Before the Hearings Panel
At Wellington

Under	the Resource Management Act 1991
In the matter of	an application for resource consent to discharge contaminants to land, air and water associated with the proposed long term upgrade and operation of the Featherston Wastewater Treatment Plan
Applicant	**South Wairarapa District Council**

Statement of evidence in response by Jack Feltham on behalf of Greater Wellington Regional Council (nutrient loss)

Date: 10 May 2019

INTRODUCTION

1. My full name is Jack Aaron Feltham. I am a Senior Environmental Engineer in the Auckland office of Pattle Delamore Partners Ltd.

2. My evidence in response is given on behalf of Greater Wellington Regional Council (GWRC) in relation to the resource consent applications from South Wairarapa District Council (Applicant) for a suite of consents corresponding with the activities and discharges associated with the receipt, treatment, storage, surface water discharge, land application and general management of wastewater received at the Featherston wastewater treatment plant (WWTP) (the "Application"). In particular, my evidence in response relates to the land treatment nutrient loss assessment for wastewater irrigated to land under the proposed land discharge consent.

Qualifications and Experience

3. I hold the following relevant qualifications:

    i. Bachelor of Civil and Environmental Engineering (Hons) from Auckland University.

    ii. Advanced Level Certificate in Sustainable Nutrient Management in New Zealand Agriculture from Massey University.

4. I am a member of Engineering New Zealand and a collaborative member of the New Zealand Land Treatment Collective, and have presented papers on land treatment at both New Zealand Land Treatment Collective and Water New Zealand conferences:

5. In the course of my work, I have obtained experience in the treatment and disposal of industrial and municipal wastewaters, in particular in land treatment of wastewaters and associate solid waste streams. Wastewater treatment and land treatment assessments that I have been involved in include: Review of Foxton WWTP Resource Consent Application and subsequent supporting documents and assisting in preparation of evidence by others (Robert Docherty) on behalf of Horizons Regional Council, The Tatua Co-Operative Dairy Company wastewater irrigation, Wallace Corporation wastewater irrigation, Omaha treated sewage irrigation, Taupo treated sewage irrigation, and alternatives assessments for irrigation of treated wastewater to land for Wellsford, Warkworth, and Waiuku, as well as providing specialist technical review of numerous onsite wastewater applications for Auckland Council.

My role

6. I was involved in review of Applicant's Application documents and its Appendices on behalf of Greater Wellington Regional Council.

7. I was involved in Section 92 information and clarification requests and reviewing responses provided by the Applicant.

8. I was involved in technical discussions with Applicant technical experts, including Ms. Katie Beecroft (LEI), Mr. Chris Simpson (GWS) as well as PDP technical experts Mr. Aslan Perwick and Mr. Robert Docherty (Mr. Robert Docherty is not presenting evidence as he is unavailable to attend this Hearing, although he has been involved throughout this project as the Technical Director for PDP). Technical discussion occurred on 24 January 2018, and 25 September 2018.

9. I participated in conferencing with Ms Katie Beecroft (LEI), Mr Chris Simpson (GWS), Mr Robert Docherty (PDP), Mr Aslan Perwick (PDP), and Mr Daryl Irvine (PDP) on 18 December 2018 and signed a Joint Witness Statement (Land Treatment and Groundwater JWS) dated 20 December 2018.

10. I co-authored the Section 42A Appendix 8 Report (FWWTP RC Review Report) dated 27 February 2019 (S42A Appendix 8). This report was attached as Attachment 8 to GWRC's Section 42A Officers Report. I reaffirm the contents and conclusions of the FWWTP RC Review Report, subject to the matters noted below.

11. In preparing my evidence in response I have:

    i. Read the evidence of Ms. Katie Beecroft, Mr Chris Simpson, Ms. Emma Hammond, and the proposed conditions from Mr Sven Exeter, for the Applicant;

    ii. Read the evidence in response of Mr Aslan Perwick (PDP), Mr Daryl Irvine (PDP) and Dr Olivier Ausseil for GWRC.

Code of conduct

12. I have read and agree to comply with Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014. My qualifications as an expert are set out above. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions that I express, and that except where I state that I am relying on the evidence of another person, this evidence is within my area of expertise.

