



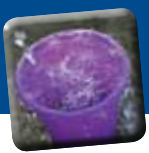
Government of **Western Australia**  
Department of **Health**

# Code of Practice for the Reuse of Greywater in Western Australia 2010



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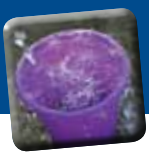
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## PART 1: General Information

### 1. INTRODUCTION

The opportunity exists for appropriately treated greywater to be reused for a variety of different end uses, such as irrigating gardens and flushing toilets. This will reduce the demand on quality ground and surface water supplies. Considering the dry environment in many parts of Western Australia and the sometimes limited supply of water, it is important that water is used efficiently and conserved wherever possible. Reuse of greywater is therefore supported and encouraged by Government to help conserve water. However, this has to be accomplished without compromising public health, causing unacceptable environmental impact, or downgrading the amenity of our residential areas.

Pathogenic microorganisms such as bacteria, protozoa, viruses and parasites can be present in greywater in concentrations high enough to pose a health risk. Therefore, a level of caution must be exercised with greywater reuse. The health risk associated with greywater reuse can be minimised by not allowing human contact with untreated greywater, or by treating the greywater to an appropriate quality level for its intended end use(s).

Greywater also contains oils, fats, detergents, soaps, nutrients, salts and particles of hair, food and lint, which can affect operational performance and life of a greywater system. If these contaminants are not managed appropriately, they can degrade soil structure, clog groundwater flow paths, escape to the ground surface or even cause non-wetting characteristics in garden soils.

A clear understanding of the potential health risks, operational problems and environmental impacts is necessary to ensure only suitably designed greywater treatment and land application systems are used. Greywater systems must be designed for long-term use. Experience has shown that poorly developed greywater systems will saturate the soil, cause odours, blockages and become a burden (financial and time) due to constant maintenance requirements.

## 1.1 Objective

The objective of this Code is to assist in the promotion of acceptable long-term greywater reuse and promote conservation of our quality ground and surface water supplies without compromising public health by:

- establishing acceptable means of greywater reuse as a guide for local government, industry and homeowners;
- setting minimum design and installation standards for greywater systems;
- establishing proper procedures to obtain an approval to install a greywater system;
- ensuring that greywater installations are designed, installed and operated so when used on a long term basis they;
  - do not harm humans, animals or the environment,
  - do not cause a nuisance, and
  - are appropriately sited and maintained to a satisfactory standard.

## 1.2 Scope

This code sets the minimum requirements for the reuse of greywater in sewered areas of Western Australia on:

- single residential domestic premises
- multiple dwellings producing up to 5000 L/day of greywater
- Commercial premises reusing up to 5000 L/day.

Part 1 of the code provides information about greywater composition and the health and environmental risks of using greywater

Part 2 of the code set out the minimum requirements for each one of the greywater reuse options. The code provides details on greywater volume calculations, land application and installation requirements.

The Local Government is responsible for the approval of all greywater reuse systems used in single dwellings. For multi-dwelling and commercial premises, this code defines the responsible agency (i.e. local government or the Department of Health, Western Australia) that will approve the greywater reuse system based on treatment method, proposed end uses and estimation of volumes of greywater produced (see section 5: Approvals required for greywater reuse).

Greywater reuse and management techniques presented in this document are still relevant to unsewered areas. Consideration for greywater reuse in unsewered areas is discussed in section 2.1.2.

This document does not cover greywater recycling schemes for multi-dwellings. Proponents should consult the Western Australian **Guidelines for the Use of Recycled Water in Western Australia**.

This document does not give guidance on how to get a greywater recycling product approved. Manufacturers should consult the Department of Health's **Code of Practice for Product Approval of Onsite Wastewater Systems in Western Australia**.



## 1.3 Legislation

The “Code of Practice for the Use of Greywater in WA 2010”, has been endorsed by the by the Executive Director Public Health in accordance with Section 344A (2) of the Health Act 1911. This document replaces any previous edition.

## 1.4 What is Greywater?

Wastewater is made up of “Greywater” and “Blackwater”.

Greywater is wastewater from:

- Washing Machines
- Showers
- Baths
- Wash basins
- Spa Baths
- Laundry Tubs
- Kitchens

Blackwater is the wastewater from toilets, urinals or bidets.

Kitchen greywater must be treated before reuse in gardens as it can contain elevated levels of greases, oil and detergents. Kitchen greywater must not be reused through a Greywater Diversion Device.

## 1.5 Why Use Greywater?

Recent widespread drought in Australia, combined with the continued population growth, has resulted in increasing pressure on drinking water supplies in most large cities and many regional areas of Australia.

Greywater is a resource that can be reused on-site for garden and lawn irrigation or, when treated adequately, for toilet flushing and laundry use (cold-water washing machine only). Substituting the use of drinking water with greywater for these end uses will not only reduce the demand on drinking water supplies, but also reduce the amount of wastewater discharged to the environment.

Reusing greywater provides a number of benefits including:

- Reducing potable water demand
- Reducing the amount of wastewater discharged to the ocean or rivers
- A healthier garden, especially during drought periods.
- Reducing house-hold water bills

The disadvantages of greywater reuse may include:

- The potential for pollution and undesirable health and environmental effects when greywater is not reused appropriately
- Initial cost of setting up a greywater system and plumbing requirements
- Ongoing maintenance and system owner commitment.

## 1.6 Greywater Sources

There are essentially two main greywater sources, they are:

- **Bathroom Greywater (bath, basin, and shower)** contributes about 51% of the total usable greywater volume. Bathroom greywater can be contaminated with hair, soaps, shampoos, hair dyes, toothpaste, lint, nutrients, body fats, oils and cleaning products. It also contains some faecal matter (and the associated pathogens) from body washing.
- **Laundry Greywater** contributes about 42% of the total usable greywater volume. Wastewater from the laundry varies in quality from wash water to rinse water to second rinse water. Laundry greywater can contain faecal matter with the associated pathogens, lint, oils, greases, chemicals, soaps, nutrients and other compounds derived from soiled clothes or cleaning products.

Kitchen wastewater can also be a greywater source. However, kitchen greywater is heavily polluted with food particles, cooking oils, grease, detergents, and other cleaning products such as dishwashing powders. It is for these reasons that kitchen wastewater must not be reused via manual bucketing or greywater diversion devices (GDD). Kitchen greywater may be reused if treated by a greywater treatment system (GTS) that has been approved to receive kitchen greywater.

## 1.7 Greywater Volumes

Greywater generation will vary according to the water usage practices of each individual in the household and the use of water efficiency devices.

The average house (based on three persons per house) uses 825L of water everyday. This equates to approximately 120L of greywater per person per day. Of this 40 litres is produced in the laundry and 60 litres from the bathroom (ANZS 1547:2000).

## 1.8 Composition of Greywater

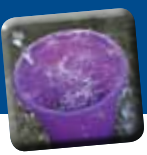
The quality of greywater can be highly variable due to factors such as the number of household occupants, their age, lifestyle, health, water source and products used (such as soaps, shampoos, cleaning products) and other site specific characteristics.

### 1.8.1 Microbiological Quality

The **Escherichia coli** (E.Coli) group of bacteria are used as an indicator of microbiological quality. E.coli belongs to the thermotolerant faecal coliforms group. They are a type of microorganism, which typically grow in the intestine of warm-blooded animals (including humans) and are shed in their millions in each gram of faeces. Occurrence of E.Coli in greywater indicates a risk of pathogens being present and hence, the risk of contracting illness or infection through contact with the water.

In general, the number of E.Coli in greywater is low unless greywater is generated from washing nappies or clothes contaminated with faeces or vomit (Jeppesen and Solley, 1994). This suggests that the numbers of harmful pathogens are also low.

When untreated greywater is stored, it will turn septic, giving rise to offensive odours and providing suitable conditions for microorganisms to multiply. Thermotolerant coliforms multiply between 10 and 100 times during the first 24 to 48 hours of storage. Therefore, untreated greywater must only be stored temporarily, for less than 24 hours, in a surge tank.



### 1.8.1 Chemical and Physical Quality

There is a high amount of variability in the chemical and physical quality of greywater produced by any household, due to factors such as the source of water, the water use efficiency of appliances and fixtures, individual habits, products used (e.g. detergents, shampoos, soaps etc.) and other site-specific characteristics.

The amount of salt (sodium, calcium, magnesium, potassium and other salt compounds), oils, greases, fats, nutrients and chemicals in greywater can largely be managed by the types of products used within a household.

#### **Nutrients**

Phosphorus and nitrogen are nutrients necessary for plant growth. Greywater, containing nutrients generated from the bathroom and laundry, may be supplemented for fertiliser to provide phosphorus and nitrogen to the garden and lawn.

Excessive nutrient loads should be avoided to prevent damage to soil, plants, groundwater and off-site waterways. The reuse of greywater has the potential to significantly reduce the need for fertiliser application on gardens and lawns. The application of nutrients through the irrigation process is also preferred, as the nutrients will be applied more gradually and this will reduce the risk of nutrients being washed away during rain events.

The variability in the nutrient loadings is influenced by the use of different washing detergents, personal hygiene products (soaps, shampoos), and cleaning agents. The amount of nutrients in the products being used by the household has a direct relationship with the amount of nutrients that are present in the greywater when it is reused for irrigation.

By managing the type and amount of washing detergents, personal hygiene products and cleaning agents that are used, the amount of nutrients in greywater can be managed.

#### **Salts**

Salts in greywater originate from washing detergents and are commonly in the form of sodium, magnesium and calcium compounds (Patterson, 2006).

The application of greywater to land introduces to the soil quantities of many salts that cannot be drained from the root zone under normal rainfall. Increases in salt concentration in soil will depend upon the unique combination of soil type, greywater composition and drainage (Patterson, 2006).

The major risks of salts contained in greywater are the accumulation of salts in the soil structure leading to a loss of soil permeability (ability to absorb water) which can cause degradation to vegetation. Sodium salts are always very soluble, many times more soluble than calcium or magnesium salts, and soil sodicity (soil degradation due to sodium salts) presents particular problems to soil and vegetation, including soil permeability and plant growth (Patterson, 2006).

The salts originate from washing detergents, which vary in their salt content. Reducing the quantity of salts, particularly sodium, is the most effective method to reduce the risk to soil and vegetation due to salts, and especially soil sodicity.

Generally, powdered detergents contain the most salt as it is used in washing powders as filler. Concentrated powders generally contain less salt than normal powdered detergents, and liquid detergents contain the least salt of all washing detergents.

In addition to choosing washing detergents that are low in salts, and in particular sodium salts, there are other ways of managing a household's soil to reduce the risks caused by salt application. These include incorporating organic matter into the soil by mulching, and the addition of lime or gypsum.

## 1.9 The risks of using Greywater

It is assumed by many that greywater is “clean” and “safe for reuse” as it does not contain “blackwater”. However, greywater may contain high levels of the following substances:

- Disease causing organisms (such as bacteria, viruses, protozoa, helminths).
- Suspended matter, organic matter, fats and oils, including but not limited to dirt, lint, food, hair, body cells and fats, and traces of faeces, urine, and blood.
- Chemicals derived from soaps, shampoos, dyes, mouthwash, toothpaste, detergents, bleaches, disinfectants, caustic dishwashing powders and other products (such as boron, phosphorus, sodium, ammonia and other nitrogen based compounds).

### 1.9.1 Public Health Considerations

The health of a household is usually reflected in the wastewater produced. However, a household enjoying good health will still excrete pathogenic microorganisms, which are a normal part of the gut. All types of greywater (laundry, bathroom and kitchen) are capable of transmitting disease.

The disease causing organisms in greywater are mainly transferred through contact with greywater via:

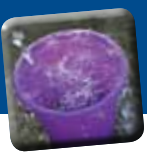
- contaminated hands,
- inhalation of greywater spray, and
- contact with broken skin.

Indirect methods of transfer include:

- contact with contaminated items such as toys, garden implements, grass or soil;
- transmission by pest vectors such as rats, mice, flies and cockroaches;
- transmission by family pets.

There are a number of requirements, which must be followed in order to reduce the risk to public health, including:

- Untreated greywater (from a greywater diversion device) must only be used via subsurface irrigation. Subsurface irrigation systems reduce exposure to humans, pets and other animals which may otherwise come into contact with the untreated greywater and potentially transfer disease causing organisms;
- Specific setback distances from buildings, boundaries, wells, bores, watercourses, swimming pools and rainwater tanks are required to be met for all irrigation systems. This is to prevent contamination and transmission of disease;
- Greywater must not be used in a manner that will result in direct contact with vegetables or other edible plants eaten uncooked. It may be used to irrigate above-ground food plants such as fruit trees and leaf vegetables where the fruit or edible vegetable part does not make direct contact with the greywater.
- Greywater must be contained within the confines of the premises on which it is generated.



### 1.9.2 Environmental Considerations

To minimise negative impacts on the environment from greywater reuse, the following requirements apply:

- a) Greywater must be contained within the confines of the premises on which it is generated and not be permitted to run off onto neighbouring properties. Greywater must not run onto driveways or any hard surfaces where it can run into the street and into stormwater drains and eventually into surface waters e.g. rivers and lakes.
- b) Only products with no or very low phosphorus content should be used. Phosphorus content can range from a low content of 0.05% up to 10% in various detergents.

