CONSTRUCTED WETLANDS FOR WASTEWATER TREATMENT

Fabio Masi, Italy
Claudia Wendland, Germany
Nathasith Chiarawatchai, Germany

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Constructed Wetlands

DEFINITION:

“Constructed wetlands can be defined as engineered water saturated or unsaturated areas in which the natural removal processes for the water pollutants are reproduced and enhanced in order to optimize the purification performances”

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Classification

KIND OF USED MACROPHYTES

1. Floating macrophyte-based system
2. Submerged macrophyte –based system
3. Rooted emergent macrophyte –based system

KIND OF WATER FLOW DIRECTION

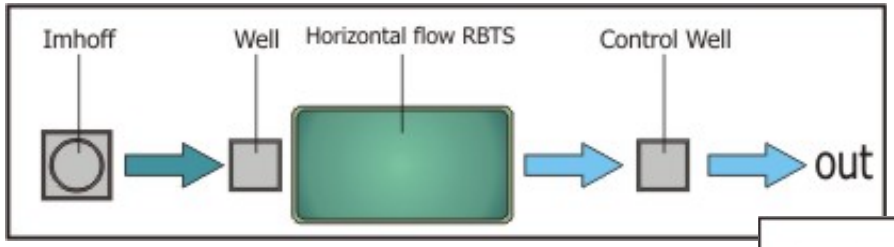
a) Systems with free water surface (FWS)

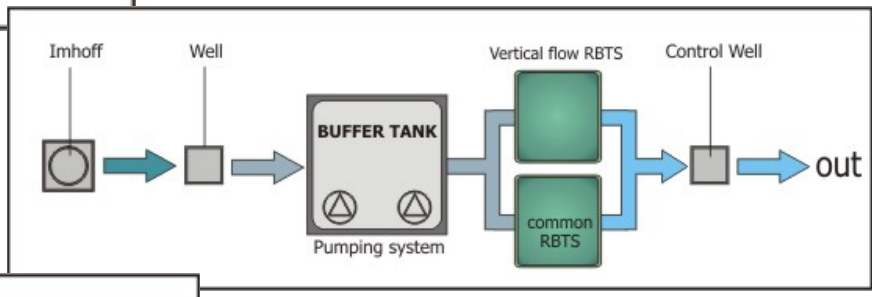
b) Systems with horizontal subsurface flow (HSF)

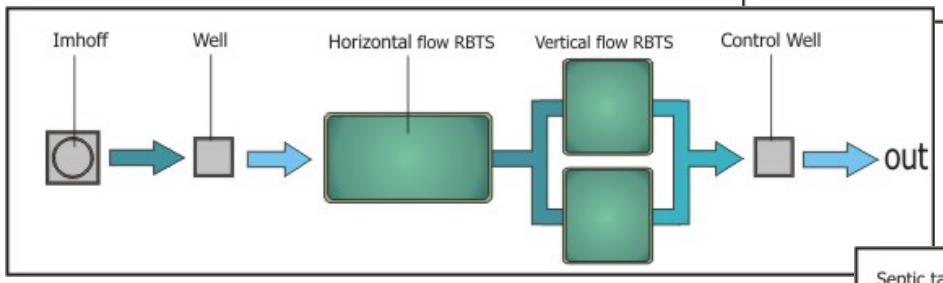
c) Systems with vertical subsurface flow (VSF)

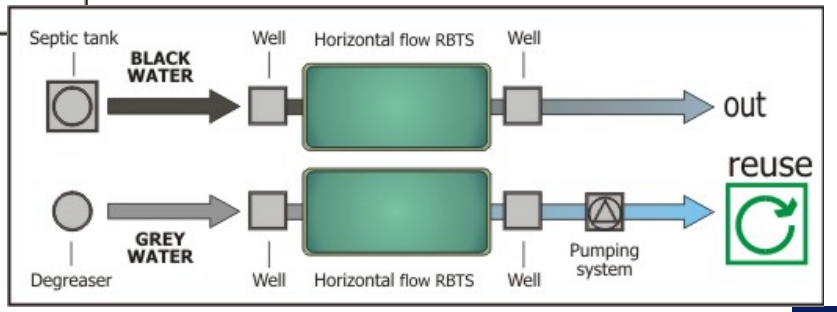
d) Hybrid systems (combinations of a,b,c)

