Contents

1.1: Rainwater harvesting and greywater recycling – in context

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Module objectives

The aim of this module is to appreciate the role of rainwater harvesting and greywater recycling in a sustainable water strategy and their potential in the UK to reduce the stress on the mains water supply (rainwater harvesting and greywater recycling) and to reduce localised flooding incidents (rainwater harvesting, ideally as part of a Sustainable Drainage System).

On completion of this module you should be able to:

- Identify the main uses for rainwater and greywater in the UK
- Identify the role rainwater harvesting plays in a Sustainable Drainage System (SUDS) strategy
- Identify the role rainwater harvesting and greywater recycling play as part of a demand reduction strategy
- State the types of water efficient appliances that form part of a sustainable water strategy.

If after reading this module and completing the self-assessment questions you are unsure about items of the module content, just make a note of the topic and discuss it with your trainer when you attend the course.

50% of water in dwellings and over 60% in offices does not need to be of potable water quality and can be replaced by rainwater or greywater.

Rainwater harvesting and greywater recycling as part of a sustainable water strategy

Flooding incidents and the demand for potable water are both increasing in the UK

Flooding is increasing in the UK due to the higher incidence of intense storm events and increasing development (both on brownfield and greenfield sites). Existing surface water sewers are unable to cope leading to localised flooding incidents. Computer modelling of the effect of global warming on the UK shows that, winters in the north and west will get wetter and that the chance of extreme storm events will increase across the whole of the UK, including during the summer. (Climate Change Scenarios for the United Kingdom. The UKCP09 Scientific Report). Therefore, the problem of localised flooding is also likely to increase.

Localised flooding © Environment Agency

The demand for potable water has risen by 55% since 1980. This is due to various factors. A higher standard of living results in an increased demand for high water-using appliances, such as power showers, automatic multi-purpose garden watering systems and outside spas and pools. The average decrease in household size has led to an increase in per capita demand as a person living alone uses, on average, 10% more water than if they were sharing. Large numbers of new dwellings have been built in the UK since 1990, adding to the increase in water use. In the south and the east of the UK, the pressure on water resources is now acute. Global warming will lead to less summer rainfall in most parts of the UK (UKCP09) leading to even greater pressure on existing water sources. There is no national water grid in the UK and unlikely ever to be one therefore localised solutions must be found.

Rainwater harvesting has the potential to alleviate localised flooding incidents and reduce the demand for mains water. Greywater recycling has the potential to reduce the demand for mains water.

The UK water industry emits under 1% of total UK greenhouse gas emissions. However, when emissions from hot water use in dwellings (which totals 35 million tonnes of greenhouse gas emissions) is added, emissions from water use are over 5% of the UK total.

As rainwater harvesting has the potential to alleviate the increased incidence of localised flooding events, when part of a SUDS, and to reduce demand from the mains water supply and greywater recycling has the potential to reduce demand from the mains water supply, both are important parts of a sustainable water strategy.

The carbon load of mains water

On average in the UK, it takes 1.2kWh of (mostly) electrical energy to supply and treat 1m^3 of mains water, which results in 0.65kgCO_2 emissions per m^3 of mains water used. The breakdown of emissions between the supply of mains water and the treatment of wastewater is about 0.3kgCO_2 for supply and 0.35kgCO_2 for treatment. When specifying alternative sources of water such as greywater or rainwater, the system chosen should have as low a carbon load as possible. Careful design and correct choice of components are vitally important tools to achieve this.

Reducing water demand

Per capita consumption (pcc) in the UK is 150 litres per day. This level of pcc, coupled with drier summers, will increase the pressure on water resources. Demand is expected to rise in all areas of the UK unless a concerted effort is made to prevent it. Following the drought of 2006, the Environment Agency produced a map showing the degree of water stress in England. As Figure 1.1.1 shows, the areas of severe water stress (red) are concentrated in the south and the east of England. Area of moderate water stress (orange) are Devon and Cornwall which experience a high seasonal increase in water demand, and the West Midlands area of England. An area being classified as under water stress can be due to all or several of the following factors: current permissible abstraction levels from rivers are already at a level that is not sustainable; there is no groundwater or the groundwater is being abstracted in an unsustainable manner; there is a lack of reservoir capacity and insufficient space for new reservoirs to be built; the local population is increasing due to migration from other parts of the UK; there are lower occupancy rates for dwellings; summers are expected to become hotter and drier under climate change scenarios.