Low or no phosphorus products will mean less phosphorus can possibly reach waterways via subsoil flow, runoff or stormwater, which can create serious water quality problems. The salts, nitrogen and phosphorus content of various washing detergents available in Australia can be found at [www.lanfaxlabs.com.au](http://www.lanfaxlabs.com.au).

The symbol **NP** is used to identify products, which have no added phosphorus, although levels below 0.5% may be present. The symbol P denotes “the product complies with agreed industry standards on phosphorus, which impose a maximum content of 7.8 grams per wash”.

- c) Greywater tends to be slightly alkaline, with a typical pH range of between 6.5 and 10.5, and the extensive use of greywater for irrigation could cause the soil to become progressively more alkaline.

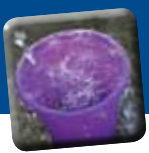
A washing detergents ability to remove stains is linked the pH. Soil and greases are more easily removed at a high pH. Shade loving and acid loving plants do not like the alkalinity of greywater. These include azaleas, camellias, gardenias, begonias and ferns.

- d) Washing powders that contain sodium salts as bulking agents should be used sparingly. High levels of sodium can produce saline (i.e. salty) greywater. Sodium is detrimental to plants, can damage soil structure, reducing the air space, giving it a greasy texture and poor drainage capability. The salts, nitrogen and phosphorus content of various washing detergents available in Australia can be found at [www.lanfaxlabs.com.au](http://www.lanfaxlabs.com.au).

Liquid detergents (instead of powders) or products, which use potassium salts, should be used as they produce better quality, less saline greywater

- e) Try to avoid the use of:
  - bleaches or softeners,
  - detergents with ingredients which include: boron, borax, chlorine, bleach, sodium perborate and sodium tryochlorite (salts), sodium tripolyphosphates (STPP), phosphorus, phosphates, polyphosphates, phosphate builders, acids etc, and
  - products used to clean drains.
- f) The following materials should not enter a greywater system
  - Paints, automotive oils and greases, waste chemicals, pesticides and pharmaceuticals etc
  - Any matter designated as trade waste or industrial liquid waste.
- g) In soils where the phosphorous retention index (PRI) of the soil is less than five, the greywater systems should be installed more than 100 metres away from any wetland, stream flow or other water sensitive ecosystems. Information about local water features can be obtained from the Department of Water.

- h) Greywater systems within a proclaimed public drinking water source areas, located in designated Priority 1 areas, wellhead protection zones or reservoir protection zones (as defined in published drinking water source protection plans or land use and water management strategies) must be approved in writing by the Department of Water. Information on these areas and zones is available online at [www.water.wa.gov.au](http://www.water.wa.gov.au).
- i) If within a Priority 1 Drinking Water Source Protection Area, the PRI of the soil will need to be assessed by a soil scientist. Soil tested must be collected from the soil in which the greywater is to be irrigated. The testing procedure must be conducted by a NATA registered laboratory.
- j) System flow rates on coarse sandy soil/gravel should be carefully designed to avoid greywater directly entering surface water bodies. A minimum vertical path length of 600mm soil absorption zone is required for all types of soils to comply with AS 1547:2000 i.e. 600mm of vertical absorptive soil between water bodies and the greywater land application area.



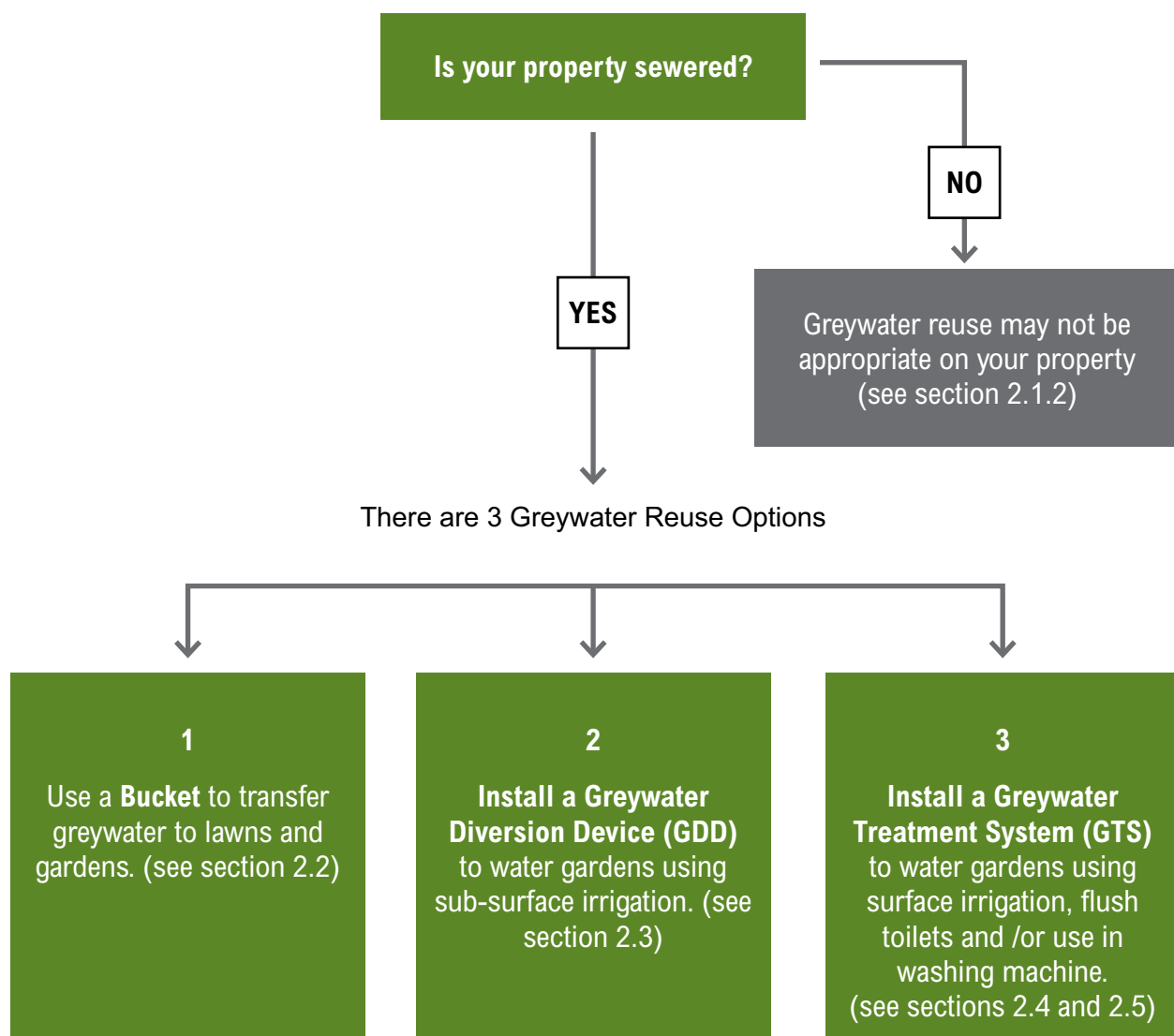
## PART 2: Guide to Reusing Greywater

### 2.1 Greywater reuse options

There are three options for greywater reuse, they are:

1. Bucketing
2. Greywater Diversion Device (GDD)
3. Greywater Treatment System (GTS)

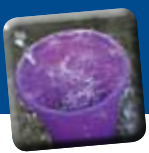
#### Flowchart 1: Greywater Reuse Option Flowchart for single dwellings



Each reuse option has different permitted end-uses and approval requirements. Tables 1 and 2 show how greywater can be reused depending on the treatment method and depending on whether it is for a single residence or a multi-dwelling/commercial premises

**Table 1: Approved uses of Greywater for Single Domestic Premises**

Treatment Method	Permitted use of greywater sourced from and recycled on single domestic premises	
Bucketing	Subsurface irrigation <sup>5</sup>	N/A
	Surface irrigation <sup>4</sup>	N/A
	Toilet flushing	Yes
	Washing machine	Yes
Diversion Device	Subsurface irrigation <sup>5</sup>	Yes
	Surface irrigation <sup>4</sup>	No
	Toilet flushing	No
	Washing machine	No
GTS with no disinfection (20/30 standard) <sup>6</sup>	Subsurface irrigation <sup>5</sup>	Yes
	Surface irrigation <sup>4</sup>	No
	Toilet flushing	No
	Washing machine	No
GTS with disinfection (20/30/10 standard) <sup>7</sup>	Subsurface irrigation <sup>5</sup>	Yes
	Surface irrigation <sup>4</sup>	Yes
	Toilet flushing	No
	Washing machine	No
GTS with Advanced secondary treatment and disinfection (10/10/1 standard) <sup>8</sup>	Subsurface irrigation <sup>5</sup>	Yes
	Surface irrigation <sup>4</sup>	Yes
	Toilet flushing	Yes
	Washing machine	Yes



**Table 2: Approved uses of Greywater for Multi-dwelling / Commercial Premises**

Treatment Method	Permitted use of greywater sourced from and recycled on multi-dwelling/ commercial premises	
Bucketing	Subsurface irrigation <sup>5</sup>	N/A
	Surface irrigation <sup>4</sup>	N/A
	Toilet flushing	No
	Washing machine	No
Diversion Device	Subsurface irrigation <sup>5</sup>	No
	Surface irrigation <sup>4</sup>	No
	Toilet flushing	No
	Washing machine	No
GTS with no disinfection (20/30 standard) <sup>6</sup>	Subsurface irrigation <sup>5</sup>	No
	Surface irrigation <sup>4</sup>	No
	Toilet flushing	No
	Washing machine	No
GTS with disinfection (20/30/10 standard) <sup>7</sup>	Subsurface irrigation <sup>5</sup>	Yes <sup>2</sup>
	Surface irrigation <sup>4</sup>	Drip Only <sup>2</sup>
	Toilet flushing	No
	Washing machine	No
GTS with Advanced secondary treatment and disinfection (10/10/1 standard) <sup>9</sup>	Subsurface irrigation <sup>5</sup>	Yes <sup>2</sup>
	Surface irrigation <sup>4</sup>	Drip Only <sup>2</sup>
	Toilet flushing	AGWR standard only <sup>3</sup>
	Washing machine	AGWR standard only <sup>3</sup>

**Notes for Tables 1 and 2**

1. Multi-dwelling premises: one site with numerous buildings, some or all of which are connected to one common onsite greywater treatment system.
2. Sites with sensitive subpopulations such as hospitals, aged care facilities, childcare centres and schools should only use sub-surface irrigation, and not irrigate children's play areas (such as lawns).
3. Recycling greywater for internal use at multi-dwelling and commercial premises is not approved unless the system that has demonstrated compliance with the National Water Quality Management Strategy: Australian Guidelines for Water Recycling (AGWR), including the ongoing operation and management.
4. Surface irrigation describes the application of water at ground level. Unless otherwise indicated it includes the use of low-rise sprinklers, micro-sprayers, and drip systems.

5. *Sub-surface irrigation describes the application of water at a depth of 100mm to 300mm below ground level.*
6. *20/30 standard describes a water quality of <20 mg/L BOD and <30mg/L suspended solids*
7. *20/30/10 standard describes a water quality of <20 mg/L BOD, <30mg/L suspended solids and <10 E.coli/100mL*
8. *10/10/1 standard describes a water quality of <10 mg/L BOD, <10mg/L suspended solids and <1 E.coli/100mL.*
9. *10/10/1 standard describes a water quality of <10 mg/L BOD, <10mg/L suspended solids and <1 E.coli/100mL, <1pfu/100mL coliphages, and <1cfu/100mL clostridia.*

### 2.1.1 Instances where Greywater Reuse is not permitted

There are certain conditions, which have to be fulfilled before a greywater system can be installed. Approval will not be granted for the installation of greywater systems under the following circumstances.

- The greywater system is not one approved by the Executive Director, Public Health.
- The property is connected to a municipal effluent reuse system and the Sewerage Service Provider will not approve the diversion of greywater from the reuse scheme (see section 5.5 Approval from Sewerage Service Provider – Local Government).
- The proposed site for installation is located in an area registered as environmentally sensitive under Environmental Protection (Environmentally Sensitive Areas) Notice 2005 (see Section 5.3 Installation approval from Department of Water);
- Unsuitable site conditions (e.g. unsuitable soils and/or elevated ground water levels, see section 4: Land Application of Greywater).
- Insufficient property area is available to achieve the necessary setbacks and area required for irrigation, see section 4.3: Setback Distances.

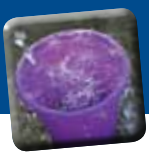
### 2.1.2 Greywater Reuse in Unsewered Areas

In unsewered areas, the primary onsite wastewater systems should be sized to receive the total wastewater flow, as there is no option to divert greywater to the sewer when the greywater system or land application area fails.

The removal of greywater from the primary sewage system also has the potential to adversely impact on the proper operation of that system. Reassurance that the primary sewage system can cope with the separation of the greywater must be investigated before Local Government approval can be granted.

In most cases the primary sewage system should be sized on the total wastewater flow when a GDD is installed (as greywater will still need to be diverted back to the primary sewage system seasonally when the greywater is not required for garden irrigation).

