

Reclaimed Water Systems

Information About Installing, Modifying or Maintaining Reclaimed Water Systems

1. Introduction

- 1.1 Reclaimed water systems can play a part in water conservation by reducing the amount of mains supply water used in the home and commercial buildings. This Guide will be of help to those engaged in the design, selection, installation and maintenance of reclaimed water systems. The potential exists for reclaimed water systems to contaminate potable mains water supplies by inadvertent cross connection or backflow, therefore, installations must comply with the Water Supply (Water Fittings) Regulations 1999 in England and Wales, the Water Byelaws 1999 in Scotland, or the Water Regulations in Northern Ireland for the prevention of contamination and waste of public water supplies.
- 1.2 The design and development of reclaimed water systems is an emerging area of technology involving the water industry, architects, developers, building owners, equipment suppliers, health professionals, environmental consultants and the Water Supply Industry's customers. This Guide looks at reclaimed water installations in terms of potential hazards, how these may be assessed and which safeguards are appropriate to adopt for a given installation or design. It is recognised that over time and with practical experience, knowledge will increase and this will enable the development of specific standards and test criteria. This Guide will be updated regularly as and when required.
- 1.3 Due to a lack of straightforward, factual information about costs, reliability and control of hazards there has been little enthusiasm to install reclaimed water systems. The adoption of reclaimed water systems is strongly influenced by user perceptions and economic benefit, but once installed, reclaimed water systems should not be allowed to fall into a state of disrepair or disuse and attention is drawn to the importance of prompt investigation and resolution of problems.

2. When reading this guide the following definitions apply:-

- 2.1 **GREYWATER**
Water originating from the mains potable water supply that has been used for bathing or washing, washing dishes (see section 4.7) or laundering clothes.
- 2.2 **RAINWATER**
Water collected from the external surfaces of buildings and hardstanding areas by diverting the flow to a storage cistern or system.
- 2.3 **RECLAIMED WATER**
Water, other than potable water direct from the mains, which has been collected and treated so its quality is suitable for particular, specified purposes. eg. irrigation, toilet flushing.
- 2.4 **RECLAIMED WATER SYSTEM**
A water installation used to collect, store, treat and distribute water, other than potable water direct from the mains, the purpose of which is to reduce both the amount of mains supply water used by a premise and the amount of waste water entering the sewer or septic system from that premise.
- 2.5 **IRRIGATION WATER**
Any water used to maintain gardens and plants

3. Scope of this guide

- 3.1 The aims of this Guide are to support water conservation and to prevent reclaimed water systems from contaminating potable mains water supplies. It is also intended to help those who are considering the design, installation and maintenance of reclaimed water systems.
- 3.2 This Guide sets out to encourage the development of good practice through practical experience with reclaimed water systems. A standardised approach towards the assessment and control of the potential hazards associated with reclaimed water systems is described.

