BEFORE A HEARINGS PANEL OF THE HAMILTON CITY COUNCIL

UNDER	**the Resource Management Act 1991 ("the Act")**
IN THE MATTER OF	**Resource Consent Applications to Hamilton City Council pursuant to section 88 of the Act for the proposed Amberfield subdivision**
BY	**Graham Burnley McBride**

BRIEF OF EVIDENCE OF GRAHAM BURNLEY MCBRIDE

CONCERNING PUBLIC HEALTH RISK

DATED 23 April 2019

EVIDENCE OF GRAHAM BURNLEY MCBRIDE

My qualifications/experience

1. My name is Graham Burnley McBride.

2. I hold a Bachelor of Science degree in mathematics (Victoria University, Wellington) and Master of Science degree (Water Resources) from the University of Newcastle-upon Tyne, Department of Civil Engineering, UK.

3. I am an active scientific researcher as a Principal Scientist for a Crown Research Institute in water-related issues and have been doing so for over 40 years. I have published over 80 scientific papers and two books on these matters.

4. I am a Life Member of WaterNZ. I also hold membership of the New Zealand Hydrological Society, the New Zealand Statistical Association, the New Zealand Freshwater Sciences Society, and the New Zealand Society for Risk Management.

5. I have read the Environment Court's practice note 'Expert Witnesses – Code of Conduct' and agree to comply with it.

6. This brief evidence reflects my personal opinions. It does not necessarily reflect the view of my employer (National Institute of Water and Atmospheric Research, NIWA, in Hamilton).

My submission

7. This was submitted to the City Council on 27 September 2018. It is submission number 42, repeated on the last two pages of this evidence. In it, I expressed concern that any emergency overflows from Amberfield sewerage could cause contamination of the water extracted downstream from the Waikato River for Hamilton City's water treatment plant, with attendant health effects related to that contamination. I recommended that consents should not be granted until and unless a suitable risk assessment has been performed.

8. My submission states that, with regard to public health effects, I am 'neutral' to the issuing of any consents for the proposed Amberfield development. After reading the s.42a Officer's Report and Applicant's Evidence, I remain so.

Officer's Report

9. My concerns have been addressed in part, in Appendix G(b) of the Officer's report ('Wastewater Statement of Evidence')—at paragraphs 39, 43 and 44. These paragraphs reflect good practice with regard to wastewater reticulation design and operation. But in my submission, I advocated that a Quantitative Microbial Risk Assessment should be carried out to examine the potential for contaminated water supply delivered to Hamilton's population. This need for this assessment has not been addressed in the Officer's Report.

Applicants Evidence

10. In Mr Callaghan's evidence ("Civil Engineering Infrastructure Statement of Evidence", at section 112), he states "I note the points raised in the submission from Mr McBride (submission 42) where he has attempted to calculate the possible level of contamination in the river water in the event of a wastewater spill from Amberfield. In his calculation (and I accept that he clearly states that his calculation is only for indicative purposes) he has allowed a dilution factor of 10 for mixing between the Amberfield site and the Water Treatment Plant. I have been involved in several wastewater outfall projects and the dilution of a wastewater spill from Amberfield would be very different from his assessment. If a wastewater overflow occurred from Amberfield it would have a flow rate of a few litres/second and this compares to a river with a flow rate of several hundred cubic metres per second. The distance between the two is sufficient for full mixing to occur. The dilution is therefore more likely to be in the order of 10^5 not 10".

11. I accept Mr Callaghan's view that the dilution of an overflow spillage from the Amberfield site to the water treatment plant intake is under-estimated in my evidence. Having regard to the work on river mixing in the Waikato river,[1] I don't expect it to be as high as 10^5 (i.e., 100,000), because (i) full transverse and vertical mixing across the river may not have occurred in the kilometre between the overflow point and the water treatment plant intake, and (ii) there may be 'dead

[1] Rutherford, J.C. (1994). *River Mixing*, Wiley, Chichester, UK, at section 3.5.3.

zones' near the river's edge. Nevertheless, on reflection, I accept that I have significantly under-estimated dilution.

12. This does not obviate the desirability of a health risk assessment, as other 'perfect storm' components may come into play.

Precautionary approach

13. The risk assessment should be based on the precautionary approach. So, if it results in wide agreement that drinking-water-related health risks do not arise, even in a 'perfect storm' (for example, compromised disinfection processes at the drinking-water treatment plant), there would be no need for further action. Otherwise, a sewage overflow management plan would be appropriate, to be signed off by the City and the Medical Officer of Health.

14. To give further weight to that recommendation, I note that 'perfect storms' do occur regarding drinking-water safety, even in affluent nations, as described in an influential international text by Drs Steve and Elizabeth Hrudey.[2] Water New Zealand has endorsed the use of 'water safety plans' ensure provision of safe drinking-water in cases where the water supply chain could be compromised—see the article in the WaterNZ Journal of July-August 2017 entitled "Converting Hindsight into Foresight" https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=2441)

Recommendation

15. The appropriate Amberfield consent should include a condition requiring that a quantitative microbial risk assessment be performed, recognising that if it indicates a possible health risk then a water safety plan should be prepared.

