Department of Primary Industries
Office of Water

RECYCLED WATER | INFORMATION SHEET NUMBER 3

Calculating Log Reduction Values

May 2015

Log Reduction Values

Reduction in pathogen concentrations in recycled water are calculated using log reduction values (LRV). The LRV required for each end use of recycled water is based on the likely exposure volumes ingested from the use of the water. For more details refer to Information Sheet 2: *Indicators, Reference Pathogens & Log$_{10}$ Reductions: What does it all mean?*

What affects log reduction requirements?

Requirements for the reduction in microbial hazards are affected the exposure (volume), the frequency of exposure and the number of pathogens in the source water.

Water quality log reduction requirements for common end uses are published in the AGWR, some examples of which are shown in Table 1.

Table 1 Common end uses and LRV requirements

Use	LRV Requirement		
	Protozoa	Viruses	Bacteria
Commercial food crops	4.8	6.1	5.0
Dual reticulation	4.9	6.3	5.1
Fire fighting	5.1	6.5	5.3
Municipal use	4.0	5.2	4.0

Source: *NSW Guidance for RWMS Table 4*

LRVs can be achieved through:

- treatment processes
- reduction in the level of exposure at the endpoint through non-treatment barriers
- dilution or blending

Treatment system LRV

Indicative LRV values for treatment processes are published in the AGWR Table 3.4. The minimum values in a range should be used unless supported by validation or verification data. Actual values need to be assessed using surrogates. For further information refer to Information Sheet 7: *Validation and Verification*.

For a treatment system with primary, secondary and tertiary treatment, the log reduction is the sum of the individual processes. Table 2 shows an example calculation for such a system.

Table 2 Example LRV for a treatment train

Treatment Step	Indicative LRV reduction		
	Protozoa	Viruses	Bacteria
Primary Treatment	0-0.5	0-0.1	0-0.5
Secondary Treatment	0.5-2.0	0.5-2.0	1.0-3.0
Chlorination	0-0.5	1.0-4.0	2.0-4.0
Total	**0.5-2.0**	**1.5-6.1**	**3.0-7.5**

Source: *NSW Guidance for RWMS Table 8*

It is important to maintain multiple barriers, with reduction in pathogen concentration needing to be achieved by more than one process so that there is redundancy built into the system if one or more barriers were to fail.

A maximum of 4 log reduction can be claimed for any treatment barrier.

Additional log requirements

To determine if additional log reductions are required, the water quality requirements of the scheme must be compared to the treatment system log reduction calculations.

> *Additional log reduction requirements = Water quality requirements – treatment system log reduction*

If the treatment system log reductions are less than the water quality requirements, non-treatment barriers or further treatment processes will need to be considered.

Non-Treatment Barriers

A range of preventive barriers at the end point can be used in calculating LRV of the scheme, these are known as non-treatment barriers. Common non-treatment barriers are shown in Table 3. Due to the lack of scientific data surrounding LRVs for non-agricultural irrigation a maximum of 3 LRVs attributed to non-treatment barriers can be claimed.

The risks of different user groups (e.g. produce consumers, workers or the public accessing the site) must be considered when applying non-treatment barrier LRVs.

Not all non-treatment barriers can be added together when the risks to different end users are considered. For example when considering the risk to a consumer of a produce, buffer zones are not applicable and cannot be added to that of drip irrigation of crops.

Table 3 Common non-treatment barriers

Non-treatment barrier	LRV
Cooking or processing of produce (e.g. cereal, wine grapes)	4 log
Removal of skins from produce before consumption	2 log
Drip irrigation of crops	2 log
Spray drift control	1 log
No public access during irrigation	2 log
Buffer zones (25–30 m)	1 log

Source: *NSW Guidance for RWMS Table 9*

The end user group with the lowest total non-treatment barrier LRV should be used in calculating the schemes total LRV, an example calculation is shown in Table 4.

Table 4 Example non-treatment barrier LRV calculations

End user group	Non-treatment barrier	LRV
Produce consumers	Cooking or processing of produce	4 log
Neighbors	Spray drift control	1 log
	Buffer zones (25–30 m)	1 log
	Total	***2 log***
LRV used in scheme calculation		**2 log**

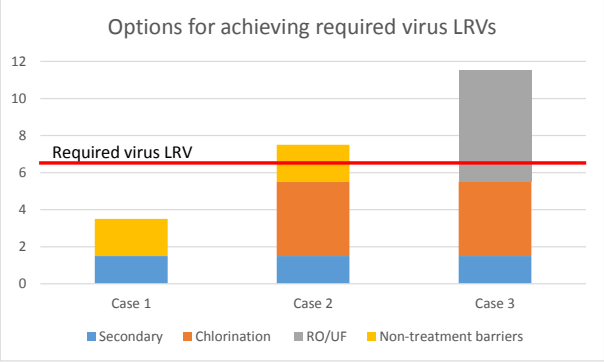
Example LRV calculations are included in Table 5 for a scheme with primary, secondary and tertiary treatment (Table 2) and the non-treatment barriers listed in Table 4.

Table 5 Example scheme LRV calculations

Treatment Step	LRV		
	Protozoa	Viruses	Bacteria
Treatment processes (Table 2)	0.5-2.0	1.5-6.1	3.0-7.5
End use controls (Table 4)	2	2	2
Total Scheme LRV	**2.5-4.0**	**3.5-8.1**	**5.0 – 9.5**
Commercial food crops water quality requirement	5.0	6.1	4.8
Difference between scheme LRV and water quality requirements	**-2.5 to -1.0**	**-2.6 to 2.0**	**0.2-4.7**

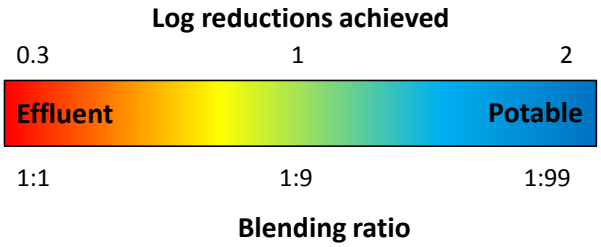
From the above example the scheme LRVs do not meet the commercial food crop water quality requirements, specifically for Protozoa and possibly for viruses (shown as Case 1 in Figure 1). Consideration of further treatment process and non-treatment barriers would be needed in this case (Cases 2 & 3 in Figure 1).

Figure 1 Example of options for achieving the required virus LRV



Log reductions through blending

The reduction in pathogen concentration achieved through blending is also logarithmic. It is difficult to achieve a useful LRV unless blended with large volumes of cleaner water. The following illustrates the blending required to achieve up to 2 log reductions.



The quality of the water the effluent is blended with affects the achievable LRV. Storm water which may be contaminated from runoff will require a greater blending volume or depending on its water quality, may result in a pathogen increase in the blended water. The illustration below shows the actual log reductions achieved when effluent requiring 3 LRs is blended with stormwater requiring 1.5 LRs for the end use.

More information

For more information visit www.water.nsw.gov.au or contact: rwapprovals@dpi.nsw.gov.au

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