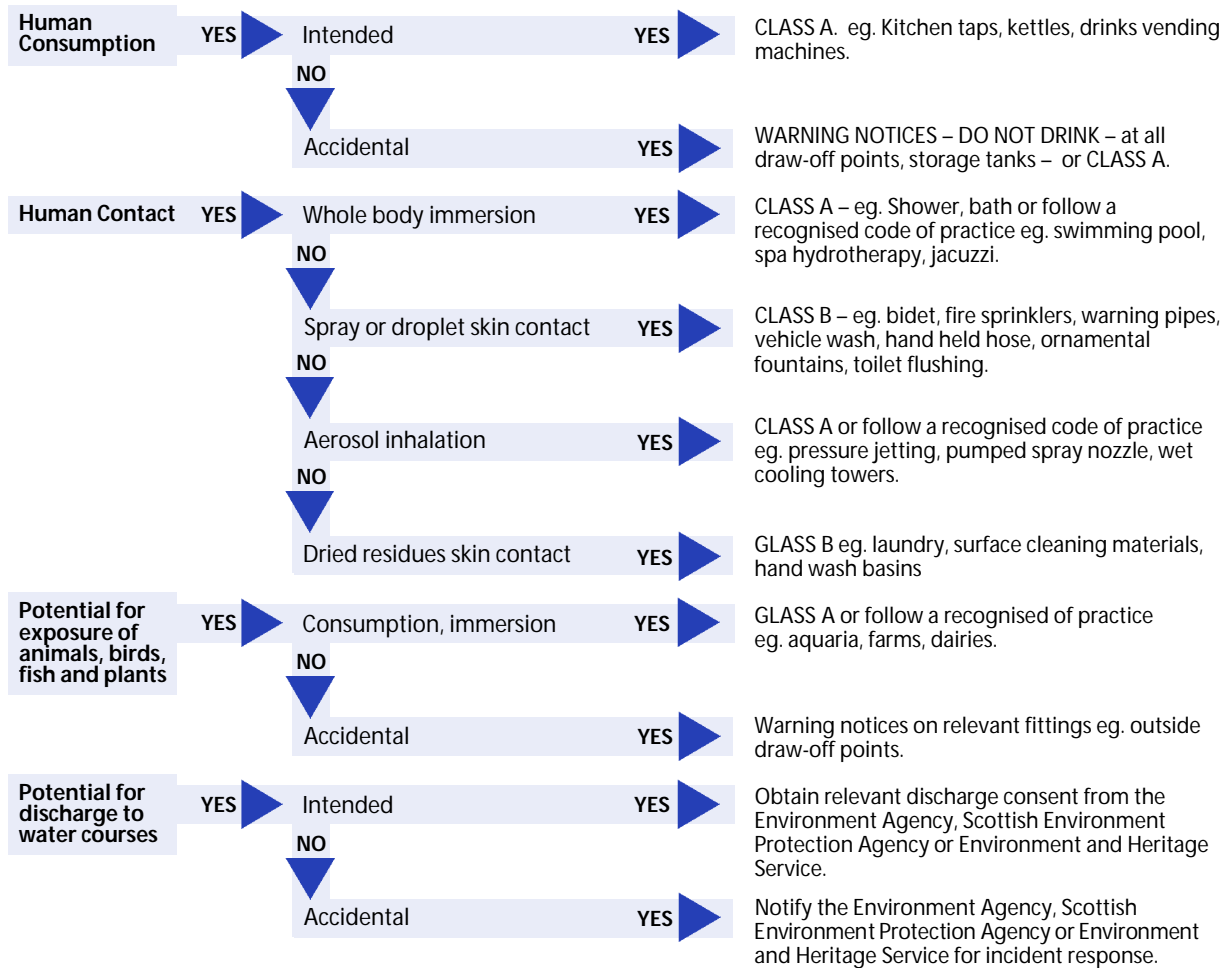
4. Causes of contamination

- 4.1 Pipes conveying rainwater, greywater and reclaimed water for collection, storage, treatment and distribution must not be laid in ground contaminated or likely to have been contaminated by faecal matter. There is a risk of cross contamination via leaking joints in the greywater, rainwater or reclaimed water pipes and any pipes carrying foul fluids. Sources of faecal matter include sewers, foul drainage, septic tanks or other solid or liquid waste storage.
- 4.2 Care should be taken in the choice of materials where pipes conveying rainwater, greywater and reclaimed water for collection, storage, treatment and distribution are to be laid in ground that is contaminated by, for example, hydrocarbons. Contaminants can present a risk of pipe material decomposition or permeation leading to contaminants entering the water which may be a risk to health.
- 4.3 Pipes and water fittings must be clearly identified and marked because reclaimed water systems add to the number of pipes and water fittings on a site and, therefore, increase the opportunities for inadvertent cross connection with the potable mains drinking water distribution system.
- 4.4 It is imperative that contamination of the site mains drinking water supply does not occur as a result of badly designed or installed site water systems. Regard must therefore be paid to the need for backflow prevention measures throughout the site systems.
- 4.5 Water fittings, plumbing systems, water storage structures and particularly cross connections can lead to contamination of potable water if backflow preventative measures are not installed or maintained.
- 4.6 The quality of rainwater, greywater and reclaimed water, like potable water, will deteriorate if it is in contact with unsuitable materials of construction. The use of materials, water fittings and chemicals listed in the Water Fittings and Materials Directory will safeguard against contamination of this type.
- 4.7 Water used to wash cooking utensils will contain some fats, grease and oils and these substances if allowed to accumulate will cause fouling and this can cause offensive odours or blockages leading ultimately to the reclaimed water system malfunctioning. Generally this type of water source (from kitchens) is to be avoided as a source of greywater but if used, it will require a high degree of treatment and special attention to maintenance regimes.
- 4.8 Any system based on rainwater collection will contain traces of atmospheric and environmental pollutants, together with some animal and bird faecal matter. The extent of such contamination will vary from site to site but some degree of contamination must always be assumed and catered for by the design of such a reclaimed water system. Special attention is needed if hardstanding areas are used for vehicle parking due to risks of oil and fuel spills. (See 4.2)
- 4.9 Water used to launder clothes and that from baths, washbasins, showers, spas and swimming pools will contain dissolved chemical additives such as phosphates, nitrates, chlorine, chlorides, sodium as well as organic particulate matter. Characteristics of these sources of water such as pH, dissolved oxygen and temperature will be subject to considerable variation. The chemical, physical and biological properties of these source waters must be measured as an integral part of the design and commissioning of the reclaimed water system.
