

GREYWATER AND GREEN INFRASTRUCTURE



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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

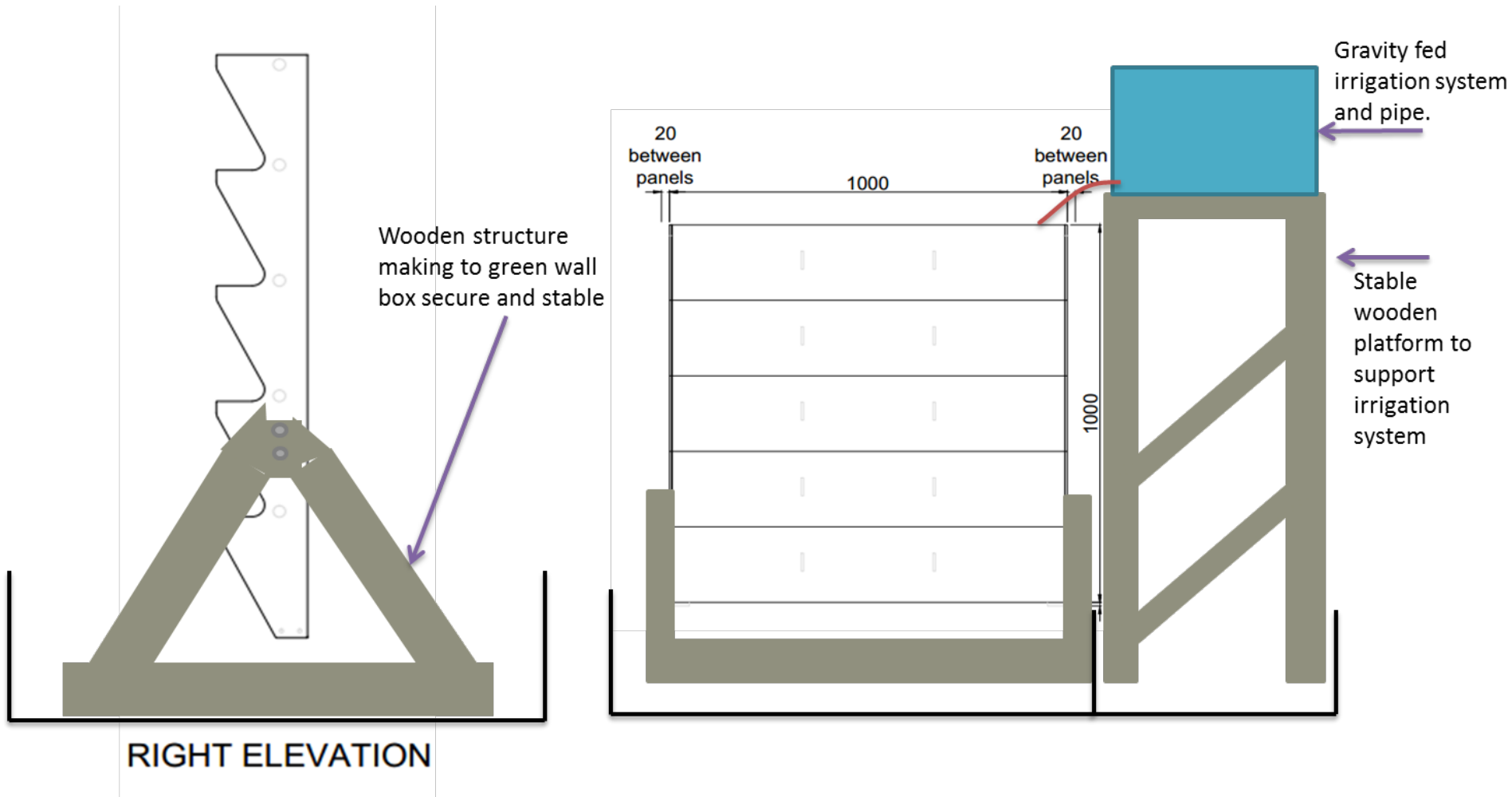
- However, the quality of greywater can vary considerably, due in part to the previous uses to which the water was put.
- Personal hygiene products in greywater tend to contain many different Sodium compounds and constituents.
- Sodium compounds that were present in the test shower gel were: Sodium Laureth 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 in-to 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