GDD are designed in accordance with Australian Standard AS5200.460 and as such are required to have an overflow pipe that must be connected to a primary sewage system. This overflow ensures that when the filter blocks the greywater automatically overflows back to the primary sewage system. Therefore, GDD's cannot be installed with a composting toilet as there is no provision for greywater overflow. Where single residential dwellings install composting toilets and



a sedimentation tank is installed to treat, kitchen, bathroom and laundry wastewater streams, the sedimentation tank must have a minimum volume of 1820L.

Local Governments can approve the use of greywater in unsewered areas where:

- The primary sewage system or “apparatus for the treatment of sewage” is one approved by the Department of Health, Western Australia under the Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulation 1974, and
- The Local Government is satisfied the primary sewage system can operate effectively with the reduced wastewater flow, and
- Kitchen wastewater is not reused through a GDD, and
- Kitchen wastewater must pass through a grease trap when reused through a GTS.

## 2.2 Bucketing

A bucket can be used to manually reuse greywater (e.g. collecting shower and laundry water for reuse).

Bucketed greywater can be reused for irrigation of gardens, lawns and outdoor pot plants, toilet flushing and washing machine use.

Local Government approval is not required for manual bucketing if greywater is reused in accordance with this Code.

Manual bucketing is considered a low risk activity for the following reasons:

- Manual bucketing reuses low volumes of greywater. Accordingly, only low quantities of contaminants will be applied to the soil and there is a limited ability for runoff to neighbouring properties or waterways.
- It is unlikely that manual bucketing will occur during wet weather, reducing the risk of over-watering or runoff.

It is important that manual bucketing be undertaken in accordance with this document to ensure that public health and the environment are protected.

### 2.2.1 How to safely bucket greywater

The following Do's and Don'ts for bucketing greywater reduce the risks associated with reuse, whilst providing a water source that has the potential to improve the health and appearance of soil and plants.

When undertaking manual bucketing of greywater:

- ✓ DO be careful when lifting and carrying buckets of greywater, particularly over slippery surfaces and on stairs or steps.
- ✓ DO select garden-friendly detergents that are biodegradable and low in phosphorus, sodium, boron and chloride.
- ✓ DO select washing detergents that are low in salt – consider using a powder concentrate, or a liquid washing detergent.
- ✓ DO reuse greywater in the garden in several locations to avoid pooling.
- ✓ DO monitor plant and soil response to greywater irrigation.

- ✓ DO consider applying a soil-rewetting agent every six months.
- ✓ DO wash your hands after reusing greywater.

When undertaking manual bucketing of greywater:

- ✗ DON'T reuse kitchen wastewater.
- ✗ DON'T reuse greywater during rainfall periods.
- ✗ DON'T allow greywater to pool on the ground.
- ✗ DON'T apply greywater in areas that are readily accessible to children, people with a low immune system or pets.
- ✗ DON'T reuse greywater generated from the washing of nappies or soiled clothing.
- ✗ DON'T reuse greywater when a resident is sick, e.g. has diarrhoea.
- ✗ DON'T reuse greywater generated by cleaning in the laundry or bathroom, or when using hair dye or other chemicals.
- ✗ DON'T reuse greywater generated by washing rags used for painting or for maintaining machinery and vehicles.
- ✗ DON'T reuse greywater to top up rainwater tanks or swimming pools.
- ✗ DON'T store untreated greywater for longer than 24 hours.
- ✗ DON'T over-water, avoid pooling.
- ✗ DON'T reuse greywater on plants that will be eaten raw or where fruit has fallen to the ground and could be eaten.
- ✗ DON'T use greywater to wash paths, driveways or cars.
- ✗ DON'T reuse greywater so that it flows onto the streets or down stormwater drains.
- ✗ DON'T let greywater go beyond the property boundary and cause a nuisance to neighbours.
- ✗ DON'T reuse greywater on low permeability or water repellent soils

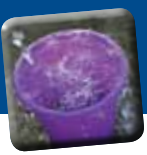
See section 4.5 “How to safely irrigate your garden with greywater” for information on maintaining the condition of the greywater irrigation area.

### 2.3 Greywater Diversion Devices (GDD)

A greywater diversion device (GDD) diverts greywater without storage or treatment, it incorporates a hand activated switch or tap to divert the greywater to the garden or the sewer. Greywater from a GDD must only be reused in gardens via sub-surface irrigation only (irrigation buried at least 10cm below the surface of soil or mulch).

GDD's may only be used in single residential domestic dwellings where the greywater is kept within the confines of the premise on which it is generated.

The reuse of greywater by a GDD for commercial premises, multi dwelling, including groups of town houses, and villas, is not permitted. This is because other residents will not have been exposed to the pathogens through personal contact, therefore increasing the risk of spreading disease through the community. A town house occupant using only that residence greywater on the garden within the premises is permitted. Use on common property gardens is not permitted.



### 2.3.1 Overview

GDD must comply with the following criteria:

- ✓ Have received a WaterMark licence and Department of Health, Western Australia approval for use in Western Australia.
- ✓ Have a hand-activated valve, switch or tap that provides easy access to divert greywater for reuse, or to sewer, as required.
- ✓ Have an automatic overflow to sewer or where approved in unsewered areas, an overflow to the primary sewage system.
- ✓ Be connected to a sub-surface irrigation system.

Greywater diversion is for the productive reuse, not easy disposal, of greywater.

It is important for homeowners to recognise that a GDD must be treated like a garden tap. The diverter should only be turned on when the garden needs watering, at all other times it must be turned off. If the diverter is turned on all the time, overwatering has the potential to significantly damage plants and soil, as well as increase the risk to residents' health.

Any greywater that cannot be reused immediately, for sub-surface irrigation at the residential premises must be diverted to sewer.

GDD's are assessed in accordance with the Australian Technical Specification ATS 5200.460-2005. The manufacturer obtains certification to the technical specification for plumbing and drainage products by way of a WaterMark licence.

A list of approved GDD's can be found on the Department of Health, Western Australia website at: [www.public.health.wa.gov.au](http://www.public.health.wa.gov.au)

There are two types of diversion devices: gravity diversion and pumped diversion

#### ■ Gravity GDD

Gravity diversion devices are most appropriate for properties that have a slope downwards away from the house to the garden or lawn area. In these systems, gravity provides pressure to move the water from the house to the irrigation system.

#### ■ Pump GDD

Pump diversion devices are used when the garden or lawn area is uphill away from the house, or the area is too flat for a gravity system to work. A pump is installed to pump water from the diversion device and surge tank to the area that is to be irrigated. Pump diversion devices must have a backflow prevention device installed to prevent greywater flowing back to the house.

### 2.3.2 Installing a GDD

A formal application to the Local Government is required to obtain approval to install a GDD. See section 5: Approvals required for Greywater Reuse.

Only GDD's that have been approved by the Department of Health, Western Australia can be installed in Western Australia.

To gain Local Government approval the following conditions must be met:

- ✓ The proposed site for installation is not located in an area registered as environmentally sensitive under Environmental Protection (Environmentally Sensitive Areas) Notice 2005 (see Section 5.3 Installation approval from Department of Water);
- ✓ Wastewater is not diverted from kitchen or toilet plumbing;
- ✓ Greywater is not stored in any way, or treated other than primary screening or filtration;
- ✓ The GDD must be a Department of Health, Western Australia approved device and carry a WaterMark;
- ✓ The greywater must be reused via a sub-surface irrigation system;
- ✓ The GDD has a switching or selection facility so that greywater can be easily diverted back to sewer (or primary sewage system);
- ✓ The GDD must be installed by a licensed plumber;
- ✓ The homeowner complies with this Code of Practice and any other conditions issued by the Department of Health, Western Australia or the Local Government;
- ✓ Every GDD installed must have installation, operation and maintenance instructions provided to the homeowner, including irrigation requirements, and approval requirements from the relevant Local Government; and
- ✓ Be a single residential domestic premise.
- ✓ Have enough land application area after taking into consideration the necessary setbacks.

It is the responsibility of the homeowners to engage a licensed plumber to install the GDD.

All plumbing work in sewerred areas must be undertaken by a plumber licensed under the Water Services Licensing (Plumbers Licensing and Plumbing Standards) Regulations 2000 and must comply with the AS/NZS 3500 – National Plumbing and Drainage Code. The plumber must obtain approval from the Sewerage Service Provider for any required connection or modification to the plumbing works connected to the sewer system.

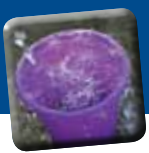
The sub-surface irrigation system connected to the GDD does not require installation by a licensed plumber, but must meet the requirements of this Code of Practice and any other conditions set by the Local Government

### **2.3.3 How to safely use a GDD's**

The following Do's and Don'ts for the GDD reduce the risks associated with reuse, whilst providing a water source that has the potential to improve the health and appearance of soil and plants at the household.

When undertaking diversion of greywater:

- ✓ DO install a greywater diversion device that has a WaterMark licence and is listed as approved by the Department of Health, Western Australia.
- ✓ DO reuse diverted untreated greywater only for sub-surface irrigation (at least 100 mm below the surface of soil or mulch).
- ✓ DO ensure the greywater diversion device is switched back after irrigation periods so that greywater is diverted to sewer.



- ✓ DO undertake a water balance to estimate the amount of water that can be reused by the household.
- ✓ DO select garden-friendly detergents that are biodegradable and low in phosphorus, sodium, boron and chloride.
- ✓ DO select washing detergents that are low in salt – consider using a powder concentrate, or a liquid washing detergent.
- ✓ DO monitor plant and soil response to greywater irrigation.
- ✓ DO occasionally irrigate with drinking water to disperse salts from the soil (only necessary during extended periods of zero rainfall).
- ✓ DO consider applying a soil-rewetting agent every six months.
- ✓ DO use a filter to screen solids when using a diversion device.
- ✓ DO ensure that regular maintenance is undertaken, including cleaning out the GDD filter weekly and maintaining the sub-surface irrigation system.
- ✓ DO mark and label all pipes and use signs to indicate greywater reuse (refer to Section 6: Marking, Labelling and Signage).

When undertaking diversion of greywater:

- ✗ DON'T leave a diversion device on all the time. Treat it like a garden tap and only reuse greywater when the garden needs watering. Greywater is for reuse, not disposal.
- ✗ DON'T reuse toilet or kitchen wastewater.
- ✗ DON'T reuse greywater during rain.
- ✗ DON'T reuse greywater from the washing of nappies or contaminated clothing.
- ✗ DON'T reuse greywater when a resident is sick, e.g. has diarrhoea.
- ✗ DON'T reuse greywater generated by cleaning in the laundry or bathroom, or when using hair dye or other chemicals.
- ✗ DON'T reuse greywater generated by washing rags used for painting or for maintaining machinery and vehicles.
- ✗ DON'T reuse greywater to top up rainwater tanks or swimming pools.
- ✗ DON'T store untreated greywater.
- ✗ DON'T over-water.
- ✗ DON'T reuse greywater on plants that will be eaten raw or where fruit has fallen to the ground and could be eaten.
- ✗ DON'T use greywater to wash paths, driveways or cars.
- ✗ DON'T allow direct contact or ingestion of the greywater.
- ✗ DON'T use greywater to irrigate on dune sand or shallow rocky soil unless the soil has been enriched to a minimum 300mm in depth.
- ✗ DON'T reuse greywater so that it flows onto the streets or down stormwater drains.
- ✗ DON'T install drippers of a sub-surface irrigation system within one metre of boundary lines, in ground pools and in ground potable water tanks and buildings.
- ✗ DON'T let greywater go beyond the property boundary and cause a nuisance to neighbours.
- ✗ DON'T use greywater in households where immuno-suppressed occupants are present.

### **When should greywater be diverted to sewer?**

All approved GDD are required to have a device that allows greywater to be diverted to the sewer in certain situations. It is the responsibility of the householder to see that greywater is diverted to the sewer when:

- nappies or pets are being washed or when someone in the household is ill;
- during spells of wet weather when the water is not needed on the garden and is more likely to pool or run off into neighbouring properties;
- the water is pooling or causing an unpleasant odour;
- any substance that may be harmful to people, pets, wildlife or plants is going down the drain. (Responsible householders will try to avoid putting potentially harmful substances such as oils, solvents and harsh cleaning chemicals down the drain at any time even if the water is going into the sewer).

### **2.3.4 Maintenance requirements for GDD**

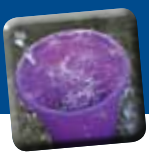
Once a GDD is installed, it is the homeowner's responsibility to ensure it is maintained for the life of the installation.

GDD's and their associated sub-surface irrigation distribution systems require regular maintenance, such as cleaning and replacing of filters and periodic desludging of the surge tank, regular periodic inspection of the subsurface distribution system, and soil condition evaluation.

The filter screen on the inlet of the GDD is important as it removes a variety of materials that may clog the diversion device, pump or irrigation system. If the screen becomes clogged, less greywater can get to the garden.

This maintenance work itself has inherent health risks, just like managing a worm farm or compost bin. Rubber gloves and a mask should be worn and thorough washing of hands and clothes should take place immediately afterwards.

The following table provides a summary of possible maintenance requirements.