- 4.10 When water is stored or stands in pipes and fittings it will be prone to warming which encourages growth of organisms. Stagnation of water increases the potential for pick up of contaminants from surfaces and air or by ingress. Rainwater storage systems must be covered with screens on both inlets and outlets. Insulation to minimise heat gain and for frost protection must be a feature of the design of a reclaimed water system. Particular attention must be paid to water replacement/turnover in all parts of the system, periods where water is likely to be static for longer than a week are to be avoided.
- 4.11 If large underground storage tanks are to be installed on the site, compliance with the relevant Building Regulations will be required.

5. Hazard assessment protocol

- 5.1 Each situation where a reclaimed water system is to be installed or is to be modified, should be the subject of a hazard assessment. The same is recommended when taking over responsibility for ownership or operation of an installed reclaimed water system.
- 5.2 A hazard assessment protocol is included in this Guide (See page 3). This protocol illustrates the type of assessment process that is required to identify the necessary safeguards to be adopted to minimise potential risks to users, owners, installers, the general public and the environment.
- 5.3 The protocol describes four generic routes of exposure. Each is to be considered in turn.
- 5.4 The most important exposure to be considered is any intended or accidental human consumption of reclaimed water. If the system is intended to supply potable water then a Class A (see classification list) design is required since the system must produce water of equivalent quality to the UK standards for potable mains drinking water. Potable standards safeguard against the risk of gastrointestinal waterborne diseases. The early involvement of the local authority (environmental health), the district health authority (public health) and the local Water Supplier is recommended especially with setting up the required water quality monitoring and reporting arrangements. If the system is to have a top-up arrangement from the mains water supply, the Water Supplier will advise on backflow prevention measures and may want to inspect the installation. If only accidental human consumption is anticipated, the safeguards required will be the posting of clear 'do not drink' warning notices at each draw off point.

Health Risk – Hazard Assessment Protocol



5.5 Always anticipate accidental exposure for taps situated in public access or outdoor areas.

5.6 Also consider other routes of human exposure. Here the potential hazards are mainly skin or respiratory health effects. The extent and route of exposure are both important. For inhalation hazards, care must be taken to distinguish between aerosol production and the more common occurrence of water droplets. If aerosols will be generated by water fittings or maintenance procedures, then a legionellosis hazard assessment will be required. A Control Of Substances Hazardous to Health (COSHH) Regulations assessment will be required for any chemical additives in the greywater or used in water treatment. Water quality is more critical, where there is regular, as opposed to one off exposure of individuals. If the reclaimed water system is to supply a heating or ventilating system a water treatment and maintenance regime will be required which is adequate for that purpose.

