BEFORE THE TARANAKI REGIONAL COUNCIL

under: the Resource Management Act 1991

in the matter of: Resource consent applications by Remediation New Zealand to renew resource consents to discharge waste material, treated stormwater & leachate, and to discharge emissions into the air from composting operations, at State Highway 3 1460 Mokau Road, Uruti ("Applications")

Statement of evidence of **Kathryn Jane McArthur** for
Te Rūnanga o Ngāti Mutunga
(16 March 2021)

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STATEMENT OF EVIDENCE OF KATHRYN JANE MCARTHUR

QUALIFICATIONS AND EXPERIENCE

1. My full name is **Kathryn (Kate) Jane McArthur**. I am an independent freshwater specialist, ecologist and water quality scientist based in Palmerston North.

2. I hold a Bachelor of Science degree with Honours in Ecology and a Master of Applied Science with Honours in Natural Resource Management, both from Massey University. My post-graduate research included the influence of land use on freshwater macroinvertebrates and the interaction between policy and science in resource management, focussing on water quality objectives and limits in regional plans. I have 20 years of post-graduate experience in freshwater resource management.

3. I started my own independent consultancy (KM Water) in August 2020. Prior to starting KM Water, I was the Practice Leader – Water with The Catalyst Group for eight years. My work with The Catalyst Group included providing expert advice and evidence on eleven regional plans for a range of clients across Aotearoa New Zealand and assessing many resource consent applications on behalf of councils, tangata whenua and other submitters. Before this, I held the role of Senior Scientist – Water Quality with Horizons Regional Council (Manawatū-Whanganui Region). In this role I coordinated monitoring programmes for State of the Environment (SOE), periphyton, indigenous fish and point-source discharges, and produced expert evidence for many resource consent hearings, enforcement actions, the Horizons 'One' Plan Council-level and Environment Court hearings (the Horizons 'One' Plan being a combined regional plan/regional policy statement).

4. I have authored and co-authored a range of reports and publications, including technical reports on water quality and aquatic biodiversity to support the Horizons One Plan and the draft Nelson Resource Management Plan and section 42A reports for various resource consent applications. I have authored and co-authored papers in peer-reviewed journals on the relationship between flow and nutrients in rivers; nutrient limitation; methods for monitoring indigenous fish; the calculation of in-river nutrient loads and limits, and the setting of water quality objectives and limits in water policy. I have provided evidence in these topic areas before the Environment Court, and in Board of Inquiry and council hearings processes across the country.

5. I have provided ecological, water quality and freshwater policy advice to Nelson City Council, Northland Regional Council, Horizons Regional Council, Ngāti Kahungunu Iwi Incorporated, Ngāti Pāhauwera Development Trust, Te Rōpū Taiao o Ngāti Whakatere, Te Taiwhenua o Heretaunga, Hawke's Bay Regional Council, the national Iwi Leaders Group, the Department of Conservation, the Ministry for the Environment, the National Objective Framework Reference Group, Forest and Bird, Fish and Game, Environmental Defence Society and the Biodiversity Collaborative Group. I have recently been, or am currently involved in, freshwater plan processes in Northland, Auckland, Waikato, Bay of Plenty, Hawke's Bay, Manawatū-Whanganui, Wellington, Tasman, Nelson, Canterbury and Southland, and resource consent processes in many regions.

6. I was appointed as a member of the National Objectives Framework reference group for the National Policy Statement for Freshwater Management (2017) by the Ministry for the Environment. Since 2016, I have co-led national workshops on best practice freshwater science, policy development and implementation of the NPS FM for the New Zealand Planning Institute. I am a guest lecturer in environmental planning, freshwater resource management practice and science at Massey and Canterbury Universities.

7. I have been a member of the New Zealand Freshwater Sciences Society since 2001 and I am currently the Society's President. I am a member of the Resource Management Law Association of New Zealand (RMLA) and was the RMLA scholarship recipient in 2010 for my master's thesis work on water quality policy and limits for the Manawatū River.

8. I am an accredited and experienced RMA hearings commissioner with hearing chair endorsement and have recently been appointed by the Minister for the Environment as a Freshwater Commissioner for the new Freshwater Planning Process under the RMA amendments, to implement the NPS FM (2020).

9. I am presenting this evidence for Te Rūnanga o Ngāti Mutunga ("TRONM") in relation to an application to Taranaki Regional Council (TRC) by Remediation New Zealand Limited (RNZ) for discharges to land and water at the Uruti Composting Facility, Taranaki.

CODE OF CONDUCT

10. I have read and agree to comply with the Code of Conduct for Expert Witnesses produced by the Environment Court 2014 and have prepared my evidence in accordance with those rules. My qualifications as an expert are set out above.

11. I confirm that the issues addressed in this brief of evidence are within my area of expertise.

12. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed. I have specified where my opinion is based on limited or partial information and identified any assumptions I have made in forming my opinions.

13. As a member of the New Zealand Freshwater Sciences Society, a constituent organisation of the Royal Society of New Zealand - Te Apārangi, I am also bound by the Royal Society of New Zealand Code of Professional Standards and Ethics in Science, Technology, and the Humanities.[1]

14. In preparing my evidence I have read the following:

    a. Application documents, AEE and Appendices dated June 2020.

    b. TRC Annual Compliance Monitoring reports 2012-2013, 2014-2015, 2015-2016, 2016-2017, 2017-2018, 2018-2019 and 2019-2020 (draft).

    c. Clements KA 2020 Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti. TRC Report no. KC016, 2 May 2020.

    d. Clements KA 2021. Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Ltd composting site at Uruti January 2021 - Draft. TRC draft report no. KC031.

    e. Section 42A TRC Officer's Report dated 2 March 2021.

[1] https://royalsociety.org.nz/assets/Uploads/Code-of-Prof-Stds-and-Ethics-1-Jan-2019-web.pdf

f. Ministry for the Environment 2018. *A Guide to Attributes in Appendix 2 of the National Policy Statement for Freshwater Management (as amended 2017)*. Wellington: Ministry for the Environment.

g. Ministry for the Environment 1998. Environmental guidelines for water discharges from petroleum industry sites in New Zealand.

h. The evidence of Katie Beecroft for Te Rūnanga o Ngāti Mutunga.

i. The cultural evidence of Anne-Maree McKay and the (draft) cultural evidence of Jamie Tuuta for Te Rūnanga o Ngāti Mutunga

j. The evidence of Hayden Easton and Kathryn Hooper on behalf of RNZ.

SCOPE OF EVIDENCE

15. My evidence will cover the following:

a. Executive Summary.

b. Haehanga Stream and Mimitangiatua River aquatic ecological values.

c. TRC monitoring data and 2019/2020 compliance report.

d. TRC biomonitoring reports (2020 and draft 2021).

e. Contaminants of concern.

f. Ammoniacal nitrogen – surface water monitoring.

g. Dissolved inorganic nitrogen – surface water monitoring.

h. Other contaminants.

i. Site visit observations.

j. Response to the TRC section 42A officer's report.

k. Response to the Applicant's evidence.

l. Conclusion.

EXECUTIVE SUMMARY

16. I have analysed water quality and aquatic ecological monitoring data associated with the RNZ Uruti composting facility. I have assessed the results of this data against the conditions in the previous consent, attributes in Appendix 2 of the National Policy Statement for Freshwater Management (NPS FM 2020) and ecological guidelines and thresholds in published reports and literature to determine the level of current adverse effects on water quality and aquatic life.

17. In my view there are significant adverse effects on water quality and ecosystem health as a result of contaminants discharged at the site reaching surface waters, both directly and indirectly. There appears to be a high degree of connectivity between soils, subsurface flows and surface water at the site. In my view the current operation of the site is not adequate to prevent the transport of high loads of contaminants from the land discharge, vermiculture and composting areas of the site (primarily nitrogenous contaminants including ammonia) from reaching the surface waters of the Haehanga Stream.

18. Furthermore, biomonitoring of the macroinvertebrate communities upstream and downstream of the wetland treatment discharge directly to a tributary of the Haehanga Stream, shows the discharge causes a 25% reduction in SQMCI, which is in my view (and commensurate with standards in other regional plans) evidence of a significant adverse effect on aquatic life resulting from the discharge.

19. In my view, the discharge of ammoniacal nitrogen both directly (from the wetland treating the paunch waste) and indirectly via overland flow and subsurface drainage (resulting from poor management of stormwater, irrigation areas, vermicomposting, composting and drilling waste pads, truck wash and irrigation ponds) is having a clear and significant adverse effect on aquatic life and ecosystem health. Ammoniacal nitrogen is also contributing to eutrophication of the Haehanga Stream and to some degree nutrient inputs to the wider Mimitangiatua catchment, although there is uncertainty as to the magnitude of this effect due to a lack of monitoring of the Mimitangiatua River.

20. Ammoniacal nitrogen concentrations regularly exceed national bottom lines in the NPS FM (2020) at many sites in the mid to lower catchment and the discharge from the treatment wetland causes the downstream tributary site to grade a D band for ammonia toxicity.

21. Conductivity and chloride in the stream are also elevated as a result of operations across the site. There is also evidence (albeit limited) that contaminants (including ammonia) affect water quality in the Mimitangiatua River downstream of the confluence with the Haehanga Stream.

22. Given the nature of the biological waste processed on site (e.g., chicken carcasses and other animal waste), there is also significant potential for microbial pathogens to reach surface water in the Haehanga Stream and this may adversely affect human health when cultural or recreational activities are undertaken downstream.

23. Furthermore, unmanaged plastic waste in the paunch pond has the potential to cause gross pollution (plastic litter) of the Haehanga Stream and Mimitangiatua catchment. This potential is significantly increased following storm events, given the poor management of gross plastic waste and overland flows at the RNZ site.

24. Water quality enhancements as a result of RNZ's recommended improvements are not quantified and remain uncertain.

25. I have reviewed the proposed consent conditions recommended in the Officer's Report, and those conditions that RNZ have indicated it would accept.[2]

26. TRC recommends consent conditions that are intended to improve environmental management of the site. While I have not seen any modelling of what those improvements would achieve in terms of surface water quality, the instream parameters contained in consent conditions proposed by TRC would not be sufficient to avoid significant adverse effects on ecosystem health and mahinga kai (species) values occurring, particularly in the short term (with respect to ammonia) or in the longer term with respect to nutrient enrichment and subsequent effects on macroinvertebrate health and ecosystem health. Human health effects for downstream users (cultural and recreational) are also not managed through conditions.

27. The proposed in-stream limits beyond a mixing zone of 30 metres (condition 18) are, in my opinion, inadequate to provide sufficient confidence that more than minor adverse effects will not occur due to the proposed discharges. Condition 18(b) for un-ionised ammonia of ≤0.025 g/m^3 is not currently managing the toxicity of ammonia

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[2] Evidence of Kathryn Hooper for RNZ, Attachment A.

and concentrations are having a significant adverse effect on macroinvertebrate communities downstream of the discharge. This effect would be allowed to continue until 1 June 2026 according to the proposed conditions.

28. Mr Easton proposes condition 18(c) contain a 15 g/m^3 threshold for total recoverable hydrocarbons from the Environmental Guidelines for Water Discharges from Petroleum Industry Sites in New Zealand (MfE 1998). These are very old guidelines, predating even the (now obsolete) ANZECC 2000 guidelines. Furthermore, the guidelines relate to spills and leaks from petroleum industry sites, which are not relevant to the RNZ site and discharges. Should consent be granted, I recommend the proposed condition for total recoverable hydrocarbons in the Officer's Report be accepted. In my evidence I also set out an alternative approach which is to use the most recent default guideline values from ANZG (2018). If this approach were adopted then no exceedance of the 95% species protection threshold for toxicants, metals, and metalloids (which includes all types of hydrocarbons), excluding ammonia and nitrate toxicity, would apply as a consent condition.[3]

29. Should the consent be granted, I recommend the following instream nutrient limits apply to all surface waters within the RNZ site to ensure ammoniacal nitrogen does not exceed national bottom lines and there is no high risk of nuisance periphyton or macrophyte biomass and subsequent effects on ecosystem health:

    a. Annual median ammoniacal nitrogen (adjusted to pH 8) shall not exceed 0.24 mg/L, and

    b. Annual maximum ammoniacal nitrogen (adjusted to pH 8) shall not exceed 0.4 mg/L, and

    c. Annual median dissolved inorganic nitrogen (NNN + unadjusted total ammoniacal nitrogen) shall not exceed 0.5 mg/L.

