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Memorandum

TO	Paul Barrett	FROM	Neil Thomas, Laura Drummond, Hilary Lough
	Hawke's Bay Regional Council	DATE	5 May 2022
RE	Review of further information for applications to take and use Ruataniwha Tranche 2 groundwater		

1.0 Introduction

Pattle Delamore Partners Limited has been engaged by Hawke's Bay Regional Council to assist with the technical review of a group of applications to take and use Tranche 2 groundwater from the Ruataniwha Basin. These applications propose to take deep groundwater (Tranche 2 groundwater defined in the decision on Plan Change 6 for the HBRC Regional Plan) from bores in the Ruataniwha Basin. The various applications have been lodged individually (since 2014), although an updated assessment of environmental effects was provided in 2021, which superseded and replaced the individual assessments that were lodged by each of the eight applicants. The updated assessment of environmental effects (AEE) was provided to HBRC on 23 August 2021.

PDP had previously reviewed information provided for the individual applications. We subsequently reviewed drafts of the technical reports prepared to support the updated combined AEE and provided comments on these (PDP, 2020 and PDP, 2021a) and the updated AEE (PDP, 2021b). Since that time further information relating to the potential effects of the application has been requested and provided. The application was publicly notified in December 2021 and a number of submissions were received both in support of, and opposing, the application.

Our review of the updated AEE prior to notification was completed in September 2021 and the applicant responded to comments in that review. In addition to the further information provided on the groundwater take and use applications, at the request of HBRC, information was provided on nutrient losses related to production land use consents required for the properties. This memorandum provides a summary of the key issues with the applications in terms of the potential effects on the environment and provides comments on whether the additional information provided by the applicants in November 2021 addresses those issues. PDP is preparing a separate memorandum addressing the land use information.

1.1 Summary of application

The applications propose to take and use deep groundwater (Tranche 2 groundwater defined in the decision on Plan Change 6 for the HBRC Regional Plan) from bores in the Ruataniwha Basin. The decision defining Tranche 2 groundwater also specifies that the water can only be allocated if the consent holder augments surface water flows with the intention to ensure that stream depletion effects that could arise as a result of groundwater abstraction are mitigated.

A summary of the applications is provided in Table 1 below.

Table 1: Summary of Tranche 2 consent application volumes

Application Number/s	Applicant Name/s	Total Tranche 2 Volume (m^3/year)	Irrigation Volume (m^3/year)	Augmentation Volume (m^3/year)	Original total volume sought (m^3/year)
WP140512T	Te Awahohonu Forest Trust (TAFT)	4,914,920	2,841,220	2,073,700	4,914,920
WP150016T	Springhill Dairy Partnership	1,005,213	588,313	416,900	1,005,213
WP150044T	Tukituki Awa Ltd	636,600	607,000	29,600	952,400
WP160193T	Plantation Road Dairies	3,751,225	2,418,225	1,333,000	3,751,225
WP140555Tb APP-124498	Papawai Partnership	1,475,517	1,010,817	464,700	1,475,517
WP170155T APP-124500	I&P Farming Limited	1,200,010	916,010	284,000	1,200,010
WP170166T	Buchanan Trust No. 2	1,145,794	786,594	359,200	1,145,794
APP-125281	Purunui Trust	554,921	370,321	184,600	554,921

The key conclusions from our August 2021 review of the application are repeated below.

The Tranche 2 applications represent a relatively large scale increase in the volume of water that may be abstracted from the Ruataniwha Basin. We recognise that the Tranche 2 applications will not all be utilised immediately and that there will be a lead in period as infrastructure is developed. In addition, the effects presented in the application are intended to represent a 'worst case' where irrigation occurs at full capacity during a dry year. However, we also note that the Tranche 1 groundwater takes are not yet fully utilised i.e., there is water that has been consented but is not yet used, so therefore there are additional consented effects that could occur outside the effects from the Tranche 2 takes, in addition to climate change.