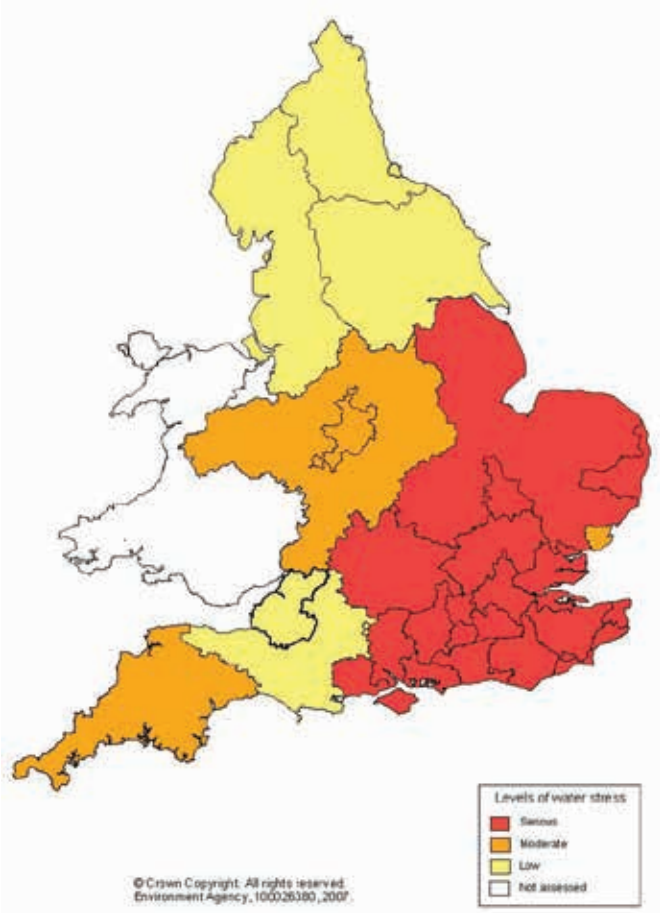


Figure 1.1.1: © Environment Agency

Garden watering

As the stress on water sources increases, it is recognised that drier and hotter summers lead to an increased requirement for garden watering, a requirement that could become difficult to meet in some areas of the country. In the summer of 2006, hosepipe bans were implemented across large parts of the south and east of the UK. Although demand for garden watering is less than 3% of the overall demand for a house, it comes at a time when water supplies are low and therefore has a greater cumulative effect. If all new developments in the south and east had a large store to collect winter rain for use in the summer months, the requirement for hosepipe bans could be lessened.

Collecting and storing winter rainfall for use in the summer reduces strain on the mains at peak times.

Rainwater and greywater will reduce demand on the mains supply, but simple water efficiency measures should always be implemented first. Rainwater and greywater can be used for garden watering, and this option can often be the best solution for small single dwellings.

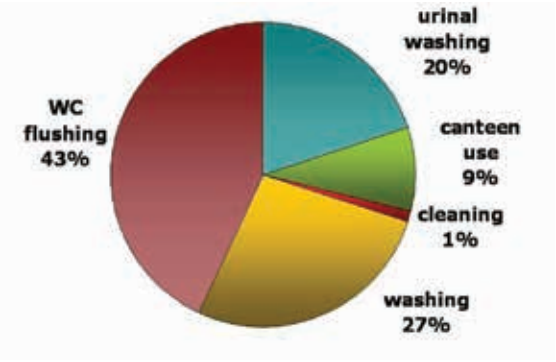
Water efficiency

Rainwater harvesting or greywater recycling are just one part of a sustainable water strategy. It is important to reduce demand at point of use first.

To understand where it is easiest to save water it is important to know where water is used. Then a combination of technical fixes and behavioural changes will bring about a reduction in demand. Substantial water demand reduction can be achieved by using water efficient appliances. 'Technical fixes' are available to reduce demand at WCs, urinals, taps and showers. Simple measures like dual flush WCs in place of 6 litre single flush WCs, flow regulators on taps and showers, and A-rated washing machines and dishwashers can save 20-25% of water in a typical household.

On average in the UK, it takes 1.2kWh of (mostly) electrical energy to supply and treat 1m^3 of mains water, which results in 0.65kgCO_2 emissions per m^3 of mains water used. Water efficiency is always the best environmental option.

Domestic usage



Commercial usage

Figure 1.1.2: Pie charts for water use breakdown

WCs and urinals

In a domestic situation, in most existing buildings, WC flushing still accounts for the largest proportion of water use at 33% of average demand. Over 60% of water in offices and schools is used for WC or urinal flushing. In both public and private buildings, reducing the amount of water required for flushing WCs and urinals results in significant savings. This is especially so when retrofitted into existing buildings where most WCs are still flushing with 9 litres of water and many urinals still flush 24 hours a day, 365 days a year.

