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Proposal of a procedure to asses Pollutographs. Application to Murcia's Combined Sewer Overflows (CSOs)

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Introduction

- During a rainfall event, flushing on urban catchment areas and sewer systems involves an increase in pollution load in waste water. Reduction of pollution emissions from combined sewers overflows (CSOs) is a prime issue nowadays.
- Directives 91/271/EEC and 93/481/EEC set norms regarding the management of CSOs. During the year 2019 all the utilities should be able to quantify the pollution spilled during storm events.
- In this study a method to estimate the transported pollution during events is proposed as well as to serve as a tool for developing plans to lessen the corresponding pollution.

A.Periodical measurements of all relevant pollutants

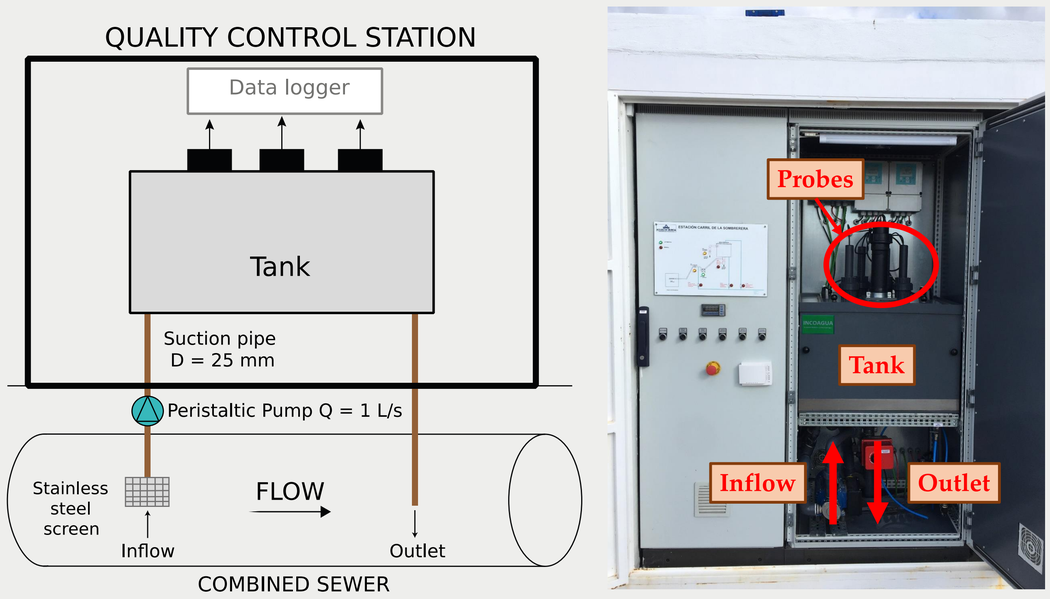
- Periodical measurements of all relevant pollutants, e.g. total suspended solids and chemical oxygen demand, in wet and dry weather. Such pollutant "concentrations" are correlated with the turbidity, updating the relation among them.
- Total suspended solids (TSS) concentration is one of the most important parameters for evaluating pollution in sewer systems. In effect, pollutants such as heavy metals, phosphorous, chemical oxygen demand (COD) and biological oxygen demand (BOD) are relationated with these particles so that a high TSS load indicates the potential impact on the receiving waters.
- Turbidity is the pollution variable that are used to estimate TSS concentration. The empirical equation used in this study is:

$$TSS(\text{mg/l}) = 2.4569 \cdot \text{Turbidity(NTU)} - 18.197$$

B.Continuous measures of the turbidity

- Continuous water-quality monitoring sensors are being increasingly implemented in sewers. In order to replace traditional sampling, turbidimeters can be used to estimate pollutants concentrations by linear regression of on-site turbidity with site-specific measurements.
- Turbidity is continuously register in the sewer areas near overflow spillways. In this way, turbidity measurements provide us a estimation of the pollutant concentration on real time.
- Turbidimeters are located at Quality Control Stations (Figure 1).

Figure 1: Scheme and image of Quality Control Station devices.



- Two urban catchments have been studied is this city. Their characteristics are shown in Table 1.

