Constructed Wetlands as a Viable Remedial Alternative Contributing to Improved Site Climate Resilience

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Background/Objectives. At an active industrial plant in Belgium, a multi-faceted remedial strategy has been developed to address a complex mixture of impacts present in both soil and groundwater. Contaminants of concern (COCs) included chlorinated solvents, chlorobenzenes, chlorotoluenes, nickel and per- and polyfluoroalkyl substances (PFAS). Following assessment of the site in the context of the local regulatory requirements, remediation is required to mitigate groundwater off-site migration. The initial remedial strategy consisted of (i) installing a hydraulic containment barrier (pump & treat system) at the downgradient site border to limit off-site contaminant migration, and (ii) a phased approach to remediate the major source zones in line with the best available technique not entailing excessive costs (BATNEEC) principles as defined in the European Union directives.

As a direct result of increased heavy rain events and longer periods of drought linked to ongoing climate change, Belgian regulators developed a Water Code incentivizing stakeholders to opt for a comprehensive and integrated water cycle management system. Within this framework, the site has been requested to no longer discharge rainwater to the municipal sewer system. Given that rainwater infiltration is currently the preferred approach, the regulatory incentive was used to re-evaluate components of the remedial strategy to improve the climate resilience of the site. To develop an integrated water resources management solution, the site remedial strategy was re-assessed taking into account nature-based alternatives that treat the contaminated groundwater extracted through the hydraulic containment barrier, and also facilitate the infiltration of rainwater as requested by the local authorities.

Approach/Activities. An initial feasibility assessment favored the implementation of a constructed wetland (CW) to replace the existing treatment installation for the hydrogeological barrier. This low energy, sustainable and nature-based remedial technology would treat the polluted extracted groundwater while minimizing both the energy usage and the amount of waste produced. In addition, the wetland system would also infiltrate part of the rainwater collected at the site into the soil to locally recharge the aquifer. Furthermore, in case of heavy rain, the CW could act as a retention basin, protecting residual areas downstream. Finally, the wetland system would increase the overall biodiversity in the area.

Results/Lessons Learned. In order to evaluate the feasibility and performance of the groundwater remediation by the CW, a field pilot test has been designed and implemented at the site. The pilot test simulated the flow of water similar as expected in a full-scale wetland via a treatment train composed of three sequential compartments, each with different physico-chemical conditions (being aerobic, anaerobic and combined). During the pilot test the degradation rates of the COCs have been assessed in order to estimate the viable treatment efficiencies for a full-scale CW. In addition, specific design information for the implementation of the full-scale CW has been gathered on site. Given the need for hydraulic containment throughout the year, potential seasonal impacts on removal efficiencies are one of the key elements being evaluated during this field study.

At the time of the presentation, further details will be shared with the audience about the design and testing of the CW, including the results obtained to date and the next steps planned.