**Table 3: Maintenance requirements for GDD's**

Greywater Diversion Device Component	Maintenance Required	Frequency
Filter	Clean filter – filter should be removed and cleaned, removing physical contaminants (sand, lint, hair, etc)	Weekly
	Replace Filter	As recommended by the manufacturer or as required (usually every 6–12 months)
Surge Tank	Clean out sludge from surge tank	Every 6 months
Sub-surface irrigation distribution system	Check that water is dispersing – regularly monitor soil to ensure all areas are wet after an irrigation period.	Weekly
Soil condition	Check that soil is healthy. Signs of unhealthy soil include: – damp and boggy ground hours after irrigation – surface ponding and run-off of irrigated water – poor vegetation growth – unusual odours – clumping of soil – fine sheet of clay covering surface	Monthly
Sensor probe (if applicable)	Clean sensor to ensure correct readings and therefore pump operation	Weekly

See section 4.5 “How to safely irrigate your garden with greywater” for information on maintaining the health of the greywater irrigation area.

## 2.4 Greywater Treatment Systems (GTS)

A greywater treatment system (GTS) collects and treats greywater to a higher quality. Where the treated greywater is not disinfected, it may only be reused via subsurface irrigation. Where the treated greywater from a GTS is disinfected and can achieve the water quality targets specified in Table 1, surface irrigation, toilet flushing, and cold-water laundry washing machine use may be considered.

See tables 1 and 2 for the approved uses of greywater based on the treatment level.

### 2.4.1 Overview

Only GTS's that are approved by the Department of Health, Western Australia can be installed.

A list of approved GTS's can be found on the Department of Health, Western Australia website at: [www.public.health.wa.gov.au](http://www.public.health.wa.gov.au)

GTS's must be designed, installed and maintained to ensure:

- ✓ An appropriate back-up supply of water is provided in the event that the supply of recycled greywater fails.
- ✓ The system automatically diverts untreated greywater to sewer if the system fails as a result of a malfunction or power failure,
- ✓ All plumbing work is undertaken by a licensed plumber in accordance with AS/NZS 3500 National Plumbing and Drainage Code (this specifies the use of management controls such as backflow prevention devices and purple coloured pipes).
- ✓ An authorised service agent conducts regular maintenance.

The treated greywater must not be used for:

- ✗ drinking by humans or animals
- ✗ bathing or showering
- ✗ topping up swimming pools or spas
- ✗ car washing
- ✗ food preparation or washing dishes or kitchen appliances
- ✗ irrigating edible parts of herbs, fruit or vegetables

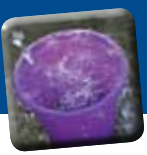
### 2.4.2 Installing a GTS

A formal application for an approval to install a GTS must be sought from and granted from the Local Government. See section 5: Approvals required for Greywater Reuse

To gain Local Government approval the following conditions should be met:

- The proposed site for installation is not located in an area registered as environmentally sensitive under Environmental Protection (Environmentally Sensitive Areas) Notice 2005 (see Section 5.3 Installation approval from Department of Water)
- Wastewater is not diverted from kitchen or toilet plumbing;
- The GTS must be approved by the Department of Health, Western Australia for use in WA, see list of approved GTS online at [www.public.health.wa.gov.au](http://www.public.health.wa.gov.au);
- The GTS must be installed by a licensed plumber;
- The homeowner/applicant complies with this Code of Practice and any other conditions issued by the Department of Health, Western Australia or the Local Government.

It is the responsibility of the homeowners/applicant to engage a licensed plumber to install the GTS.



All plumbing work in seweraged areas must be undertaken by a plumber licensed under the Water Services Licensing (Plumbers Licensing and Plumbing Standards) Regulations 2000 and must comply with the AS/NZS 3500 – National Plumbing and Drainage Code. The plumber must obtain approval from the Sewerage Service Provider for any required connection or modification to the plumbing works connected to the sewer system.

The garden irrigation system connected to the GTS does not require installation by a licensed plumber, but must meet the requirements of this Code of Practice and any conditions from the Department of Health, Western Australia and Local Government. Before approval to reuse the greywater, an inspection of the GTS and irrigation area by the Local Government is required.

### 2.4.3 How to safely use a GTS

The following Do's and Don'ts for the GTS reduce the risks associated with reuse, whilst providing a water source that has the potential to improve the health and appearance of soil and plants at the household.

There are minimum requirements for GTS's and Local Government may also have other requirements and conditions when the approval for installation is given. Each approved GTS also will have additional conditions of approval as issued by the Department of Health, Western Australia.

When reusing greywater treated by a GTS:

- ✓ DO get Local Government approval and install a Department of Health, Western Australia approved GTS.
- ✓ DO ensure that regular maintenance of the greywater system is undertaken by an authorised service agent and as per the GTS product approval requirements.
- ✓ DO reuse greywater only for the end uses approved by the Department of Health, Western Australia for that particular GTS.
- ✓ DO mark and label all pipes and use signs to indicate greywater reuse (see Section 6: Marking, Labelling and Signage).
- ✓ DO undertake a water balance before installing a GTS to calculate the amount of water that can be reused by the household.
- ✓ DO select garden-friendly detergents that are biodegradable and low in phosphorus, sodium, boron and chloride.
- ✓ DO select washing detergents that are low in salt – consider using a powder concentrate, or a liquid washing detergent.
- ✓ DO monitor plant and soil response to greywater irrigation.
- ✓ DO occasionally irrigate with rainwater or drinking water to disperse salts from the soil (only appropriate during extended periods of zero rainfall).
- ✓ DO consider applying a soil-rewetting agent every six months.

When reusing greywater treated by a greywater treatment system:

- ✗ DON'T reuse greywater to top up rainwater tanks or swimming pools.
- ✗ DON'T use greywater to wash paths, driveways or cars.
- ✗ DON'T reuse greywater so that it flows onto streets or down stormwater drains.

- ✗ DON'T let greywater go beyond the property boundary and cause a nuisance to neighbours.
- ✗ DON'T irrigate gardens with greywater during rain.
- ✗ DON'T reuse greywater generated by cleaning in the laundry or bathroom, or when using hair dye or other chemicals.
- ✗ DON'T reuse greywater generated by washing rags used for painting or for maintaining machinery.
- ✗ DON'T over-water gardens.
- ✗ DON'T reuse greywater on plants that will be eaten raw or where fruit has fallen to the ground.

#### 2.4.4 Maintenance requirements

Once a GTS is installed, it is the homeowner's/applicant's responsibility to ensure it is maintained for the life of the installation.

The GTS must be maintained by an authorised service person in accordance with the manufacturer's specifications. A minimum annual inspection is required to be conducted as part of the maintenance requirements. The Local Government should require that a service report sheet is completed for each service. The original shall be given to the owner, the duplicate forwarded to the Local Government and the triplicate retained by the service contractor. This process is similar to the requirement for regular service agreements for aerobic treatment units.

The GTS shall be operated and maintained in accordance with the manufacturer's recommendations, Department of Health, Western Australia product approval conditions, and the Local Governments installation approval.

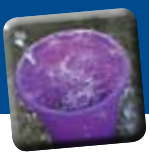
The Department of Health, Western Australia issued approval for the GTS may include specific maintenance requirements for the system.

If the greywater is being reused in the garden see section 4.5 "How to safely irrigate your garden with greywater" for information on maintaining the health of the greywater irrigation area.

### 2.5 Indoor Greywater Reuse in Multi Dwelling / Commercial Premises

The reuse of treated greywater for indoor purposes in multi-dwelling or commercial premises must be designed, operated and maintained in accordance with the *Australian Guidelines for water recycling: Managing Health and Environmental Risks (Phase 1) [AGWR]*.

The risk to human health from greywater recycling in multi-dwelling/commercial premises is high and requires robust ongoing validation and management controls. Approval of indoor greywater use in multi-dwelling/commercial premises must be sought from the Department of Health, Western Australia through the Local Government. A water service provider may be required to operate and maintain the greywater scheme.



### 3. Calculating Greywater Volumes

The volume of greywater generated by any household will vary according to the dynamics of the household. This is influenced by the number of occupants, the age of the occupants, their lifestyle and water usage patterns.

The method of calculating greywater volumes will depend on the greywater reuse system (i.e. GDD or GTS) and the type of building. Greywater volumes can be calculated by using one of the following methods;

1. **“Simplified Greywater Volume Calculation”**, where the bathroom and laundry greywater is to be reused in the garden within a single residential premise. This method should be used for single residential premises using a GDD.
2. **“Detailed Greywater Volume Calculation”**, where the bathroom and laundry (and sometimes kitchen greywater) is to be used for toilet flushing, laundry use, and/or garden watering in residential, commercial, industrial or public premises. See appendix 1 for calculation method.

#### 3.1 The Simplified Greywater Volume Calculation Method

To determine an appropriate land application area for greywater from a single residential premises, consider the volume of greywater likely to be generated under normal circumstances as listed below in Table 4.

**Table 4: Recommended estimates for greywater flows<sup>1, 2, 3</sup>**

Source	Litres/person/day	Litres/person/week
Bathroom	60	420
Laundry	40	280

**Notes for Table 4:**

1. Adapted from AS/NZS 1547:2000, *Onsite Domestic Wastewater Management*.
2. The estimates assume a top loading washing machine and no water saving devices in the bathroom and laundry. Where water efficient appliances are used, this may affect the estimates.
3. These volume estimates are recommended average figures generated by an average house (three-bed house and four occupants). Local governments may upon considering the public health and environmental conditions for the particular site vary these estimates to reflect local conditions.

Greywater flow is based upon the number of bedrooms rather than the actual number of people who currently occupy a dwelling, because the number of bedrooms will remain constant, while the number of people may vary over time. To estimate the quantity of greywater generated in a household follow the steps below:

1. Calculate the number of occupants of a house as follows
  - 2 persons for first bedroom
  - 1 person per additional bedroom

2. Calculate each person's daily greywater flow allocation as per table 4.

Calculate the volume of greywater generated.

40 litres	+	60 litres	=	100 litres	x		x	7	=	litres
Laundry usage*		Bathroom usage*		Total daily usage*		Number of people in the household		Days per week		Greywater volume per week

\* pp/day: per person per day

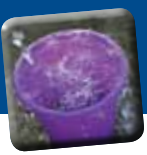
\* based on top loader washing machine and no water saving devices in bathroom/laundry

### Sample calculation

A three bedroom house reusing both bathroom and laundry greywater.

Number of persons for a three bedroom house = 4 persons

Greywater volume (L/week) = 4 persons x 100 litres/person/day x 7 days = 2800 litres/week



## 4. Land Application of Greywater

Before greywater reuse can be considered the following must be determined:

- Are the site and soil conditions suitable?
- Is there enough land area after taking into consideration the necessary setbacks?
- What type of irrigation is permitted with the proposed greywater reuse system?
- Are the plants suitable to be irrigated with greywater?

### 4.1 Site Assessment

Approval for land application of greywater should only be granted if the property has suitable site conditions.

Greywater contains many impurities, including nutrients, nitrogen and phosphorus that may harm the environment. Great care must be exercised when designing land application areas to ensure that they are sustainable. Some contaminants cannot be treated or degraded in the soil.

Therefore, the land application area must be capable of absorbing, assimilating or treating the chemical impurities and nutrients without medium and long-term degradation of the soil or the surrounding environment.

Greywater systems are designed primarily to treat organic matter and are not normally designed to remove chemical salt such as sodium, nitrate and phosphate, which may be found in greywater. Greywater must therefore be contained within the premises on which it is generated.

To assess land suitability the main considerations will be:

- **Will the land be susceptible to ponding and run-off?** Is the soil type likely to resist absorption of greywater? Is there sufficient soil depth to absorb greywater without ponding?
- **Is the greywater likely to seep through to adjoining properties?** Is the soil type likely to absorb and retain greywater? Is the slope of the land application area too steep and will it cause seepage off-premises?
- **Is the greywater likely to seep into the underground water table?** Is the soil type likely to absorb and retain greywater or will it allow rapid seepage? How far is the land application area from the underground water table? Will the slope of the land increase the likelihood of seepage?
- **Is the greywater likely to seep into areas, on premises, that will affect the stability of buildings?** Is the soil type likely to promote seepage? How far is the land application area from adjacent buildings? Will the layout of the application (slope, proximity to buildings) prevent seepage and undermining of existing structures such as retaining walls?

Most of the information required for land suitability assessment can be obtained by visually assessing the property, siting plans and using existing information about local soil types and topography. In circumstances where there is a high risk of seepage or contamination, Local Governments may require detailed information on soil profiles and structure. Local Governments will determine their requirements in terms of soil and land assessment for greywater system applications.

Homeowners/applicant are advised to contact Local Government prior to submitting an application to determine the need for independent technical reports.

When assessing the suitability of land for greywater irrigation, Local Governments should take into account flood potential, exposure, slope, landform, potential for run-off, upslope seepage, site drainage, fill, buffer distances and geology.

Where the land gradient is greater than 1:10 and it is practicable, the surface irrigation area may need to be modified by benching or bunding and/or increased in size to prevent runoff.

Local governments need to assess these features and determine if the land is suitable for greywater irrigation. In some cases the problems posed by a limiting feature or features can be overcome by using special designs or by modifying the site. Advice on other suitable design options can be provided to applicants.

Local governments have two options for assessing land suitability:

1. Individual lots—the first option is to assess land suitability on a case-by-case basis for individual lots when an application is submitted.
2. Blanket assessments—alternatively, local governments may wish to identify in advance of applications, larger areas of land where it is possible to generalise about the suitability of individual lots.

Local governments may use a combination of individual lot and blanket assessments to manage greywater applications.

