



Marshall Greywater Reuse System

Installation & Operating Instructions for Users and Plumbers



***System designed and manual written by Glenn
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NOTE FROM DESIGNER AND AUTHOR

This system has been developed with four main goals in mind:

- 1) Maintenance is limited to 10 minutes per year to replace the filter.*
- 2) All greywater is applied below mulch or subsurface so there is no risk of kids playing in it, and odours are minimised.*
- 3) All components can be purchased off the shelf to allow ease of installation by home handypersons or plumbers.*
- 4) The system is simple and robust, minimising costs and problems.*

Glenn Marshall
Centre for Sustainable Arid Towns, August 2006

READ FIRST

For a reasonable fee, the Centre for Sustainable Arid Towns in Alice Springs, can project manage installation of your Marshall Greywater Reuse System. This includes all equipment ordering, on site labour, plumbers' inspection and testing. Alternatively, this document gives sufficient information for you to install your own system with the assistance of a licensed plumber.

Before installing the system

Checks required before starting:

1. Is the garden suited to greywater reuse?
2. How quick will greywater soak into the soil?
3. How many soakage tunnels are needed?

1. Is the garden suited to greywater reuse?

Is there impenetrable rock or a seasonal watertable within 1 metre of the garden's surface? If so, greywater reuse may not be viable – consult the NT Health Department.

2. How quick will greywater soak into soil?

Greywater soaks into different soils at different rates – it will soak into sand faster than clay. This is called the 'soil absorption rate' and dictates the number of soakage tunnels required.

Use one of the following two methods to determine the soil type and soil absorption rate:

Soil type method (for Alice Springs only)

- Obtain a copy of 'Land Resources of the Alice Springs Area' from the NT Department of Natural Resources, Environment and the Arts¹.
- Locate your site address on the map and identify the 'Land Unit Type'.

¹ Go to <http://www.nt.gov.au/nreta/naturalresources/soil/datarequest.html>, download a data request form, complete the details and either:

- email the form to datarequests.nreta@nt.gov.au,

- fax it to +61 (0)8 8999 3667; or

- send / deliver to: NRETA Data Request, PO Box 30, PALMERSTON NT 0836, Australia

- Go to the 'Soil Classification Table' for this Land Unit Type. In the 'Soil Texture' column, identify the soil type from 0.3 metres to 1.0 metre deep (if more than one type, select the least soaking option). It will be either 'sand', 'sandy loam', 'clay loam sandy', 'clay loam', 'silty clay' or 'clay'.
- Then compare the soil type against Table 1 below to identify the daily absorption rate.

Table 1: Soil Types and Daily Absorption Rates (L/m²)

Soil type	Absorption rate (L/m²/day)
'Sand'	30
'Sandy loam', 'Clay loam sandy' or 'Clay loam'	20
'Silty clay' or 'Clay'	Contact NT Health Dept ^(A)

^(A) Soil most likely not suitable for greywater reuse

Soil absorption method

- Dig a hole 300 mm x 300 mm square with vertical sides to 400 mm deep.
- Rake bottom and sides of hole to remove smeared or compacted soil surfaces.
- Remove all loose material from hole and add 50 mm of washed gravel to protect base from scouring.
- Fill hole with water and allow to soak away. Preferably keep hole filled overnight.
- Next morning, fill or adjust water level to a depth of 150 mm above gravel.
- Note the time taken for water to fall 25 mm.
- Use Table 2 below to determine the soil type.

Table 2: Soil Absorption Method and Soil Types

Time for water to fall 25 mm	Soil type	Absorption rate (L/m²/day)
1 to 5 minutes	Sand	30
More than 5 to 60 minutes	Loams or gravels	20
More than 60 minutes	Impervious clays	Contact NT Health Dept ^(A)

^(A) Soil most likely not suitable for greywater reuse

3. How many soakage tunnels are needed?

In general there should be **four soakage tunnels per irrigation line**. If using a four way distribution valve, this would be four irrigation lines, giving a total of 16 soakage tunnels altogether.

Each tunnel should have the equivalent of 3 plastic milk crates or 2 Atlantis® drainage cells². However, the exact number of soakage tunnels will be determined by your household's average daily greywater volume.

