

**IN THE ENVIRONMENT COURT  
WELLINGTON REGISTRY**

**I TE KŌTI TAIAO O AOTEAROA  
TE WHANGANUI-A-TARA ROHE**

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|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>UNDER</b>         | the Resource Management Act 1991                                                                                                                                                                                              |
| <b>IN THE MATTER</b> | of appeals under sch 1, cl 14(1) against the decision of<br>Manawatū-Whanganui Regional Council on Plan Change 2<br>to the One Plan                                                                                           |
| <b>BETWEEN</b>       | <b>TE RUNANGA O RAUKAWA</b><br>ENV-2021-WLG-20<br><br><b>NGĀTI TURANGA</b><br>ENV-2021-WLG-21<br><br><b>ANDREW DAY</b><br>ENV-2021-WLG-22<br><br><b>WELLINGTON FISH AND GAME COUNCIL</b><br>ENV-2021-WLG-23<br><br>Appellants |
| <b>AND</b>           | <b>MANAWATŪ-WHANGANUI REGIONAL COUNCIL</b><br><br>Respondent                                                                                                                                                                  |

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**SUPPLEMENTARY STATEMENT OF EVIDENCE OF DR ANTONIUS SNELDER ON  
BEHALF OF MANAWATŪ-WHANGANUI REGIONAL COUNCIL**

**WATER QUALITY MODELLING**

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**SUPPLEMENTARY STATEMENT OF EVIDENCE OF ANTONIUS SNELDER****A. INTRODUCTION**

- [1] My full name is Antonius Hugh Snelder.
- [2] I prepared a statement of evidence dated 6 October 2023 on state of environment and water quality modelling (**Evidence**) on behalf of the Manawatū-Whanganui Regional Council (**Horizons**) for Proposed Plan Change 2 to the One Plan (**PC2**). I also prepared a statement of reply evidence dated 13 November 2023 (**Reply Evidence**).
- [3] My experience and qualifications are set out in my Evidence.
- [4] I repeat the confirmation given in my Evidence that I have read and will comply with the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2023, and that my evidence has been prepared in compliance with that Code.

**B. SCOPE**

- [5] This supplementary evidence responds to requests for further information:
- (a) During cross-examination, in relation to Table 6 of my Evidence; and
  - (b) In emails from the Registry dated 22 November 2023 and 24 November 2023, in relation to further modelling data.

**C. AMENDED TABLE**

- [6] In my Evidence, Table 6 describes the expected reduction in total nitrogen leaching from intensive farming land use (**IFLU**) as a percentage from a baseline for the targeted water management zones affected by PC2. The reductions for dairy farms commercial vegetable growing (**CVG**) were estimated by Professor Horne and Dr Jolly respectively, based on their modelling of the risk management tool.
- [7] During cross-examination, Ms Wright pointed out a potential discrepancy between Table 4 (which sets out the expected on-farm nitrogen leaching

reductions from implementing the DV-PC2 and AV-PC2 provisions from several sub-regions, provided to me by Professor Horne) and Table 6 (which sets out the expected reductions in total nitrogen leaching from the sub-regions). Ms Wright pointed out that in Table 4, the 'West Coast Lakes and Horowhenua' sub-region had a larger reduction in nitrogen leaching from IFLU for DV-PC2 than for AV-PC2 but that in Table 6 the total nitrogen leaching rate from the sub-region was larger under AV-PC2 than for DV-PC2.

[8] I was asked to explain why Table 6 indicates that the 'West Coast Lakes and Horowhenua' sub-region showed a larger reduction in total nitrogen leaching under AV-PC2 than DV-PC2, while Table 4 indicates the sub-region has a lower nitrogen leaching rate from IFLU under AV-PC2 compared to DV-PC2.

[9] There is a larger reduction in total nitrogen leaching shown for West Coast Lakes and Horowhenua sub-region in Table 6 for the AV-PC2 than for DV-PC2 because Dr Jolly did not estimate the reduction in the baseline loss rate for CVG under DV-PC2 (see my Evidence at Table 4 and the footnote). This was because Dr Jolly was not directly involved in the modelling work that was undertaken by Dr Cox and I prior to the council hearing for PC2.<sup>1</sup> However, Dr Jolly estimated a reduction in the baseline CVG associated with the risk management tool for AV-PC2 of 70%<sup>2</sup> with reference to the Bloomer work, but after accounting for more recent changes in Overseer (see my Table 4).<sup>3</sup> Because most of the CVG in the region is within the West Coast Lakes and Horowhenua (and is concentrated within one WMSZ, Hoki-1a) the assessment of the reduction in total loss from West Coast Lakes and Horowhenua sub-region is much larger for AV-PC2 than DV-PC2.

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<sup>1</sup> Note that in the modelling work carried out prior to the council hearing for PC2, Dr Cox and I used estimates of nitrogen leaching and reductions thereof under mitigation assumptions that were provided by Bloomer et al. (2020).

<sup>2</sup> Note that in the modelling work prior to the council hearing for PC2, reductions in the baseline CVG nitrogen loss rates of 35% and 55% were simulated. In my Statement of Reply Evidence (13 November 2023) at 22, I have indicated that reductions less than those estimated by Dr Jolly would still produce reductions in nitrogen loads and concentrations downstream of areas occupied by CVG.

<sup>3</sup> Statement of Evidence of Anne-Maree Jolly (6 October 2023) at [61]–[69].

**D. INTENSIVE FARMING LAND USE DATA**

- [10] The Court has requested additional information regarding water quality modelling data, which I provide in the Appendix to this supplementary evidence. I have derived this information from the inputs and outputs of the model that Dr Cox and I used to simulate the impacts of various scenarios associated with DV-PC2. The model is described in the evidence of Dr Cox.<sup>4</sup>
- [11] I have used the model input data to quantify the proportion of estimated total nitrogen leaching loads attributable to three of the four categories of IFLU (Cropping, Dairy, and CVG) within each of the water management sub-zones (**WMSZ**) that comprise the target catchments in **Table 1**.
- [12] The data shown in Table 1 responds to the second question in the Registry's email of 22 November 2023 and provides the proportion of estimated total nitrogen leaching attributable to each of the IFLU land uses (excluding irrigated sheep and beef) within each WMSZ for the pre-regulation condition.
- [13] Table 1 does not include the total nitrogen leaching attributable to the irrigated sheep and beef land use even though this is an IFLU and this land use category contributes to nitrogen leaching from several of the WMSZs. This is because irrigated sheep and beef farms were not represented by a unique category in the catchment models. Rather they were represented by the spatial intersection of the sheep and beef land use category and a spatial layer representing irrigated land. The contribution of irrigated sheep and beef is therefore represented in the model but the contribution to nitrogen leaching of this land type is not easily retrieved as an explicit category. To provide some appreciation of the contribution of all IFLU types (i.e., including irrigated sheep and beef), I have included **Table 2**, which shows the land area in each of the five IFLU categories.
- [14] Across the 32 WMSZs that comprise the target catchments, the median contribution of IFLU to the total nitrogen leaching was 50% (range is zero to 92% because there is large variation in the proportion of IFLU in each

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<sup>4</sup> Statement of Evidence of Timothy Cox (6 October 2023).

WMSZ). This helps to explain why PC2 would achieve modest improvements in water quality downstream of the target catchments (i.e., the regulation will cause reductions in nitrogen leaching for IFLU land, which on average makes up only 50% of the total contribution of nitrogen from each WMSZ).

#### **E. SIN TARGETS AND WMSZ PREDICTIONS**

[15] The Court also requested the following information for each priority catchment:

- (a) SIN targets;
- (b) Current SIN concentrations;
- (c) Current total nitrogen load reaching the receiving environment;
- (d) Load reduction required to meet the SIN target; and
- (e) Load reduction predicted to be achieved by meeting Table 14.2.