#### **4.1.1 Soil Assessment**

A number of soil features can affect the suitability of land for greywater irrigation:

- depth to bedrock— indicates the potential for water logging and run-off
- depth to water table— indicates the potential for seepage and water table contamination
- permeability— indicates the potential for water logging or seepage
- bulk density— indicates the likelihood of water logging or seepage.

These soil characteristics are critical because they indicate the potential of the soil to absorb greywater without run-off or excessive seepage.

It is also important to be aware of soil features that affect plant growth:

- electrical conductivity—indicative of salt levels
- sodicity—affects potential for structural degradation
- cation exchange capacity—affects nutrient availability
- pH—affects plant growth
- dispersiveness—indicates potential for structural degradation.

The following checklist of critical factors for soil assessment is provided and may be used by local governments in determining the suitability of land for greywater irrigation.



**Table 5: Soil Assessment Checklist**

Soil Feature	Minor limitation	Moderate limitation	Major limitation <sup>1</sup>	Restrictive feature
Depth to bedrock or hardpan (m)	>1.0	0.5 – 1.0	<0.5	Indicates potential for excessive runoff and/or water logging
Depth to high episodic/ or seasonal watertable (m)	>1.0	0.6 – 1.0	<0.62	Groundwater pollution hazard, resurfacing hazard
Slope (%)	0-10	10-20	>20	Indicates potential for runoff and erosion
Soil permeability Category	Massive Sandy Loams, Loams, Clay Loams	Weakly pedal Sandy Loams, Light Clays	Gravels, Sands, Medium to heavy clays	Excessive runoff, water logging and percolation
Bulk density (g/cm <sup>3</sup> )	<1.8		>1.8	Indicates permeability
Sandy loam Loam and clay loam	<1.6		>1.6	
Clay	<1.4		>1.4	
Electrical conductivity(dS/m)	< 4	4 – 8	> 8	Excessive salinity undesirable

1. Sites with these properties are generally not suitable.
2. The Perth Groundwater Atlas can be used to estimate depth to groundwater at [www.water.wa.gov.au](http://www.water.wa.gov.au)

#### 4.1.2 Summary of Soil and Siting Considerations

##### Soil depth

Soil depth of less than 0.6 metres to bedrock might not have enough capacity to filter nutrients and pathogens. Shallow soils also have a risk of effluent resurfacing near the land application area. The recommended minimum soil depth will vary depending on the type of land application system used and the site and soil characteristics. The values given in table 5 are based on ideal site and soil conditions. If these conditions are less than ideal, the minimum soil depth requirement should be increased.

### Depth to episodic/seasonal water table

Attention should be given to groundwater protection, particularly if the groundwater is used or may be used for potable or irrigation water supplies. Once a particular contaminant has reached the groundwater, the rate of transport may be greater compared to it being in the unsaturated zone. The movement of the plume will be in the direction of the regional groundwater movement. Microorganisms can be carried substantial distances in this zone.

A minimum depth from the irrigated greywater discharge point to the minimum periodic water table or gravel layer in a floodplain adjoining a river or stream is recommended to maintain aerobic conditions in the soil to prevent surface ponding and prevent contamination of groundwater. These minimum depths will vary, depending on the type of application system proposed and the site and soil characteristics of the site.

Table 5 details the recommended minimum site and soil conditions. If the soil condition has limitations, the minimum depth to the water table should be increased.

### Soil permeability

Permeability is a measure of the ability of a soil to transmit water. It is affected by soil properties like structure, texture and porosity.

In general, highly permeable soils such as gravels and sands can allow wastewater to percolate rapidly through the soil profile, allowing the transport of potential pathogens and nutrients into groundwater and off-site. Low permeability soils, such as medium and heavy clays, can cause water logging and surfacing of the irrigated greywater.

Permeability can be estimated by a field assessment of soil texture and structure, where the properties of a soil are correlated with the indicative permeability.

Further information on how to conduct a soil percolation test is given in AS/NZS 1547.

### Soil texture

Soil texture is determined by the percentage of sand, silt and clay in the soil. Soil texture can have a significant effect on the ability of the soil to transmit or retain irrigated greywater.

The soil particles that make up the soil texture are clay, silt and sand.

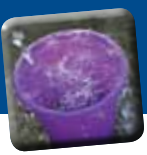
Further information on hand texturing of soil is given in AS/NZS 1547.

### Bulk density

Bulk density is the mass of dry soil per unit bulk volume. It is a measure of soil porosity and structure. Specific soil textures have a critical bulk density (Table 6). The following bulk densities for the specified soil textures should not pose problems for land application areas:

**Table 6: Bulk density of specific soils**

Soil feature	Grams per cubic centimetre
Sandy loam	< 1.8
Loam and clay loam	< 1.6
Clay	< 1.4



## **pH**

The pH value of a soil influences soil conditions and vegetation growth. Soil pH affects the solubility and fixation of some nutrients in soils. Soils with a pH of between 4.5 and 8.5 should pose no constraints for land application areas.

## **Soil Salinity**

Salinity is the presence of soluble salts in soils or waters. Salinity is measured in electrical conductivity (EC) and total dissolved salts (TDS). Plant sensitivity to salinity varies considerably. Plants affected by salinity have a reduced growth rate and show signs of water stress. Leaves may suffer burning along the margins

## **Climate**

Climate influences the amount of greywater used for all types of land application systems. Areas with high evaporation compared with precipitation are preferred for land application systems, as they allow greater use of the hydraulic load. Areas using irrigation and experiencing periods when rainfall exceeds evaporation must divert greywater to the sewer or primary sewage system during periods of wet weather. Applying greywater during wet weather cause pollutants to leach into groundwater, or the greywater could surface, with consequent environmental and health risks. Local governments may wish to use water balance data (historical precipitation and evaporation) to determine whether greywater irrigation is appropriate for local climate conditions or to provide advice on design of irrigation systems.

## **Flood potential**

It is best to locate all the components of greywater use facilities above the one in 100-year probability flood contour, but the one in 20-year probability contour may be used as a limit for land application areas. Electrical components, vents and inspection openings of wastewater treatment devices should be sited above the one in 100-year probability flood contour. Information on flood prone areas is available from Department of Water, see website [www.water.wa.gov.au](http://www.water.wa.gov.au)

## **Exposure**

Sun and wind exposure on land application areas should be maximised to enhance evaporation. Factors affecting exposure include the geographical aspect of the area, vegetation and buildings near the proposed application area. Evaporation may be reduced by up to two-thirds in some locations by a poor aspect or overshadowing and sheltering by topography, buildings or vegetation.

## **Slope**

Excessive slope might pose problems for installing systems and create difficulties in evenly distributing the treated greywater to land, resulting in run-off from land application areas. The recommended maximum slope will vary depending on the type of land application system used and the site and soil characteristics. The values given in Table 5 are based on ideal site and soil conditions. If these conditions are less than ideal, the maximum slope requirement should be reduced. Sites with slope >20% may require engineered drainage controls.

## **Run-on and up-slope seepage**

Run-on of precipitation to the land application area from up-gradient areas should be avoided. Run-on should be diverted around any land application area by using earthworks or a drainage system approved by local government. Up-slope seepage can be at least partly controlled by installing groundwater cut-off trenches, provided the lowest level of the trench is above the level at which effluent can enter the land application area.

**Erosion potential**

Greywater land application areas should not be located on land that shows evidence of erosion or that has potential for mass movement or slope failure.

**Site drainage**

Greywater land application areas should not be installed on damp sites. The type of vegetation growing on the site often indicates poor drainage and surface dampness. Sedges and ferns are likely to grow in damp conditions. Seepage springs and soaks are indications of poor site drainage. Site drainage can best be determined by inspecting the soil at the site.

**Fill**

Fill can be described as soil resulting from human activities that have led to modification, truncation or burial of the original soil or the creation of new soil parent material by a variety of mechanisms. Fill often has highly variable properties, such as permeability. Fill can be prone to subsidence and could contain material that might not be suitable for plant growth or for constructing land application systems. Fill can be removed, but if this is not possible, a detailed assessment of the fill might be needed. Fill less than 0.3 metres deep could be suitable, depending on the nature of the material and the suitability of the underlying soil.

**Buffer/Setback distances**

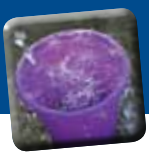
Buffer zones should be kept between greywater land application areas and sensitive environments on and off-site, to ensure protection of community health, the environment and community amenity. A buffer distance should be left between greywater use facilities (particularly land application areas) and features like public or private bores, boundaries of premises, driveways, buildings and swimming pools. See section 4.3: Setbacks.

**Rocks and rock outcrops**

The presence of rock outcrops usually indicates highly variable bedrock depths and can be associated with preferential pathways (short circuits) for effluent to flow along rock fissures and surface elsewhere. The presence of rocks can limit evaporation and interfere with drainage. Rocks can also interfere with trench and pipe installations. Cobbles and larger stones can collapse into installations causing problems with even effluent distribution.

**Geology/regolith**

Land application areas should not be installed near major geological discontinuities, fractured or highly porous regolith, as these structures can provide preferential pathways for greywater to groundwater.



## 4.2 Calculating Land Application Areas

Before the Local Government can approve plans for homeowners/applicants to install a greywater system with a land application system, it must ensure the property has sufficient land to distribute the generated greywater.

To calculate whether the homeowner/applicant has sufficient land to cope with the volume of greywater that is likely to be generated complete the following four steps:

**1. Calculate the Land Application Area available (A available)** — the area of land available for greywater irrigation after allowance for setbacks and paved areas.

- Using a scaled site plan mark out the greywater application area taking into consideration the required setback distances. See section 4.3: Setbacks.
- Calculate the area of land available for greywater application.

**2. Calculate the Greywater generated (G volume)** — the amount of greywater generated by the household (see section 3)

**3. Calculate the Land Application Area needed (A needed)** — the area of land needed to absorb all of the greywater generated.

- Calculate the area of land needed to absorb the greywater generated. The Design Irrigation Rate (DIR) measures the ability of a soil to transmit water. In the calculations, use a DIR value from Table 7 (below) taken from AS1547.

<b>Greywater volume per week (Litres/week)</b>	÷	<b>Design Irrigation Rate (DIR) (mm/week)</b>	=	<b>Area needed (m2)</b>
_____		_____		_____ m2
litres/week		mm/week		

**Table 7: Recommended Design Irrigation Rate (DIR) for Irrigation Systems.**

Soil Category	Soil Texture	Indicative permeability (Ksat) (m/d)	Design Irrigation Rate (DIR)		Indicative drainage class
			(mm/day)	(mm/week)	
1	Gravels and sands	>3.0	5	35	Rapidly drained
2	Sandy loams	1.4 – 3.0	5	35	Well drained
3	Loams	0.5 – 3.0	4	28	Moderately well drained
4	Clay Loams	0.06 – 1.5	3.5	25	Imperfectly drained
5	Light Clays	0.06 – 0.12	3	20	Poorly drained
6	Medium to heavy clays	<0.06 – 0.5	2	15	Very poorly drained

Note: Soil categories and DIR are modified from AS 1547.

#### 4. Compare the Area available with the Area needed

- ✓ If the **Area available** is greater than the **Area needed**, the proposed application area is sufficient to cope with the volume of greywater that is likely to be generated and approval may be granted if all other conditions are met.
- ✗ If the **Area available** is less than the **Area needed**, the proposed application area is insufficient to cope with the volume of greywater that is likely to be generated. Greywater reuse may not be possible. Alternatives available include:
  - Limit volume diverted – install a device to do this, or only collect greywater from either laundry or bathroom.
  - Limit diversion times – only collect greywater for parts of a day.

#### Sample calculation

The following sample calculation is included as a guide to determine whether a homeowner has sufficient application area to deal with the greywater generated on site.

##### 1. Calculate area available for irrigation

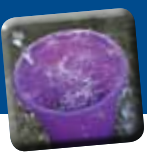
**A available** (m<sup>2</sup>) = area of gardens and lawns not covered by buildings or impermeable surfaces, leaving appropriate setbacks from buildings and boundaries. See section 4.3 for setback distances.

An example:

Allotment = 700m<sup>2</sup>

Dwelling = 192m<sup>2</sup>

Available greywater irrigation area = 130 m<sup>2</sup>



## 2. Calculate volume of greywater that will be generated

Greywater flow from both bathroom and laundry combined = 100 litres/person/day

Assume three-bedroom house (i.e. four persons):

The daily volume is calculated as follows

**G volume** (L/week) = 4 persons x 100L/person/day x 7 days = 2800 L/week

## 3. Calculate the area needed to soak up this volume of greywater

The ability of the soil to soak up greywater will depend on the type of soil that is present onsite (see Table 7).

The **Design Irrigation Rate (DIR)** is taken from AS/NZS 1547: 2000 table 4.2A4.

For this example, assume the soil is a clay loam with average permeability and a design irrigation rate (DIR) of 25 mm/week.

$$\text{A needed (m}^2\text{)} = \frac{\text{G volume (Litres/week)}}{\text{DIR (mm/week)}} = \frac{2,660}{25} = 106 \text{ m}^2$$

In this case the homeowner does have the area of land (106m<sup>2</sup>) needed to distribute all the greywater from the bathroom and laundry.

If there is plenty of land, then a system can be planned that uses all the greywater generated.

