RÉPUBLIQUE FRANÇAISE
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Cerema
CLIMAT & TERRITOIRES DE DEMAIN

# PhD proposal in environmental sciences/ecological engineering

**"CONTRIBUTION OF PLANT FUNCTIONAL DIVERSITY TO EFFICIENT AND SUSTAINABLE BIOFILTERS"**

3-years fixed term contract

**Deadline to apply: March, 24th 2021**

**Beginning of the contract: autumn 2021**

## 1. PhD project description

Faced with the constant soil sealing processes of urban surfaces, quickly harvesting and treating rainwater in order to avoid pollution risks associated with runoff has become a challenge. In a context of climate change leading to extended drought periods, enhanced water infiltration would promote groundwater recharge. Questions remain about the reduction capacities of groundwater contamination with the use of so-called bioretention/biofiltration systems. Long-term management may also require replacement and specific disposal of (sometimes-clogged) contaminated surface layers of these green infrastructures.

Despite numerous examples in agronomy and environmental management on the role of plants in water transfer (infiltration, evapotranspiration) and pollutant remediation, the majority of studies on bioretention have mainly focused on hydraulic and pollutant retention properties of biofilter media. Research within Cerema – TEAM has revealed contrasted performances of bioretention systems for the retention of micropollutants due to their fractionation between dissolved and particulate phases, their release depending on the dissolved organic carbon content or the formation of preferential flows in media. A consensus is currently emerging on the pivotal role of vegetation regarding the hydraulic functioning and remediation performances of biofilters, emphasizing the need for a more holistic view of soil-plant interactions in these green infrastructures. A recent study reported a weak but positive correlation between root biomass and metal concentration in biofilter effluents, illustrating the significant influence of this plant functional trait in contaminants mobility. To our knowledge, no study on vegetated biofilters has concomitantly investigated the influence of plant functional traits on water and pollutant transfer, as well as the effects on pollutant fractionation and the resulting mobility through bioretention media.

The main objective of this PhD project will be to identify and determine the relative contribution of plant biological characteristics/ functional traits affecting both the water infiltration property of biofilter media and micropollutant mobility (focusing mainly on the colloidal and dissolved forms of heavy metals). First, an in-depth analysis of the literature will aim to establish a list of the main plant functional traits likely to influence water and pollutant transfer (e.g. root traits, bioaccumulation, photosynthetic strategies, microbial symbioses). Then, a multi-scale experimental approach, ranging from mono-specific tests under controlled conditions to multispecies "pilot tanks" mimicking the functioning of vegetated biofilters will make it possible to depict the relationships between plant traits (with some insights into the identification of potential root-associated microbes) and biofiltration performances. Results interpretation (e.g. in the form of structural equation modeling for instance) would help to quantify the relative importance of each measured functional trait, as well as latent variables (which could not have been observed but “captured” thought these trait analyses) in the biofilter performances. Finally, methods to improve the efficiency and sustainability of biofilters could be identified and specified, potentially leading to guidance on vegetation selection/maintenance in those green infrastructures.

## 2. Required skills

Candidates should have good skills in environmental sciences, a taste for applied and interdisciplinary approaches, as well as very good speaking/writing capacities in French / English. Knowledge in plant ecophysiology/phytoremediation and/or biogeochemistry/microbiology, as well as statistical analyses (multivariate analyses / structural equation modelling) would be also appreciated. English proficiency is mandatory.

## 3. Working conditions

- The PhD student will be employed by the Cerema with a Fixed Term Contract from autumn 2021 to autumn 2024 (the exact dates are to be fixed with the student)
- The net salary will be around 1500€ the first two years and 1700€ the third one
- The project will take place mainly (at about 90 % of the student's time) at the Cerema's laboratory of Nancy:

Cerema Est – Laboratoire de Nancy
71 ue de la Grande Haie, 54 510 Tomblaine

- The dispositions will permit to the PhD student to beneficiate of a training of the doctoral school of registration: SIReNa (Sciences et Ingénierie des Ressources Naturelles) of the Lorraine University.

## 4. PhD thesis supervision

- The PhD student will be welcomed in the Cerema's research team TEAM, under the leadership of Ivana Durickovic.
- The project will take place under the supervision of Michael Danger of the “Laboratoire Interdisciplinaire des Environnements Continentaux” (LIEC) of the Lorraine University. http://bddc.liec.univ-lorraine.fr/cv/DANGER%20M.htm
- The project will be co-supervised by Didier Técher, researcher in the Cerema – TEAM. https://www.cerema.fr/fr/innovation-recherche/recherche/equipes/team-transferts-interactions-lies-eau-milieu-construit

## 5. Application procedure

The interested candidate is invited to contact as soon as possible the Cerema supervisor of the project:

Didier Técher,
Cerema Est, Laboratoire de Nancy, 71 rue de la Grande Haie, 54 510 Tomblaine
didier.techer@cerema.fr
Tel +33 (0)6.98.23.53.15

The candidate will transmit the **complete folder** (content below) by electronic **mail before March, 24th 2021**.

Content of the application folder:

• CV of the candidate

• a copy of his/her identity card or of his/her passport

• Master grades (at least of master 1 if grades of the master 2 are not available)

• a copy of his/her last diploma (engineer, research master if already obtained).

• a motivation letter of the candidate explaining its interest for the subject (maximum 1 page double-sided).

• a recommendation letter.