Common configurations









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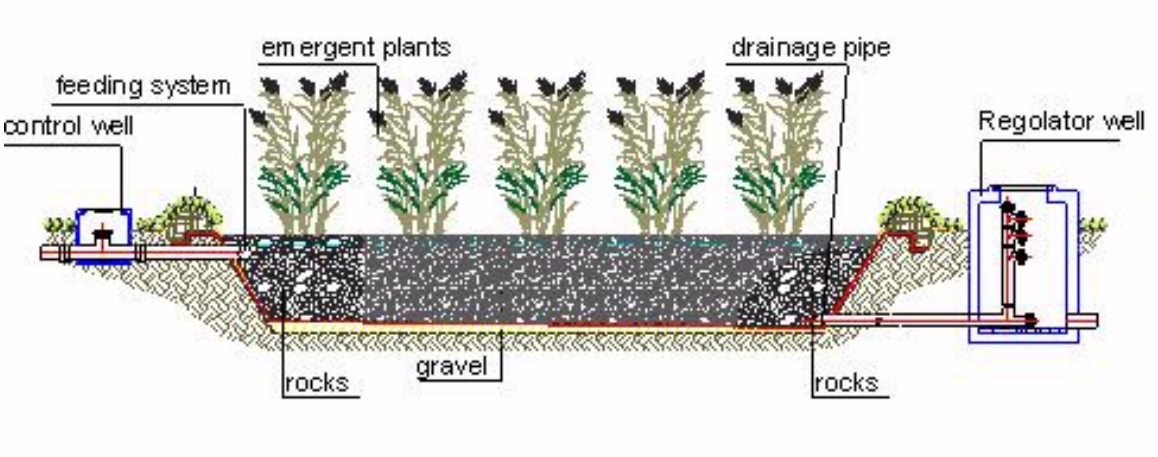
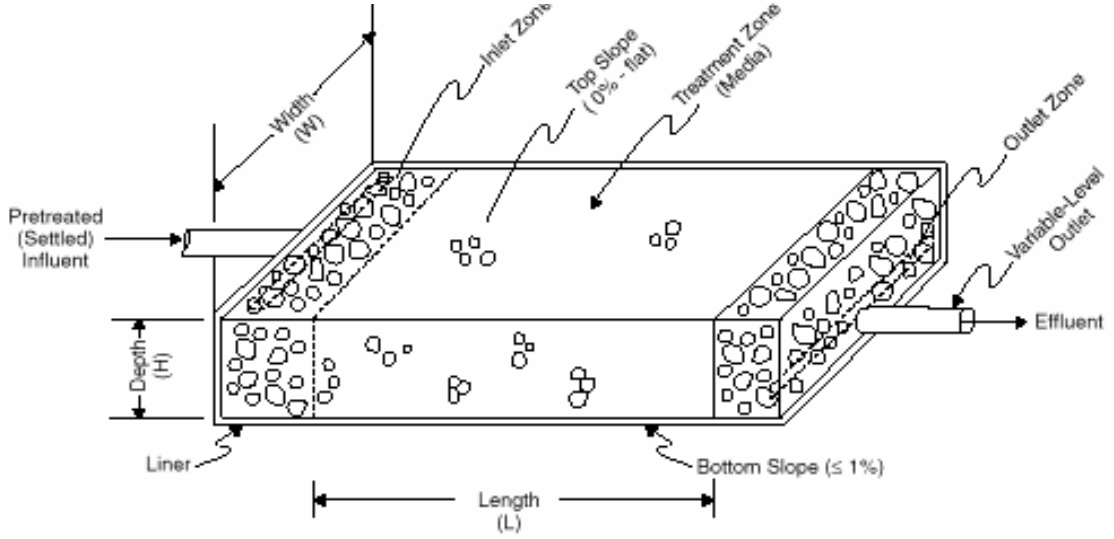
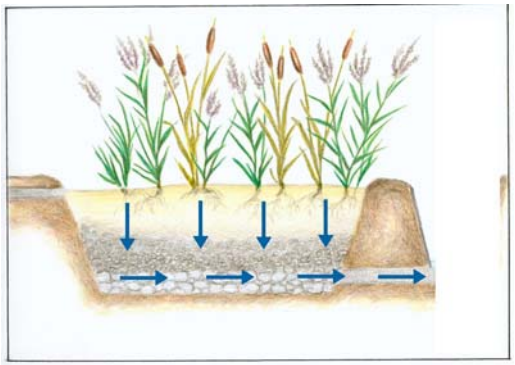
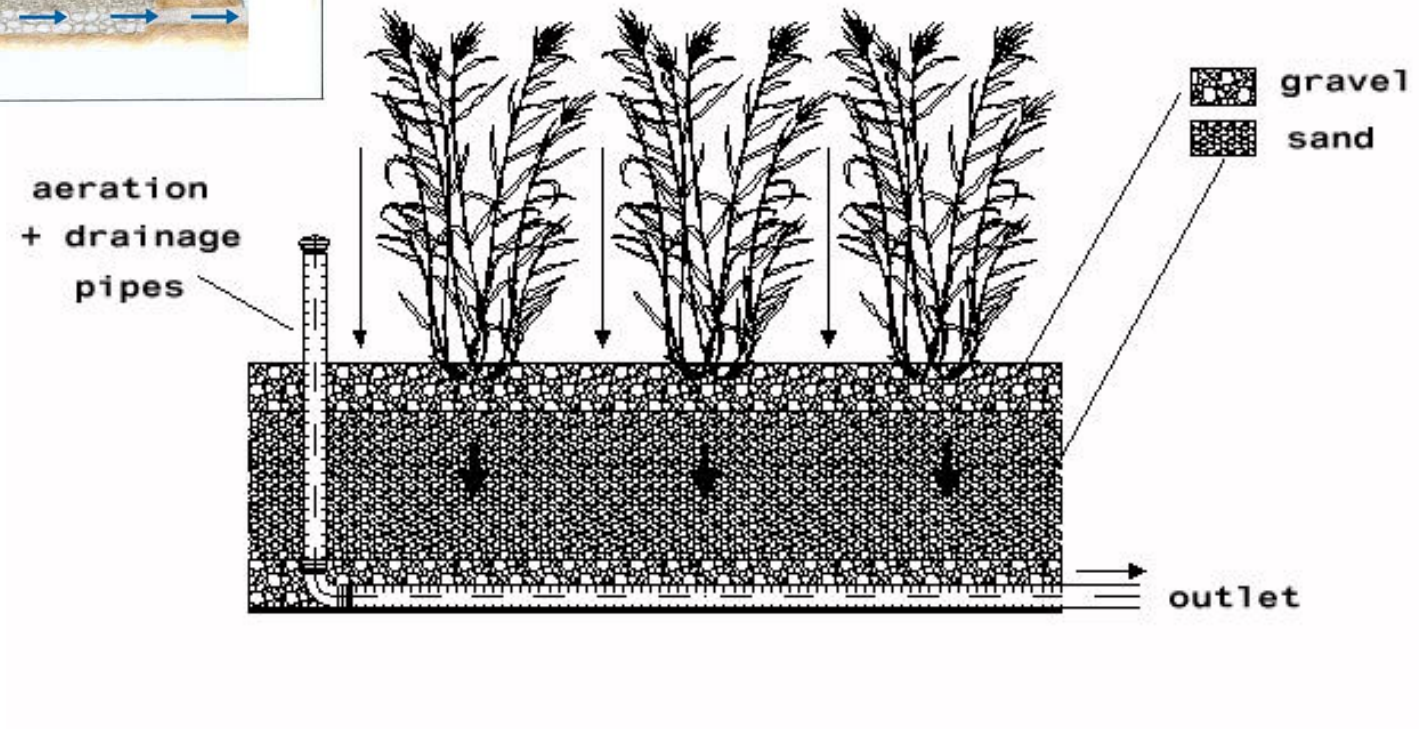
Horizontal Flow Constructed Wetlands





Vertical Flow Constructed Wetlands





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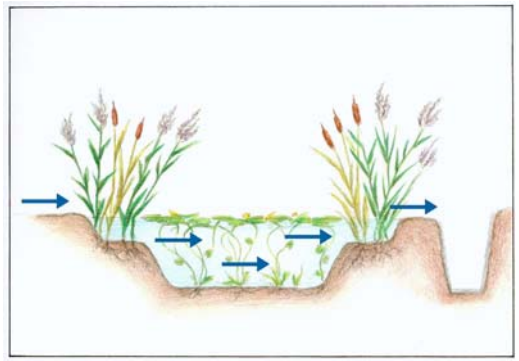
Free Water Surface (FWS) Systems