There are a number of tools that can be used to determine daily water use. It is important that you take into account seasonal variations (i.e. especially winter and summer) and only consider the water fixtures (bath, shower, laundry tub etc) that you are going to plumb to the greywater system. There are many online tools which can help you do this. Two good ones are:

http://www.mountisawater.qld.gov.au/pdfs/water_audit.pdf

http://education.melbournewater.com.au/content/home_water_investigator/home_water_investigator.asp#

OR call Desert Knowledge Australia COOLmob for a household water audit (08) 8952 0299.

Using this average volume and the absorption rate calculated in the section (2) above, you can work out how much soakage area is required.

$$\text{Daily soakage area (m}^2/\text{day)} = \text{Average daily household greywater volume (L)} \times \text{Soil absorption rate (L/m}^2/\text{day)}$$

To get the number of soakage tunnels required, use one of the following equations:

For plastic milk crates (0.35 x 0.35m²):

$$\text{Number of soakage tunnels} = \frac{\text{Soakage area (m}^2/\text{day)}}{3 \text{ crates} \times 0.12\text{m}^2}$$

For Atlantis® drainage cells (0.61 x 0.41m²):

$$\text{Number of soakage tunnels} = \frac{\text{Soakage area (m}^2/\text{day)}}{2 \text{ cells} \times 0.25\text{m}^2}$$

² See <http://www.atlantiscorp.com.au>

Installation instructions

Before starting

1. Check that bathroom and laundry drainage pipes exit house slab before joining kitchen and toilet lines. If not, major concrete cutting works may be required to access uncontaminated shower and laundry water.
2. Check depth from ground level to top of pipes where bathroom and laundry pipes exit house.
3. If greater than 700mm, a Teampoly tank will not be tall enough and you will need to source a higher tank.
4. Check depth from ground level to top of existing sewer pipe where connection planned. Ensure min. 1-in-100 fall from tank to sewer.
5. Comply with minimum setback distances for the tank, plumbing, power and soakage tunnels.

Minimum setback distances (NT & WA only)

Tank to:

Buildings	2.0 m
Property boundary (closed fence)	0.5 m
Property boundary (open or no fence)	1.2 m

Subsurface tunnels to:

Property boundary (closed fence)	0.5 m
Property boundary (open or no fence)	1.2 m
Buildings*	1.2 m
Paths, drives, carports etc.	0.5 m
sub-soil drains	6 m
Bores (private) for human consumption**	30 m
Public water supply bores***	100 m
Wetlands & water reliant ecosystems***	100 m

Note: * *Greywater may contain chemicals that can damage your house if discharged against the foundations.*

** *Only the NT Health Department may vary this setback requirement.*

*** *If unsure, contact Power and Water Corporation*

Pipework

6. Install as per CSAT Greywater Reuse System Specification Sheet available on the CSAT website at www.csat.com.au
7. Ensure drainage pipe from house to tank is min. 1-in-60 fall.
8. Install overflow relief gully and vent pipe on greywater line (as required by AS3500:2003).

Pumpout tank

9. Standard Teampoly 545L water tank lids have a hole for a leaf sieve. Instead, order a custom lid with 'solid manhole cover' from Teampoly at no extra cost. (Ph (08) 8326 2256 or www.teampoly.com.au)
10. Do not run any pipes or power cords through the lid – it must be fully removable.
11. Excavate hole and install tank on sand bed. Pour concrete collar around base to stop tank 'floating' out of ground.

Warning - Tank may collapse inwards if water table is very high or ground is saturated. Consult tank manufacturer for tolerances.

12. Cut holes in tank wall for pipes. Install pipes and seal surrounds with waterproof silicon sealant. Allow to dry before backfill.
13. For filter sock, place leg of stocking inside shade cloth filter and secure the top of both to lip of 90° pipe socket using octopus strap. Ensure bottom of sock faces away from pump, float and tank wall.
14. Cut top of tank to required height above ground (min. 100mm). Cut so top corrugation curves inwards. If necessary, cut 3-5mm from bottom of lid rim to allow manual fitting/removal of lid whilst retaining a good seal.

Warning - To stop children accessing tank, ensure lid is secured to tank with three (3) teck screws AND manhole cover is secured to lid with three (3) teck screws.

