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The potential impact of storm water runoff on the quality of receiving water bodies

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In the framework of an integrated approach to water management, the deterioration of receiving water quality due to pollutants associated with storm water runoff from the paved surfaces of the urban environment has become a primary issue. Experimental data reported in the literature point out the relevance of particulate matter and heavy metals associated with storm runoff whose concentration values strongly vary of several orders of magnitude between different rainfall-runoff events.

In storm runoff, as well as in any aqueous system, metals temporarily partition between solution and solids (suspended or settable) and may cause acute or chronic toxicity effects for the aquatic ecosystem, depending on their respective phases. Furthermore, as for the dissolved phase, metals reveal different dominant aqueous species including the ionic form, and the organic or inorganic complexes.

This paper aims at examining the pollutant delivery behavior of urban stormwater, mainly focusing on the partitioning of metals between the dissolved and the particulate-bound fractions and the speciation of their dissolved fraction across the rainfall-runoff event. The investigation was carried on based on an water quality and quantity database collected at both the University of Genoa and the Florida University where monitoring campaigns were carried out in the last years to characterize storm water runoff associated with different land-uses paved surfaces.

For these purposes, the variation of the dissolved metal fraction $fd$and the equilibrium partitioning coefficient Kdwere evaluated across each monitored rainfall event

in order to analyse the mobility of metals, in particular with respect to Zinc, Lead and Copper. In order to assess the potential toxicity of storm runoff on receiving water bodies, the species distribution of each metal was simulated by using the thermodynamic equilibrium model MINTEQ.

Results indicate the key role of TSS and pH values in affecting the partitioning of metals, especially in the case of Zinc. Furthermore, regarding the speciation of dissolved metals, the relevance of ionic species, which represent the most bioavailable species to the aquatic ecosystem, emerges.

Finally, metals partitioning and speciation providing relevant information to the mobility, bioavailability and toxicity of metal elements in the water ecosystem, have a direct implication in designing suitable treatment systems and they allow to assess the impact of storm water discharges on the receiving water bodies in terms of acute and chronic toxic effects.