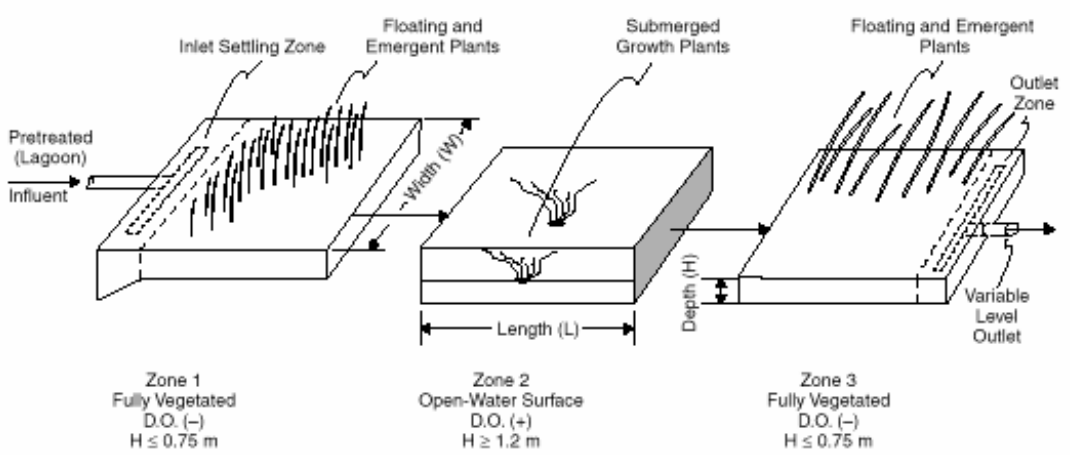
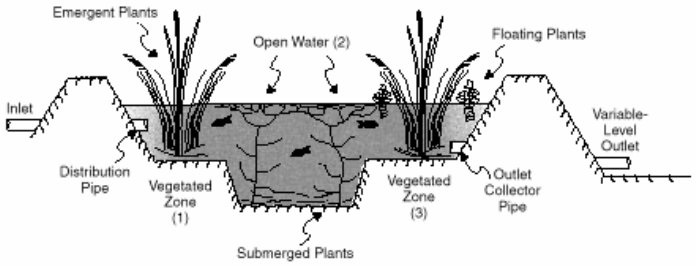
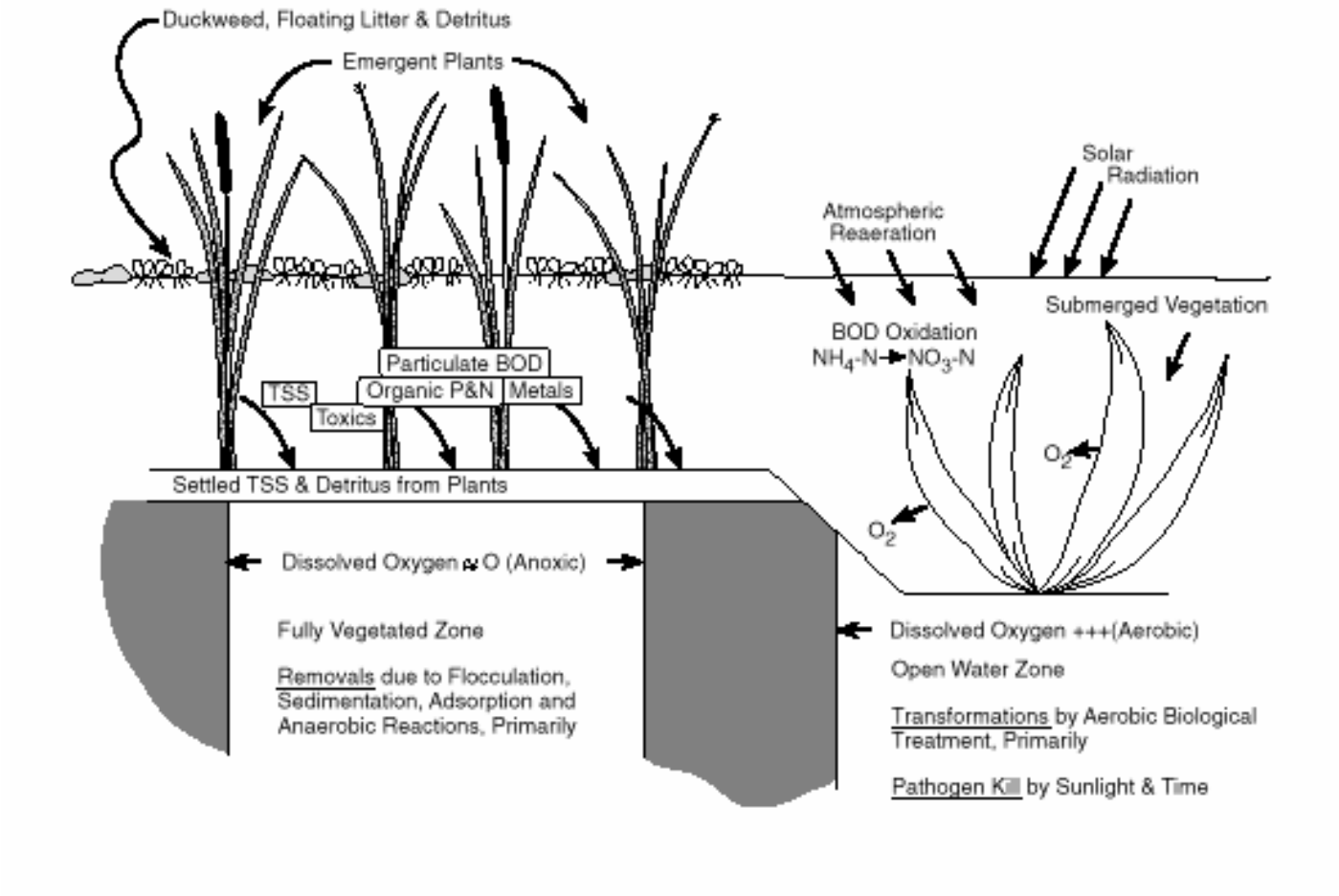


