BEFORE THE NORTHLAND REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991 (the **Act**)
AND	
IN THE MATTER	22 resource consent applications for new Water Permits for the taking and use of groundwater and 2 applications for changes to consent conditions of current Water Permits from the Waihopo, Houhora, Other, Motutangi, Waiparera, Paparore, Waipapakauri, Ahipara, and Sweetwater aquifer management sub-units of the Aupōuri Aquifer, Northland

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REPLY EVIDENCE OF JON WILLIAMSON ON BEHALF OF THE APPLICANTS

DATED 21 JUNE 2021

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1. OVERVIEW

1.1 This following reply evidence is structured to address matters under the following headings in response to the residual concerns stated by the Department of Conservation (**DoC**):

(a) Response to criticisms of sufficiency of assessment of potential effects;

(b) Response to criticisms of sufficiency of monitoring regime to inform adaptive management; and

(c) Conclusion.

2. SUFFICIENCY OF ASSESSMENT OF EFFECTS ANALYSIS

General comment on DOC's right of reply

2.1 Mr Baker restates his thoughts on the Conceptual Setting and summarises his Position of Concern in [7] to [11]. In [9] Mr Baker asserts that "the system can be described as a discharge-driven system rather than a recharge-driven system."

2.2 In my opinion, the system is neither discharge driven nor recharge driven. Rather, aquifer pressures reflect the balance between recharge and discharge, with some locations such as along the east coast at Houhora, providing strong vertical confinement that facilitates artesian pressures in the deep aquifer when both recharge and the consequential hydraulic head (driving force) are high.

2.3 Perhaps this point sheds further light on the different conceptual understandings that Mr Baker and I have. My conceptual understanding is that water recharging forms the hydraulic head gradient that largely drives the rate of coastal discharge, in balance with the ability of the aquifer materials to transmit and store water. The vast majority of deep recharge is sourced within the sandy Aupōuri Forest area on the western side of the peninsula, evidenced by the lack of surface waterways in this area compared to the lower lying areas to the east i.e. rainfall infiltrates the sandy soils (except in dune lakes) within the forest area and percolates downwards and then moves laterally from the groundwater divide to both coastlines. Conversely, in the eastern side of the peninsula where surficial soils comprise greater proportions of silty sand, clay and peat, a greater proportion of rainfall is partitioned into surface runoff or shallow groundwater discharge that collects in drains and streams (**Figure 1**). Yet as stated above, within the deep aquifer in this location (eastern side), artesian pressure resides as a function of water recharging further inland under the Aupōuri Forest and then flowing eastward from the groundwater divide.

Figure 1. Map of the Houhora area showing the higher propensity of well-defined drainage pathways on the eastern side compared to under the Aupōuri Forest on the western side of the peninsula.

2.4 In [11] Mr Baker states "Pumping from the shellbed aquifer increases the volume of groundwater recharging into the deeper system from the overlying layers. The more pumping that occurs, the more vertical flow is induced (leakage). Over time this water drawn vertically must come from the shallow unconfined aquifer system".

2.5 I agree with this statement for areas that are directly hydraulically connected, but there are circumstances that add complexity to this simple conceptualisation, and the inference made from it. For example:

(a) ***Perched surface waters*** – Additional leakage cannot be induced from areas where perched water tables prevail, such as under elevated dune lakes;

(b) ***Spatial distribution of lower permeability materials*** – as indicated in [3] above, the eastern side of the peninsula comprises materials with greater proportions of silt, clay and peat, which provide a significant degree of progressive confinement with depth;

(c) ***Depth and storage effects*** - the steady release of water from storage within the thick overburden materials (~80 m) under pumping subdues the propagation of upward depressurisation;

(d) ***Spatial distribution of the orchard bores*** – the orchard bores are dispersed over a wide region and the consequential drawdown effect in the shallow aquifer even more distributed and subdued for the reasons mentioned in points i) to iii) above.

2.6 Consideration of these conceptual features of the aquifer and distribution of the takes over a wide area assists in explaining why the shallow groundwater and surface water impacts from deep pumping are predicted to be no more than minor in areas that are weakly hydraulically connected, and nil in areas that are perched such as dune lakes.