## 4.3 Setback Distances

Once the greywater irrigation system has been correctly sized, identification of a suitable location for siting the system in the garden needs to be considered. It must be located to avoid damage to buildings, structures and adjoining properties. A range of minimum setback distances is necessary from drip/spray irrigation areas and tanks.

Greywater irrigation systems must be sufficiently distanced from environmental features or water supplies. Greywater systems must be located within the property boundary and not on the street verge. Setback distances are given in Table 8 and 9.

Greywater systems within a proclaimed public drinking water source areas, located in designated Priority 1 areas, wellhead protection zones or reservoir protection zones (as defined in published drinking water source protection plans or land use and water management strategies) must be approved in writing by the Department of Water. Information on these areas and zones is available online at [www.water.wa.gov.au](http://www.water.wa.gov.au).

**Table 8: Horizontal Setback Distances for irrigation systems**

Item	Subsurface Drip Irrigation Area (meters)	Spray Irrigation Area (meters)
Closed Fence Boundaries	0.3	0.5
Open Boundaries (i.e. open fence or no fence)	0.5	1.2
Buildings <sup>1</sup>	0.5	1.5 or 0.5
Retaining wall and embankments, escarpments cuttings	1	3.0m or 450 angle from toe of wall (whichever is greater)
Bores (private) intended for human consumption <sup>2</sup>	30.0	30.0
Paths, drives, carports etc.	0.3	1.2 or 1.8
In ground potable water tanks	1	3
In ground swimming pools	1	3
Public Water Supply Production Bores located in Public Drinking Water Source Areas <sup>3</sup>	100	100
Wetlands and water dependent ecosystems where the PRI of the soil is <5 <sup>4</sup>	100	100

Note: Drip distance measured from pipework.

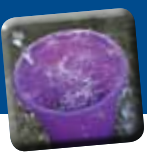
*Spray distance measured from the edge of the irrigated wetted area to any point of the feature. The separation distances are based on a spray plume with a diameter not exceeding 1m or a plume height not exceeding 0.3m above the finished surface level.*

1. Greywater may contain chemicals that can damage your house if discharged against the foundations.
2. Only EDPH may vary this setback requirement.
3. For description of Public Drinking Water Supply Areas (PDWSA) contact the Department of Water, [www.water.wa.gov.au](http://www.water.wa.gov.au). Greywater systems within 100 metres of a Priority 1 Drinking Water Source Protection Area must be approved by the DOW.
4. For wetland positioning contact the Department of Environment and Conservation.

**Table 9: Vertical Setback Distances for irrigation systems**

	Distance in meters*
Groundwater	0.6 – 1.2
Hardpan or bedrock	0.6 – 1.2

\* dependant on soil type, minimum of 0.6m for loams and clays, and 1.2m for gravels and sands.



## 4.4 Land Irrigation Types

There are two main types of irrigation that can be used, they are:

- Sub-surface irrigation, and
- Surface irrigation.

**NOTE:** The type of irrigation is dependant of level of treatment, see table 1

The irrigation system should include:

- In-line strainers (150–200 mesh) on the pump discharge side of pumped systems to protect pipework from any solids carried over from the greywater unit into the irrigation.
- Flush valves in surface boxes should be installed to allow periodic flushing for cleaning of the system.
- A minimum gradient of 1:100 for gravity-fed irrigation systems to prevent pooling of the greywater in the lines and to allow even distribution of the greywater. That means for every one metre of irrigation line there will need to be a gradual change in depth of the irrigation line of 1 cm.

For further information, AS1547:2000 outlines in detail information on the design, installation and maintenance of sub-surface and surface irrigation systems.

### 4.4.1 Sub-surface irrigation

Greywater from a greywater diversion device or a greywater treatment system can be distributed by sub-surface irrigation.

Sub-surface irrigation means that the irrigation distribution system needs to be buried at least 10 cm below the surface level of soil or mulch. It is recommended that distribution pipes and fittings are setback from boundaries, buildings, in-ground swimming pools, or in-ground potable water tanks. This protects structures from becoming destabilised and prevents runoff to neighbouring land.

The sub-surface irrigation system is not required to be installed by a licensed plumber, but the manufacturer's recommendations or design should be adhered to. Irrigation systems shall not be connected to both the mains water and the greywater system.

The simplest sub-surface irrigation systems consist of a pipe network to transport the greywater to targeted areas of the garden, and a water spike/dripper distribution head.

The following is a list a possible subsurface irrigation types that are available, this list is not exhausted:

- Perforated pipes (refer to AS1547)
- Irrigation domes
- Piped trenches (refer to AS1547)
- Netafim irriGREY system ([www.netafim.com.au](http://www.netafim.com.au))
- Nylex irrigation domes ([www.nylex.com.au](http://www.nylex.com.au))
- A borby tube ([www.borby.com.au](http://www.borby.com.au))
- G2G dripper from grey to green ([www.greytogreen.com](http://www.greytogreen.com))

#### 4.4.2 Surface Irrigation

Surface irrigation is only permitted via manual bucketing or an approved greywater treatment system (GTS) with disinfection.

Surface irrigation is not permitted if greywater comes from a greywater diversion device (GDD).

Surface irrigation systems use sprinklers and/or exposed drippers to disperse the greywater on the garden or lawn.

When using greywater for surface irrigation, it is important to control the droplet size, throw and plume height of the sprinkler system and to allow for wind drift to ensure the water distributed within the designated area. Spray heads that produces large droplets (rather than mists) should be used.

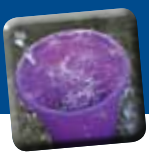
In addition, there are increased setback distance from property boundaries and swimming pools. See section 4.3 Setback distances.

#### 4.5 How to safely irrigate your garden

The following Do's and Don'ts for irrigating the garden with greywater reduce the risks associated with reuse, whilst providing a water source that has the potential to improve the health and appearance of soil and plants at the household.

When reusing greywater in the garden:

- ✓ Monitor the garden and use information about plant type, soil type to ensure the irrigation rate meets the plants needs.
- ✓ Divert greywater back to sewer (or primary sewage system) in winter and rainfall periods prior to the soil becoming saturated.
- ✓ Post warning signs, at all greywater outlets and at the boundaries of the irrigation area in at least two places. The signs must be clearly visible to property users, with wording such as, "Recycled Water – Avoid Contact – DO NOT DRINK".
- ✓ Ensure all distribution pipes are coloured purple (AS 2700) and are clearly and permanently marked "Recycled Water – Avoid Contact – DO NOT DRINK".
- ✓ Distribute the greywater evenly within the irrigation area to prevent ponding and ensure the greywater is applied efficiently.
- ✓ Comply with the setback distances (see section 4.3)
- ✓ Select garden-friendly detergents that are biodegradable and low in phosphorus, sodium, boron and chloride.
- ✓ Select washing detergents that are low in salt – consider using a powder concentrate, or a liquid washing detergent.
- ✓ Consider applying a soil-rewetting agent every six months.



When irrigation greywater in the garden:

- ✗ DON'T irrigate vegetable patches or any plants, vegetables or fruit intended for human consumption. Irrigation of fruit and nut trees is allowed in some circumstances.
- ✗ DON'T connect irrigation systems to both the mains water and the greywater system.
- ✗ DON'T apply greywater in areas that are readily accessible to children, people with a low immune system or pets.
- ✗ DON'T reuse greywater when a resident is sick, e.g. has diarrhoea.
- ✗ DON'T reuse greywater generated by cleaning in the laundry or bathroom, or when using hair dye or other chemicals.
- ✗ DON'T reuse greywater generated by washing rags used for painting or for maintaining machinery and vehicles.
- ✗ DON'T store untreated greywater.
- ✗ DON'T over-water or irrigate in the rain.
- ✗ DON'T reuse greywater so that it flows into the streets or down stormwater drains.
- ✗ DON'T let greywater go beyond the property boundary and cause a nuisance to neighbours
- ✗ DON'T use greywater in households where immuno-suppressed occupants are present.
- ✗ DON'T reuse greywater to top up rainwater tanks or swimming pools.
- ✗ DON'T use greywater to wash paths, driveways or cars.

#### 4.5.1 Choosing 'Friendly' Detergents and Cleaners

When using greywater on your garden or lawn, you will need to consider the type of household detergents, soaps, or other chemicals you use. Many contain ingredients that could detrimentally affect your plants and soil.

The salts, nitrogen and phosphorus content of various washing detergents available in Australia can be found at [www.lanfaxlabs.com.au](http://www.lanfaxlabs.com.au), [www.choice.com.au/detergents](http://www.choice.com.au/detergents), and on the Water Corporation's website [www.watercorporation.com.au](http://www.watercorporation.com.au)

#### Laundry Detergents

Salt is included in washing powders as filler. There is generally less salt in concentrated powders, and even less in liquids. Minimising the salt content of the greywater is important to prevent soil salinity.

Washing detergents also include phosphorus and nitrogen, which are nutrients necessary for plant growth, so greywater can be substituted for fertiliser and provide phosphorus and nitrogen to the garden and lawn.

The typical nutrient loads that are applied to the soil by irrigating with greywater are very similar to those that are applied by following the directions on common fertiliser packages. The reuse of greywater, therefore, has the potential to reduce the need for fertiliser application on gardens and lawns. The application of nutrients through the irrigation process is also preferred, as the nutrients will be applied more gradually and will reduce the risk of nutrients being washed away during wet weather events.

However, too much phosphorus in greywater can be toxic to some plants, most notably native Australian plants. If the garden has native plants, the homeowner should try to minimise the phosphorus content of the greywater by choosing a laundry detergent that is low in phosphorus.

- ✓ Choose a liquid or concentrated powder washing detergent.
- ✓ Choose a washing detergent that is low in phosphorus and salts.

### **Soaps**

Fats in greywater generated from soaps and fabric softeners can make soil water-repellent. The soil will benefit from an application of a soil-rewetting agent every six months.

### **Bleaches and Disinfectants**

Bleaches (such as hair dyes and nappy wash), disinfectants (including eucalyptus and tea tree oil) and germicides can detrimentally affect the health of soils by killing soil organisms.

Don't reuse greywater when using cleaning chemicals in the bathroom or laundry, or when using hair dye, disinfectants, germicides or other chemicals, instead, divert the water to the sewer.

## **4.5.2 Maintenance of the Land Application areas**

Regular checks must be made to ensure that the use of greywater is not damaging the health of the soil, lawn and plants.

### **✓ Check Irrigation systems are working correctly**

It is important to check the irrigation system works properly as it can become blocked with debris. It is also easy to forget because it is partly located underground.

A way of checking whether your irrigation system is working is the appearance of the plants. If an area of the garden appears to be wilting or dying, there may be a blockage.

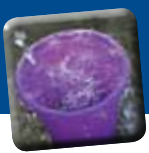
Buried irrigation systems can be flushed by removing the cap from the end of the distribution line and flushing with clean water. Drip emitters can be pulled out of the ground to ensure they are working properly.

### **✓ Check the health of plants & soils**

Check the health of the garden regularly. Signs of unhealthy soil, lawn and plants include:

- Damp and boggy ground hours after irrigation;
- Surface ponding and run-off of irrigated water;
- Poor vegetation growth;
- Excessive vegetative growth with reduced fruit;
- Evidence of pests and diseases on plants;
- Unusual odours;
- Clumping of soil; or
- Fine sheet of clay covering surface.

If any of the above signs are identified the homeowner/applicant should reassess the amount of greywater they are using for irrigation and check that the irrigation distribution system is working correctly. If plants or soils appear to be showing signs of stress, such as damage to the leaves of the plants, contact the local nursery or gardening expert for further advice. One cause of stress on the garden could be the type of laundry detergent used.



To reduce the impact, choose laundry detergents with low levels of sodium and phosphorus. The lower the levels, the lower the potential impact on the garden.

Opt for liquid detergents as they generally contain much less sodium (salt) than powders. Use detergents that contain less than 20 grams of sodium for each wash.

Choose detergents that comply with the Australian Industry Standard of less than 7.8mg/L of phosphorus. Phosphorus concentrations can usually be found on the label.

✓ **Switch the GDD to the sewer when raining**

There is no need to divert greywater to the garden when it is raining. Additional water increases the chance of runoff from the property.

✓ **Check for signs of waterlogging**

Check the area of garden that is being irrigated with greywater monthly to ensure that it is not becoming waterlogged and that greywater is not running off the property. Look for damp and boggy ground hours after irrigation or surface ponding and runoff of irrigated water.

✓ **Check the pH level of your soil**

The contaminants in greywater can directly impact pH levels and soil structure. The pH level of soil is very important to plant health and can be increased when using greywater. This can cause an iron deficiency in plants where new leaves may be yellow with green veins.

When soil is strongly acidic (low pH) nutrients such as nitrates, phosphates and potassium become less available to plants. When soil is strongly alkaline (high pH) vital minerals such as iron and zinc are locked up in the soil and become less available to plants.

Speak to your garden centre about how to fix problems with soil pH or purchase a soil pH test kit so that you can check the levels yourself.

## 5. Approvals required for Greywater Reuse

### 5.1 Product Approval (Manufacturer)

All greywater systems are an “Apparatus for the Treatment of Sewage” as defined under Section 3(1) of the Health Act 1911, and as such, the Executive Director, Public Health, must approve their design, manufacture and use. This ensures that all systems available to the general public comply with the relevant regulations and are safe, compatible with household plumbing, and will provide effective long-term operation.