[16] In paragraphs [19] and [20] below, I also address the Court's query with regard to the nitrogen loss baseline, and how many consented farms were assessed based on their Overseer files and how many farms were assessed based on assumed nitrogen losses.<sup>5</sup>

[17] Because the information that is relevant to the Court's request concerns in-river concentrations and loads, I have provided data that pertains to 36 model assessment points that represent in-river conditions downstream of the target catchments (**Figure 1**). Each assessment point is named according to the WMSZ that it is at the downstream end of. However, it is important to note that these river locations do not always represent the concentration or load resulting from the single WMSZ after which the point is named. This is because some WMSZs discharge into the upstream end of other WMSZs. The information I provide for the Court is therefore appropriately interpreted as the in-river conditions at various points downstream of the target catchments.

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<sup>5</sup> Email from the Registry dated 24 November 2023. See Question 2.

- [18] In general, when using catchment water quality models, there is greater confidence in the relative changes in predictions made by the models (i.e., by comparing the two sets of predictions) than of the absolute values of predictions. I made this point in my Reply Evidence in response to questions raised by Dr Parlato.<sup>6</sup> Therefore, in responding to the request for additional information by the Court I have generally provided comparative figures.
- [19] When I have provided comparative figures, I have used the pre-regulation condition as the comparator. This is because the pre-regulation condition is a historic condition about which we have available data. In particular, Horizons had data describing the nitrogen leaching rate estimates for 213 consented and 70 unconsented dairy farms (the HRC database). The nitrogen leaching rates from these farms prior to any regulatory intervention were referred to during the Council level hearing as the “baseline” rates. The land covered by the 213 consented and 70 unconsented dairy farms was referred to by Snelder et al. (2020b) as “Known” IFLU (i.e., the nitrogen leaching rate was “known”).<sup>7</sup> The nitrogen leaching rate from CVG under the pre-regulation conditions was also “Known” IFLU based on work by Bloomer et al. (2020).<sup>8</sup>
- [20] The Known IFLU did not cover all IFLU in the region and therefore Snelder et al. (2020a) referred to land as “Unknown” IFLU. The nitrogen leaching rates for the “Unknown” land were assigned from a set of “lookup tables” that was used to calibrate the catchment model nitrogen leaching rates from both the Unknown IFLU and other land use categories. The use of lookup tables that describe contaminant loss rates from different land types is a standard practice in catchment water quality modelling (see Snelder et al. 2020a for details).<sup>9</sup>
- [21] With respect to items (b), (c) and (e) requested by the Court, the information I have provided should not be interpreted as “current” loads or

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<sup>6</sup> Statement of Reply Evidence of Antonius Snelder (13 November 2023) at [11].

<sup>7</sup> Statement of Evidence of Antonius Snelder (6 October 2023) at Attachment A, page 202.0745.

<sup>8</sup> Statement of Reply Evidence of Anne-Maree Jolly (13 November 2023) at Attachment A.

<sup>9</sup> Statement of Evidence of Antonius Snelder (6 October 2023) at Attachment A, pages 202.0693–202.0699.

concentrations. The modelling that Dr Cox and I performed pertained to the pre-regulation (i.e., historic) condition and to potential (i.e., simulated) conditions arising from the various scenarios associated with the implementation of PC2. Those scenarios are described in detail in Snelder et al. (2020) and the most relevant 11 scenarios were summarised in Attachment B to my Evidence.<sup>10</sup> Therefore:

- (a) Item (b) requested by the Court is our estimate of the pre-regulation soluble inorganic nitrogen (**SIN**) concentration; and
- (b) Items (c) and (e) requested by the court, are therefore predicted total nitrogen loads reaching the model assessment points and the predicted load reduction (as a proportion of the pre-regulation load) achieved by the pre-regulation condition and each of the scenarios respectively.

[22] While considering the Court's queries I discovered an error associated with two simulations (Pathway B and C) that are evident for a small number of the assessment points. This means I have provided water quality modelling data that pertains to nine scenarios (not 11) when responding to the Court's queries (c) and (e). The scenarios are summarised in **Table 3**. The error was that incorrect nitrogen loss rates were specified for CVG under Pathway B and C. Because CVG only occurs in a few WMSZs the error only affected the results for a few assessment points, which means that the summary values for Pathway B and C provided in Attachment B to my Evidence are reasonably accurate.<sup>11</sup> However, the errors are more significant when we look at the model outputs for the individual assessment points (which is what the Court has now asked for). Therefore, in this supplementary evidence, I have not provided the modelling results for the Pathway B and C simulations. In my opinion, it is unnecessary to remodel the scenarios as a reasonable approximation of the values at each assessment point for Pathway B and C can be obtained by linear interpolation of the results I present in this

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<sup>10</sup> Statement of Evidence of Antonius Snelder (6 October 2023) at Attachment B, page 202.0800.

<sup>11</sup> Additionally, Pathways A–D only model reductions in leaching from pastoral IFLU. Pathways E–F model the combined effects of pastoral and CVG leaching reductions.

evidence for Pathway A and D. Further, as I have expressed in my Evidence and to the Court, the differences between the various scenarios is so small, in any event, that differences in the predicted water quality between the scenarios are not of practical (i.e., environmental or ecological) significance.

- [23] To assist the Court, I have also added a further reporting item. This data is the relative difference between the predicted SIN concentration for the pre-regulation condition and each of the nine scenarios for the 36 model assessment points that are downstream of the target catchments. I note that in my Evidence I provide a formula for the relative difference. This includes a term that is referred to as the “current concentration”. The words “current concentration” in this context means the predicted concentration for whichever of the pre-regulation or nine scenarios are being considered. This additional information allows an appreciation of the amount by which the SIN concentration changes at each assessment point under each of the nine scenarios and the variability of these changes over the assessment points.
- [24] In my Evidence, I summarised the predicted SIN concentration pertaining to the pre-regulation condition and each of the nine scenarios as the “mean relative difference” over the 36 model assessment points that are downstream of the target catchments. These averages were included in the table summarising the pre-regulation condition and the nine scenarios in Attachment A to my Evidence. These averages are derivable from the relative differences I have provided as an additional item in this evidence (see paragraph 23 above).
- [25] **Table 4** responds to items (a), (b) and (d) requested by the Court. Table 4 shows the SIN target, the predicted pre-regulation concentration, and nitrogen load reduction required to achieve the target for each of the 36 model assessment points downstream of the target catchments. The negative values for reduction required indicate that the pre-regulation SIN concentration is less than (i.e., is compliant with) the target concentration.
- [26] **Table 5** provides the estimated total nitrogen loads reaching the 36 assessment points downstream of the target catchments under each of the nine scenarios. Note that the 36 assessment points represent river receiving

environments and therefore this data responds to item (c) requested by the court.

[27] **Table 6** and **Figure 2** show the nitrogen load reductions predicted to be achieved by each of the nine scenarios at the 36 assessment points downstream of the target catchments (i.e., item (e) requested by the court). The load reductions are expressed as a percentage of the pre-regulation load. It is noted that in Table 6 and Figure 2 there are some negative load reductions shown for some combinations of assessment point and scenario. For example, negative reductions (i.e., increases) in SIN were modelled for WMSZs West\_4 and West\_5 in most scenarios. There are also other combinations of WMSZ and scenario for which small negative reductions (i.e., increases) in SIN were modelled. This occurs for two reasons:

- (a) First, there is Known IFLU that is consented and the nitrogen leaching rates allowed by those consents are less than that allowed by the scenario. In these cases, the modelling assumption was that the IFLU would be allowed to leach up to the amount allowed by recalibrated Table 14.2 except for the Proposed Consented Strict scenario.
- (b) Second, there is Unknown IFLU for which the assigned baseline leaching rates in the model were derived from lookup tables were less than that allowed under the modelled scenarios. In those cases, the modelling assumption was that the IFLU would be able to leach up to the amount anticipated by the scenario.

