Unit 301: Understand the fundamental principles and requirements of environmental technology systems

# Handout 9: Rainwater harvesting and greywater re-use

## Learning outcomes

The learner will:

1. Know the fundamental working principles of micro-renewable energy and water conservation technologies.
2. Know the fundamental requirements of building location/building features for the potential to install micro-renewable energy and water conservation systems to exist.
3. Know the fundamental regulatory requirements relating to micro-renewable energy and water conservation technologies.
4. Know the typical advantages and disadvantages associated with micro-renewable energy and water conservation technologies.

## Assessment criteria

The learner can:

* 1. Identify the fundamental working principles of the following co-generation technologies:
* rainwater harvesting
* greywater re-use.

2.9 Clarify the fundamental requirements for the potential to install a rainwater harvesting/greywater re-use system to exist.

3.1 Confirm what would be typically classified as ‘permitted development’ under town and country planning regulations in relation to the deployment of the following technologies:

* rainwater harvesting
* greywater re-use.

3.2 Confirm which sections of the current building regulations/building standards apply in relation to the deployment of the following technologies:

* rainwater harvesting
* greywater re-use.

4.1 Identify typical advantages associated with each of the following technologies:

* rainwater harvesting
* greywater re-use.

4.2 Identify typical disadvantages associated with each of the following technologies:

* rainwater harvesting
* greywater re-use.

## Rainwater harvesting and greywater re‑use

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| Rainwater harvesting The UK practice of using mains water to supply all our water needs is needlessly wasteful, both financially and environmentally.  Mains water is expensively purified to drinking water standards, but much of the water is used for non-potable purposes, like flushing toilets, cleaning and gardening.  Harvested rainwater can be substituted for mains water, saving money and contributing to the protection of a key natural resource.  Rainwater harvesting (RWH) is a practice of growing importance in the UK, particularly in the South East of England where there is less water available per person than in many Mediterranean countries. |  |

Rainwater harvesting in the UK is both a traditional and reviving technique for collecting water for domestic uses. This water is generally used for non-hygienic purposes like watering gardens, flushing toilets, and washing clothes.

There is a growing demand for larger tank systems collecting between 1,000–7,500 litres of water. The two main uses for harvested rainwater are botanical uses, like gardening for plant irrigation, and domestic uses, like flushing toilets and running washing machines.

Rainwater is almost always collected strictly from the roof, then heavily filtered using either a filter attached to the down pipe, a fine basket filter or for more expensive systems like self-cleaning filters placed in an underground tank.

The Velodrome of the London Olympic Park is designed to harvest rainwater.

There are three types of rainwater systems available:

* **Gravity (non-pressurised):** Collected rainwater is pumped from the main holding tank to an elevated/header tank. The connected appliances are then supplied from the tank as in a normal gravity fed system.
* **Direct (pressurised):** Collected rainwater is pump-fed direct from the main holding tank to the serviced appliances.
* **Combination:** Collected rainwater is pumped or gravity-fed to a low-level break tank. In turn, the water is then gravity-fed to an integral or external booster pump system for onward distribution to the serviced appliances.

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When it rains, the water runs off the roof into the premise’s guttering and downpipe. Before passing to the underground tank the water passes through the filter; this removes debris including leaves, bird faeces, moss, etc, and passes this through to the normal waste system.

Relatively clean rainwater passes from the filter to the tank via the inlet pipe. The calming inlet prevents the water from creating turbulence within the tank thus preventing sediment in the tank from being stirred up. If the rainfall is heavy and the storage tank fills completely, excess water will pass via the overflow pipe to the premise’s rainwater waste system.

When the float switch in the loft tank detects the tank water level has dropped below a certain level the pump in the storage starts operating to pump water up to the loft tank. The water is drawn from the storage tank via the floating outlet. This is used so as not to draw sediment from the bottom of the tank but also not from the surface where floating debris may be.

If however, the storage tank is empty maybe after a long dry spell, the storage tank float switch will detect this and deactivate the pump. The customer will still need water so in this case the two‑port zone valve in the loft will open to permit the loft tank to be filled from the water mains.

The air gap between the mains water inlet and the loft storage is a requirement of water regulations to provide backflow protection to prevent contamination of the water mains from the rainwater.

When the float switch in the loft tank detects the water level is sufficient it will turn off the pump.

### Installation location

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| The biggest consideration is the location of the storage tank. This can be on the surface like the one in the picture right but it will need protection against freezing in winter.  However, it is much better to have a buried tank as this keeps the water cool and dark and greatly reduces the likelihood of the build‑up of algae in the water.  However, this means that sufficient garden space is required and fairly extensive excavations must be carried out. Once the tank and associated pipe work has been installed and buried only the lockable serviceway will be visible. |  |

Inside the premises a new loft storage tank additional to any others must be installed. Also new pipe work from this loft tank to equipment using the rainwater must be installed. This pipe work must be kept completely separate from that feeding other equipment, for example the cold taps of bath, basins and sinks.

All pipe work must distinguish clearly between mains and rainwater.

It will be necessary to install wiring linking the control unit to the pump, float switches and zone valve.