15. Backfill tank hole carefully so tank shape is not distorted (lid will not fit properly).

Pump

16. Ensure pump sits solidly on (but unattached to) tank floor by proper height of pumpout pipe. Fit a decoupling fitting so pump can be removed from tank if necessary.
17. Ensure float is not obstructed by filter sock or tank wall.
18. Ensure float activates when approximately 100 litres of greywater enters tank (Davey D15VA pumps 115 litres per time).

Sewer overflow

19. Install a sewer overflow pipe from the tank to the sewer line. Include an inspection opening with water seal to stop sewer odours entering the tank.
20. If the sewer is absent or not conveniently close, install three metres of septic system absorption trenches to take emergency overflow greywater.

Distribution valve

21. Use LILAC TOP distribution valve (signifies effluent reuse).
22. Use a 4-way distribution valve unless in clay soil with poor soakage, or unless the owner wants maximum control over greywater reuse via a 6-way distribution valve.
23. If distribution valve placed above ground, ensure bottom of 32mm outlet pipe from tank to dist. valve is min. 300mm above ground level to enable connection of 25mm poly pipe.
24. Use LILAC STRIPE 25mm poly pipe to avoid accidental cross-connection with fresh water poly pipes in the garden.
25. For unrelated fresh water poly pipe lines in the garden, fit backflow prevention valves at the tap to prevent accidental cross-connection sucking greywater into drinking water supply pipes.
26. Ensure one outlet from one greywater line is installed through sidewall of inspection riser pipe to charge the water trap leading to the sewer.
27. Excavate tunnels prior to laying out poly pipe. Top of cell/crate should be minimum 100mm below ground level.
28. Place tunnels at drip line of fruit or shade trees. Generally two or three tunnels per tree.
29. For each tunnel, use the 2 Atlantis® drainage cells or 3 plastic milk crates.
30. Shroud top and sides of cells/crates with geotextile. DO NOT wrap geotextile under the cells – leave this clear for optimal soakage.
31. Backfill tunnels with excavated soil. Sand or gravel backfill is not needed.
32. Before covering top of tunnels, fit poly pipe inlets.
33. For each of the four or six lines, create a loop of pipe around all tunnels on a line. This equalises water pressure and distributes greywater evenly to each outlet. DO NOT lay long straight sections with dead-ends.

Warning - Do not make any lines longer than around 60 metres.

34. Once loops are laid in their final locations, cut and fit tees for each tunnel.
35. Use secateurs to cut a small hole in top of each cell/crate. Fit tee to end of each outlet pipe where it extends into the tunnel to stop kids pulling pipes out of cell/crate.
36. Lay pipe on ground surface or bury, as per standard poly pipe.

Getting the flows right

37. Once all poly pipe is laid and connected, disconnect each outlet immediately downstream of the ball valve.
38. Run water into tank until pump starts then walk around each outlet and adjust ball valves until desired flow is reached at each outlet. This may take two or three adjustments of each ball valve because changing one affects another. Once set, flows to each tunnel should not vary over time.

Operation & maintenance

Once installed, the CSAT Greywater Reuse System is designed for minimum maintenance.

Operation

- Your plants will be the best indicator of system performance. If a plant begins to show water stress, check that it is getting an adequate flow from the tank and that nothing is restricting the flow through the poly pipe.
- New plantings next to greywater tunnels will most likely require some fresh water irrigation until roots reach the greywater. After that the plants should grow well on greywater alone provided adequate greywater is delivered.
- Some plants such as citrus trees have seasonally different water requirements. Greywater may need to be supplemented by fresh water in flowering and fruiting seasons.

Maintenance

- Annually change the filter sock.
- Remove the tank's manhole cover or lid and remove the existing sock. Make sure its contents are not accidentally spilled back into the tank during removal. Discard the sock into a rubbish bin.
- Fit a new sock filter using the same octopus strap. Ensure the shade cloth is secure and the pump is not obstructed.
- Use a texta to write the change-over date on the tank lid or inlet pipe. This will help prompt next year's change-over.
- Annually check flows to all tunnels by disconnecting the poly pipe downstream of each ball valve where they enter tunnels. Run greywater through the lines and adjust ball valves if necessary until desired flow is reached.

- Young trees may require modifications to their greywater volumes as they grow.

Make your own sock filter

- Take a 900mm x 500mm rectangle of 90% shadecloth and sew it into a sock shape using fishing line. Place the sewn side on the outside of the bag.