Scope of evidence

13. My evidence in response addresses the following matters:
    i. A summary of my evidence in response;
    ii. An overview of key points from Land Treatment and Groundwater JWS;
    iii. An overview of key points from the Section 42A report that relate to my area of expertise;
    iv. Response to issues raised in the Applicant's evidence (Response to the Applicant's evidence);
    v. Draft conditions and proposed mitigation (Conditions/Mitigation); and
    vi. Conclusions.

SUMMARY

14. Overall, I am satisfied that the proposed activity, carried out under the irrigation regime described in the Application documents and Applicant expert evidence (Ms. Katie Beecroft) will result in decreased nutrient loss from land areas, given adequate controls are in place through Consent Conditions.

15. I consider that the site information on shallow soils is suitable for the purposes of assessing the land treatment, specifically nutrient removal, achieved through the proposed irrigation of treated wastewater to land operated as an agricultural activity, either as grazed pasture for dry stock or as a cut and carry system. Assessing the adequacy of deeper soil and geology information is outside my area of expertise and I will rely on Mr. Aslan Perwick's evidence in response to address this.

16. I consider the use of Overseer® Nutrient Budget software (Overseer®) as outlined by Ms. Katie Beecroft to estimate the change in nutrient loss under the proposed activity compared with the prior irrigated dairy grazed pasture land use to be appropriate. I consider the conclusions drawn from assessments utilising Overseer® to be appropriate and technically sound, as discussed further in Cl. 18 of my evidence.

17. To clarify my view expressed in Cl 16, there have been discussions within New Zealand around the limitations of using Overseer® in the assessment of effects for regulatory purposes, most recently in the Parliamentary Commissioner for the Environment 2018 report "Overseer and regulatory

oversight" [1]. This document discusses limitations of Overseer, including the uncertainty of the model's estimated nutrient leaching results, but also acknowledges there are limited alternatives for modelling nutrient movement and loss from agricultural soils. Ms Katie Beecroft has utilised Overseer® to assess the nutrient loss from prior land use activities and under the proposed activity in order to assess the relative change in nutrient loss, and has concluded that the proposed activity will result in reduced nutrient loss to the environment. I consider this an appropriate use of Overseer for assessing the effects of nutrient loss under a land treatment system.

18. Overseer® modelling assessments carried out by the Applicant's expert Ms Katie Beecroft have shown estimated nitrogen loss to reduce from 63 kgN/ha/yr under the previous irrigated dairy farm operation, to 43 kgN/ha/yr under the proposed activity operated as a grazed dry stock system, or 21 kgN/ha/yr under the proposed activity operated as a cut and carry system. I consider these outputs to be reasonable based on the following points:

    i. Review of the inputs in Applicant's Overseer® modelling, which were considered representative of the proposed wastewater irrigation activity, and considered reasonable where assumptions around agricultural inputs were made.

    ii. Assessed nutrient loading from the treated wastewater irrigation is less than the nutrient requirements of the grazed dry stock or cut and carry operation. Fertiliser is proposed to be applied to meet this shortfall. This indicates that as long as hydraulic loading is managed as discussed in Cl 18.v & vi, nitrogen loss will be in line other typical irrigated grazed dry stock systems or cut and carry systems.

    iii. The assessed decrease in nitrogen loss is considered reasonable for the proposed activity if operated under best farming practice. Grazed dry stock systems generally have lower nitrogen loss than dairy operations due to a lower land use intensity and nutrient inputs, while cut and carry systems have lower nitrogen loss as urine patches and the associated elevated nitrogen leaching are avoided.

    iv. Although nutrient loading proposed is lower than nutrient requirements of the proposed land use activities, it is noted that

[1] Parliamentary Commissioner for the Environment (2018). *Overseer and regulatory oversight: Models, uncertainty and cleaning up our waterways.* https://www.pce.parliament.nz/publications . 12 December 2018.

the hydraulic loading of irrigation (even “freshwater” irrigation which is not proposed here) can promote nutrient loss through increased drainage and “flushing” of nitrogen from soil, as well as the risk of phosphorus runoff. However, the proposed irrigation regime seeks to limit the potential for increased nutrient loss due to hydraulic loading.