IMPACTS UPON SOILS OF SODIUM FROM GREYWATER

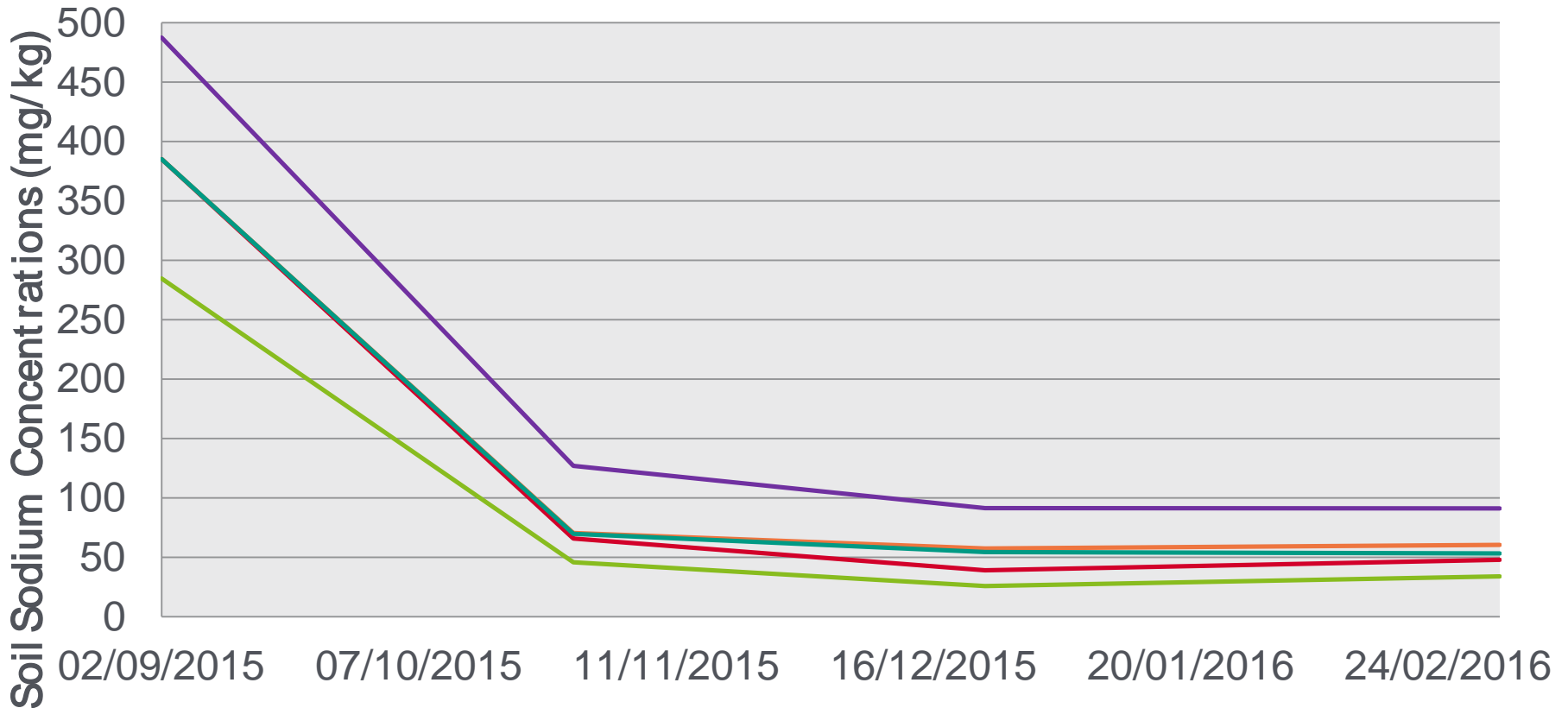
- Sodium due to its conservative nature can accumulate in soils, having a detrimental effect on plant health.
- Increasing concentrations of Sodium (Na^+) can displace nutrients including magnesium and calcium, affecting the sodium absorption ratio (SAR), and impacting on plant health.
- Sodium ions 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)

