Pōrangahau township and Te Paerahi township wastewater treatment plants resource consent application – Human health aspects

Follow-up to QMRA Review for Regional Council

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Background

Human health aspects of this resource consent were considered in a quantitative microbial risk assessment (QMRA) (Dada, 2022). This QMRA was reviewed by ESR in March 2022, with three substantive issues identified; (1) the log viral reductions expected due to tertiary UV treatment of the wastewater, (2) the estimation of wastewater dilution in the Pōrangahau River, and (3) the use of marine recreational water quality guidelines as a benchmark for risks estimated in the QMRA (Cressey, 2022). The first of these issues was satisfactorily resolved in a response from the Applicant. However, the remaining two issues remain unresolved.

The Applicant has made a decision to install UV treatment at the Pōrangahau WWTP as a matter of urgency and will proceed to a land disposal solution as soon as possible.

A meeting was held between Garrett Hall (Beca, for the Applicant) and Peter Cressey (ESR, for the regional council) on 26 July 2022. While the outstanding issues were not resolved, a decision was made to consider whether these issues would have a substantive impact on the conclusions of the QMRA.

Dilution estimates

Dilutions used in the QMRA were based on a dye mixing study carried out in 2009 (Taylor and Strang, 2009). The study estimated dilution of the dye tracer of 1000-3000 at the end of a 200 m long mixing zone. The discharge from the WWTP was 0.5 L/s (0.0005 m^3/s) and the river flow rate was 0.7 m^3/s. The estimated dilution on a proportion volume basis would be 1400, in reasonable agreement to the estimates from the dye tracer study.

Based on a median dilution of 2000 at assessment Site 1, the QMRA estimated median dilutions of 4546, 6274 and 8989 at assessment Sites 2, 3 and 4, respectively. Based on reported median river flows and a median dilution of 2000 at Site 1, the dilutions at Sites 2, 3 and 4 would be 2250, 2270 and 2320, respectively.

For the scenario of pond plus UV treatment, describing the phase following installation of UV disinfection but before commencement of disposal to land, the estimated individual illness risks (IIR) at site 1 (closest to the discharge point) are 0.06, 0.03 and 0.13% for norovirus, enterovirus and adenovirus, respectively, due to primary (norovirus and enterovirus) or secondary (adenovirus) contact recreation. The IIRs at sites 2, 3 and 4 will be lower, irrespective of the dilutions applied to these sites. For the same scenario (pond plus UV), the IIRs for consumption of raw shellfish harvested from site 4 were 0.47 and 0.29% for norovirus and enterovirus, respectively. If the dilutions are closer to those calculated from relative river flows than those used in the QMRA these IIRs could be up to 4-fold higher, based on the differences in dilution estimates.

Benchmark risk levels

The New Zealand *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas* have different risk cut-offs for classification of marine and freshwaters (MfE, 2003). The freshwater risk levels are derived from QMRA and relate to the risk of *Campylobacter* infection, while the marine risk levels are derived from epidemiological studies and relate to the risk of gastroenteritis or acute febrile respiratory illness. The QMRA applied the marine guidelines on the basis that the Pōrangahau River has a high level of tidal influence. However, the guidelines do not specify whether such situations should be considered marine or freshwater. The marine and freshwater categories are summarised in Table 1.

Table 1. Microbiological assessment category risk cutoffs for marine and freshwater

Microbiological assessment category (MAC)	**Risk cutoff**	
	Marine	**Freshwater**
A	<1% GI illness risk <0.3% AFRI risk	<0.1% occurrence of *Campylobacter* infection
B	1-5% GI illness risk 0.3-<1.9% AFRI risk	0.1-1% occurrence of *Campylobacter* infection
C	5-10% GI illness risk 1.9-3.9% AFRI risk	1-5% occurrence of *Campylobacter* infection
D	>10% GI illness risk >3.9% AFRI risk	>5% occurrence of *Campylobacter* infection

Source: MfE (2003)

GI: gastrointestinal, AFRI: acute febrile respiratory illness

As it is unclear which guidelines are applicable in the current instance, a conservative approach would be to apply the more stringent freshwater risk levels. Based on risks at Site 1, as the worst-case location, irrespective of which dilution values are used, and the treatment regime that the Applicant has committed to in the short term (pond plus UV treatment), estimated IIRs for primary or secondary contact recreation are at or below the lowest risk cutoff for freshwater environments (MAC = A or B).

Conclusions

Based on the wastewater treatment regime that the Applicant has committed to in the short-term, risks associated with primary and secondary recreation in the Pōrangahau River, as estimated in the QMRA, will be equivalent to those for the highest recreational water grading (MAC = A or B), irrespective of the approach to calculating wastewater dilutions and whether marine or freshwater guidelines are applied.

The situation related to risks associated with consumption of raw shellfish harvested at Site 4 is more complex. With the addition of UV treatment, but with the lower flow-proportional dilution estimates, IIRs will be approximately 2% and 1% for norovirus and enterovirus, respectively. The MACs in Table 1 are not directly applicable to risks from shellfish consumption. However, if it is considered that contact water recreation and feral shellfish harvesting are both voluntary recreational activities, it is reasonable to expect that similar levels of acceptable risk could be applied to both activities. Irrespective of whether marine or freshwater guideline risk cutoffs are applied, risks associated with consumption of raw shellfish from Site 4 would not be within the highest quality category. However, given that the addition of UV disinfection will decrease IIRs relative to the status quo, and the interim

nature of the continued discharge to the Pōrangahau River, this level of risk should not be viewed as a barrier to granting of resource consent. Appropriate signage to alert the public to the potential risks should be considered.

It should be noted that the dilutions used to estimate risks associated with the Pōrangahau WWTP discharge were based on dye experiments carried out at a discharge rate from the WWTP of 0.5 L/s and river flow rate of 0.7 m^3/s. The median discharge from the WWTP has been reported to be 94 m^3/day or 1.1 L/s, while mean annual low flows (MALF) for the Pōrangahau River at or downstream of the discharge point have been reported to be approximately 0.4-0.5 m^3/s. The QMRA did not specifically consider risks under river MALF conditions. Given that dilution of wastewater will be markedly lower under conditions of typical discharge rates and river MALF than the conditions of the dye experiments, consideration should be given to limiting discharge volumes or managing recreational activities in the river under MALF conditions. Given the interim nature of the continued discharge to the river and the probable improvements in effluent quality due to the addition of UV disinfection, the existing signage may be sufficient.

References

Cressey P. (2022) Review of quantitative microbial risk assessment (QMRA) for the Porangahau wastewater treament plant discharge. ESR Client Report CSC22001. Christchurch: Institute of Environmental Science and Research.

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Taylor D, Strang T. (2009) Porangahau Township Oxidation Pond Discharge Mixing Study. Wellington: Opus International Consultants Ltd.