LIFE GREEN ADAPT

WETPOL 2023
Bruges Meeting & Convention Centre, Belgium

Implementation of landfill leachate treatment with nature based solutions: LIFE GREEN ADAPT

Luz Herrero Castilla
AIMEN Technology Centre - Spain

With the contribution of the LIFE Programme of the European Union under agreement No. LIFE20 CCA/ES/001795

Project overview

LIFE GREEN ADAPT

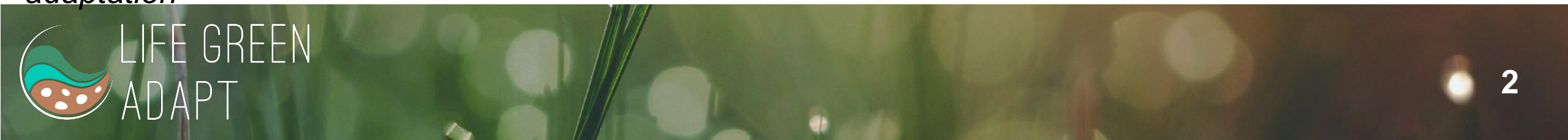
Green and Nature-Based Solutions for climate change-resilient waste infrastructure

Start date: 01/07/2021
End date: 31/12/2024

Total project budget: 3,038,828 €
EU financial contribution requested:

Work area: *Resilience of infrastructure, including application of blue-green infrastructure and ecosystem-based approaches to adaptation*

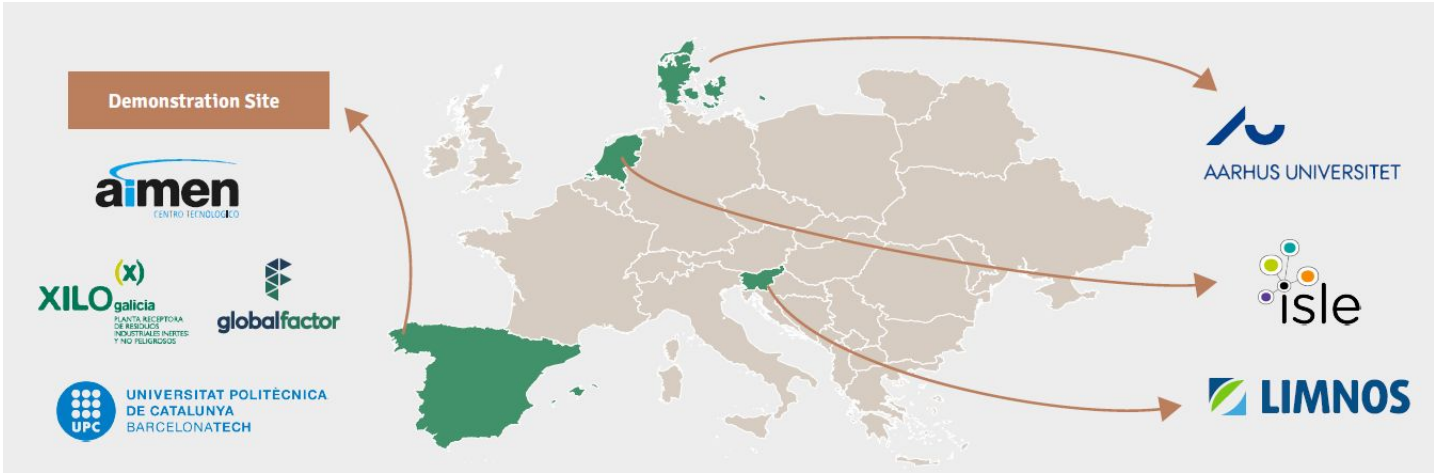
LIFE Climate Change Adaptation



Intro & acknowledgments

Co-Authors: *Gómez-Cuervo S., Ávila Martín, C., Otero M., Villar P., Pancorbo E.,Toca V., Brodnik U. , Arias C., Herrero Castilla L.P.*

Work area: *Resilience of infrastructure, including application of blue-green infrastructure and ecosystem-based approaches to climate adaptation*



