bio2clean

Phytoremediation of dredged sediments polluted with mineral oil, naphtalene and PAH

Managing Partners

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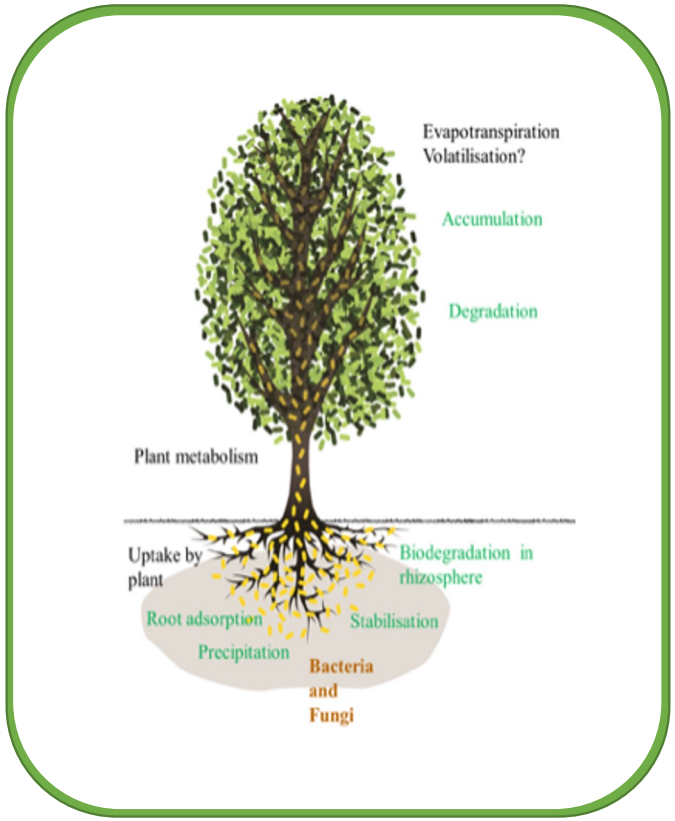
Phytoremediation

Definition

A remediation strategy that uses plants and plant-associated micro-organisms to remove contaminants from soil, water or sediment through degradation, extraction, transformation or volatilisation or to stabilise the contamination (immobilisation).

Code of Good Practice on Phytoremediation – january 2019

Phytoremediation



- Phytovolatilisation — Hg, org
- Phytoextraction — Metals
- Phytodegradation — Org