Much of the assessment provided in the application is based on the results of a numerical groundwater model that was developed to represent groundwater and surface water interaction within the basin. In general, although there is uncertainty with any model that represents a real world system, the model is considered appropriate at a broad scale and reasonably represents flows in the Tukituki and Waipawa Rivers at the basin outlets. Accordingly, the predictions from the model regarding the effects of the Tranche 2 takes and the effects of the proposed augmentation approach at those sites are likely to be reasonable. These generally indicate that (up to the 1 in 10 year event level) the impact of the Tranche 2 takes on flows at the basin outlets (i.e. the Waipawa at SH2 and Tukituki at Tapairu Road flow sites) can likely be offset by the proposed augmentation including where a range of parameter values are considered. In our opinion, the overall impact of the proposed takes on flows at those flow locations is

likely to be relatively low based on the information provided, but effects in some years could be much greater if the consented augmentation volume is reached prior to or during low flow periods.

However, based on the information provided, the model appears to generally overestimate losses from, and underestimate gains to, streams within the basin, suggesting that the model parameters may not be accurate in some areas. The model is not calibrated to intra-basin flows and therefore this leads to uncertainty in the predictions from the model in terms of impacts on groundwater levels and stream flows within the basin. Furthermore, where there is no pumping test data to inform the model parameters, there is also additional uncertainty in terms of those parameters.

Predictions from the model form the basis of the assessment of drawdown interference effects and the assessment of effects on wetlands and local streams within the model and there is therefore uncertainty in those assessments. This uncertainty is not assessed in the application. In our opinion, there are also significant shortcomings in the methodology applied for the drawdown interference assessment, as well as the wetland assessment, which does not consider the ecological values of the potentially affected water bodies.

Based on the assessments of the individual applicant properties, drawdown interference assessments and assessments of potential effects on nearby streams and wetlands should be undertaken based on the results of site specific testing, including pumping tests. This is illustrated in several instances, where the modelled estimates of drawdown interference are not consistent with the results of pumping tests.

Overall, based on the information that has been currently provided, our view is that adverse effects on smaller streams, wetlands, existing abstraction wells and the main rivers during periods of low flows in very dry years could be significant and further assessment is warranted to address this.

2.0 Comment on further information provided by the Applicant

2.1 Summary of further information received

In regard to groundwater and the modelling to support the assessment of effects, the applicants have provided further information on four main areas including:

- Effects of abstraction on smaller streams and rivers
- Comparison between measured and modelled simulations of gaining and losing reaches of streams and rivers within the basin
- Drawdown interference effects between bores
- Efficient use

Neil Thomas has provided summary comments on these aspects in sections 2.2 to 2.4 of this memorandum. Laura Drummond has reviewed the information provided related to surface water quality and ecology in section 2.5, while Katherine McCusker is currently undertaking a review of the proposed use of water and nutrient losses and this will be provided in a separate memorandum.

2.2 Effects of abstraction on smaller streams and rivers

In their response to the Section 92 request (October 2021), Aqualinc note that a numerical model that allows for varying stream locations relative to an abstraction point and other boundaries is likely to provide a more realistic assessment of stream depletion effects compared to an analytical model. Provided the numerical model is suitably calibrated to stream flows, in addition to calibration to groundwater levels, and the resulting hydrogeological parameters are representative, we agree that is generally true. We have not specifically recommended that analytical stream depletion modelling is carried out.

However, in this case, the model is not calibrated to flows within the Ruataniwha Basin. It is only calibrated to flows at the basin outlets, together with some groundwater levels within the basin. Furthermore, we note that the model only generally represents groundwater levels within the basin, such that the model represents observed levels within an 'envelope' of pumped and unpumped model scenarios. It is not calibrated such that it can necessarily represent the effect of pumping on flows in smaller streams and rivers within the basin with a reasonable degree of certainty.

Aqualinc have provided a table of modelled stream depletion effects on the major streams and rivers within the basin, both upstream and downstream of the augmentation locations and noted that generally, these are locations that are expected to experience the greatest and least (respectively) stream depletion effects. They have commented that the negative flow differences in the 7 day MALF are 'very small (1 to 10 L/s), less than both model and measurement precision' and represent 'negligible' differences.

However, in the context of the streams that are affected, these effects could represent a significant proportion of the flow. For example, Aqualinc have estimated stream depletion effects on the Mangaoho Stream upstream of the augmentation due to pumping from the Springhill Dairies abstraction as up to 7 L/s, yet based on NIWA flow modelling, the 1 in 5 year low flow in this reach of the Mangaoho Stream is around 50 L/s. We note that the effect from Springhill Dairies would be in addition to any existing effects.