Stream Depletion Assessment

2.7 The comprehensive stream depletion analysis undertaken in my Supplementary Statement of Evidence (28 September 2020) supersedes any prior analysis done by myself or any other consultant on behalf of the applicants[1].

2.8 Mr Baker [17] states his concerns regarding "a lack of discussion of the residual uncertainty in relation to streamflow and baseflow". My analysis using the leaky aquifer model (Scenario 2) [2] is considered overly conservative. Even with this conservative approach, the stream depletion values are significantly under the level of hydraulic connection threshold in Policy H.5 for the "Other" category of 40%, ranging from 0% to 25%. If we applied a 50% increase to account for further residual uncertainty, all bores would still be less than the 40% threshold.

2.9 At [22a] Mr Baker places reliance on the Northland Regional Council's (**NRC**) Water Allocation Calculator. Throughout this assignment and other projects my company has undertaken in Northland over the last 2 years we have encountered numerous examples of where the allocation calculator is presenting incorrect information. For example, takes in incorrect catchments, high flow takes counted as part of core allocation (low flow), and allocations for stock drinking water, when the properties have been converted to horticulture. Consequently, NRC has taken down the

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1 Mr Baker [18] in reference to the analysis undertaken using the Hunt & Scott analytical tool for P&G Enterprises.

2 Recall, Scenario 2 is a leaky aquifer setting assuming limited confinement, whereas Scenario 3 assumes a much stronger degree of confinement, which has the effect on increasing deep aquifer drawdowns, but reducing vertical leakage and potential shallow aquifer drawdown.

calculator as explained on its website[3]. I understand project funding has been granted to upgrade the calculator.

2.10 In [26] Mr Baker expresses concern that the approach of assessing stream depletion effects without having drilled or tested the production bores may underestimate these effects. He references Policy H.5 sub-clause 2, which states: "*2) Representative hydraulic properties for assessment of the magnitude of surface water depletion will be derived from aquifer testing as well as assessment of representative values from the wider hydrogeological environment*;". Mr Baker infers that this drilling and testing should be undertaken prior to the consent being granted.

2.11 During the processing and Council hearing for the Sweetwater Station irrigation takes consent application in 2010, the arguments of the Applicant were accepted, in that further testing would not significantly alter the findings presented in the work completed to date, due to the existing knowledge of the aquifer system (18 tests had been undertaken at that time) and the fact that variability in shellbed aquifer parameter values is relatively low.

2.12 Since 2010, numerous additional test pumping exercises have been undertaken[4]. These values were taken as "representative" as required by Policy H5 and utilised in the groundwater model underpinning the effects assessment for these applications. Therefore, I consider the analysis performed using the groundwater model is the most appropriate representation at this point in time of what would occur.

2.13 As noted in Ms Letica's Reply Evidence [3.7], the NRC may impose a consent condition for test pumping of the production bores following bore construction (separate permit) but prior to exercising of the water take consent, should they deem it necessary. However, as indicated above, I think this has limited value other than providing the bore owner with comfort on their bore's hydraulic performance and setting a benchmark to compare future bore performance.

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3 *Indicative Groundwater and Surface Water Allocation Maps: Due to issues with the data presented in the Indicative Groundwater and Surface Water Allocation Maps they have been temporarily disabled. We are working to resolve this issue as soon as possible. Our apologies for the inconvenience. https://www.nrc.govt.nz/your-council/about-us/council-projects/new-regional-plan/indicative-water-quantity-allocation-maps/#Indicative%20surface%20water%20allocation

4 Jon Williamson EIC for the MWWUG Applications. [12] and [56].

3. MONITORING REGIME TO INFORM ADAPTIVE MANAGEMENT

Adequacy of proposed monitoring

3.1 Mr Baker, at [35]-[36], suggests that water level monitoring should be undertaken in all identified wetland Area of Interests (**AOIs**). I consider this approach to be unnecessary in the context of:

(a) **Location of proposed monitoring** - The locations of monitoring proposed are:

(i) adjacent to the areas with the greatest proposed cumulative pumping; and

(ii) within the shallow aquifer, which will detect local changes in shallow groundwater level prior to any changes occurring in the overlying wetlands i.e. the "canary in the mine" analogy.

