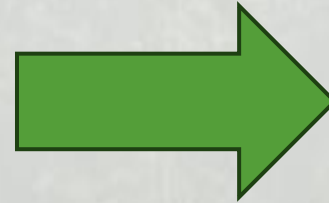


ONLINE EVENTS | People, Planet, Possibility

Welcome! The event will begin at: **12:00 BST**
Please note that this event will be recorded.

Please fill out this pre-webinar survey



Treatment Wetlands in the UK Water Industry: Key case studies highlighting 40 years of biological treatment performance

*Part of the CIWEM Nature-based Solutions and
Wastewater and Biosolids series.*

Hosted by CIWEM and CWA
Friday 3rd October 2025

<https://forms.gle/VbdyhbiXKN7xYrCA8>



General Housekeeping

- This webinar event will be recorded
NB. We only put recordings of our events up on the CIWEM website | YouTube when the authors | speakers give us permission to do so and as long as there are no copyright issues. You can view past digital series at <https://www.youtube.com/c/CIWEMviews/videos>
- If you experience any technical issues and need assistance, please raise your hand and use the chat feature on Zoom to let us know what the problem is and what help is required. If you have any problem accessing the chat, please use the Q&A.
- We will take your questions at the end of the presentation. If you would like to put a question or make a comment about the talk, please use the Q&A facility on Zoom. Chat should be for technical issues with Zoom only. When asking your question please state who you are posing the question to.
- 1.00 hours CPD attributable to this webinar however, we do not provide CPD certificates, as this is not CPD accredited training.

CIWEM

ABOUT CIWEM

CIWEM is a royal chartered professional body and independent charity.

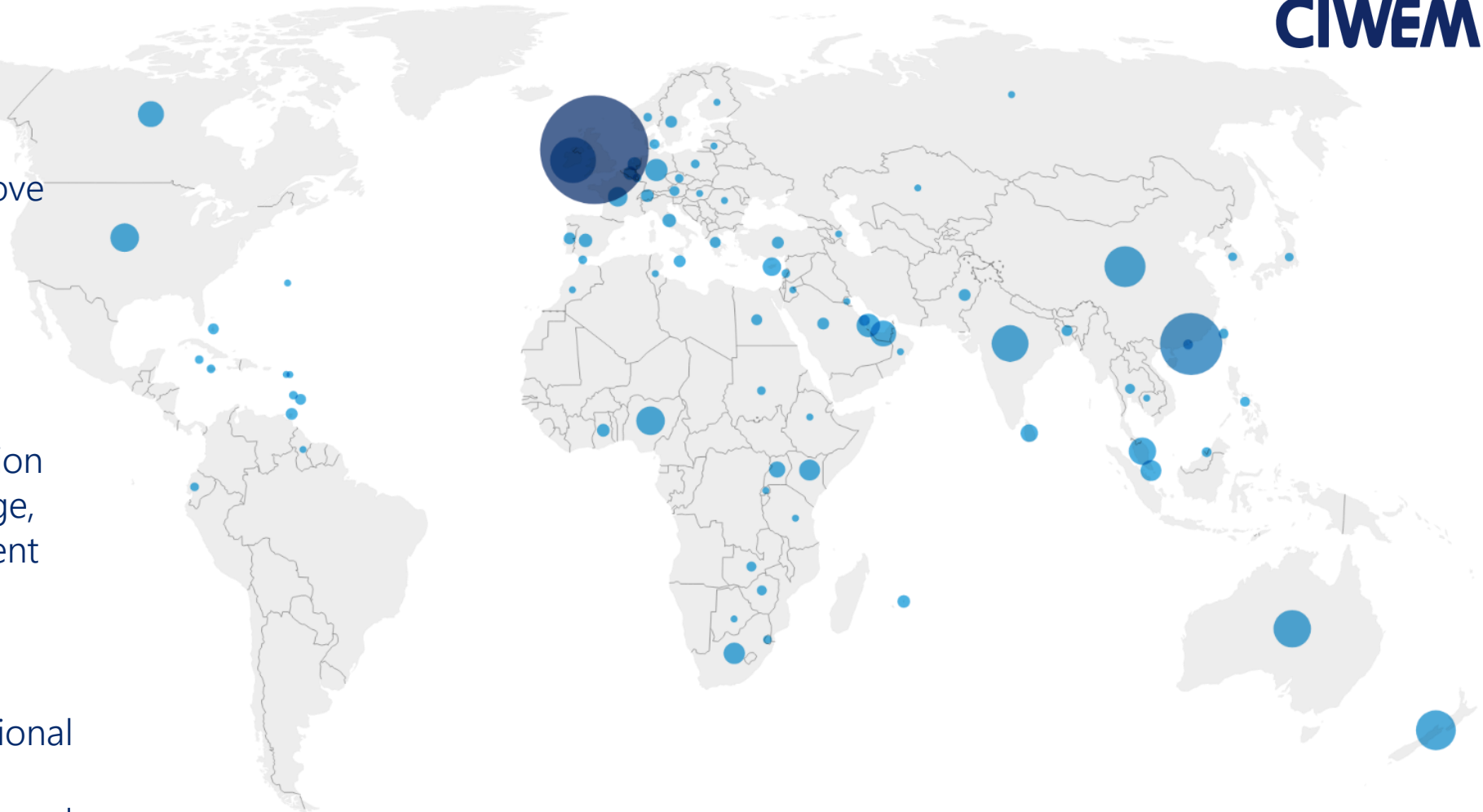
CIWEM | <https://www.ciwem.org/#>

CIWEM vision and strategy | People, Planet, Possibility | <https://www.ciwem.org/Corporate%20Strategy.pdf>

CIWEM MEMBERSHIP | <https://www.ciwem.org/membership/>

who we are

- CIWEM's mission is to improve water and environmental management for the public.
- We are a community of practitioners and visionaries working on issues like adaptation and resilience to climate change, enhancing our built environment and improving water security.
- As a UK Royal Chartered institution charity, and professional membership body, we are recognised as an independent and trusted voice on water and the environment.



11,000+ members
57 organisations & universities
89 nations
united by excellence in practice



CIWEM



Treatment wetlands in the UK water industry: Key case studies highlighting 40 years of biological treatment performance



Gabriela (Gaby) Dotro

&



David Naismith

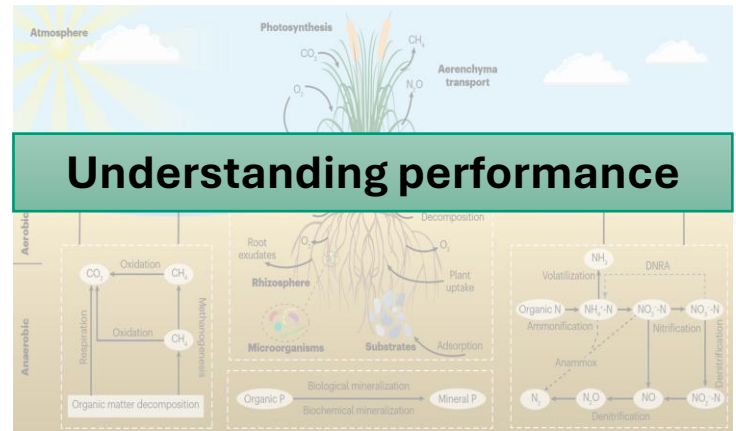
3rd October 2025

Today's session

About
the
CWA

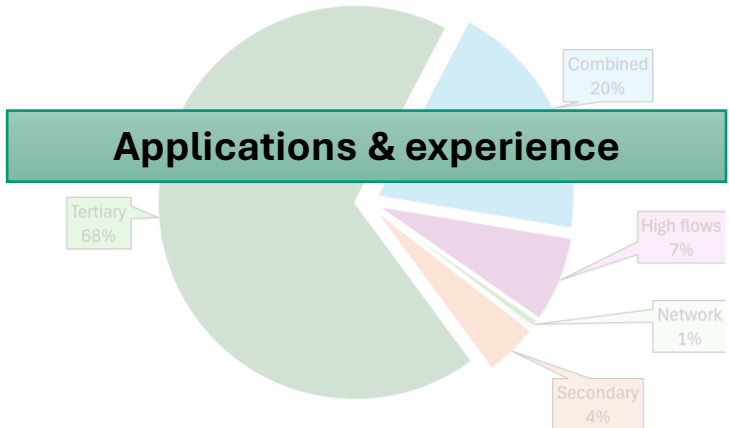


ICWs, reedbeds, islands



Treatment wetlands in practice

Questions &
Answers
(and promotion)