[28] The negative load reductions shown in Table 6 are small (i.e., generally  $\leq 5\%$  increase of the current SIN concentration) because IFLU makes up only a small proportion of the land in these WMSZs (see paragraph 14 and Tables 1 and 2). Mrs Foster describes the planning response within the PC2 rule framework for DV-PC2 and AV-PC2 in her reply evidence (including preventing known IFLU to 'leach up'), which received the agreement of

witnesses for the Director-General of Conservation at the Council level hearing.<sup>12</sup>

- [29] **Table 7** shows the areas of IFLU in each of the 32 WMSZs that comprise the target catchments for which the baseline leaching rates in the model are above and below the DV-PC2 leaching limits. It is noted that there is not a direct relationship between the data shown in Table 7 with that shown in Table 6 because the baseline leaching rates for IFLU is variable. However, the WMSZs West\_4 and West\_5 most consistently have negative load reductions (as shown in Table 6) and these have the largest proportions of IFLU land for which the model baseline leaching rates are below the DV-PC2 leaching limits and the assumptions described in paragraph 27 apply.
- [30] Finally, the relative difference between the predicted SIN concentration for the pre-regulation condition and each of the nine scenarios is shown in **Table 8**. The mean value over all 36 assessment points is shown on the last line in the table. These values correspond to the mean relative difference values given in the summary table provided in Attachment A to my Evidence (with some small differences associated with rounding of values).

**18 January 2024**

**Dr Antonius Snelder**

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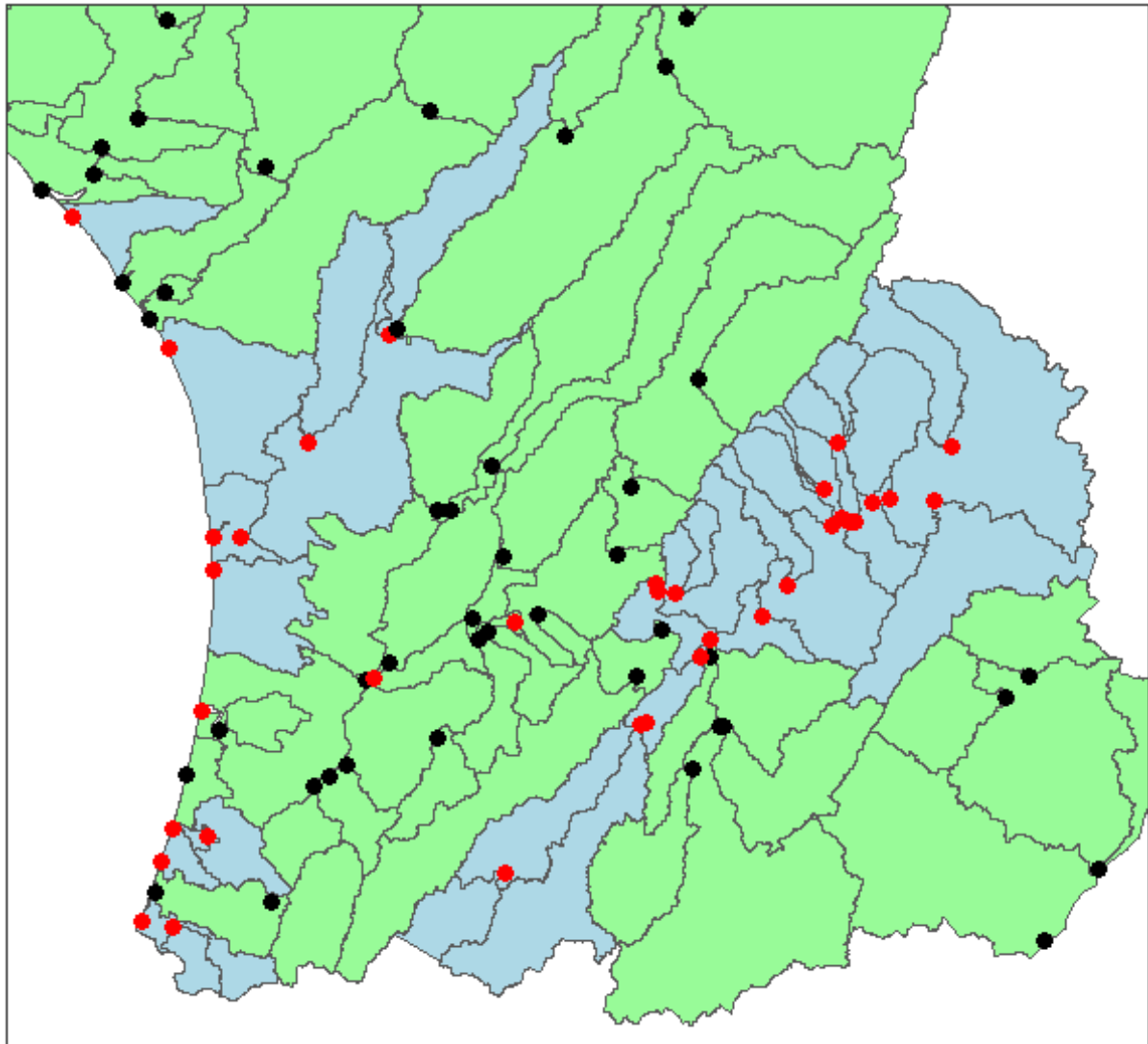
<sup>12</sup> See Statement of Reply Evidence of Christine Foster (13 November 2023) at 57 [[202.1162]]; and paragraphs 3.109–3.118 of the Panel’s decision [[101.0304]]. The agreement reached between Mrs Foster and the witnesses for the Director-General of Conservation on this approach is referenced at 3.118 of the Panel’s decision.

**F. REFERENCES**

- Bloomer, D., G. O'Brien, and L. Posthuma, 2020. Modelled Loss of Nutrients From Vegetable Growing Scenarios In Horowhenua. Page Bloomer Associates, New Zealand.
- Snelder, T., T. Cox, and T. Kerr, 2020a. Scenario Modelling of Nitrogen Management in Manawatū-Whanganui Region. Supporting Regional Plan Change 2. LWP Client Report, LWP Ltd and SEL Ltd, Christchurch and Hamilton, New Zealand.
- Snelder, T., T. Cox, T. Kerr, C. Fraser, and S. Collins, 2020b. Manawatū-Whanganui Region Catchment Nitrogen Models. Supporting Regional Plan Change 2. LWP Client Report, LWP Ltd and SEL Ltd, Christchurch, New Zealand.

**G. APPENDIX: TABLES AND FIGURES**

**Figure 1:** Map indicating the 32 WMSZs that comprise the target catchments and the 36 model assessment points that are downstream of the target catchments.



Assessment point downstream of target catchment    ● FALSE    ● TRUE

Target catchment    ■ FALSE    ■ TRUE

**Table 1:** Contribution (%) of four categories of intensive farming land use and total IFLU to total nitrogen loss for the 32 WMSZs that comprise the target catchments. The table omits the irrigated sheep and beef category.<sup>13</sup> Note that rows are ordered by Catchment and area of catchment upstream of each WMSZ.