v. The proposed irrigation regime limits the depth of irrigation above soil field capacity (as discussed in Ms. Katie Beecroft’s evidence), and this will reduce the occurrence of bypass drainage around the active soil layer in which nutrient uptake and other removal processes occur.

vi. In order to achieve this, the proposed irrigation regime includes deferred irrigation (as discussed in Ms. Katie Beecroft’s evidence), limiting discharge during wetter winter periods through storage and or surface water discharge. Irrigation during wetter periods promotes nitrogen leaching to groundwater, as well as the potential for runoff.

vii. The proposed irrigation regime excludes irrigation where groundwater level is within 0.6 m of the ground surface (Ms. Katie Beecroft’s evidence Cl. 42.b.ii.). This is considered appropriate, as the top 600 mm is the soil depth across which soil moisture and nutrient uptake is assessed to occur within the Overseer® modelling software. Groundwater depths shallower than this will reduce the soil profile across which nutrient uptake and other processes can occur, limiting nitrogen uptake and promoting nitrogen leaching above the rates assessed by the Applicant.

viii. The Overseer® modelling assumes best practice farming operations. The proposed irrigation regime, if achievable, is considered reasonable for modelling within Overseer®, given that irrigation above soil deficit is limited, and that irrigation during wetter periods is limited through storage and surface water discharge, making the proposed irrigation in line with goals of best farming practice.

ix. I have assumed that the nutrient loss assessment undertaken by Ms. Katie Beecroft for the proposed activity has been based on the best practice of the land use activity. The actual nutrient inputs for the land use activity will impact the nutrient loss from the site. I consider that suitable nutrient input and best practice can be promoted through Consent Conditions, namely nutrient loading

limits and reporting requirements, as discussed in Cl. 41. I also note that the management of the irrigation system specifically hydraulic loading and the on-farm management must be undertaken in line with the management outlined in the AEE and Ms. Katie Beecroft's evidence to ensure the nutrient leaching remains as modelled. I note that in his evidence (Cl. 68 to 70) Mr. Daryl Irvine has outlined some concerns with the proposed consent conditions controlling irrigation, identifying that they don't currently align with Ms. Katie Beecroft's evidence, and that they need to. I have relied on Mr. Daryl Irvine's assessment of conditions to address these concerns and I support his recommendations that the consent conditions need to align with the controls outlined in Ms. Katie Beecroft's evidence.

19. I note that the assessment of effects for surface water were based on earlier assessments of nitrogen loss, which have not been updated. However, these assessments were slightly more conservative (i.e. they assessed a higher nitrogen loss) and therefore I consider the assessed nitrogen leaching contribution on the receiving surface water environment assessed in the evidence of others (namely, Ms. Emma Hammond) based on these earlier assessments to be appropriate.

20. Phosphorus loss from land treatment systems is generally the result of elevated soil Olsen P levels, and application of phosphorus during wetter winter periods when the potential for runoff of phosphorus is elevated. Pugging of soils by stock also promotes runoff and phosphorus loss through runoff. I consider the potential for increased phosphorus loss under the proposed activity to be low, for the following reasons:

    i. The proposed irrigation scheme aims to limit the potential for runoff through soil moisture controls and storage over wetter periods.

    ii. The proposed application of wastewater phosphorus loads is low, and the majority of phosphorus loading is from fertilizer sources. Therefore, as long as there is adequate monitoring of soil nutrient levels, the application of phosphorus fertiliser can be reduced where soil Olsen P levels rise higher than pasture requirements and where risk of soil phosphorus runoff is increased, in line with best framing practice.

    iii. The removal of stock under a cut and carry system would also avoid pugging and the potential phosphorus runoff risk this presents. It noted that this mitigation will only occur if cut and

carry land use is undertaken, and note that dry stock grassing has also been considered and assessed.

21. Note that my assessment is based on the data presented in the original AEE document (dated 28 February 2017) and subsequent Section 92 documents (dated 2 June 2017, 24 July 2017 and 20 October 2017). My assessment of land treatment as discussed above is based on assumption that the proposed irrigation regime is achievable, as outlined in the Application documentation, Ms. Katie Beecroft's expert evidence, and as carried through into Overseer® modelling inputs and the assessment of nutrient loss. However, I note that potential limitations to achieving the proposed irrigation scheme are outlined in Mr Daryl Irvine's evidence.