Figure 2-2. Elements of a free water surface (FWS) constructed wetland



Removal mechanisms



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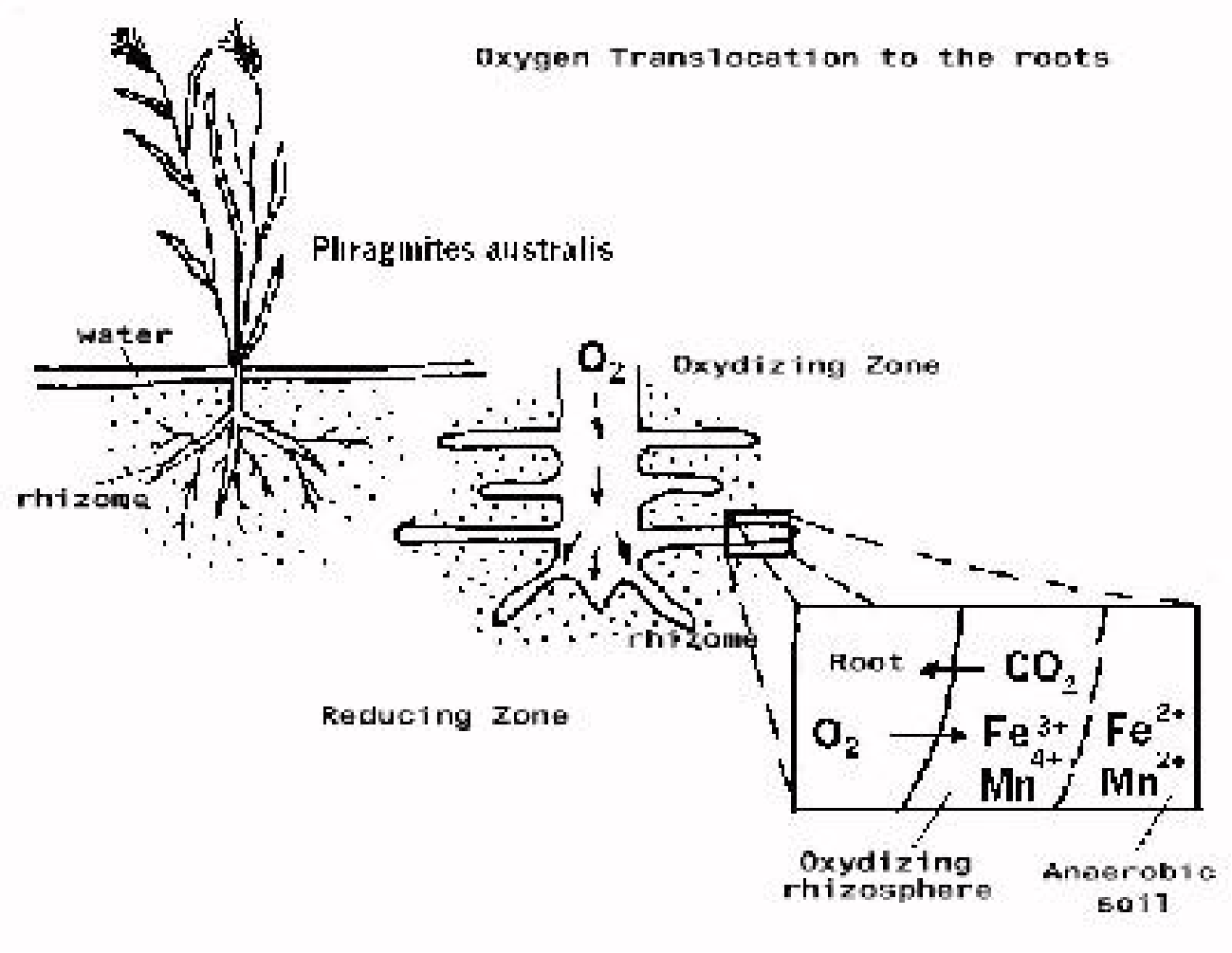
Role of plants



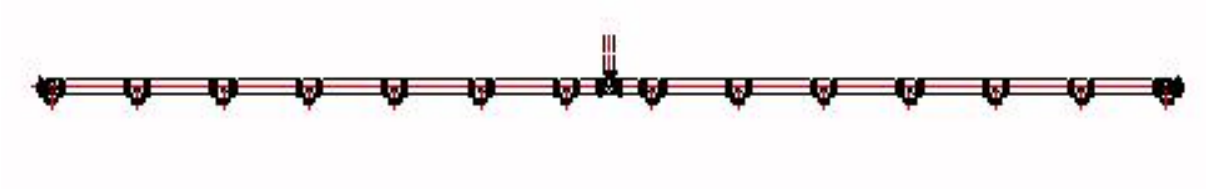
Design Criteria

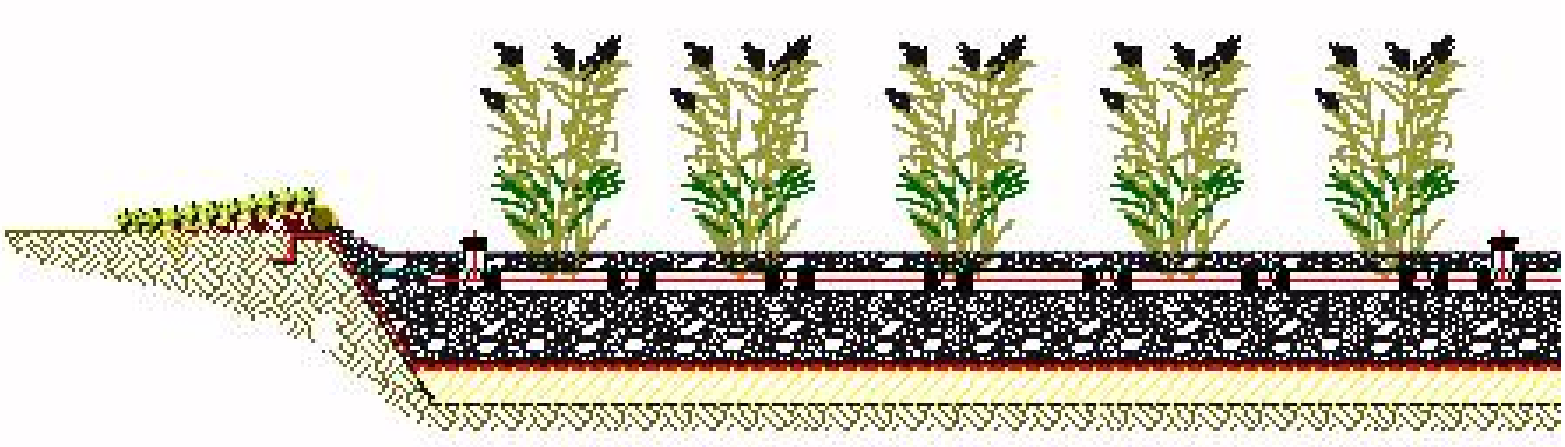
Hydrology
Hydraulic Retention Time
Hydraulic Loading Rate
Filling Media (porosity, hydraulic conductivity kf)
Redox conditions (aerobic, anaerobic, mix reactor)
Geometry of the bed
Waterproofing
Inlet and Oulet devices
Cells configuration (series and/or parallel)
Choose of macrophytes
Treatment goals (in terms of specific pollutants overall removal)