30. The ammonia thresholds are based upon the B band in the NPS-FM (2020). As set out in my evidence, the NPS FM (2020) requires that a target attribute state must be set at or above the "baseline state" for the relevant attribute. I note at present there is some uncertainty over the "baseline state" for ammonia at the site upstream of the treatment wetland discharge as this site appears to have been historically affected by ammonia leaching from adjacent worm beds when the long term record (rather than

[3] There are some issues with this alternative approach which I set out in my evidence (below).

the latest year) is assessed. Based on the last year of monitoring the upstream site is in an A band state for ammonia. If this site is to remain unimpacted by vermiculture activities it should not be allowed to degrade to a lower attribute band, in which case the A band ammonia thresholds should apply (rather than the B band as recommended above).

31. In response to the proposed consent condition 19 that would allow a transition prior to more stringent instream limits for ammonia and nitrate nitrogen toxicity (until 1 June 2026), in my evidence I comment that:

   a. There is evidence that a limit on un-ionised ammonia of no greater than 0.025 g/m^3 is currently inadequate to manage potentially toxic effects of ammonia on aquatic life and ecosystem health and this limit is considerably out of date with the methods and guidelines to manage ammonia toxicity that have been in place since 2000 (ANZECC 2000; ANZG 2018).

   b. The national bottom line for ammonia toxicity is more stringent in the NPS FM (2020) as compared with the 2014 and 2017 versions. This more stringent bottom line applies now, there is no transitional 'standard' in the NPS FM (2020). In any case, the lower bottom line (D Band) levels for ammonia toxicity contained in those previous NPS FM versions has also been exceeded in the last year of monitoring at the monitoring site (HHG000103) downstream of the wetland treatment discharge.

   c. I am not aware of a direction in the NPS FM 2020 that requires previous water quality results to be interpreted according to the NPS FM version that existed at the time of monitoring, as is suggested in Mr Easton's evidence. National bottom lines were made more stringent as it was acknowledged that the former C Band threshold did not adequately protect sensitive aquatic life (freshwater mussel juveniles and fingernail clams) from the <u>acute</u> effects of ammonia toxicity.

   d. Riparian management alone will not improve ecosystem health whilst contaminant concentrations remain at levels that cause significant adverse effects on water quality, aquatic life and thereby ecosystem health.

   e. The s42A Report Condition 19 limits for nitrate would not manage nutrient enrichment and periphyton/macrophyte growth. I have recommended a more stringent limit for DIN (which includes both nitrate and ammoniacal nitrogen) that will ensure there is a lower risk of adverse effects on ecosystem health and that other national bottom lines for periphyton, fish, dissolved oxygen and macroinvertebrates will not be exceeded.

f. A significant and sustained improvement would be needed at the site in order to avoid the potential for toxic effects in the future. Although the Officer's Report refers to RNZ investigating "*possible alternative options and /or improved technology*" for meeting condition 19 limits,[4] I have not seen a rigorous proposal as to how this would occur. Although Mr Easton proposes improvements to the treatment systems, there is considerable uncertainty as to whether this will achieve surface water outcomes (as Mr Easton acknowledges). Furthermore, there is no inflow contaminant concentration or load data to determine the degree of treatment required from the wetland system to reduce ammonia in the paunch waste or any treatment of leachate from the worm beds, as proposed.

BACKGROUND

32. I have been asked by Ngāti Mutunga to assess TRC monitoring reports, the applicant's AEE and water quality information associated with discharges from the Remediation New Zealand Ltd (RNZ) composting site, affecting the Haehanga Stream, Uruti in the Taranaki Region. The following evidence is my assessment of water quality and aquatic ecology effects arising from the operation of the RNZ site on the Haehanga Stream, a tributary of the Mimitangiatua River in the rohe of Ngāti Mutunga.

33. Remediation NZ hold consents to discharge treated stormwater and leachate from composting to land where it may enter water (across the Haehanga Stream catchment) and directly to water from a constructed treatment wetland to an unnamed tributary of the Haehanga Stream. Twelve surface water monitoring sites are measured for water quality approximately six times annually. An annual biomonitoring survey of macroinvertebrate communities is undertaken by TRC at seven sites and a fish netting survey was conducted in 2019. Regular surface and groundwater quality monitoring is also undertaken at a number of sites in the Haehanga Stream catchment by TRC. Remediation NZ operates the Uruti Composting facility located approximately two kilometres south of Uruti Village. The

[4] Paragraph 427 of the Officer's Report.

composting operation at Uruti holds six resource consents with TRC and two of these expired on 31st May 2018:

a. R2/5839-2 Discharge to air - odour/dust; and

b. R2/5838-2.2 Discharge of waste material/treated stormwater and leachate to land.

34. An application for renewal of these consents was submitted to TRC in November 2017, and subsequently revised in June 2020.

35. I visited the site on 18 November 2020 accompanied by Marlene Benson from Ngāti Mutunga, Jared Glasgow and Kelby Clements of TRC, and David Gibson from Remediation New Zealand. I also visited candidate sites for the purposes of identifying a new biomonitoring reference (upstream comparison) site with Kelby Clements and Anne-Maree McKay (Ngāti Mutunga).

HAEHANGA STREAM AND MIMITANGIATUA RIVER AQUATIC ECOLOGICAL VALUES

36. The Taranaki Regional Policy Statement (RPS) and the Regional Freshwater Plan for Taranaki (RFP) recognise the Mimitangiatua River as having high natural, ecological and amenity values and it is listed in Appendix 1A of the RFP. Policies within the RPS afford protection to the rivers and streams listed in Appendix I of the RPS (including the Mimitangiatua). Policy 3.1.4 of the RFP states: "*The high natural, ecological and amenity values of those rivers and streams listed in Appendix 1A will be maintained and enhanced as far as practicable. Adverse effects of activities on these values will be avoided as far as practicable, or remedied or mitigated*".

37. The New Zealand Freshwater Fish Database holds the following records for indigenous aquatic species in the Mimitangiatua River, threat classifications for each species are noted in brackets (Grainger et al. 2014; Dunn et al. 2018):

a. Longfin eel *Anguilla dieffenbachii* (at risk – declining nationally)

b. Giant kōkopu *Galaxias argenteus* (at risk – declining nationally)

c. Kōaro *Galaxias brevipinnis* (at risk – declining nationally)

d. Banded kōkopu *Galaxias fasciatus* (not threatened)

e. Īnanga *Galaxias maculatus* (at risk – declining nationally)

f. Shortjaw kōkopu *Galaxias postvectis* (threatened – nationally vulnerable)

g. Redfin bully *Gobiomorphus huttoni* (not threatened)

h. Kōura/freshwater crayfish *Paranephrops planifrons* (not threatened)

i. Freshwater shrimp *Paratya curvirostris* (not threatened)

38. The aquatic habitat and species are of high ecological value, of note is the presence of shortjaw kōkopu, a species threatened with extinction and nationally vulnerable to further population declines (Dunn et al. 2018). Freshwater mussels (kākahi: *Echyridella menziesii*) are also known to inhabit the catchment. Kākahi rely on indigenous fish as hosts for their parasitic larval stage and are classed as at risk of extinction and declining nationally (Grainger et al. 2014). Significant īnanga spawning sites are also found in the lower reaches of the river.

39. The Mimitangiatua River catchment is of considerable cultural significance to Ngāti Mutunga, as recognised through statutory acknowledgement, and described in the evidence of TRONM cultural experts.

40. The Haehanga Stream is a small tributary of the Mimitangiatua River in the mid to lower reaches. The RNZ site almost completely fills the catchment, and encompasses a number of smaller tributaries, although indigenous vegetation remains on the steeper areas of the site. Ecological values in this stream would have been high when the catchment was in complete indigenous vegetation cover. Given the elevation and proximity to the sea, the Haehanga Stream would have once held a rich indigenous aquatic fauna.

TRC MONITORING DATA AND REPORTS

TRC compliance report 2019/2020

41. I have reviewed some of the earlier TRC compliance reports for the RNZ site. However, I focus only on the latest report for the purposes of this evidence.[5] In the sections which follow I also provide my own analysis of the data collected by TRC in 2019 and 2020.

[5] Uruti and Waitara Road Monitoring Programme: Annual Report 2019-2020. *Draft pending Remediation New Zealand's comments.* Technical Report 2020-84

42. During the 2019/2020 monitoring period, TRC identified that RNZ demonstrated an overall ‘needs improvement’ level of environmental performance.[6] The report records a number of exceedances of the ammoniacal nitrogen bottom line from the NPS FM in the most recent year’s data and then goes on to state: “*The monitoring showed that no significant impacts to surface water were recorded throughout the monitoring period.”* I find it difficult to reconcile this statement with the data which exceeds the national bottom line for ammonia toxicity acknowledged in the report which indicates a high likelihood of adverse effects on aquatic life. Despite holding a different view on the degree of current effect, I largely agree with the analysis within the compliance report and present my own analysis of the most recent data further below.

Biomonitoring reports 2020 and 2021

43. I have reviewed the 2020 and draft 2021 biomonitoring macroinvertebrate reports by Kelby Clements of TRC.[7] At the time of writing, the 2021 report, which incorporates comparison monitoring between the RNZ sites and a new reference site (Waikekeho Stream tributary) in the Uruti stream catchment, was available for review in draft form.

44. The 2020 report noted that macroinvertebrate community health at all sites in the Haehanga Stream were indicative of ‘poor’ to ‘fair’ water quality. Five sites out of six recorded macroinvertebrate community index (MCI) scores below their historic medians and the number of taxa (types of animals) recorded were lower than for other lowland, hill country streams at similar altitude. Some improvements were seen in 2021, particularly at control site T2 upstream of the wetland discharge, although the majority of sites still graded fair to poor.

45. In 2020, all MCI and semi-quantitative macroinvertebrate community index (SQMCI) scores across the RNZ site were below national bottom lines for macroinvertebrates

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[6] According to the 2019/2020 compliance monitoring reports ‘improvement required’ means: “***Improvement required:*** *Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or during investigations of incidents reported to the Council by a third party. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.*”
[7] Clements KA, 2020. Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti. TRC Report no. KC016, 2 May 2020; Clements KA 2021. Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Ltd composting site at Uruti January 2021 - Draft. TRC draft report no. KC031.

in the NPS FM (2020). In 2021, all sites except for site T2 (upstream of the wetland treatment discharge) were below national bottom lines for MCI and SQMCI.

46. Poor habitat management, the effects of other activities (e.g., stock access and earthworks) and low flow conditions were noted by Clements (2020) to have an impact on the macroinvertebrate results for the upstream (control) sites. Land irrigation of wastewater has also incrementally increased in the upper catchment of the Haehanga Stream, encroaching on the upstream sites, which were previous control sites for comparison with those further downstream. These impacts cumulatively reduce the ability for control sites to provide representative comparisons with downstream sites affected by RNZ activities. A new reference site with similar stream size, elevation and catchment characteristics was proposed for future comparison with macroinvertebrate and fish communities in the Haehanga Stream. I participated in the site visit to select an appropriate reference site for comparison in the Waikekeho Stream, a tributary of the Uruti Stream. I agree that this stream is an appropriate reference site for comparison with sites in the Haehanga Stream.

47. Based on an extensive site visit to each of the biomonitoring points I agree that the stream habitat is significantly degraded at most sites, with very little canopy cover, shade or riparian margins to filter overland contaminant flows such as sediment and stormwater. Many of the tributary streams have been substantially modified and diverted to allow for the construction of irrigation fields in the valley floors. This has also affected their habitat value, natural character, and morphology. I do not know what the original (natural) length of the multiple diverted stream reaches was, so I cannot determine whether there has been a loss of stream extent in the stream reaches diverted to create each of the irrigation fields (for comparison with Policy 7 and the effects management hierarchy of the NPS FM (2020)). The poor habitat quality, combined with the degraded water quality (assessed below), mean it is unsurprising that macroinvertebrate health is below national bottom lines.