22. Whilst I agree with Ms Katie Beecroft's statement in Cl. 130 of her evidence that nutrient loss and particularly Overseer® modelling estimates of nutrient loss are based on long term average conditions, and do not consider year to year climate variation, I consider that any assessed ongoing increase in the hydraulic loading of a particular irrigation area or all irrigation areas due to ongoing loss of available land due to unacceptable groundwater mounding or ongoing increased flows (e.g. due to less than expected levels of flow reduction due to I&I remediation works) should be considered in land treatment and nutrient loss assessments. I expect an increase in hydraulic loading to land treatment areas would increase nutrient loss from receiving soils. If significant changes to the proposed irrigation regime occur as a result, or to address, concerns raised by Mr Daryl Irvine around the potential impact of groundwater mounding or potential inflow changes on land irrigation capacity, such as might be presented at expert caucusing, then I would also expect Overseer modelling to be updated and provided for review.

23. Ms. Katie Beecroft notes that alternative land use (tree crop) may be appropriate. It is noted that no assessment of the land treatment capacity of forestry or alternative land-use has been provided by the Applicant, and so this has not been considered in my evidence.

24. The controls which I consider to be necessary and appropriate to ensure the land treatment performs as assessed by the Applicant are as outlined in the Consent Condition Review Section.

LAND TREATMENT AND GROUNDWATER JWS

25. I have limited my review of the JWS to items specifically relating to land treatment of applied nutrients as assessed by the Applicant. I note that Mr. Daryl Irvine has outlined a number of alternative assessment scenarios which were agreed as part of the JWS would be analysed and reported

back to PDP by the Applicant, but to date have not been addressed. As a result there is some uncertainty around the proposed irrigation regime operation under these alternative scenarios. As discussed in Cl. 22 and Cl. 39., I expect that any significant changes to the proposed irrigation regime would impact the inputs of Overseer modelling and therefore require updated assessment by the Applicant.

26. As described in Item 1 of the JWS Land Treatment and Groundwater, it was agreed that unacceptable groundwater mounding will result in reduced nutrient uptake and removal, creating variation from Overseer® modelling results. The Applicant has proposed not to irrigate where groundwater is within 0.6 m of the ground surface (Ms. Katie Beecroft's evidence Cl. 83.h.). I consider this appropriate as discussed in Cl. 35 of my evidence. I note this condition has been recommended in Ms. Katie Beecroft's evidence (Cl. 178), but that this has not been carried through to proposed conditions in Mr. Exeter Sven's evidence. I recommend this Consent Condition is included.

27. JWS Item 2 – Experts agreed on unacceptable groundwater mounding, which was agreed would be defined as mounding that resulted in vadose zone thickness reduction to less than 0.6 m. (i.e. depth to groundwater from ground surface of <0.6 m being unacceptable). This is relevant to the assessment of nutrient loss as outlined in Cl. 18.vii of my evidence.

SECTION 42A REPORT

28. I consider the points made in the PDP report (FWWTP RC Review Report) attached to the s42A Officers Report and summarised in the s42A Officers Report to still be valid in relation to nutrient loss estimates for land treatment, and I have re-affirmed the relevant points in this evidence.

29. In particular, I note that concerns I raised with the proposed conditions have been largely uncovered in Mr Sven Exeter's evidence.

RESPONSE TO THE APPLICANT'S EVIDENCE

30. I have limited my response to the Applicant's evidence to Ms. Katie Beecroft's evidence, which deals with nutrient loss assessments.

31. As outlined in my summary, I consider the nutrient loss assessment carried out by Ms. Katie Beecroft to be representative, for the proposed and assessed irrigation regime. Notwithstanding that, I have the following responses to specific points in Ms. Katie Beecroft's evidence.

32. In Cl. 34, 88,93, 95, 96, 97, and 117, of her evidence Ms. Katie Beecroft discusses the sufficiency of the site characterisation information provided in the Application documents. Although I agree that the information

provided is sufficient for the assessment of land treatment, the assessment on whether this information is suitable for groundwater modelling is outside the area of expertise of both my evidence and Ms. Katie Beecroft's evidence. I have relied on Mr. Chris Simpson and Mr. Aslan Perwick to provide evidence on the basis of groundwater modelling assessments.

