

RAIN, DUST, GULLY POTS AND ???, A CHAIN OF CONCERNS

Drainage systems help protect our cities and a good urban drainage system not only relies on its design, but also its long-term maintenance. Gully pots are one of the most common urban drainage infrastructures and their lack of maintenance is estimated to be a threat on receiving waters' eco-system by the mobilisation of polluted "dusts". To inform the role of gully pots in the sustainable urban drainage system, we therefore need to gain an up-to-date knowledge of their on-site performance and efficient maintenance.

Don't worry about the question marks in the title, just replace them with the name of any aquatic creature you can think of. Or you can just put in 'fish', as they are really something that should concern you, or rather, your dining table. All aquatic creatures are in danger, due to the rain, dust, and gully pots. What a strange combination!

Rain water rinses our cities

It all starts with the rain. From the moment a single raindrop falls to the ground from tens of thousands of metres up in the sky, it will have a large impact on our planet. It paves its way along the urban surface, from retro copper roofs to concrete drainage gutters, from dusty busy roads to greasy parking lots. Billions of such raindrops wash our urban surface, each acting like a small but powerful laundry machine. But where do we discharge this water after it has swept through the corners of our city? Unlike our household laundry water, which will end up in wastewater treatment plants, rainwater is most likely to be discharged directly into natural water bodies through the (separate) urban drainage pipe systems, together with a mixture of urban pollutants e.g. fuel leakages, exhaust gases, metals from roofs and cars, and organic substances from building materials and animal wastes.

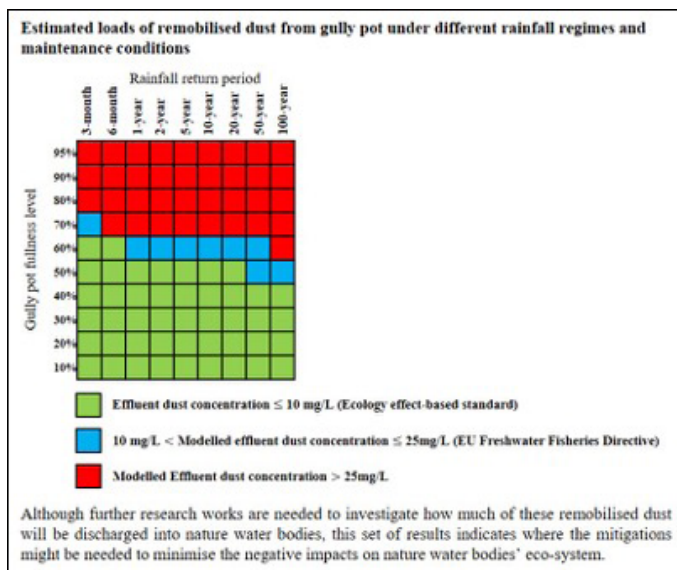
Gully pots and dust

As early as in 1900s, gully pots were introduced to the entrance of urban drainage pipe systems to

capture particulate pollutants carried by rain water. Since then, overwhelming preference is given to the use of such infrastructures with, for example, more than 17 million gully pots installed in England and Wales alone. Ironically, in comparison with the interests that they received when first installed, there is not much concern for the shadow that they cast: whilst tons of dust and dirt get trapped by gully pots annually but are rarely emptied often enough. Nowadays, gully pot management is undoubtedly listed as one of the top headaches for most municipalities' drainage departments. In fact, there are now so many gully pots that it is difficult to keep track of them as a number of them were simply installed without documentation. This, combined with increased labour costs, makes it almost impossible to empty them in a frequent manner. For example, only 1500 out of 30,000 (5%) roadside gully pots in Oslo, Norway are emptied annually. The challenges arising from these full gully pots, however, are more than what you can imagine, which will inevitably make you start wondering the purpose of having them as a part of our urban drainage system.

What is wrong with gully pots?

In addition to the well-recognised challenges, such as full gully pots contribute to urban flooding, our study further identifies another challenge which desperately needs our attention. In this initial work, full gully pots are also recognised as a great threat to receiving water quality or even long-term ecological status. During rainfall events, an increasing amount of these "trapped" polluted dusts will be flushed by rainwater into urban drainage piped systems and from there directly drain into our natural water bodies. The red squares in the figure below, for example, shows a high potential of such tendency in our simulations. With more extreme weathers anticipated under the impact of climate change, even more dust will be discharged into natural water bodies. These polluted dusts,



with their associated toxicity, can harm aquatic creatures' organs, leading to, for example, a lower reproduction rates or even abnormal growth patterns. By blocking the light penetration and oxygen level in water environment, they will also additionally disturb spawning activities.

Our work provides a new understanding of the conditions (e.g. weather regimes, and gully pot maintenance conditions) under which gully pots act as a potential source of contamination. The results generated are of great relevance to water regulators in gully pot management in order to fulfil the EU Water Framework Directive (EU WFD) objective and contribute to achieving “Goal 6: Clean Water and Sanitation”, “Goal 11: Sustainable Cities and Communities”, and “Goal 14: Life Below Water” of Sustainable Development Goals (SDGs) adopted by all United Nations Member States. Idea such as integrating gully pot emptying planning within a weather forecast system coupled by smart sensors offers an exciting new approach to reduce levels of flooding and negative impacts on receiving waters, especially at this age of digitalisation.

Visionary, sustainable urban drainage systems

When the role of urban drainage systems encompasses more than eliminating flooding areas only, when the priorities for receiving waters have been considerably upgraded, our approaches to the role

and management of gully pots, cannot stay in the 20th Century. As Einstein noted “we cannot solve today’s challenges by using the same mind-set that created them”. We need to gain an up-to-date understanding of how gully pots perform and what their impacts are (e.g. where is the balance between their roles as a short-term sink and a long-term source?) The challenges are many: we need to form a regulatory framework for their management; we need to be creative and fearless to retrofit them. Their failures here is not a blaming game. Rather, we should see this re-vitalisation as an opportunity to contribute to a visionary and sustainable urban drainage system in future cities. “Rain, dusts, gully pot, and ???” is just the beginning!

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 His research work directly
 contributes to meeting the
 objectives of the innovative
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