48. The tributary stream which receives the paunch wetland treatment discharge has one of the better remaining habitats on site, however, ecosystem health is significantly affected by poor water quality downstream of the discharge.

49. Ecosystem health is a compulsory national value under the National Policy Statement for Freshwater Management (NPS FM 2020). National work to define a framework for ecosystem health for implementation of the NPS FM (Clapcott et al. 2018) has identified the five core components of ecosystem health as:

a. Aquatic life.

b. Physical habitat.

c. Water quality.

d. Water quantity.

e. Ecological processes.

50. All five components must be managed to ensure a good state of ecosystem health. Whilst I agree with the recommendation of the biomonitoring reports (Clements 2020 and 2021) that significant habitat improvement is needed across the RNZ site through better riparian management, stock exclusion and increased planting and subsequent shading, it is important to consider that improving the habitat will only improve one aspect of ecosystem health. Commensurate water quality improvement is also needed across the site and in the wetland treatment discharge for ecosystem health to improve.

51. It is common practice (and indeed a limit/standard in several regional plans)[8] to test the degree of change in macroinvertebrate community health between sites in appropriately matched habitats upstream and downstream of a point discharge, to assist in determining the significance of effects and for assessing against the requirements of s107(1)(g).[9] Often, a fully quantitative method with full species-count protocols is needed to calculate the QMCI (rather than SQMCI) to compare statistically between the two sites. A reduction in QMCI of more than 20% is considered an ecologically meaningful change (Stark 2010) *c.f.* a significant adverse effect.[10] However, Stark (2010) notes that SQMCI, which is a semi-quantitative measure using coded abundance classes (i.e., extremely abundant, very abundant, abundant, common, rare) can be used as a cost-effective compliance measure for more minor discharges. SQMCI and MCI indices are calculated by TRC from the macroinvertebrate data collected during annual compliance monitoring of the RNZ site.

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[8] E.g., Horizons One Plan, Plan Change 6 Hawkes Bay Regional Resource Management Plan, Proposed Natural Resources Plan for Greater Wellington.
[9] S107(1)Except as provided in subsection (2), a consent authority shall not grant a discharge permit … allowing - (g) "any significant adverse effects on aquatic life".
[10] https://www.horizons.govt.nz/HRC/media/Media/One%20Plan%20Documents/Appendix-4-Advice-from-John-Stark-on-QMCI-Standard.pdf?ext=.pdf

52. The 2021 biomonitoring survey shows a 25% reduction in SQMCI between upstream (site T2, SQMCI 5.6 = 'good') and downstream (site T3, SQMCI 4.2 = "fair") of the wetland treatment discharge. In my opinion this signifies degradation of water quality and a significant adverse effect on aquatic life (and thereby ecosystem health).

CONTAMINANTS OF CONCERN

Ammoniacal nitrogen – surface water monitoring

53. Ammonia is a nitrogenous toxicant that can cause lethal or sub-lethal[11] effects on aquatic life. Effects can occur from short-term (hours to days) or long-term (weeks, months, years) exposure to ammonia. Ammonia toxicity has no 'safety margin' between concentrations that have lethal and sub-lethal effects across the range of aquatic organisms tested. For example, the ammonia concentration that provides protection of 80 per cent of species from chronic exposure may not protect some sensitive freshwater mussel juveniles (known as glochidia) or Sphaeriid fingernail clams from lethal effects.

54. Kākahi (freshwater mussels) are taonga species to Ngāti Mutunga, listed on page 33 of the Ngati Mutunga Deed of Settlement and included in Appendix 5 page 1 of the Ngati Mutunga Iwi Environmental Management Plan. *Echyridella menziesi* (the species of freshwater mussel found in Taranaki) are considered At Risk [of extinction] and Declining nationally (Grainger et al. 2014).

55. Furthermore, taonga species (including those with mahinga kai values) have recently been ranked for their vulnerability to climate change (Egan et al. 2020). Kākahi are considered 'highly vulnerable'. This species of freshwater mussel is already subject to threat and environmental vulnerability and is declining at the national scale.

56. The NPS FM (2020) defines ammonia toxicity attribute states in Table 5 of Appendix 2A, based on concentrations that protect a proportion of test species (from ecotoxicological studies) from long-term exposure to ammonia. The NPS FM describes the attribute states for each of the four bands (A through D). The 2020 national bottom line is set to protect 95 per cent of species (Band B), based on the methods of Hickey (2015), this level of protection can have effects that start impacting occasionally on the 5% most sensitive species. The higher attribute state (A band) provides protection from effects of long-term exposure for 99 per cent of

[11] Sub-lethal effects include reduced growth and/or reproductive success.

species and is essentially a no-effects level of ammonia. For sites with a C band grading, the NPS FM (2020) describes the effects of ammoniacal nitrogen as starting to impact regularly on the 20% most sensitive species (reduced survival of most sensitive species). For sites graded as a D band, ammoniacal nitrogen concentrations approach acute impact levels (risk of death) for sensitive species. The poor macroinvertebrate results in TRC compliance reports (Clements 2020 and 2021) are largely consistent with the degree of potential effects assessed from ammoniacal nitrogen results measured across the site.

57. Ammonia is generally found in very low concentrations (i.e., A band) in surface water and has few 'natural' sources, ordinarily ammonia concentrations are below the level of laboratory detection in unimpacted waters. Very few river sites in Aotearoa New Zealand show ammoniacal nitrogen concentrations that exceed the B band (except for sites immediately downstream of major point source discharges). Elevated ammonia generally occurs as a result of point source discharges of wastewater, particularly those which are poorly treated or contain very high loads of organic or animal wastes such as meat works discharges.

58. The term 'ammonia' refers to two chemical species of ammonia that are in equilibrium in water: un-ionised ammonia (NH_3) and ionised ammonium (NH_4) (ANZECC 2000). The proportion of each form in water varies with the ionic composition of the water, temperature, and pH, and these can vary throughout the day. Ammonia is very soluble in water and concentrations of ammonia are usually expressed as total ammonia (or total ammoniacal nitrogen) – which is the sum of NH_3 and NH_4, or as a concentration of the un-ionised ammonia (NH_3) only.

59. The toxic effects of ammonia generally come from the un-ionised form, although ionised ammonium can be responsible for some toxicity at lower pH (ANZECC 2000). The numeric attribute states in the NPS FM (and most guidelines associated with routine ammonia monitoring) are defined for (total) ammoniacal nitrogen. Temperature and pH have a significant effect on the fraction of un-ionised ammonia and the toxicity of ammonia generally, so the numeric attribute states, are defined and standardised for a pH of 8 and temperature of 20°C. To compare measured data against the NPS FM ammonia attributes requires the data to be pH adjusted, temperature is not taken into consideration in the ANZECC or NPS FM methods for pH adjustment in New Zealand.

60. Adjusting the ammonia concentration for pH does not mean that the amount of total ammonia present changes. Instead, pH adjustment means calculating the amount of ammoniacal nitrogen at pH 8 that would have the equivalent toxicity to the amount of ammoniacal nitrogen measured in the sample at the pH of that sample.

61. Photosynthesis by aquatic plants removes dissolved inorganic carbon from the water as the day proceeds, causing the pH of the water to increase. The maximum 'pH-adjusted' ammonia concentration is likely to occur during the afternoon – particularly in streams that contain algae and plants. Compliance monitoring that is undertaken primarily in the morning (which I understand to be the case for the RNZ site) is unlikely to identify worst case conditions for ammoniacal nitrogen because pH is likely to be lower at these sampling times. A monitoring programme focused on warm, sunny afternoons may be needed instead to capture the maximum toxicity effects, as recommended by MfE (2018).

62. The ammoniacal nitrogen concentrations that define the NPS FM attribute states are linked to observed effects from long-term exposure to ammonia in studies on 19 freshwater species (Hickey, 2015). The first set of attribute state thresholds (i.e., median concentration) are set at the No Observed Effect Concentration (NOEC) for each level of species protection (A through D bands) and reflect the exposure of aquatic life to ammonia under average conditions (chronic exposure). The second set of attribute state thresholds (i.e., maximum) are set at the Threshold Effect Concentration (TEC[12]) for each level of species protection (A through D), which can be interpreted as below the level of an effect. The maximum concentration attribute manages the exposure of aquatic life to critical events with daily or seasonal peaks in ammonia concentration (acute exposure).

63. Acute ammonia toxicity can cause loss of equilibrium, hyperexcitability, increased breathing rate, cardiac output, and oxygen uptake; and, in extreme cases, convulsions coma and death in fish. Chronic effects of ammonia include a reduction in hatching success, reduction in growth rate and morphological development, and pathological changes in gill, liver, and kidney tissue (USEPA 1986 in ANZECC 2000).

64. Ammonia is not only directly toxic to aquatic life but can cause adverse behavioural effects including avoidance behaviour by juvenile fish and crustacea, potentially

[12] The threshold effect concentration (TEC) is the geometric mean of the no observed effect concentration (NOEC) and the lowest observed effect concentration (LOEC). The TEC value is below the lowest statistically significant effect concentration.

disrupting fish migration into upstream catchments (Richardson et al. 2001). Ammonia also contributes to nutrient enrichment which can lead to eutrophication of surface waters and is immediately bioavailable for the growth of plants and algae. The s42A report (and TRC compliance biomonitoring reports) record abundant algal and periphyton growths at times in the Haehanga Stream.

65. Figure 1 shows the plotted total ammoniacal nitrogen after adjustment for pH (as per MfE 2018 methods) for all monitoring sites in the Haehanga Stream. Because there are some very high values at some sites (particularly site HHG000103 downstream of the wetland treatment discharge) it is difficult to compare between-site differences on the graph. To make this easier to see, Figure 2 is a zoomed version of the same graph which cuts off the Y axis below the highest maximum values. The national bottom lines (NBL) for ammonia toxicity (median and maximum) from the NPS FM (2020) are also shown on Figure 2.

66. All sites on the Haehanga Stream from site HHG000106 and the tributary site downstream of the wetland treatment discharge (HHG000103) exceed either one or both thresholds of the national bottom line for ammonia toxicity[13] (Figure 2; Table 1). Comparing ammonia concentrations between site HHG000098 and site HHG000103 there is a clear and significant increase between the upstream control and downstream of the treatment wetland discharge on the tributary receiving the paunch waste. The ammonia attribute state shifts from an A band upstream to a D band downstream when the last year of annual data is assessed against the NPS FM (2020). This discharge results in the highest measured ammoniacal nitrogen concentrations at the RNZ site over the last year of monitoring. The D band attribute state is described in the NPS FM as "*starts approaching acute impact level (that is, risk of death) for sensitive species*" and is of serious ecological concern. The biomonitoring of these sites also shows a significant reduction in macroinvertebrate community health upstream to downstream (Clements 2020 and 2021).

[13] To grade a site as within an attribute band in the NPS FM, both the median and the maximum values must be within the attribute band boundaries e.g., if one if the numeric attribute states (either the median or the maximum) exceeds the B band threshold then the site is graded as a C band.

Table 1. NPS FM (2020) ammoniacal nitrogen toxicity attribute states for Remediation NZ Ltd water quality monitoring data for the Haehanga Stream and tributaries provided by TRC (August 2019 – August 2020), data is pH adjusted before comparison with band thresholds (MfE 2018). Sites below national bottom lines are highlighted grey.

Site no.	Site description	Ammonia cal-N median band	Ammonia cal-N max band	Overall grade
HHG000090	Haehanga u/s upper irrigation (control)	A	A	A
HHG000093	Haehanga d/s upper irrigation	B	B	B
HHG000097	u/s wetland (tributary)	B	B	B
HHG000098	u/s wetland discharge (tributary)	A	A	A
HHG000103	d/s wetland discharge (tributary)	C	D	D
HHG000099	Haehanga u/s ponds d/s upper irrigation	B	B	B
HHG000100	Haehanga d/s upper irrigation	B	C	C
HHG000106	Haehanga u/s tributary confluence	C	C	C
HHG000109	Haehanga opposite ponds	C	C	C
HHG000115	25m d/s ponds u/s duckpond	C	C	C
HHG000150	30m d/s lower irrigation	C	C	C
HHG000160	d/s lower irrigation	C	C	C
HHG000165	Unnamed lower tributary[14]	B	B	B
HHG000168	Haehanga d/s unnamed tributary	C	C	C
HHG000190	50m u/s SH3	B	C	C

[14] An irrigation field was under construction in this tributary catchment at the time of my site visit. The stream had been diverted and significantly channelised to accommodate an irrigation area in the centre of the valley floor. I understand this has also occurred in the other irrigation areas previously.