5.7 The potential for exposure of mammals, birds, fish and plants must be assessed. Always obtain specialist advice for any unusual or exotic flora and fauna on the site. Water for domestic pets, ornamental fish ponds and aviaries will all need to be considered. Generally rainwater will be more acceptable than greywater as a source of irrigation water.

5.8 An environmental impact assessment will be of considerable value and early contact with the Environment Agency (EA) in England and Wales, the Scottish Environment Protection Agency (SEPA) in Scotland or the Environment and Heritage Service (EHS) in Northern Ireland, will identify the need for any discharge consents. Planning for periodic maintenance or system malfunctions will highlight ways to avoid the risk of pollution of water courses.

6. Classes of water quality

6.1 Class A is potable water meeting the standards set by the Water Supply (Water Quality) Regulations 1989 in England and Wales, the Water Supply (Water Quality) Scotland Regulations 1990 in Scotland and the Water Quality Regulations (Northern Ireland) 1994 in Northern Ireland and any subsequent amendments. These apply to all aspects of the system design, construction, operation and maintenance including all chemicals, disinfecting agents and materials of construction. Regular monitoring of water quality during commissioning and subsequently will be required to establish an adequate maintenance and operating regime. The designated sample point for checking compliance with water quality standards shall be a draw off point where reclaimed water is stored, after collection and treatment.

6.2 Class B Water quality guidelines will vary but must relate directly to the intended uses of the water. When drawing up and documenting guidelines for a system refer to, and apply all relevant codes of practice published by government and professional agencies. Always include Guide Values for parameters indicative of the aesthetic water quality and the general hygienic condition of the system. Examples of useful measures are turbidity, faecal coliforms, faecal enterococci, pH and Biological Oxygen Demand (BOD). Measurements must be considered for any specific additives or contaminants identified during the hazard assessment or dosed into the system. Care must be taken to use only relevant measurements, simple tests undertaken frequently provide greater reassurance of water quality than sophisticated tests done occasionally. Provide a clear definition of each measurement and how the Guide Value relates to any potential hazard and what action will be required, by operators and owners in the event of a breach of the Guide Value.

6.3 A NOTE ABOUT PRINCIPLES OF HYGIENE

6.3.1 An aid to developing realistic water quality guidelines.

6.3.2 People are exposed to millions of faecal organisms during everyday life activities. The toilet environment, particularly surfaces, will be contaminated with faecal residues. Droplets formed during toilet flushing will frequently contain large numbers of faecal organisms and only a very few will be harmful types (pathogens). For reclaimed water to add to the burden of exposure, the faecal coliform content would need to be in excess of 10,000 per 100ml.

6.3.3 Several aspects of laundry processes create conditions unfavourable to the survival of faecal organisms. Chemical additives are often toxic or exert toxic effects by changing water properties such as pH. Even though the temperature of some machine washes is low, subsequent drying of garments will kill organisms by desiccation. Additionally heat-kill will occur during ironing or pressing. Since all worn garments accumulate faecal residues, hand washing of garments routinely involves exposure to faecal organisms. Organisms in greywater are unlikely to add to the normal burden.

6.3.4 The microbial hazards which can arise from reclaimed water systems are generally akin to those which can arise during food preparation where best practice relies on awareness and consistent application of simple hygiene precautions. Public awareness through factual information leaflets and the posting of notices, where basic rules need to be followed, is the most important and effective way of mitigating concerns of users and the general public.

6.3.5 Situations where hygiene rules – e.g. posting of notices – will be helpful, are draw off taps, where accidental water consumption may arise. Typical scenarios might be teeth cleaning, taking of medicines or care of domestic pets.

6.3.6 Testing for specified pathogens is not recommended. In the unlikely event of a reclaimed water system becoming the focus of concern as a possible source of waterborne illness, local health agencies will need to examine records of testing for

faecal indicator organisms (see 6.1). Reclaimed water results consistently below 10,000 per 100ml faecal coliforms and 100 per 100ml faecal enterococci would provide reassurance about any reclaimed water system used for normal household and irrigation purposes. Results above these guidelines would require investigation.

