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Geochemistry and speciation of phosphorus in an urban river basin: implications for sustainable water management

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Phosphorus (P) is a key nutrient within river basins and often cited as the cause of eutrophication. Eutrophication of lowland rivers is a worldwide concern and accordingly, the EU Water Framework Directive appeals for widespread control of P inputs to rivers. The fractionation of P in water and channel bed sediments within the urbanised River Irwell and associated tributaries in Northwest England is investigated in order to understand environmental mobility and sources, and eutrophication status of the study catchment. The focal objective is to determine the impact of known point sources on the receiving water and ascertain downstream changes in water and sediment quality below the Sewage Treatment Works (STWs) input.

Results show consistent spatial patterns throughout the study period with regards to water. Soluble reactive phosphorus (SRP) concentrations downstream from STWs increased with values ranging from 0.00-1.55 μg g $^{-1}$(mean 0.27 μg g $^{-1}$). Highest concentrations were observed in the summer months (low flow) suggesting that STW sources of P may have an important influence on bioavailable P levels through the growing season. SRP concentrations exceeded Environment Agency (EA) management targets of 0.1 μg g $^{-1}$and 0.2 μg g $^{-1}$(interim target for heavily enriched rivers) on 70% and 49% of occasions, respectively. Sediment total P (TP) concentrations ranged from 811-3429 μg g $^{-1}$ (mean 1771 μg g $^{-1}$), 841-2704 μg g $^{-1}$ (mean 1454 μg g $^{-1}$) for inorganic P (IP), 325-1420 μg g $^{-1}$ (mean 876 μg g $^{-1}$) for non apatite

inorganic P (NAIP), 275-1098 μg g $^{-1}$ (mean 490 μg g $^{-1}$) for apatite P (AP) and 130-429 μg g $^{-1}$ (mean 265 μg g $^{-1}$) for organic P (OP). Mean percentage of P followed the sequence of IP 86% $>$ NAIP 51% $>$ AP 29% $>$ OP 16%. Thus, IP was the dominate fraction reflecting previous studies whereby the majority of the P load in urban basins was in inorganic form due to STWs discharges. TP and IP concentrations exceeded Sediment Quality guidelines set at 2000 μg g $^{-1}$ (severe effect level) at 29% and 8% of the sites respectively, which suggests that the P present within the sediment is probably not having a deleterious effect on aquatic species.

Results suggest that inputs from STWs are a major issue with elevated water SRP concentrations observed throughout the catchment and levels exceeding EA management targets. Conversely, sediment P concentrations are of a lesser concern as overall levels do not exceed Sediment Quality guidelines.