Scottish Universities Green Infrastructure Research Group

2019 International Seminar : Persistent pollutants and Green Infrastructure - Problems & Opportunities

Summary report, taken from notes. Presentations will in due course become available through the SUGIR website.

1.   Persistent pesticide pollution in Thailand

Dr Krajitvichyanukul; Naresuan University, Thailand.

In Thailand, agricultural pesticides are heavily used in food production; especially for sugarcane growing, which has rapidly expanded in the past 2 decades. Paraquat is the main herbicide, but others are also used often in ad-hoc 'cocktails' devised by farmers. Routine overdosing by 4x the recommended concentration is also a problem. The products, and breakdown products, accumulate in receiving watercourses and lakes, causing skin damage to people using the water for washing, swimming, fishing etc. The incidence of necrotising fasciitis more than doubles in areas of sugarcane production, due to the levels of paraquat in the waters.

Research has focussed on the use of biochar, applied to water and to land, to adsorb the chemicals. Bacterial activation can then bind and breakdown the chemical. SuDS wetlands systems are good locations for such bacterial action, where the soil is intermittently moist and aerated.

Progress on wider public health measures include stimulating the growing and marketing of organic produce, education of consumers, and annual blood testing in affected areas.

It is a serious public health problem, which is stimulating the development of techniques for cleaning of contaminated environments.

2.   Mesocosm investigations on the fate of PAHs in swales

Prof. John Williams; University of Portsmouth

Dating back to their development and monitoring as part of the A34 Newbury Bypass, where vegetated detention ponds, swales and porous asphalt were used and it was proven that they trap sediments on which pollutants have adhered (Pontier PhD), and that plants help to remove pollutants (Robinson PhD). Recent research has considered the most effective shape for a pond to remove sediments - an elliptical pond with an elliptical island (2014 study).

A Model Swale was created in lab conditions, and was then charged with polluted water from upstream end (creosote solution used as it has a wide range of representative organic and PAHs). It demonstrated that the swale both delayed and dissipated the peak flow, and that it cleaned the water. Analysis of the soil beneath the swale showed a growing plume of pollutants within the topsoil depth.

The ProSUDS project (NERC Green Infrastructure Innovation) looked to define the economic values of SUDS. 6 exemplar housing schemes of large scale and with a good range of SUDS techniques were used - including Bernard, Upton, Hampton and Riverside Barking. Residents were surveyed, with following findings:

• Greenspace was seen as a desirable influence on the purchase of a home (Upton & Hampton)
• However, awareness of SUDS was low, and not in itself a factor
• The SUDS benefits of flood protection and wildlife were recognised by many
• Also the urban design value offered by SUDS in some of the sites (esp. Upton)

• Litter, pests and extra costs were seen as disadvantages of SUDS; safety came next on the list.

Thus, the importance of regular maintenance of edges and litter removal - 'cues to care'

A RICS study demonstrated that the uplift in property value caused by a goods SUDS scheme was just less than that of a private garden. Interestingly, the uplift was relatively greater for smaller properties, whereas developer layouts tend to place larger homes overlooking SUDS.

ProSUDS is now developing, with RICS, a costing tool for comparing conventional drainage with SUDS.

3. Landscapes as filters for environmental protection

Dr Brian D'Arcy; International Water Association (IWA)

Diffuse pollution can be defined as the weather-driven spread of contaminants or natural pollutants. CIWEM Report "Diffuse Pollution Impacts" in 2000 made clear the link between land use and water quality, and the form of pollutant impacts.

UV light and aerobic soils optimise biodegradation; therefore, permanently wet SUDS are not the most effective. SUDS must dry out to work best!

The IWA will produce a report 'Land Use and Water Quality' in 2020; look out for it.

4. Landscapes as filters for environmental protection

Dr Saran Sohi; University of Edinburgh

Biochar is made using thermal pyrolysis (removing O and H); it is stable, porous, can adsorb chemical pollutants and heavy metals, and retains the structure of the source material. Manufacture is energy neutral or can even generate heat and power. Manipulating the heating process can control PAH production, and mixed waste can be used - e.g. plastics burns off to gas, so does not pollute the product.

It offers long-term storage of carbon from waste materials - wood, seed or grain husks, sewage cake, segregated municipal waste. It offers capture, degradation and removal of contaminants, having an affinity for contaminants and offering heavy metal sequestration. It supports plant growth, providing moisture storage and a source of phosporous. It buffers pH. The potential for use in GI systems is huge. It could mitigate the carbon emissions embodied in infrastructure.

Biochar could be used in rural agriculture at a large scale. Biochar production could become an important industry of the peri-urban zone, taking urban and rural wastes and turning them into a product for agriculture, land remediation, green infrastructure and new product developments.

5. Use of satellite and UAV (drone) to survey Green Infrastructure

Dr Alistair Hamilton; SRUC

Remote sensing data is available from satellite surveying; use the EO browser to access data from Sentinel 1, Sentinel 2 and Landsat 8. These offer large-scale mapping of different factors, including visual and non-visual wavelengths - e.g. UV, near and far infra-red. They can be fed into GIS mapping.

UAV should be considered where smaller scale, more detailed data is needed.

An illustration of the use of drone photography to generate a 3D photographic model of a city was shown. UAVs can carry a range of cameras, including hyper-spectrum camera that records the full range of wavelengths. From this it becomes possible to even identify individual species by their spectral reflectance characteristics. For instance, remote sensing to detect the presence of invasive alien species, and thereby inform eradication programmes.

6. Assessing ecosystem services using Bayesian Belief Networks

Dr Alistair McVittie; SRUC

A demonstration of how different ecosystem services could be evaluated through an approach based on weighting of benefit and of cost; complex interactions between different factors can be modelled in the form of a Bayesian Belief Network, a kind of matrix of judgements/valuations (e.g. riparian buffer strips and their effect on sustainable crop yields and on habitats). Although this appears rather esoteric to the practitioner, the method provides help in reaching judgements based on cost:benefit appraisal of ecosystem services.

7.   Use of legumes in green roofs

Stuart Dick; University of Portsmouth

The inclusion of legumes in green roof plantings can increase the capacity of the roof to act as a sink for N pollution. It benefits vegetation health by increasing fertility, and removes the need for artificial fertiliser applications to the green roof (which is recommended by green roof suppliers in some cases).

Legumes can also benefit biodiversity through their floral and foliage characteristics.

8.   Rural SUDS on farms in Ayrshire

Stewart Moir; Moir Environmental

Rural SUDS have a different emphasis to urban SUDS. Urban SUDS have tended to prioritise attenuation (flood volume) over treatment (pollutant removal), whereas rural SUDS has treatment as the key objective. The main pollution impacts occur in winter, with rainfall, cattle concentrated at the steading, and diminished vegetation cover.

The Water Environment (diffuse pollution) regulations 2008 promoted use of the Constructed Farm Wetlands Design Manual (2008). BUT, the resulting design of wetlands were too large to be economic, because they required the wetland to be 2x the area of the drained surfaces (roofs and yards); thus slurry tanks became the preferred solution to meet the regs.

The Rural SUDS Guidance produced by CREW (2016) introduces other treatment methods through SUDS, and these techniques have been trialled on a number of farms in Ayrshire through a EU supported project. The use of filter strips, swales, wetlands and ponds has been demonstrated to provide good levels of treatment at farm scale; segregation of runoff between roof, 'clean yard' and 'general yard' sources is key; this keeps the volume down for the treatment system and means that residence time can be longer.

Nick Bowen
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