| Assessment point | Catchment  | Catchment area (km <sup>2</sup> ) | Cropping | Dairy | Commercial Vegetables | Total IFLU |
|------------------|------------|-----------------------------------|----------|-------|-----------------------|------------|
| Hoki_1a          | Hokio      | 63                                | 3        | 32    | 14                    | 49         |
| Hoki_1b          | Hokio      | 70                                | 0        | 36    | 0                     | 36         |
| Mana_4           | Manawatu   | 15                                | 0        | 57    | 0                     | 57         |
| Mana_9b          | Manawatu   | 27                                | 0        | 24    | 0                     | 24         |
| Mana_3           | Manawatu   | 34                                | 0        | 63    | 0                     | 63         |
| Mana_5c          | Manawatu   | 45                                | 3        | 89    | 0                     | 92         |
| Mana_5e          | Manawatu   | 46                                | 0        | 64    | 0                     | 64         |
| Mana_5d          | Manawatu   | 57                                | 2        | 77    | 0                     | 79         |
| Mana_8a          | Manawatu   | 58                                | 0        | 14    | 0                     | 14         |
| Mana_1b          | Manawatu   | 86                                | 0        | 41    | 0                     | 41         |
| Mana_2b          | Manawatu   | 113                               | 0        | 48    | 0                     | 48         |
| Mana_9c          | Manawatu   | 149                               | 0        | 50    | 0                     | 50         |
| Mana_8d          | Manawatu   | 202                               | 0        | 51    | 0                     | 51         |
| Mana_1c          | Manawatu   | 222                               | 0        | 0     | 0                     | 0          |
| Mana_8b          | Manawatu   | 382                               | 0        | 74    | 0                     | 74         |
| Mana_8c          | Manawatu   | 419                               | 0        | 53    | 0                     | 53         |
| Mana_1a          | Manawatu   | 699                               | 0        | 19    | 0                     | 19         |
| Mana_2a          | Manawatu   | 874                               | 0        | 24    | 0                     | 24         |
| Mana_5b          | Manawatu   | 881                               | 0        | 65    | 0                     | 65         |
| Mana_5a          | Manawatu   | 1263                              | 0        | 25    | 0                     | 26         |
| Mana_6           | Manawatu   | 1305                              | 0        | 54    | 0                     | 54         |
| Mana_9a          | Manawatu   | 3190                              | 0        | 66    | 0                     | 66         |
| Rang_4c          | Rangitikei | 150                               | 0        | 9     | 0                     | 9          |

<sup>13</sup> For reasons described in paragraph 13 above.

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|         |            |      |   |    |    |    |
|---------|------------|------|---|----|----|----|
| Rang_4d | Rangitikei | 3691 | 2 | 18 | 0  | 20 |
| Rang_4a | Rangitikei | 3880 | 3 | 42 | 0  | 45 |
| Rang_4b | Rangitikei | 3917 | 1 | 50 | 0  | 50 |
| West_8  | West Coast | 15   | 0 | 39 | 0  | 39 |
| West_9b | West Coast | 28   | 1 | 36 | 12 | 49 |
| West_4  | West Coast | 48   | 1 | 12 | 0  | 13 |
| West_5  | West Coast | 48   | 0 | 23 | 0  | 23 |
| West_9a | West Coast | 79   | 0 | 74 | 0  | 74 |
| West_6  | West Coast | 95   | 0 | 80 | 1  | 81 |

**Table 2:** Catchment area as a percentage of total area (%) of five categories of intensive farming land use and for total IFLU for the 32 WMSZs that comprise the target catchments. Note that rows are ordered by Catchment and area of catchment upstream of each WMSZ.

| Assessment point | Catchment  | Catchment area (km <sup>2</sup> ) | Cropping | Dairy | Commercial Vegetables | Irrigated sheep and beef | Total IFLU |
|------------------|------------|-----------------------------------|----------|-------|-----------------------|--------------------------|------------|
| Hoki_1a          | Hokio      | 63                                | 4        | 20    | 4                     | 28                       | 55         |
| Hoki_1b          | Hokio      | 70                                | 0        | 15    | 0                     | 0                        | 15         |
| Mana_4           | Manawatu   | 15                                | 0        | 21    | 0                     | 0                        | 21         |
| Mana_9b          | Manawatu   | 27                                | 0        | 15    | 0                     | 0                        | 15         |
| Mana_3           | Manawatu   | 34                                | 0        | 12    | 0                     | 0                        | 12         |
| Mana_5c          | Manawatu   | 45                                | 6        | 70    | 0                     | 0                        | 77         |
| Mana_5e          | Manawatu   | 46                                | 0        | 34    | 0                     | 1                        | 35         |
| Mana_5d          | Manawatu   | 57                                | 3        | 40    | 0                     | 1                        | 44         |
| Mana_8a          | Manawatu   | 58                                | 0        | 2     | 0                     | 0                        | 2          |
| Mana_1b          | Manawatu   | 86                                | 0        | 14    | 0                     | 0                        | 14         |
| Mana_2b          | Manawatu   | 113                               | 0        | 32    | 0                     | 0                        | 33         |
| Mana_9c          | Manawatu   | 149                               | 0        | 27    | 0                     | 0                        | 27         |
| Mana_8d          | Manawatu   | 202                               | 0        | 24    | 0                     | 0                        | 24         |
| Mana_1c          | Manawatu   | 222                               | 0        | 0     | 0                     | 0                        | 0          |
| Mana_8b          | Manawatu   | 382                               | 0        | 47    | 0                     | 0                        | 47         |
| Mana_8c          | Manawatu   | 419                               | 0        | 25    | 0                     | 2                        | 27         |
| Mana_1a          | Manawatu   | 699                               | 0        | 10    | 0                     | 0                        | 11         |
| Mana_2a          | Manawatu   | 874                               | 0        | 11    | 0                     | 0                        | 11         |
| Mana_5b          | Manawatu   | 881                               | 0        | 30    | 0                     | 0                        | 30         |
| Mana_5a          | Manawatu   | 1263                              | 0        | 11    | 0                     | 2                        | 13         |
| Mana_6           | Manawatu   | 1305                              | 0        | 27    | 0                     | 0                        | 27         |
| Mana_9a          | Manawatu   | 3190                              | 0        | 37    | 0                     | 0                        | 37         |
| Rang_4c          | Rangitikei | 150                               | 1        | 5     | 0                     | 1                        | 7          |
| Rang_4d          | Rangitikei | 3691                              | 2        | 11    | 0                     | 0                        | 14         |
| Rang_4a          | Rangitikei | 3880                              | 3        | 26    | 0                     | 3                        | 31         |

| Assessment point | Catchment  | Catchment area (km <sup>2</sup> ) | Cropping | Dairy | Commercial Vegetables | Irrigated sheep and beef | Total IFLU |
|------------------|------------|-----------------------------------|----------|-------|-----------------------|--------------------------|------------|
| Rang_4b          | Rangitikei | 3917                              | 1        | 20    | 0                     | 7                        | 28         |
| West_8           | West Coast | 15                                | 0        | 19    | 0                     | 0                        | 20         |
| West_9b          | West Coast | 28                                | 1        | 17    | 3                     | 1                        | 22         |
| West_4           | West Coast | 48                                | 1        | 4     | 0                     | 5                        | 10         |
| West_5           | West Coast | 48                                | 0        | 8     | 0                     | 9                        | 18         |
| West_9a          | West Coast | 79                                | 0        | 25    | 0                     | 0                        | 25         |
| West_6           | West Coast | 95                                | 0        | 50    | 0                     | 2                        | 52         |

**Table 3:** Summary of the model simulations that were used to produce the evidence provided in this evidence. The first simulation is of the pre-regulation condition which is used as the comparator for the other nine simulations that are referred to as “scenarios” in this evidence [see paragraph 19]. The table also shows two summary statistics pertaining to the predicted water quality outcomes under each simulation<sup>14</sup>. First, the table provides the number of assessment points at which the One Plan SIN concentration targets are predicted to be achieved<sup>15</sup>. Second, the table provides the mean relative difference between the predicted SIN concentration and the One Plan SIN concentration targets. Note that there are 35 assessment points, which are downstream of the Target catchments.

| Simulation                       | Description                                                                                                                                                       | No. of points not achieving target | Mean relative difference (%) |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------|
| Pre-regulation                   | Nitrogen leaching rates in 2012 prior to consenting.                                                                                                              | 32                                 | 44.6                         |
| Post-regulation A                | N leaching rates for consented-IFLU are set to consented rates.                                                                                                   | 32                                 | 43.4                         |
| Proposed Consented               | Implementation of PC2 with no provision for a discretionary activity pathway but existing consents at consented rates.                                            | 29                                 | 39.5                         |
| Proposed Pathway A               | Implementation of PC2 discretionary pathway for non-consented/non-compliant IFLU with 9kg/ha/yr reduction from current leaching rates.                            | 30                                 | 40.8                         |
| Proposed Pathway D               | As above but with 18 kg/ha/yr reduction.                                                                                                                          | 30                                 | 40.2                         |
| Proposed Pathway E (GMP pathway) | Implementation of PC2 discretionary pathway for non-consented/non-compliant IFLU with 9kg/ha/yr reduction from current leaching rates and 36 % reduction for CVG. | 30                                 | 41.8                         |
| Proposed Pathway F (BMP pathway) | Implementation of PC2 discretionary pathway for non-consented/non-compliant IFLU with 18kg/ha/yr reduction from current leaching rates and 55% reduction for CVG. | 30                                 | 40.6                         |

<sup>14</sup> All results are for the Year 20 outcome.

