Microbes in residential and commercial greywater in New Zealand

Greywater reuse systems could reduce network demand for water during droughts and improve the resilience of properties during natural disasters. The biggest barrier to greywater reuse in New Zealand is concern about water quality and the risk to human health from waterborne disease. BRANZ and other research organisations studied bacteria levels in greywater from households and commercial buildings.

GREYWATER REUSE systems capture and reuse wastewater from bathroom basins, showers and baths and from the laundry. Toilet and urinal wastes are not captured in these systems. Kitchen wastewater from sinks and dishwashers is not usually collected by newer systems, as it contains fat and grease. The collected greywater is stored in a small tank and can be reused for toilet flushing, subsurface garden irrigation and exterior cleaning.

The benefits of greywater reuse systems include:

- savings for houses with water meters
- increased resilience during natural disasters or emergencies
- uninterrupted use of water outside during hosepipe bans and local water restrictions
- reducing demand on the water supply network during peak periods and droughts
- savings for water service providers and the potential for extending the timeframe for network infrastructure upgrades if these systems become more widely adopted
- reducing the volume of wastewater treatment.

However, despite the clear benefits of these systems, a 2017 industry survey showed that the biggest barrier to the uptake of greywater reuse in New Zealand is concern about water quality and the risk to human health from waterborne disease.

E. coli and *P. aeruginosa* bacteria in New Zealand greywater

BRANZ sampled greywater from eight residential properties and two commercial buildings over a period of 2–6 months on a weekly basis. Sources of greywater included hand basins, showers and washing machines at the residential properties. As wastewater from kitchens is generally not reused, this was not sampled. Two of the residential properties had greywater capture systems in place, and samples from these were collected before water treatment.

The samples were tested for all forms of *Escherichia coli* and for *Pseudomonas aeruginosa* bacteria. There was great variation between samples in the same place and in different properties. In all samples from the showers, hand basins and washing machines, the concentrations of both types of bacteria were noticeably lower than observed in previous studies.

One of the sampling locations had a greywater system that irrigates the garden directly from the shower. A comparison between samples of shower water and the water that had been through the storage tank and piping showed variation in the concentration of *E. coli* over time but no noticeable trend of higher or lower concentrations between the two sampling points. However, the sampling showed that levels of *P. aeruginosa* increased significantly after passing through the system.

E. coli is a bacterium normally found in the gut, but some types can cause vomiting or diarrhoea via drinking contaminated water. It is typically used to measure water quality and to assess public health risk. *P. aeruginosa* is a naturally antibiotic-resistant bacterium living in the general environment that can cause infections in people, animals and plants.

Legal requirements

A challenge to the increased uptake of greywater reuse systems is the lack of consistent guidance. There are no specific guidelines or national legislation for greywater reuse or quality in New Zealand. Greywater disposal is covered by general legislation for installing and maintaining systems and wastewater discharge including the Building Act 2004, the Health Act 1956 (when there is a public health risk) and the Resource Management Act 1991. The Building Code also has specific requirements for the design and installation of on-site systems.

The rules are set by local authorities, and these vary enormously. There is also overlap between territorial authorities and regional councils in dealing with greywater consents. Some councils allow greywater reuse, whereas others have no policy for this.

Comparison with overseas guidelines

BRANZ compared the results of the greywater study with reclaimed water *E. coli* thresholds in guidelines implemented in South Australia in 1999 (Table 1). These are also consistent with 2003 guidelines in the state of Victoria.

Comparison with these guidelines showed that the basin and laundry samples were consistent with water that can be safely used for class A uses. However, observations of *E. coli* concentrations in samples in international studies were higher. For example, the concentration of bacteria in laundry wastewater depends on what is being washed. Water used to wash nappies will likely contain higher *E. coli* levels. Therefore, it is recommended that a more cautious approach is taken for uses of this type of wastewater.

The shower greywater samples corresponded to classes C and D of the South Australian guidelines, which have more restricted uses.

Class	Uses
A	• Primary contact recreation • Residential non-potable - garden watering, toilet flushing, car washing, path/wall washing • Municipal use with public access/adjoining premises • Dust suppression with unrestricted access
B	• Secondary contact recreation • Ornamental ponds with public access • Municipal use with restricted access • Restricted crop irrigation • Irrigation of pasture and fodder for grazing animals • Washdown and stock water • Dust suppression with restricted access
C	• Passive recreation • Municipal use with restricted access • Restricted crop irrigation • Irrigation of pasture and fodder for grazing animals
D	• Restricted crop irrigation • Irrigation for turf production • Silviculture • Non-food chain aquaculture

Table 1. Classes of greywater and their recommended uses from South Australia guidelines.

System use and limitations

The variability of the measured bacteria concentrations at each property over time and variability between the properties means further testing is required before drawing firm conclusions from the research. Research is also needed into other microorganisms, such as viruses, protozoa and parasites, and additional sampling is needed to make a more robust comparison between systems at domestic and commercial properties.

Future work should include a larger study of microbes in greywater reuse systems, including environmental factors such as water chemistry and organic particles. Households that use environmentally friendly cosmetic and cleaning products should be compared with those that don't.

At present, decisions about how to reuse greywater at a property should be made on a case-by-case basis. When using greywater for irrigation, it should be distributed under the soil and never through a sprinkler or hose. It should never be used on vegetable and salad crops. All water collected from showers should be treated before use.

More information

BRANZ Facts: Harvesting rainwater and greywater #2 *Greywater reuse systems for New Zealand houses*

BRANZ Facts: Harvesting rainwater and greywater #5 *Benefits of rainwater and greywater systems in New Zealand houses*

BRANZ Facts: Harvesting rainwater and greywater #6 *What is holding back rainwater and greywater systems in New Zealand?*

BRANZ Facts: Harvesting rainwater and greywater #7 *Potential network savings from rainwater and greywater systems in New Zealand*

Garnett, A. (2019). *Microbial water quality of commercial and residential greywater sources.* BRANZ Study Report SR420. Judgeford, New Zealand: BRANZ Ltd.

Bint, L. & Jacques, R. (2017). *Drivers and barriers to rainwater and greywater uptake in New Zealand.* BRANZ Study Report SR382. Judgeford, New Zealand: BRANZ Ltd.