Project overview – Climate problem

>500.000

EXTREME WEATHER EVENTS

80%

20%

140 years

ADVERSE EFFECTS

DROUGHTS

HEATWAVES

FIRES

HEAVY RAINS

INCREASE OF LEACHATES

LANDSLIDES

FLOODS

ADAPT

Climate problem – Some examples

@cnn

Delhi (India) – March-April 2022

Extreme Temperature Heatwaves T > 40ºC

Urban waste landfill

Rafa Jover @informacion.es

Monávar (Alicante - Spain) – 26/07/2022

Heatwave T > 30ºC overnight & Humidity > 75%

Inert waste landfill

Climate problem – Some examples

Asunción (Paraguay) – July 2014

Extreme rainfall – Floods

Urban waste landfill

@rtve

Zaldibar (Spain) – February 2020

Extreme rainfall – Landslide

Hazardous waste landfill

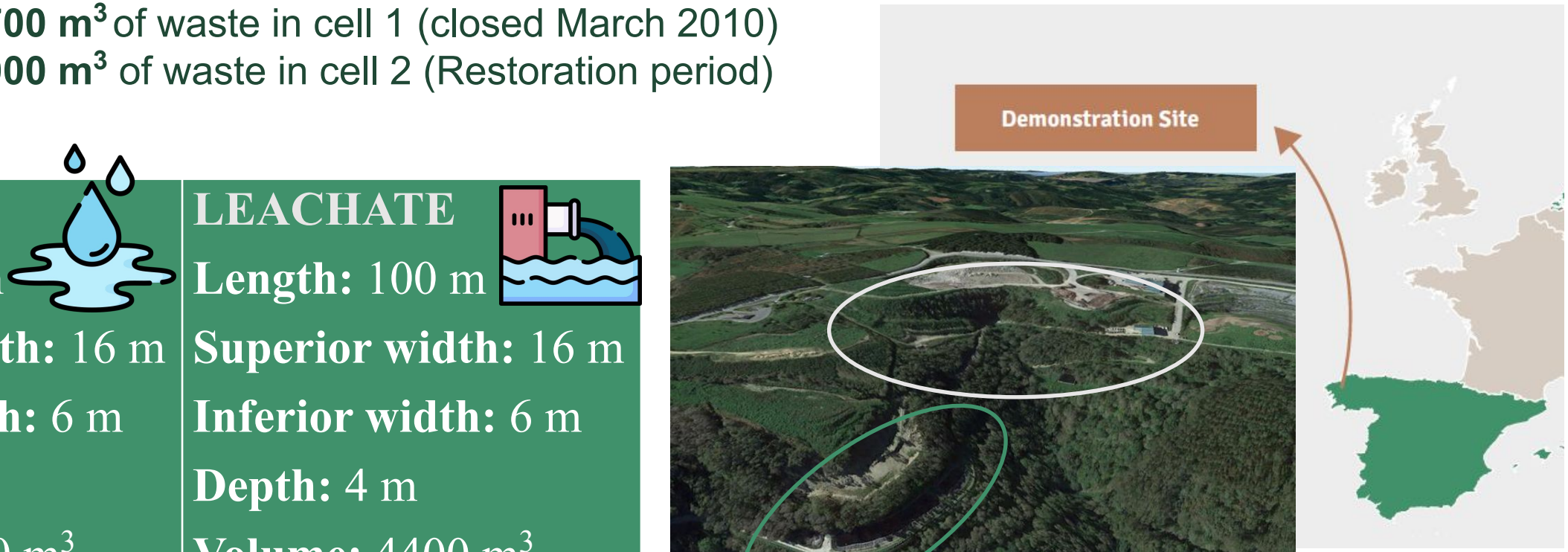
Project overview – Main objective

LIFE GREEN ADAPT aims to ***increase the resilience of EU waste infrastructures*** (focused on landfills as potential source of severe pollution episodes when impacted by extreme events) against Climate Change by demonstrating ***blue-green infrastructures (BGI) and ecosystem-based approaches potential***.