<sup>15</sup> For an explanation of the mean relative difference see statement of Evidence of Antonius Snelder (6 October 2023) paragraph 65.

|                           |                                                                                                                                                                                                                                                |    |      |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|------|
| Proposed Consented Strict | Year 20 implementation of PC2 with no provision for a discretionary activity pathway and adherence to consented rates where these are below Table 14.2 and reduction of N loss rates to Table 14.2 where consented rates are above Table 14.2. | 29 | 35.3 |
| Dairy Sector Pathway A    | Alternative approach to restricting the leaching rates for the unconsented-IFLU applied only to the 70 Known-Unconsented dairy farms                                                                                                           | 30 | 40.9 |
| Dairy Sector Pathway B    | Alternative approach to restricting the leaching rates for the unconsented-IFLU applied to all Unconsented dairy farms in the Target Catchments                                                                                                | 31 | 41.3 |

**Table 4:** The SIN target, predicted pre-regulation concentration and nitrogen load reduction required to achieve the target for each of the 36 model assessment points downstream of the target catchments. Note that rows are ordered by Catchment and catchment area.

| Assessment point | Catchment  | SIN Target (mg/L) | SIN Pre-regulation (mg/L) | Reduction Required (%) |
|------------------|------------|-------------------|---------------------------|------------------------|
| Hoki_1a          | Hokio      | 0.167             | 2.15                      | 92                     |
| Hoki_1b          | Hokio      | 0.167             | 2.28                      | 93                     |
| Mana_4           | Manawatu   | 0.07              | 0.41                      | 83                     |
| Mana_9b          | Manawatu   | 0.444             | 0.41                      | -7                     |
| Mana_3           | Manawatu   | 0.07              | 0.20                      | 66                     |
| Mana_5c          | Manawatu   | 0.444             | 0.80                      | 44                     |
| Mana_5e          | Manawatu   | 0.444             | 0.41                      | -8                     |
| Mana_5d          | Manawatu   | 0.444             | 0.66                      | 33                     |
| Mana_8a          | Manawatu   | 0.07              | 0.09                      | 21                     |
| Mana_1b          | Manawatu   | 0.167             | 0.51                      | 67                     |
| Mana_2b          | Manawatu   | 0.444             | 0.66                      | 33                     |
| Mana_9c          | Manawatu   | 0.444             | 0.44                      | 0                      |
| Mana_8d          | Manawatu   | 0.444             | 0.67                      | 34                     |
| Mana_1c          | Manawatu   | 0.11              | 0.45                      | 76                     |
| Mana_8b          | Manawatu   | 0.444             | 0.78                      | 43                     |
| Mana_8c          | Manawatu   | 0.444             | 0.91                      | 51                     |
| Mana_1a          | Manawatu   | 0.167             | 0.44                      | 62                     |
| Mana_2a          | Manawatu   | 0.444             | 0.45                      | 1                      |
| Mana_5b          | Manawatu   | 0.444             | 0.45                      | 1                      |
| Mana_5a          | Manawatu   | 0.444             | 0.52                      | 14                     |
| Mana_6           | Manawatu   | 0.444             | 0.52                      | 14                     |
| Mana_7b          | Manawatu   | 0.444             | 0.62                      | 29                     |
| Mana_9a          | Manawatu   | 0.444             | 0.62                      | 28                     |
| Mana_10a         | Manawatu   | 0.444             | 0.50                      | 11                     |
| Mana_11a         | Manawatu   | 0.444             | 0.61                      | 27                     |
| Mana_13a         | Manawatu   | 0.444             | 0.59                      | 25                     |
| Rang_4d          | Rangitikei | 0.11              | 0.16                      | 31                     |
| Rang_4c          | Rangitikei | 0.11              | 0.42                      | 74                     |
| Rang_4a          | Rangitikei | 0.11              | 0.12                      | 11                     |

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|         |            |       |      |     |
|---------|------------|-------|------|-----|
| Rang_4b | Rangitikei | 0.167 | 0.12 | -34 |
| West_8  | West Coast | 0.167 | 2.46 | 93  |
| West_9b | West Coast | 0.167 | 0.62 | 73  |
| West_5  | West Coast | 0.167 | 2.38 | 93  |
| West_4  | West Coast | 0.167 | 1.55 | 89  |
| West_9a | West Coast | 0.167 | 0.27 | 39  |

**Table 5:** Predicted loads of total nitrogen reaching the receiving environments represented by the model assessment points downstream of the target catchments under each scenario (tonnes per year). Note that rows are ordered by catchment and catchment area.

| Assessment point | Pre-regulation | Post Regulation A | Proposed Consented | Proposed Pathway A | Proposed Pathway D | Proposed Pathway E | Proposed Pathway F | Proposed Consented Strict | Dairy Pathway A | Dairy Pathway B |
|------------------|----------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------------|-----------------|-----------------|
| Hoki_1a          | 83             | 81                | 81                 | 81                 | 81                 | 82                 | 81                 | 80                        | 81              | 81              |
| Hoki_1b          | 93             | 91                | 91                 | 91                 | 91                 | 92                 | 91                 | 88                        | 91              | 91              |
| Mana_4           | 16             | 16                | 14                 | 14                 | 14                 | 14                 | 14                 | 14                        | 14              | 15              |
| Mana_9b          | 26             | 25                | 25                 | 25                 | 25                 | 25                 | 25                 | 23                        | 25              | 25              |
| Mana_3           | 20             | 20                | 16                 | 16                 | 16                 | 18                 | 17                 | 16                        | 16              | 16              |
| Mana_5c          | 95             | 94                | 78                 | 85                 | 82                 | 85                 | 82                 | 76                        | 85              | 86              |
| Mana_5e          | 45             | 44                | 37                 | 41                 | 39                 | 41                 | 39                 | 34                        | 42              | 42              |
| Mana_5d          | 105            | 98                | 98                 | 100                | 98                 | 100                | 98                 | 91                        | 101             | 102             |
| Mana_8a          | 38             | 37                | 37                 | 37                 | 37                 | 37                 | 37                 | 35                        | 37              | 37              |
| Mana_1b          | 79             | 77                | 65                 | 71                 | 69                 | 73                 | 70                 | 62                        | 69              | 72              |
| Mana_2b          | 260            | 259               | 208                | 237                | 225                | 237                | 225                | 197                       | 236             | 237             |
| Mana_9c          | 161            | 159               | 147                | 147                | 147                | 152                | 148                | 142                       | 147             | 147             |
| Mana_8d          | 309            | 290               | 274                | 274                | 274                | 282                | 279                | 221                       | 274             | 274             |
| Mana_1c          | 181            | 181               | 181                | 181                | 181                | 181                | 181                | 181                       | 181             | 181             |
| Mana_8b          | 645            | 605               | 588                | 588                | 588                | 596                | 593                | 448                       | 588             | 588             |
| Mana_8c          | 720            | 675               | 657                | 657                | 657                | 666                | 662                | 514                       | 657             | 657             |
| Mana_1a          | 678            | 673               | 647                | 659                | 652                | 662                | 654                | 634                       | 662             | 665             |
| Mana_2a          | 998            | 992               | 910                | 952                | 933                | 957                | 935                | 887                       | 953             | 961             |

