above in my evidence even if Alliance made a substantial reduction to *E.coli* levels in its present discharge levels monitored at the downstream site would still not always comply because of the existing high levels in the upper catchment.

167 It is acknowledged however, that the proportion of samples exceeding the NPS-FM bathing water standards increased substantially between upstream and downstream sites. Whilst further detailed analyses is discussed in the evidence of Dr Dada, the high number of *E.coli* did not result in high levels of pathogens of concern in the treated wastewater or receiving environment. However, an upgrade to the treatment of the discharge via disinfection is proposed in the short term. In particular, Alliance has committed to installing disinfection equipment within five years of consent being granted. This will significantly reduce the microbial levels in the discharge and the contribution

to the bathing site downstream but standards at that site will still not be met all the time because of the other catchment inputs.

168 The submission says the Applicant should be aiming for an improvement in the downstream receiving waters and ensure that levels of *E.coli* are suitable for contact recreation. As described above a comprehensive QMRA has shown that the risk for swimmers at the Mataura Bridge is acceptable and thus suitable for contact recreation (discussed more in Dr Dada's evidence).

Visual clarity

169 Fish and Game is concerned that there is no monitoring of visual clarity or limit proposed. However, Alliance will continue to monitoring water clarity upstream and downstream of the discharge during its biological surveys as it has done since 2012. Colour and clarity measurements have also been added weekly from Nov-April. This will allow analyses of whether water clarity reductions meet the required standards of waters not being changed by a conspicuous extent.

Department of Conservation

170 The Department of Conservation (**DOC**) also made a submission in opposition to the Alliance application. The DOC submission relates to the following ecological issues:

- The weir and water race structures create a complex environment for fish to navigate and screens on intakes need to be appropriate;
- The discharge significantly alters water quality in terms of TN, ammoniacal-N and *E.coli*;
- The elevation of ammoniacal-N is a more than minor effect and could affect species such as kanakana; and
- Upgrades will not come into effect until 2034.

Weir and water race structures

171 DOC has requested that the salmonid ladder and trap and transfer programme be reflected in the conditions for the discharge not just the hydro consent. Alliance have proposed it in the water take consent, rather than the wastewater discharge consent, which is the appropriate place for this.

Ammoniacal-N toxicity and E.coli

172 The issues of ammonia toxicity and *E.coli* have been dealt with above under the response to Fish and Game. It should be noted that at present with the existing discharge there is no evidence of toxicity restricting native fish populations and kanakana are regularly observed above the discharge at the Falls. Attribute state B would protect all native fish fish species that have been tested and most would fall into the state C. For kanakana the advice from NIWA is that at worst ammoniacal-N concentrations in the plume will drive a behavioural response i.e. they will move out of the plume and could still safely passage through to the Falls.

173 Expert advice (Dr Cindy Baker, NIWA, pers. comm.) is that lamprey are very difficult to hold in cages or tanks to test resilience and in any event a short-term exposure to ammoniacal-N would not be lethal. The higher concentrations will be in a plume near the discharge and lamprey can easily move further across the river if they detected high levels. Importantly Alliance plans to improve the quality of the discharge including ammoniacal-N with an upgraded treatment plant.

174 Alliance are working with iwi to develop a plan for kanakana and look at ways to facilitate their passage and understanding of the populations passing through the area.

175 Concern is also expressed that the planned upgrades will not come into effect until 2034. While this is true for nitrogen, significant improvements to microbial levels will be made in 5 years through installation of a disinfection plant. The nitrogen issue is addressed above.

Hokonui Runanga and TRONT

176 Hokonui Runanga and TRONT's submission requests that as a minimum the following ecological matters be included:

- Cultural health monitoring while the discharge continues;
- Implementation of a culturally informed trap and transfer programme and provision of fish passage;
- Appropriate fish screening be put in place and adherence to any environmental flows and allocation applicable to the Mataura River.

177 Most of these matters have been dealt with above or are under discussions with Alliance. I would endorse the ongoing requirements for a culturally

informed trap and transfer programme, improved screening of intakes and cultural health monitoring.

CONCLUSION

178 The lower Mataura River is enriched by nutrients and microbial contamination and has been classified as degraded based on some water quality parameters. The Toetoes Estuary is also showing signs of degradation that reflects the cumulative effect of nutrients from the Mataura River catchment. There is no evidence that the discharge from the Mataura Plant is causing adverse effects on water quality, except potentially in the immediate vicinity downstream of the discharge where there are elevated ammoniacal-N and TN concentrations and significantly elevated numbers of *E. coli*. Based on information available and limits in the NPS-FM the elevated ammoniacal-N will not affect the benthic community present or expected in this type of downstream environment. Potential effects on fish passing through the plume area immediately below the discharge can be avoided and there is no evidence that fish populations are affected by the discharge.

