Response by Dr Mark Gyopari (on behalf of Greater Wellington Regional Council) to Statement of Jon Williamson for the Wairarapa Water Users Society, and Ongaha Farms Limited (28 August, 2017)

5/9/17

Subject area A: Accuracy and appropriateness of groundwater category maps

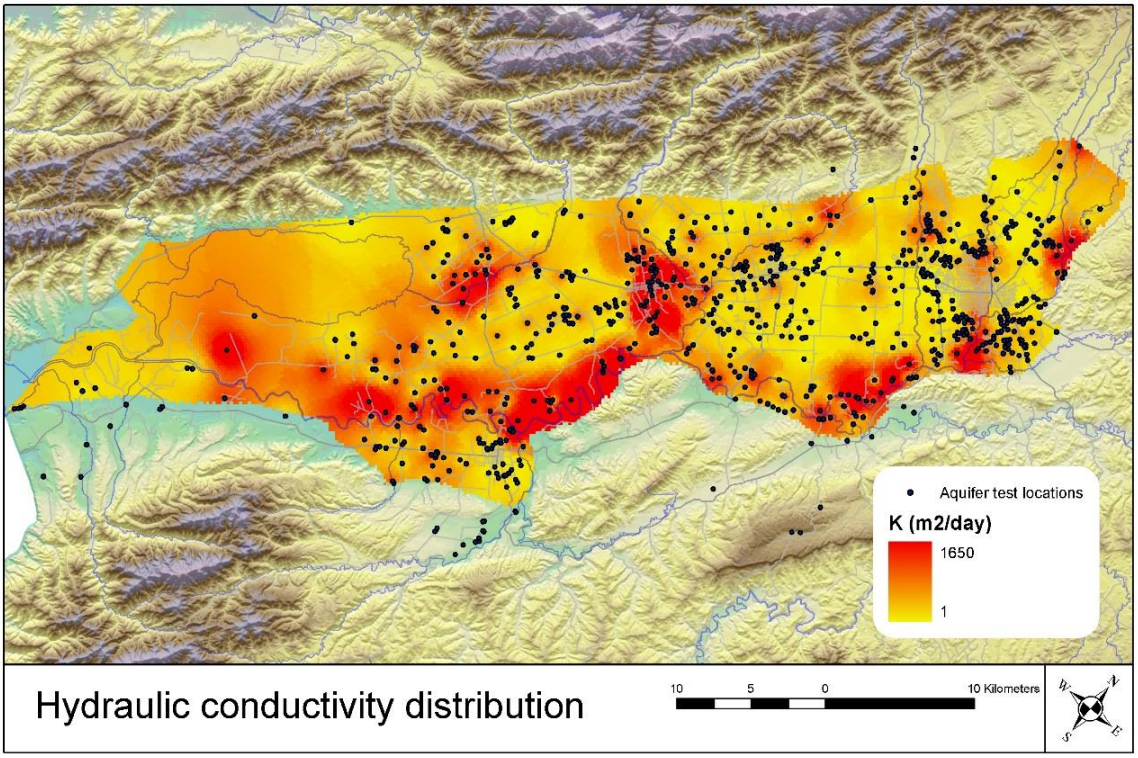
Mr Hughes will also address this theme. My responses are as follows:

Para 44: Issue: Definition of Category A boundaries is flawed

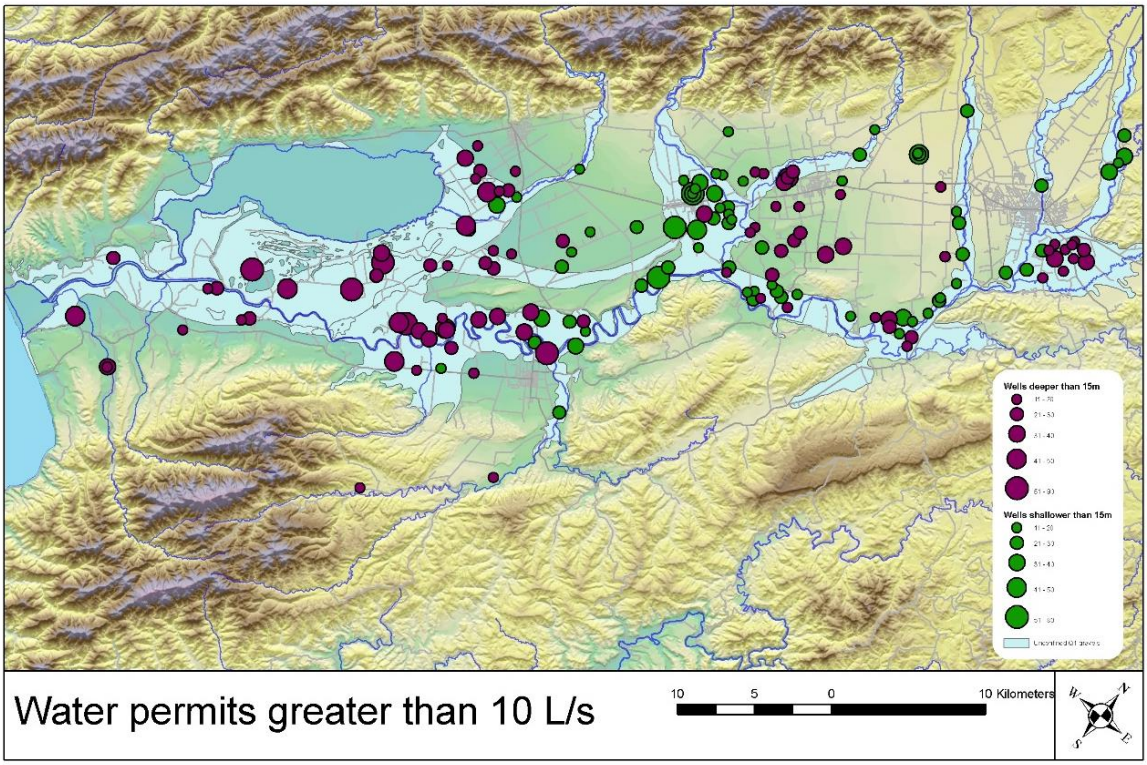
1. Para 44 (JW): Basis for the definition of Category A boundaries was largely based on the spatial extent of Q1 alluvium deposits. He considers this extremely inaccurate.

2. *MG response:* Mr Williamson is correct in saying that Q1 alluvium is a mixture of gravels/sands and silts – all river alluvium is. However, he does not acknowledge the very large body of information which shows a strong correlation between aquifer hydraulic conductivity (from bore tests) and bores yields which correlate closely to the Q1 alluvium in the Wairarapa Valley as documented in the technical reports.

3. The map below (taken from Jones and Gyopari, 2006) shows that, on a valley-wide scale, the highest permeability ('K') areas, shown in red, are restricted to areas mapped as Q1 alluvium – this is especially evident along the Ruamahanga flats, the Waiohine Plains, Tauherenikau River and in the Te Ore Ore area.



4. The following figure shows that all shallow high-yielding bores are located in Q1 alluvium (shaded light blue). The Wairarapa's most productive aquifers and largest irrigation takes are predominantly located in Q1 or Q2 aquifers in close proximity to rivers



5. Combined with the other evidence that Mr Hughes references (pumping test responses, water chemistry and groundwater modelling), this provides a good deal of confidence and justification for using the boundaries of the Q1 alluvium to delineate Category A areas.

6. I would like to add that some takes, particularly those located near the outer margins of mapped Cat A may have localised geological conditions which means they may not be Category A. The proposed Plan framework allows for re-classification where there are suitable hydrogeological reasons for doing so.

7. I therefore cannot agree with Mr Williamson's opinion that the use of Q1 areas to define category A areas is extremely inaccurate.

- **Para 45: Emphasis on observed losses and gain in river flows [for delineating Category A zones]**

8. *MG response*: It is unclear as to whether para 45 refers to whether Mr Williamson considers river gaugings were heavily relied upon for delineating Category A zones, or more generally to challenge whether they are robust enough to prove groundwater surface water interaction (I am assuming both).

9. Mr Williamson states that great emphasis was placed on the concurrent river flow gaugings for delineating Category A zones.

10. I reiterate my evidence (para 47): *'Surface water flows (river, springs and streams) are not uniformly characterised and groundwater-surface water fluxes tend to be focussed on low flow conditions. The accuracy in measuring groundwater exchanges with larger rivers, such as the Ruamāhanga River, are reduced by the difficulties associated with obtaining accurate flow gaugings. The gaugings do however provide good information concerning spatial patterns of flow losses and gains'*

11. Mr Williamson asserts that GW has relied on (or 'placed great emphasis on') the observed river loss/gain patterns (as displayed in his Figure 1) to define Category A zones. This is incorrect – Mr Hughes has clarified how the Category A areas were mapped which does not rely on the concurrent gauging data. The 'neutral', 'gaining' and 'losing' terminology in Figure 1 is merely qualitative and illustrates what the rivers were appeared to be doing at a particular moment in time. No quantitative meaning should be attributed to these terms.

12. The gauged river loss/gain information provides us with one strand of semi-quantitative information (amongst many) with which to conceptualise groundwater-surface water exchanges between surface water and groundwater. On some river reaches the information was considered more reliable than others when gauging error were taken into consideration.