Therefore, in our opinion, there is uncertainty in the assessments provided by Aqualinc and effects on smaller streams and rivers are potentially significant relative to the flows in those streams. The additional information provided does not allay this concern, although further information to demonstrate that the model suitably represents the local strata at all locations and local groundwater and surface water interaction would be helpful to increase confidence in the model.

One further issue regarding the effect of augmentation is that the modelling carried out by the applicants is based on all the abstractions occurring together and all the augmentation discharges occurring simultaneously. However, the augmentation volumes for each applicant do not appear to be set to offset each individual's stream depletion effect but instead are set to offset the combined stream depletion effect of the takes. The application also notes that irrigation and augmentation volumes will increase progressively across each applicant's property as irrigation develops.

Therefore, there is some further uncertainty in how the augmentation will work in practice as the irrigation development will be staged, but the staging is unlikely to be uniform across all the applicants' properties. Consequently, as some of the applicants provide a greater proportion of the augmentation water compared to others, the volume of augmentation water available will not be uniform and may not always be sufficient to address the stream depletion effects at some locations until, and if, full development occurs. Some consideration of this issue would be helpful together with an approach to address this issue should it arise.

2.3 Gaining and losing stream reaches

In our review of the AEE in September 2021, we noted that the pattern of modelled gains and losses to and from streams within the Ruataniwha Basin indicated that the model over-represented stream losses and underestimated stream gains. In our opinion, this pattern of discrepancies implies that the modelled pattern of streambed conductances may not be correct. Consequently, whilst the overall model calibration to the flows out of the basin may be reasonable, the modelled impact on flows within the basin has greater uncertainty.

Aqualinc have commented that although the flows may not be precisely modelled within the basin, the model has been used to estimate changes in flows and the effects of stream depletion is the same whether abstraction causes additional seepage through the river bed, or reduces the volume of groundwater that discharges into the stream. Therefore, Aqualinc comment that the differences between the modelled pattern of flow gains and losses is immaterial.

Aqualinc's comment is only true if the cause of the difference in modelled and measured flows is due to differences in groundwater levels and assumes that the streambed conductance value in the model is correct. In our opinion, the modelled streambed conductances may not be correct (in addition to storage and hydraulic conductivity values), and therefore the modelled stream depletion is uncertain.

As above, although it is helpful that effects on individual streams have been calculated using the model, the further information provided by the applicants does not fully cover this concern.

2.4 Drawdown interference effects

In our September 2021 review, there were a number of key concerns regarding the drawdown interference assessment provided in the AEE. Those concerns included:

- Estimating drawdown interference based only on one model layer (layer 6)
- Inaccurate estimation of seasonal water level changes to estimate available drawdown in neighbouring bores
- Use of an arbitrary threshold of 20% for drawdown interference effects.
- No consideration of cumulative effects

Aqualinc have provided some further information regarding these points, particularly around estimating drawdown interference based on a representative model layer and also undertaking drawdown interference assessments on some neighbouring bores based on site specific parameters.

The further information provided by Aqualinc regarding site specific parameters is helpful and comparison with the modelled results helps to provide a range of potential effects due to the individual effect from each abstraction. Aqualinc notes that they have used peak flow rates from each bore, which represent extreme effects that are unlikely to occur. Although that may be correct, it is important to highlight that those are the effects that, if granted, the consents would enable. Therefore, to characterise these effects as extreme and less likely to occur is considered inappropriate in the context of assessing the potential environmental effects of the proposed take.

Aqualinc has presented updated drawdown interference assessments based on site specific parameters. In some cases, this has resulted in a change in the individual drawdown interference effects due to pumping from a particular bore. However, this assessment continues to use the same seasonal water level changes, the same 20% threshold for interference effects and a continued absence of cumulative effects

from other, neighbouring pumping, as in the original AEE reviewed in September 2021. No allowance has been provided for increases in the use under existing Tranche 1 groundwater consents.

Therefore, whilst the additional information is helpful, it does not address all of the concerns raised in our review from September 2021. As a result, concerns on the appropriateness of the drawdown interference assessment remain. In our opinion, these effects, particularly on shallow bores, are not defined with sufficient certainty for the magnitude of these applications.

In addition to the information provided by Aqualinc, some further information has also been provided by Bay Geological Services to assess the proposed discharge of augmentation water by Papawai Partnership. Papawai Partnership have proposed to discharge augmentation water to a 1.2 m diameter bore located around 560 m from the Waipawa River. The s92 request requested information on mounding effects and how effectively the proposed discharge would augment flows in the Waipawa River. An assessment of mounding effects has been provided, but no assessment of how the discharge will impact flows in the Waipawa River has been provided.