About the Constructed Wetland Association

The CWA works to promote the awareness of constructed wetland technology in water pollution control and takes a lead role in advocacy for the application of constructed wetlands in pollution prevention and the delivery of multiple benefits

- *Design standards
- *Research
- *Training
- ***Dissemination**
- *Peer review
- *Accreditation



Alexandra Combes
Member
Scottish Water



Lucy Crockford
Secretary
Harper Adams University



Gaby Dotro
Chair
NbS Future



Andy Freeman
Treasurer
ARM



Isobel Love
Member
Wye & Usk Foundation



Liam Reynolds
Member
Solutions by Nature



Dan Roberts
Member
WWT



Matt Simpson
Member
35percent

CWA Annual conference

From reedbeds to nature-based solutions: 25 years of UK constructed wetlands for water quality improvement

Coventry University Technology Park, Puma Way, Coventry CV1 2TT

Block	October 21st	October 22nd
Registrations, coffee and welcome		
Morning	"Surface flow wetlands and Uisce Éireann: lessons learnt and looking to the future" Thomas Shryane (Ireland)	"Applying Nature-Based Solutions in Urban Environments – Challenges, Limitations, and Insights from Case Studies" Prof Magdalena Gajewska (Poland)
	Technical talks	Technical talks
	Early career flash presentations	Panel: Treatment wetlands for future water challenges Nicola Neill (EA), Helen Wake (NE), Ruth Johnston (NRW), TBC (Defra)
Lunch		
Afternoon	Site visits - Hinckley CSO wetlands - Urban restoration	Early Careers mentoring over coffee session
		Technical talks
Evening	Conference dinner (19.00, Cosy Club)	Prizes and conference ends

REGISTRATION
CLOSES ON 5th
OCTOBER!

A wetland is...a marsh, a reedbed, a meadow, a swamp...

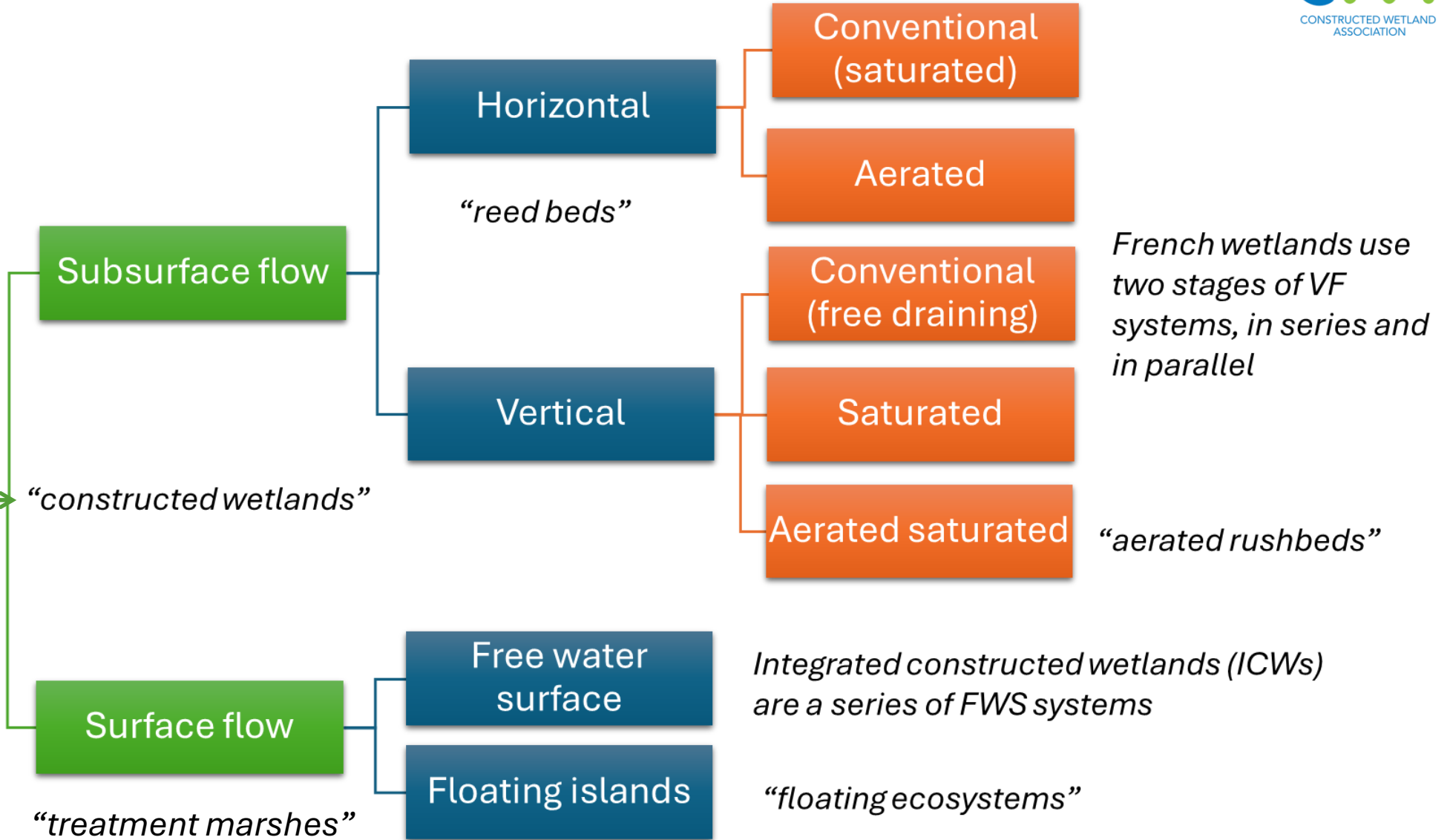


Treatment wetlands are *engineered* ecosystems that are designed to harness the treatment processes that occur in natural wetlands. They require three components: media, water-tolerant plants and the water that is passed through the system for water quality improvement.





Treatment Wetlands



Subsurface flow wetlands (“reed beds”)



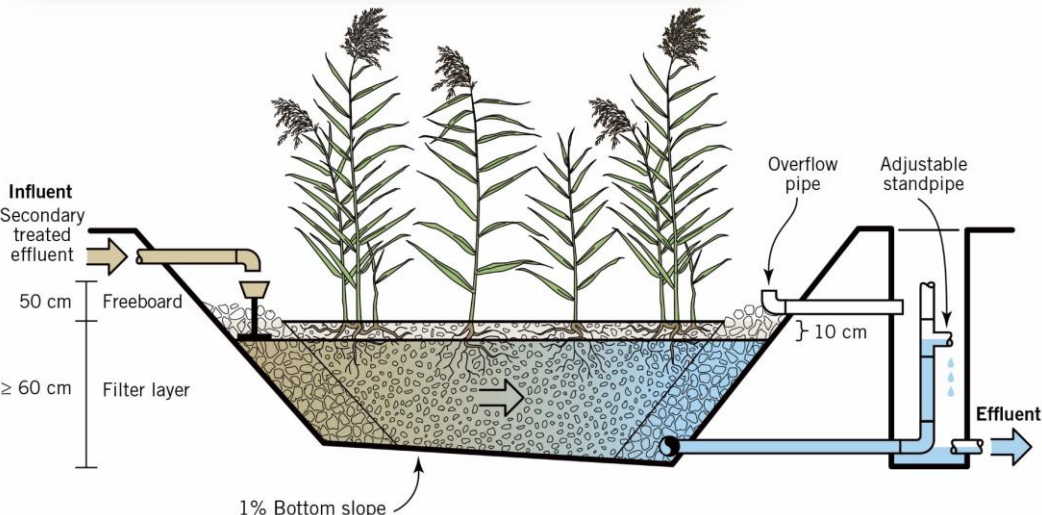
© Dotro

Horizontal Flow	Parameter	Vertical Flow
Gravel	Media	Sand
Saturated	Water level	Unsaturated
2ry and 3ry	Common application	2ry