13. The gauging data were only used to assist in the calibration of the models where they were assessed as being valid (i.e. outside gauging errors). I have always been cognisant in my reporting around gauging errors (all model reports show error bars e.g. Lower Valley modelling report Fig 7.33A-C). Mr Williamson's error bands in his Figure 2 are therefore by no means revelatory.

14. The river gaugings were 'snapshots' of what was happing in the river at the time (usually low flow) and have therefore been regarded to be indicative. Large rivers such as the Ruamahanga River are difficult to accurately gauge and the gauging results were always treated with caution – and appropriately weighted in any analyses.

15. In my view, the best way to comprehend groundwater-surface water connectivity under a range of flow regimes is through accurate simulation of shallow groundwater and river levels. The FELFOW models used a coupled river bed model ('MIKE11') in which the bed levels and stage height were accurately constrained. Providing the adjacent groundwater levels are accurately simulated using available monitoring sites – the flow loss patterns of the rivers can be accurately ascertained

under a range of flows. These can be compared to the measured loss and gaining patterns – but not verified by them.

16. The conjunctive surface-water groundwater modelling shows the complexity of groundwater surface water exchanges both in time and space.

17. I wish to add a final comment on this matter – we know that the groundwater basins in the Wairarapa Valley are largely 'closed' –groundwater does not flow out to sea, or to anywhere else outside the valley. From a simple water balance perspective, this means that all water that enters the plains aquifers (from rainfall infiltration, river bed losses) must leave through either surface water (in rivers and springs), groundwater abstraction or through evapotranspiration. All groundwater must therefore be eventually forced back in to the surface water environment at some point in time (or trapped in very deep aquifers). This means that groundwater and surface water are inextricably connected and interdependent – hence we observe complex and seasonally variable exchanges between groundwater and rivers. We are dealing with a single hydrological system.

- **Paras 48 to 72: Ongaha Farms technical consent information**

18. *MG response:* This information is specific to a particular consent application and is a copy of the detailed evidence provided by Mr Williamson for the ongoing appeal for a resource consent application by Mr Barton. I do not intend to comment further on this information as it is being addressed in a separate process and would detract from the purpose of this hearing. It contains the detailed technical arguments and interpretations of Mr Williamson for those specific bores, which I do not consider would assist this hearing.

- **Recommendations – Para 72**

Mr Williamson recommends a Category A to 10m depth and a Category C classification at >10m depth for the Lower Ruamahanga Groundwater Zone

19. *MG response:* I consider that the Lower Ruamahanga Groundwater is more complex than previous regarded on the basis of information provided during the Ongaha

consent application and this process. I am open to re-considering the surface water connectivity of this zone through collaborative modelling approach with the other experts to collectively agree on a scale of cumulative effects of abstraction from this zone (i.e., through expert conferencing).

20. The Lower Ruamahanga Zone is a small area in a much larger regional groundwater flow model. Interrogation of the detail in this area has revealed that the model could be refined. The proposed framework is designed to allow for on-going classification as new information becomes available.

21. It is my opinion at this stage that this zone is not a Category C zone, as suggested by Mr Williamson, on the basis of the hydrogeological configuration of the zone and the very high cumulative groundwater abstraction. However, the final outcome will be guided by the collaborative modelling results.

22. I am of the firm opinion that there is no evidence, and that we have no reason to believe, that there are issues with the model outside of the Lower Ruamahanga zone. The Category A zone in the Lower Ruamahanga is unique in that is partially covered by an aquitard layer – there are no other such zones with this characteristic. There are only three other Category A zones (Moiki, Middle Ruamahanga and Waoihine) – all are geologically simple unconfined shallow Q1 alluvial plains.

23. I strongly disagree with Mr Williamson's assertion in Para 29 that other areas (i.e. zones) may not conform to the current groundwater categorisation (presumably referring to the other Category A zones). This comment is purely speculative and is not evidence based.

Subject Area B: Challenges for water users seeking re-classification

Para 73: The pNRP does not provide detailed enough guidance around how a reclassification can be achieved.

Mr Williamson describes in detail the consenting process at Ongaha Farms and his frustrations around proving a low degree of river connectivity. I believe this description/experience is unique to the particular circumstances surrounding the Barton resource consent process. Therefore, I do not intend to rebut this part of his evidence as I do not consider that it belongs in this forum (paras 76-82).

Para 83 – Recommendations

Mr Williamson requests a more definitive methodology or list for reclassifying takes, or placing the PNRP process on hold to allow for a more thorough analysis of surface water connective in areas of concern.

24. *MG response:* I regard it to be reasonable to place on hold only the categorisation of the Lower Ruamahanga Groundwater Management Zone to allow for a collaborative review and possible reanalysis of this zone. I consider it would be of value to reach for consensual agreement regarding effects in this zone.

