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Title:

Maximising Multiple Benefits from Sustainable Drainage Systems - Identification and Decision Support

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Extended Abstract:

This paper describes efforts in Scotland UK to assess urban diffuse pollution sources, pathways and sinks; to establish mitigation measures, which can address waterborne urban pollution and also provide multiple benefits. The paper will describe the results from an extensive review exercise, which culminated in the development of a new decision support tool. The tool is intended to help urban planners and water managers tackle urban diffuse pollution with mitigation measures, which could provide multiple environmental and societal benefits, in addition to delivering pollution mitigation.

Introduction

Across Europe, point source discharges have been targeted through the implementation of several European Directives (e.g. EU Integrated Pollution Prevention and Control Directive (2008) and the EU Urban Waste-Water Directive (1991)). Partly as a result of the on-going success of these Directives, increasing attention is being directed towards tackling diffuse pollution sources. For example, the EU Water Framework Directive (WFD) (2000) specifically refers to the need to mitigate both point and diffuse urban pollution sources in order to offer protection to aquatic ecosystems. Measures set out in the WFD include reducing emissions of specified priority substances (PSs) and the phase-out of discharges of priority hazardous substances (PHSs) to achieve good ecological and chemical status within river basins. Target concentrations, known as environmental quality standards (EQS), which should not be exceeded in receiving waters in order to protect human health and the environment, have been defined for all currently identified PSs and PHSs (EU Environmental Quality Standards Directive, 2008), with the inclusion of a further 15 substances recently proposed. However, whilst point source polluters such as industrial facilities and municipal wastewater treatment plants can be relatively easy to identify and appropriate emission control measures developed, sources of diffuse pollutants can be more difficult to locate and control. This is particularly the case in urban areas, which are spatially and temporally dynamic. Diffuse pollutants are derived from a range of sources

(e.g. traffic; industrial, commercial and residential activities; combined sewer overflows; polluted land). The resultant pollutant load is primarily a function of rainfall frequency, intensity and duration in combination with the type, distribution and usage-intensity of impermeable surfaces, all of which can vary on a site-by-site basis. In addition, further pollutant transformations can occur during residence and conveyance within the piped or open channel networks. Hence even relatively simple surfaces can have time- and storm-varying responses.

The EU WFD states that both point and diffuse sources of pollutants are to be mitigated through the development of Programmes of Measures (PoMs). However, whilst PoMs are identified as requiring a catchment-wide approach, actions to be undertaken are not specified. Whilst reductions in diffuse pollution loadings can be targeted through a range of technological and non-technological mitigation measures (e.g. sustainable drainage systems, alternative management practices and voluntary awareness campaigns), the applicability of alternative approaches will vary in relation to a range of catchment characteristics, from pollutant source, type and release factors to land availability and the willingness-to-act of local communities. Approaches to identifying and quantifying these catchment specific characteristics and their impacts on receiving waters also vary, from water quality modelling approaches (e.g. Crabtree et al., 2009) and risk prioritisation approaches (Lundy and Wade, 2011) to GIS-based derivation of unit surface area loadings (Ellis and Revitt, 2008) and substance flow analysis (Revitt et al., under review).

In making complex environmental decisions, research has indicated that engaging a wide range of stakeholders in the decision-making process can increase the acceptability and hence successful implementation of strategies adopted. It is also known that stakeholder engagement is not easy, particularly in urban areas where the range of views, priorities and concerns of local residents can often conflict and land-use is at a premium. Under such conditions, the selection of strategies which are multi-functional and hence potentially beneficial to a wider number of stakeholders may be of particular value. It is within this combined social, environmental and economic context that this work has evaluated methodologies to identify the sources and pathways of diffuse urban pollutants and strategies for their mitigation.

Method

The methods used for this research included extensive literature review, data collection, information management and field work in the case study area. Collaborative meetings were required to share information between partners and stakeholders at all stages of the work. An extensive volume of information was gathered in the review stages of the work and this was used to undertake a comparative analysis of the performance of a range of alternative diffuse pollutant mitigation strategies, assess the type of land use and pollutants they addressed and provide an evidence base of reported benefits associated with those strategies. This process generated a considerable body of data and information, which would be of great use to decision-makers, but was too large a dataset to be easily interrogated. To resolve this limitation the data were developed into a diffuse pollution

mitigation 'decision support tool', which could be interrogated for different land use types. The tool was tested within a Glasgow based case study area. The development of the tool and the results of the testing are presented.

Policy Implications of the research

Many policy agendas, particularly those associated with environmental issues, are now recognising the need to work across disciplines, departments and organisations. Joined up thinking and good communication are needed to tackle urban diffuse pollution and deliver multiple benefits. Recognition of cross-over in policy agendas and in the delivery of measures to meet different directives (e.g. flooding and biodiversity, WFD and well-being/recreation) would be welcome.

Current data are sufficient to determine that urban diffuse pollution is a cause of WFD standard failure; increasing populations and climate change pressures are likely to make the situation worse. This research has shown that there are a range of methods available to identify sources, pathways and mitigation measures. It has also increased the understanding of the level of uncertainty associated with their use in practice. Policy should require optimisation of benefits from the current tools that are available; these should be implemented but any measures need to be subject to regular review, to allow the results to inform the development of databases/on-going practice. Mechanisms for cross-disciplinary communication and cross-departmental working will aid in the improvement of multiple benefit recognition and delivery.

Conclusion

This research informs the development of policy and supports implementation of sustainable surface water management, flooding and pollution in urban areas. In addition to these benefits, increases in health and well-being (through green-space provision or improvement), in traffic management, in operation and maintenance delivery (and cost savings) for urban areas, and in biodiversity and climate change planning can be delivered. This work reports on the development of integrated tools that are relevant to understanding sources, pathways and mitigation of diffuse contaminants. It provides a critical assessment of methods to best identify sources and pathways for a given urban environment and; identifies mitigation strategies, from source to end-of-pipe that meet the twin challenge of diffuse pollution prevention and delivery of multiple benefits.

References:

Crabtree, B., Kelly, S., Green, H., Squibbs, G. and Mitchell, G., 2009. Water Framework Directive catchment planning: a case study apportioning loads and assessing environmental benefits of programme of measures. Water Sci Technol, 59(3), 407-416.

Lundy, L. and Wade, R (2011) Integrating sciences to sustain urban ecosystem services. Progress in Physical Geography 35; 5, 653-669

Ellis, J.B and Revitt, D.M. (2008). Quantifying diffuse pollution sources and loads for environmental quality standards in urban catchments. Water, Air and Soil Pollution: Focus, 8 (5-6), 577-585.

Revitt, D.M. Lundy, L. Eriksson E. and Viavattene C. Comparison of pollutant emission control strategies for Cd and Hg in urban water systems using substance flow analysis. Submitted to Journal of Environmental Management.