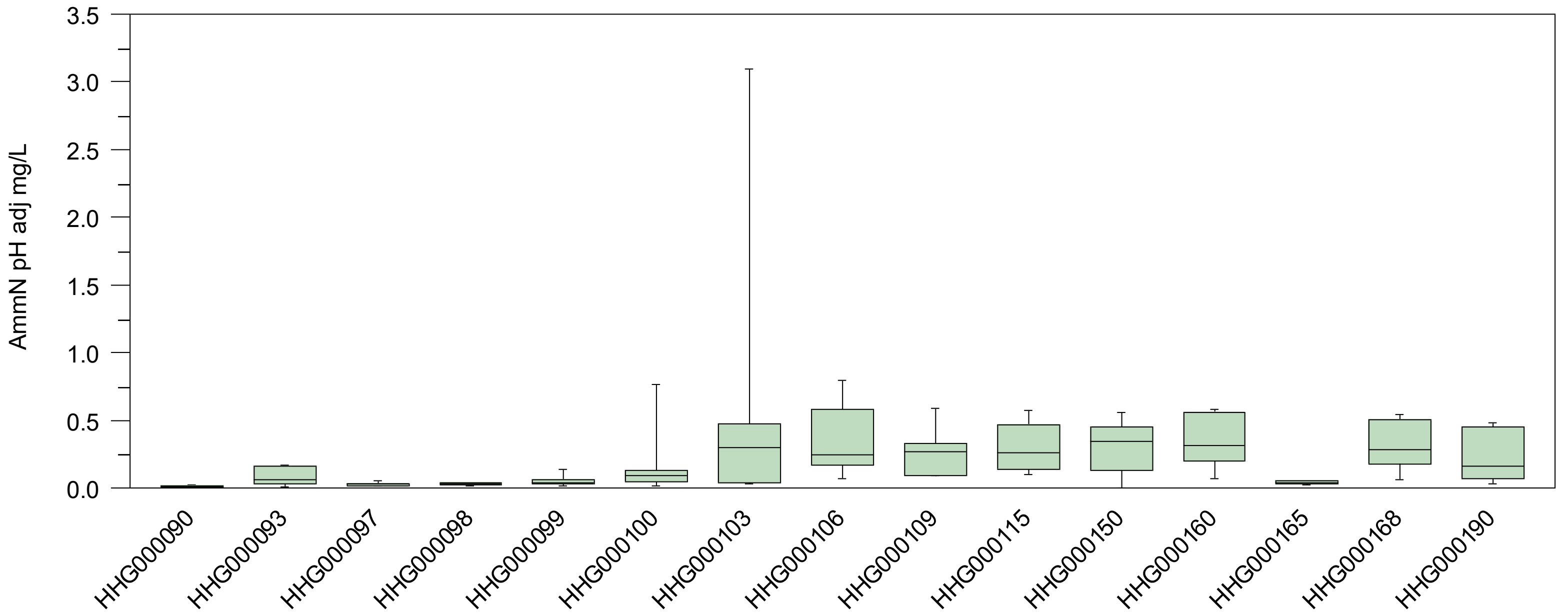

Figure 1. Total ammoniacal nitrogen (pH adjusted) for sites in the Haehanga Stream catchment, Remediation NZ site, Uruti. Data provided by TRC for August 2019 – August 2020. Boxes encompass interquartile range, midpoint line = median, bars = min and max.

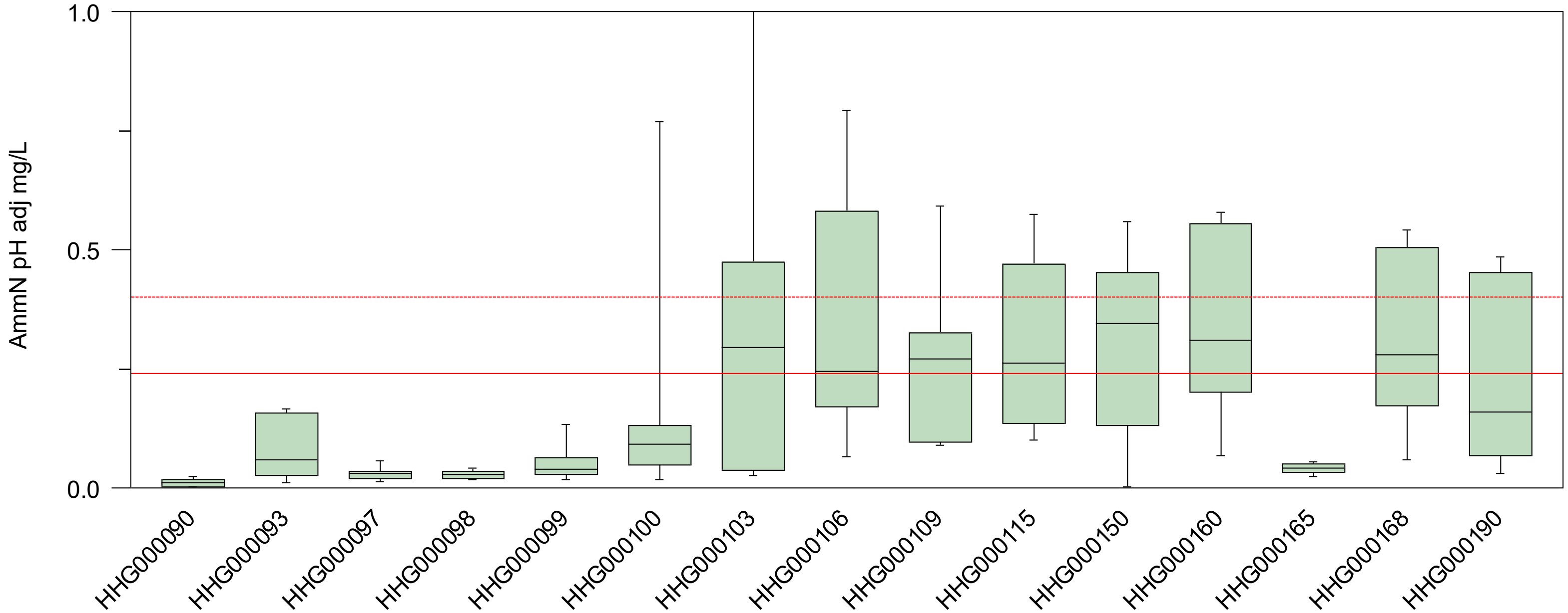

Figure 2. Total ammoniacal nitrogen (pH adjusted) for sites in the Haehanga Stream, Remediation NZ site, Uruti – Y axis zoomed view. Data provided by TRC for August 2019 – August 2020. Solid red line is NPS FM (2020) national bottom line (NBL) for ammonia toxicity (median), dashed red line is NBL (max).

67. I have examined the laboratory method used to determine the un-ionised ammonia in the samples, which is used to assess compliance against the 0.025 g/m^3 consent maximum. The method is a calculation from a table in ANZECC (2000) whereby un-ionised ammonia can be estimated based on the total ammoniacal nitrogen concentration analysed and then corrected for pH and temperature. I understand from my enquiries with TRC that the laboratory uses the pH value from the field sample and the temperature at the time of laboratory analysis (which is not the temperature in the field and is inconsistent with the pH value). Although this method applies a correct calculation to estimate un-ionised ammonia, I have two major concerns with the reported data:

i. The standard method to determine the toxicity of ammoniacal nitrogen in Aotearoa New Zealand is to adjust (correct) only for pH and then compare with standardised guidelines to determine potential effects on aquatic life (Hickey 2015), this is consistent with US EPA methods and has been used in ANZECC (2000), ANZG (2018) and the NPS FM (2020). Thus, we do not have ecotoxicologically tested standards for the un-ionised fraction of the ammonia reported by the laboratory for the RNZ site and it is difficult to adequately determine the effects using this species of ammonia at this concentration.

ii. Whilst correcting for temperature and pH *may* give a more complete measure of the un-ionised ammonia in a sample, it does not necessarily reflect the ammonia toxicity at the time of sampling as not all toxicity comes from the un-ionised fraction and the proportion of ionised to un-ionised ammonia (and the toxicity) changes throughout the day at a site (ANZECC 2000). Furthermore, the measured stream temperature is not used by the laboratory in the correction, so the reported estimate of un-ionised ammonia may be different from what was occurring in the stream when the sample was collected. In my view this is not a reliable measure of potential toxic effects.

68. I have reviewed condition 25 (b) of consent 58383-2.2 to discharge paunch wastewater from the wetland treatment system. I find the condition, which reads: "*Discharges from the Wetland Treatment System shall not give rise to… (b) A level of un-ionised ammonia greater than 0.025 g/m*^{3}" is inadequate to manage the potentially toxic effects of ammonia on aquatic life and ecosystem health. This

consent standard is considerably out of date with more recent guidelines to manage ammonia toxicity (ANZECC 2000; ANZG 2018) and the national approach in the NPS FM. It is also unlikely to adequately manage effects such that condition 25 (g): "*Any significant adverse effects on aquatic life*" can be met or assessed with any confidence using the un-ionised ammonia standard alone. In other words, even when un-ionised ammonia concentrations do not exceed this standard, we cannot conclude that there is no significant adverse effect on aquatic life.

69. According to MfE (2018) guidance on the ammoniacal nitrogen attribute from the NPS FM (2017): "*setting limits and management actions to achieve ammonia freshwater objectives is likely to require limits on ammonia concentrations associated with point source discharges*." To ensure freshwater objectives (now known as attributes and including ammoniacal nitrogen and periphyton) were met (MfE 2018), council management actions to give effect to the previous NPS FM (2017) included the setting of discharge consent conditions.

70. Although the NPS FM (2020) has a slightly different structure within the National Objectives Framework (NOF) to previous versions, section 3.12(1)(c) anticipates councils may set consent conditions to achieve target attributes states. Target attribute states have yet to be set for Taranaki under the new Freshwater Plan Process.

71. Section 3.11 of the NPS FM (2020) describes the requirements for setting target attribute states. Section 3.11(2) requires that target attribute states must be set at or above the baseline state of that attribute.[15] The NPS FM (2020) defines the baseline state as follows:

> "*baseline state, in relation to an attribute, means the* <u>*best state out of the following*</u>*:*
> *(a) the state on the date it is first identified by a regional council*
> *(b) the state on the date on which a regional council set a freshwater objective for the attribute under the National Policy Statement for Freshwater Management 2014 (as amended in 2017)*
> *(c) the state on 7 September 2017*."
>
> [My emphasis added]

72. In the case of the wetland discharge, there are some challenges with applying this definition from the NPSFM. The ammonia attribute state of the upstream site for the

[15] As also identified by Mr Easton in his technical report (Appendix 1 section 3.0 4th paragraph).

last year of monitoring is currently in the A band (Table 1). However, there are some high values in the longer time-series dataset that appear to reflect other impacts (such as vermicomposting activities adjacent to the site). Looking at the annual data preceding the baseline state as at 1 September 2017 (as per point (c) of the NPS FM (2020) definition) the upstream site grades a C band. In any case, targets cannot be set below national bottom lines (B band), and so I have utilised the B band when recommending instream limits for ammonia toxicity for this discharge.

73. In my view, these NPS FM (2020) requirements are a relevant consideration for the consent application by RNZ, which results in a shift from the A to the D band as a result of the wetland discharge over the last year and currently exceeds national bottom lines as a result of the discharge.

Dissolved inorganic nitrogen – surface water monitoring

74. Dissolved inorganic nitrogen (DIN) is comprised of nitrate and nitrite nitrogen and ammoniacal nitrogen. Figure 3 shows the indicative[16] DIN concentrations for sites in the Haehanga Stream catchment. Again, the Y axis is skewed by extremely high ammoniacal nitrogen results from some sites and a zoomed view (Figure 4) allows a clearer between-site comparison. At most sites, the DIN is strongly driven by elevated ammonia concentrations and so the same pattern of increase as ammonia is apparent at sites from HHG000106 in the Haehanga mainstem and HHG000103 downstream of the wetland treatment discharge in the tributary through to the downstream sites. However, examination of the data shows that nitrate-nitrite nitrogen becomes more elevated and makes up a larger fraction of the DIN at sites HGH000115, HGH000150, HGH000160 and HGH000168 (Figure 5).