A current list of all greywater system approved by Department of Health, Western Australia for use in Western Australia and advice on choosing the most appropriate system can be obtained from Local Government offices or the Department of Health website.

Manufacturers wishing to get a greywater system approved need to contact the Water Unit at the Department of Health, Western Australia and consult the Department of Health’s **Code of Practice for Product Approval of Onsite Wastewater Systems in Western Australia**.

### 5.2 Installation Approval from Local Government (Homeowner/Applicant)

GDD and GTS require an installation approval from the relevant Local Government in accordance with this Code, the product approval conditions, and as per instructions provided by the product manufacturer.

Local Government approval is not required for manual bucketing if greywater is used in accordance with “Section 2.2 Bucketing”, of this Code.

**The following greywater system applications are to be submitted to and approved by the Local Government:**

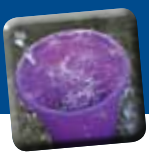
- single dwellings up to (and including) 10 persons,
- Commercial and multi dwellings up to 5000L/day where sub-surface irrigation is proposed,

**The following greywater system applications are to be submitted through the Local Government to the Executive Director, Public Health for approval:**

- All multiple dwellings or commercial premises intending to use the greywater for “in house” end-uses.
- Commercial and multi-dwelling premises intending to reuse greywater via spray irrigation.
- Commercial and multi-dwelling premises intending to reuse greywater via subsoil irrigation and producing more than 5000 L/day of greywater.

An *Application to Construct or Install an Apparatus for the Treatment of Sewage* form can be obtained from the Local Government. The applicant must complete the relevant sections in full.

All plumbing work in sewered areas must be undertaken by a plumber licensed under the *Water Services Coordination (Plumbers Licensing) Regulations 2000* and must comply with the *Metropolitan Water Supply Sewerage and Drainage By-laws 1981*. The plumber must obtain approval from the Sewerage Service Provider for any required connection or modification to the plumbing works connected to the sewer system.



To manage greywater use effectively Local Governments must:

- Assess applications – consider all relevant issues when approving the installation or operation of a greywater use facility, particularly health and environmental issues at the site.
- Set conditions of approval – specify site and system specific conditions of approval to operate and maintain facilities.
- Monitor systems – check regularly to make sure applicants comply with approval conditions, including the requirement for regular servicing.
- Communicate with applicants – and help applicants to understand their responsibilities, how to manage risks and operate the systems effectively.

### **5.3 Installation approval from Department of Water**

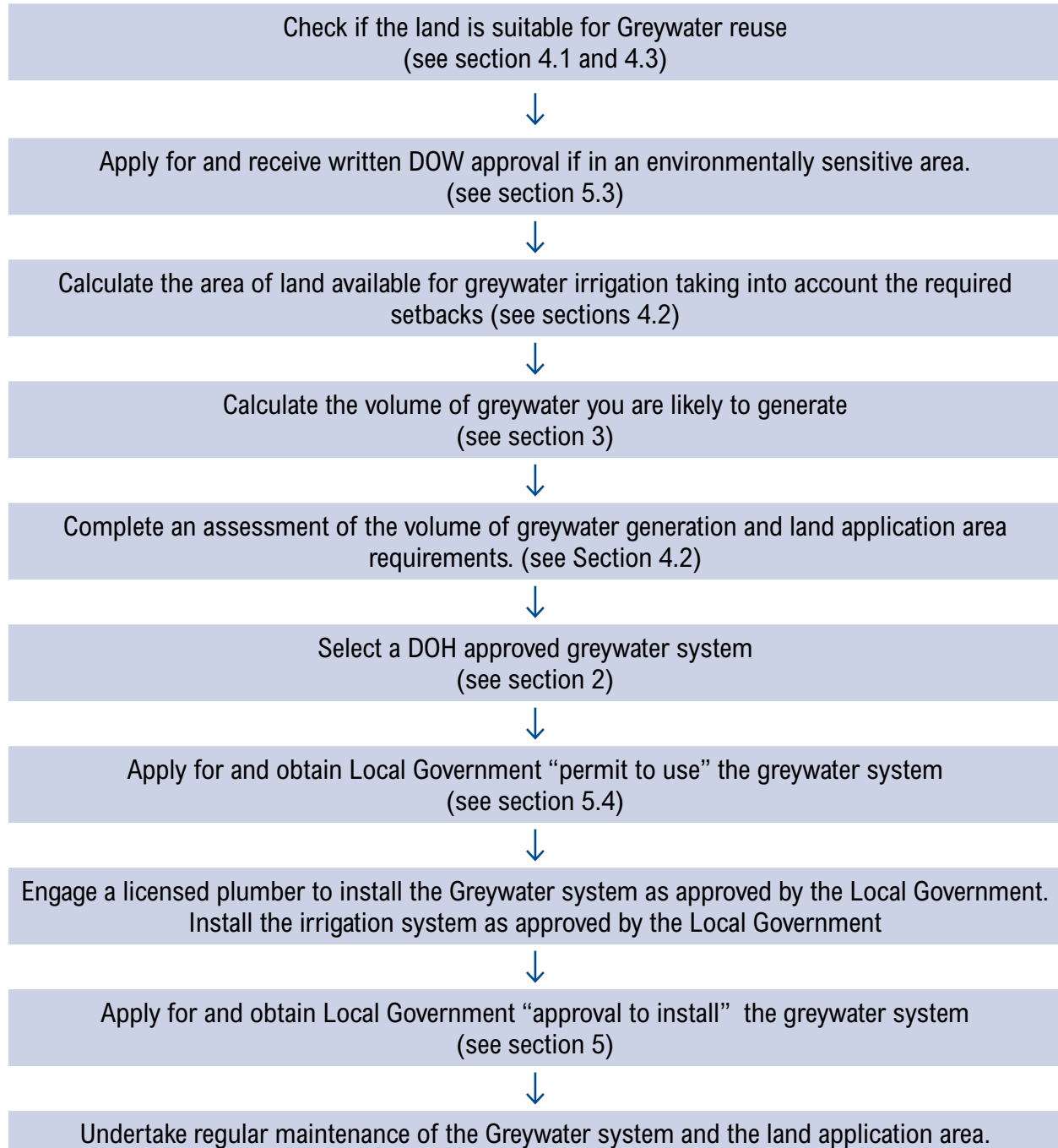
Greywater systems within a proclaimed public drinking water source areas, located in designated Priority 1 areas, wellhead protection zones or reservoir protection zones (as defined in published drinking water source protection plans or land use and water management strategies) must be approved in writing by the Department of Water. Information on these areas and zones is available online at [www.water.wa.gov.au](http://www.water.wa.gov.au). This written approval should be submitted to the Local Government with the application.

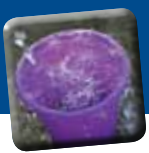
### **5.4 “Permit to use” approval from Local Government (Homeowner/applicant)**

It is an offence to commence construction of a greywater system without an approval. Once the Local Government issues an approval to construct or install a greywater system, the system may be constructed but not used.

Before a greywater system can be used, the Local Government must inspect the greywater system and reuse system/land application area (before excavations are back-filled) to ensure that it is installed correctly. If satisfactory, the Local Government will issue an approval for the system to be used. It is an offence to commence using the system prior to receiving the Local Government’s “Permit to Use”.

## 5.5 Greywater Application Process Summary for single dwelling domestic premises





## 6. Marking, Labelling and Signage

The marking, labelling and signage of the greywater plumbing and/or irrigation systems has to be in accordance with AS/NZS 3500 and other Australian Standards, AS 1345, AS 2700 and AS1319.



All pipes or pipe sleeves and identification tapes (including those on greywater irrigation systems) shall be coloured purple as per AS 2700 and marked with the following in accordance with AS 1345 “WARNING RECYCLED WATER – DO NOT DRINK” at intervals not exceeding 0.5 m.



All below ground pipes (including those used for sub-surface irrigation) shall have an identification tape marked in accordance with AS/NZS 3500.1 installed on top of the greywater pipeline, running longitudinally, and fastened to the pipe at not more than 3 m intervals

Greywater outlets (connections, taps, appliances) shall have signs that are marked “WARNING DO NOT DRINK” in accordance with AS 1319.

Land irrigation areas must have at least two warning signposts, complying with AS 1319, at the boundaries of the irrigation area. The signs must be clearly visible to property users, with wording such as, “Recycled Water – Avoid Contact – DO NOT DRINK”.

## Useful Links

### Department of Health, Western Australia – Water Unit

[www.public.health.wa.gov.au](http://www.public.health.wa.gov.au)

- List of approved greywater systems
- Greywater Code of Practice
- Draft Guidelines for Water Recycling

### Department of Water

[www.water.wa.gov.au](http://www.water.wa.gov.au)

- Information of environmentally sensitive areas
- Perth Groundwater Atlas

### Department of Environment and Conservation

[www.dec.wa.gov.au](http://www.dec.wa.gov.au)

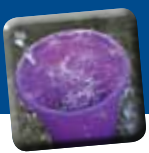
- Information of wetland positioning

### Ingredients in laundry detergents

- Water Corporation [http://www.watercorporation.com.au/\\_files/waterwise/Laundry\\_Detergent\\_CHOICE\\_CityWest.pdf](http://www.watercorporation.com.au/_files/waterwise/Laundry_Detergent_CHOICE_CityWest.pdf)
- Lanfax Laboratories [www.lanfaxlabs.com.au](http://www.lanfaxlabs.com.au)
- Choice [www.choice.com.au/detergents](http://www.choice.com.au/detergents)

### Phosphorus-free detergent list and alternate cleaners

- Sercul [www.sercul.org.au/pap.html](http://www.sercul.org.au/pap.html)



## Definitions

**10/10/1 standard** – describes a water quality of <10 mg/L BOD, <10mg/L suspended solids and <1 *E.coli*/100mL, <1pfu/100mL coliphages, and <1cfu/100mL clostridia. Greywater of this quality may be recycled indoors via toilet flushing or cold water supply to washing machines. It may be used for surface and subsurface irrigation.

**20/30 standard** – describes a water quality of <20 mg/L BOD and <30mg/L suspended solids. Greywater of this quality may be recycled outdoors via subsurface irrigation.

**20/30/10 standard** – describes a water quality of <20 mg/L BOD, <30mg/L suspended solids and <10 *E.coli*/100mL. Greywater of this quality may be recycled outdoors via subsurface and surface irrigation.

**Absorption** – uptake of liquid into the soil.

**Authorised Service Person** – a person who has been suitably trained by the system manufacturer in the installation, operation and service requirements of the system and is accredited by the system manufacturer in writing to undertake this service.

**Blackwater** – is the wastewater generated from toilets and is contaminated with faeces and urine.

**BOD<sub>5</sub> (Biochemical Oxygen Demand)** – a measure of the dissolved oxygen required for the breakdown of organic material in the effluent; usually refers to a five day test which typically represents 70 – 80% of the total BOD in a sample; expressed in milligrams per litre (mg/L).

**Disinfection** – a process that reduces the number of microorganisms but does not sterilise or remove all microorganisms.

**Design Irrigation Rate (DIR)** – The loading rate that applies to the irrigation of a land application area with effluent. It is expressed in L/m<sup>2</sup>/week or mm/week.

**Drinking water** – water suitable for human consumption, used for drinking, food preparation, personal hygiene, and the removal of human waste.

**Greywater** – for the purposes of this Code, means wastewater from washing machines, laundry tubs, showers, hand basins and baths, but does not include wastewater from a kitchen, toilet, urinal or bidet.

**Greywater Diversion** – the installation and operation of a method for diverting untreated greywater generated by a household to sub-surface irrigation of a garden or lawn at that same premises.

**Greywater Diversion Device (GDD)** – a device that diverts greywater generated by a household for sub-surface irrigation reuse.

**Greywater Treatment System (GTS)** – a system that collects, treats, and disinfects greywater generated by a household, for reuse for one or more of the following end uses: toilet and urinal flushing; washing machine; and surface or sub-surface irrigation.

**Greywater System** – is a device or system that either diverts or treats greywater, it is the term used to describe both the Greywater Diversion Device (GDD) and Greywater Treatment System (GTS).

**Groundwater** – water beneath the surface held in, or moving through, saturated layers of soil, sediment or rock.

**Land Application Area** – the system used to apply greywater from a greywater system into or onto the soil for further in-soil treatment and reuse.

**Non potable water** – water suitable for purposes other than drinking water use.

**Overflow Device** – a device that allows greywater to automatically overflow into the primary sewerage system.

**Pathogens** – an organism that is capable of causing disease in human and animals e.g. viruses, bacteria, helminths and protozoa.

**Percolation** – the descent of water through the soil.

**Phosphorus Retention Index (PRI)** – a measure of the soils ability to bind phosphorous. The PRI is defined as the ratio of amount of Phosphorus (P) adsorbed to 5 grams of soil, expressed as mg P/kg of soil, and concentration in solution (mgP/L) after addition of 100 mL of a 10 mg/L P solution in 0.02 M KCl and equilibration for 18 hour. The practical scale of PRI is from 0 to about 1000 (above which results become meaningless). A PRI of 20 indicates that 5 mg P/L remains in solution after the initial addition of 10 mg P/L in 100 mL to 5 grams of soil.