HF systems design

Detailed Component Design:

Inlet device

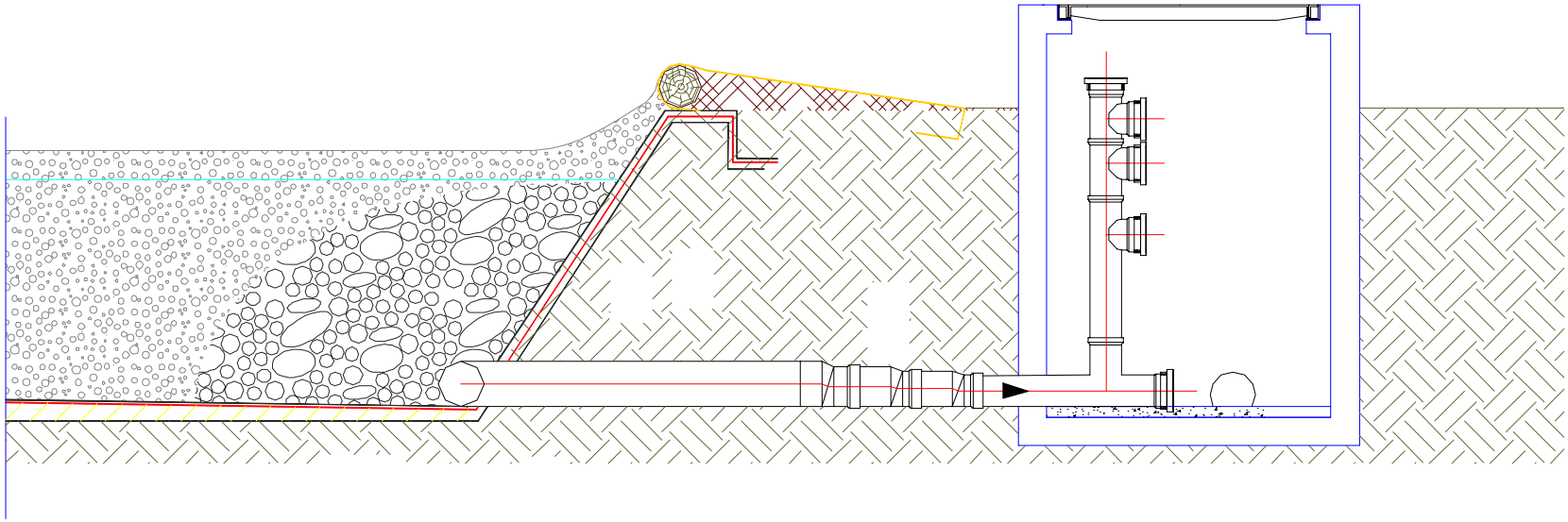




HF systems design

Detailed Component Design:

Oulet device



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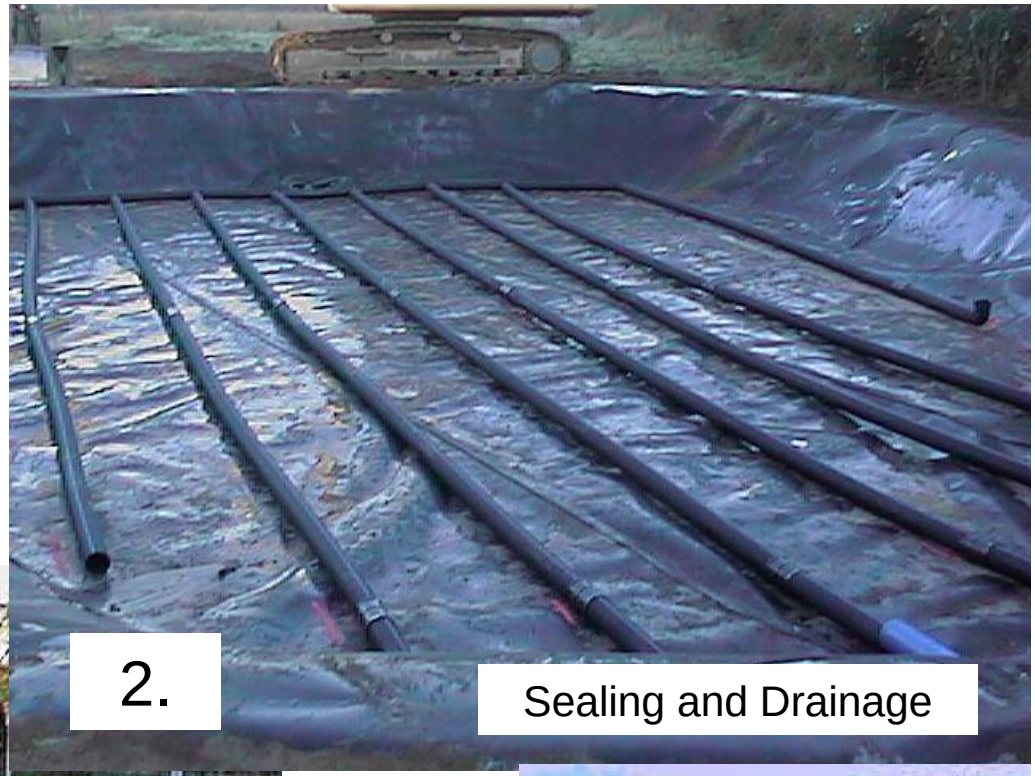
Vertical Flow CW Construction