LIFE GREEN ADAPT will demonstrate BGI ability to manage ***flush flooding and run-off*** caused by heavy rainfall and ***prevent fires and explosions*** caused by droughts and unusual heatwaves

Project overview – Case study

XILOGA Landfill: Operational since 1999 (Industrial/Inert waste)
24,700 m³ of waste in cell 1 (closed March 2010)
58,000 m³ of waste in cell 2 (Restoration period)



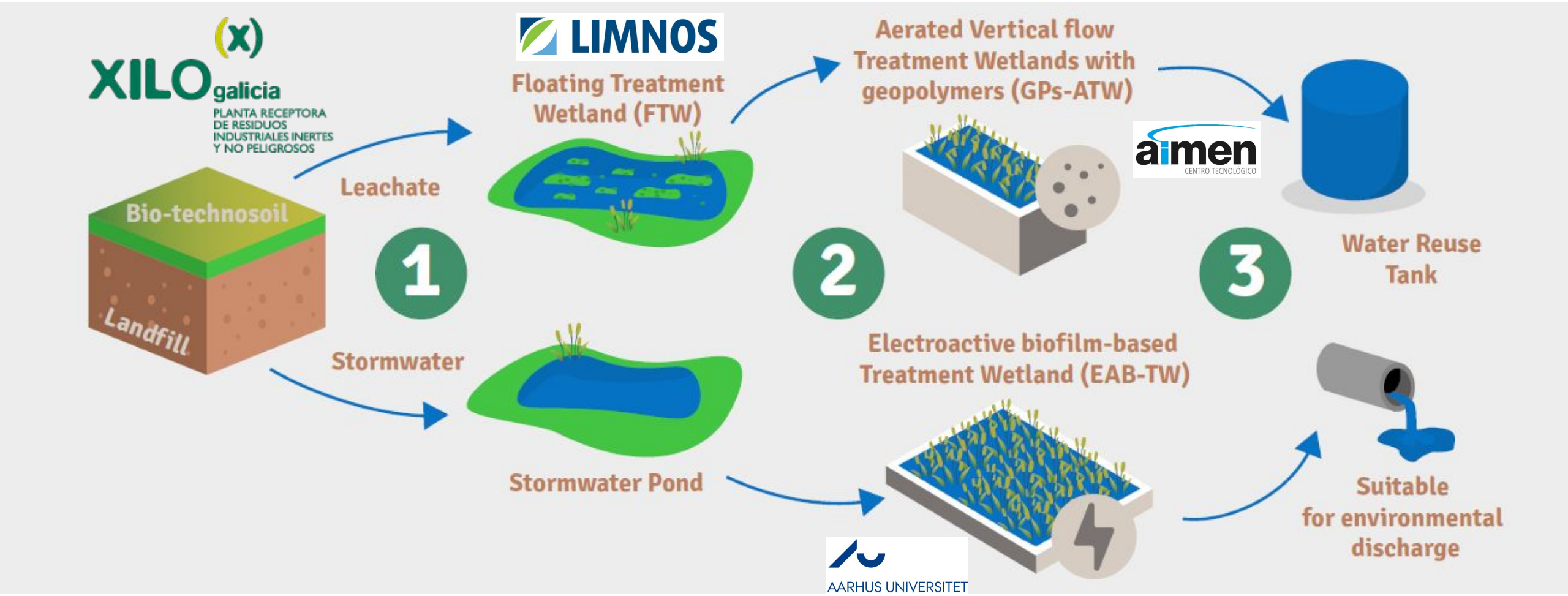
RUN-OFF	LEACHATE
Length: 50 m	**Length:** 100 m
Superior width: 16 m	**Superior width:** 16 m
Inferior width: 6 m	**Inferior width:** 6 m
Depth: 4 m	**Depth:** 4 m
Volume: 2200 m³	**Volume:** 4400 m³

Rainfall: **1,000 mm/year**

- 37% Dec–Feb
- 34% Sep–Nov
- 27% Mar–May

- Summer: Hot and dry (T 20ºC – 30ºC)
- Winter: T (10 ºC)
- NW winds

Concept (Blue & Green infrastructures)



Green infrastructures - Biotechnosoil

XILO galicia
PLANTA RECEPTORA DE RESIDUOS INDUSTRIALES INERTES Y NO PELIGROSOS

Green infrastructures - Biotechnosoil

XILO galicia
PLANTA RECEPTORA DE RESIDUOS INDUSTRIALES INERTES Y NO PELIGROSOS

Green infrastructures - Biotechnosoil

XILO galicia
PLANTA RECEPTORA DE RESIDUOS INDUSTRIALES INERTES Y NO PELIGROSOS

Green infrastructures - Biotechnosoil

Sampling campaigns for TW design

- **Sampling plan in the ponds** for TW design (leachate and run-off)
- **Representative samples:**
  - 3 sampling points/pond
  - 2 composite samples/week
  - 3 weeks (Jan – Feb. 2022)
- **Characterization parameters chosen according to discharge thresholds and historical data monthly analysis (2019-2021)**
- **Parameters analysis:**
  - Organic matter and Nutrients
  - Other compounds: Ion, heavy metals, oils