| Assessment point | Pre-regulation | Post Regulation A | Proposed Consented | Proposed Pathway A | Proposed Pathway D | Proposed Pathway E | Proposed Pathway F | Proposed Consented Strict | Dairy Pathway A | Dairy Pathway B |
|------------------|----------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------------|-----------------|-----------------|
| Mana_5b          | 107            | 102               | 91                 | 91                 | 91                 | 95                 | 92                 | 81                        | 93              | 96              |
| Mana_5a          | 1524           | 1502              | 1379               | 1438               | 1410               | 1450               | 1415               | 1326                      | 1445            | 1460            |
| Mana_6           | 3027           | 2959              | 2783               | 2842               | 2814               | 2883               | 2832               | 2587                      | 2849            | 2864            |
| Mana_7b          | 1455           | 1409              | 1367               | 1367               | 1367               | 1390               | 1377               | 1224                      | 1367            | 1367            |
| Mana_9a          | 3511           | 3439              | 3206               | 3264               | 3236               | 3332               | 3261               | 2999                      | 3271            | 3287            |
| Mana_10a         | 4019           | 3946              | 3687               | 3746               | 3718               | 3826               | 3748               | 3480                      | 3752            | 3768            |
| Mana_11a         | 4865           | 4793              | 4508               | 4567               | 4539               | 4659               | 4573               | 4302                      | 4574            | 4590            |
| Mana_13a         | 6841           | 6768              | 6359               | 6417               | 6389               | 6572               | 6436               | 6152                      | 6424            | 6440            |
| Rang_4d          | 174            | 170               | 176                | 176                | 176                | 176                | 176                | 176                       | 176             | 176             |
| Rang_4c          | 130            | 128               | 129                | 129                | 129                | 129                | 129                | 129                       | 129             | 129             |
| Rang_4a          | 2393           | 2365              | 2402               | 2402               | 2402               | 2404               | 2403               | 2397                      | 2402            | 2402            |
| Rang_4b          | 2465           | 2434              | 2474               | 2474               | 2474               | 2478               | 2476               | 2469                      | 2474            | 2474            |
| West_8           | 27             | 27                | 24                 | 24                 | 24                 | 26                 | 25                 | 24                        | 24              | 24              |
| West_9b          | 44             | 43                | 42                 | 42                 | 42                 | 42                 | 42                 | 39                        | 42              | 42              |
| West_5           | 145            | 139               | 148                | 148                | 148                | 149                | 148                | 139                       | 148             | 148             |
| West_4           | 79             | 78                | 81                 | 81                 | 81                 | 84                 | 82                 | 81                        | 81              | 81              |
| West_9a          | 93             | 89                | 85                 | 85                 | 85                 | 87                 | 85                 | 79                        | 85              | 85              |

**Table 6:** Tabulation of the predicted reduction of total nitrogen load at each of the 36 model assessment points downstream of target catchments for each of the nine scenarios. The load reduction is expressed as a percentage of the pre-regulation load (%). Note that rows are ordered by Catchment and catchment area.

| Assessment point | Post Regulation A | Proposed Consented | Proposed Pathway A | Proposed Pathway D | Proposed Pathway E | Proposed Pathway F | Proposed Consented Strict | Dairy Pathway A | Dairy Pathway B |
|------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------------|-----------------|-----------------|
| Hoki_1a          | 2                 | 2                  | 2                  | 2                  | 1                  | 2                  | 4                         | 2               | 2               |
| Hoki_1b          | 3                 | 3                  | 3                  | 3                  | 2                  | 3                  | 6                         | 3               | 3               |
| Mana_4           | 0                 | 12                 | 12                 | 12                 | 11                 | 12                 | 12                        | 10              | 5               |
| Mana_9b          | 2                 | 3                  | 3                  | 3                  | 3                  | 3                  | 9                         | 3               | 3               |
| Mana_3           | 0                 | 19                 | 19                 | 19                 | 8                  | 14                 | 19                        | 19              | 19              |
| Mana_5c          | 1                 | 18                 | 10                 | 14                 | 10                 | 14                 | 20                        | 11              | 9               |
| Mana_5e          | 2                 | 17                 | 8                  | 13                 | 8                  | 13                 | 24                        | 6               | 5               |
| Mana_5d          | 6                 | 7                  | 5                  | 6                  | 4                  | 6                  | 13                        | 4               | 3               |
| Mana_8a          | 2                 | 3                  | 3                  | 3                  | 2                  | 2                  | 7                         | 3               | 3               |
| Mana_1b          | 2                 | 18                 | 10                 | 12                 | 7                  | 11                 | 21                        | 12              | 9               |
| Mana_2b          | 0                 | 20                 | 9                  | 13                 | 9                  | 13                 | 24                        | 9               | 9               |
| Mana_9c          | 1                 | 8                  | 8                  | 8                  | 5                  | 8                  | 12                        | 8               | 8               |
| Mana_8d          | 6                 | 11                 | 11                 | 11                 | 9                  | 10                 | 28                        | 11              | 11              |
| Mana_1c          | 0                 | 0                  | 0                  | 0                  | 0                  | 0                  | 0                         | 0               | 0               |
| Mana_8b          | 6                 | 9                  | 9                  | 9                  | 8                  | 8                  | 31                        | 9               | 9               |
| Mana_8c          | 6                 | 9                  | 9                  | 9                  | 8                  | 8                  | 29                        | 9               | 9               |
| Mana_1a          | 1                 | 5                  | 3                  | 4                  | 2                  | 4                  | 6                         | 2               | 2               |
| Mana_2a          | 1                 | 9                  | 5                  | 7                  | 4                  | 6                  | 11                        | 4               | 4               |

| Assessment point | Post Regulation A | Proposed Consented | Proposed Pathway A | Proposed Pathway D | Proposed Pathway E | Proposed Pathway F | Proposed Consented Strict | Dairy Pathway A | Dairy Pathway B |
|------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------------|-----------------|-----------------|
| Mana_5b          | 4                 | 15                 | 15                 | 15                 | 11                 | 14                 | 24                        | 13              | 10              |
| Mana_5a          | 1                 | 9                  | 6                  | 7                  | 5                  | 7                  | 13                        | 5               | 4               |
| Mana_6           | 2                 | 8                  | 6                  | 7                  | 5                  | 6                  | 15                        | 6               | 5               |
| Mana_7b          | 3                 | 6                  | 6                  | 6                  | 4                  | 5                  | 16                        | 6               | 6               |
| Mana_9a          | 2                 | 9                  | 7                  | 8                  | 5                  | 7                  | 15                        | 7               | 6               |
| Mana_10a         | 2                 | 8                  | 7                  | 7                  | 5                  | 7                  | 13                        | 7               | 6               |
| Mana_11a         | 1                 | 7                  | 6                  | 7                  | 4                  | 6                  | 12                        | 6               | 6               |
| Mana_13a         | 1                 | 7                  | 6                  | 7                  | 4                  | 6                  | 10                        | 6               | 6               |
| Rang_4d          | 2                 | -1                 | -1                 | -1                 | -1                 | -1                 | -1                        | -1              | -1              |
| Rang_4c          | 1                 | 0                  | 0                  | 0                  | 0                  | 0                  | 0                         | 0               | 0               |
| Rang_4a          | 1                 | 0                  | 0                  | 0                  | 0                  | 0                  | 0                         | 0               | 0               |
| Rang_4b          | 1                 | 0                  | 0                  | 0                  | -1                 | 0                  | 0                         | 0               | 0               |
| West_8           | 0                 | 9                  | 9                  | 9                  | 3                  | 7                  | 9                         | 9               | 9               |
| West_9b          | 4                 | 7                  | 7                  | 7                  | 5                  | 7                  | 13                        | 7               | 7               |
| West_5           | 4                 | -3                 | -3                 | -3                 | -3                 | -3                 | 4                         | -3              | -3              |
| West_4           | 1                 | -3                 | -3                 | -3                 | -7                 | -5                 | -3                        | -3              | -3              |
| West_9a          | 4                 | 9                  | 9                  | 9                  | 6                  | 8                  | 15                        | 9               | 9               |