75. Dissolved reactive phosphorous (DRP) is also an important consideration when assessing the eutrophication potential of surface waters as both DIN and DRP contribute to growth and biomass of periphyton (algae)[17] and macrophytes (aquatic plants). High levels of algal and plant growth from nitrogen and phosphorous addition adversely affect ecosystem health and can reduce dissolved oxygen concentrations available to aquatic life. There is no DRP data collected for the Haehanga Stream sites. I would assume that DRP is naturally slightly elevated in the Haehanga stream, consistent with other catchments in soft-sedimentary or volcanic

[16] DIN concentrations are indicative only as nitrate and nitrate nitrogen was not measured at some sites (HHG000098, HHG000099, HHG000103, HHG000106, HHG000109, HHG000190). At these sites the DIN represents only the ammoniacal fraction of DIN and is an underestimate.
[17] Which has been recorded as abundant in TRC compliance biomonitoring reports.

geology. Ms Beecroft identifies a risk of phosphorous (and other contaminants) entering surface waters from RNZ operations and I share her view that phosphorous effects should be assessed and managed.

76. Matheson et al. (2012 and 2016) recommend national DIN and DRP limits to achieve 85% compliance with the NPS FM periphyton national bottom line (Table 2). Booker and Snelder (2012) examined nuisance macrophyte and DIN/DRP relationships associated with the total macrophyte cover outcome for Canterbury and Matheson et al. (2012) approximated DIN and DRP concentrations associated with low and high risk for nuisance macrophyte growth (Table 3). These publications provide good guidance on dissolved nutrient concentrations that cause a risk of nuisance periphyton or macrophyte growth. These thresholds are also useful as limits to achieve periphyton and macrophyte outcomes and are identified in MfE (2018) for implementing the periphyton attribute of the NPS FM.

77. Comparing the Table 2 and 3 nutrient criteria with measured DIN concentrations in the Haehanga Stream and tributaries (Figure 4) shows there is potential for nuisance periphyton and/or nuisance macrophyte growth to occur when flow conditions are suitable (i.e., low flows). The DIN concentrations in Figures 3 and 4 are very likely underestimates, given the lack of NNN samples at all sites.

78. Elevated DIN increases the likelihood of adverse effects on aquatic life and ecosystem health and is required to be managed by councils under section 3.13 of the NPS FM (2020) to achieve dissolved oxygen, macrophyte, fish, macroinvertebrate, and ecosystem metabolism attribute states for the compulsory ecosystem health value.

Table 2. DIN and DRP nutrient criteria for 85% compliance with the NPS FM periphyton biomass (chlorophyll *a*) attribute bands and associated periphyton weighted composite cover (WCC) classes. Concentrations which exceed these criteria carry a risk of nuisance periphyton growth when stream conditions are suitable (e.g., between high flows events). Sources Matheson et al. (2012 and 2016).

Periphyton biomass - Chlorophyll *a* mg/m^2	Periphyton cover % Weighted Composite Cover	DIN mg/L	DRP mg/L
50 (A band)	20	0.1	-
120 (B band)	43	0.63	0.011
200 (C band NBL)	55	1.1	0.018

Table 3. Nutrient concentrations suggested to constrain nuisance macrophyte growth. Concentrations which exceed these criteria carry a high risk of nuisance macrophyte growth. Sources: Booker and Snelder (2012) and Matheson et al. (2012).

Macrophyte growth	DIN mg/L	DRP mg/L
<50% macrophyte cover (Canterbury)	0.75	0.015
Low risk for nuisance macrophyte growth	0.1	0.01
High risk for nuisance macrophyte growth	>1.0	>0.1

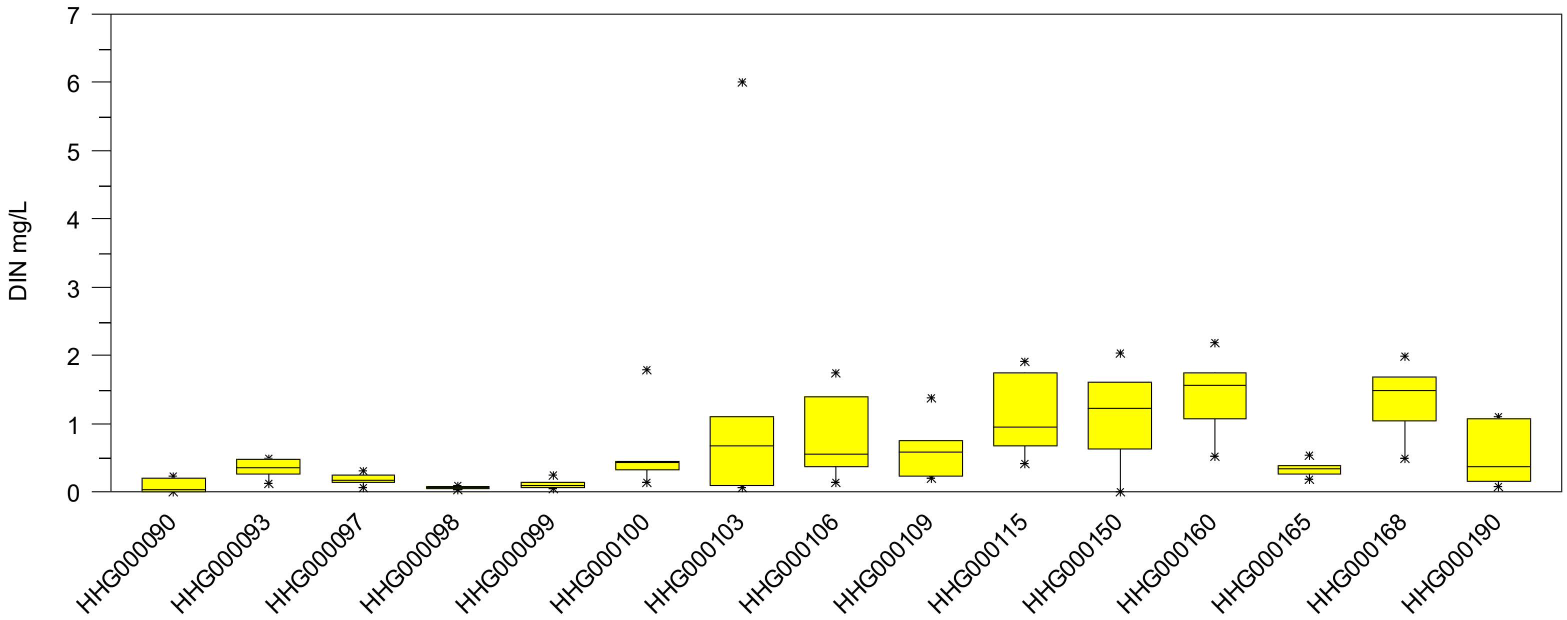

Figure 3. Dissolved inorganic nitrogen (DIN) for sites in the Haehanga Stream, Remediation NZ site, Uruti. Data provided by TRC for August 2019 – August 2020. Boxes encompass interquartile range, midpoint line = median, stars = min and max.

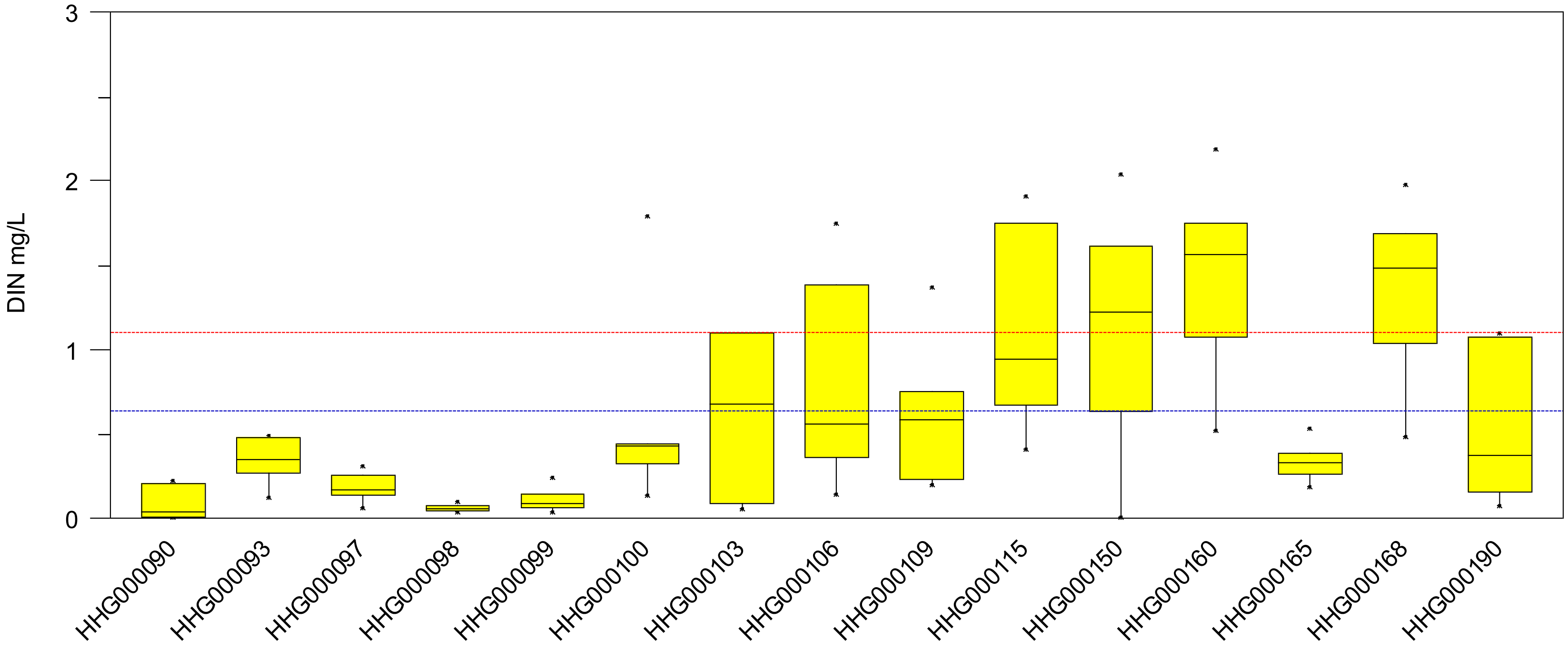

Figure 4. Dissolved inorganic nitrogen (DIN) for sites in the Haehanga Stream, Remediation NZ site, Uruti – Y axis zoomed view. Blue dotted line = nutrient criteria for B band periphyton, Red dotted line = Matheson et al. (2012 and 2016) DIN criteria for C band periphyton (National Bottom Line), median concentrations exceeding these thresholds carry a risk of nuisance growth. Data provided by TRC for August 2019 – August 2020.

