

Sediment characterisation at the urban river scale, Mersey Basin, Manchester, UK: implications for water quality management

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Introduction

The urban environment is becoming of increasing importance globally. Cities have suffered a legacy of pollution which has degraded water, sediments, air and wildlife. Due to the heavily engineered nature of urbanization, the physics and chemistry of sediment and water contrast with that in natural environments. Our research, in collaboration with the user community and legislative bodies, is focussed on characterising sediments, and sediment-water interactions, in an urban catchment in Northwest England with the view to improving management strategies for water and sediment quality. The Mersey Basin is a large catchment (5000 km²), with a well-developed integrated catchment management plan (through the Government-funded Mersey Basin Campaign).

The aims of this research programme are to characterise the sources and nature of sediment in an urban river catchment, to determine their role on contaminant transport and mobility, and to develop models that integrate sediments and water with the view to the sustainable management of sediment and water quality, compliant with the European Water Framework Directive.

Sediment Characteristics

1) Road Deposited Sediment

These are composed of a wide range of particles derived from vehicle combustion and building material, as well as natural sources. These particles are highly reactive in the environment and contain high levels of metal pollution. Spatial analysis shows that pollution levels in Manchester are highly variable and street sediments may act as good indicators of the distribution of urban pollution. This sediment is washed into storm drains and rivers and an understanding of its contaminant loadings, spatial distribution and contribution to river

sediments helps develop management practices to minimise impacts upon water quality.

2) Urban Rivers

Urban rivers are commonly culverted, and due to concrete surfaces dominating urban areas, river level response to rainfall events is rapid. During these high flow events, sediments is picked up and transported through the river system. These sediments carry the major pollution load (much higher than the water itself) and so understanding the movement of sediment helps to understand the transport of aquatic pollution in urban environments. Our finding is that as a result of this sediment transport during only high river levels, pollution events in urban rivers are acute, but short-lived.

3) Canals and Docks

Once sediment is deposited in canals and other standing water bodies they lead to reduced capacity of shipping draft, and act as a store of historical contamination. The former requires sediment dredging, and so the sediments need characterising from the viewpoint of risk assessment for dredged material disposal. In addition, the determination of the sources of this sediment allow for at-source management approaches to be developed. Chemical diagenesis taking place in these sediments also leads to the release and remobilisation of contaminants stored in these sediments, with marked impacts upon overlying water quality.

Application

This research has highlighted that water quality in cities is controlled to a large degree by the presence of sediment particulates in the water, or on street surfaces. These sediments have been largely ignored when considering water quality. However, under the Water Framework Directive we will need to consider the role that these sediments play in urban catchments. This is one of the first integrated studies to consider this.