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New 'full scale' monitoring method for (subsurface) stormwater infiltration to protect groundwater, long term (hydraulic) efficiency of SuDS in The Netherlands

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Management of sustainable urban drainage systems (SuDS) for retention and infiltration is an example of an approach that complies with climate adaptation. Next to the implementation of surface infiltration facilities (swales), in the densely populated Dutch cities most infiltration facilities are sited under roads and pavements located in or just above the groundwater level. Compared to infiltration at surface level, the environmental risks of subsurface infiltration are presumed to be higher because of anaerobic conditions in the surrounding soil. Although subsurface infiltration systems are widespread in The Netherlands (www.climatescan.nl), little knowledge is available about their long-term hydraulic and environmental performance, maintenance requirements and expected life span.

The hydraulic performance of several types of SuDS has been monitored in over 100 Dutch locations using a new full-scale method where SuDS such as swales, subsurface infiltration facilities, permeable pavement and watersquares are fully submerged to determine the (loss of) infiltration capacity. Most of the swales meet the hydraulic guideline of emptying their storage volume within 48 hours even in the low-lying parts of the Netherlands (below sea level with high groundwater tables and low permeable soil). Loss in infiltration capacity due to clogging is found at some locations with permeable pavement that are in need of cost effective maintenance.

In some cases, additional environmental monitoring related to groundwater quality is executed mapping accumulation of pollutants around infiltration facilities. In seven specific locations the hydraulic and environmental performance have been monitored over a period of ten to thirteen years with different subsurface constructions and different geo-hydrological conditions. Specific attention was paid to environmental risks due to micro pollutants, heavy metals and polycyclic aromatic hydrocarbons (PAHs) in the infiltrated storm water. Samples of the soil and groundwater were taken and analyzed at sequential distances around the infiltration devices. Also new cost effective quickscan method using XRF is applied on swales to study the long term efficiency. After many years of data collection, conclusions have been drawn leading to recommendations for design, construction and maintenance.

Overall, it can be concluded that at all sites investigated (with a single exception) there is no ecological or health risk to the local population. Despite the high groundwater levels most heavy metals seem to have been bound within the first 0.5 meter below the infiltration system. At all research locations the vast majority of concentrations are below reference values. There is therefore an acceptable risk to the environment and human health.
This means that subsurface infiltration with relatively high groundwater levels is possible, and the useful life span of these constructions could be compared to those of normal drainage systems.

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