Results sample campaigns - Leachate

LANDFILL LEACHATE		DISCHARGE LIMITS
pH	8.3 ± 1.2	5.5 – 9.5
EC (mS/cm)	23.4 ± 10	
TSS (mg/L)	19.6 ± 2,5	80
COD (mg/L)	2542 ± 13,1	160
BOD_5	112.7 ± 26.6	
NH_4^+ (mg/L)	3156 ± 1133	
NO_3^- (mg/L)	46 ± 44	
Total N (mg/L)	841.5 ± 75,9	15

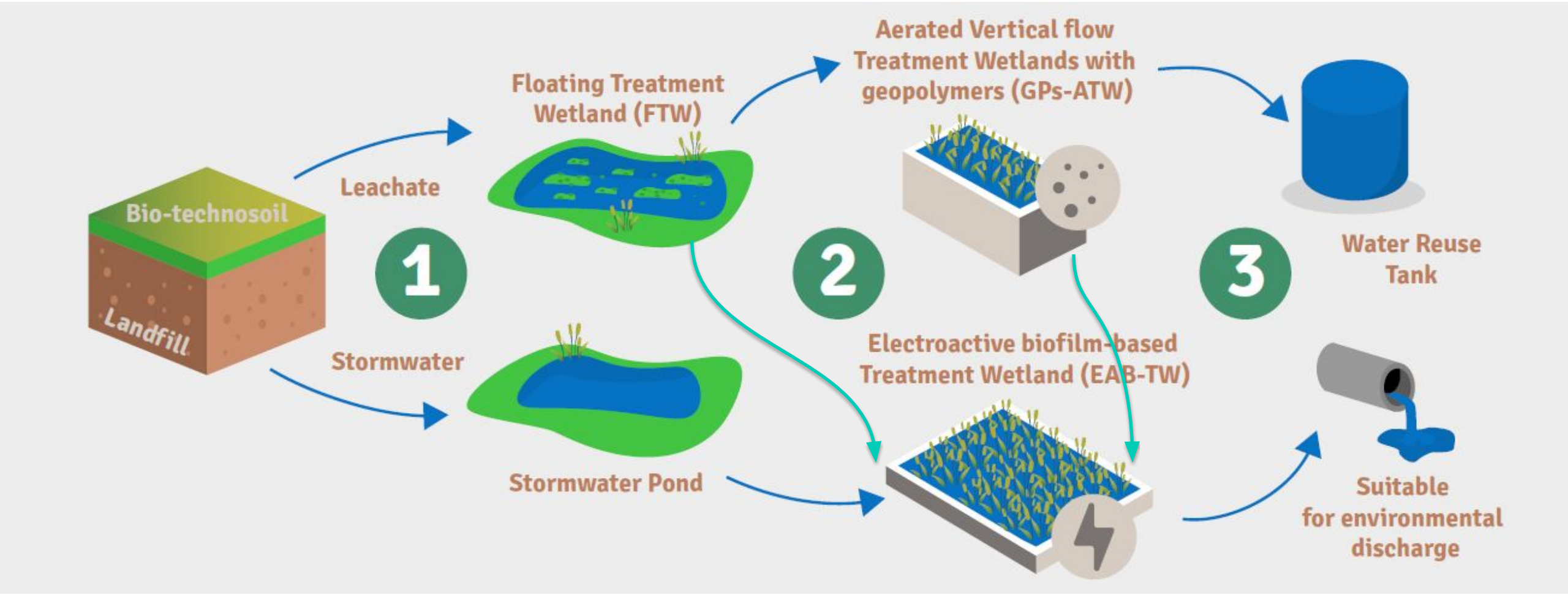
LANDFILL LEACHATE		DISCHARGE LIMITS
PO_4^{3-} (mg/L)	52,8 ± 29,5	
Total P (mg/L)	8.7 ± 1.8	10
SO_4^{2-} (mg/L)	133.2 ± 97.5	2000
Cl^- (mg/L)	2999 ± 405	2000