The mounding assessment is based on a simple analytical solution using Theis and based on local aquifer parameters. In general, this style of assessment is likely to result in a conservative estimate of mounding effects as the effect of the Waipawa River is not accounted for. The assessment indicates that mounding effects could reach around 0.4 m in neighbouring shallow bores, which, based on a reported depth to water of around 4 to 5 m is not expected to result in adverse effects on those bores. We note that it would be helpful if the groundwater levels in the neighbouring bores were compared with the likely stage elevation in the Waipawa River to confirm whether the river is likely to lose or gain in this reach. If the river loses water in this reach, the discharge may be less effective at maintaining low flows.

2.5 Surface water quality and ecology effects

As discussed in the sections above, in our opinion there remains considerable uncertainty in the assessment of effects on surface waterbodies within the basin. The proposed Tranche 2 groundwater abstraction applications have been modelled to result in a reduction in stream flows. The modelled flow reduction (stream depletion) is proposed to be mitigated through stream flow augmentation for the four major waterways impacted (the Waipawa, Tukituki, Tukipo and Mangaonuku rivers).

The augmentation discussed above is only proposed for the Waipawa, Tukituki, Tukipo and Mangaonuku rivers, although some of the discharges will occur to smaller streams to convey the water to these rivers. There are a high number of smaller streams, as well as wetland habitat, within the Tranche 2 area that could also be impacted by the proposed groundwater takes and no mitigation has been proposed for these systems. Figures showing the distribution of streams and wetlands in relation to the consent properties are attached to this letter report (Figures 1 and 2, respectively). While there is a modelled reduction in flows to some of these smaller streams, as well as water levels in wetland habitats, the AEE has described the effect as 'less than minor'. Based on our review of the provided information (including additional section 92 information), we do not agree with this conclusion.

During the initial review of the AEE, PDP requested further information/assessment be provided on effects to surface waterbodies including wetlands. In response Boffa Miskell were contracted by Sage Planning to undertake the following scope:

"broadscale mapping of potentially affected wetlands and small streams within the Ruataniwha basin that may potentially be affected by drawdown from the proposed groundwater takes, and provision of a preliminary statement of the anticipated effects of the proposed Tranche 2 groundwater takes on the ecological values of the wetlands and small-scale streams identified, including a broad assessment of the scale of sensitivity of effects on aquatic life given predicted changes in groundwater levels (e.g. the sensitivity of the water body to changes in water level etc.)".

Review of the Boffa Miskell report (Keesing, 2021) has resulted in further concern that adverse effects to surface water quality and instream ecological values could occur as a result of these applications and that there is a lack of certainty on proposed mitigation. To provide further clarity for the potential effects to waterways within the Tranche 2 area we provide Figure 1, attached, which illustrates the affected catchments, modelled mean annual low flows (MALF), and modelled depletion effects. The locations of the modelled impacts on stream flows are in line with the descriptions provided in Appendix A of the Aqualinc memorandum (30/10/2021), however the actual locations and magnitude of effects are uncertain and effects can be expected to extend upstream and downstream of the locations shown. In the following sections, information provided is summarised and information gaps identified related to potential effects to aquatic habitat from the Tranche 2 applications.

2.5.1 Major waterways

The table below (from the Aqualinc report dated 3/11/21 (pg 2)) summarises the proposed low-flow triggers and net changes in 7-day MALF for key river low monitoring sites. Augmentation is proposed as mitigation for the modelled effects. While technically this approach could result in a net balance of water within these target waterways, stream augmentation is typically used to mitigate/remediate existing effects to surface waterways where degradation in either flow volume or water quality (i.e., elevated nutrients) has occurred, with the augmented/additional water providing an increase in flow or dilution of contaminants. In this case, the augmented flow is proposed as specific mitigation for the predicted additional stream depletion effect from these applications, which in a catchment that is already impacted by reduced groundwater and surface water levels, and land use effects is considered risky. It is also unclear as to the upstream extent of stream depletion effects and how these will be mitigated above the augmentation location.