Lübeck-Flintenbreite

www.flintenbreite.de/de/wasser1.html



VF systems design

Feeding and distribution system

Syphons

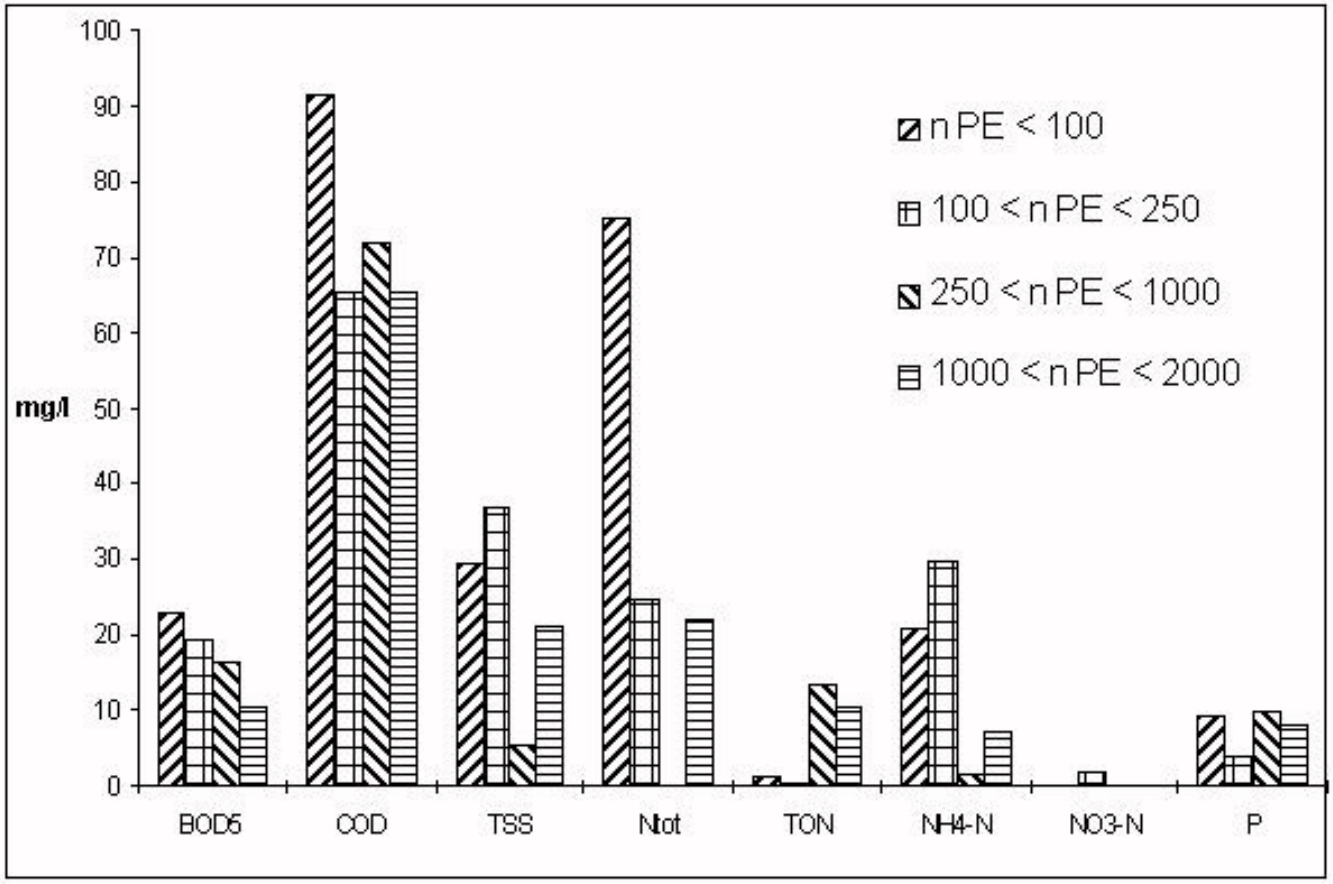
Floating Valves

Distribution system

Electric Pumps

Performance

Mean outlet values on 213 european HF CWs for secondary treatment



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1st Case study: Constructed wetland Haran-Al-Awamied, Syria

(A. Mohamed 2004)

- Combined public sewer system
- 7000 pe
- Pre treatment in a sedimentation tank
- 2-reed beds (68 m x 22 m x 1.5 m) for wastewater treatment
- A reed bed (20 m x 10 m x 1.8 m) for sludge treatment
- A 150 m^3 collection tank for treated water for irrigation purposes

http://www2.gtz.de/ecosan/download/ecosan-pds-015-Syria-HaranAlAwamied.pdf

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Constructed wetland Haran-Al-Awamied Syria

A. Mohamed 2004

http://www2.gtz.de/ecosan/download/ecosan-pds-015-Syria-HaranAlAwamied.pdf

Parameter	Inlet	Outlet	Efficiency
COD mg/l	446	70	84%
BOD_5 mg/l	220	32	85%
PO_4-P mg/l	19,3	6,1	68%
NO_3-N mg/l	1	45	
Worm-Egg	-	1 egg/l	

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2nd Case study: Treatment of „raw“ wastewater

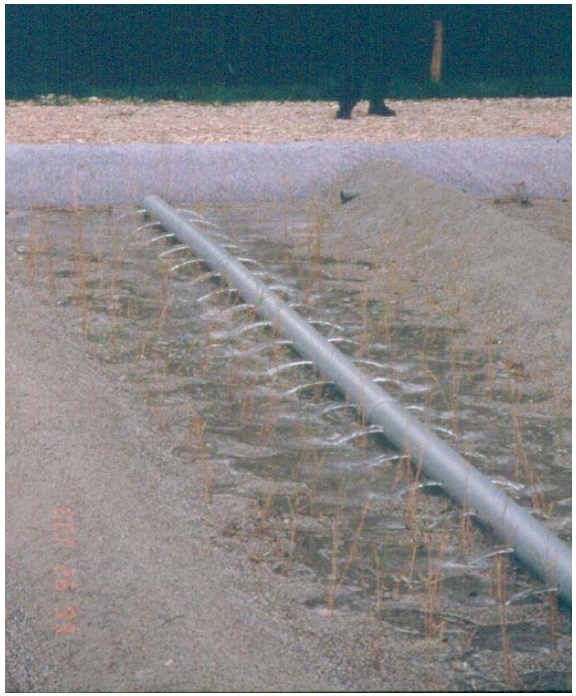
French system by CEMAGREF: with 2 stages VSF