Graham Burnley McBride

23 April 2019

[2] Hrudey, S.E., Hrudey, E.J. (2005). *Safe Drinking Water: Lessons from recent outbreaks in affluent nations*. Published by International Water Association Publishing. ISBN: 1843390426. 486 p.

SUBMISSION DELIVERED TO HCC ON 27 SEPTEMBER 2018 (2 PAGES)

Additional Information for a submission to a resource consent application for the proposed Amberfield development

Graham B McBride
37 Balfour Crescent, Riverlea, 27 September 2018

Overflows from sewerage systems can find their way into water courses, particularly during wet weather. Indeed, the AEE (Assessment of Environmental Effects) contemplates such an event for the proposed Amberfield development:

> The key aspects above are maximum avoidance of risk of additional overflows of wastewater to the Waikato River and avoidance of operational problems within the network that could trigger failures in the infrastructure (AEE Appendix L, "Wastewater Disposal Report", page 9).

If an overflow were to occur above the City's water treatment plant, there is a possibility that sewage-related pathogens could be carried down-river to the City's water treatment plant intake. That plant will consistently reduce pathogen concentrations in its influent water—in the normal course of events to 'safe' levels .[3] But the 2016 Havelock North drinking water *Campylobacter* contamination event has highlighted the need to anticipate a (rare) 'perfect storm'—a combination of system failures that can have dramatic consequences for drinking water quality. This possibility should be assessed before any resource consent is granted for Amberfield, because the Resource Management Act (section 3) defines an “effect” to include "any potential effect of low probability which has a high potential impact".

Therefore, I submit that the possibility of such a 'perfect storm' occurring and associated prevention steps should be properly assessed. The appropriateness of such an assessment should be reviewed by a competent authority, e.g., a Medical Officer of Health.

Because I have some experience with quantitative microbial risk assessment, including as an author of peer-reviewed international science papers, I have included a brief Appendix outlining some appropriate calculations.

[3] The plant uses a 'multiple barrier' approach in that its components comprise: screening, coagulation and sedimentation, filtration, granulated activated carbon, UV disinfection and chlorine addition.

APPENDIX

Indicative QMRA (Quantitative Microbial Risk Assessment) for downstream human-health effects of potential discharge of sewage overflows from the proposed Amberfield development into the Waikato River above the Hamilton Water Treatment Plant intake

Graham McBride, 37 Balfour Crescent, Riverlea, grmcbride@hnpl.net
27 September 2018

Many water-related QMRA studies worldwide have identified norovirus as the main human health pathogen of concern in human sewage—if it is present.[4,5] Ingestion of noroviruses can cause short-term but very unpleasant gastrointestinal illness. The dose-response relationship between norovirus dose and illness has been established (from a clinical trial[6]), showing that this virus is highly infectious for some people, with doses less than 10 'genome copies' being sufficient to cause illness.

Imagine that the norovirus concentration in dry-weather sewage is about one million genome copies per litre of water (as found for Napier[7,8]). For sustained overflows in wet weather, up to a ten-fold dilution in the sewerage network could occur. Another ten-fold reduction can be expected resulting from dilution with river water in transit to the water treatment plant intake. The intake water will therefore be receiving water with about ten thousand norovirus genome copies in every litre. The treatment plant and its associated distribution system would have to reduce the concentration of this virus by four orders-of-magnitude so that one litre of water would contain only one genome copy. So, on average, a person drinking one litre of water each day could receive one norovirus particle. There is some health risk associated with even such a low concentration.

I emphasise that these calculations are indicative only. A formal assessment would have to take full account of various components, especially network dilution, overflow duration, river mixing, and the virus removal performance of the treatment plant and its associated distribution system.

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[4] McBride, G.B.; Stott, R.; Miller, W.; Bambic, D.; Wuertz, S. (2013). Discharge-based QMRA for estimation of public health risks from exposure to stormwater-borne pathogens in recreational waters in the United States. *Water Research 47(14)*: 5282–5297.

[5] Soller, J.; Schoen, M.; Steel, J.A.; Griffith, J.F.; Schiff, K.C. (2017). Incidence of gastrointestinal illness following wet weather recreational exposures: Harmonisation of quantitative microbial risk assessment with an epidemiological survey of surfers. *Water Research 121*: 280–289.

[6] Teunis, P.F.; Moe, C.L.; Liu, P.; Miller, S.E.; Lindesmith, L.; Baric, R.S.; Le Pendu, J.; Calderon, R.L. (2008). Norwalk virus: how infectious is it? *Journal of Medical Virology 80(8)*: 1468-1476.

[7] McBride, G.B. (2011). A Quantitative Microbial Risk Assessment for Napier City's Ocean Outfall Wastewater. NIWA Report to Napier City Council, Project NAP11203, Report HAM2011-16, 28 p.

[8] More commonly, maximum norovirus concentrations in raw sewage are about one hundred thousand genome copies per litre of water. The concentrations in sewage reflect the health status of the contributing population.