Results sample campaigns – Run -off

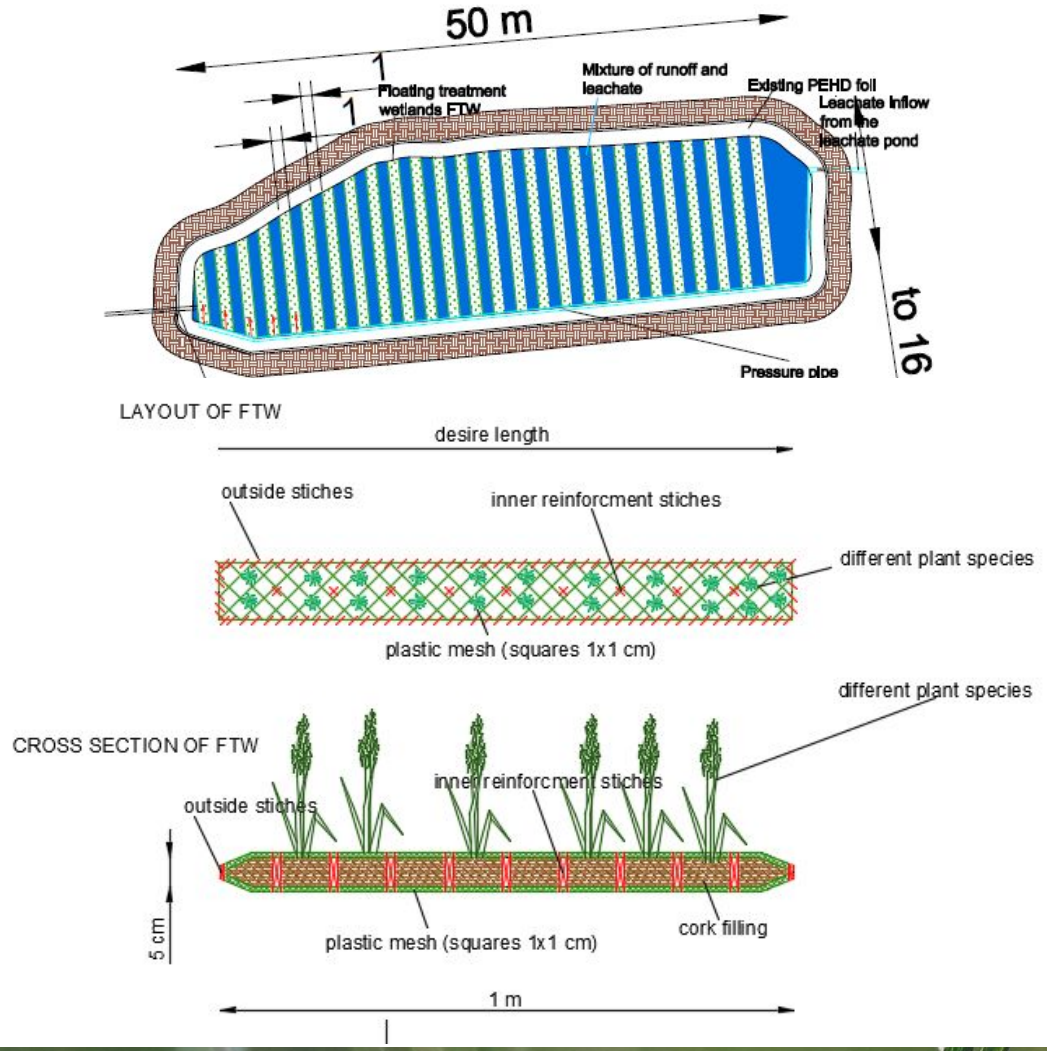
RUN - OFFT		DISCHARGE LIMIT
pH	7.06 ± 0.67	5.5 -9.5
EC (µS/cm)	278 ± 394	
TSS (mg/L)	42.4 ± 40.0	80
COD (mg/L)	8.5 ± 2.5	160
NH4+ (mg/L)	0.25 ± 0.42	0
NO3- (mg/L)	32.5 ± 51.5	
Total N (mg/L)	16.9 2.4	15