- Phytostabilisation
- Rhizodegradation — Org, CN
- Phytohydraulics

Phytoremediation

Different pollutants

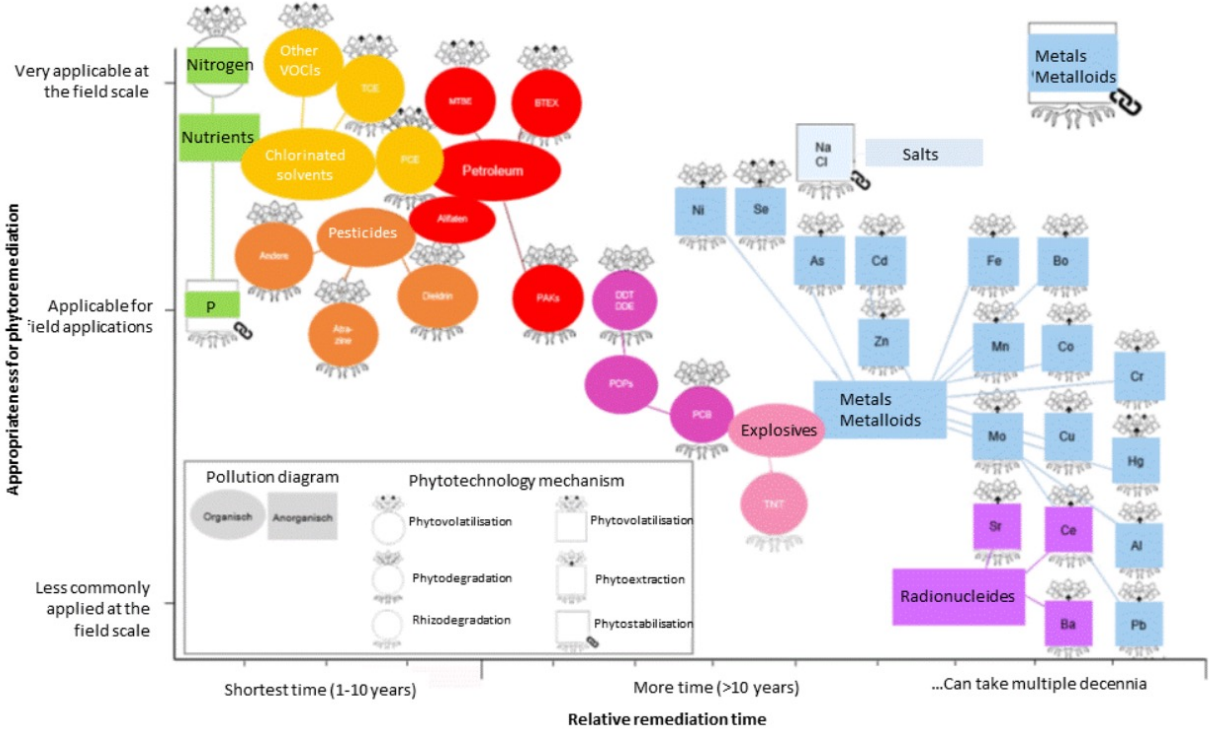
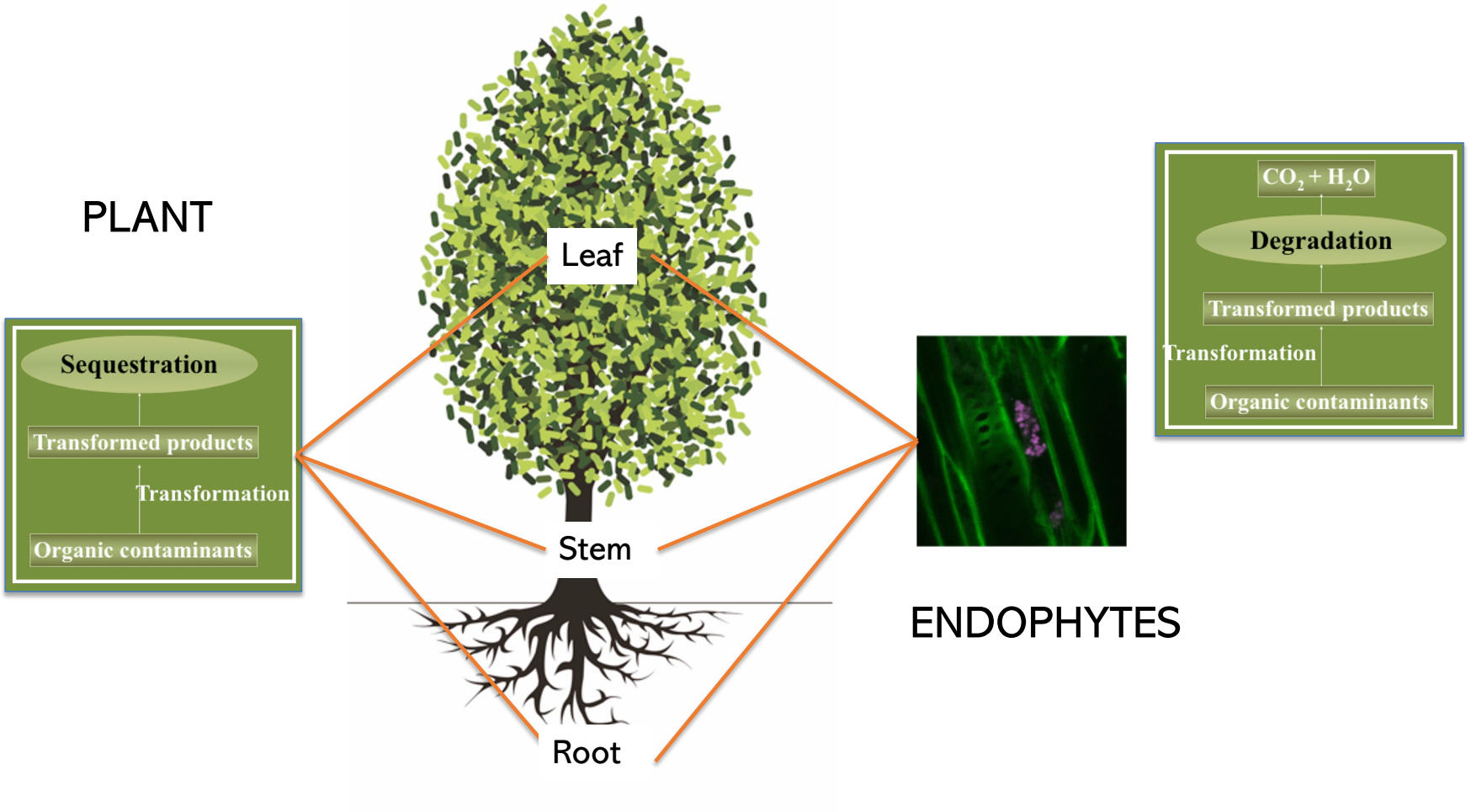


Figure 8: Overview of the phytoremediation potential of some contaminants and associated phytoremediation mechanism. Adapted from "PHYTO, Principles and resources for site remediation and landscape design," by Kate Kennen and Niall Kirkwood, 2015. Adjustments are based on information from field studies (up to 2019) and may change in subsequent editions as more remediation is performed.