179 A decrease in the abundance of the mayfly *Deleatidium* sp. was observed immediately downstream in February 2019 and both upstream and downstream in March 2019. The March decline followed a long accrual period and thus likely to be the result of a combination of stressors including higher periphyton cover and biomass, late successional stage algal growth and elevated river temperatures. Overall, in terms of nitrogen the river can be characterised as degraded, with periphyton accumulation that reflects moderate to high enrichment following long accrual periods, and the macroinvertebrate indices MCI and QMCI reflect fair to poor health, noting that these conditions occur upstream and downstream of the discharge. There is no evidence linking these in-river observations with the discharge.

180 The discharge does result in increased ammoniacal-N and contributes to high TN which in turn will contribute to higher loads and lower water quality downstream, noting that there is no consistent trend in higher periphyton downstream. However, the contribution of the loads to the Toetoes Estuary are negligible compared with the wider catchment. The significant increase in *E. coli* downstream is not related to increased risk of illness from contamination based on a robust QMRA and consideration of the zoonotic pathogens. This is confirmed in the evidence of Dr Dada.

181 Alliance acknowledges that it will need to reduce ammoniacal-N, total nitrogen and *E. coli* levels to assist in meeting the SWLP and NPS-FM standards and limits and to contribute to an improvement in water quality in the catchment as a whole. To address this Alliance have proposed installing a UV plant within 5 years to decrease *E.coli* levels and within 15 years to make a significant investment in further improvements to wastewater treatment that will significantly decrease ammoniacal-N and TN concentrations and loads. The lack of evidence of any effects from ammoniacal-N toxicity and the negligible contribution to the nitrogen load downstream does not warrant the urgency stated in the 42A report of 5 years for a full biological system when it is likely to be at the time scale of at least a decade before improvements catchment-wide will be made.

182 A comprehensive monitoring programme is proposed that will set limits in the discharge and monitor key parameters of water quality upstream and downstream to ensure and demonstrate that the discharge is not affecting river health.

Mark James
16 November 2020

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Appendix 1: Summary of applicable water quality guidelines and standards for the Mataura River in the vicinity of Alliance Group Limited's Mataura Processing Plant

Water Quality Indicator	National Policy Statement for Freshwater Management 2020				ANZECC (2000) and MfE (2003) Guidelines	Water Conservation (Mataura River) Order 1997[3]	Operative Regional Water Plan[2]
	Attribute A	Attribute B	Attribute C	National Bottom Line			
Dissolved Oxygen (mg/L or % saturation)	≥8.0 (7-day mean min*) ≥7.5 (1-day mean min*)	≥7.0 and <8.0 (7-day mean min*) ≥5.0 and <7.5 (1-day mean min*)	≥5.0 and <7.0 (7-day mean min*) ≥4.0 and <5.0 (1-day mean min*)	5.0 (7-day mean min*) 4.0 (1-day mean min*)	98 – 105%	>5 mg/L	>5 mg/L
Nitrate – Nitrogen toxicity (mg/L)[4]	≤1.0 (annual median) ≤1.5 (annual 95th percentile)	>1.0 and ≤2.4 (annual median) >1.5 and ≤3.5 (annual 95th percentile)	>2.4 and ≤6.9 (annual median) >3.5 and ≤9.8 (annual 95 percentile)	2.4 (annual median) 3.5 (annual 95th percentile)	<0.444 (lowland site median)	-	-
Ammoniacal Nitrogen toxicity (mg/L)[3]	≤0.03 (annual median) ≤0.05 (annual maximum)	>0.03 and ≤0.24 (annual median) >0.05 and ≤0.40 (annual maximum)	>0.24 and ≤1.30 (annual median) >0.40 and ≤2.20 (annual maximum)	0.24 (annual median) 0.40 (annual maximum)	<0.021	-	-
Total Nitrogen (mg/L)	-	-	-	-	<0.614	-	-

* Summer Period: 1 November to 30 April

3 These standards apply to the effects of discharges following reasonable mixing with receiving waters

4 Numeric attribute state is based on pH 8 and temperature of 20°C. Compliance with the numeric attribute states should be undertaken after pH adjustment.