(b) **Degree of risk** – the majority of the wetlands identified as moderate to high risk that are located some distance from the areas of greatest cumulative pumping were only picked up in the screening due to the overly conservative risk matrix utilised. [5] I expressed my concern during witness conferencing with the assignment of 'moderate' risk to areas where shallow aquifer drawdown was between 0 and 0.1 m, recommending an alternative criterion where in my opinion the magnitude of drawdown is minor. [6] The reason for this is that the drawdown was calculated for the change in groundwater level within the shallow aquifer rather than for the standing water body itself. However, the manifestation of that change in groundwater level within an adjoining surface water body would be significantly less due to the effect of aquifer porosity. Responding to this point during the MWWUG hearing, Mr Baker agreed with the Commissioners' that if maximum drawdown in the aquifer was 0.2 m, the change in a standing water level (i.e. water sitting at the surface of the wetland) would be an order of magnitude less (i.e. 0.02 m) due to the effect of porosity. [7] It was agreed that the risk criterion proposed by DoC would be used as an initial screen, with further review of the cut-off for 'low' risk once the analysis was completed and comment

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5 Memorandum of Counsel for DOC 14 September 2020. Risk evaluation matrix PDF pg 5.

6 JWS dated 22 September 2020 [2].

7 Right of Reply Evidence of Jon Williamson for MWWUG. [19]

provided by other DoC experts[8]. This further review of the risk criterion was not undertaken, hence the list of agreed AOIs is conservative.

3.2 At [37] Mr Baker also requests three additional shallow groundwater and one wetland monitoring piezometers, which I respond to below:

(a) **AOI "M"**. I disagree with this request since the magnitude of shallow aquifer drawdown at the height of the largest drought is approximately 0.1 m, and as stated above this would relate to a maximum change in any standing water body in this area of 0.01 m (10 mm).

(b) **New Wetland Piezometer**. I disagree that an additional piezometer is required in the wetland because:

(i) predicted drawdown in the location proposed is insignificant;

(ii) the MWWUG have installed two sites in the wetland that provide adequate coverage, and DoC itself is already monitoring nine additional sites not shown on these maps, but known to be located within the northern end of the wetland;[9]

(iii) monitoring to date (through one of the most severe droughts in the last 50 years – 2019/2020 summer) does not indicate any clear potential for adverse effects on Kaimaumau Wetland (if anything the reverse); and

(iv) as a consequence of the monitoring to-date in the wetland, Mr Hughes during the Stage Implementation Monitoring Programme Review (**SIMPR**) for the MWWUG[10] recommended that the Southern wetland site could be removed because it behaves in the same manner as the Northern and therefore provides limited value from a cost-benefit perspective.

In [55] Mr Baker refers to **analysis** undertaken by Mr Blyth regarding DOC sites KM3 and KM4 to justify another wetland monitoring site. I am not aware of the analysis undertaken by Mr Blyth, but my own analysis of piezometers

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8 JWS dated 22 September 2020. [2].

9 Right of Reply Evidence of Mr Baker. [58]

10 Hughes, B (2020). Motutangi-Waiharara Water User Group. Staged Implementation and Monitoring Programme Review. Land and Water People (LWP) report prepared for Northland Regional Council.

KM3 and KM4 was discussed in Williamson (2020)[11] attached to my Evidence in Chief:

> *"the proximity of the monitoring locations to external drains and internal wetland swales or streams have implications for the observed oscillatory response. For example, KM3 is located approximately 5 m from the Bacica Drain, while KM4 and KM7 are located approximately 30 m from the drain. Consequently, the range in oscillatory response is dampened in KM3, particularly as receding water levels occurred during the drought, which is presumably due to flow from upstream and outside of the wetland maintaining water levels."*

This analysis indicated that the water level behaviour of piezometers KM3 and KM4 is strongly influenced by drain flows, which explains why they behave differently to the piezometers located further into the wetland itself and away from external surficial influences.

(c) **AOI "P" and "J"**. This location is unnecessary because the closest AAWUG production bore is located 1.7 km to the west, there are already two shallow monitoring piezometers 1-2 km away at Norton Road and Honey Tree Farms, and the wetland ecological survey will provide adequate surveillance of any potential impacts.