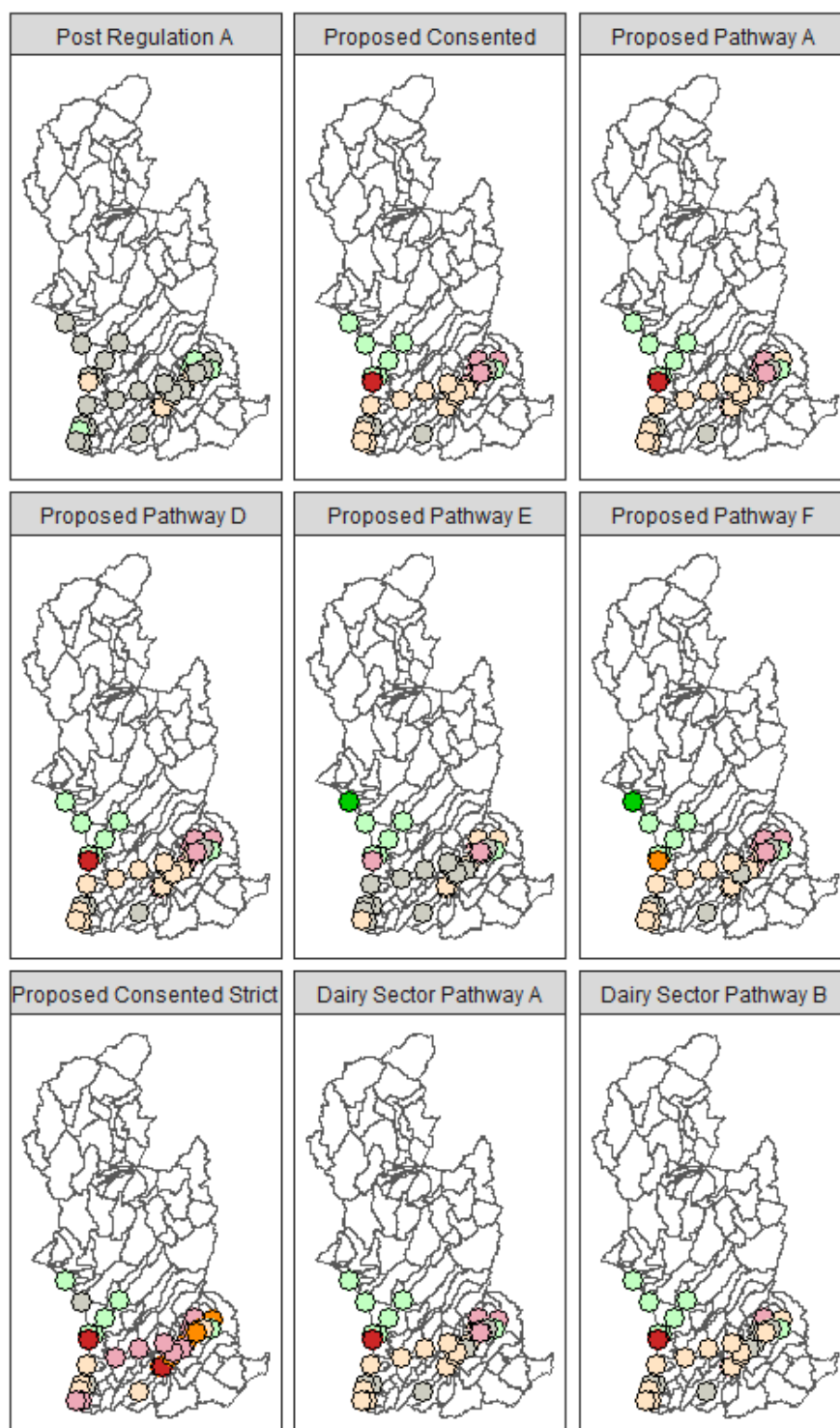
**Table 7:** Areas of IFLU in each of the 32 WMSZs that comprise the target catchments for which the baseline leaching rates in the model are above and below the DV-PC2 leaching limits. Note that rows are ordered by Catchment and catchment area.

| Assessment point | Catchment  | Area of IFLU below DV-PC2 leaching limits (Ha) | Area of IFLU above DV-PC2 leaching limits (Ha) | Area of IFLU below DV-PC2 leaching limits (percentage of total IFLU) |
|------------------|------------|------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------|
| Hoki_1a          | Hokio      | 613                                            | 944                                            | 39.4                                                                 |
| Hoki_1b          | Hokio      | 0                                              | 106                                            | 0                                                                    |
| Mana_4           | Manawatu   | 0                                              | 263                                            | 0                                                                    |
| Mana_9b          | Manawatu   | 156                                            | 288                                            | 35.2                                                                 |
| Mana_3           | Manawatu   | 131                                            | 263                                            | 33.3                                                                 |
| Mana_5c          | Manawatu   | 925                                            | 1681                                           | 35.5                                                                 |
| Mana_5e          | Manawatu   | 44                                             | 1569                                           | 2.7                                                                  |
| Mana_5d          | Manawatu   | 1206                                           | 1300                                           | 48.1                                                                 |
| Mana_8a          | Manawatu   | 0                                              | 163                                            | 0                                                                    |
| Mana_1b          | Manawatu   | 469                                            | 800                                            | 36.9                                                                 |
| Mana_2b          | Manawatu   | 531                                            | 2988                                           | 15.1                                                                 |
| Mana_9c          | Manawatu   | 13                                             | 3250                                           | 0.4                                                                  |
| Mana_8d          | Manawatu   | 31                                             | 4713                                           | 0.7                                                                  |
| Mana_1c          | Manawatu   | 6                                              | 44                                             | 12.5                                                                 |
| Mana_8b          | Manawatu   | 188                                            | 5563                                           | 3.3                                                                  |
| Mana_8c          | Manawatu   | 219                                            | 825                                            | 21                                                                   |
| Mana_1a          | Manawatu   | 1763                                           | 2213                                           | 44.3                                                                 |
| Mana_2a          | Manawatu   | 0                                              | 569                                            | 0                                                                    |
| Mana_5b          | Manawatu   | 6                                              | 1425                                           | 0.4                                                                  |
| Mana_5a          | Manawatu   | 375                                            | 1681                                           | 18.2                                                                 |
| Mana_6           | Manawatu   | 6                                              | 1138                                           | 0.5                                                                  |
| Mana_9a          | Manawatu   | 0                                              | 1769                                           | 0                                                                    |
| Rang_4c          | Rangitikei | 444                                            | 600                                            | 42.5                                                                 |
| Rang_4d          | Rangitikei | 356                                            | 1444                                           | 19.8                                                                 |
| Rang_4a          | Rangitikei | 1794                                           | 7688                                           | 18.9                                                                 |

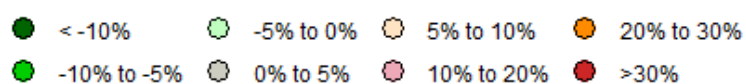
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|         |            |      |      |      |
|---------|------------|------|------|------|
| Rang_4b | Rangitikei | 731  | 781  | 48.3 |
| West_8  | West Coast | 13   | 406  | 3    |
| West_9b | West Coast | 331  | 325  | 50.5 |
| West_5  | West Coast | 1756 | 1613 | 52.1 |
| West_4  | West Coast | 413  | 300  | 57.9 |
| West_9a | West Coast | 50   | 1113 | 4.3  |
| West_6  | West Coast | 238  | 6231 | 3.7  |

**Figure 2:** Predicted reduction of total nitrogen load at each of the 35 assessment points downstream of target catchments for each of the nine scenarios. The load reductions are expressed as a percentage of the pre-regulation load.



