

7 reusing greywater and harvesting rainwater

The apparent madness of using fresh drinking water to flush the toilet or water the garden partly explains the appeal of reusing bath and shower water or rain from the roof for these purposes.

However, for UK homes, it is more cost effective to save water than to reuse rainwater or greywater. Also, efficiency measures save energy and CO₂ emissions, whereas greywater and rainwater systems often increase the total amount of energy used and CO₂ emissions¹⁸. Even from a purely environmental point of view, cost effective measures should be prioritised as they allow greater benefits for a given outlay. For large communal domestic or commercial developments the economics may be better.

Where gardens need a lot of watering, simple, low cost greywater diversion systems can save considerable quantities of water at a time of peak demand. Similarly, the humble water butt is able to capture rain from summer showers, allowing gardeners to apply the water where it is needed most.

Reusing greywater

Greywater refers to all household wastewater other than wastewater from the toilet (blackwater). Greywater from baths, showers and washbasins is less contaminated than that from the kitchen.

Typically, domestic reuse systems collect greywater and store it before reusing it to flush the toilet. More advanced systems treat greywater to a standard that, it is claimed, can be used in washing machines and the garden. The most basic systems simply divert cooled and untreated bath water to irrigate the garden.

Systems for flushing the toilet can save around a third of daily household water demand. A trial by the Environment Agency showed a range of water savings from about five per cent to 36 per cent¹⁹. As newer properties tend to have lower toilet consumption, the maximum savings in a new build might be closer to 20 per cent.

What treatment is necessary?

Problems can arise when warm, nutrient-rich greywater is stored, as it incubates bacteria. There are currently three approaches for dealing with this problem.

The first is to limit the time that the greywater is stored. These systems might incorporate an electronically controlled dump valve to empty the storage tank after a period of inactivity before refilling with mains water.

The second approach is to use chemical disinfectants such as chlorine or bromine compounds that inhibit biological activity and extend possible storage time.

The third approach is to treat the greywater in a small sewage treatment plant, either by using traditional biological methods or newer membrane filtration technology. The treated water is clear and free of unpleasant odours and contains little organic matter, allowing it to be stored and reused. However, this uses a significant amount of energy and is very expensive.

Untreated greywater can be used for watering the garden if it is used immediately after it is produced, but it should not be used on edible crops. The wastewater from kitchen sinks and dishwashers is not usually collected as it is too heavily contaminated.

¹⁸ Crettaz, P, Jolliet, O, Cuanillon, J-M and Orlando, S, 1999. Life Cycle of assessment of drinking water and rain water for toilet flushing. *Aqua* 48(3), pp.73-83.

¹⁹ A study of Domestic Greywater Recycling, Environment Agency 2000.

Harvesting rainwater

If it is correctly collected and stored, rainwater can be used for toilets, washing machines and watering gardens without further treatment. In practice, most domestic roof areas are too small to satisfy all this potential demand regardless of the size of the storage cistern, so it is important to evaluate the potential savings before investing in an expensive installation.

The garden water butt is the simplest way of collecting rainwater. It does not need any treatment or mains backup, and it does not have to supply water when temperatures are below freezing. Household rainwater systems are, however, much more sophisticated and their installation is quite complex.

Table 4 gives an idea of the amount of water systems can yield with different roof areas and rainfall volumes. It is assumed that 60 per cent of the rain falling on the roof is collected and used. This is because there may be times when the tank is overflowing and unable to collect additional rainwater or there may be insufficient demand to use all of the water collected.

Table 4: Approximate annual yield of rainwater in cubic metres per year for a range of roof sizes with varying rainfall.

Plan roof area m ²		50	75	100	125	150
mm rain/year	500	15	22.5	30	37.5	45
	1000	30	45	60	75	90
	1500	45	67.5	90	112.5	135
	2000	60	90	120	150	180

Table 5 gives a summary of different drainage factors for different roof types. A factor of 1 indicates all the water that falls on the roof will reach the gutter, a factor of 0.5 indicates that half the rain falling on the roof will reach the gutter.

Table 5: Drainage factors for different roof types.

Roof type	Drainage factor
Pitched roof tiles	0.75 – 0.9
Flat roof smooth tiles	0.5
Flat roof with gravel layer	0.4 – 0.5

Tank sizing

Rainfall can be sporadic and so storage is needed, but the optimum tank size is usually much smaller than you might think. As a guideline, size the tank to hold 18 days worth of demand, or five per cent of annual yield, whichever is lower. To calculate the optimum tank size, first calculate the potential yield. Once you know the potential yield, simply find five per cent of this.

Calculating the tank size

The formula below can be used to calculate the optimum tank size for a rainwater harvesting system

Roof area (m²) x drainage factor x filter efficiency x annual rainfall (mm) x 0.05

Example: Consider a property with a roof area of 100 m². This is a tiled, pitched roof, so has a drainage factor of 0.9 is used (see table 5). The filter efficiency is assumed to be 90 per cent, so a filter efficiency factor of 0.9 is used. Annual rainfall is assumed as 905 mm per year, the 1961 to 1990 long run average from Met Office data for England and Wales (in a real example local rainfall must be used, as rainfall varies significantly across England and Wales²⁰).

Summary of parameters for yield calculation

Effective collection area (m ²)	100
Drainage factor	0.9
Filter efficiency factor	0.9
Average rainfall (mm/yr)	905
Five per cent of annual yield	0.05

Tank size = 100 x 0.9 x 0.9 x 905 x 0.05 = 3665 litres
or 3665/1000 = 3.7 cubic metres (m³)

Using these parameters the optimum tank size is 3665 litres or 3.7 cubic metres.

²⁰ www.metoffice.gov.uk/climate/uk/averages/19611990/areal/england_&_wales.html

Water Supply (Water Fittings) Regulations 1999:

There are currently no UK regulations relating to the quality of water needed for toilets and washing machines. Extensive studies in Germany have concluded that, if rainwater is collected properly, it can be used in toilets and washing machines without being disinfected. Mains water backup must be in accordance with the Water Regulations, which means using a type AA or AB airgap, and pipes should be clearly identified.

Some commercial systems have included UV disinfection to address perceived health risks, but this uses a large amount of energy which can offset some of the benefit of saving water. As well as the environmental impact of UV treatment, it is also expensive to run and maintain.

Further information:

Environment Agency Greywater information:
www.environment-agency.gov.uk/savewater

Create an Oasis with Greywater, Art Ludwig 1994.

Harvesting rainwater for domestic uses: an information Guide, Environment Agency 2003.

Reclaimed Water Systems; Information About Installing, Modifying or Maintaining Reclaimed Water Systems, WRAS Information and Guidance note, August 1999 No. 9-02-04. www.wras.co.uk

UK Rainwater Harvesting Association:
www.ukrha.org