Water Quality Indicator		National Policy Statement for Freshwater Management 2020				ANZECC (2000) and MfE (2003) Guidelines	Water Conservation (Mataura River) Order 1997[3]	Operative Regional Water Plan[2]
		Attribute A	Attribute B	Attribute C	National Bottom Line			
Periphyton - Trophic State	**Chlorophyll-*α* (mg chl-a/m^2)[5]**	≤50 (no more than 8% of samples)	>50 and ≤120 (no more than 8% of samples)	>120 and ≤200 (no more than 8% of samples	200 (no more than 8% of samples)	-	-	-
Dissolved Reactive Phosphorus (mg/L)[6]		≤0.006 (median) ≤0.021 (95th percentile)	>0.006 and ≤0.010 (median) >0.021 and ≤0.030 (95th percentile)	>0.010 and ≤0.018 (median) >0.030 and ≤0.054 (95th percentile)	-	<0.010	-	-
Total Phosphorus (mg/L)		-	-	-	-	<0.033	-	-
Faecal coliforms (CFU/100mL)		-	-	-	-	-	-	<1000
***E. Coli* (CFU/100mL)**		≤ 130 (annual median) ≤540 (95th percentile) >540 (exceed <5%)	≤ 130 (annual median) ≤1000 (95th percentile) >540 (exceed 5-10%)	≤ 130 (annual median) ≤1000 (95th percentile) >540 (exceed 5-10%)	-	261-550/100mL (Microbiological Assessment Category C)	-	<130 at “Popular Bathing Sites” defined in Appendix K and within 1 km immediately upstream of these sites.

5 The Mataura River defined as Default class. Based on a monthly monitoring regime. The minimum record length for grading a site based on periphyton (chl-a) is 3 years.

6 Numeric attribute state must be derived from the median of monthly monitoring over 5 years.

Water Quality Indicator	National Policy Statement for Freshwater Management 2020				ANZECC (2000) and MfE (2003) Guidelines	Water Conservation (Mataura River) Order 1997[3]	Operative Regional Water Plan[2]
	Attribute A	Attribute B	Attribute C	National Bottom Line			
	>260 (exceed <20%)	>260 (exceed 20-30%)	>260 (exceed 20-30%)				
pH	-	-	-	-	7.2 - 7.7	6.0 – 9.0 except when due to natural causes	6.0 – 9.0 except when due to natural causes
Suspended fine sediment / Clarity (m) black disc (Class 1)[7]	≥1.78	<1.78 and ≥1.55	<1.55 and >1.34	1.34	>0.8	No conspicuous change	No conspicuous change
Turbidity (FNU)	-	-	-	-	<5.6	-	-
Colour	-	-	-	-	-	No conspicuous change	No conspicuous change
Fish	-	-	-	-	-	-	Fish shall not be rendered unsuitable for human consumption by the presence of contaminants.
Temperature (°C)	-	-	-	-	-	The natural water temperature must not be changed by	The daily maximum ambient water temperature shall not be increased by more

[7] The Mataura River is defined as Class 1. The minimum record length for grading a site is the median of 5 years of at least monthly samples (at least 60 samples). Councils may monitor turbidity and convert the measurement to visual clarity.

Water Quality Indicator	National Policy Statement for Freshwater Management 2020				ANZECC (2000) and MfE (2003) Guidelines	Water Conservation (Mataura River) Order 1997[3]	Operative Regional Water Plan[2]
	Attribute A	Attribute B	Attribute C	National Bottom Line			
						more than 3 degrees Celsius.	than 3°C when the natural or existing water temperature is 16°C or less, as a result of any discharge. If the natural or existing water temperature is above 16°C, the natural or existing water temperature shall not be exceeded by more than 1°C as a result of any discharge.
Fungus, Bacteria, Slime	-	-	-	-	-	-	There shall be no bacterial or fungal slime growths visible to the naked eye as obvious plumose growths or mats. Note that this standard also applies to within the zone of reasonable mixing for a discharge.

report

November 2020

Environmental Management Plan
Alliance Mataura

Submitted to:
Alliance Mataura

freshsolutions water
environmental consultants

Quality Assurance

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1.0 Introduction

This report presents an Environmental Management Plan (EMP) for Alliance Group Limited's (Alliance) Mataura Plant (the Plant). The EMP sets out the aims and methods for monitoring treated wastewater discharge (the discharge) water quality and monitoring physical habitat, water quality and biological community health in the Mataura River receiving environment.

1.1 Relevant Resource Conditions

The aim of this EMP is to meet the requirements of Conditions 17 and 18 outlined below obtained from *The Resource Consent Application and Assessment of Effects* document dated 31 May 2019 (see Appendix A for full list of conditions).