33. In Cl 57, Ms. Katie Beecroft outlines a nitrogen loading rate of 300 kgN/ha/yr. I consider this a reasonable for cut and carry pasture. However, this is higher than what I would consider typical for a dry stock grazed pasture, and it is much higher than the nitrogen loading rate modelled for the dry stock scenario in Overseer. I consider a limit of 150 kgN/ha/yr more appropriate for dry stock grazed pasture, and have recommended this in Cl. 41.

34. In Cl. 60 of Ms. Katie Beecroft's evidence, net phosphorus uptake rates of 34-84 kgP/ha/yr are discussed. However, it is noted that Overseer modelling outlines a lower net phosphorus uptake rates of 27 kgP/ha/yr for the cut and carry model. However, as discussed in Cl. 20 I am not concerned with the proposed phosphorus loading rate given that soil phosphorus levels will largely be dictated by phosphorus fertilizer applications. In order to maintain phosphorus loss in-line with the proposed land use activity I consider that a phosphorus loading limit should be set, as discussed in Cl. 41.

35. I agree with Cl. 83.(h) of Ms. Katie Beecroft's evidence, where the proposal to limit irrigation by depth to groundwater is noted to create "a minimum treatment depth of unsaturated soil". I consider this minimum depth of unsaturated soil to be a very key point. My experience of modelling land treatment systems with Overseer® supports this, as reducing the minimum rooting depth of receiving soils can result in significantly increased estimated leaching of nitrogen to groundwater. As discussed in Cl. 18.vii, 0.6 m below ground level is the default depth over which Overseer® assesses nutrient uptake and removal, and therefore ground water levels of 0.6 m below ground level is considered an appropriate limitation for irrigation.

36. In Cl. 90 of her evidence, Ms. Katie Beecroft outlines her opinion that tree crops may be suitable for the irrigation areas, however, acknowledges that an assessment of the site and proposed discharge to tree crops has not been undertaken. As an assessment has not been provided for review, this not been considered in my evidence. I would consider such a change would require variation to the any consent which stipulates land use. The nutrient uptake rate of a tree crop will be different to that modelled in the

Overseer model for dry stock pasture or cut and carry pasture and so this would require re-consideration of the issue of nutrient leaching.

37. In Cl. 104 and 105 of her evidence, Ms. Katie Beecroft outlines that she does not consider there to be unacceptable uncertainty and risk to enable the assessment of the effects of discharge to land, and discusses the relative risk of nitrogen loss. While I consider that there is sufficient information provided to assess the effects of nutrient loss under the proposed irrigation regime, I note that Mr Daryl Irvine and Mr. Aslan Perwick address the uncertainty and risk presented by groundwater mounding and its effect on the proposed irrigation regime in their evidence.

38. In Cl. 118 of her evidence, Ms. Katie Beecroft outlines that a site visit may have assisted with providing confidence in the provided soil information. I am satisfied with the information provided by the Applicant about shallow soils for the purposed of the nutrient loss assessment.

39. In Cl. 130 of her evidence, Ms. Katie Beecroft responds to Paragraph 28, of the PDP report (FWWTP RC Review Report) attached to the S42A Officer Report. This paragraph notes the need to review updated Overseer® modelling in light of any changes to the irrigation regime. Ms. Katie Beecroft outlines that Overseer® is an annualised average model which is based on monthly inputs but representing a long-term average nutrient loss, and concludes that therefore it is not necessarily relevant to model specific years in this case. While I agree with Ms. Katie Beecroft, that Overseer® is an annualised average model representing a long-term average nutrient loss, I consider that any changes in the irrigation regime which result in variation to assessed long term inputs of Overseer, should be re-assessed by the Applicant. I consider that this could include but is not limited to:

    i. An increase in the average annual treated wastewater discharged to land.

    ii. A decrease in the average available land irrigation area (due to unacceptable groundwater mounding from year to year).

    The potential or risk of these increases is not discussed in my evidence, and is covered by others.

CONDITIONS MITIGATION

40. I would expect consent conditions to be in place requiring appropriate soil nutrient monitoring, the preparation of an annual Nutrient Budget Plan

(including nutrient modelling with Overseer®) and annual reporting of soil monitoring and Nutrient Budget Plans to GWRC.