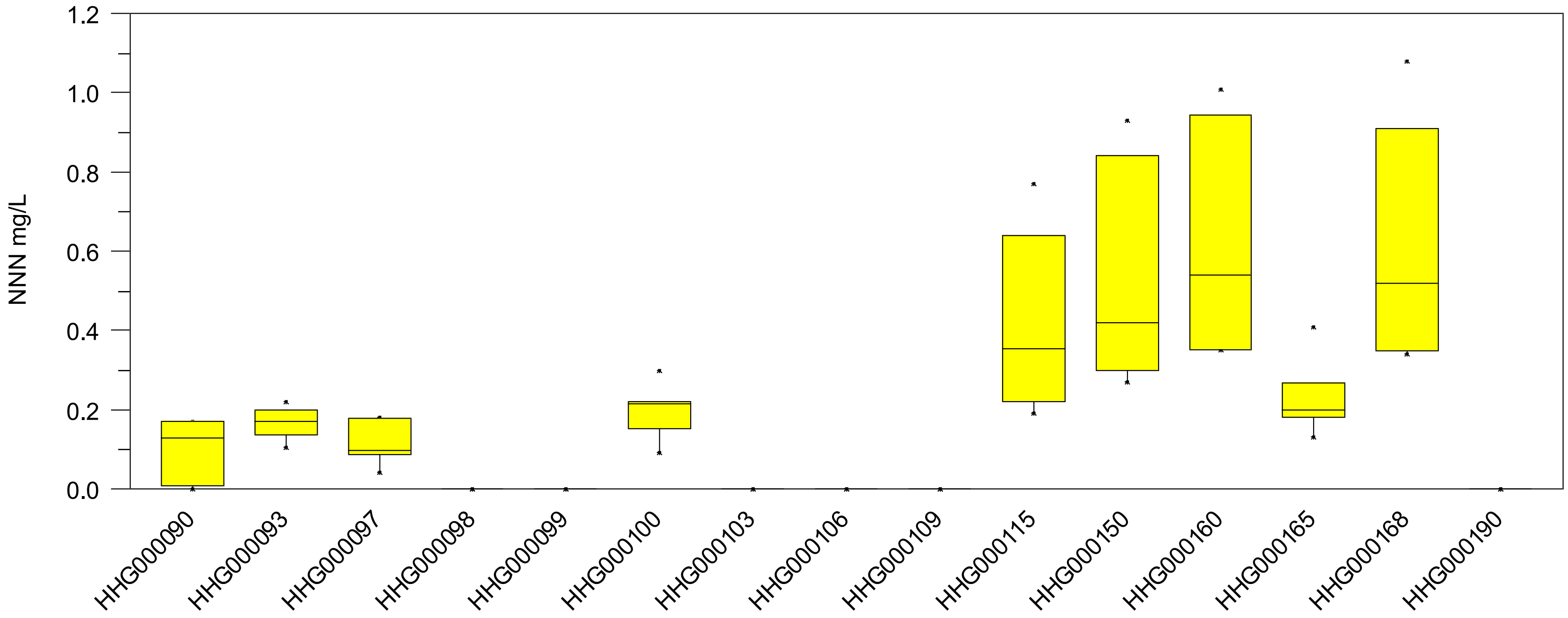

Figure 5. Nitrate-nitrite nitrogen (NNN) at sites in the Haehanga Stream catchment, Remediation NZ site, Uruti. Data provided by TRC for August 2019 – August 2020.

79. Should the consent be granted, I recommend the following instream nutrient limits apply to all surface waters within the RNZ site to ensure ammoniacal nitrogen does not exceed national bottom lines and there is no high risk of nuisance periphyton or macrophyte biomass and subsequent effects on ecosystem health:

  a. Annual median ammoniacal nitrogen (adjusted to pH 8) shall not exceed 0.24 mg/L, and

  b. Annual maximum ammoniacal nitrogen (adjusted to pH 8) shall not exceed 0.40 mg/L, and

  c. Annual median dissolved inorganic nitrogen (NNN + unadjusted total ammoniacal nitrogen) shall not exceed 0.5 mg/L.

Other contaminants – surface water monitoring

80. Chloride concentrations and conductivity, although not often exceeding levels identified as causing significant adverse effects in surface water (i.e., 150 g/m^3 chloride as per condition 11 of consent 5838-2.2), both increase significantly at sites between upstream and downstream of the Haehanga Stream catchment.

81. At times, very elevated *Escherichia coli (E. coli)* have been recorded at sites lower in the Haehanga catchment which significantly exceed standards for safe human contact with water. Stock on the site (particularly with unrestricted access to water) and the composting operation itself are both likely contributors to elevated microbial contaminants reaching surface water in the Haehanga Stream. Composting of animal waste such as carcasses, paunch and skins carries a high risk of microbial contamination of surface water if run-off and stormwater are not adequately controlled and appropriately treated. Downstream users are at risk of pathogenic infections such as *Campylobacter*, *Salmonella*, *Cryptosporidium*, *Giardia* or gastric viruses if levels of *E. coli* are high upstream.

82. The NPS FM has gradings for *E. coli* in Table 9 of Appendix 2, however not enough data has been collected to grade the Haehanga Stream sites. Table 22 of the NPS FM contains a national bottom line for *E. coli* which applies in rivers with primary contact sites, during the season of use (e.g., bathing season). The national bottom line is a 95^{th} percentile concentration of 540 *E. coli*/100ml, more samples are needed to calculate a certain 95^{th} percentile. However, at least three monitoring results show that the national bottom line was exceeded on occasions monitored in the last year at sites HHG000106, HHG000150 and HHG000190 at the bottom of the site and near the confluence with the Mimitangiatua River. The upstream control site HHG000090 was

in excellent to good condition for *E. coli* when compared with the NPS FM primary contact attribute.

83. It is important to note that although the NPS FM refers to a ‘bathing season’, primary contact between humans and surface water (including immersion and ingestion) can also occur in association with cultural practices and tangata whenua may not always utilise the river at times associated with swimming and recreation. Cautious management and appropriate monitoring are needed to protect human health when making contact with water for cultural practices (and recreation) at whatever time of year these uses occur.

Contaminants of concern – irrigation pond and treatment wetland discharge

84. Monitoring results for the irrigation pond show extremely elevated concentrations of ammoniacal nitrogen, total nitrogen, biochemical oxygen demand (BOD) and very high electrical conductivity (indicating the presence of multiple contaminants). The ‘duckpond’ (Photo 4) near the drilling wastes and irrigation pond also shows significant contamination by chloride, nitrogen (all forms including ammonia), BOD and electrical conductivity. Although only two samples have been collected in the last year, given these results it is likely the duck pond is hydrologically connected to the irrigation pond and drilling waste area through overland and/or subsurface flow.

85. The AEE proposes using the duckpond water as irrigation for the composting pads to assist with compost moisture levels. This carries a risk of elevated concentrations of contaminants being added to the compost piles with potential for them to also occur in any surface run off from the piles under heavy rainfall.

86. The treatment wetland discharge (from the paunch waste pads/pond) also shows highly elevated ammoniacal, nitrate and total nitrogen and this is clearly having a significant adverse effect on ammonia concentrations and macroinvertebrate health in the tributary stream which receives the discharge (site HHG000103). As above, ammonia in the treatment wetland discharge causes the tributary stream site to significantly exceed national bottom lines for ammonia toxicity.

87. Metals and BOD are not measured in the treatment wetland discharge, however there is high potential for these contaminants to also be present, among others. Metals and animal medicines are likely sourced from animal health supplements contained within boluses inside the paunch of killed animals e.g., zinc, copper, anthelmintics (drench) etc (Photo 3) and BOD is very likely to be high as the decomposition of organic waste (such as paunch) in water has a very high oxygen demand. It is unclear to what degree the constructed wetland treats the paunch waste as no inflow contaminant

concentrations have been measured to compare with the outflow discharge. Ms Beecroft also comments on this. During my site visit I recommended to TRC officers additional monitoring of inflowing paunch waste contaminant concentrations to identify whether this constructed wetland provides any appropriate treatment of the paunch waste. In any case, a demonstrably significant and sustained improvement would be needed to the treatment of paunch waste, if toxic effects are to be avoided in future.

SITE VISIT OBSERVATIONS

88. A significant storm front was affecting the Taranaki Region on the 18 November 2020. Heavy rain fell prior to and during the site visit. I observed significant overland flow occurring throughout the RNZ site and stormwater across the entire site appeared to be almost completely uncontrolled in all areas, with surface water drains potentially exposed to run off. The composting, paunch waste, truck wash and drilling waste areas were either not obviously lined or inadequately concreted (only in the case of the truck wash pad, no other pads are concreted or sealed in any way) and were not obviously bunded by impermeable materials to capture and divert any contaminants from entering overland flow and ultimately surface waters (Photos 1a and b).

89. When I observed the paunch waste area there was a significant volume of water surrounding piles of paunch waste comprising a large ‘pond’ (Photo 2). Significant amounts of free-floating plastic waste (oesophageal clips and animal supplement bolus capsules) were also evident within the paunch ‘pond’ (Photo 3). I understand from Ngāti Mutunga representatives that these clips have been found at the Mimitangiatua mouth and nearby coastline. I understand TRC compliance officers have investigated these reports and have found no evidence of oesophageal clips in the Haehanga Stream environment. However, the s42A report (at paragraph 131) lists other consented activities in the catchment, none of which have the potential to contaminate the river with oesophageal clip waste.

90. The ‘duckpond’ was very full at the time of the site visit (Photo 4) and is in close proximity to the leachate collecting in stormwater around the drilling wastes (Photo 5).

91. There was a significant amount of leachate pooling around the drilling waste pad (Photo 5) and the overflow pipe into the irrigation pond was not flowing (Photo 6). The irrigation ponds were not obviously lined[18] and were bunded only by permeable material (earth bunds). As a result, the potential for contamination of surface water, subsurface flow and groundwaters is very high in my opinion. There was a strong hydrocarbon odour detectable in the vicinity of the treatment ponds.

[18] No impermeable liners, common to wastewater treatment and irrigation ponds were visible.

92. I am informed by My Gibson, the General Manager that the ponds and pads are lined with 'papa' clay. Ms Beecroft raises concerns with respect to the efficacy of clay liners and as the use of papa as bunding material. I have no evidence of the degree of impermeability this papa provides, and I am concerned that this layer is permeable and likely to be breached, including during routine (monthly) mechanical desludging of the ponds. Water quality analysis suggests[19] that the leachate collection around the drilling waste and the irrigation ponds are quite permeable.

93. I have reviewed the Riparian Management Plan attached to the AEE as further information. I note there are reaches of stream identified as 'complete' on the attachment, although certainly not all the streams. I assessed the riparian condition of the streams near all the monitoring sites during my site visit (Photo 7) and make the following observations:

    a. Riparian planting across the site is very patchy or absent in many cases.

    b. Many areas planned for riparian management are incomplete.

    c. Some areas that are planted provide ineffective riparian buffers and add little habitat value or shading to the streams and there are large gaps between plants.

    d. Many plants are overtopped by grass and weeds and planting has not been maintained.

94. For riparian margins to be effective at providing quality instream habitat, a wide margin of vegetation is needed. For example, Parkyn et al. (2000) recommended a buffer width of 10 to 20 metres as the minimum necessary for the development of sustainable indigenous vegetation with minimal weed control, and to achieve many other positive aquatic functions. It is important to note here that riparian margins and buffers will not provide any protection from the sub-surface leaching of nitrogenous contaminants (including ammonia).

[19] See below with respect to 25 February 2021 monitoring results.

(a)

(b)

Photo 1 (a). Uncontrolled stormwater and overland flow in the vicinity of the composting pad and truck wash. **(b)** Composting pad (unlined and not bunded) showing significant and uncontrolled overland flow of stormwater. RNZ site, Uruti – 18 November 2020.


Photo 2. Paunch waste area, RNZ site Uruti – 18 November 2020.


Photo 3. Paunch waste 'pond' gross plastic waste, RNZ site, Uruti – 18 November 2020.

Photo 4. The ‘duckpond’, RNZ Uruti site – 18 November 2020.

Photo 5. Leachate collection around drilling waste (Pad 3) with ‘duckpond’ in the distance, RNZ site Uruti – 18 November 2020.

Photo 6. Irrigation pond with perched pipe inflow from drilling waste leachate collection area.

Photo 7 a-c. Riparian margins of the Haehanga Stream, RNZ site, Uruti – Kate McArthur, 18 November 2020.

RESPONSE TO THE TRC SECTION 42A REPORT

95. The s42A report, when discussing the wetland treatment system (at paragraph 38) states that the wetland treatment system receives leachate from the vermiculture process. I think it is more correct to say that the wetland treatment system receives waste from the paunch pond associated with Pad 2 as this is what is pumped up to the top of the wetland. I did not observe any leachate collection associated with vermiculture in the vicinity of the wetland treatment system during my site visit and the worm beds upstream of the discharge point were not in active use, despite large amounts of paunch waste present within the pond (Photo 2). I share Ms Beecroft's concerns that management of stormwater associated with the vermicomposting is unclear and I note that earlier monitoring (pre-2019) of site HHG000098, upstream of the wetland discharge, appears to be adversely affected by ammonia, the only source of which in this part of the catchment is the adjacent worm beds when they were in active use.