RUN – OFF		DISCHARGE LIMIT
PO43- (mg/L)	0,34 ± 0.23	
Total P (mg/L)	0.12 0.07	10

Concept (Blue & Green infrastructures)



Floating treatment wetlands - FTW



	Type	Percentage represented	Planted area [m^2]	Number of plants
GROUP 1	Any type of *Carex*	40-50 %	120 - 150	1200 - 1500
GROUP 2	*Juncus, Typha latifolia, Schoenoplectus lacustris, Phalaris arundinacea*	20 %	60	600
GROUP 3	Flowering plants	30-40 %	90-110	900 - 1200
			TOTAL	3000

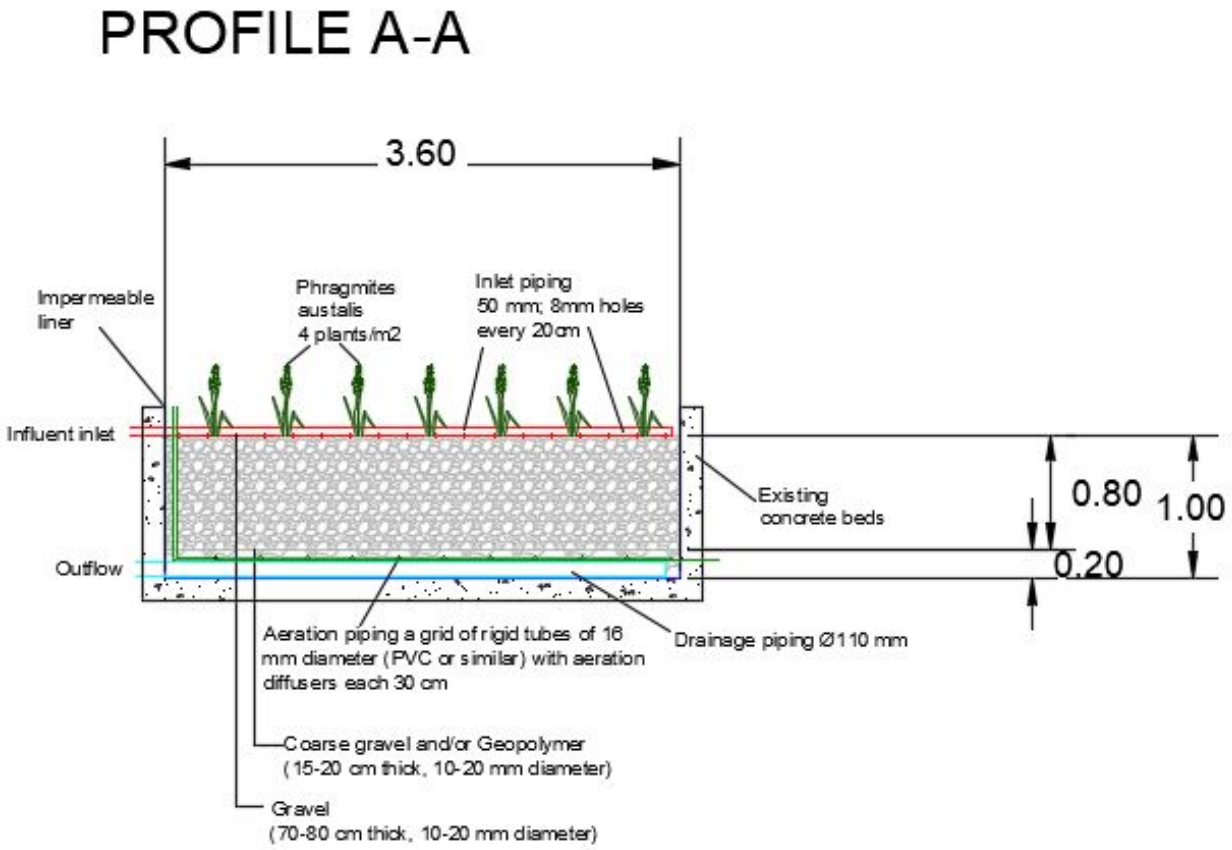
Floating treatment wetlands - FTW

- Expanded polystyrene (EPS) foam for platforms
- Mix of plants
- Challenges to place the platforms in an existing pond
- Adaptation period
- Start - up

Aerated Vertical flow treatment wetlands with geopolymer (GPs – ATW)