17. No later than six months from this consent commencing the Consent Holder shall prepare and submit to the Consent Authority an Environmental Monitoring Plan (EMP) for certification.

    The purpose of the EMP shall be to describe the methods for monitoring the physical characteristics and water quality parameters of the discharge, and the physical, water quality and biological characteristics and parameters of the Mataura River receiving waters as prescribed by Consent XXXX.

    The objectives of the EMP are to:

    Confirm compliance with consent limits on discharge quality;

    Understand the effects of the discharge on Mataura River water quality and instream ecology and confirm no unexpected effects are arising as a result of the exercise of Consent XXXX.

    The EMP shall include but not be limited to:

    a. The inclusion of a description and maps identifying the monitoring sites;

    b. A description of the methods and appropriate timing for undertaking the following monitoring requirements:

        i. Discharge monitoring.

        ii. Receiving water quality monitoring.

        iii. Ecological instream monitoring.

        iv. Fish health monitoring.

    c. The reporting requirements associated with any monitoring undertaken in accordance with these conditions.

18. The EMP, as a minimum, shall provide for the following monitoring requirements:

    a. maintenance of records of the times and volumes of treated wastewater discharged on each day the permit is exercised;

    b. representative weekly samples of the treated wastewater at the point of discharge for the following parameters:

        - *E. coli.*
        - Temperature.

- pH.
- Total Kjeldahl Nitrogen.
- Ammoniacal Nitrogen.
- Dissolved Inorganic Nitrogen (nitrate- and nitrite-N plus ammoniacal N)
- Total Nitrogen.
- Total Suspended Solids.
- Total Phosphorus.
- Dissolved Reactive Phosphorus.
- Carbonaceous BOD_5.

c. representative weekly samples of receiving water quality both upstream and downstream of the point of discharge while a discharge is occurring for the following parameters:

- Enumerate *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.
- Carbonaceous BOD_5.

d. Ecological monitoring to understand the effects of the discharge including by monitoring the periphyton and benthic invertebrate communities of the Mataura River at points above and below the point of the discharge.

e. A fish health monitoring survey.

2.0 Responsibilities

Environmental Manager

The Environmental Manager is responsible for ensuring that compliance with resource consents and the maintenance, operation and adherence to this procedure is proactively managed. The Environmental Manager is responsible for the maintenance and operation of

this plan, compliance and annual review. In addition, they are responsible for reviewing this EMP at five yearly intervals in accordance with Condition 19. Results of the review should be reported to the Consent Authority within 30 working days of the review being undertaken.

Environment Southland

Environment Southland (ES) is responsible for certifying this plan and any future amendments to it.

3.0 Treated Wastewater Discharge Water Quality

3.1 Discharge Volume

Condition 1 of the wastewater discharge consent permits the discharge of up to 8,000 m³/day of treated wastewater from a meat processing plant into the Mataura River. Treated wastewater is discharged through two 200 mm diameter pipes that exit the Plant ~100 m below the hydro race discharge and drop ~10 m to the river bed. The discharge is currently monitored electronically by two flow meters (Jessica McKee pers. comm.).

3.2 Discharge Quality

Pre-Upgrade Discharge Limits

Condition 2 of the discharge consent sets out the limits applied to the treated wastewater prior to its discharge to the Mataura River (Table 1). These limits apply to the discharge before the intended Wastewater Treatment Plant upgrade which should be fully commissioned and operational no later than 15 years from the commencement of consent.

Condition 4 of the discharge consent states:

> *The Consent Holder shall ensure that the annual load of total nitrogen measured in the discharge between 1 October and 30 September does not exceed 60 tonnes. In circumstances where this total annual load is exceeded, the Consent Holder shall report to the Consent Authority in accordance with Condition 22.*

Condition 5 of the discharge consent states:

> *No more than 780 tonnes of total nitrogen may be discharged in the wastewater prior to the wastewater treatment plant upgrade required by condition 12 being commissioned. Advice note: This is equivalent to 52 tonnes per year being discharged over the 15-year period before the wastewater treatment plant upgrade is required.*

Table 1: Pre-upgrade Treated Wastewater Limits.