A 6/4 litre dual flush WC installed in an office saves 1,200 litres of water per person per year compared to a 6 litre single flush WC, and 12,000 litres of water if installed in the average household.

A 4/2.5 litre dual flush WC installed in an office saves 2,500 litres of water per person per year compared to a 6 litre single flush WC, and 26,000 litres of water if installed in the average household.

An uncontrolled urinal can use 87,600 litres of water per year. Retrofitting **urinal controls** can reduce use in an office to 25,000 litres, and in a school to 14,000 litres, a potential saving of 62,600 litres and 73,600 litres per urinal per year respectively.

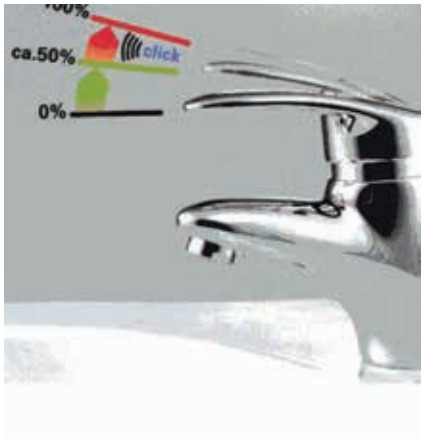
Waterless urinals use no water, but the removal of uric sediment is required. There are different types of waterless urinals available in the UK. Most have a maintenance charge or the replacement of traps or gels, so there is an ongoing component cost.

In low traffic situations, urinals can have a **controlled flush per use.** Each urinal is flushed with 1 litre of water with the flush controlled by a PIR sensor.

Efficient terminal fittings – taps and showers

Flow regulators control flow rates at 1 bar and above regardless of pressure fluctuations, can save up to 50% of water while a tap or shower is running, and prevent starvation at end appliances. Flow regulators are designed to supply a particular flow rate and range from 4-12 litres/minute. An O-ring inside the regulator is compressed as flow increases, thus flattening and letting less water by. **Aerated heads** should also be fitted to change the laminar flow into aerated flow which, due to the bubbles of air introduced, gives the impression of more water than is the reality. Behavioural instinct is to be satisfied with a flow rate that "looks" full. **Brake taps** open to give 50% of maximum flow. A secondary motion is required to open the tap fully. Spray taps, which have a flow rate of just 1.5 litres per minute, should be installed in commercial washrooms.

Flow regulator



Brake tap


Aerated flow from a flow regulated tap

Washing machines and dishwashers

Washing machines and dishwashers are rated for energy use in the UK. As the main energy requirement is for heating the water, the more efficient the appliance the less water (in general) is used. Machines rated at 'AAA' level are the most efficient.

The main driver for SUDS in Scotland is to keep rivers clean by restricting the amount of polluted run-off from stormwater. In England and Wales, the main driver for SUDS is to prevent localised flooding incidents.

Green roof

Sustainable drainage systems

Stormwater run-off is an increasing concern for the UK. Increasing development exacerbates run-off problems as the more roads and paved areas, the greater the volume of contaminated run-off, which pollutes receiving waters. The increasing intensity of summer storms, coupled with this increased run-off, means that the existing drainage infrastructure is becoming overloaded and localised flooding incidents occur. Stormwater run-off from roads is contaminated with petrol, diesel and oil spills, which concentrate in the silt at the bottom of rivers. It is considered best practice to minimise the amount of impermeable surfaces, and traditional drainage in a development, as they increase the risk of flooding and inhibit groundwater recharge. Stormwater should be disposed off on site by infiltration as far as possible, rather than discharge to a watercourse or connection to a sewer.

Sustainable Drainage Systems (SUDS) are engineered solutions that replicate natural drainage systems by attenuating, treating and disposing of stormwater to reduce pollution and localised flooding incidents. SUDS can reduce the amount of stormwater run-off and improve the quality of receiving waters.

Permeable paving, Cambourne

Detention basin, Northhants

Swale, Berlin

SUDS pond

SUDS include source control devices such as rainwater harvesting and green roofs, conveyance devices such as swales, infiltration devices such as permeable paving, permeable tarmac and filter drains, and storage and infiltration devices such as basins and ponds. When rainwater harvesting is installed in a SUDS surface water management train, it can be used to reduce the required capacity of downstream SUDS components.

3.4: Greywater recycling – maintenance and fault finding

Model Answers