25. I do not consider it necessary to re-evaluate any other groundwater zone as the Category A connectivity issues relevant to the Lower Ruamahanga Zone are not present elsewhere.

Subject area C: Proposed guidance for re-classification

Paras (84-89): Mr Williamson proposed a scoresheet to help clearly define the degree of connectivity with the river and hence the take category.

26. *MG Response*: I have no objection to further developing a more comprehensive framework and methodology for reclassifying groundwater takes. I consider this an essential component of the adaptive nature of the allocation framework – that as new information is received users have a clear pathway for identifying which take category would be most appropriate. I consider Mr Williamson's scoresheet

proposal rather simplistic or 'black and white' and would potentially lead to some erroneous conclusions. Especially missing from the scoresheet proposal is the ability to assess an appropriate scale for evaluation (consistent with the size of the take and extent of drawdown effects) and an inability to place the take in a cumulative effects context. I consider that a higher level assessment such as provided in the proposed new schedule (Information required for the reclassification of a groundwater take category) could be developed through expert conferencing.

Subject area D: Thresholds for distinguishing between groundwater categories

Mr Hughes and Mr Thompson will respond to this section of Mr Williamsons evidence.

Subject Area E: Overview of GWRC's Approach to Groundwater Categorisation

In this section, Mr Williamson discusses his experience in the Ongaha Farm appeal process and his attempt to reclassify the groundwater takes from Category A to Category C.

27. Whilst I will not respond to the technical detail of this section (it being a copy of evidence presented to the Court for an appeal), there are some aspects I wish to comment upon which may assist this hearing.

28. With respect to Mr Williamson's comments around the applicability of the models at a local scale.

29. There may be some confusion around terminology in my evidence. I would like to clarify that I generally consider the models to be applicable/relevant at a sub-catchment or sub regional (i.e. groundwater zone scale). The geological characterisation upon which they are constructed is designed to be representative of a sub-catchment scale. This is because they are designed to examine the cumulative effects of groundwater abstractions within the groundwater management zones.

30. There will be inevitable localised inaccuracies in a complex hydrogeological area – all models have limitations, particularly in such a geologically complex area. It should

be appreciated that the Wairarapa Valley is extremely geologically complex and the geology incorporated in the models is the product of both hard evidence and judgement (i.e. numerous lengthy geological workshops with GNS scientists were held to provide the best possible interpretations). I regard the geological interpretations incorporated into the models encapsulates the collaborative understanding we had at the time of their construction.

31. However, there will always be opportunities to challenge interpretations at a local scale. When one small more complex area (i.e. the Lower Ruamahanga Groundwater Zone) is examined with greater scrutiny and more information provided, it may be necessary to revisit to assessment and modelling of that zone if the information is critical to the classification of the zone. This will inevitably occur as new information is received. The allocation framework is designed to be adaptable to new information. I believe that the models represent our best effort at representing the groundwater environment with the best information at the time.

32. I draw a distinction between 'local scale' and 'sub-regional scale' – the former being a farm scale or scale of a few kilometres or so. My evidence states (para 44) that the models have been designed to provide meaningful information at a groundwater zone (sub-catchment) scale and to simulate cumulative effects at this scale. I apologise if I have sometimes confusingly used the term 'local-scale sub catchments' in my evidence (meaning local to the regional scale, or just sub-catchment).

33. I also make the point that most large groundwater takes cause drawdown effects that extend many kilometres from the pumping site (estimated to be 5km + for the Barton takes). This means that it is more relevant or important to have a good representation of the groundwater environment at a sub catchment or catchment scale than a local scale. This is even more important when the cumulative effects of abstractions need to be considered – the response at the sub-catchment scale over-rides the local individual bore response when determining cumulative effects.

34. My evidence makes it clear that (para 41) that because fine geological detail and small-scale heterogeneity cannot ever be fully physically characterised, carefully considered simplifying assumptions must necessarily be made when constructing groundwater models. I go on to address the contention that the models cannot

represent local scale geological detail or provide confidence for the effects of a specific bore at a specific location through my response that:

- *The proposed allocation framework allows individual consent holders or applicant to undertake a site-specific analysis of effects, provided they are contextual with respect to the wider groundwater environment and take into consideration cumulative abstraction effects; and*
- *[In most areas] the shallow groundwater environment (up to 30-50m deep) is recognised to act as a single leaky interconnected groundwater system which exhibits a strong connectivity to the surface water environment. This means that local scale geological heterogeneity generally has little impact on how the groundwater environment functions and responds under abstraction stresses – particularly when cumulative effects are considered.*