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Large Wastewater Volumes in Small Rivers: the Case of Madrid, Spain

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In the European Union the pollutant concentration limits set by the Urban Waste Water Treatment Directive (UWWTD, 91/271/EC) have been the common standard for effluents of wastewater treatment plants (WWTP). Annex I of this Directive states that "more stringent requirements (...) shall be applied where required to ensure that the receiving waters satisfy any other relevant Directives", thus creating a connection to compliance with other Directives.

Since 2000, the Water Framework Directive (WFD, 2000/60/EC) requires Member States to work toward the achievement of good status of all their water bodies. In this context, maximum pollutant concentrations are defined for different types of surface water bodies, which often act as receiving waters for the WWTP effluents. When WWTP effluent flows are a small percentage of the in-stream flow of the recipient surface water body, compliance with the UWWTD standards may be sufficient to achieve the WFD objectives. This may not be true when effluents of a large urban area are discharged in streams with low natural flows. This is the case of the city of Madrid, where the aggregate flow of its WWTPs can amount to 90% of the flow of Manzanares river downstream of the city.

The preamble (31) of the WFD states that "In cases where (...) it may be unfeasible or unreasonably expensive to achieve good status, less stringent environmental objectives may be set on the basis of appropriate, evident and transparent criteria (...)." Using this exemption, less stringent environmental objectives are defined in the Spanish legislation (RD1/2016, Appendix 8) for some water bodies in the vicinity of Madrid.

This paper looks into whether and how the discharge of large volumes of WWTP effluents can be compatible with good status of the Manzanares river and the complex interlinkages of pressures and impacts across different water bodies of the same river basin district (Tagus).

The methodology consists in the application of well-established water-quality kinetics to the river stream in order to infer the evolution of pollutants. The evolution of physical-chemical pollutants in the river is modelled using available tools (Qual2k, Aquatool/Gescal). Data used to model the stream include river flow historical data, river and WWTP effluent quality collected by the Spanish Ministry in charge of environmental issues and Tagus River Basin Authority.

In view of the results of the modelling we conclude that in some scenarios the simple application of the effluent concentrations of Urban Wastewater Treatment Directive results in a water quality in the receiving river that is far from the good status required by the Water Framework Directive. In those cases, ad-hoc models are needed to define the specific limits for the WWTP.