Wastewater Treatment and Greenhouse Gas Emissions: Herbaceous Vs Woody Horizontal Constructed Wetlands

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Introduction

- Predictions estimate that 2.8 billion people will lack safely managed sanitation in 2030 [1].
- Constructed wetlands provide nature-based, low-cost, decentralised solutions to wastewater treatment [2].
- Horizontal subsurface constructed wetlands have been used across Europe since the 1980s and are predominantly planted with Phragmites australis (ie. common read) [3].
- Woody species (especially Salix, ie. willow) could improve the longevity of constructed wetlands [4] and be coppiced for biofuel [5], which could provide added income in rural areas.
- Limited literature compares Phragmites australis and Salix species for the removal of conventional pollutants.

Methodology

- 6 existing flumes adopted from previous experimentation.
- Medium pea gravel underneath fine angular gravel (Figure 1).
- 8 flumes: 4 planted with Salix alba vitellina (golden willow), 3 with Phragmites australis, and 1 unplanted
- Active aeration is applied at the inlet through air stones following Table 1.
  - Continuous
  - Intermittent (aerated for 1 hour 4 times a day)
  - Seasonal (continuous aeration applied during the coldest six months)
  - Not aerated
- There are 15 trees per mesocosm, and there will be 23 rhizomes per mesocosm.
- Synthetic secondary treated municipal effluent will be continually applied to the wetlands and recirculated.
- Methane and nitrous oxide will be measured by static chambers, where trees will be enclosed in chambers and the emissions monitored.

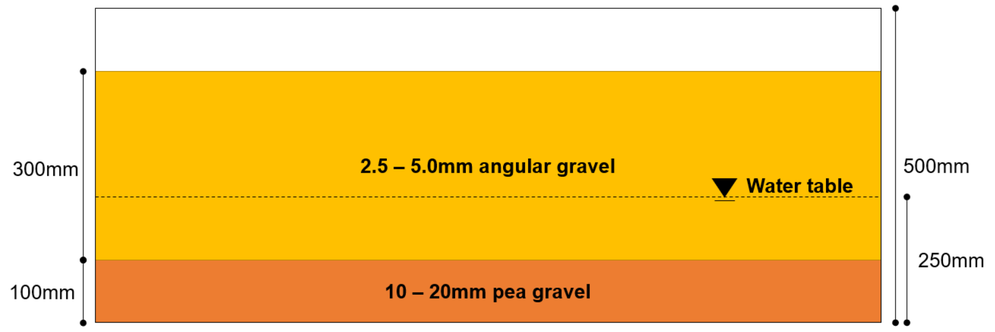


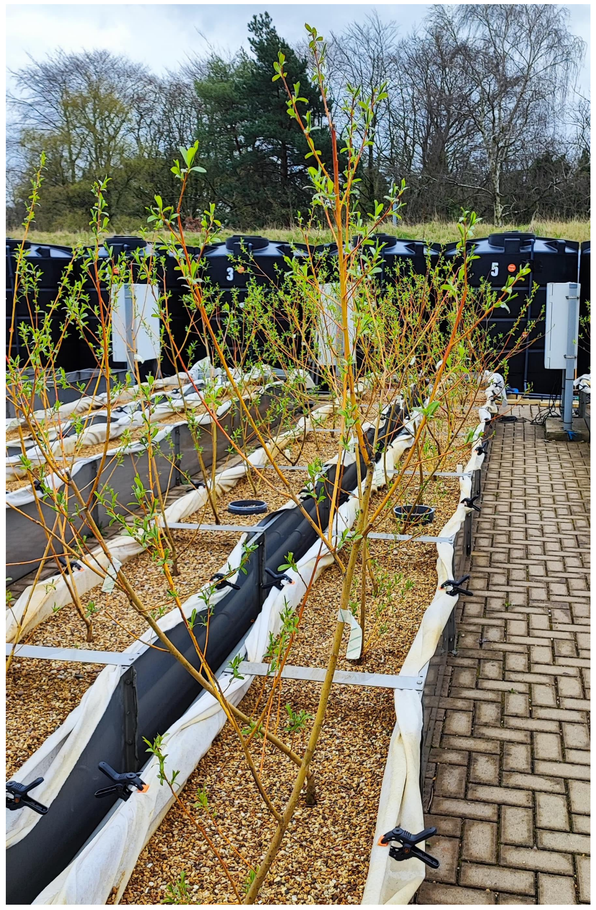
Figure 1. Flume and gravel schematic

Table 1. Plant-Aeration matrix

	Continuous	Intermittent	Seasonal	No aeration
Phragmites australis	X	X		X
Salix alba vitellina	X	X	X	X
Unplanted	X			

Expected Results

- Difference between herbaceous and woody constructed wetlands annually and seasonally.
- Removal efficiency of conventional pollutants.
- Quantify the amount of carbon dioxide, methane, and nitrous oxide emitted.
- The effect of aeration on treatment efficacy and greenhouse gas emission.



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Researcher Bio

Dee Phillips is a PhD Researcher at the University of Birmingham (UK) funded by the EPSRC. Her topic is horizontal constructed wetlands for wastewater treatment with industry involvement. Her focus is comparing Phragmites australis and Salix species regarding seasonal treatment efficiency and greenhouse gas emissions. She also completed her Masters in Civil Engineering from the University of Birmingham (UK), where she graduated in July 2022.

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