First stage of treatment: larger inlet size to prevent clogging

Molle et. al., CEMAGREF

2nd Case study: Treatment of „raw“ wastewater

Second stage of treatment: finer inlet size to evenly distribute the wastewater



Molle et. al., CEMAGREF

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3rd Case study “Lambertsmühle”, Germany

Initiative and Finance:
- Wupperverband and Verein Lambertsmühle

Development of the Sanitation Concept
- Otterwasser GmbH, Lübeck

Scientific consultation
- TUHH Institute. of Wastewater Management

Elements of the Sanitation Concept:

- Urine-sorting Toilets and waterless Urinals
- Storage Tank for Yellow Water
- Pre-Composting Tank (2 chambers, Filter Bags)
- Constructed Wetland for filtered Grey- and Brownwater

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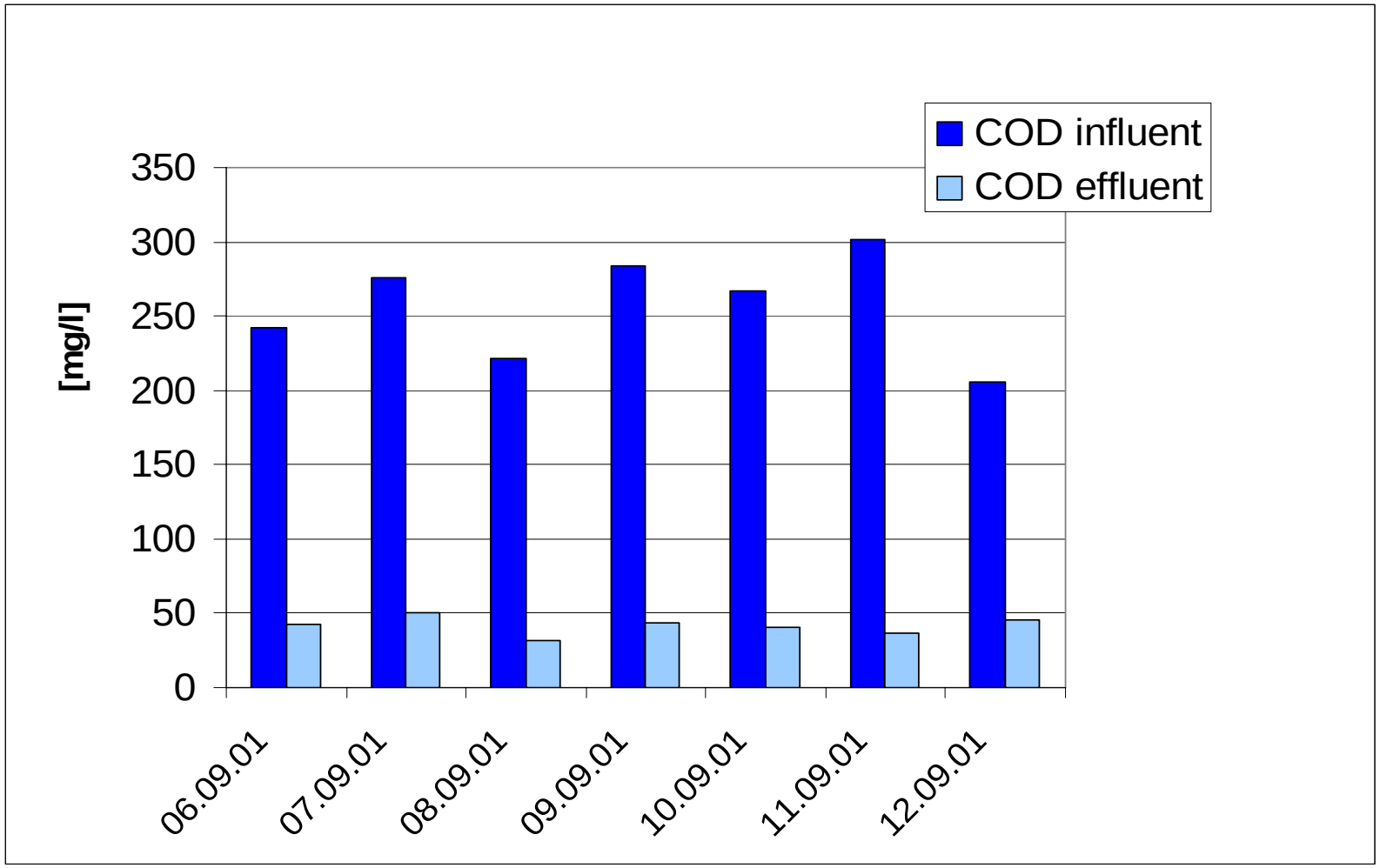
Pilot Project *Lambertsmühle*
Constructed Wetland - COD Concentrations



