USING GREYWATER TO IRRIGATE GREEN WALLS

• Greywater is prolific and arises at many points within buildings.
• From a purely logistical viewpoint, the wide occurrence of greywater presents opportunities for irrigation of green walls and roofs, especially since-
• Much greywater from handbasins and showers is lightly loaded with low concentrations of pollutants.
• Therefore during 6 months of tests for sustaining green walls, we applied three types of irrigation water; 1. mains water, 2. untreated greywater and 3. treated greywater.
• The use of greywater for irrigation, especially during times of drought, could provide a significant benefit to communities.
GREYWATER COMPOSITION

• However, the quality of greywater can vary considerably, due in part to the previous uses to which the water was put.
• Personal hygiene products in greywater tend to contain many different Sodium compounds and constituents.
• Sodium compounds that were present in the test shower gel were: Sodium Laureth Sulfate, Sodium Chloride, Sodium Styrene/Acrylates Copolymer, Sodium Hydroxymethylglycinate, Sodium Lauryl Sulfate, Sodium Hydroxide, Sodium Benzoate.
• Tests were run continuously over 6 months at 100 litres of irrigation per week.
• Green roofs have previously been tested longitudinally. No historic evidence found for green walls.
LICENCING OF GREYWATER DISCHARGES TO ENVIRONMENT?

• It would be preferable to have analysed daily each constituent in greywater before using it for irrigation, but clearly this is impractical.
• Most domestic greywaters are not regulated in the sense that they are not required in UK regulation to be tested and monitored before discharge into the environment, unless very heavily contaminated.
• So effectively, for individual households there are NO generally applicable discharge requirements of greywater.
TEST RIG FOR IRRIGATING GREEN WALLS

Wooden structure making to green wall box secure and stable

Gravity fed irrigation system and pipe.

Stable wooden platform to support irrigation system
IMPACTS UPON SOILS OF SODIUM FROM GREYWATER

- Sodium due to its conservative nature can accumulate in soils, having a detrimental effect on plant health.
- Increasing concentrations of Sodium (Na⁺) can displace nutrients including magnesium and calcium, affecting the sodium absorption ratio (SAR), and impacting on plant health.
- Sodium ions can bind clay particles leading to platelet and aggregate swelling and soil dispersion.
- This would reduce feasibility since, if binding happened persistently, increasing costs would be based upon replacement planting.
IMPACTS UPON SOILS OF SURFACTANTS (OR DETERGENTS) IN GREYWATER

• Surfactants are constituents that may affect any greywaters.
• Surfactants in soils have been shown to cause water repellence, reducing the soil water holding capacity and affecting the soil productivity.
• The severity of the impacts is heavily dependant on the source of greywater used for irrigation.
• Lightly loaded greywater showed the greatest opportunity for reuse in these trials since; unwanted and damaging effect on soils were not observed.
SOIL SODIUM CONCENTRATIONS

Box 1: Mains water (50:50) average soil sodium (mg/kg)
Box 2: Greywater (50:50) average soil sodium (mg/kg)
Box 3: Treated Greywater (50:50) average soil sodium (mg/kg)
Box 4: Greywater (80:20) average soil sodium (mg/kg)
Box 5: Greywater (20:80) average soil sodium (mg/kg)
IMPACTS OF SODIUM ON PLANTS

• The effect of sodium on a plant is strongly related to its species and its individual tolerance
• Excessive sodium affects the water transportation within leaf tissue, causing areas of leaves may dry out.
• In the most extreme cases Sodium accumulation can cause stunted growth, and arrested cell development.
SEDUM LEAF TISSUE SODIUM CONCENTRATIONS

Box 1: Mains water (50:50) average sodium (mg/g)
Box 2: Greywater (50:50) average sodium (mg/g)
Box 3: Treated Greywater (50:50) average sodium (mg/g)
Box 4: Greywater (80:20) average sodium (mg/g)
Box 5: Greywater (20:80) average sodium (mg/g)
SODIUM

- Sodium was tested on a weekly basis for 6 months
- Sodium samples were collected in triplicate and analysed using a flame photometer.
- Sodium concentration in the soil was initially higher than concentration after 6 months of greywater irrigation.
- Little, if any sodium accumulation was observed in plants and soils.
- No differences were observed in sodium concentrations of plants and soils between boxes irrigated with mains water and greywater.
- Soil composition can effect sodium concentrations. Larger amounts of compost in the green wall soil mix gave elevated concentrations of sodium from start to finish of the experimentation period.
- Natural dieback of plants were observed during winter months and was not linked to sodium accumulation.
CONCLUSIONS

• Personal responsibility may be key in reducing the amount of sodium and detergents in greywater.
• Bathroom and hand wash basin greywater is recommended for reuse as it makes up a large proportion of the resource and is lightly loaded with pollutants.
• Results from our testing are positive and shows little if any impact of greywater irrigation on plant health and soil conditions.
• The evidence suggests that greywater presents an important opportunity to benefit the urban environment and to sustain green infrastructure during times of water stress and drought.