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Urban river restoration: implications on channel sedimentation patterns and associated ecosystem and human health

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Urban river restoration, which alters the physical and hydraulic conditions of rivers, creates rivers favourable to increased sedimentation through greater sediment availability and heterogeneous flow patterns. Sediments, particularly finer-grained, store contaminants including metals which can have detrimental impacts upon aquatic ecosystems and potentially human health. This research therefore looks at the effect of urban river restoration practices upon sedimentation patterns, the associated changes in sediment metal storage and the potential impact upon river function and use in terms of the aquatic ecosystem and human health.

Research was undertaken at four sites on urban rivers in London. The spatial extent of different bed sediment types (unvegetated gravel, sand, finer and sediment around in-channel vegetation) in adjacent restored and unrestored stretches was mapped in July 2010. Additionally, sediments were sampled through the year and analysed for a range of metals and sediment characteristics.

Two sites (Chinbrook Meadows and Sutcliffe Park) showed a clear difference in bed sediment type channel cover between the restored and unrestored stretches. The majority of the concrete-lined unrestored stretch at Chinbrook Meadows had no sediment deposition, whereas the restored stretch had over half of the channel occupied by finer sediment either on the open channel bed or accumulated around in-channel vegetation. At Sutcliffe Park, the dominant bed sediment type in the restored stretch was finer sediment on the open bed and accumulated around in-channel vegetation, whereas in the unrestored stretch the dominant bed sediment type was gravel.

At both sites there were significant differences in metal concentrations and sediment characteristics between bed sediment types. Metal concentrations, organic matter and % <63μm were generally higher in the finer sediment whether on the open bed or around in-channel vegetation. Total loadings of all metals were greater in the restored as opposed to the unrestored stretch at both sites, and this difference persisted after standardisation to loading/m2 of channel to account for differing channel dimensions.

Metal concentrations at the two sites were analysed using sediment quality guidelines to assess the potential impact upon both the aquatic ecosystem (Environment Agency draft freshwater quality guidelines, 2008) and human health (Dutch Intervention Values for human, plant and/or animal life, 2009). Greater exceedances occurred for the ecological rather than the human health guidelines. Cu, Ni, Pb and Zn were of greatest concern in terms of ecological sediment quality at Sutcliffe Park and Pb and Zn at Chinbrook Meadows. At Sutcliffe Park a greater proportion of samples exceeded the Predicted Effects Level (PEL) in the restored as opposed to the unrestored stretch; conversely at Chinbrook Meadows a greater proportion of samples in the unrestored stretch as opposed to the restored stretch exceeded the PEL. In terms of human health, exceedances only occurred for Cu and Zn at Sutcliffe Park, with the greater proportion being in the restored stretch.

The results from this research will have implications for the design, management and maintenance of restored urban rivers in terms of fine sediment accumulation assessment, its quality and the associated potential impact upon ecosystem and human health.