Parameter	Limit
Ammoniacal Nitrogen [1]	Shall not exceed a maximum of 50 g/m³ and consistently maintained at <30 g/m³
$cBOD_5$ Load	Shall not exceed a maximum of 3,500 kg/day
$cBOD_5$	Shall not exceed a maximum of 300 g/m³
Total Suspended Solids [1]	Shall not exceed a maximum of 200g/m³ and consistently maintained at <100 g/m³
Total Kjeldahl Nitrogen	Shall not exceed a 12-month rolling median of 60 g/m³ and 95th %ile of 80 g/m³
Dissolved Inorganic Nitrogen	Shall not exceed a 12-month rolling median of 40 g/m³ and 95th %ile of 60 g/m³
Total Phosphorus	Shall not exceed a 12-month rolling median of 5 g/m³ and 95th%ile of 10 g/m³
Dissolved Reactive Phosphorus	Shall not exceed a 12-month rolling median of 0.5 g/m³ and 95th%ile of 1.5 g/m³

Note: [1] to *be "consistently maintained" if not less than four results out of each set of five meet the lesser specified value, when a set of five results is obtained in accordance with the EMP.*

Disinfection Treatment

Within 5 years of the commencement of the consent, equipment to disinfect the process water will be installed. Post disinfection upgrade wastewater *E. coli* limits are:

(i) Annual median <1,000 cfu/100ml.

(ii) 95th percentile of 10,000 cfu/100 ml.

Upgraded Discharge Limits

A full biological treatment system that will reduce BOD, ammoniacal nitrogen and total nitrogen loads in the Plant's wastewater will be operational by Year 15. Condition 13 of the discharge consent sets out limits following the treatment system upgrade (Table 2).

Table 2: Upgraded Treated Wastewater Limits

Parameter	Limit
Ammoniacal Nitrogen	Shall not exceed a rolling 12-month median of 5 g/m³ and 95th %ile of 10g/m³
$cBOD_5$ Load	Shall not exceed a maximum of 3,500 kg/day
$cBOD_5$	Shall not exceed a rolling 12-month median of 50 g/m³ and 95th %ile of 100 g/m³
Total Suspended Solids	Shall not exceed a rolling 12-month median of 40 g/m³ and 95th %ile of 80 g/m³
Total Nitrogen	Shall not exceed a rolling 12-month median of 20 g/m³ and 95th %ile of 40 g/m³
Total Phosphorus	Shall not exceed a rolling 12-month median of 5 g/m³ and 95th %ile of 10 g/m³
Dissolved Reactive Phosphorus	Shall not exceed a 12-month rolling median of 0.5 g/m³ and 95th%ile of 1.5 g/m³
Dissolved Inorganic Nitrogen	Shall not exceed a 12-month rolling median of 20 g/m³ and 95th %ile of 35 g/m³
E. coli	95th %ile of 1,000 cfu/100 ml

Condition 14 states:

> *Once the upgraded Wastewater Treatment Plant has been commissioned and fully operational for 12 months, the annual load of total nitrogen measured in the discharge between 1 October and 30 September must not exceed 25 tonnes. In circumstances where this total annual load is exceeded, the Consent Holder shall report to the Consent Authority in accordance with Condition 22.*

The annual load of total nitrogen is calculated as the product of the total nitrogen concentration (recorded once per week) and the weekly total discharge volume to give a weekly total nitrogen load, which can be aggregated over a 12-month period.

Sampling Sites

The wastewater treatment discharge should be sampled at the discharge lines prior to the discharge lines entering the Mataura River. The samples are collected from each line (green and non-green) and then combined.

Sampling Methodology

Composite samples over 8 hours should be collected at the discharge line sampling sites (with the exception of *E. coli* that is collected via a grab sample) and chilled before transport to an IANZ registered laboratory for analysis. Samples should be collected directly into laboratory supplied bottles and must arrive at the laboratory within 24 hours of collection.

Monitoring Frequency and Analytical Parameters

The frequency of the discharge water quality monitoring and required analytes are presented in Table 3. Samples are collected once per week, rotating through Monday to Thursday when the Plant is in operation and a discharge is occurring.

Table 3: Discharge water quality monitoring schedule.

Parameter	Unit	Daily[2]	Weekly	Who
Volume[1]	m^3/day	●	●	Alliance
Temperature	°C		●	Alliance
pH	-		●	Lab
Total Ammoniacal Nitrogen	g/m^3		●	Lab
Dissolved Inorganic Nitrogen	g/m^3		●	Lab
Total Kjeldahl Nitrogen	g/m^3		●	Lab
Nitrate-Nitrite-Nitrogen	g/m^3		●	Lab
Total Nitrogen	g/m^3		●	Lab
Total Phosphorus	g/m^3		●	Lab
Dissolved Reactive Phosphorus	g/m^3		●	Lab
Total Suspended Solids	g/m^3		●	Lab
Carbonaceous BOD_5	g/m^3		●	Lab
E. coli	CFU/100mL		●	Lab

Note: [1]Discharge volume is currently monitored electronically by two flow meters. [2]Data is collected daily but reported on a weekly basis along with other sampling.