96. The s42A report also states (at paragraph 43 and referencing the AEE) that wetland areas were cleaned out and replanted in early 2019. While this may have had some benefit to the retention time and functioning of the treatment system, extremely elevated levels of ammonia have been measured since that time in the discharge from the treatment wetland (i.e., 14 August 2020 ammoniacal nitrogen of 6 mg/L, pH adjusted value of 3.09 mg/L).

97. The s42A report authors appear to agree with concerns held by Ms Beecroft and I that there is minimal treatment in the ponds that collect stormwater and leachate (at paragraph 236). The level of treatment appears to be largely comprised only of settling, with some skimming.

98. As stated above, the concentrations of ammoniacal nitrogen measured in the irrigation pond (Figure 8 of the s42A report) are extremely high. These concentrations (440 g/m^3 in the 2019/2020 monitoring period) are commensurate with a nitrogen heavy waste stream (e.g., tannery waste) and are at times two to four times higher than the treatment pond ammonia concentrations at the nearby Riverlands Eltham meatworks (TRC online compliance monitoring reports), which are traditionally high-nitrogen waste streams.

99. The s42A report (at paragraph 79) notes contamination of the groundwater bore adjacent to the duckpond (GND003009) (paragraph 223 records an ammonia

concentration in this bore of 24 g/m^3). My view of the likelihood of contamination of the duckpond is outlined above. I share the Council officer's concerns that this contamination could be reaching the Haehanga Stream via subsurface flows, given the close hydraulic connection between surface and shallow groundwater.[20]

100. I have reviewed the list of incidents in Table 9 of the s42A report that have occurred between 1 October 2020 and 31 January 2021. There has been a subsequent incident not included in the s42A report table on 10 February 2021. I have reviewed the laboratory report associated with water samples collected by TRC compliance officers responding to that recent incident (which as I understand it was a foamy change to the Haehanga Stream noted by a local resident and reported to TRC). Contaminants of note in the results for that sample show the presence of methylene blue substances (0.1 g/m^3) and BOD at twice the concentration (4 g/m^3) commonly applied to protect aquatic life from hypoxia or anoxia[21] of 2 g/m^3.

101. The latest monitoring also showed elevated contaminant concentrations at a number of stream sites. Ammonia (pH adjusted) at two sites (HHG000106 in the vicinity of the drilling waste pile and HHG000115 just downstream of the irrigation pond) exceeded national bottom lines (1.63 mg/L and 0.94 mg/L respectively). These results were collected after a period of fine weather of at least nine days and are therefore not associated with run-off or overland flow of contaminants. At the time of writing, I understand TRC compliance officers are actively investigating these results.

102. The s42A report identifies (at paragraph 168) *potential* effects on surface water. In my opinion, based on the most recent monitoring data for the Haehanga Stream and tributaries, exceedances of national bottom lines for ammonia and shifting the attribute state from an A band (upstream) to a D band (downstream) can be considered *actual* effects on water quality. The numeric attribute states for ammonia in the NPS FM are set to provide defined levels of species protection, when exceeded it should be considered that effects on the survival of sensitive species <u>are occurring</u> or have a high likelihood of occurrence. Measurement of these effects on individual species is difficult to prove absolutely (e.g., the absence of sensitive species from aquatic ecosystems due to avoidance or mortality) unless there is an obvious gross pollution incident resulting in wide-scale fish kills. Furthermore, the

[20] As indicated in BTW (2015) Haehanga catchment preliminary groundwater investigation.
[21] Hypoxia is low dissolved oxygen in water whereas anoxia is the absence of oxygen in water.

draft biomonitoring report (Clements 2021) shows a significant reduction in macroinvertebrate health downstream of the wetland treatment discharge, which is an actual and measured adverse effect.

103. Paragraph 173 of the s42A report discusses the sensitivity of fish to ammonia, however, in the aquatic ecosystems of Aotearoa New Zealand it is invertebrates which have the greatest sensitivity to ammonia. Fingernail clams (Sphaeriidae), freshwater shrimp, freshwater snails and the glochidia (juvenile phase) of freshwater mussels (kākahi) are most at risk of mortality from elevated ammonia (Richardson et al. 2001; Hickey 2015) at concentrations much lower than those which affect fish. Protection of these animals was considered when setting the species protection levels for ammonia in the NPS FM (2020).

104. Onsite measures to avoid, remedy or mitigate the effects of runoff or leaching of ammonia from the composting operation (including the irrigation fields and loads applied to them) are not working, as evidenced by the elevated ammonia concentrations (and conductivity and chloride) that are pervasive across most of the sites in recent monitoring data. As stated above, the paunch waste operation directly discharges elevated ammonia to the tributary stream and this in turn contributes to elevated ammonia in the Haehanga mainstem. Whether the elevated ammonia from the wetland treatment discharge is as the result of the paunch waste or 'plant die-back' is immaterial with respect to assessing the effects, as this is a constructed treatment system that is clearly not working (rather than discharge from a natural wetland).[22]

105. Paragraph 187 of the s42A report discusses the NPS FM and ammonia national bottom lines, noting that concentrations of ammonia in the receiving environment must 'at least meet national bottom lines by 2026'. I note that regardless of any community conversation to develop plans under the NPS FM (2020), target attribute states cannot be set below national bottom lines when applying the National Objectives Framework. Section 3.12(1)(c) of the NPS FM (2020) anticipates that one of the ways of achieving target attribute states and environmental outcomes is through imposing conditions on resource consents to achieve target attribute states (which must be above national bottom lines).

[22] As noted elsewhere in this evidence, no samples of inflowing waste into the wetland have been collected, so it is unknown whether or to what degree the treatment system actually improves the quality of the waste prior to discharge.

106. The s42A report (and TRC compliance biomonitoring reports) recommend riparian management of the streams to reduce temperatures and mitigate algal growth effects through shading, which will in turn improve habitat for indigenous fish and invertebrates. While this intent is supported, I comment (above) that it is unlikely that riparian management alone will improve ecosystem health whilst contaminant concentrations remain at levels that cause significant adverse effects on water quality. Riparian management was a condition of the previous consent (2010) and has yet to be effectively completed.

107. I disagree with the Council Officers statement (at paragraph 320) that un-ionised ammonia is the most appropriate parameter to assess the treatment capability of the wetland treatment system for the reasons noted above. In my opinion a more appropriate parameter and threshold for ammonia, to manage the adverse effects of the wetland discharge, is the ammonia toxicity attribute and national bottom line from the NPS FM (2020).

108. I also disagree with the assertion (in paragraph 325) that if the wetland treatment discharge were having significant effects this would be identified in the macroinvertebrate monitoring results for site T3. Organisms that are most sensitive to ammonia toxicity are fingernail clams and freshwater mussel juveniles (glochidia). Neither of these animals are likely to be found in traditional macroinvertebrate sampling as they are exceedingly small and difficult to identify. Thus, biomonitoring results from site T3 alone cannot be used to claim there is no significant toxic effect of ammonia in the tributary or the Haehanga mainstem.

109. Notwithstanding this, the draft biomonitoring compliance report for 2021 (Clements 2021) identified: "*Site T2* [upstream control] *in the unnamed tributary recorded an MCI score indicating 'good' macroinvertebrate health and was significantly higher than T3* [downstream impact] *below the wetland discharge*." … "*SQMCI in the unnamed tributary dropped significantly below the wetland discharge*."

110. Clements (2021) also noted: "*MCI declines significantly downstream of consented activities such as the wetland treatment system discharge as well as the irrigation areas. Additionally, affected sites (T3, 2, 5, 6, and 7) exhibit lower macroinvertebrate community health scores than what was recorded at a reference site in a similar catchment in the area: significantly lower at the two most downstream sites (6 and 7). <u>This suggests that the wetland treatment system discharge, storm water run-off, or potential leachate run off / through flow from the irrigation areas into</u>*

<u>the Haehanga stream are likely contributing to the decline in macroinvertebrate health</u>." [My emphasis added]

111. I fundamentally disagree with the s42A officers' findings (paragraph 420) that s107 effects will not arise. In my opinion, organic enrichment, and the concentrations of ammonia in the discharges, both from the wetland treatment system and to land via irrigation (and likely as leachate from the ponds, vermicomposting, and pads) are having significant adverse effects on aquatic life throughout the Haehanga Stream[23] and there is also a high potential for toxic effects to be occurring that are not measured through standard biomonitoring protocols.

112. Further, I question paragraph 374 of the s42A report that states: "*However recognising that the health and wellbeing of water is the top priority, at the very least any adverse effects on the water and aquatic ecosystems <u>must not be significant and must be reversible</u>*" [my emphasis added]. When considering the health and well-being of waterbodies and freshwater ecosystems as the first priority under Te Mana o te Wai, the NPS FM (2020) does not contain any qualifiers about significance of adverse effects (which is a s107 matter in respect of discharges) or the reversibility of effects.

Mimitangiatua River

113. The Mimitangiatua River is identified in Appendix 1A of the Regional Freshwater Plan for Taranaki as a catchment with high natural, ecological, and amenity values and is of considerable significance to Ngāti Mutunga as recognised in their Statutory Acknowledgement. There is little information to determine whether and to what degree the RNZ activities are having an adverse effect on water quality and aquatic life in the Mimitangiatua River. The applicant has presented only one monitoring result for the Mimitangiatua River upstream and downstream of the Haehanga Stream confluence (Appendix W and discussed in section 4.6 of the AEE), collected on 2 May 2018. There are no corresponding samples of the Haehanga Stream on that date. Although this one sampling observation does not raise any significant concerns with respect to water quality, there is certainly not enough information to determine there is no effect or to support such statements in the AEE or Applicant's evidence.

[23] As noted above in my review of the biomonitoring results, the wetland treatment discharge has a measurable and ecologically meaningful adverse effect on macroinvertebrate health in the Haehanga Stream tributary (a reduction of 25% in SQMCI between upstream and downstream sites) which represents a significant adverse effect on aquatic life and thereby ecosystem health.

114. I disagree with the s42A report (paragraph 390) which implies that because consent conditions are being met at the site boundary, this means there is no effect on the Mimitangiatua River. As I have stated above, in my opinion the current and proposed consent conditions (for un-ionised ammonia) are inadequate to manage the adverse effects on aquatic life, there are significant adverse effects on aquatic life and water quality currently occurring and these effects are likely to continue unless major interventions are initiated. Furthermore, there is a single observation associated with an incident involving shellfish mortality which suggest there is a measurable effect, at least on that one occasion (3 July 2020).

115. Additional sampling was undertaken by TRC on the 3 July 2020 in response to dead kākahi (freshwater mussels) found at the Mimitangiatua River by a local resident. These incident results show the concentrations of ammoniacal nitrogen, conductivity, and sodium between upstream and 1.2 km downstream of the point where the Haehanga Stream enters the Mimitangiatua River and this can be compared with water quality in the Haehanga Stream samples taken at the same time (Table 4).

116. There is a measurable increase in ammoniacal nitrogen between the upstream and downstream Mimitangiatua River sites, although both samples are within the B band of the NPS FM (2020). The ammoniacal nitrogen value at the downstream Haehanga site exceeds national bottom lines. Given the chronically elevated concentrations of ammonia and DIN, it can be concluded that the Haehanga Stream contributes nutrients (and possibly other contaminants) to the Mimitangiatua River. The degree to which this affects enrichment of the Mimitangiatua River is not known with any certainty at this time.

Table 4. Results from incident monitoring of the Mimitangiatua River and Haehanga Stream 3 July 2020. Data collected by TRC compliance officers.

Parameter	Upstream site (UI544)	Incident site (UI533) 1.2 km downstream of Haehanga confluence	Haehanga Stream (UI427) compliance monitoring site HHG000190
Conductivity (µS/cm)	111	118	272
Total sodium (g/m^3)	9.4	9.6	16.5
Total ammoniacal-N	0.043	0.073	1.12

117. With respect to nitrate toxicity limits proposed by Council officers to apply from 1 June 2026 in condition 19(b) I do not agree that these limits are adequate to protect ecosystem health from the effects of nitrogen enrichment. Section 3.13 of the NPS FM (2020) describes the required approach by Councils to set appropriate instream concentrations and exceedance criteria for DIN (and DRP) and these must also be set with consideration of sensitive downstream receiving environments i.e., the Mimitangiatua River.