**Primary Sewerage System** – is either the municipal sewerage system, septic tank system or aerobic treatment unit, whichever system is primarily responsible for removing the wastewater from the property or treating it on site.

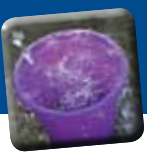
**Public Drinking Water Source Areas (PDWSAs)** – those areas declared under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, and the *Country Areas Water Supply Act 1947* for the management and protection of water sources used for public drinking water supply. They include Underground Water Pollution Control Areas, Water Reserves and Catchment Areas. A three-tier priority classification system is used to manage PDWSAs, these are:

- **Priority 1 Source Protection Areas** are defined to ensure that there is no degradation of the water source. Priority 1 areas are managed in accordance with the principle of risk avoidance, so land development is generally not permitted.
- **Priority 2 Source Protection Areas** are defined to ensure that there is no increased risk of pollution to the water source. Priority 2 areas are managed in accordance with the principle of risk minimisation, so some development is allowed under specific guidelines.
- **Priority 3 Source Protection Areas** are defined to manage the risk of pollution to the water source. Priority 3 areas are declared over land where water supply sources need to co-exist with other land uses such as residential, commercial and light industrial developments.

**Relevant Sewerage Provider** — the body holding a licence from the Office of Water Regulation for the provision of sewerage services, which would be affected by the application of a sewerage requirement to a proposed subdivision or development.

**Residential Premises** – Refers to a single household residential premises. It does not include premises comprising of more than one dwelling.

**Reticulated Sewerage** — a network of sewers collecting wastewater, for off-site disposal from a subdivision or development.



**Secondary Treatment Systems** – these systems treat and disinfect greywater to within a standard of BOD5 20mg/L, suspended solids (SS) 30mg/L and thermotolerant coliforms <10cfu/100ml, prior to irrigation via drip and/or surface irrigation methods.

**Sewage** – see Wastewater

**Sewer** – a collection drain that conveys sewage to the treatment plant.

**Sewerage** – the network of collection drains carrying domestic wastewater to the treatment plant.

**Sub-Strata Drip Irrigation** – irrigation placed on the top of the ground surface and covered with a minimum of 100mm of approved material (e.g. mulch, woodchips) placed over the irrigation pipework.

**Sub-Surface Irrigation** – irrigation at a depth of at least 100mm below the surface level of soil or mulch.

**Surface Irrigation** – greywater applied to the ground from above the ground surface.

**SS (Suspended Solids)** – in wastewater analysis, solids retained after filtration through a glass fibre filter paper followed by washing and drying at 105°C, or by centrifuging, followed by washing and removal of the supernatant liquid; expressed in milligrams per litre (mg/L).

**Thermotolerant Coliforms** – (also known as faecal coliforms) a subset of coliforms found in the intestinal tract of humans and other warm-blooded animals. Consists chiefly of *E.coli*. They are used as indicators of faecal pollution and effectiveness of disinfection processes and measured as a colony forming unit or cfu/100mL.

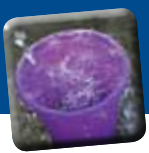
**Wastewater** – the used water arising from domestic activities consisting of all wastes, greywater and blackwater.

**WaterMark** – a graphic symbol that is issued for products that have been approved under the WaterMark Certification Scheme as defined in the Plumbing Code of Australia (PCA).

## Abbreviations

The following abbreviations are used in this document:

<b>AGWR</b>	Australian Guidelines for Water Recycling
<b>BOD<sub>5</sub></b>	Biochemical Oxygen Demand - 5 days
<b>cfu</b>	colony forming unit
<b>DOH</b>	Department of Health
<b>DOW</b>	Department of Water
<b>EDPH</b>	Executive Director, Public Health
<b>L</b>	Litre
<b>m</b>	metre
<b>mL</b>	millilitre
<b>mm</b>	millimetre
<b>AS/NZS</b>	Australian Standards/New Zealand Standards (latest version)
<b>PRI</b>	Phosphorus Retention Index
<b>SS</b>	Suspended Solids (includes NFR or Non Filterable Residue)



## References

BS 8525-1:2010 British Standard Greywater Systems – Part 1: Code of Practice

Christova-Boal D, Lechte P, Shipton R (1995) *“Installation and Evaluation of Domestic Greywater Reuse Systems”* Department of Civil and Building Engineering, Victoria University of Technology, Victoria, Australia.

Department of Health, Western Australia *“Treatment of Sewage and Disposal of Effluent and Liquid Waste Regulations”* 1974. (available from: [www.slp.wa.gov.au](http://www.slp.wa.gov.au))

Department of Health, Western Australia (2001) *“Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units (ATUs) Serving Single Dwellings”*. Perth, Western Australia.

Department of Health, Western Australia (2005) *“Code of Practice for the Reuse of Greywater in Western Australia”*. Perth, Western Australia.

Jeppesen, B and Solley, D (1994) *“Domestic Greywater Reuse: Overseas Practice and its Applicability to Australia”*. Research Report No 73. Urban Research Association of Australia, Brisbane City Council.

Jeppesen, B and Solley, D (1996) *“Model Guidelines for Domestic Greywater Reuse for Australia”*. Research Report No 107. Urban Research Association of Australia, Brisbane City Council.

Loh, M and Coghlan, P (2003) *“Domestic Water Use Study – In Perth, Western Australia 1988–2001”*. Water Corporation, Perth.

National Water Quality Management Strategy (2006) *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1)*.

NSW Department of Health (2000) *“Greywater Reuse in Sewered Single Domestic Premises”*, NSW Government, Sydney NSW Australia.

NSW Department of Water and Energy (2008) *“Greywater reuse in sewerred single household residential premises”* NSW Government, Sydney NSW, Australia.

Patterson, R.A. Laundry Products Research, summary paper on website [www.lanfaxlabs.com.au](http://www.lanfaxlabs.com.au)

Patterson, R.A. (2006). *Consideration of soil sodicity when assessing land application of wastewater*. Septic Safe Technical Sheet 01/7. Department of Local Government and Lanfax Laboratories. Armidale, Australia.

Standards Australia. AS 1319, Safety signs for the occupational environment.

Standards Australia. AS 1345, Identification of the contents of pipes, conduits and ducts.

Standards Australia. AS 2700, Colour Standards for general purposes.

Standards Australia. AS 1546.1, Onsite Domestic Wastewater Management – Septic Tanks.

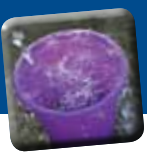
Standards Australia. AS/NZS 1547, Onsite domestic wastewater management.

Standards Australia. AS/NZS 3500, Plumbing and drainage – Water services,

Standards Australia. ATS 5200, Technical Specification for plumbing and drainage products – Procedures for certification of plumbing and drainage products.

Standards Australia. ATS 5200:460, Technical Specification for plumbing and drainage products – Greywater Diversion Device (GWDD).

Standards Australia. HB 326 – 2008, Urban Greywater Installation Handbook for Single Households



## Appendix 1: Detailed Greywater Volume Calculation Method

A more detailed greywater volume calculation method should be used where the bathroom and laundry greywater is to be used for toilet flushing, laundry use and garden watering in residential, commercial, industrial or public premises. The following method has been provided as a guide, it has been adapted from the British Standard BS8525-1:2010 Greywater Systems – Part 1: Code of Practice.

### Toilet Flushing

Toilets are either full flush (one button) or dual flush (two buttons). Full flush toilets use 11 litres per flush, and dual flush toilets use 3.0 litres for a half flush and 5.5 litres per full flush on average (source AS1172:1992, AS/NZS 6400:2005).

### Washing Machine

Washing machines can be front loading or top loading and can be small (up to 5.5 kg), medium (6 – 7 kg), or large (over 7.5 kg). In general, front loading washing machines are more water-efficient than top loading washing machines, based on washing machines available for domestic use over the last five years. The average front loading washing machines are medium in size and have a 4-Star rating under the Water Efficiency Labeling and Standards (WELS) Scheme. The average top loading washing machines are large in size and have a 2-Star rating under the Water Efficiency Labeling and Standards (WELS) Scheme. The size of the washing machine can be found in the manufacturer's user manual or written on the machine itself.

### Shower

Shower heads are given a rating of 1-Star to 6-Stars under the Water Efficiency Labeling and Standards (WELS) Scheme depending on the amount of water they use. 3-Star use 9L/min, 2-Star use 12L/min, 1-star use 16L/min (source: AS/NZS 6400:2005). Only 1-Star to 3-Star shower heads are currently available. The average shower is 7 minutes (source: Loh and Coughlan, 2003).

### Baths

The amount of greywater generated by a bath is between 60 and 300 litres depending on the size of the bath and the level that the bath is filled to. An average bath size is 260 litres when full. However, the majority of baths are for children and will be filled to between a quarter to a half of the full bath level, generating 60 to 130 litres of greywater per bath.

### Basin Taps

It is estimated that each person uses 4 litres of water from the bathroom hand basin per day (face washing, teeth brushing, hand washing). Typical taps discharge 15 to 18 litres per minute compared with low-flow and aerating models which use as little as 2 litres per minute depending on the intended application (source: AS/NZS 3718:2005).

### Laundry Taps

An average laundry tub has a capacity (full to the brim) of 50 litres. Laundry taps are generally used for soaking clothes and hand washing delicates. It is estimates that a residential premises with three or less residents uses the equivalent of half a laundry tub of water per week, and a residential premises with four or more residents uses the equivalent of one full laundry tub of water per week.

## A1: Greywater Produced/Yield Calculation

The following equation (1) can be used to determine the greywater yield, YG, in litres (L):

$$YG = n(\{SU_s\} + \{BU_b\} + \{(H_{wb} U_{hwb}) + F_{wb}\} + \{(W \div L) U_{wm}\})$$

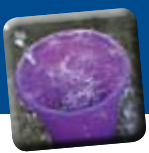
where:

- n is the number of persons
- S is the average flow rate from the shower in litres per minute (L/min)
- U<sub>s</sub> is the typical usage factor for the shower
- B is the bath volume to overflow (unoccupied) in litres (L)
- U<sub>b</sub> is the typical usage factor for the bath
- H<sub>wb</sub> is the mean peak flow rate from taps in litres per minute (L/min)
- U<sub>hwb</sub> is the typical usage factor for the hand wash basins
- F<sub>wb</sub> is the fixed flow from basin taps used for vessel filling
- W is the washing machine water consumption per wash cycle in litres (L)
- L is the maximum dry wash load recommended by manufacturers in kilograms (kg)
- U<sub>wm</sub> is the typical usage factor for the washing machine

The following are some typical values that can be used in equation 1. Where more precise values are not known, these values may be used for estimation purposes.

- n: two people in the master bedroom and one additional person in each of the remaining bedrooms
- S: 9 L/min for 3-star; 12 L/min for 2-star; 16 L/min for 3-star
- U<sub>s</sub>: 5.60 for a shower only; 4.37 where there is also a bath
- B: 120 L to 250 L
- U<sub>b</sub>: 0.5 for a bath only; 0.11 where there is also a shower
- H<sub>wb</sub>: 5 L/min to 15 L/min
- U<sub>hwb</sub>: 1.58
- F<sub>wb</sub>: 1.58 L per person per day
- W: 30 L to 60 L
- L: 4 kg to 10 kg
- U<sub>wm</sub>: 2.1

Where the performance of the washing machine is unknown, the ratio may be assumed to be 8.17 litres per kilogram.



## A2: Greywater Demand Calculation (greywater volume needed for toilet flushing and laundry use)

The following equation (2) should be used to determine greywater demand, C, in litres (L) where the treated greywater is to be distributed for toilet flushing (single-, full- or part-flush cisterns) and laundry use, as relevant.

*NOTE: Where more than one type of toilet is installed, the consumption can be calculated for each toilet or it can be assumed that all toilets will be used equally, in which case the standard consumption for each type can be calculated and the results simply averaged.*

$$C = n(\sum\{V_{WC} U_{sf}\} + \{V_{FWC} U_{Ff} + V_{PWC} U_{Pf}\} + \{(W \div L) U_{wm} P_{WM}\})$$

where:

- n is the number of persons
- $V_{WC}$  is the flush volume for a single-flush toilet
- $U_{sf}$  is the usage factor for a single-flush toilet
- $V_{FWC}$  is the full-flush volume for a dual-flush toilet
- $U_{Ff}$  is the full-flush usage factor for a dual-flush toilet
- $V_{PWC}$  is the part-flush volume for a dual-flush toilet
- $U_{Pf}$  is the part-flush usage factor for a dual-flush toilet
- W is the washing machine water consumption per wash cycle in litres (L)
- L is the maximum dry wash load recommended by manufacturers in kilograms (kg)
- $U_{wm}$  is the usage factor for the washing machine
- $P_{WM}$  is the proportion of water consumed by the washing machine to be supplied by non-potable water

The following are some typical values that can be used in equation 2. Where more precise values are not known, these values may be used for estimation purposes.

- n: two people in the master bedroom and one additional person in each of the remaining bedrooms
- $U_{sf}$ : 4.42
- $U_{Ff}$ : 1.46
- $U_{Pf}$ : 2.96
- W: 30 L to 60 L
- L: 4 kg to 10 kg
- $U_{wm}$ : 2.1
- $P_{WM}$ : 1

Where the performance of the washing machine is unknown, the ratio may be assumed to be 8.17 litres per kilogram.



# Delivering a **Healthy WA**