41. The assessment of nutrient loss for the proposed activity assesses a reduction from the prior irrigated and dairy grazed pasture land use activity to the proposed activity of treated wastewater irrigation to either grazed pasture or a cut and carry pasture system. As discussed, I consider this assessment to be reasonable. However, this assessment of nutrient loss reduction relies largely on the proposed changes in land use activity, the intensity of the proposed land use, and the understanding that the land use would be operated under best practice so that nutrient loss aligns with that assessed in Overseer modelling. I consider that the following consents condition recommendations would be appropriate to control nutrient loss in line with that assessed in the AEE and Ms. Katie Beecroft's evidence:

    i. A condition that requires the land treatment area including buffer zones to be managed under one of the following activities:

        a. Grazed pasture for dry stock (non-lactating dairy, beef cattle or sheep).

        b. Cut and carry pasture.

        I consider this appropriate, as the identified reduction in nutrient loss has been assessed for the proposed irrigation regime operating under best practice of these land use systems.

    ii. A condition that limits average nitrogen loading for a cut and carry pasture to 300 kgN/ha/yr (from all fertilizer and wastewater sources), as recommended by Ms Katie Beecroft in Cl. 178 of her evidence, and aligning with nitrogen loading rates assessed in Overseer modelling for this land use. I consider this an appropriate nutrient loading application for a cut and carry land treatment system.

    iii. A condition that limits average nitrogen loading for grazed pasture to 150 kgN/ha/yr (from all fertilizer and wastewater sources). This aligns with the nitrogen loading assessed in Overseer modelling. I consider this an appropriate nutrient loading application for a grazed pasture land treatment system.

    iv. A condition limiting average phosphorus applications to land treatment areas (from all fertilizer and wastewater sources) in line with that assessed in Overseer modelling. Based on Overseer

modelling I would consider an appropriate rate to be in the order of 50 kgP/ha/yr.

v. A condition requiring Olsen P to maintained within appropriate levels for pasture growth. I would consider this be within the range of 20-30 mg/L Olsen P.

vi. Schedule 4, Condition 4 of Mr Sven Exeter's evidence Annexure 5, outlines that loading above proposed nutrient limits for cut and carry (300 kg N/ha/yr) should be considered compliant where the mass of nitrogen applied above 300 kgN/ha/yr is removed in harvested material. In the reported Overseer modelling nitrogen removal by cut and carry crops was reported at 178 kgN/ha/yr. Therefore the current wording of this consent condition allows a nitrogen load of 478 kgN/ha/yr without any increase in the nitrogen removed in harvested material. I do not consider this proposed condition to be an appropriate control. I consider that any variation to nutrient loading above those proposed in consent conditions should require a variation to consent under a s127 based on an assessment of nutrient loss effects.

42. The Applicant has proposed not to irrigate where groundwater is within 0.6 m of the ground surface (Ms. Katie Beecroft's evidence Cl. 83.h.). I note this condition has been recommended in Ms. Katie Beecroft's evidence (Cl. 178), but that this has not been carried through to proposed conditions in Mr. Sven Exeter's evidence. I recommend this Consent Condition is included.

43. I also note that the management of the irrigation system specifically hydraulic loading, must be undertaken in line with the management outlined in the AEE and Ms. Katie Beecroft's evidence to ensure the nutrient leaching remains as modelled. I have relied on Mr. Daryl Irvine's assessment of conditions to ensure that the irrigation regime is controlled in line with that proposed in the AEE and Ms. Katie Beecroft's evidence.

CONCLUSIONS

44. In conclusion:

i. I consider the provided nutrient loss assessment for the proposed land irrigation regime and land treatment system, i.e. a decrease in nutrient losses from the prior grazed dairy pasture land use, to be reasonable, assuming the constraints I have suggested above in relation to conditions are applied.

ii. I have not considered any potential impact on the provided nutrient loss assessment of any changes in irrigation regime beyond that provided in the AEE, but consider that an updated Overseer assessment should be undertaken in the case of any significant change to this irrigation regime given that Overseer modelling relies on the irrigation regime inputs.

Jack Aaron Feltham
10 May 2019