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The Urban Water Cycle - SuDS as a measure for preservation and prevention; example from Bergen, Norway

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Guri Venvik, Ane Bang-Kittilsen, John Dehls & Floris C. Boogaard
The infiltration systems at Bryggen in Bergen, Western Norway, were built to protect and preserve the UNESCO World Heritage Site Bryggen Wharf and its cultural layers below. This location is an example where Sustainable Urban Drainage Systems (SuDS) have been implemented to collect, infiltrate and store surface water. Rainwatergardens, swales and permeable pavement have been implemented to restore the groundwater level and increase soil moisture in order to preserve the cultural, organic layers (Rytter & Schonhowd, 2015). Bergen city centre is prone to both subsidence and flooding. With a predicted increase in precipitation due to climate change a higher proportion of rainfall becomes surface runoff, which results in increased peak flood discharges. In addition, sea level rise and increasing storm surges are predicted which causes coastal flooding. The hydraulic infiltration capacity of the rain garden has been tested with a full-scale infiltration test with the response on the groundwater levels monitored in wells. Result show that infiltration capacity meets the international guidelines requirement of 100 -300 mm/h, with 1600 mm/h for the large and 510 mm/h for the smaller under saturated conditions. An immediate response of the full-scale infiltration test is shown in the wells located closest to the infiltration point, with a delayed response in the wells further away. Results show that he infiltration capacity of the rain garden exceeds the amount of available surface water and the groundwater level would, in dry periods, benefit from more water, to preserve cultural layers. Therefore, the connected runoff area can be extended to encompass the total catchment area. This can be used for improving existing and future urban drainage and water quality models used to assess the performance of SuDS, where Bryggen is a Best Management Practice (Venvik & Boogaard, submitted).
In a parallel study two different analysis methods are tested using ArcGIS tools to develop risk assessment maps for areas most prone to the combination of both flooding and subsidence. Applying user-centred principles, this work focuses on methods for maps as a support tool to identify areas where mitigation of subsidence and adaptation for surface water management will be most efficient, since there is a link between areas that suffer from surpluses or shortages of water and subsidence in urban areas, for further implementations of measures. The results indicated that one of the methods give more significant results compared to the other method. Such method will be a helpful tool for decision-makers when prioritizing areas to implement measures such as Sustainable urban Drainage Systems (Venvik et al., submitted).
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Primary author(s) : Ms VENVIK, Guri (Geological Survey of Norway); Ms BANG-KITTILSEN, Ane (Geological Survey of Norway & Faculty of Engineering, Department of Civil and Environmental Engineering, Norwegian University of Science and Technology); Mr DEHLS, John (Geological Survey of Norway); Mr BOOGAARD, Floris C. (Hanze University of Applied Sciences Groningen)

Presenter(s) : Ms VENVIK, Guri (Geological Survey of Norway)

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