FAQs – Frequently Asked Questions

Should I use a 4-way or 6-way distribution valve?

A 4-way valve is appropriate for most occasions. It allows up to 20 separate irrigation tunnels and uses less pipes and fittings (and \$\$) than a 6-way valve. Most homes create around 400 litres of greywater per day so each tunnel will be irrigated on average every day or so.

Should I change the irrigation regime between summer and winter?

Some people irrigate four areas in winter months then reduce to two areas in summer. This depends on the trees being irrigated. In particular, fruit trees may need higher irrigation to assist summer fruiting. Hardy native shade trees may not require any irrigation in summer. It may be better to supplement summer irrigation by using fresh water drippers.

Pump-out volume. Experience shows that around 100 litres per pump-out is a good volume for a greywater reuse system. It means the tank is emptied several times per day because average homes use around 400 litres per day of greywater. This means the greywater generally isn't in the tank long enough to go smelly, although in Alice Springs greywater can go smelly within an hour in summer. Also 100 litres gives ample volume to irrigate 4 to 8 trees, without requiring too big an absorption area per irrigation line.

What about when we go on summer holidays?

To stop greywater-irrigated plants dying during extended summer holidays, install a line from your automatic irrigation system into your greywater tank (through the sidewall). Set to activate four (4) times daily for about six (6) minutes each time. This mimics your normal greywater use. **DO NOT** set to deliver 400 litres in one hit, as only one of the four (or six) greywater lines will be irrigated.

Can I irrigate vegetable gardens with greywater

Generally the answer to this question is no due to the risk of edible portions coming into contact with greywater shortly before harvesting. However the system designer has successfully irrigated vegetable gardens for several years by installing 90mm slotted 'ag' pipe 150mm under the soil. Laying mulch over the top then planting aboveground crops into that. The ag pipe must be laid flat with a spirit level to ensure even flow of greywater.

Why are lilac coloured pipes and distribution valves used?

Lilac is the international colour for effluent reuse infrastructure. It alerts you and others that the pipes contain greywater. This reduces the chance of cross-connection with black freshwater poly pipe in your garden.

Why are backflow prevention valves needed on my freshwater poly pipe lines?

These eliminate the risk of sucking greywater back into the drinking water supply pipes if someone accidentally connects a greywater poly pipe line to a freshwater line. It is a safeguard for you and your neighbour's health.

Shouldn't the tank be pumped perfectly dry each time to stop it 'going off'?

No. There is a misconception that the tank should be totally emptied by the pump each time so that left-over greywater cannot go smelly or breed additional bacteria. The reality is that the small amount of greywater left in the bottom is soon diluted by new greywater entering the tank. Remember that the tank will always have stored greywater in it for various time periods, including overnight and when householders go away on weekend trips.

Smelly greywater in the irrigation lines. Greywater that is left sitting in the irrigation lines between pump-outs goes smelly very quickly. If you have a sub-mulch irrigation system, you may notice a greywater odour for the first 30 seconds after pump-out starts. This is the smelly greywater that was sitting in the lines, and is now being purged by the 'fresh' greywater from the tank. There is not much you can do about this, so if the odour is a problem for yourself or neighbours then use fully subsurface disposal tunnels to ensure odours cannot escape.

Why can't we pump the greywater onto the ground, instead of into tunnels?

Greywater contains pollutants that make it go smelly very quickly in summer, and can contain unhealthy bacteria. As such it is not advisable to leave it at the surface where it accessible to children, pets, mosquitoes or could run off into neighbours properties or gutters.

Can I pump greywater to mulch basins instead of tunnels?

The NT Health Department has allowed use of mulch basins in the past. Contact CSAT for installation details. When greywater pumps into mulch basins, an odour can be emitted for the first 20 seconds or so. This is from old greywater that has been sitting in the poly lines since last pumpout and has become smelly. Once this is flushed out, the odour quickly disappears. Therefore do not locate mulch basins close to and upwind of areas that the neighbours use regularly.

I have an existing septic tank in a non-sewered area. Can I fit the CSAT Greywater Reuse system to the end of my septic tank?

