Thesis: Waste management through storm weirs: capture system optimization and quantification

Funding: SADE, French National Company
Host Laboratories: ESTP Paris/IRC (France) and University of Liège /HECE (Belgium)
Supervisor: Jena Jeong (70%), Co-supervisor: Sébastien Erpicum (30%)

Context:
In heavy rains, storm spillway dumps excess water out of the urban sanitation system and carry pollutants. Survey and capture devices have been put in place for environmental standards and limit the release of these pollutants into the natural environment. These devices can be easily implanted for new weirs, but it is more difficult to adapt to the existing weirs. It is always difficult to estimate overflow flows with the different types of existing weirs (front, side or oblique weirs).

Goals:
The present study aims to quantify the solid pollutants and fluid flows passing over storm weirs and to limit the solid pollutants flow to comply with French and European standards. In particular, we will focus on side weirs on circular unit networks, which are most frequently encountered by SADE, French National Company.

The thesis will be conducted mainly through the use of numerical three-dimensional simulation tools.
Based on the analysis of existing data from the SADE and the literature, the first part of the thesis will lead to the definition of the geometry of the storm weirs, to the identification of relevant test cases and the characterization of solid pollutants. The use of a physical model developed as part of the thesis, and the use of in-situ data will help to calibrate the parameters of numerical simulations (turbulence, etc.). From there, we will try to propose a law linking the height of water upstream of the spillway to the flow of overflow in the case of "typical" side spillways managed by the SADE. When the physical model is fixed, we will take into account the practical aspects of in-situ measurements.

We will then focus our study on the analysis and modification of fluid flows carrying pollutants, mostly floating, in order to direct waste and limit its dumping by storm weirs. A filter system could be considered to perform this function. The numerical study is performed via a 1D hydrodynamic model incorporating the transport of floating pollutants. Once the 1D model is validated, the resolution of the 2D and especially 3D numerical model will be achieved according to the different geometries and features of the side storm weirs. These geometries will be adapted to allow the control and management of pollutants
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The thesis will be co-supervised between two laboratories, ESTP Paris (70%) and University of Liège (30%). Ph.D. program mostly contains numerical modeling (70%) rather than experiments (30%). The Ph.D. student will use the numerical tools in ESTP Paris (cloud, etc.) to model 3-dimensional fluid flows. The experiments will be carried out at the HECE laboratory at the University of Liège.

Schedule :
- 4-6 months of SADE data collection, bibliographic study and numerical tool (ESTP Paris);
- 10 months of work on the physical model to calibrate the numerical parameters (University of Liège);
- 20-22 months of numerical study (ESTP Paris)

Salary range: ~ €2000 per month

Types of contracts: Doctoral contract (The Ph.D. candidate will have 2 Ph.D. diplomas (French and Belgium).

Skills: Fluid / Solid Mechanics, Physics, Numerical Methods, Applied Mathematics

Start date: as soon as possible

Contact:

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