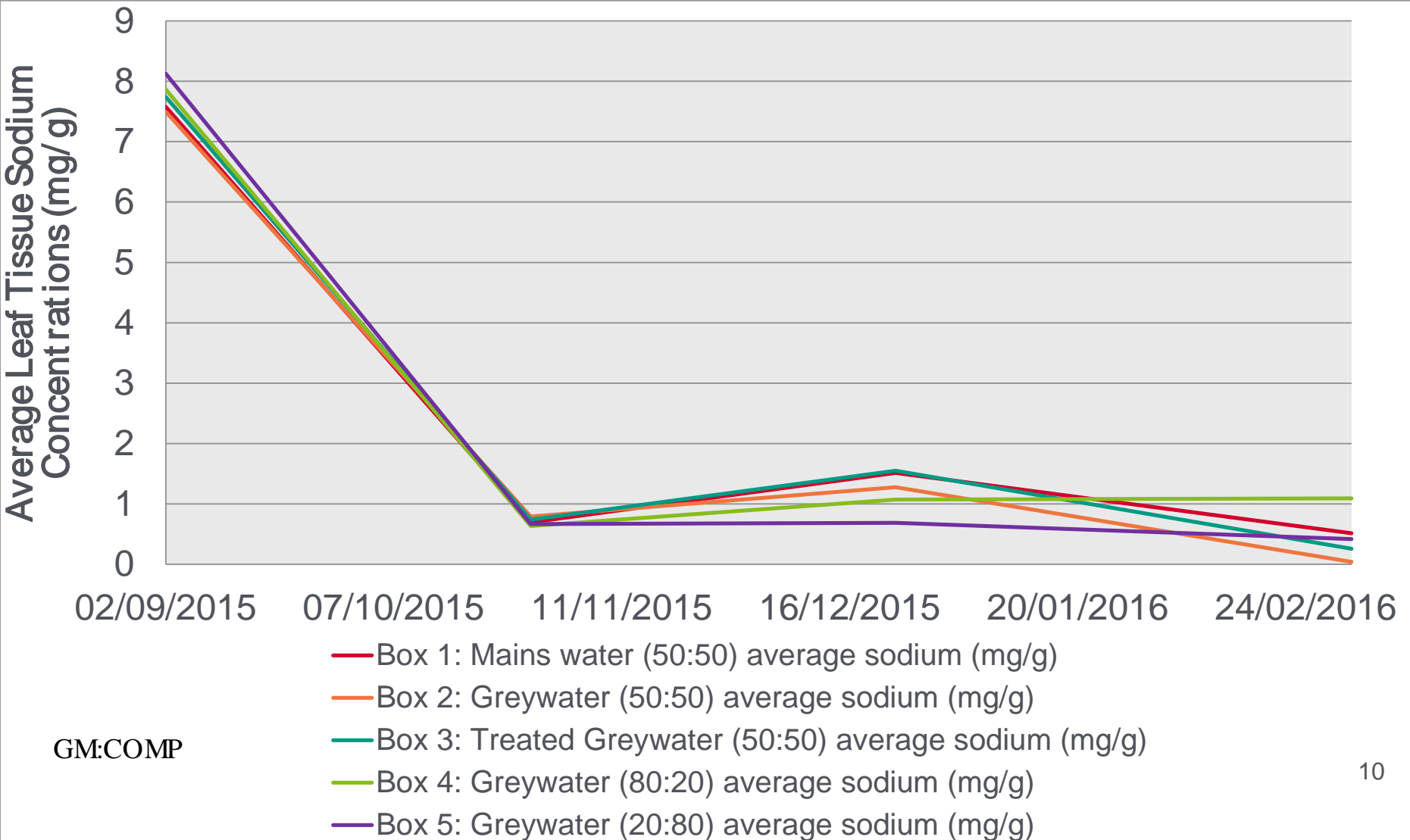
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IMPACTS OF SODIUM ON PLANTS

- 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



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.