

Submission of Dr W J Morris

1. I am Bill (Dr W J) Morris. I have lived in the village of Pukenui for fifteen years. In drought years I am dependent on the goodwill of a neighbour who has installed a stand pipe on the boundary to enable me to fill a tank with water from his bore. While at the moment, collection of rainwater is mostly adequate, I may at some time in the future feel obliged to put down a bore of my own.

2. I have been fortunate to have received a broad education in the natural sciences and am a Master of Arts and Bachelor of Medicine and Surgery of the University of Cambridge, with a few odds and ends of mathematics and Japanese language from Massey University. I have no expertise in hydrogeology, but have tried to read all the reports forwarded to me by the Regional Council with some degree of understanding. It has been no easy matter.

3. Before continuing, I ask for the indulgence of the Commissioners to reflect on the attitude of some applicants to this proceeding, as reported by Newshub on 6 July this year under the headline "Council Dragging its heels(sic)". They speak of a "drawn out process of dealing with the councils" that "creates uncertainty for growers." At the same time, they admit that they took a "multimillion dollar leap of faith," by putting down orchards before they had water consents and that the "Developments ...could be generating jobs that are sorely needed in Northland," without divulging how many full time, well-paid jobs are likely to be generated. Perhaps they have listened to politicians, or worse, believed them. They believe that regulation is excessive – for developers. In effect they are complaining that they have been dealt a bad hand because the cards are ill-shuffled, whereas in fact they chose the cards for themselves. This speaks to an arrogance that has offended and mobilised many members of the local community.

4. I am speaking for myself today, but believe that I also reflect some of the fears and aspirations of the community. There has been so much to absorb that I will on the whole confine myself to expressing concerns as they affect the Pukenui-Houhora area. If at times I appear to be impugning the integrity of the experts, it is through lack of learning and memory rather than malice, and I apologise in advance if I exasperate them.

5.1 There seems to be a fear that the water take from commercial bores will affect the ability of householders to access water from their own bores. Applicants, however, are inclined to say "There's lots down there and we want only a little bit." Mr Williamson is more nuanced and writes that the total applied for is 4.6 million cubic metres a year (Ms Letica says 6.23), *in addition to existing takes* (about 4.79 cubic metres per year) and that that may seem large to lay people. A little confusingly, he then jumps to litres per year, Olympic swimming pools and Lake Taupo. The total new take is then estimated to be 1.9 percent of the recharge, nearly all of which is by rainfall on the western part of the Aupouri peninsula.

5.2 We should note that nearly all these data are based on estimates. Even within the 75,000 hectares of the aquifer area, rainfall can show considerable local variation. Recharge estimates then have to take into account estimates of such things as ground porosity, evaporation, and leakage due to localised areas that are impermeable both above and within the sand beds above the saturated sand and shell beds. Climate change is estimated to result in hotter summers and will increase need for water, but has not been incorporated in the modelling as it is claimed that predicted effects fall within the existing range of inter-seasonal variation.

6.1 Mr Williamson has modelled the aquifer using mathematics suitable for computer analysis to solve otherwise unsolvable equations by complex numerical methods (MODFLOW). The inputs presumably use data from bore logs of drillers and from existing consented and sentinel bores over time. The computer then by repeated iterations constructs a model that eventually fits the inputted data, presumably also with interpolation of "ghost cells" where there are no data points. There are relatively few data points in the aquifer area and they are not scattered evenly throughout. Indeed, one submitter with wide expertise in geology and modelling of this type has described it to me as "dramatically under-sampled".

6.2 A point has been made repeatedly that the model fits the existing data well at a regional level, and it would be rather disappointing if it did not, since it is based on the existing data, but I would note that a large regional fault in the basement rock inferred to be present by magnetometer mapping, running across the northern part of the area from north-west to south-east and in parts 80 metres deeper on the western side than on the east, does not seem to feature in the modelling results of the aquifer (fig 15, layer 6. Modelling re-run reports). A model of course cannot represent every detail of that which is modelled, but if the data input is limited, as for the Aupouri aquifer, such detail as is present must necessarily be on a rather coarse scale, so that the sub-surface structure is certainly more complex than the modelling suggests. If all the errors of estimation conspire to be in the same direction, the actual state of affairs in the aquifer, it seems to me, may well be significantly different from the modelled recharge, pressures, flows, and topography of the aquifer.

7. There seem to be two threats to the sustainability of groundwater supply to the Pukenui-Houhora area: effects of excessive drawdown and potential for saline intrusion. Both are interlinked.