Yes, although normal maintenance for septics should still occur. The set up of the tank and tunnels will be exactly the same except no filter sock is required (the septic tank settles out the solids). The presence of toilet water is not a problem, as all tunnels are subsurface like traditional absorption trenches. The extra nutrients in toilet water will help plants grow better than just greywater.

Can I reuse nappy water from the washing machine?

Nappy water is regarded as a no-no for greywater reuse systems. For the system described here, the use of nappy greywater is not a problem due to all greywater being applied beneath mulch or soil where it is not accessible to kids or pets or others. Care should be taken that greywater is not surfacing and running into local waterways or stormwater drains (whether there is nappy water or not!). If soils are too free-draining and greywater is likely to contaminate an underlying aquifer or nearby water course then no greywater should probably be reused on your block.

No-no's for stored greywater

Greywater that is stored prior to reuse goes smelly very quickly, as short as one hour on a hot summer day in Alice Springs so it is not recommended to use this on the surface and certainly not via sprinkler on your block. Your neighbours will not be happy about this at all.

Materials list

Item	Quantity	Detail
House to tank		
Sewer pipe & fittings	As required	100mm UPVC sewer. Includes additional overflow relief gully and vent pipe for new lines.
Pump-out tank		
Tank	1	545 L plastic corrugated rain tank. Order sealed lid from manufacturer. www.teampoly.com.au
Concrete anchoring collar	0.16m ³ concrete	7 x 40kg bags pre-mix concrete
Inlet pipe elbow	1	DN100 UPVC sewer 90° elbow
Silicon sealant	1 x tube	For permanently wet application
Filter sock Octopus strap. Shade cloth outer filter. Stocking inner filter.	1 2 (1 as spare) 2 (1 as spare)	30cm octopus strap. 90% shade cloth 900 x 500mm square sewed 3-sides with fishing line. 1 x leg of light weave nylon women's stockings
Submersible pump	1	Davey D15VA with float switch www.davey.com.au
<u>Pipe from pump to distributor</u> DN32 pipe Joiner, pump outlet Decoupling fitting Elbow 90°	2 m 1 1 1 (or 3)	DN32 high pressure PVC Male valve take-off: DN32 slip fitting – 1 ¼" BSP. DN32 decoupler DN32 high pressure PVC 90° elbow
<u>240V power</u> Option A. Outdoor powerpoint next to tank Option B. Conduit to indoor powerpoint		As required.
Sewer overflow		
Sewer pipe	As required	
Water trap	1	DN100 UPVC sewer trap
Inspection opening threaded cap	1	DN100 UPVC threaded cap with o-ring
Concrete collar	1	1 x 40kg bag pre-mix concrete
Connection to existing sewer	1	DN100 UPVC fittings as required
Distribution valve assembly		
Distribution valve	1	4- or 6-way lilac top PPI 'Hydrotek 4000' distribution valve. www.ppi.com.au

<u>Joiner: Distribution valve to poly pipe</u> PVC joiners	4 or 6	DN25 high pressure PVC faucet socket with 1" female BSP thread. 'Poly director' male 1" thread to 25mm barbed poly joiner. 25mm lo-pol barbed 90° elbows
Lo-pol barbed joiners	4 or 6	
Lo-pol elbows	4 or 6	
<u>If distribution valve below ground:</u> Valve box	1	Heavy duty 19" x 14" tapered valve box with lid
Irrigation system		
Poly pipe	As required	25mm lilac stripe low-poly from PPI. www.ppi.com.au
Poly fittings	4 or 6	
For 16 tunnels 25mm elbow 25mm tee 25mm ball valve	16 32 16	25mm lo-pol barbed fittings.
For 20 tunnels 25mm elbow 25mm tee 25mm ball valve	20 40 20	25mm lo-pol barbed fittings.
For 24 tunnels 25mm elbow 25mm tee 25mm ball valve	24 48 24	25mm lo-pol barbed fittings.
If poly pipe below ground Valve boxes to access ball valves	As per # of tunnels	6" round valve box
Tunnels		
Option A. Atlantis drainage cells.	As required.	Atlantis drainage cells with 3 plates per cell (if no vehicular traffic) or 5 plates per cell (vehicular traffic).
Option B. Plastic milk crates	As required.	Not to be used if vehicular traffic over tunnels.
Geotextile	Up to 50m	1.5 - 2m wide roll woven geotextile.