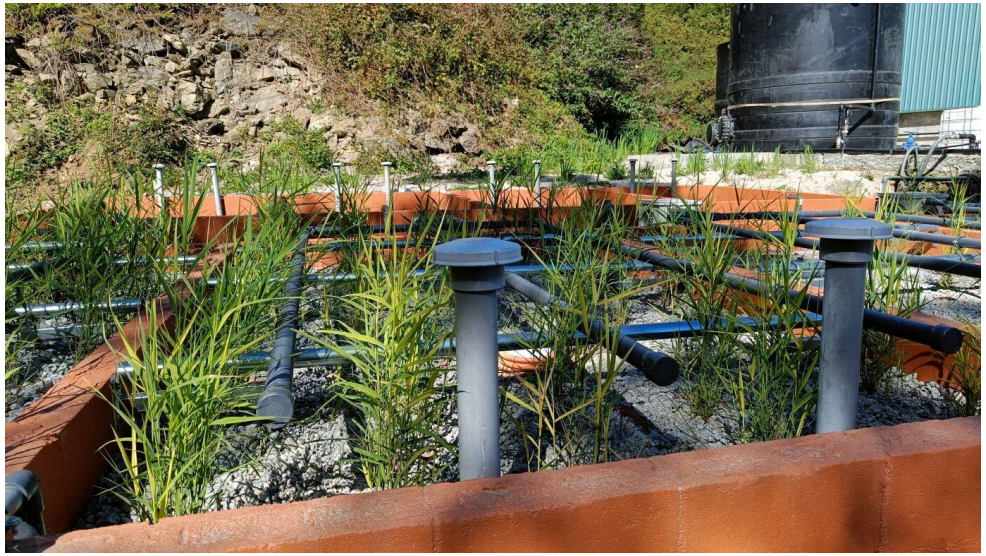
- Total wetland surface of 33 m^2
- 4 parallel beds of 3.6 x 2.3 m (8.3 m^2 per cell):
- 3 beds with GP in the ATW in two different settings
  - i) GP into the filter media.
  - ii) GP pre-treatment unit
- 1 bed as control ATW without the GP
- HLR: 3.3 cm/d
- HRT: 4-5 days per bed
- OLR: 160 g COD/m^2·d
- Aeration requirements: 360 g O_2/m^2 d

Aeration time per day (h)	Airflow requirement per cell (m^3/h)	Total airflow requirement (m^3/h) for the 4 cells
4	1,23	4,91
6	0,82	3,27
8	0,61	2,45
12	0,41	1,64
16	0,31	1,23



Aerated Vertical flow treatment wetlands with geopolymer (GPs – ATW)

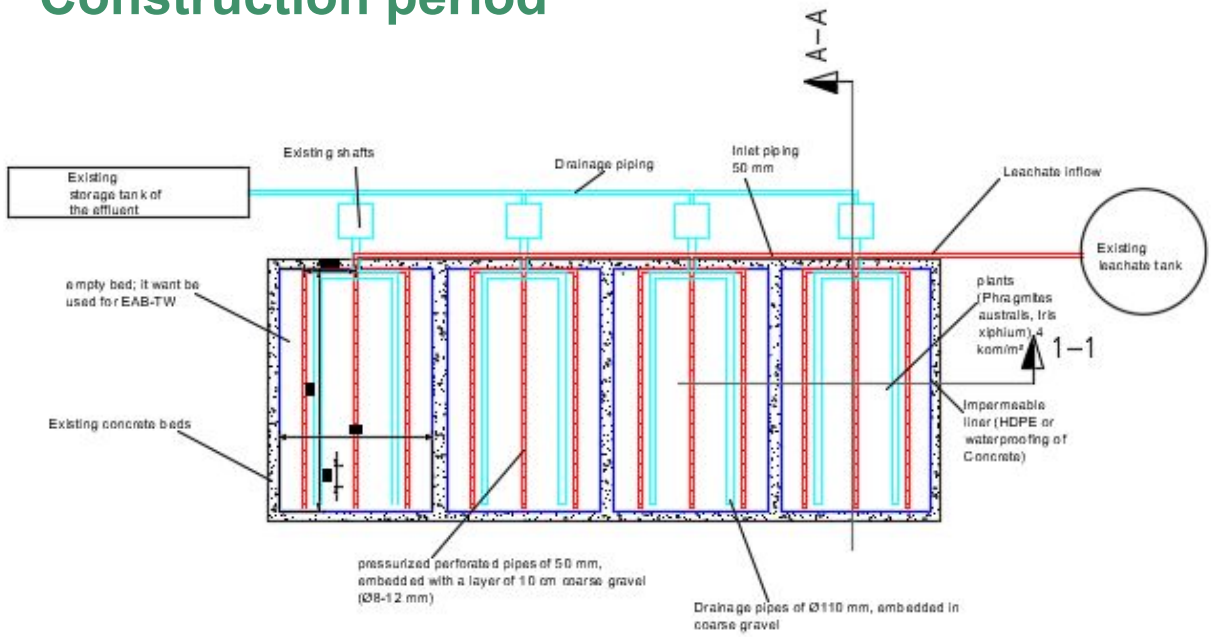
- **Start-up feeding manually the system with leachate**
- **Problems to manufacture high quantities of GP**
- **Sampling campaigns**
- **Automation of feeding/aeration**

