

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER Variation 6 to the Proposed Canterbury
Natural Resources Regional Plan

**STATEMENT OF EVIDENCE OF Dr Chris Nokes
on Behalf of Canterbury District Health Board**

1. My full name is Christopher John Nokes residing in Hamilton. I am a scientist and have been working in the area of drinking water chemistry, treatment, regulation, management and related matters since 1985. I am presently employed as a senior scientist by Environmental Science and Research Ltd. in its Water Programme.

Qualifications and Experience

2. I hold a BSc(Hons) degree and PhD from the University of Canterbury, both in chemistry. I have been a member of the Ministry of Health's Expert Committee on Drinking-Water Quality since 1999, and have also worked on a World Health Organisation task force on disinfectants and disinfection by-products. I was project leader for the work undertaken by ESR for the Ministry of Health that provided the basis for the public health risk management plans now in use to protect the quality of drinking waters. I worked with the Ministry for the Environment (MfE) in preparing background material on water supplies for the MfE's Users' Guide for the National Environmental Standard on Sources of Human Drinking water (NES), and also fronted the presentations on the NES during the MfE's national roadshow to regional councils before the NES came into force.

Code of Conduct for Expert Witnesses

3. I acknowledge that I have read the code of conduct for expert witnesses contained in the Environment Court's Practice Note (last updated 25 June 2009 on the Environment Court's Website). I have complied with it when preparing my written statement of evidence and I agree to comply with it when I give any oral evidence.

Ambit of My Evidence

4. My evidence outlines the principles used in the risk management of drinking water supplies, discusses the importance of source protection in ensuring the safety of water supplies, and shows that the enactment of the NES acknowledges the importance of these principles. These subjects are within my area of expertise.

Introduction

5. Variation 6 to Chapter 4 of the Environment Canterbury's proposed Natural Resources Regional Plan (NRRP) is primarily concerned with protecting the quality of the water in the aquifers that are the source water of Christchurch's drinking water supply.
6. In his statement, Mr Hanson discussed the vulnerability of these aquifers in some areas because of the thin soil cover, which provides little capacity to adsorb contaminants, and the underlying sediments of coarse sand and gravel, which also provide little adsorption capacity. Mr Hanson also identified instances of contamination in some of the wells used as sources for the Christchurch water supply. These examples show that existing activities in the area are already having an effect on the quality of the city's water source.
7. The vulnerability of parts of some of the aquifers, the absence of treatment , which is uncommon for a major city, and the evidence of contamination already occurring show there is a need to put in place plans to manage the risk of aquifer contamination if Christchurch is going to continue to enjoy a safe water supply. Variation 6 sets out the means by which this may be achieved.

Risk management of water supplies

8. It is well accepted internationally that drinking water quality management using monitoring alone is unsatisfactory. This approach fails because:
 - a. most monitoring is by intermittent sampling, therefore most of the time the quality of the water is unknown;
 - b. sample analysis takes time (at least one day in the case of microbial indicators of faecal contamination), and consequently test results are historical information by the time they become available, so that if the water is contaminated, the community receiving it will already have been exposed to the contaminants;
 - c. in the case of microbiological contaminants, surrogates, e.g. *E. coli*, rather than the pathogens themselves are monitored, and the absence of a surrogate does not necessarily indicate the absence of pathogens.

9. Water supply operation based on risk management principles is now international best practice (WHO, 2008). Risk management improves the level of protection to the consumer by identifying how contaminants can enter the system, which contaminants these might be, what might happen during treatment that could result in contaminants not being removed from the water, and by taking preventive steps to reduce the likelihood of such events occurring. Monitoring of water quality is still undertaken, but as a check that the preventive measures are operating satisfactorily. Protection of the supply is achieved primarily by minimising the likelihood of contamination occurring.

The Multiple Barrier Principle

10. One of the components in managing the risk to water supplies is the multiple barrier principle. This principle holds that the safety of consumers is increased if multiple barriers to contaminants reaching the consumers are in place. Typically, the multiple barriers in a water supply consist of:
 - a. measures to prevent contaminants entering the source;
 - b. several treatment processes at the treatment plant;
 - c. measures to prevent contaminants entering the treated water after it leaves the treatment plant.

The Christchurch water supply is atypical in not having any treatment barriers.