Site				
Waipawa at SH2	**Tukituki at Tapairu Rd**	**Tukipo at SH50**	**Tukipo at Ashcott Rd**	**Mangaonuku u/s Waipawa**
RRMP Table 5.9.6 minimum flow (l/s)				
2,500	2,300	150	1,043	1,170
Assumed low-flow restriction applied (l/s) (1)				
2,725	2,360	155	1,085	1,295
Change in mean 7-day annual low flow (MALF) (l/s)				
+3	+135	-1	+1	+2
Change in 7-day MALF as a percentage of low-flow limit				
+0.1%	+5.7%	-0.6%	+0.1%	+0.2%

(1) These are higher than current RRMP Table 5.9.3 limits to provide greater environmental benefit during low flows and to protect reliability of existing users.

2.5.2 Smaller Streams

The Boffa Miskell report (Keesing, 2021) has provided an assessment of effects that summarises the current state of streams within the Tranche 2 catchments (where information is known from previous studies) and provides a magnitude of effects in order to gain an overall 'level of effect' of the proposed

activity. This assessment generally follows the EIANZ impact assessment framework (Roper-Lindsay, 2018). While this type of methodology is often a transparent way to determine potential effects and propose mitigation, in this case there are too many sites and too many unknowns to provide a well-informed outcome, in particularly related to the 'magnitude of effect'. We also note that the latest data summary on these streams (Tukituki Catchment State and Trends of River Water Quality 2013-2018) has not been used to determine ecological value, instead, the 2003 report has been relied upon.

The report outlines the potential effects to smaller streams within the catchment, noting that they are "*generally in poor condition while retaining a hard bottom, generally lacking good riparian cover and diversity (willow in the main) and suffering summer low flow and even surface depletion*." This statement reinforces the need to retain flow within these smaller streams, which are important habitat for aquatic life and provide different habitat requirements to the larger streams where augmentation is proposed. As noted in the report, there is a strong presence of dwarf galaxiids (*Galaxias divergens*) in the New Zealand Freshwater Fish Database (NZFFD) records, which have the threat classification status of At Risk – declining (Dunn et al. 2018) and require habitat protection and enhancement, not reduction.

The report concludes that there will be a low (minor shift) in the magnitude of effects and the resultant level of effect will be very low/less than minor. We do not agree with this statement as the scale of potential effects has not been clearly and robustly assessed. Along with potential habitat reduction effects (reduced flow, reduced habitat availability), reduced flow during the summer low flow season could also result in increased periphyton and/or macrophyte growth, and subsequent effects to instream water quality such as reduced dissolved oxygen, increased water temperatures and smothering of streambed habitat.

We agree that seasonally drying/intermittent streams can have fauna adapted to seasonal responses (physical and behavioral responses); however, this proposed hydrological change is not natural and is modelled with a margin of error, therefore there is no certainty in effects for these streams and basic primary productivity and water quality effects have not been considered. The NPS-FM (2020) has strengthened the call for Te Mana O Te Wai and the need to put the health of the stream first. It is unclear how the potential effects from these applications will be mitigated, or even monitored.

2.5.3 Wetlands

Boffa Miskell conducted a desktop review and high-level walkovers to determine potential effects to wetlands within the Tranche 2 area (Keesing, 2021). The assessment has not used the HBRC wetland inventory (which was not available at the time of assessment) and only one wetland has been classified in the ecological report as a 'natural inland wetland' under the NPS-FM. There is no mention on the Inglis Bush Reserve and associated wetland, or riparian wetlands associated with potentially affected streams and rivers. The HBRC wetland inventory has been peer reviewed, but not ground truthed therefore it cannot be taken as a definitive list of wetland presence; however, a draft version has been made available, and we have provided in Figure 2 a high-level overview of the mapped wetlands in relation to the consent properties. There are a number of mapped possible wetlands adjacent to and downgradient of the consent properties that have the potential to be impacted. We note that many of the wetlands assessed in Keesing (2021) were considered as artificial/constructed and were not classified as not being 'natural inland wetlands' based on formal delineation following the MfE protocols, but based on the presence of some artificial components being present. Often, those 'man-made' systems will be modified natural wetlands, for example a landowner could have blocked drainage to create more open water, and wetland habitat (including flora and fauna) adapt to this new area. Therefore, consideration for their 'current' values should be included in the assessment.

Based on the assessments provided, we do not agree that there will be 'less than minor' effects on wetlands, as the assessment completed is too broad to robustly determine potential effects.