4.0 Mataura River Water Quality

4.1 Mataura River Water Quality Limits

Condition 16 states instream water quality limits for the Mataura River below the zone of reasonable mixing as follows:

> *The discharge shall not directly result in any of the following below the zone of reasonable mixing:*
>
> *a. A change in the natural water temperature by more than 3 degrees Celsius.*
>
> *b. The acidity or alkalinity of the waters as measured by the pH to not be within the range of 6.0 or 9.0.*
>
> *c. The waters being tainted so as to make them unpalatable following treatment, nor must they contain toxic substances to the extent that they are unsafe for consumption by humans or farm animals, nor must they emit objectionable odours.*
>
> *d. The destruction of natural aquatic life by reason of a concentration of toxic substances.*

e. A conspicuous change in the natural colour and clarity of the waters.

f. The oxygen content in solution in the waters being reduced below 5 milligrams per litre.

For the purposes of this condition, the downstream sampling site is at the Mataura Bridge 330 m downstream of the discharge and has been selected to be as close as possible to the extent of the mixing zone.

4.2 Mataura River Water Quality Monitoring Programme

Sampling Sites

Two Mataura River sites should be sampled while a discharge is occurring. One site is upstream (Hydro-race) and one site is downstream (Bridge) of the discharge point. Refer to Table 4 and Figure 1 for site locations.

Sampling Methodology

Grab samples should be collected at the Mataura River sampling sites and chilled before transport to an IANZ registered laboratory for analysis. Samples should be collected directly into laboratory supplied bottles and must arrive at the laboratory within 24 hours of collection.

Table 4: Water quality monitoring sampling sites.

Site	Location	NZTM coordinates	
		Northing	Easting
Discharge	Discharge	4876329.6	1281321.3
Hydro-race	Mataura River upstream of discharge	4876660.1	1281480.1
Bridge	Mataura River downstream of discharge	4876028.6	1281177.8

Monitoring Frequency and Analytical Parameters

The frequency of Mataura River water quality monitoring and required analytes are presented in Table 5. Samples are collected Monday to Thursday rotating through the week when the Plant is in operation and a discharge is occurring.

During the key contact recreation period, defined as 1 November to 30 April for the purpose of this EMP, black disc measurements should be recorded at Sites U2 and D1 to assess water clarity and water samples collected to test for turbidity and total suspended solids. Sampling should be carried out on a fortnightly basis when river flow, recorded at the Tuturau monitoring station, is below 30 m^3/s and the sites can be safely accessed ensuring health and safety protocols can be met.

In addition, a water sample should be collected from the Waikana Stream that flows under the Mataura Industrial Estate on the true left bank immediately before it discharges to the Mataura River and analysed for total suspended solids and turbidity. Health and safety issues prevent the measurement of black disc at this location.

Figure 1: Sampling site locations.

Table 5: Mataura River water quality monitoring schedule at Hydro-race and Bridge Sites.

Parameter		Weekly	Responsibility
Temperature	°C	●	Alliance
Dissolved Oxygen	g/m³ and %	●	Alliance
Conductivity	µS/cm	●	Lab
pH	-	●	Lab
Total Ammoniacal Nitrogen	g/m³	●	Lab
Total Kjeldahl Nitrogen	g/m³	●	Lab
Total Nitrogen	g/m³	●	Lab
Nitrate-N	g/m³	●	Lab
Nitrite-N	g/m³	●	Lab
Total Phosphorus	g/m³	●	Lab
Dissolved Reactive Phosphorus	g/m³	●	Lab
Total Suspended Solids	g/m³	●	Lab
Carbonaceous BOD_5	g/m³	●	Lab
E. coli	CFU/100mL	●	Lab
Foams, scums, odour [1]	Visual inspection	●	Alliance

Note: [1] To be collected during summer low flow conditions.

Table 6: Mataura River water quality monitoring schedule at Sites U2 and D1.

Parameter	Unit	Fortnightly between Nov-Apr [1]	Responsibility
Black disc	m	●	Alliance
Total suspended solids [2]	g/m³	●	Lab
Turbidity [2]	NTU	●	Lab
Colour [2]	Hazen units	●	Lab

Note: [1]River flow below 30 m³/s; [2]Water sample should also be collected from Waikana Stream and tested for turbidity, total suspended solids and colour.