11. The use of multiple barriers is protective in two ways:
 - a. should one barrier fail, the consumer is still protected to some degree by the remaining barrier(s).
 - b. water treatment processes remove only a percentage of contamination from the water, they are not absolute barriers. Having more than one barrier to a contaminant increases the overall percentage removal of that contaminant.
12. In my opinion, the most important barriers are those associated with the source. These are designed to stop contaminants entering the water in the first place. In general, taking actions to stop the entry of contaminants into the water supply provides more effective protection, and is more cost effective, than permitting their entry and then trying to remove them.

13. To treat water adequately, the water supplier must know the contaminants that have to be removed and their concentrations. Gathering this information is made difficult when a source is unprotected and potentially subject to contamination from a range of activities.
14. Source protection minimises the contaminant levels challenging the treatment plant, thereby reducing:
 - a. reliance on the treatment processes;
 - b. the level of treatment required;
 - c. the cost of treatment.
15. A belief that treatment processes will provide adequate contaminant removal, irrespective of the levels of contaminants challenging the treatment plant, overlooks the fact that treatment processes work on a percentage-removal basis. Even a treatment process operating optimally, can be breached when challenged by high enough contaminant concentrations.
16. For example, if a treatment process removes 99% of contaminant A and the maximum acceptable value for A is 2 mg/L, the treatment process can provide acceptable water if the concentration of A in the source is 100mg/L (A is reduced to 1 mg/L), but not if the concentration is 1,000mg/L (A is reduced to 10 mg/L).

Protection of Christchurch's source waters

17. Christchurch's water supply is without the barriers provided by treatment processes. Protection of the consumer from waterborne contaminants relies on protection of the quality of the source water. Should contaminants appear in the city's wells at unacceptable concentrations, parts of the Christchurch water supply could be rendered non-potable for a period of unknown duration.
18. The ability of processes active in gravel aquifers to reduce contaminant concentrations to acceptable levels depends, *inter alia*, on the nature of the contaminant, the amounts of contaminants entering the ground, the depth of the aquifer under the surface, and the distance between the point (or area) of contamination and the abstraction point.
19. The most vulnerable of Christchurch's wells are those that are shallowest, closest to their recharge zones, and which contain potential contaminant

sources in their recharge zones. Christchurch's drinking water source cannot be protected by shifting the recharge zones. Variation 6 aims to protect the aquifers by controlling contaminant sources within the recharge zones.

Managing the level of risk

20. Risk is defined as the product of two factors: the likelihood of an event occurring, and the consequences of the event should it occur. The Risk Management Standard AS/NZS 4360 provides qualitative descriptors for likelihood and consequence. In the case of consequence, they range from "insignificant" to "catastrophic".
21. The consequences of contaminants entering Christchurch's supply wells at unsafe levels are, in my opinion, classifiable as being "major" (second highest ranking) to "catastrophic". Depending on the wells affected, areas of the city could be without a reticulated, potable water supply for an indefinite period. With such consequences, an acceptably low level of risk can only be maintained by ensuring that the likelihood of a contamination event occurring is "unlikely" to "rare", that is, somewhere between the two lowest rankings.
22. Variation 6 allows for existing activities to continue with appropriate levels of risk management. New activities in some locations, however, would be prohibited. This is one means of ensuring the low likelihood of a contamination event. In preparing variation 6, Environment Canterbury has concluded that allowing new permitted activities in the recharge areas of the vulnerable aquifers represents too great a likelihood of aquifer contamination. I agree with this conclusion for the reasons set out in the following paragraphs.
23. The proposal that other activities could be allowed and controlled by resource consent conditions requires examining. Statistics on consent non-compliance indicate that permitting activities with the expectation that the criteria for compliance would be met, is unlikely to work. ECan has reported significant or major non-compliance in 234 of 2993 consents (7.8%) in July to September 2009 (ECan, 2009). Other parts of the country also show unacceptable figures. An audit by Environment Waikato in 2008-09 (EW, 2009), which did not include dairying operations, showed that 30% of sites with resource consents showed either only partial compliance, or significant non-compliance.

24. Further, even if compliance levels could be raised to near perfect, natural events, such as earthquakes capable of disrupting storage facilities for fuels or hazardous chemicals, or sewerage systems, could have catastrophic results in this vulnerable area.
25. These levels of non-compliance, and the threat from natural events, in my opinion, justify Environment Canterbury's decision to avoid potentially contaminating activities in the recharge zones.

