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Modelling the Precipitation Impacts on Wastewater Influent Volumes in Galway, Ireland

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Precipitation plays a critical role in determining the influent volumes of wastewater for many urban wastewater treatment plants (WWTPs). Urban stormwater runoff, resulting from impervious surfaces and infiltration, can significantly increase WWTP influent volumes above normal dry weather flows. Other factors such as demographics and changing landuse landcover can also impact influent volumes. In the context of climate change, projected changes in precipitation events could, in particular, cause significant challenges to existing collection networks. However, there has been limited research to date on the direct impacts of various precipitation variables on combined collection systems. This research aims to assess the impacts of precipitation on influent wastewater volumes using an urban area case-study in Ireland. In Ireland, most collection networks in urban areas are combined foul and storm water systems. Thus, these networks, and their connected wastewater treatment plants, can be impacted significantly by storm water (both in terms of volume and wastewater characteristics).

Daily data of influent volume and precipitation for a relatively large municipal wastewater treatment plant in Ireland for the period of 2011-2018 was used for this study. The precipitation intensity was categorised based on the percentile values to obtain clarity on its effects on influent volume. This study investigated the relationship between influent wastewater volume and precipitation, number of wet days (wet day characterised by rainfall greater than or equal to 1 mm) and the number of zero rainfall days. It was observed that on a monthly basis, the relationship between average daily values of influent volume and precipitation showed significant linear trends with R^2 values as high as 0.86 for all the years. Average daily influent volume estimated per month showed strong relationships and significant trends for all years when analysed with the number of wet days and separately with the number of zero rainfall days in that month. Impacts of rainfall events were generally seen on the same day with residuals over the following days, meaning any time lag could not be detected. The dry weather flow was estimated by averaging the flow of consecutive zero rainfall days excluding the flow values of the first two dry days of such an event to eliminate the effects of any preceding rainy days. This analysis gave

insight to the impacts of other factors such as demographic changes due to tourism or seasons on influent wastewater volumes. Factors which were also considered in this study included the impacts of tides on the sewer network. This work is informing the ongoing analysis of a further 16 wastewater treatment plants which will enable improved planning and adaptation of wastewater infrastructure to climate change.