118. Setting limits in the consent for nitrate toxicity does not meet the section 3.13 NPS FM (2020) requirements as this will not protect the Haehanga Stream and sensitive downstream receiving environments from nutrient enrichment effects on periphyton, dissolved oxygen, fish, macroinvertebrates, and ecosystem metabolism. The nitrate limits for toxicity to aquatic life are set at significantly higher concentrations than the thresholds at which the risk of effects on these other attributes occurs.[24]

119. I have recommended a more stringent limit for DIN (which includes both nitrate and ammoniacal nitrogen) that will ensure there is a lower risk of adverse effects on ecosystem health and that other national bottom lines for periphyton, fish, dissolved oxygen and macroinvertebrates will not be exceeded.

[24]https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/FS30A%20Managing%20nitrogen%20factsheet%20final.pdf

RESPONSE TO THE APPLICANT'S EVIDENCE

Hayden Easton

120. I have not seen any evidence that RNZ obtained water quality advice on meeting the NPS FM 2014 and 2017 version at the time they were released. The only surface water quality analysis I have seen produced by RNZ is Mr Easton's evidence. I note that Mr Easton undertook his site visit on the 4th of February, after a period of dry weather (TRC rainfall data for Uruti at Kaka Road).

121. Mr Easton recommends a pond permeability assessment is undertaken, and I agree with him that this is necessary, particularly given the incident monitoring results from 25 February 2021 noted above. Mr Easton notes if permeability is greater than 1×10^{-9} m/s a "new" liner should be installed. It is my understanding that there is currently no pond liner in place.

122. I maintain my view that stormwater is not well-controlled at the site, based on my observations during my site visit under heavy rainfall. Whilst sheet flow may be generally directed towards the ponds, there are no clear gradients, interception or diversion channels or devices in place to ensure this is the case. From my observations under sustained rainfall, stormwater flows preferentially into the wheel tracks formed by the movements of heavy machinery and runs downgradient along those wheel tracks wherever they lead (rather than being directed as sheet flow to the ponds).[25]

123. Furthermore, I could not see any stormwater interventions associated with capturing and diverting leachate from the vermicomposting operation to a treatment system. Ms Beecroft shares my concerns on this matter in her evidence and provides comment on the adequacy of the analysis of stormwater management provided by RNZ.

124. Mr Easton and I largely agree[26] on the degree to which total ammoniacal nitrogen (which he calls TAN) exceeds national bottom lines from the NPS FM (2020) in the Haehanga Stream. At his paragraph 5.7 he correctly notes that the NPS FM

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[25] Mr Easton states (at his paragraph 4.10) that to implement diversion channels would limit the movement of vehicles. It is my experience that sites with heavy machinery movements are still able to control and manage stormwater effectively whilst maintaining operations if they are appropriately designed and maintained.

[26] Noting that there are some differences in the time-series data analysed and the methods used for pH adjustment of ammonia between us.

‘guidelines’[27] (national bottom lines) are significantly lower (more stringent) in the 2020 version than in previous versions of the NPS FM (2014 and 2017 which both had the same bottom lines for ammonia toxicity). However, it is important to note:

a. Site HHG000103 downstream of the wetland treatment discharge exceeded the earlier national bottom line (graded as a D band in the last year of monitoring) as well as the current one within the data for the last year of monitoring.

b. Recent monitoring results (25 February incident described above) exceed the former median bottom line (D band), showing ammoniacal nitrogen is still a current and significant issue in the Haehanga Stream.

c. The national bottom lines were made more stringent as it was acknowledged that the former C band threshold did not adequately protect sensitive aquatic life (freshwater mussel juveniles and fingernail clams) from the acute effects of ammonia toxicity.

125. I disagree with Mr Easton’s analysis of the s42A report conclusions from assessing the ammonia toxicity data. In my view it <u>is</u> correct to assess the data against the current NPS FM (2020) as that is the only currently operative national policy statement. Analysing historic datasets against current thresholds is an appropriate way to assess the effects (the NPS FM requires this in many cases for other attributes). Furthermore, the degree of effect and the attribute band descriptions have not changed. In other words, aquatic life has not suddenly become more sensitive as a result of changing the national bottom lines. I note however that Mr Easton goes on to use the NPS FM (2020) national bottom line in his assessment at Table 1 of the appended PDP technical report.

126. By looking only at the most downstream site (HHG000190) when determining that the national bottom lines are not exceeded (from the previous NPS FM (2014 and 2017)), Mr Easton[28] ignores the fact that site HHG000103 would still exceed national bottom lines as a result of the discharge of the wetland treatment system, regardless of which version of the NPS FM is used.

127. Mr Easton analyses the full record of pH adjusted ammonia (TAN) for all sites in Table 1 of the PDP technical report appended to his evidence. I note Mr Easton’s

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[27] To be clear these are not ‘guidelines’ but attribute states with national bottom lines.
[28] Paragraph 7.7 of the evidence of Hayden Easton.

adjustment calculation (using ANZECC 2000 and ANZG 2018) is not the same as that used by myself and the s42A authors which comes from MfE (2018), whereby every observation of ammoniacal nitrogen is pH adjusted before determining the median and maximum statistics to compare with the NPS FM (2020) attribute states. I have tested the data using both methods and whilst this results in some differences between us they are minor, and do not result in any change to the grading of the attributes states (i.e., A through D bands).

128. Mr Easton's Table 1 shows the tributary site upstream of the wetland discharge (HHG000098) has exceeded the ammonia national bottom line for annual maximum when compared with the NPS FM (2020) and using the full time-series dataset. I note there are some high values within the longer time-series dataset, and I assume these to be as a result of leachate from the adjacent worm bed (which I observed has not been operating recently and does not appear to affect the more recent results which grade the upstream site as band A). This site grades a C band using the baseline state for the annual statistics (median and maximum) as at 1 September 2017 (as per the NPS FM (2020) definition of baseline state).

129. In the PDP technical report appended to Mr Easton's evidence (section 4.0) Mr Easton asserts that the treatment of water from the paunch waste via a wetland is appropriate. I do not consider this assessment can be made without inflow concentration data for ammonia (and other contaminants) for the paunch waste. Without such data the treatment method and efficacy in order to achieve instream limits after discharge is not known. Mr Easton does however acknowledge[29] that improvements to water quality resulting from undertaking his recommendations for the treatment systems cannot be quantified at this point and that further measures may be needed in future once monitoring confirms the degree of improvement in treatment. Thus, whether the proposed upgrades to the treatment systems in his evidence will result in bottom lines being exceeded in the future remains uncertain.

130. At his paragraph 8.4, Mr Easton recommends a total petroleum hydrocarbon limit for condition 18(c) of 15 g/m^3 from the Environmental Guidelines for Water Discharges from Petroleum Industry Sites in New Zealand (MfE 1998). In my view this limit is not an appropriate limit to manage the effects of RNZ's operations for the following reasons:

[29] PDP technical report section 4.0 4th paragraph, page 8.

a. The RNZ operation is not a petroleum industry site. The relevant types of sites identified in the guidelines (MfE 1998) are service stations, truck stops, terminals and depots, and lubricating oil blending and grease manufacturing plants. The MfE (1998) guidelines are designed to manage leaks and spills from these sites that may result in discharges to water, not hydrocarbon discharges of a more chronic and diffuse nature.

b. The MfE (1998) guidelines are significantly outdated, preceding even the (now obsolete) ANZECC (2000) guidelines and ANZG (2018) and thus omit a significant body of ecotoxicological testing, research, and guideline development for a wide range of toxicants since that time.

c. The guidelines were developed prior to national policy direction on freshwater ecosystems and water quality (under various versions of the NPS FM).

131. Should consent be granted I would support proposed condition 18(c) as worded in the s42A Officer's Report, with the consent limit being '*the presence of total recoverable hydrocarbons*' as this appropriately protective of aquatic life in the Haehanga Stream and downstream receiving environments from the effects of toxicants.

132. An alternative approach with numeric limits is to use the species protection thresholds from ANZG (2018). ANZG (2018) contains individual toxicant default guideline values (DGVs) for a range of categories of hydrocarbons (e.g., aromatic hydrocarbons and poly-cyclic aromatic hydrocarbons) and the various types of toxicants in each category (e.g., Benzene Toluene, Napthalene). Each DGV contains guideline thresholds for various species protection levels: 99%, 95%, 90%, and 80% species protection, depending on the sensitivity of the receiving environment and the aquatic life within it. Should consent be granted and a more numeric approach be preferred by the panel, the 95% species protection threshold for toxicants, metals, and metalloids (excluding ammonia and nitrate toxicity) from the ANZG (2018) could be set as a consent limit, consistent with the same NPS FM (2020) attribute state and species protection level for ammonia and nitrate toxicity limits. Applying the ANZG (2018) species protection levels for toxicants will require testing of multiple toxicants associated with hydrocarbons to establish compliance and this may carry significant laboratory costs.

Kathryn Hooper

133. Ms Hooper notes at paragraph 37 that there are other activities (particularly forestry) occurring in the Mimitangiatua River upstream of the Haehanga Stream confluence. She then goes on the make a statement about 'overall water quality' in the catchment. As there is very little monitoring data available for the Mimitangiatua, such statements cannot be verified, including those made at paragraph 110 in relation to the degraded nature of the Mimitangiatua River. I agree with Ms Hooper that the Haehanga Stream is certainly degraded, however, I do not hold the same degree of confidence that the Applicant's management of the stream will not exacerbate concerns further downstream, given the concentrations of nutrients exported from the stream into the river and the lack of any monitoring results for the Mimitangiatua that conclusively show no effect.

134. Ms Hooper (at paragraph 46 (a)) notes that Mr Easton concludes that '*the treatment ponds and wetlands are holding water, and groundwater contamination from these sources is likely to be negligible'*. I can find no such conclusion in Mr Easton's evidence. At paragraph 47 statements referring to Mr Easton's conclusions about '*pond integrity*' are inconsistent with Mr Easton's recommendation that permeability testing be undertaken. I disagree with Ms Hooper that it is unlikely that the ponds are a pathway for contaminants to enter water. As stated above, recent monitoring results from 25 February 2021 support these concerns.

135. I disagree with Ms Hooper (at her paragraph 50) that the NPS FM anticipates a period of transition with respect to ammonia bottom lines (for point source discharges). I understand Ms Ongley will address this matter further. I consider it important to note that ammonia bottom lines are for *toxicity.*

136. Whilst I agree with Ms Hooper at her paragraph 113 that riparian planting, stock exclusion and afforestation contribute to enhancing the well-being of the Haehanga Stream, as I have identified above, physical habitat is only one component of ecosystem health which requires consideration, water quality and aquatic life (both of which are degraded by RNZ activities) are also critical components of the health and well-being of freshwater ecosystems.

137. I also disagree with Ms Hooper (at paragraph 161) that forested areas of land on the site can be considered an 'offset', at least from a water quality perspective.

Offsetting requires careful quantification and accounting of values, losses and gains[30] and should comply with the principles of offsetting. I have seen no such quantifiable evidence that would constitute a reliable or certain 'offset', at least of water quality or aquatic biodiversity.

138. I have addressed the proposed consent conditions appended to Ms Hooper's evidence (in particular condition 18) above.

Kathryn Jane McArthur

16 March 2021

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[30] https://www.lgnz.co.nz/assets/Uploads/7215efb76d/Biodiversity-offsetting-under-the-resource-management-act-full-document-....pdf In the NPS-FM (2020) "Aquatic offset" means:
"*a measurable conservation outcome resulting from actions that are intended to:*

(a) redress any more than minor residual adverse effects on a wetland or river after all appropriate avoidance, minimisation, and remediation, measures have been sequentially applied; and

(b) *achieve no net loss, and preferably a net gain, in the extent and values of the wetland or river, where:*
(i) ***no net loss*** *means that the measurable positive effects of actions match any loss of extent or values over space and time, taking into account the type and location of the wetland or river; and*
(ii) ***net gain*** *means that the measurable positive effects of actions exceed the point of no net loss*"

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