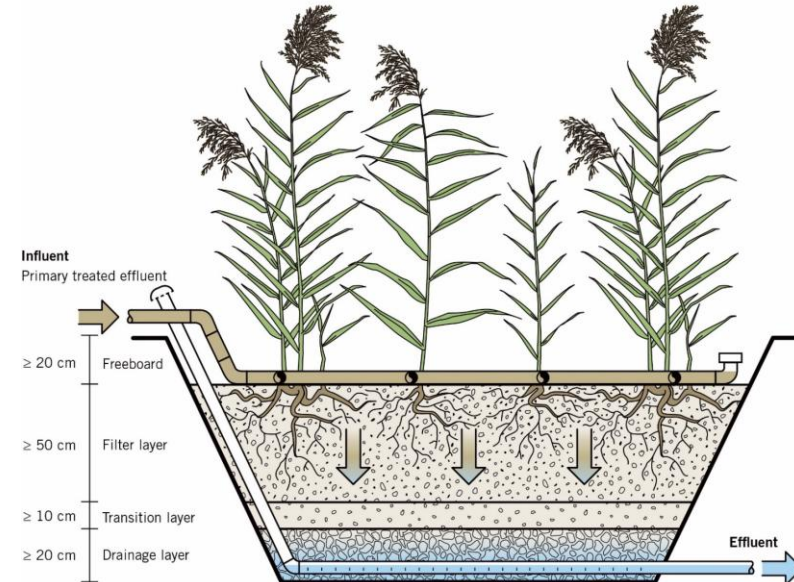


© Naismith

Conventional configurations



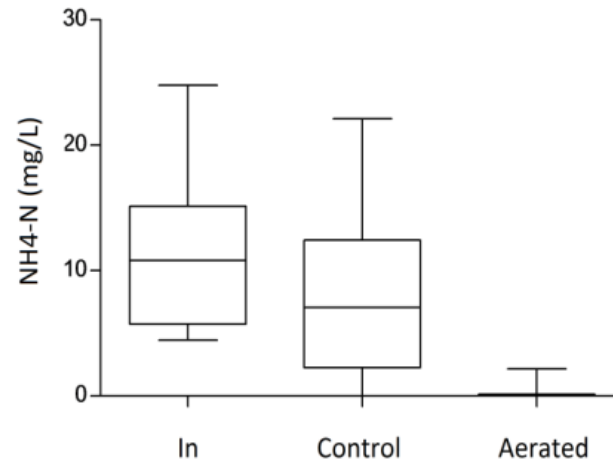
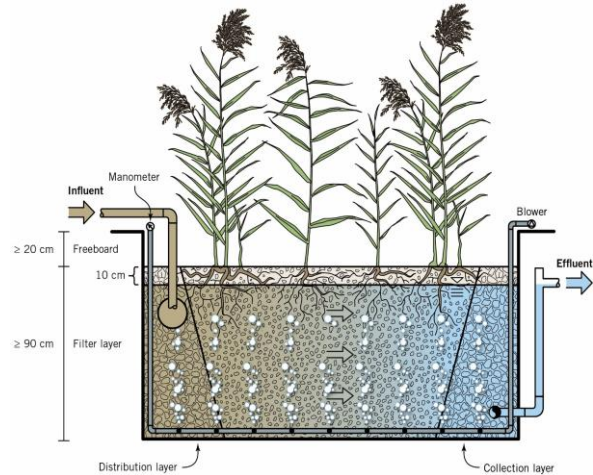
Schematics from Dotro et al (2017)



Intensified subsurface flow wetlands

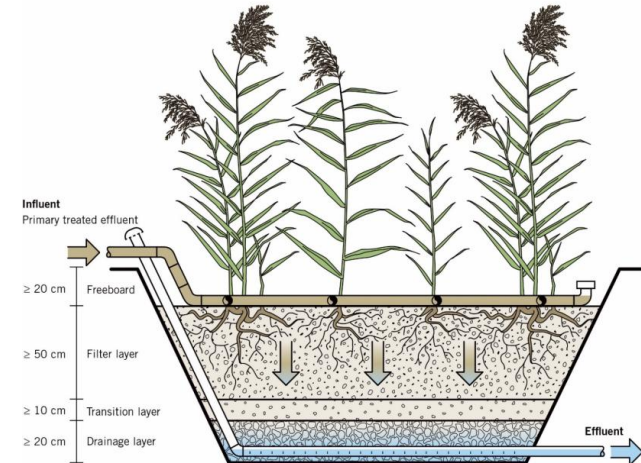


- ✓ Gravel based
- ✓ Saturated and artificial aeration
- ✓ 2ry and 3ry treatment



Butterworth et al (2013). *Ecological Engineering* 54:236-244
 Butterworth et al (2016). *Water*, 8. (free to download)

- ✓ Gravel based
- ✓ Saturated and artificial aeration
- ✓ 2ry treatment and CSO

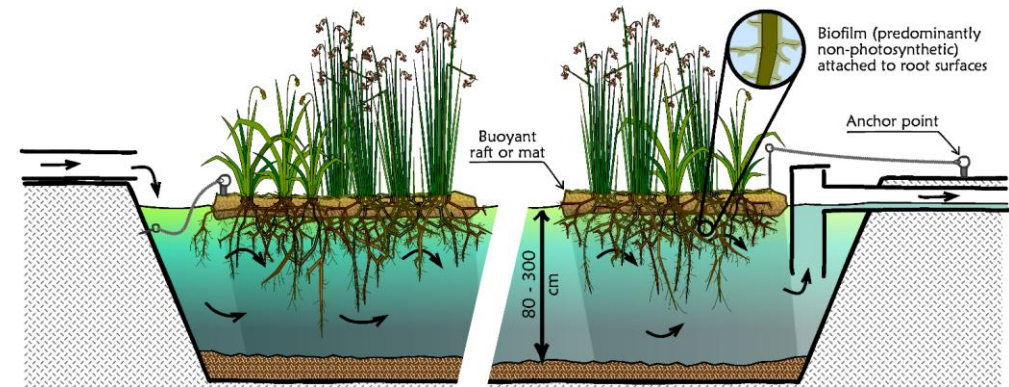
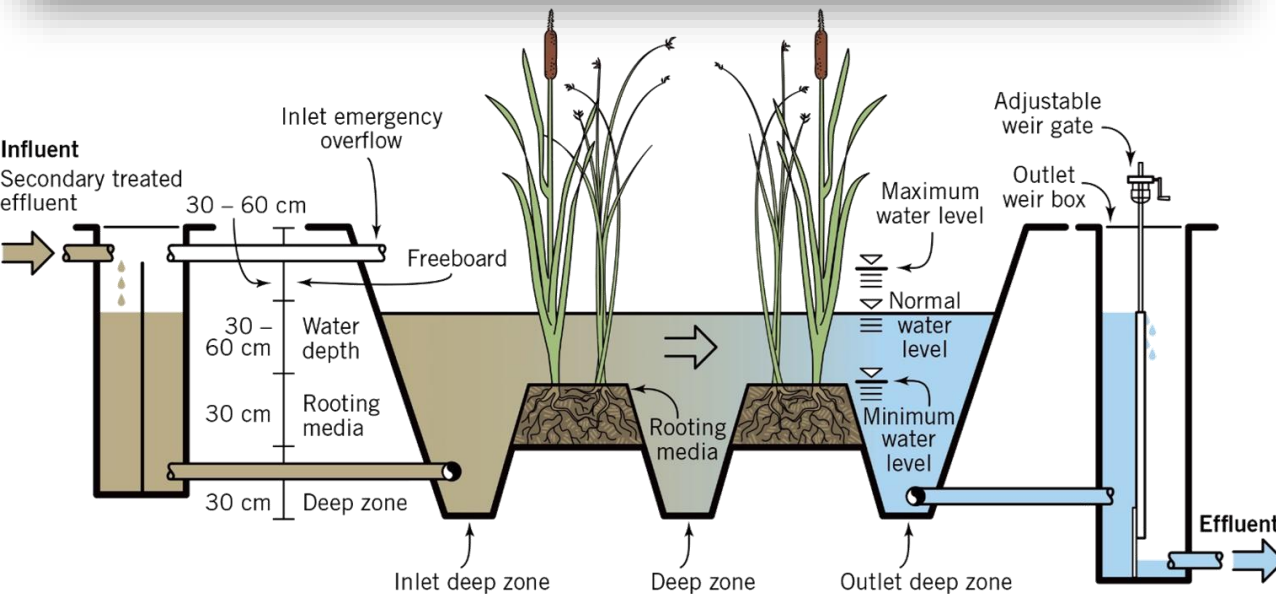


