

RETROFITTING SUDS FOR WATER RESILIENT CITIES; ROLE OF GREYWATER



Water Sensitive Urban Design; supported by CLIMATE-KIC
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WELCOME FROM THE SCHOOL OF THE BUILT ENVIRONMENT AT READING

- Current UK GOVERNMENT POSITION:
- UK Government has stated; ‘existing urban green infrastructure in the UK has not been strategically planned to deliver ecosystem services’.
- From; POSTbrief, July 2017. *Urban Green Infrastructure and Ecosystem Services*. POSTbrief number 26, Houses of Parliament, Parliamentary Office of Science and Technology, UK.

URBAN IRRIGATION AND IRRIGATION OF GREEN INFRASTRUCTURE, GI

- Greywater originates ubiquitously wherever there is human activity. This generation of greywater largely arises in close proximity to urban green infrastructure;
- The greywater provides a supply of irrigation water and nutrients that is more consistent and predictable than intermittent rainfall;
- Therefore, this supports resilience planting in cities using species with different resilience profiles;
- The proximity factor is important for both sustaining irrigation for green infrastructure, as well as the sustainable reuse of locally generated greywater.

RAINWATER COLLECTION, UPTON; POTENTIAL FOR EQUIVALENT IN GREYWATER?



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SUDS BALANCING POND; UPTON, NORTHAMPTONSHIRE



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PROJECT OUTLINE AND PURPOSE 1

- The research used a small, commercially available greywater treatment plant to provide a stream of treated greywater;
- Other authors have previously expressed the opinion that medium term watering of GI using greywater that contains sodium and detergents, can adversely affect soils and plants;
- Stands of green boxes, planted with the same mixes of *Sedum* species were irrigated;
- Three different streams of irrigation water were applied separately, each one to at least 1 train of identical planted boxes;
- One train was watered with raw greywater, three trains were watered using treated greywater and one train was watered with potable or mains drinking water.

PROJECT OUTLINE AND PURPOSE 2

- The research compares five trains of growing boxes in order to review how they perform under similar and contrasting sets of conditions;
- the research will identify how much each treatment train can contribute to additional water-holding capacity in a small, suburban catchment;
- the performance and quality of the soils and growing media were extensively tested to determine whether the three different irrigation streams resulted in detectable differences in the soil/media composition, following tests;
- this could inform the applications for retrofitting suburban SUDS.

SEDUM TEST RIGS, 2015-16; IRRIGATION USING RAW OR TREATED GREYWATER OR MAINS WATER



© Photograph by M.J. Smith, University of Reading

RESEARCH APPROACH 1

- The research rationale aligned with the funding priorities of the funding body, Climate-KIC;
- The research was not focussed towards rainwater irrigation because of the following rationale;
 - 1) greywater is a consistent stream of irrigation water; humans wash very regularly and the greywater is ‘lightly loaded’;
 - 2) when green infrastructure soil becomes dry or very dry under drought or sporadic rainfall conditions, using greywater for irrigation reduces reliance upon mains water for irrigation;
- Very importantly; keeping soil regularly watered using greywater maintains its water-holding capacity during hot weather;
- This helps to protect and maintain suburban soil water-holding capacity in readiness for peak rainfall/flow conditions.

2. RESEARCH APPROACH 2

- The research applied a type of stress testing approach whereby the planted boxes were consistently “over-watered” at a rate of approximately 60 litres per week delivered to each *Sedum* trough ;
- Resilience was tested using mixed species of *Sedum*;
- In the tests, it was important to show that the *Sedum* could survive in a water-saturated environment, particularly since *Sedum* is often chosen for its drought resistance qualities;
- Five different soil and growing media types were tested; 1) John Innes standard soil, 2) a commercial green box growing medium, and 3-5) mixes in various proportions, 50:50, 80:20, 20:80

TESTS ON PERFORMANCE OF DROUGHT TOLERANT PLANTS TO REGULAR OVER-WATERING TREATMENT

The planted layers contained mixed *Sedum* varieties; *S. album*, *S. sexangulare*, *S. kamtschaticum*, *S. acre*, *S. reflexum*, *S. spurium*, *S. pulchellum*, *Saxifraga granulata*.

The plants themselves may have an effect on the storage of surfactants (detergents) and sodium within the soil matrix, as well as on the pore space available for moisture retention in the planted troughs and boxes.

TREATING & REUSING GREYWATER AT UNIVERSITY



Similar (not actual); University of Reading, full-sized scheme, since 2013

APPLICATIONS

OPPORTUNITIES FOR INSTALLING GREYWATER DOWNPIPES AND COLLECTION/TREATMENT SYSTEMS; UPTON, NORTHANTS; photo by Nick Corker, 2007



FINDINGS 1

1. Research conducted at the University of Reading applied both treated and untreated greywater to planted green wall boxes. Tests were conducted on soil quality before and after the trials; also, quality of greywaters tested before and after irrigation;
2. No significant differential impacts between the boxes watered with either treated or untreated domestic greywater over the medium-term. The boxes irrigated using drinking water also experienced a decrease in water holding capacity.
3. Urban green infrastructure benefits from the planting of hardy species, watered using locally generated greywater. Since greywater is a relatively consistent water resource, less subject to frequency fluctuations than watering using rainwater.

FINDINGS 2

4. This pattern of greywater reuse for watering and irrigation leads to more water resilience in urban areas. SUDS, green troughs, green walls and boxes, planted beds (and green roofs) benefit from retention and maintenance of appropriate Soil Moisture Levels (SMLs).

5. This in turn enhances the wetting properties and water holding capacity before the start of rainfall, so reducing the adverse effects of initial slow water absorption/uptake. The total effective water holding capacity is then increased, when considering the duration of the whole event;

6. Innovation in design of irrigation equipment can support greywater delivery suitable for green infrastructure enhancement, in urban areas.

ACKNOWLEDGEMENTS

1. Climate-KIC
2. Treebox Ltd
3. AquaLity Ltd
4. Nick Corker, CEH

OPPORTUNITIES FOR INSTALLING GREYWATER
DOWNPIPES AND COLLECTION/TREATMENT SYSTEMS;
UPTON, NORTHANTS; **photo by Nick Corker, 2007**