7. Basic protection of potable mains water supplies within premises

7.1 The operation of any reclaimed water system must not result in waste, misuse, undue consumption or contamination of the potable mains water supply.

7.2 The inlet supply of potable water to any cistern containing rainwater, greywater or reclaimed water must be protected by an air gap suitable for protection against a Class 5 risk (see Water Supply [Water Fittings] Regulations 1999, Water Byelaws in Scotland or Northern Ireland Regulations).

7.3 Pipes or fittings conveying potable water must not be cross connected to any pipe, fitting or appliance conveying or containing greywater, rainwater or reclaimed water.

7.4 Where separate potable and greywater, rainwater or reclaimed water cisterns are installed, each must be clearly marked to show their intended use (See IGN 9-02-05).

7.5 Any pipe, fitting or vessel used to convey or store rainwater, greywater or reclaimed water must only be used for that purpose.

7.6 Pipes and fittings used to convey greywater, rainwater or reclaimed water must be clearly colour coded and labelled (see IGN 9-02-05 for colour coding of reclaimed water pipes).

7.7 Reclaimed water systems shall not be used for drinking, food preparation, cooking or bathing, unless the design, installation, operation and maintenance, including regular water quality monitoring, complies with potable water standards and regulations (Class A).

7.8 Class B water quality may give rise to a reduced operational life for taps and other fittings as a consequence. If one or more components of the reclaimed water system fails and is not repaired or replaced promptly, this may result in significant top up of the system with potable mains water. This would negate any water conservation benefit of the reclaimed water system.

8. Construction and arrangement of reclaimed water installations – information for manufacturers

8.1 All faecally contaminated waste water, such as that from WC's and bidets must pass directly into the sewer system.

8.2 A bypass to sewer arrangement must be installed to allow easy cleaning and maintenance following any faecal contamination caused by water users.

- 8.3 If the system fails to operate it must default simply to the potable mains water back up supply.
- 8.4 Filters of all types require regular cleaning and replacement of the media. Failure of filtration due to inadequate maintenance will cause blockages (no flow) unpleasant odours and health concerns. Consider the value of more than one stage of filtration e.g. coarse screening to remove residues from clothes, hair etc. to improve the efficiency and functioning of the main filtration device.
- 8.5 Where mains potable water is used for back-up supplies to rainwater, greywater or reclaimed water storage cisterns, an air gap suitable for protection against a Class 5 risk (see Water Supply [Water Fittings] Regulations 1999, Water Byelaws in Scotland or Regulations in Northern Ireland) must be provided for backflow prevention. An overflow to a suitable drain must be incorporated into these cisterns. In addition a warning pipe or other device should be fitted to warn if the system malfunctions.
- 8.6 Do not apply potable water top up at individual draw off points or appliances.
- 8.7 Find out about the local sewerage agency and environmental agency [Environment Agency (EA) in England and Wales, Scottish Environment Protection Agency (SEPA) in Scotland or the Environment and Heritage Service (EHS) in Northern Ireland] requirements. Consult them about the discharge arrangements.
- 8.8 Consult the water supplier about the discharge of rainwater to sewer.
- 8.9 All pipes, valves and fittings conveying rainwater, greywater or reclaimed water must be colour-coded and labelled according to the hazard assessment and usage.
- 8.10 Each draw off point from a Class B reclaimed water system must have a clear, visible warning sign in place.
- 8.11 The reclaimed water system must be designed, operated and maintained so as to deal adequately with the contaminants, solids and organisms in the source waters. Procedures must be well documented and records must be kept.
- 8.12 Storage of untreated greywater must be kept to a minimum and reasonable use must occur each day so as to avoid creating a nuisance or health concerns due to unpleasant odours or appearance.
- 8.13 Stored rainwater or greywater must be protected from ingress of contaminants, dust or organisms by adequate covers, exclusion of light and screens on inlets and outlets.
- 8.14 Reclaimed water systems should be easy to operate and have simple routine service requirements.
- 8.15 Reclaimed water systems should be supplied with full and clearly worded operating, maintenance and safety instructions for users and owners.
- 8.16 Any pipes and fittings used in the construction of reclaimed water systems must be fit for the purpose.
- 8.17 Reclaimed water systems should be designed to prevent blockages and residue build up within the system. Filters shall be easily accessible for cleaning and made from materials that do not biodegrade.
- 8.18 Transparent materials should not be used, and light should be excluded to prevent algal growth. The system must be taken out of service during cleaning.
- 8.19 Reclaimed water systems must be constructed, operated and maintained to prevent the likelihood of blockage, leakage or overflow. They must provide access points for maintenance and clearing of blockages. There must be adequate ventilation to prevent the likelihood of foul air accumulating in the installation or the drainage system.
- 8.20 Reclaimed water systems for the purpose of irrigation must not give rise to contamination of the underlying aquifers, neighbouring watercourses or premises and where necessary, discharge consents must be obtained.
- 8.21 Instructions for the safe disposal of treatment chemicals or residues (waste) must be provided.
- 8.22 Any equipment or apparatus supplied with water by a reclaimed water system must carry a warning label to that effect.
- 8.23 Use of materials and fittings listed in the Water Fittings and Materials Directory will help considerably to prevent adverse water quality effects due to components of the system.