Continuous Dissolved Oxygen and Temperature Monitoring

A data sonde that can continuously meaure dissolved oxygen and temperature will be deployed on the Mataura River near Chalmer Road (13 km downstream from the discharge), which has previously been identified as the dissolved oxygen sag point. Refer to Figure 2 for the sonde location. The sonde will be deployed during summer low flow conditions for a minimum of one month or more (depending on river flow conditions).

Figure 2: Dissolved oxygen sonde location.

5.0 Microbiological Monitoring

To be inserted.

6.0 Water Quality Data Management and Reporting

Data Management

The Environmental Manager and Wastewater Supervisor enter data into the "Effluent" and "River new" spreadsheets maintained on P drive / Effluent in the relevant season folder. External laboratory results are received by the Environmental Manager and Wastewater Supervisor. The Environmental Manager enters the external lab results to confirm compliance, however this is also done by the Wastewater Supervisor when the Environmental Manager is on leave.

Water Quality Reporting

In accordance with Condition 20 of the discharge consent, results of the water quality sample analysis for each five-week period shall be provided to the Consent Authority within two weeks of the receiving all of the laboratory results for that period, unless otherwise agreed with the Consent Authority.

7.0 Ecological Monitoring

7.1 Sampling Sites

There are two upstream sites (U1 and U2) and two downstream sites (D1 and D2). Sites U1 and U2 were referred to as U3 and U4 prior to 2013. Sampling site details are presented in Table 7 and Figure 1. A 30 m reach within riffle habitat at each site should be selected to collect all water physicochemistry, habitat, periphyton and invertebrate data.

Table 7: Ecological monitoring sampling sites.

Site	Location	Description	NZTM coordinates	
			Northing	Easting
U1	Upstream	2.5 km u/s from discharge	4878019.4	1282824.7
U2	Upstream	2 km u/s from discharge	4877618.5	1282525.2
D1	Downstream	580 m d/s from discharge	4875813.4	1280827.2
D2	Downstream	1.85 km d/s from discharge	4874711.2	1280228.9

7.2 Timing of Sampling

The timing of the ecological instream monitoring is presented in Table 8.

Table 8: Ecological monitoring frequency.

Survey	Frequency	Responsibility
Aquatic and riparian habitat	Annually[1]	Ecologist
Periphyton	Monthly	Alliance

Heterotrophic growths	Weekly (summer low flow)	Alliance
Benthic macroinvertebrates	Annually[1]	Ecologist
Fish health	Annually[1]	Ecologist

Note: [1]survey should be carried out during summer–autumn low flow conditions, and if possible, following 20 days of river flow below 40 m^3/s.

7.3 Aquatic and Riparian Habitat

Aquatic and riparian habitat should be assessed at each of the four sites and a photograph taken to assist in the interpretation of invertebrate and periphyton results. Habitat parameters to be assessed should include:

- Channel width (m), water depth (m) and velocity.
- Streambed substrate (percent boulder, cobble, gravel, sand/silt).
- Streambed compaction and embeddedness.
- Channel characteristics (percent pool, riffle, run, chute).
- Organic matter content (percent logs, branches, leaves and detritus).
- Riparian vegetation and channel shade (%).
- Stream bank erosion (%).

7.4 Periphyton and Heterotrophic Growths

Visual Assessment

Periphyton cover should be assessed at each site using the Rapid Assessment Method (RAM 1) outlined in Biggs and Kilroy (2000). Periphyton cover should be recorded at five points along four transects within riffle habitat where periphyton and invertebrate samples are collected. Periphyton cover results should be compared with the SWLP for lowland hard bed stream guidelines for filamentous algae and thick mat (0.3 cm) cover of <30% and <60%, respectively.

Ash-free Dry Weight and Chlorophyll-*a*

Five replicate samples should be collected from riffle habitat at each of the four sites. Each replicate should be collected by randomly selecting three rocks and scraping periphyton within a total area of 0.0085 m^2 using a scalpel blade and brush into containers. Samples should be stored on ice after collection and transferred to a freezer as soon as practicable and sent to an IANZ registered laboratory for analysis.

Ash-free Dry Weight (AFDW) analysis should be carried out using APHA 10300 C 21st ed. 2005 and chlorophyll-*a* concentration analysis should be carried out using the method outlined in APHA 10200 H 21st ed. 2005 (modified). Mean AFDW should be compared with the SWLP lowland hard bed stream guidelines of <35 g/m^2 for either filamentous algae or diatoms and cynobacteria. Mean chlorophyll-*a* should be compared with the NPS-FM and SWLP guidelines of <120 mg/m^2 for filamentous algae and <200 mg/m^2 for diatoms and cyanobacteria.