8.1 A glance at a map of existing and proposed commercial bores shows two areas of concentration to the north-west and south-west of the Pukenui village and, if other consented bores are added in, there is a concentration in and around the village.

8.2 The NRC Staff Report notes in s.60 (page 16) that existing and proposed takes would reach 97.8 percent of the allocation limit, which limit I understand to be 10 percent of the estimated recharge. It then refers to "cross boundary effects" from surrounding zones, which I take to mean that water flows from one zone of the aquifer to areas of reduced pressure that are due to draw down.

8.3 Mr Bryden Hughes in his independent report notes in s.7 that the NRC has developed a method based on a nominal radius of influence, scaled to reflect the volume for each take, and the NRC thus manages to reduce the take at Pukenui-Houhora to a suspiciously precise figure of 51.2 percent of the allocation limit. I have been unable to find anywhere in the documentation what the NRC method is, how the nominal area of influence is estimated, the likely rate of inward flow, how it is scaled and how or even if it has been validated.

8.5 Given the lack of data on the underlying geological conditions and on the groundwater system itself, I am not reassured that heavy pumping at the commercial bores will not affect smaller bores even when these bores are efficiently installed to the bottom of the relatively thin shell bed in the Pukenui area.

9.1 Mr Bryden Hughes in his review notes(s.5) that the "...area of high demand in the Houhora area is located up-gradient of the coastal Houhora Community, which relies on groundwater for its drinking supplies. It is important that the allocation of ground water consents does not induce saline water inwards towards these coastal supplies."

9.2 Most of Pukenui village lies at an elevation of 10 to 16 metres above the high water mark. The shell bed at a depth of about 80 meters is relatively thin. Little is known of the sub-surface geology and still less of that beyond the shoreline, and the modelling ends there. There is no knowledge about where the saline-water interface lies, but it is likely to be close to the shore line. It cannot lie beyond the eastern shore of the Harbour. Five bores around Pukenui have recorded chloride levels in the range of 50 to 100 g/M<sup>3</sup> and this is an appreciable fraction of the guideline for potability of less than 250 g/M<sup>3</sup>. It is all too easy to ascribe these levels to marine aerosols in the rain water when in fact they may represent diffusion from a saline-water interface very close inshore.

9.3 Full allocation is said to result in a level of 3.8 metres above mean sea level, leaving a freeboard according to the model allocation of 1.6 M (Table 8). It is not difficult to imagine a concatenation of events such as drought, heavy pumping, extreme tides and storm surge threatening to breach that level, which no doubt seems to be a lot to an expert but somewhat threatening to this layman. It seems to me that heavy pumping must cause an inward flow from *all* directions surrounding the bores, including the direction of the sea.

10.1 I am satisfied that these matters can be monitored and addressed in the Groundwater Monitoring and Contingency Plan as worked out between the MMWUG, the NRC and the Environment Court last year. This plan had a starting point of 518,000M<sup>3</sup> per year, rising in three steps to a little over 2 million M<sup>3</sup> in the ninth year, all being well. This was in addition to the 1.1 million M<sup>3</sup> already allocated. Plainly, the Court was satisfied that a 2 million M<sup>3</sup> starting point was not prudent, but the amount requested by the present applicants is more than twice that amount and in addition to existing allocations.

10.2 Now it may be argued that we now have more data that validates the modelling and that we can have more confidence in allocating more water, but the amount of additional data is not great, and in my view the present applicants should be somehow accommodated within the GMCP without significantly varying the takes. The applicants may cry foul, but it is they who took the commercial risk of planting orchards without having secured water, and the Pukenui-Houhora's community's need for a long-term secure and safe water supply should override their requirements.

11. Given the history of forestry employment of Te Aupouri on the peninsula I am not persuaded that a local long-term employment bonanza is about to take place, nor that local industries are about to benefit greatly from the development, nor that any "trickle down" will end where it is needed. I suggest it should be given little weight in your considerations.

12. Ms Letica suggests a change to wording in S36(a) to "...adverse effects associated with salt water intrusion into the aquifer.". I would suggest a further change: "...intrusion reasonably attributable to consent holder's extraction," or words to a similar effect.

13. I therefore submit

a) that the applications be denied unless the GCMP can be modified to accommodate them without a significant increase in existing take; and

b) that much more hard data be acquired at the expense of consent holders and applicants to greatly supplement the coarse data supplied by modelling, before any further consents are granted.

W J Morris