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Evaluating the effect of river restoration techniques on reducing the impacts of outfall on water quality

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Outfalls represent points of discharge to a river and often contain pollutants from urban runoff, such as heavy metals. Additionally, erosion around the outfall site results in increased sediment generation and the release of associated pollutants. Water quality impacts from heavy metals pose risks to the river ecosystem (e.g. toxicity to aquatic habitats). Restoration techniques including establishment of swales, and the re-vegetation and reinforcement of channel banks aim to decrease outfall flow velocities resulting in deposition of pollutants and removal through plant uptake.
Within this study the benefits of river restoration techniques for the removal of contaminants associated with outfalls have been quantified within Johnson Creek, Portland, USA as part of the EPSRC funded Blue-Green Cities project. The project aims to develop new strategies for protecting hydrological and ecological values of urban landscapes. A range of outfalls have been selected which span restored and un-restored channel reaches, a variety of upstream land-uses, and both direct and set-back outfalls. River Habitat Surveys were conducted at each of the sites to assess the level of channel modification within the reach. Sediment samples were taken at the outfall location, upstream, and downstream of outfalls for analysis of metals including Nickel, Lead, Zinc, Copper, Iron and Magnesium. These were used to assess the impact of the level of modification at individual sites, and to compare the influence of direct and set-back outfalls.
Concentrations of all metals in the sediments found at outfalls generally increased with the level of modification at the site. Sediment in restored sites had lower metal concentrations both at the outfall and downstream compared to unrestored sites, indicating the benefit of these techniques to facilitate the effective removal of pollutants by trapping of sediment and uptake of contaminants by vegetation. However, the impact of restoration measures varied between metal types. Restored sites also showed lower variability in metal concentrations than un-restored sites, which is linked to greater bank stability and hence lower bank erosion rates within restored sites as eroding banks were noted to be a source of metal contaminants. The success of pollutant removal by set-back outfalls was varied due to additional factors including the distance between the set-back outfall and the main channel, vegetation type, density and age. The study highlights the ability of restoration techniques to reduce metal contaminant concentrations at outfalls, and provides an indication of the potential benefits from wider application of similar techniques.