



What are Constructed Wetlands?

Constructed wetlands (CW) are engineered systems that are inspired by and mimicking processes (physical, biological, and chemical) and functions that occur in natural wetlands. Comprised of several components, impermeabilization liners and substrate, and as the key elements the plants and their associated microorganisms. They were thought primarily for wastewater treatment but nowadays are considered nature-based solution (NBS) of excellence in terms of flexibility of their application and services provided (Calheiros et al, 2020).

Framework:

CIRQUA is a project aiming to improve NBS, focusing on CW for wastewater treatment and water recovery in rural areas (Figure 1). CIRQUA will enhance CW efficiency by leveraging technological advancements, including innovative nanostructured filters, photocatalytic modules, advanced sensors and automated operational systems. The upgrade will also incorporate precision irrigation principles and integrate advanced artificial intelligence tools for optimizing performance (Figure 2).

These innovations will aid in improving effluent quality, allowing the treated water and CW biomass to be used for irrigation and fertilization purposes, respectively, thus promoting circular economy at local scale. CIRQUA will also support, by using a zero-waste process, the circular bioeconomy by which biomass is expected to play a relevant role in meeting the global climate targets.



Figure 1: Constructed wetland at Paço de Calheiros, Portugal



Figure 2: Example of a precision irrigation system

Case study:

A case study is being conducted in Portugal through by upgrading of an existent horizontal subsurface flow CW of ca 40 m². This CW was implemented in 2010 at Paço de Calheiros, a tourism house surrounded by a farm, located in Calheiros, North of Portugal in a rural area dominated by agriculture and forests (Calheiros et al, 2015) (Figure 3). The CW was designed to act as secondary biological treatment, being placed after a previously installed septic tank. It functions in a continuous mode with no energy requirements. It is a system planted with a polyculture of a) *Agapanthus africanus* b) *Canna flaccida* c) *Zantedeschia aethiopica* d) *Canna indica* and e) *Watsonia borbonica*. The substrate material used in the CW was expanded clay Leca[®]M with a particle size ranging from 4 to 12.5 mm SaintGobain Weber Portugal, SA.



Figure 3: Paço de Calheiros, Ponte de Lima, Portugal

References:

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