3.0 Conclusion

The information provided by the applicants in response to our review from September 2021 and the subsequent HBRC section 92 request is helpful. However, it does not address many of the key concerns we have raised regarding the potential impacts from the applications. Consequently, our conclusion regarding the application remains the same, that adverse effects on smaller streams, wetlands, existing abstraction wells and the main rivers during periods of low flows in very dry years could be significant and further assessment is warranted to address this.

4.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Hawke's Bay Regional Council and others (not directly contracted by PDP for the work). PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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Yours Faithfully

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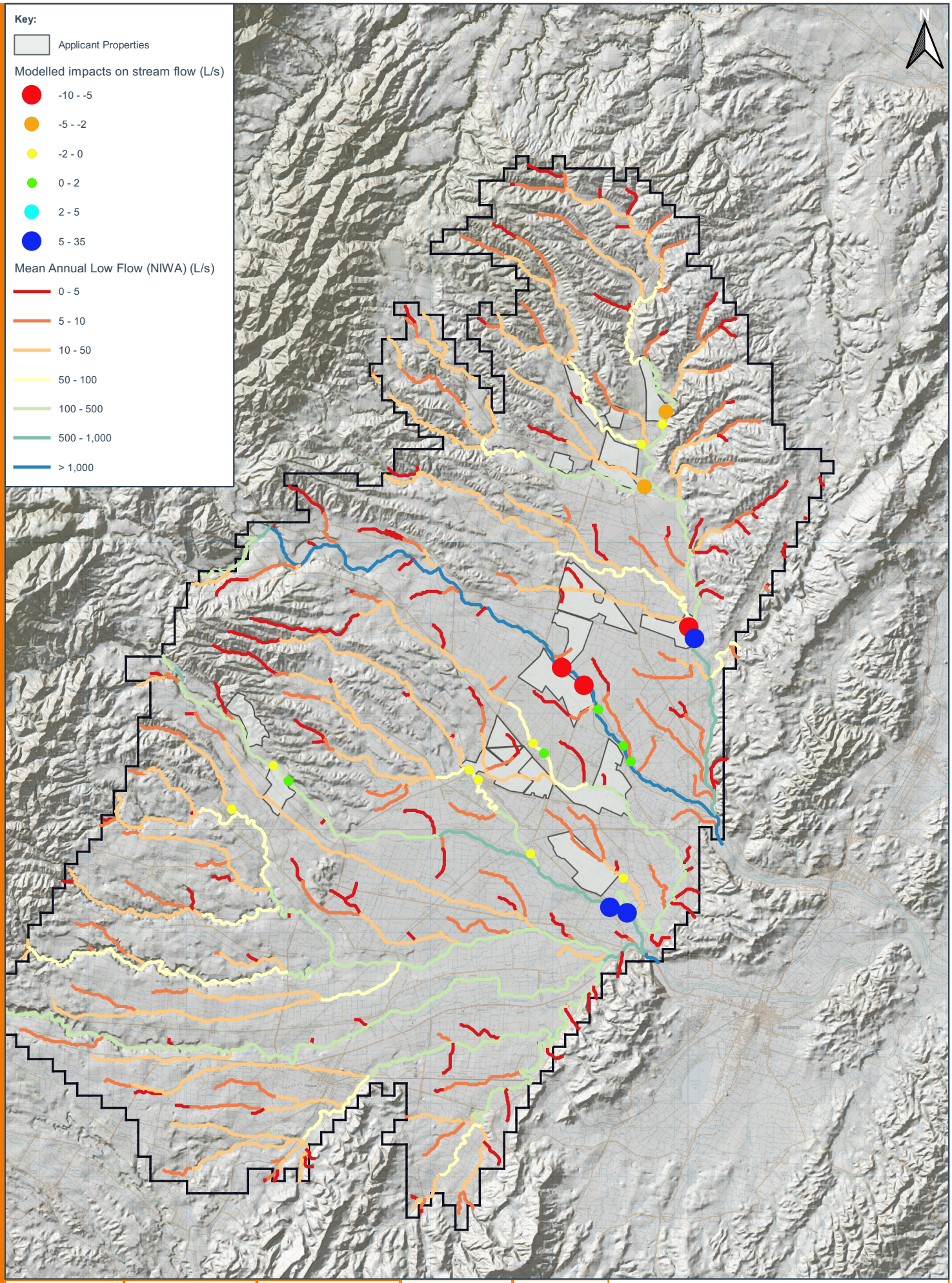