Predicted reduction of total nitrogen load as percentage of pre-regulation load (%)



**Table 8:** Relative difference between the predicted SIN concentration for the pre-regulation condition and each of the nine scenarios. The values are percentages (%) of the target SIN concentration so that positive values indicate the predicted concentration exceeds the target and vice versa. Note that negative values for indicate that the predicted SIN concentration is less than (i.e., is compliant with) the target concentration.

| Assessment point | Pre-regulation | Post Regulation A | Proposed Consented | Proposed Pathway A | Proposed Pathway D | Proposed Pathway E | Proposed Pathway F | Proposed Consented Strict | Dairy Pathway A | Dairy Pathway B |
|------------------|----------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------------|-----------------|-----------------|
| Hoki_1a          | 91.9           | 91.7              | 91.7               | 91.7               | 91.7               | 91.8               | 91.7               | 91.5                      | 91.7            | 91.7            |
| Hoki_1b          | 92.4           | 92.2              | 92.2               | 92.2               | 92.2               | 92.3               | 92.2               | 92                        | 92.2            | 92.2            |
| Mana_4           | 82.9           | 82.9              | 80.6               | 80.6               | 80.6               | 80.9               | 80.6               | 80.6                      | 81.1            | 82              |
| Mana_9b          | -7.3           | -8.9              | -10.6              | -10.6              | -10.6              | -9.9               | -10.4              | -18.2                     | -10.6           | -10.6           |
| Mana_3           | 65.5           | 65.5              | 57.4               | 57.4               | 57.4               | 62.5               | 59.8               | 57.4                      | 57.4            | 57.4            |
| Mana_5c          | 50.1           | 49.6              | 39.1               | 44.4               | 42.1               | 44.5               | 42.1               | 37.3                      | 44.1            | 45.2            |
| Mana_5e          | 5.2            | 3.6               | -13.9              | -3.4               | -9.3               | -2.8               | -9.1               | -25.4                     | -0.9            | 0.1             |
| Mana_5d          | 38.7           | 34.6              | 34.3               | 35.7               | 34.5               | 36                 | 34.6               | 29.2                      | 36.4            | 36.8            |
| Mana_8a          | 24.7           | 23.2              | 22.6               | 22.6               | 22.6               | 23                 | 22.9               | 18.9                      | 22.6            | 22.6            |
| Mana_1b          | 70.9           | 70.3              | 64.7               | 67.7               | 66.8               | 68.7               | 67.5               | 63.2                      | 66.9            | 68.1            |
| Mana_2b          | 43.1           | 43                | 28.9               | 37.6               | 34.4               | 37.7               | 34.4               | 25.1                      | 37.4            | 37.6            |
| Mana_9c          | -1.6           | -2.5              | -10.9              | -10.9              | -10.9              | -7.4               | -10.5              | -14.9                     | -10.9           | -10.9           |
| Mana_8d          | 37.9           | 34                | 29.9               | 29.9               | 29.9               | 32                 | 31.2               | 13.3                      | 29.9            | 29.9            |
| Mana_1c          | 75.8           | 75.8              | 75.7               | 75.7               | 75.7               | 75.8               | 75.7               | 75.7                      | 75.7            | 75.8            |
| Mana_8b          | 51.5           | 48.3              | 46.7               | 46.7               | 46.7               | 47.5               | 47.2               | 30.1                      | 46.7            | 46.7            |
| Mana_8c          | 57.9           | 55                | 53.8               | 53.8               | 53.8               | 54.4               | 54.2               | 40.9                      | 53.8            | 53.8            |
| Mana_1a          | 63.2           | 62.9              | 61.4               | 62.1               | 61.7               | 62.3               | 61.8               | 60.6                      | 62.3            | 62.5            |

| Assessment point | Pre-regulation | Post Regulation A | Proposed Consented | Proposed Pathway A | Proposed Pathway D | Proposed Pathway E | Proposed Pathway F | Proposed Consented Strict | Dairy Pathway A | Dairy Pathway B |
|------------------|----------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------------|-----------------|-----------------|
| Mana_2a          | 7.7            | 7.2               | -1.1               | 3.3                | 1.3                | 3.8                | 1.5                | -3.8                      | 3.4             | 4.2             |
| Mana_5b          | 9.8            | 6.1               | -6.2               | -5.5               | -6.2               | -1.3               | -4.3               | -18.6                     | -3.6            | -0.4            |
| Mana_5a          | 20.1           | 18.9              | 11.7               | 15.3               | 13.6               | 16                 | 13.9               | 8.2                       | 15.7            | 16.6            |
| Mana_6           | 19.9           | 18.1              | 12.9               | 14.7               | 13.9               | 15.9               | 14.4               | 6.3                       | 14.9            | 15.4            |
| Mana_7b          | 33.4           | 31.2              | 29.1               | 29.1               | 29.1               | 30.2               | 29.6               | 20.8                      | 29.1            | 29.1            |
| Mana_9a          | 32.3           | 30.9              | 25.8               | 27.2               | 26.5               | 28.7               | 27.1               | 20.7                      | 27.3            | 27.7            |
| Mana_10a         | 15.5           | 13.9              | 7.9                | 9.3                | 8.6                | 11.2               | 9.4                | 2.4                       | 9.5             | 9.9             |
| Mana_11a         | 30             | 29                | 24.5               | 25.4               | 25                 | 26.9               | 25.5               | 20.8                      | 25.5            | 25.8            |
| Mana_13a         | 27.3           | 26.5              | 21.8               | 22.5               | 22.2               | 24.3               | 22.7               | 19.2                      | 22.6            | 22.8            |
| Rang_4d          | 25.8           | 24.2              | 26.8               | 26.8               | 26.8               | 26.8               | 26.8               | 26.5                      | 26.8            | 26.8            |
| Rang_4c          | 73.8           | 73.5              | 73.7               | 73.7               | 73.7               | 73.7               | 73.7               | 73.7                      | 73.7            | 73.7            |
| Rang_4a          | 8.4            | 7.3               | 8.8                | 8.8                | 8.8                | 8.8                | 8.8                | 8.6                       | 8.8             | 8.8             |
| Rang_4b          | -37.3          | -39.1             | -36.8              | -36.8              | -36.8              | -36.6              | -36.8              | -37.1                     | -36.8           | -36.8           |
| West_8           | 92.4           | 92.5              | 91.7               | 91.7               | 91.7               | 92.2               | 91.9               | 91.7                      | 91.7            | 91.7            |
| West_9b          | 74.2           | 73.2              | 72.4               | 72.4               | 72.4               | 72.8               | 72.4               | 70.3                      | 72.4            | 72.4            |
| West_5           | 93             | 92.7              | 93.2               | 93.2               | 93.2               | 93.2               | 93.2               | 92.7                      | 93.2            | 93.2            |
| West_4           | 89.1           | 89.1              | 89.5               | 89.5               | 89.5               | 89.8               | 89.6               | 89.5                      | 89.5            | 89.5            |
| West_9a          | 37.8           | 35.3              | 31.9               | 31.9               | 31.9               | 33.8               | 32.5               | 26.7                      | 31.9            | 31.9            |
| West_6           | 91.8           | 91.3              | 87.8               | 87.8               | 87.8               | 89.7               | 88.4               | 87.5                      | 87.8            | 87.8            |
| Mean value       | 44.1           | 42.9              | 39.1               | 40.4               | 39.8               | 41.4               | 40.2               | 35.1                      | 40.5            | 40.9            |