Permitting new potentially polluting activities within recharge zones

26. It could be argued that with adequate monitoring requirements in consent conditions, an acceptable level of protection could be obtained for the aquifer system. I believe that, in addition to the non-compliance statistics noted above, this is unlikely for the following reasons:
 - a. For the reasons I outlined in paragraph 8, monitoring does not provide protection to the system being monitored. It can only confirm that a contamination event has occurred. This is an unacceptable situation with the consequences of contamination being so severe.
 - b. There is a level of sampling required, and therefore cost, to provide an acceptable level of assurance that contamination has not occurred. For example, the DWSNZ have sampling frequencies calculated to provide 95% confidence that no MAV has been exceeded for more than 5% of the time. To achieve this level of confidence, which may still be considered too low given the vulnerability of the aquifer, a minimum of 76 samples must be taken from the part of the water supply being monitored. The period over which the samples have to be taken depends on the period over which this certainty is required. For the purposes of the DWSNZ, the period is generally one year.

National Environmental Standards for Sources of Human Drinking Water, 2007

27. The importance of the protection of the quality of source waters is evident in the need for the National Environmental Standards for Sources of Human Drinking Water, 2007 (NES). These regulations are only one of two existing national environmental standards enacted, indicating the level of importance accorded to it by Government. Variation 6 pre-dates the NES and

consequently does not have to meet its requirements, but the proposals within the variation are in accord with the intention of the NES.

28. The NES was developed by the MfE with assistance from the Ministry of Health (MoH) because of the recognised difficulty water suppliers faced in managing the quality of their source water (MfE, 2009). Prior to the enactment of the NES, there was no legislation that explicitly required the effects of activities on sources of human drinking water to be taken into account in regional or district plans (MfE, 2009). Management of water supply catchments is outside the jurisdiction of water suppliers. As a result, water supply sources were left vulnerable to contamination.
29. The NES makes it clear that regional councils have responsibility for protecting water sources. The regulations protect drinking-water sources by ensuring that in granting water permits, or discharge consents, or including or amending rules in their regional plan, regional councils take account of the effects of activities on drinking water sources.
30. Regulation 10(1) states that

“A regional council must not include a rule or amend a rule in its regional plan to allow a permitted activity under section 9, 13, 14, or 15 of the Act [RMA], upstream of an abstraction point where the drinking water concerned meets the health quality criteria unless satisfied that the activity is not likely to—

 - (a) introduce or increase the concentration of any determinands in the drinking water so that, after existing treatment, it no longer meets the health quality criteria;...”
31. Although the regulation acknowledges the role played by treatment in reducing the risk to consumers, there is no “existing treatment” in the Christchurch supply. The criteria that establish the application of this regulation in Christchurch’s case would have to be based on the quality of the untreated water at the well.
32. In preparing Variation 6, Environment Canterbury has identified the threat to the groundwater quality, and is not permitting activities it considers could lead to the drinking water not meeting health criteria, as it would be bound to do under the NES. Mr Hanson’s evidence about existing contamination in Christchurch’s wells, and the poor non-compliance statistics for existing

consents, which is not just confined to Canterbury, both support this conclusion.

33. I note that while not stated in the NES, the MfE made it clear in presentations prior to the NES coming into force, that the regulations were not intended to allow pollution up to the maximum acceptable values (MAVs) given in the Drinking-water Standards for New Zealand. While zero contamination from activities is not expected, the approach of permitting activities that might lead to moderate levels of pollution that do not exceed MAVs, runs contrary to the spirit of the NES.

Conclusion

34. Christchurch has a very high quality water source, but it is vulnerable. Given the potential consequences to the city (both social and economic) of contamination of the source, and the reliance on source protection because of the absence of treatment, risk management principles require a very low likelihood of contamination. Appropriate management of existing activities within the recharge zone, and avoidance of new potential contamination sources being introduced into the zone, as set out in variation 6, are the most effective and efficient approach to protecting the aquifer system.
35. The approach proposed by variation 6 embodies the principles of risk management. Further, it is consistent with the definition of sustainable management used in the Resource Management Act (1991), as it offers the Christchurch, and surrounding, communities an effective way of managing this natural groundwater resource that provides for their health and safety, and their foreseeable needs and those of future generations.

Dr Christopher John Nokes

1 April 2010

References

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WHO, 2008, *Guidelines for Drinking-water Quality: incorporating the first and second addenda -Volume 1 Recommendations- 3rd Edition*, World Health Organization, Geneva.