9. General tips on reclaimed water uses and treatment

- 9.1 If greywater is to be used for irrigation, apply it direct to soil and not through a sprinkler or method that would allow contact with above ground portions of plants. Avoid aerosol generation, particularly in enclosed spaces.
- 9.2 Do not apply greywater to crops, which are eaten uncooked.
- 9.3 Do not apply greywater to plants, which thrive only in acid soil.
- 9.4 Do not apply greywater to seedlings or young plants, a better use is to well established plants, dispersing over a wide area and alternating with fresh or rainwater, as this avoids build up in the soil or roots of residues eg. sodium.
- 9.5 Remember that when demand is low (eg. seasonal irrigation), facilities to divert excess greywater or rainwater to sewer or septic systems will be required.
- 9.6 If greywater is used directly in garden ponds, it will encourage the development of algae and in excess this may cause the pond to deoxygenate and produce offensive odours and harm to pond life. An arrangement of a separate greywater pond, yielding algae for duck or fish food, should be considered.
- 9.7 If organic solvents are used in the premises, care must be taken to prevent these from entering water cisterns by dissolution from the air.

- 9.8 Design of reclaimed water systems must be based on the amount of greywater or rainwater that will be collected. About two thirds of domestic waste water is greywater. Filters and chemical additives, including disinfectants, must be sized and dosed to deal with the volumes that will be produced as well as the seasonal variations.
- 9.9 Basic treatment involves the use of settlement tanks and filtration. These measures are important for the control of micro-organisms, as well as the appearance of the water and the functionality of the system. The addition of disinfectant to a reclaimed water system, which lacks adequate filtration will be ineffective and may be hazardous.
- 9.10 Chlorine and other treatment chemicals can be hazardous. Care must be taken in their delivery, storage and dosing. Warning notices and safety procedures are essential. Do not apply or store chemicals in unventilated areas such as basements and lofts.
- 9.11 Filters made from natural cellulosic materials will biodegrade and this will eventually cause their failure.
- 9.12 When sizing tanks make allowance for residues which build up over time. The design should promote settlement of solids to the bottom. Inlets and draw off points should be located to avoid disturbing bottom sediments. Tanks will need periodic cleaning by pumping out sludge, the disposal of which needs to be planned for.
- 9.13 Filters should incorporate a perforated plate or some other device to distribute the water evenly over the top, a funnel in the bottom to assist water to the drain pipe, a cover and a vent.
- 9.14 If using household disinfectants based on bleach (chlorine), iodine or bromine, do not use a type, which contains a colouring agent or dye. Useful advice about disinfectants is issued for the treatment and management of swimming pools and spas published by the Swimming Pool and Allied Trades Association (SPATA).
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Further copies and technical information may be obtained from:

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