(d) **AOI "G"**. This is unnecessary because the location is ~3 km from nearest production bore, and the wetland ecological survey will provide adequate surveillance of any potential impacts.

Allowing Stage 1 Pumping to Occur in Absence of a Baseline

3.3 Mr Baker at [39] to [45] expresses concern regarding whether 'Stage 1' pumping should be allowed while gathering baseline data. His concerns are based on the experience from the MWWUG consenting process [39]- [41]. In my opinion the concerns surrounding the MWWUG are not applicable to the Northern Group and the Southern Group because both these areas have long term shallow and deep groundwater level monitoring established through the NRC monitoring network dating back to the late 70's and early 80's. Furthermore, the Southern Group has

11 Williamson, J., 2020. Kaimaumau Wetland Modelling Report. Assessment of Wetland Water Level Behaviour. Report prepared for the Motutangi-Waiharara Water User Group. [Section 2.2]

the benefit of an additional extensive groundwater level monitoring dataset collected as per the consent conditions for Sweetwater Station since 2016. With regard to the Middle Group, the baseline has now been established through the MWWUG monitoring, hence this is also not a relevant consideration for this application.

The Setting Of Trigger Levels

3.4 Mr Baker expresses concern at [51] to [60] with the approach taken in the MWWUG to the setting of trigger levels. I do not share this concern and considered the approach taken by Mr Hughes (LWP) [12] to be pragmatic and appropriate.

4. CONCLUSIONS

4.1 Pumping of the deep aquifer has the potential to induce vertical flow or leakage from the aquifers above, however the spacing of bores across a wide region and the conceptual hydrogeological setting of the aquifer provides mitigation of direct effects on surficial water bodies. In particular, dune lakes are perched (hydraulically disconnected) from the shallow aquifer, the depth of the bores typically being 80 m to 120 m below ground level means that water is released from the layers of overburden materials during pumping rather than being directly sourced from surface water bodies.

4.2 Stream depletion effects were calculated using the leaky aquifer model, which I consider to be overly conservative. Even with this conservative approach, the stream depletion values are significantly under the threshold of hydraulic connection in Policy H.5 for the “Other” category (40%), ranging from 0% to 25%. If we applied a 50% increase to account for further residual uncertainty, all bores would still be less than the 40% threshold.

4.3 Mr Baker expresses concern that the approach of assessing stream depletion effects without having drilled or tested the production bores may underestimate these effects, and infers that this should be undertaken prior to the consent being granted. This concern draws from Policy H.5 sub-clause 2, which states that representative aquifer values should be utilised in assessing stream depletion effects. However, I consider that “representative” aquifer parameters have been used in the stream depletion analysis. Further testing would not markedly change this analysis as the shellbed aquifer hydraulic properties reside within a narrow

[12] Hughes, B (2020). Revised Trigger Levels for MWWUG Consents. Land and Water People (LWP) report prepared for Northland Regional Council.

range and numerous tests have already been undertaken to inform the "representative" value range.

4.4 Monitoring in every AOI is not warranted because the shallow aquifer monitoring proposed by Mr Hughes adequately provides surveillance and an appropriate level of protection to the AOI's given their proximity to the heaviest pumping, hydrogeological setting and predicted drawdown, hence the level of residual risk is low. The residual risk can adequately be monitored through the ecological surveys proposed under the GMCPs.

4.5 The three additional shallow aquifer and one additional wetland monitoring piezometers proposed by Mr Baker are not warranted because adequate coverage is already proposed by Mr Hughes for the NRC. These additional locations requested by DoC are not cognisant of their proximity to the heaviest pumping and largest predicted drawdown, hence do not reflect that the level of residual risk is extremely low i.e. the sites requested have a much lower level of residual risk than the sites Mr Hughes has identified.

4.6 Stage 1 pumping can occur whilst the baselines are being established in the Northern and Southern groups because long term shallow and deep groundwater level monitoring are available through the NRC monitoring network dating back to the late 70's and early 80's. The concerns surrounding the Middle group are not valid now as the baseline for these was established during the MWWUG process.

4.7 In my opinion, the approach taken for the setting of trigger levels by Mr Hughes on behalf of the NRC is pragmatic and appropriate.

DATED this 21ST day of June 2021

Jon Williamson

Hydrogeologist for the Applicants