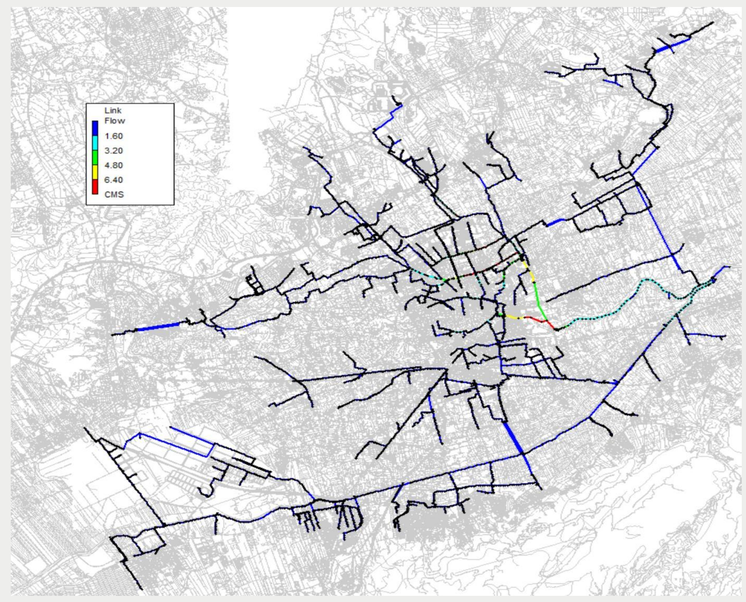
Table 1: Catchments description.

Urban Catchment	**San Félix**	**S1**
Area (km^2)	14.89	47.53
Population density (inh/km^2)	14250	2685
Ratio of imperviousness(m^2/m^2)	0.47	0.21
Mean slope(m/m)	0.0043	0.0013
Catchment flow length(km)	10.75	17.00

C.Assesment of each catchment hydrograph

- Data obtained in each storm:
  - Rain: rain gauges distributed throughout the catchments.
  - Flow: calibrated SWMM (Storm Water Management Model) hydraulic model of the city of Murcia that provides the catchments responses to any rainfall event (Figure 2).

Figure 2: Example of one time step of the storm simulations carried out using SWMM.



D.Estimation of each catchment pollutographs

- The data registered from monitoring rainfall events corresponds to the period from June 2014 to February 2017. During this period, 11 storm events were measured in the S1 QCS and 10 in the San Felix QCS.

Figure 3: Rainfall events at S1 Catchment.

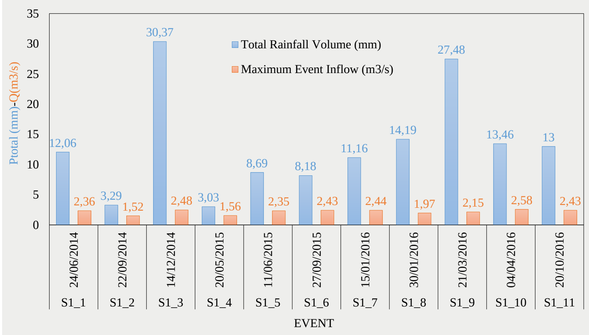
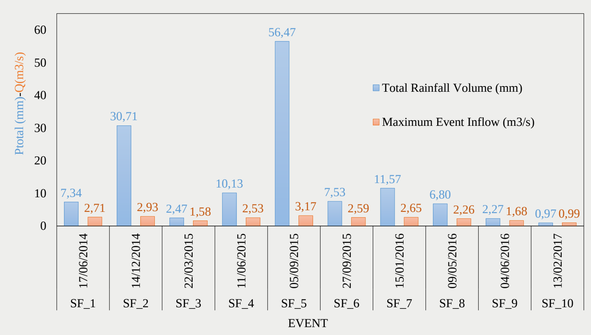


Figure 4: Rainfall events at San Felix Catchment.



- Combining the pollutant concentration, estimated in the previous steps, with the hydrographs, we can asses how the mass of pollutants are transported.

Figure 5: Rainfall, hydrograph and pollutograph of event S1 7.

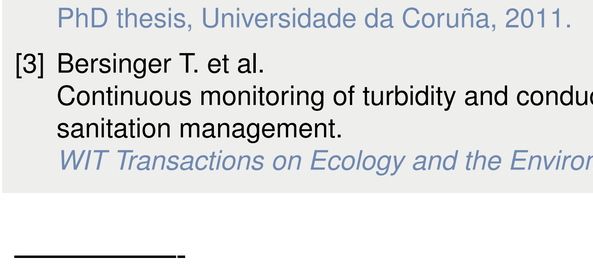
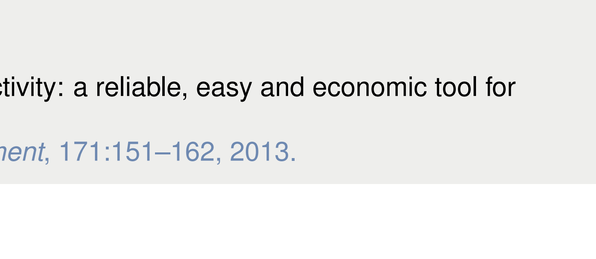


Figure 6: Rainfall, hydrograph and pollutograph of event SF 7



- This information allows us not only to comply with EU Directives, but also to design Murcia's strategy to minimize environmental impacts.

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