Heterotrophic Growths

Alliance should monitor heterotrophic growth (sewage fungus) cover weekly both upstream

and downstream of the discharge by visual inspection during summer low river flows to ensure there are no bacterial or fungal slime growths visible to the naked eye as obvious plumose growths or mats.

7.5 Benthic Macroinvertebrates

Five benthic macroinvertebrate samples should be collected from each of the four sites using a Surber sampler (0.1 m^2 area; 500 µm mesh) and following the quantitative Protocol C3 for hard-bottomed rivers (Stark et al. 2001). Samples should be preserved and identified by an experienced taxonomist using Protocol P3 (full count + sub-sampling) in Stark et al. (2001). Biological indices and metrics calculated from invertebrate data to assess community health and indicative habitat and water quality should include:

- *Community composition* – relative abundance of the main taxonomic groups making up the macroinvertebrate communities recorded from each site.
- *Taxa number* – a measure of the overall health of the benthic macroinvertebrate community and habitat and water quality.
- *Abundance* – a measure of the total number of individuals in a sample. Total abundance tends to increase in the presence of organic/nutrient enrichment but declines in the presence of toxic pollution.
- *Macroinvertebrate Community Index (MCI) – the MCI is a 'presence / absence' based index used for measuring stream health and in particular organic enrichment.*
- *Quantitative Macroinvertebrate Community Index (QMCI)* – the QMCI is a quantitative variant of the MCI used for measuring stream health and in particular organic enrichment.
- *Deleatidium Abundance – Deleatidium* sp. is a water and habitat sensitive mayfly that occurs very commonly in the Mataura River and is used as an indicator of a change in water quality.
- *EPT taxa number* – a measure of the overall health of the community and of habitat and water quality. A community that has a higher number of water and habitat sensitive taxa from the groups Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) (EPT) indicates a healthy community and stream.
- *Percent EPT (%EPT)* – another measure of suitability of the waterway for supporting water and habitat sensitive taxa. A benthic macroinvertebrate community that has a higher percentage of water and habitat sensitive taxa from the EPT groups indicates a healthier waterway.

8.0 Fish Health Monitoring

8.1 Introduction

Fish health monitoring surveys assessing resident species such as shortfin and longfin eel are to be carried out annually in conjunction with the ecological monitoring outlined in Section 5.0. The methodology is based on the observational component of the Fish Health Profile developed by Richardson (1998). The Plant is located within the Mataura River mātaitai and does not discharge persistent pollutants such as metals (e.g., mercury) and persistent organic pollutants (e.g. dioxins and other chlorinated compounds). Therefore,

euthanasia of fish for the assessment of organs and tissues is not considered appropriate for this EMP.

8.2 Methodology

Fish surveys should be carried out at two sites on an annual basis. One site is upstream and one site is downstream of the discharge. Ten baited fine mesh fyke nets (five upstream and five downstream) should be set overnight and cleared the following morning.

All fish captured should be transferred immediately into a fish bin of river water and placed in a well shaded location. Multiple fish bins should be used if there are large numbers of fish captured to reduce stress. Species other than eels should be kept in separate fish bins. Aeration pumps should be used to maintain dissolved oxygen levels in fish bins.

The following should be measured for each fish:

- Length (mm).
- Weight (g).
- External examination and assessment of eyes, fins, opercula and gills.
- External examination and assessment for lesions and parasites.

A condition score (CON) should be calculated which is a measure of the weight of the fish relative to its length (Richardson 1998).

- $CON = 100 \times W / (L / 10)^3$

9.0 Reporting

Reporting will be carried out in accordance with Condition 23 of the discharge consent:

> *On an annual basis the Consent Holder shall prepare and submit an Annual Monitoring Report to the Consent Authority. The report shall cover the 1 October to 30 September period and shall be provided to the Consent Authority by 30 November each year. The annual report shall include, but not be limited to the following information:*
>
> *(a) presentation and summary of all wastewater and receiving water monitoring results and biological monitoring as required by this consent, including any recommendations for improved monitoring*
>
> *(b) the identification of any recorded non-compliances with consent standards and the measures taken to ensure compliance is achieved.*
>
> *(c) assessment of the effects of the discharge on river water quality and periphyton, benthic invertebrate communities and fish health.*

10.0 References

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APPENDIX A

Resource Consent Conditions