http://www.otterwasser.de/english/concepts/lande.htm

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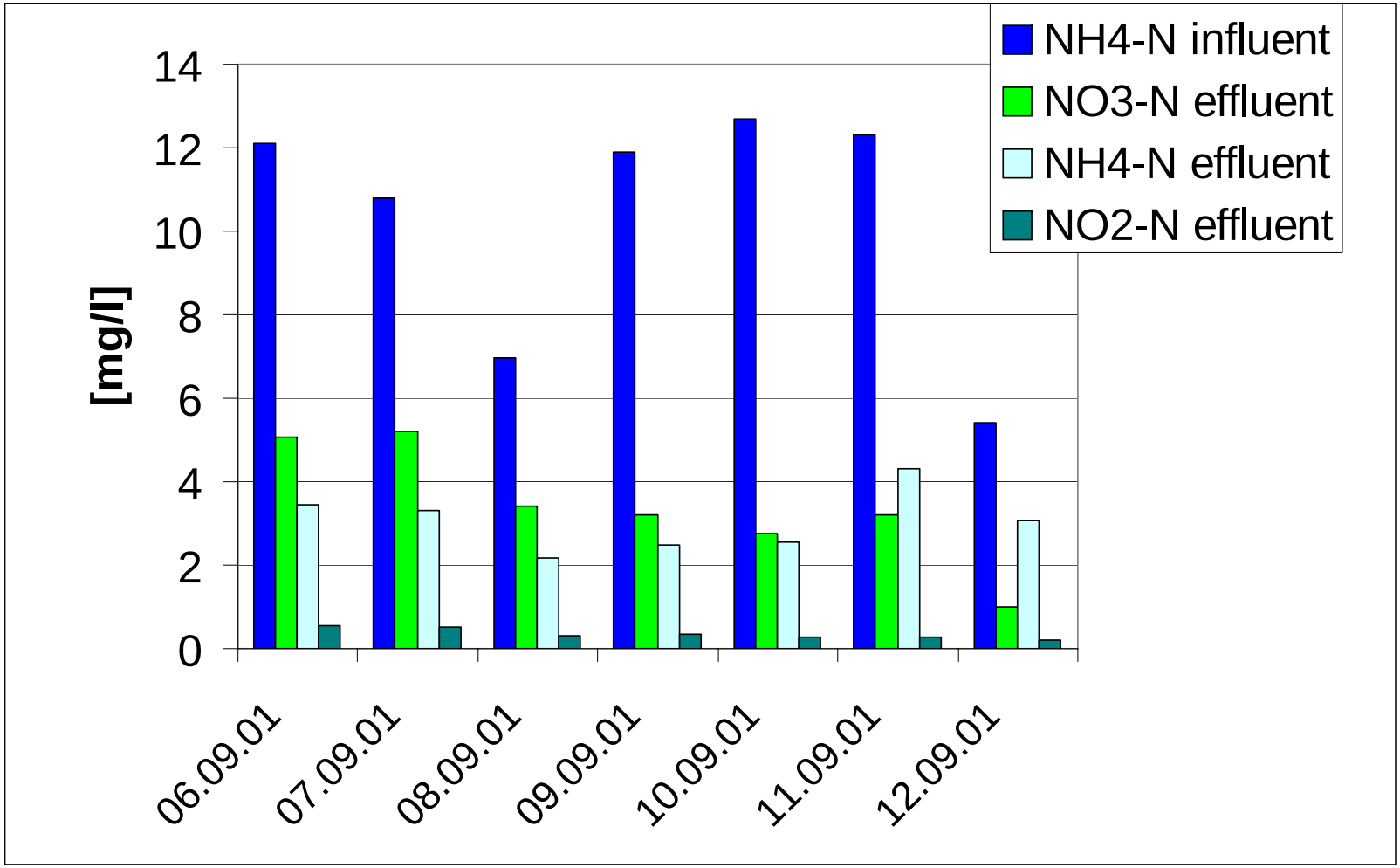
Pilot Project *Lambertsmühle*
Constructed Wetland - Nitrogen Concentrations



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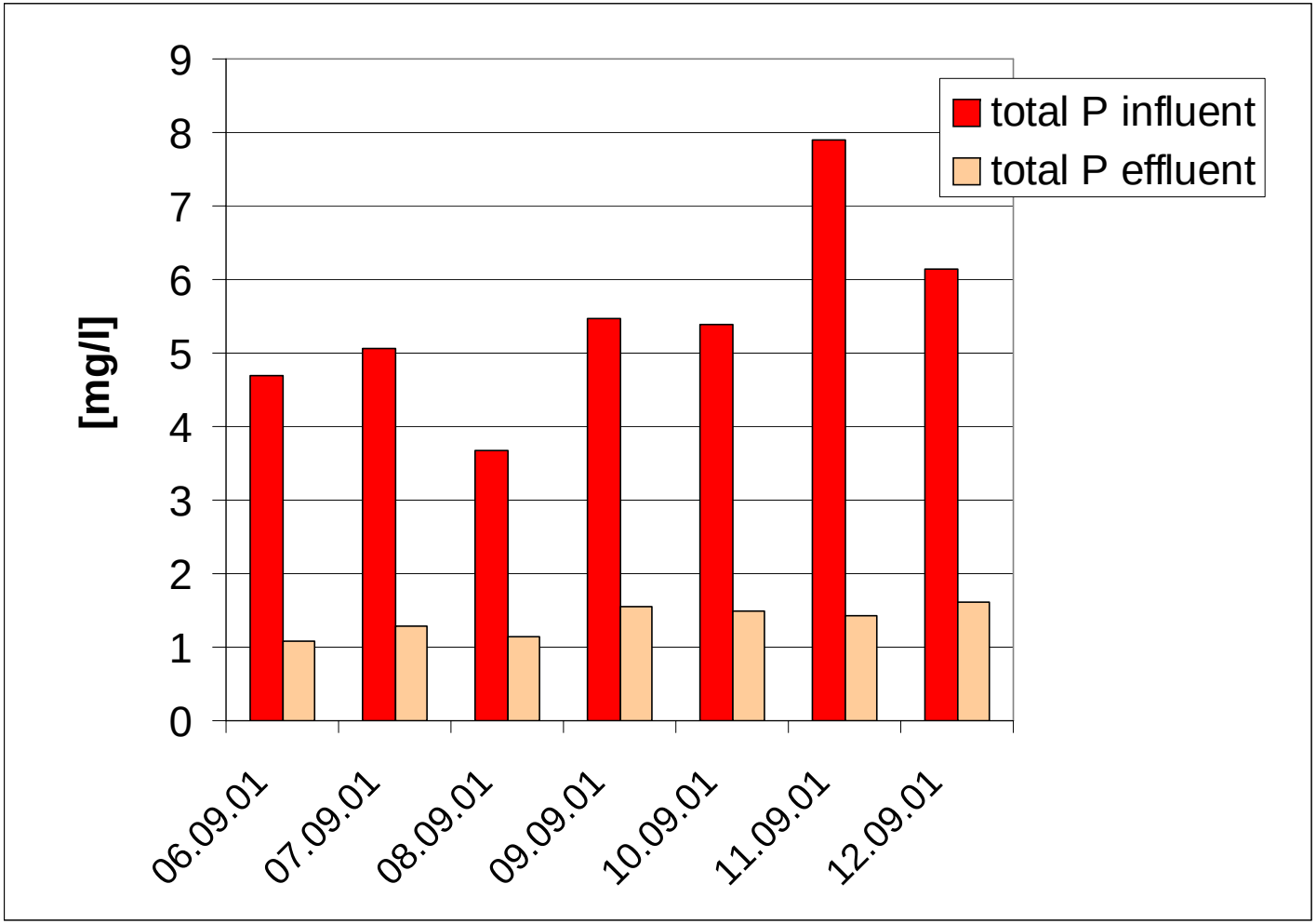
Pilot Project *Lambertsmühle*
Constructed Wetland - Phophorus Concentrations



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THANK YOU

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