Surface flow systems



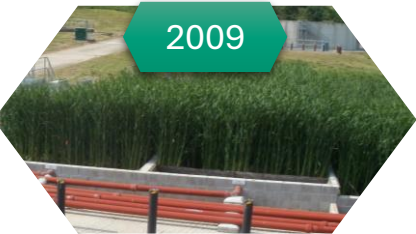
Figure from Biomatrix (2021). Boggart Hole Clough case study

- ✓ Can have aerobic and anoxic areas
- ✓ Settling
- ✓ Flow attenuation
- ✓ *Amenity value*
- ✓ *Biodiversity/ habitat value*



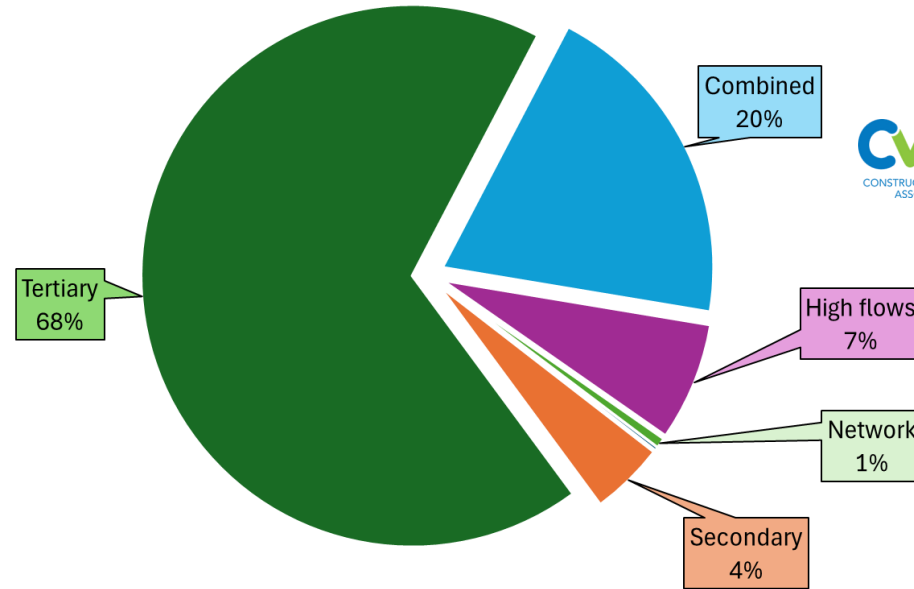
Schematics from Dotro et al (2017)

UK water industry experience



Wetland types at full-scale: SF, HF, VF, AVF, AHF, French, SDRB
Most treatment applications

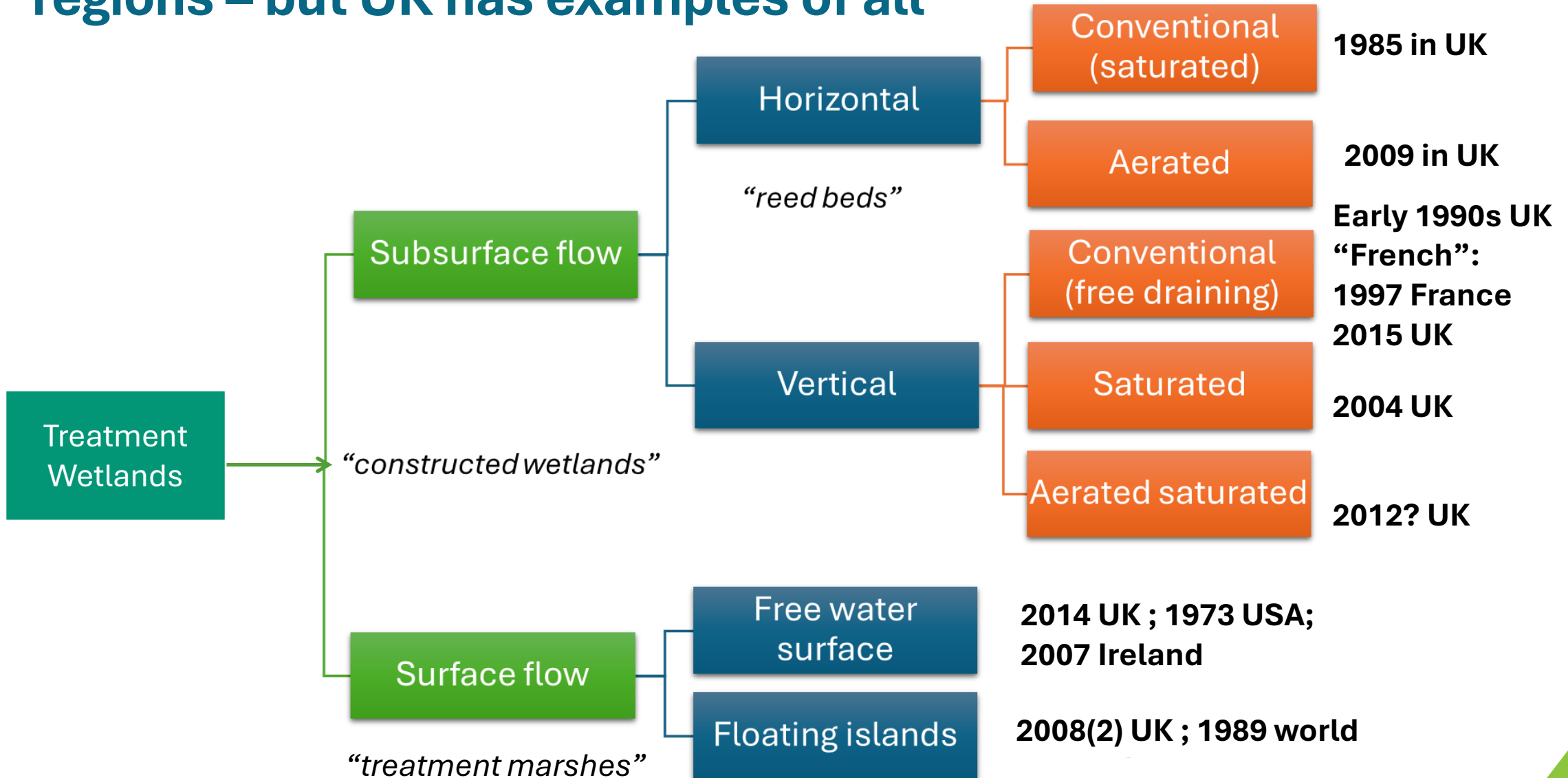
>700 sewage treatment sites
Each site has more than one wetland cell



Wetland technology has been used for treatment in the UK water industry since 1985

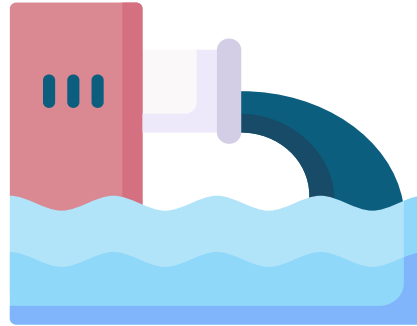
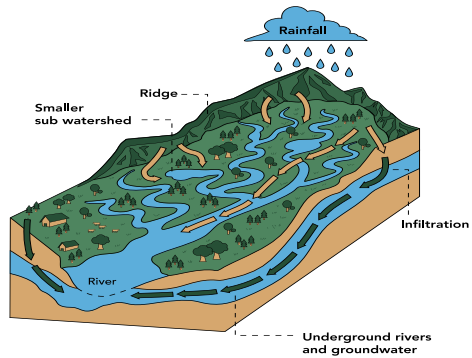
60s 70s	Seidel & Kickuth
1990	European Guidelines
2000	BRE Guidelines
2009	Kadlec and Wallace
2010	Irish ICW guidelines
2017	CWA small discharges
2017	IWA Textbook
2025	CWA sewage treatment

