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Determining the effectiveness of different types of green infrastructure through dye tracing experiments

Ian Pattison, Simon De-Ville, and Sarah Twohig

Loughborough University, Civil and Building Engineering, Civil and Building Engineering, Loughborough, United Kingdom (i.pattison@lboro.ac.uk)

The 21st century is experiencing unprecedented urban expansion due to population growth and migration. This, along with climate change and changes in rainfall patterns has resulted in the growing challenge of urban surface water flooding. Traditional approaches to urban design and particularly drainage systems are not appropriate for the 21st Century. Therefore sustainable alternatives need to be developed to allow the day to day functions of urban spaces to continue i.e. economic productivity, health and wellbeing of users, while becoming more resilient to the increasing hazard of surface water flooding. Sustainable urban Drainage Systems (SuDS) or Stormwater Control Measures (SCMs) are commonly used to reduce surface runoff and also to treat polluted water. These work with natural processes often by promoting infiltration, storing or slowing the passage of water and improving water quality. Examples include infiltration trenches, detention basins, green roofs and permeable paving. These are often applied in isolation, but the concept of a treatment train combines multiple features.

The benefit of constructing SuDS in combination rather than in isolation will be investigated through conducting experiments on a SuDS treatment train. The experiments were undertaken on a treatment train at Villanova University at the Urban Storm Water Partnership (VUSP), Philadelphia, USA. This was constructed at Villanova in 2011, with a vegetated swale, leading to two rain gardens in series and then an infiltration trench. The effectiveness of SuDS during rain events will be investigated through using experiments whereby Fluorescein dye was supplied to the inflow to the treatment train which collects rainfall from a multi-storey carpark. Curvettes were used to collect samples of water that has moved through the train at multiple locations between the different component of the treatment train. Samples were then tested using a Fluorimeter which detects light passing through sample and through correlation determines the concentration of dye. Similar experiments were undertaken on detention basins within Loughborough in the UK to compare different types of green infrastructure. Using dye tracing, the flowpaths and time of concentrations were mapped and quantified. It was found that with distance through the treatment train the degree of attenuation increased. Furthermore, the rain gardens were significantly more effective at slowing the flow than the swales.