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2. LAYER 2: LINZ Topo 50 maps
3. LAYER 3: NIWA REC RIVERS

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FIGURE 1:

Low flow rates and modelled impacts upstream and downstream of augmentation discharges

PROJECT

Ruataniwha Tranche 2 Review

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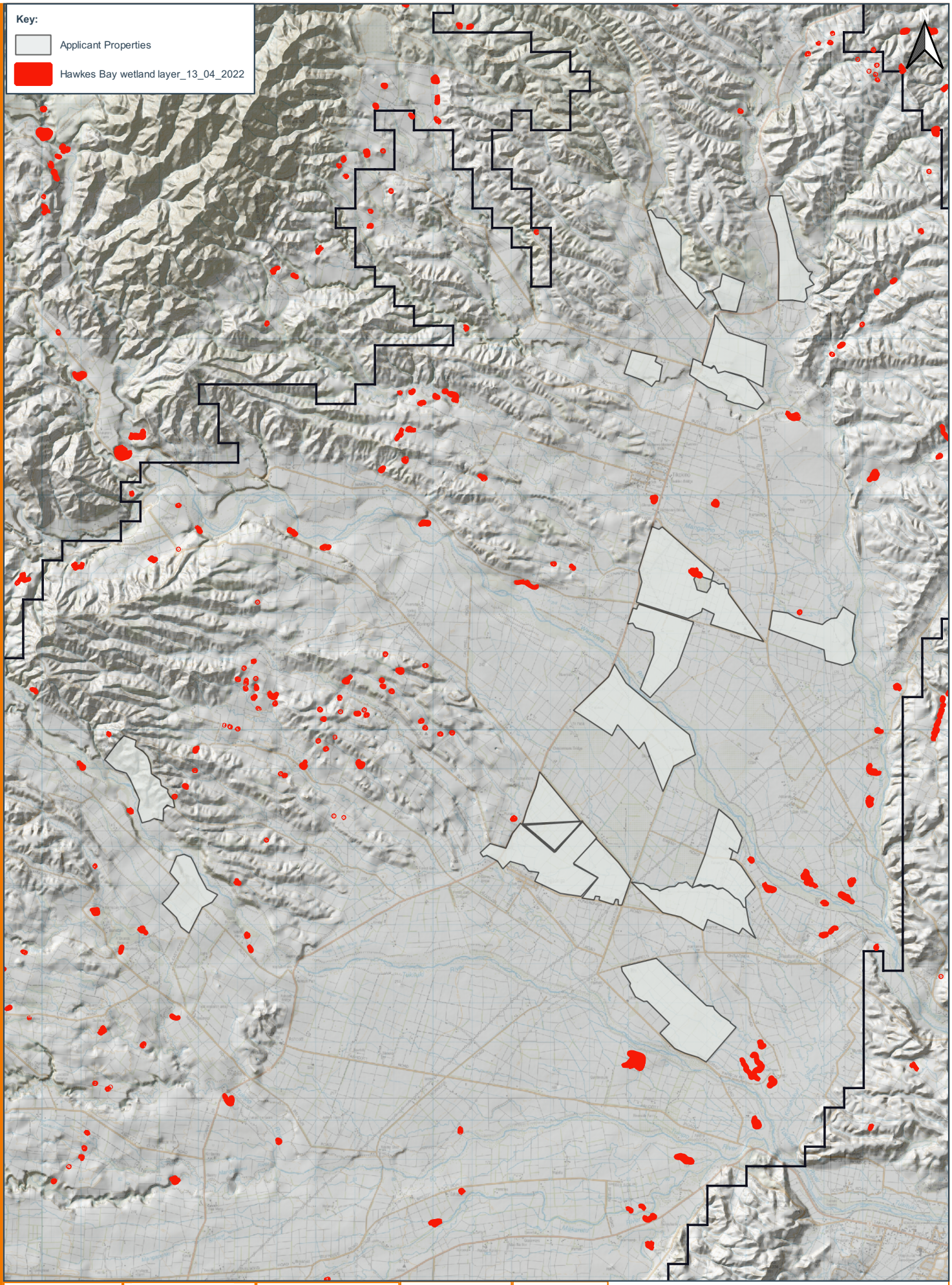

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FIGURE 2:

Locations of mapped wetlands (not to scale)

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Ruataniwha Tranche 2 Application Review