Treatment wetlands have evolved differently across regions – but UK has examples of all



Success and performance

Systems thinking & end-of-pipe



Achieve water quality first



&



Journal of Hydrology 560 (2018) 150–159

Contents lists available at ScienceDirect

Journal of Hydrology

journal homepage: www.elsevier.com/locate/jhydrol



ELSEVIER



Research papers

Flood reduction as an ecosystem service of constructed wetlands for combined sewer overflow

A. Rizzo ^{a,*}, R. Bresciani ^a, F. Masi ^a, F. Boano ^b, R. Revelli ^{b,c}, L. Ridolfi ^b

^a Iridra S.r.l. Florence, Italy

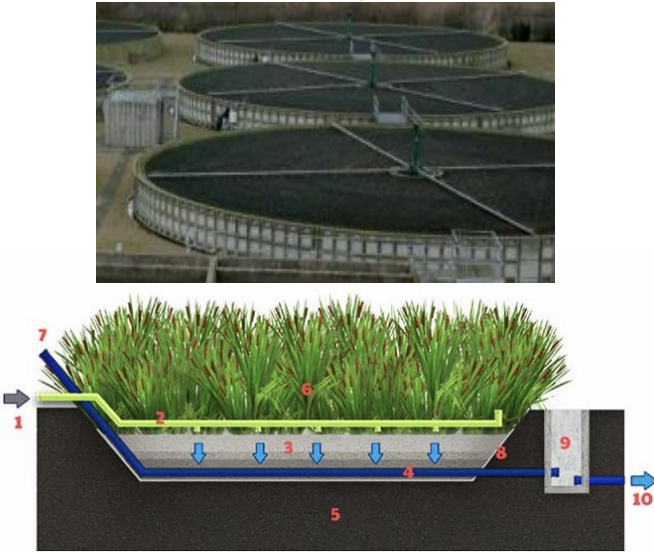
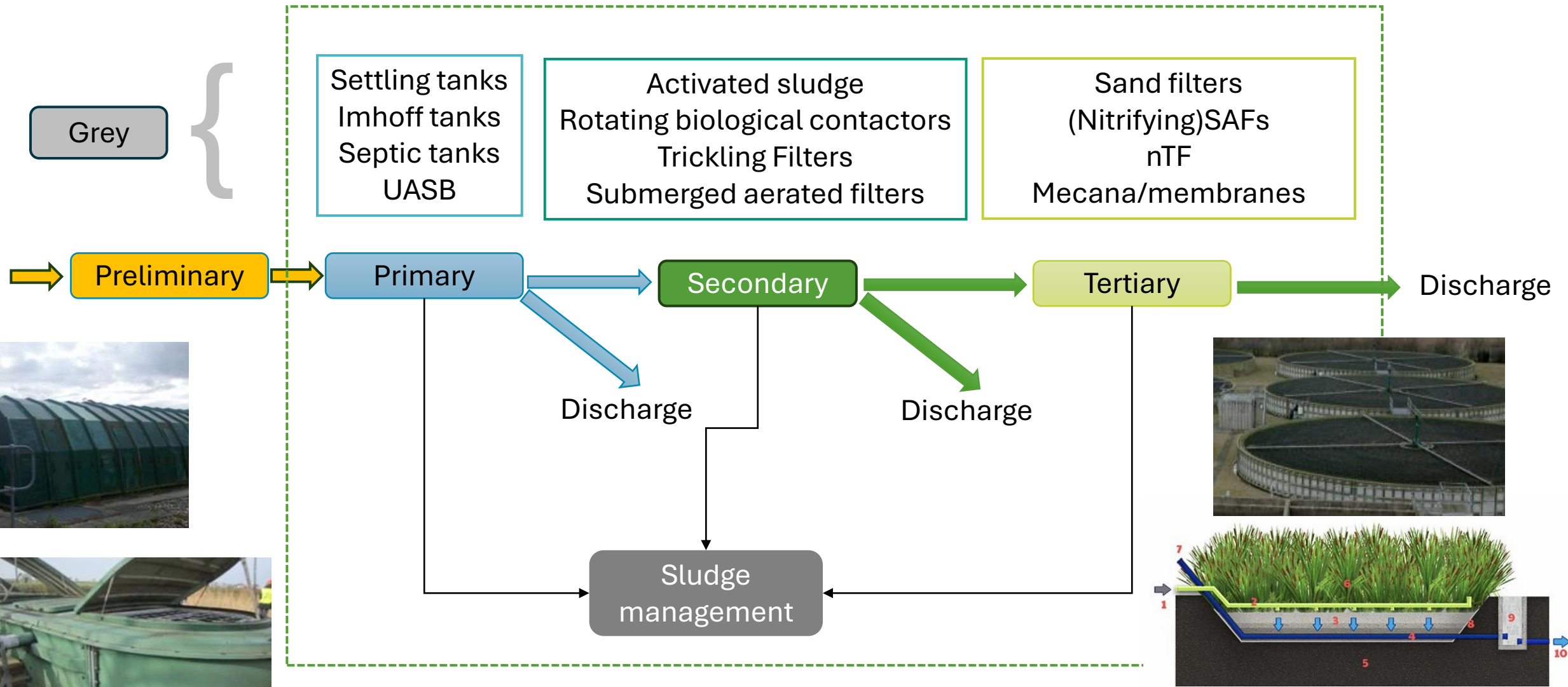
^b Department of Environment, Land and Infrastructure Engineering (DIATI), Politecnico di Torino, Turin, Italy

^c Department of Civil and Environmental Engineering, Box 90287, Duke University, Durham, NC 27708, USA