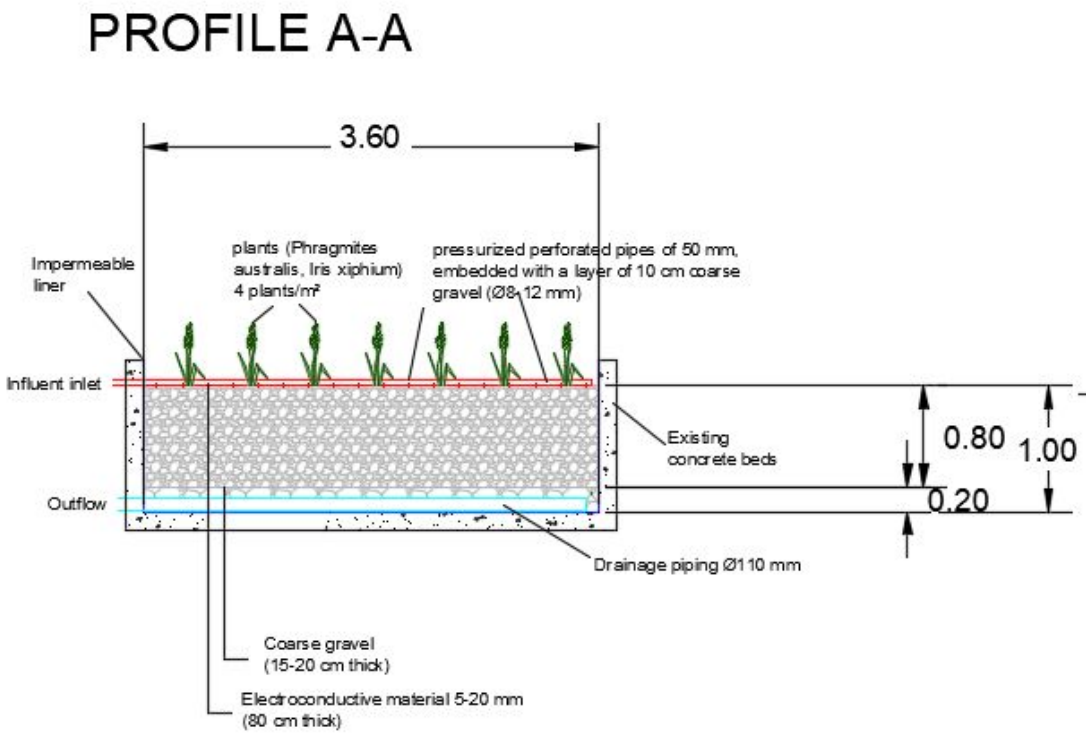


Electroactive biofilm based treatment wetland (EAB-TW)

AARHUS UNIVERSITET

- **Lack of availability of electroactive material**
- **Assessing new materials (ex: waste of welding flux)**
- **Construction period**





Conclusions – Take home messages

- Permits and construction period are the worst enemy for start-up and operation
- Allocate as much as possible time and resources for this period Save money in pharmaceuticals for headaches!
- Be open-minded when working with a waste manager (They strongly believe in circular economy!)
- Be patient with LIFE GREENADAPT project until the next treatment wetland Conference for operation results

Thanks for your attention!