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Pollution from urban development and setback outfalls as a catchment management measure for river water quality improvement

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Urban development causes an increase in fine sediment and heavy metal stormwater pollution. Pollution load estimation theorises that stormwater pollutant load and type are strongly, directly influenced by contributing catchment land use. The research presented investigates the validity of these assumptions using an extensive novel field data set of 53 catchments. This research has investigated the relationships between land use and pollutant concentrations (Cu, Zn, Pb, Ni, Ca, Ba, Sn, Mn) in urban stormwater outfall sediments. Cartographic and aerial photography data have been utilised to delineate the surface and subsurface contributing catchment land use. A zoned sub-catchment approach to catchment characterisation of stormwater pollutant concentration has been defined and tested. This method effectively describes the specific land use influence on pollutant concentrations at the stormwater outfall, showing strong dependency with road length, brake points, impervious area and open space. Road networks and open space are found to influence land use, and thus stormwater pollution, closer to stormwater outfall/receiving waterbody suggesting storage, treatment, assimilation, loss or dilution of the land use influence further away from stormwater outfall. An empirical description has been proposed with which to predict outfall pollutant contributions to the receiving urban waterbody based on catchment land use information.

With the definition and quantification of contributing catchment specific fine sediment and urban heavy metal pollutants, the influence of urban stormwater outfall management on the receiving watercourse has been considered. The locations of stormwater outfalls, and their proximity to the receiving waterway, are known as key water quality and river health influences. Water quality benefits from the implementation of stormwater outfalls set back from the receiving waterway banks have been investigated using the catchment case study. Setback outfalls provide a short, vegetated, overland flow path linking the piped stormwater outflow to the receiving waterway. With the potential to function in a similar manner to swales or filter strips, field investigation has been undertaken to assess the water quality improvement provided by setback outfalls. Assessment of 13 established setback outfalls illustrates that there is a decrease in deposited Ni, Ca, Mg, Na, Zn, Cu, K and P pollutant concentration as a direct result of this overland flow path implementation. Thus, setback outfalls function to provide passive water quality treatment and can be considered a sustainable urban drainage measure. At a reach scale, the implementation of setback outfalls may reduce the in-stream sediment adsorbed pollutant concentrations. Analysis of the field results suggests setback outfalls can function to beneficially alter the pollutant rate of change, acting to help ‘clean’ a river reach.