### Planning requirements

The installation of a RWH system does not in principle need planning permission. In fact, in gaining planning permission for a new-build or major renovation project, the inclusion of rainwater harvesting in the project can help towards approval.

Rainwater harvesting ticks two boxes for planners. Not only is rainwater harvesting seen as a means to save on mains water consumption, but also, and often, nowadays, of more importance to planners, as a way of alleviating flood threats.

### Building Regulations requirements

In 2010, a change in the Building Regulations has reinforced official support for rainwater harvesting. Building Regulations Part G (April 2010) makes 125 litres per person per day of mains water consumption the maximum. This is not too demanding in comparison to the Code for Sustainable Homes targets (eg 103 litres for level 3). But, nonetheless, for the first time in new construction, water consumption becomes a legal obligation, and rainwater harvesting helps achieve this target.

The underground tank should not be installed any closer to a house than a line drawn at a 45° angle from the base of the house. It usually works out that the closest part of the tank should not be closer to the building than the overall height of the tank. For example, a tank 2 metres deep, from its base to turret, should not be closer than 2 metres from the side of the tank to the side of the house.

Building regulations also apply to other aspects of the work such as electrical installation and plumbing work.

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| Advantages of rainwater harvesting  * Saves money by reducing water usage. * A volume of water is kept out of the storm‑water management system, thereby helping to reduce flooding risks. * Gains eco-homes rating points for your property. * Rainwater is better for your garden as it has a balanced pH and is free of chemicals such as chlorine. * In its agricultural application rainwater harvesting has also been used to provide drinking water for livestock and irrigating crops. | Description: 04 Rainwater Harvesting.jpg |
| Disadvantages of rainwater harvesting  * High cost when retro-fitting to an existing property. * Requires some maintenance to filtration. * Requires separate pipe work to be installed. * Unpredictable rainfall. * Vulnerable water quality. | Description: 05 Rainwater Harvesting.jpg |
| Greywater re-use Greywater, or sullage, is wastewater generated from domestic activities such as laundry, dishwashing, and bathing, which can be recycled on-site for uses such as landscape irrigation and constructed wetlands.  Greywater differs from water from the toilets, which is designated sewage or blackwater to indicate it contains human waste.  Most greywater is easier to treat and recycle than blackwater, because of lower levels of contaminants. |  |

If collected using a separate plumbing system from blackwater, domestic greywater can be recycled directly within the home, garden or company and used either immediately or processed and stored.

If stored, it must be used within a very short time or it will begin to putrefy due to the organic solids in the water.

Recycled greywater of this kind is never safe to drink, but a number of stages of filtration and microbial digestion can be used to provide water for washing or flushing toilets.

Greywater reuse systems vary significantly in their complexity and size from small systems with very simple treatment to large systems with complex treatment processes.

However, most have common features such as:

* a tank for storing the treated water
* a pump
* a distribution system for transporting the treated water to where it is needed; and
* some sort of treatment.

All systems that store greywater have to incorporate some level of treatment, as untreated greywater deteriorates rapidly in storage.

This rapid deterioration occurs because greywater is often warm and rich in organic matter such as skin particles, hair, soap and detergents. This warm, nutrient-rich water provides ideal conditions for bacteria to multiply, resulting in odour problems and poor water quality. Greywater may also contain harmful bacteria, which could present a health risk without adequate water treatment or with inappropriate use. The risk of inappropriate use is higher where children have access to the water.

## Installation considerations

### Storage tanks and pipe work

* The location of collection, treatment and holding tanks.
* Greywater system tanks need to be sized to provide a balance between supply and demand while maintaining a reasonable throughput.
* All pipe work carrying treated greywater must be clearly marked as a non-potable greywater supply.

### Pumps and treatment

Greywater is normally collected at a low level and then pumped to where it can refill toilet cisterns. Where greywater is used inside the home, biological treatment and disinfection will be required to control bacterial growth and provide ‘clear’ water. For other uses the degree of treatment will vary depending on the quality of water needed.

### Maintenance

* An alternative non-potable water supply is not a 'fit and forget' technology.
* Regular cleaning and maintenance and removal of debris from filters and from the biological treatment process are needed.
* Regular visual inspection of the system components and replacement of filters according to manufacturer's recommendations is required.
* Ensure mains water top-up is functioning and protected from contamination. Regular checks on greywater disinfection in accordance with manufacturer's recommendations.

### Regulations

All installations must comply with the Water Supply (Water Fittings) Regulations 1999 in England and Wales.

The Building Regulations Parts G and H apply.

British Standards BS8525‑1:2010 Greywater Systems Code of Practice covers the design, installation and maintenance of these systems.

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| Advantages of greywater re-use  * Conserves wholesome water. * Indirectly reduces energy consumption and reduces carbon emissions. * A wide range of system options exist. * Greywater is free, so for buildings where a water meter is fitted the annual cost of water will be reduced. | Description: 07 Greywater.jpg |
| Disadvantages of greywater re-use  * Payback periods can be long. * Not always straightforward to install in an existing building. * There is a risk of contamination or cross-connection. * Only certain types of outlet and appliance can be supplied using greywater. | Description: 08 Greywater.jpg |