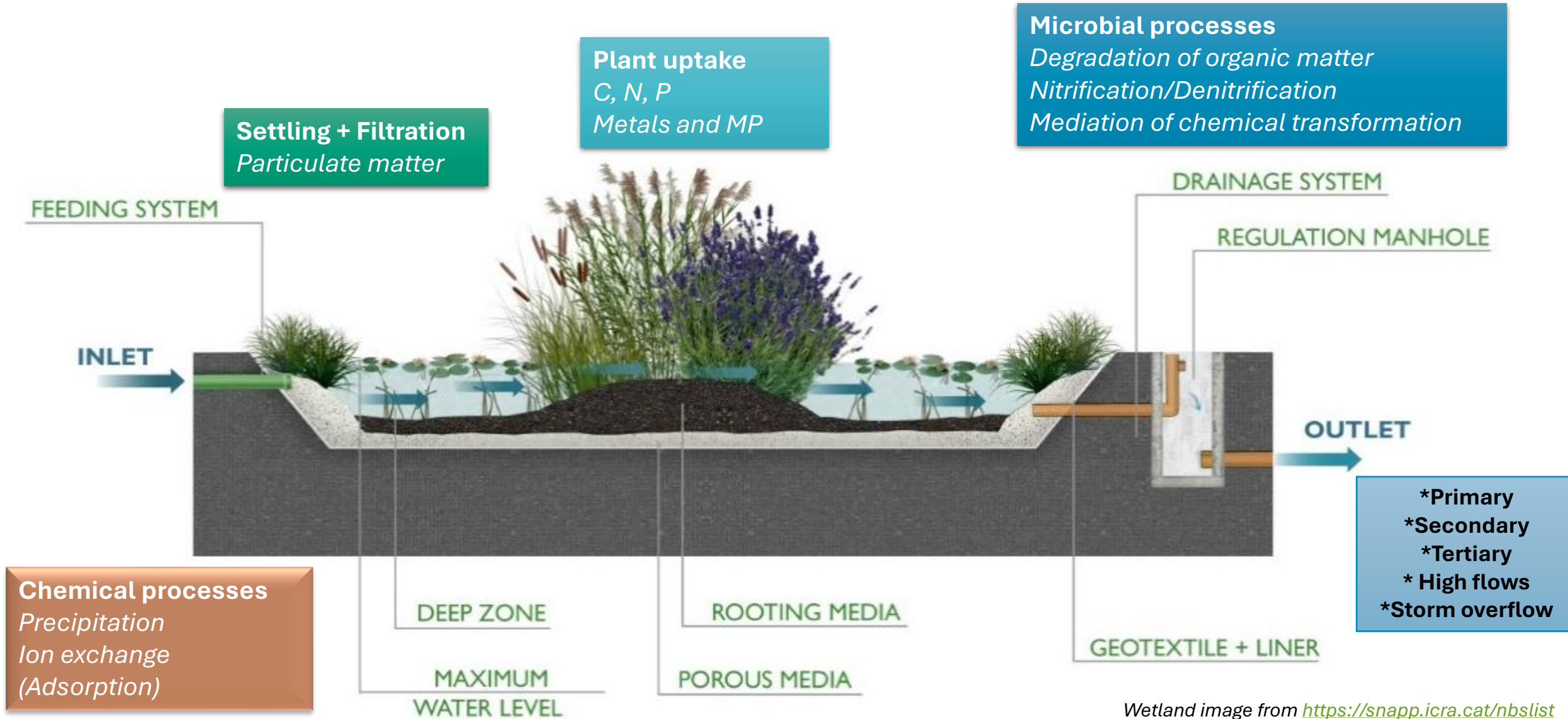


Parameter	Treatment wetlands	Grey technologies
Loading rates	g/m ² /day	kg/day
HRT	Days	Hours
SRT	n/a	Days
System	Stand alone	With secondary settling

Simplified treatment flowsheets



Biological reactors, with physical and chemical processes



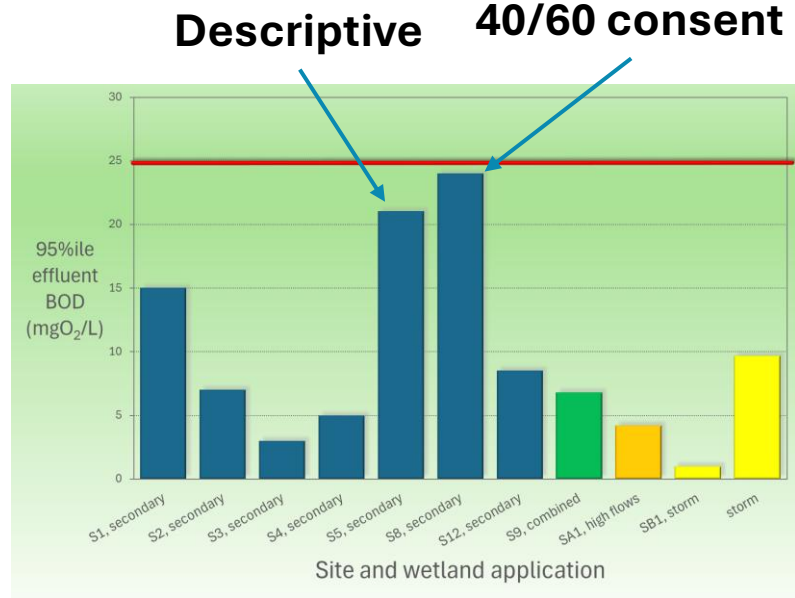
Delivering biological treatment at different treatment stages

TREATMENT WETLANDS IN THE UK:
An established biological treatment technology

Dr Gabriela Dotro and Prof John Williams

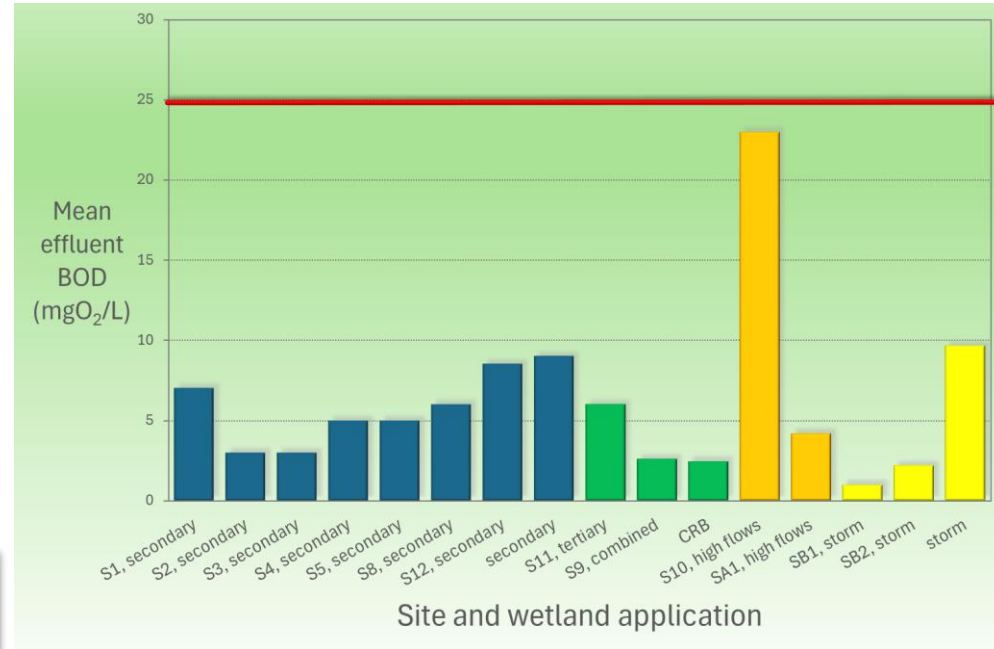
www.constructedwetland.co.uk

17 detailed case studies
Aggregated data from 19 secondary and 52 combined wetlands



Treatment wetlands can meet UWWTR
 $BOD_5 < 25 \text{ mg/L}$ or 70-90% removal
Average 87% removal, n= 11 sites

$COD < 125 \text{ mg/L}$ or 75% removal
Average 80%, n = 7 sites



Site 1

Secondary treatment with surface flow wetland (“ICW”)

SITE OVERVIEW

Population : 160
Type : Surface flow (ICW)
Application : Secondary
Year built : 2022

DESIGN PARAMETERS

Treatment area : 2,917 m²
Hydraulic loading rate : 0.018 m³/m²/d
Nominal retention time : 10 days
Target consent : Descriptive & 4 mg/L TP



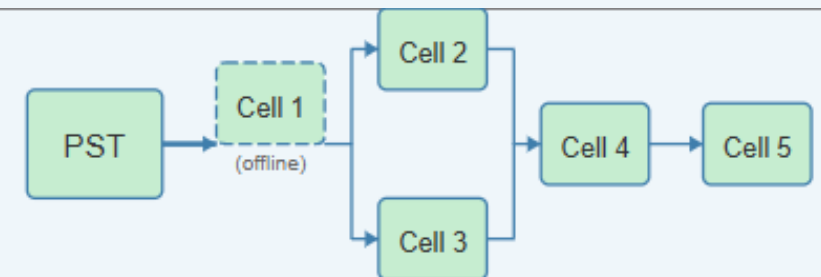
PERFORMANCE METRICS – Regulator’s perspective

Parameter	Inlet to wetland (mg/L)			Outlet (mg/L)			% Removal
	95%ile	Min	Max	95%ile	Min	Max	
BOD	312	50	376	15	2	39	95
COD	731	193	769	111	33	118	85
NH ₄ -N	78.6	21	84	41.3	7	43	47
Status	Meets UWWTR requirements for sites >1,000						

KEY FINDINGS

First UK secondary surface flow wetland demonstrating excellent performance able to meet UWWTR standards of sites > 1,000 pe

SYSTEM CONFIGURATION



Site 1

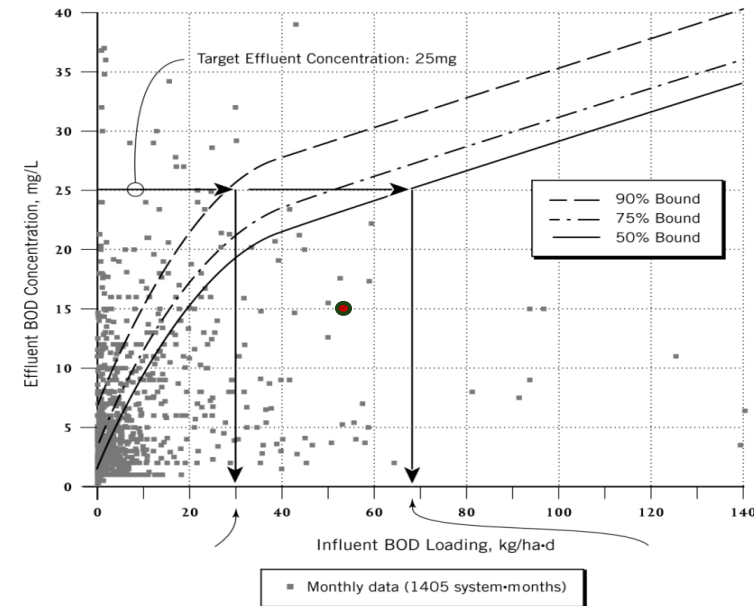
Checking performance from a wetlands' professional perspective

Rule of thumb
Mass loading charts
Reported removal rates

The vast majority of surface flow wetlands are for polishing purposes (“treatment marshes”) – agricultural & road runoff, tertiary or advanced treatment of sewage

Parameter	Biological WWT
Configuration	Plug flow, nitrifying
Settled load, BOD (kg/day)	11
Crude load, BOD (kg/day)	45

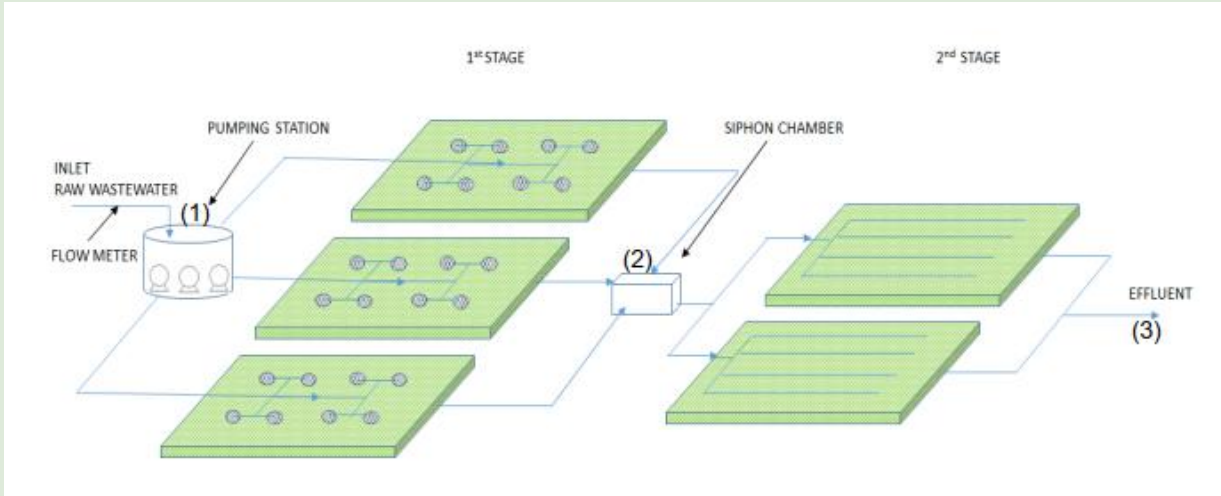
Parameter	Site 1	Literature <i>(Kayranli et al 2010; Irish guidelines)</i>
Per capita area, m ² /pe	18	23 (18.6 design)
BOD loading rate, gBOD/m ² /d	5.6	2
Removal rate (g/m ² /d)	5.3	N.R. <i>(ok on Wallace and Knight 2005)</i>



Site 4

Primary and secondary treatment (England)

French VF wetland, 941 pe



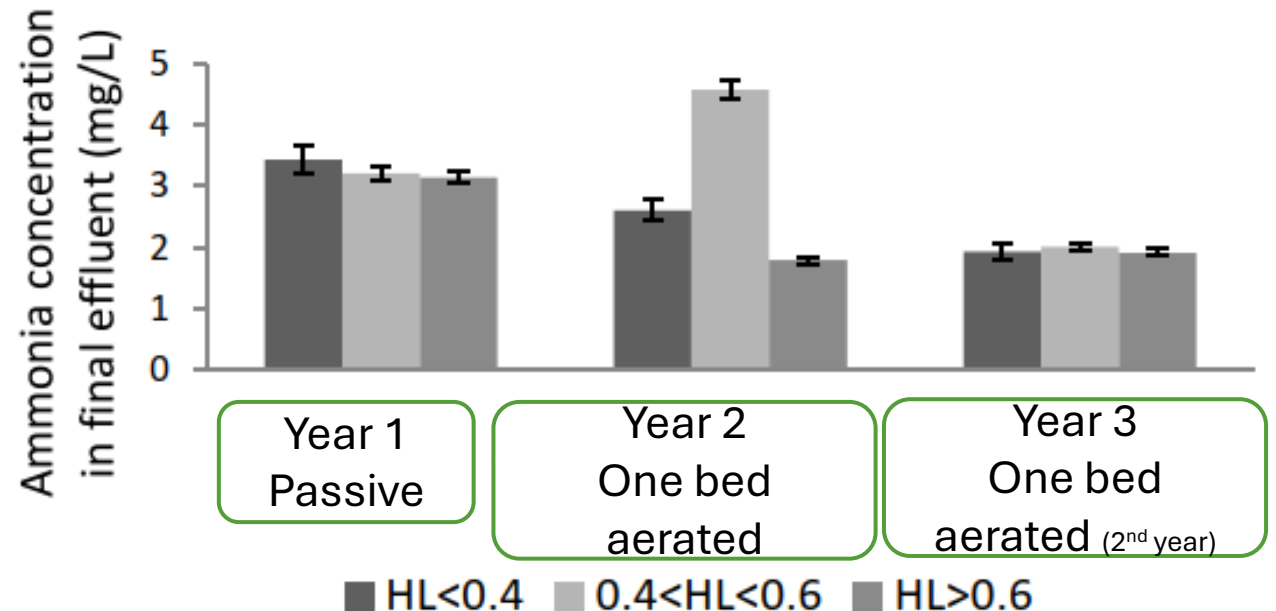
Daily visits with frequent desludging (trickling filter)
 VS
 weekly with desludging every decade (wetlands)

Target consent:
 15 mg/L NH₄-N

95%ile (passive): 9.6 mg/L
 95%ile (FBA™): 5.3 mg/L

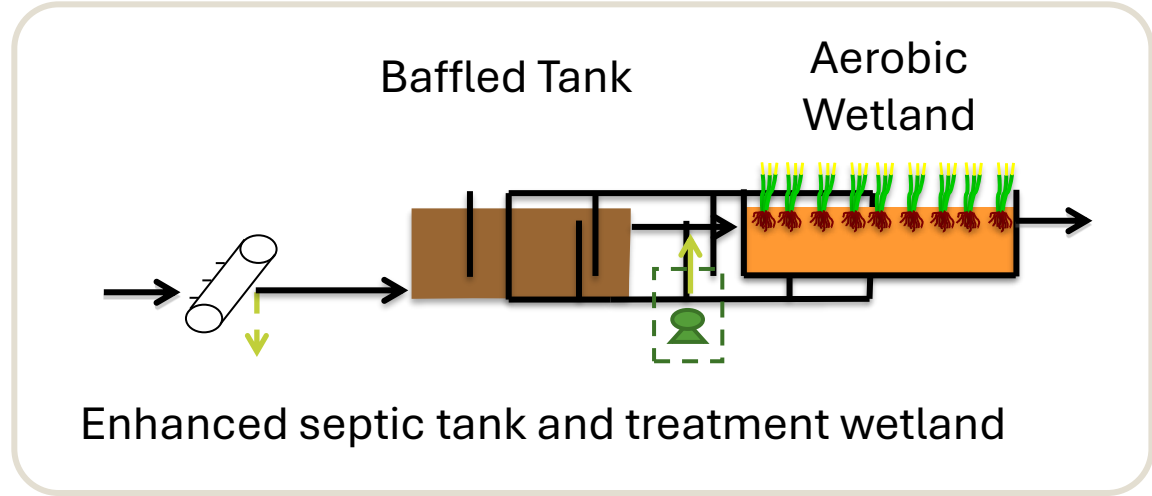
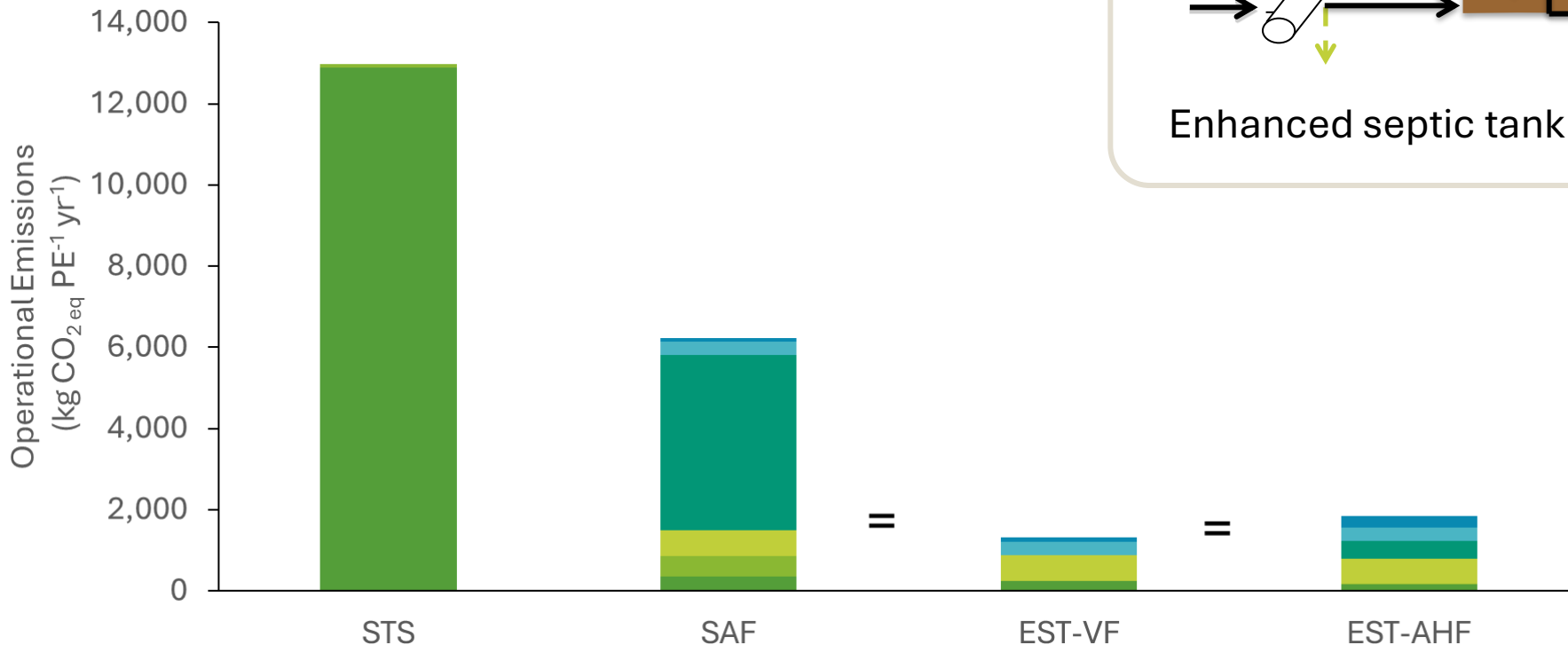


Data from Khomenko (2017)



Carbon - Operational emissions

Septic tanks
85% operational are process emissions



- Process
- Tankering
- Discharge to Surface Waters
- Electrical
- Site Visits
- Maintenance

SITE OVERVIEW

Max flow : 60 L/s
 Type : Horizontal flow
 Application : SPS overflow
 Year built : 2011

DESIGN PARAMETERS

Treatment area : 2,695 m²
 Hydraulic loading rate : 1.92 m³/m²/d
 Target consent : n/a



© Gaby Dotro

Low concentrations ≠ low treatment
 Average ammonia removal rate: ~7g/m²/d (exceeds expectations)

PERFORMANCE METRICS

Parameter	Inlet (mg/L)		Outlet (mg/L)	
	95%	Mean	95%ile	Mean
BOD	8	5	4	3
TSS	12	7	15	7
NH ₄ -N	23.2	7.1	3.1	1.7

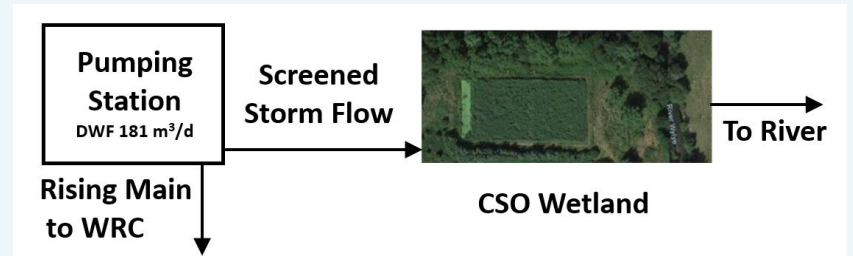
n=26

KEY FINDINGS

Single HF bed that receives flows from the sewage pumping station at times of high groundwater table – typically October to May.

Has an Operating Techniques Agreement for 2024 – 2027.

SYSTEM CONFIGURATION

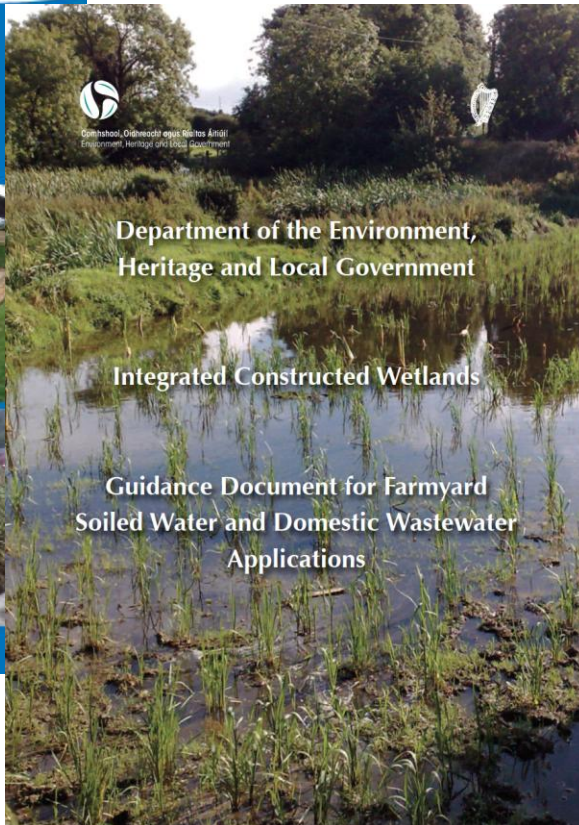


Design guidance (*free to download*)



GUIDELINES

Constructed Wetlands to
Treat Domestic Septic Tank Effluent



BIOLOGICAL WASTEWATER TREATMENT SERIES

VOLUME 7

TREATMENT WETLANDS

Gabriela Dotro, Günter Langergraber,
Pascal Molle, Jaime Nivala,
Jaume Puigagut, Otto Stein,
Marcos von Sperling



Scientific and Technical Report No. 27

Wetland Technology

*Practical information on design and
application of treatment wetlands*

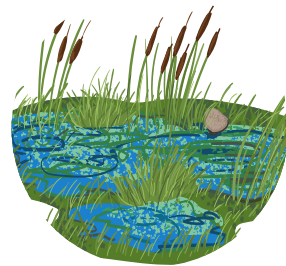
Edited by Günter Langergraber, Gabriela Dotro,
Jaime Nivala, Anacleto Rizzo and Otto R. Stein



Take Home Messages, part 1



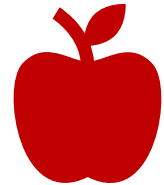
The UK has a **strong evidence base** on the use of wetlands for wastewater treatment



Applications at full-scale include primary, secondary, tertiary, combined tertiary and stepped high flows, and storm overflows



Free resources are available to help with design, evidence gathering and ensuring quality of your schemes



Benchmarking is essential – compare with the grey alternative & quantify benefits

Thank you



Dr Gaby Dotro

Chair, Constructed Wetland
Association

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Find us on the CWA LinkedIn page

<https://www.linkedin.com/company/constructed-wetland-association/>