Microorganism assisted phytoremediation



Microorganism assisted phytoremediation

Advantages

- No soil degradation
- Less percolation
- No phytovolatilisation
- Public acceptance
- Small ecological footprint
- Poplars
  ➔ Depth +/- 10m
- Organics
  ➔ Degradation to H_2O en CO_2

Microorganism assisted phytoremediation

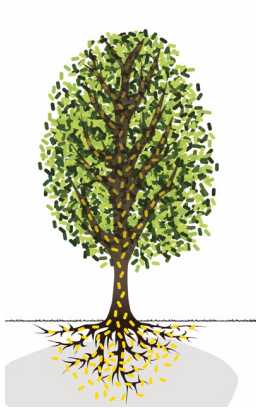
Practices

Microorganism assisted phytoremediation

More than remediation

SUSTAINABILITY

Less consumption of materials and energy
CO2 sequestration
Energy from biomass
Storage of greenhouse gases
…



BIODIVERSITY

Soil restoration
Soil structure and fertility
Erosion control
Soil life and microbial diversity
Soil ecosystem services
Habitats for animals and plants
…

ENVIRONMENTAL QUALITY

Urban green
Noise reduction
Air quality
Climate regulation
Attractive multifunctional landscapes
…

Results from the field

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EUROPESE UNIE
Vlaanderen-Nederland
Europees Fonds voor Regionale Ontwikkeling

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Pilots

- Pilot 1 (ex Carcoke)
- Pilot 2 (riparian zone Zijdelings Vaartje)
- Pilot 3 (phytopiles Envisan)

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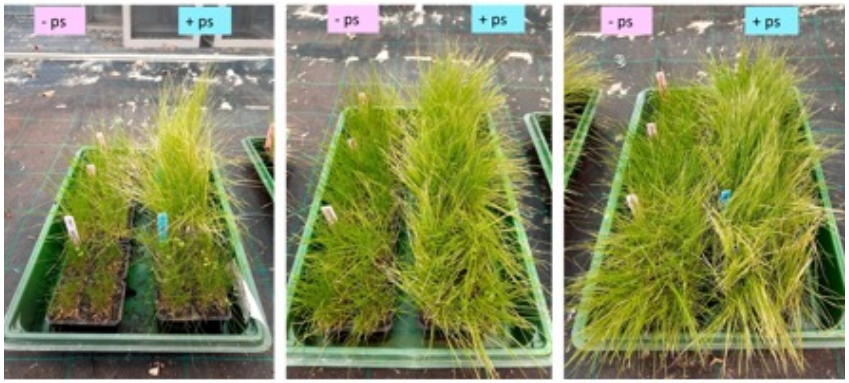
Feasibility study

1. Degrading micro-organisms are present
   DNA-extraction – qPCR:
   Pilot 1 (soil): degrading genes present for oil (log10AlkB) and naphtalene (log10NAH)
2. Degrading micro-organisms in soil and groundwater
3. Oil degradation test
4. Pot experiments grasses (phytopiles)



Sample	Treatment	Root length (cm)	Shoot length (cm)	Ratio Root:Shoot
		min-max	min-max	
LP_Fastball	No potting soil	15.8 - 17.6	8.2 - 9.4	2.13
LP_Grandslam	No potting soil	18.7 - 19.6	9.5 - 7.6	2.11
LP_Greenplanet	No potting soil	18.0 - 19.5	11.0 - 12.5	1.73
FRT	Potting soil	18.2 - 21.5	20.6 - 18.6	1.00
LP_Fastball	Potting soil	14.2 - 15.6	10.5 - 13.4	1.50
Mistral	No potting soil	12.5 - 14.7	13.2 - 14.5	1.08
Mistral	Potting soil	14.5 - 15.8	14.6 - 16.7	1.07
FA	No potting soil	13.2 - 15.1	14. - 15.5	1.07
LP_Agreement	No potting soil	13.5 - 14.2	14.0 - 15.4	1.00
LP_Greenplanet	Potting soil	12.5 - 14.7	14.6 - 15.0	1.00
LP_Grandsam	Potting soil	12.1 - 13.6	14.6 - 16.1	0.93
FRT	No potting soil	4.7 - 5.1	6.5 - 7.2	0.77
AE	No potting soil	8.3 - 9.7	14.0 - 14.8	0.64
LP_Agreement	Potting soil	7.5 - 8.9	15.2 - 15.8	0.53
AE	Potting soil	8.4 - 9.3	20.5 - 22.8	0.45
FA	Potting soil	5.5 - 7.5	18.4 - 19.5	0.39

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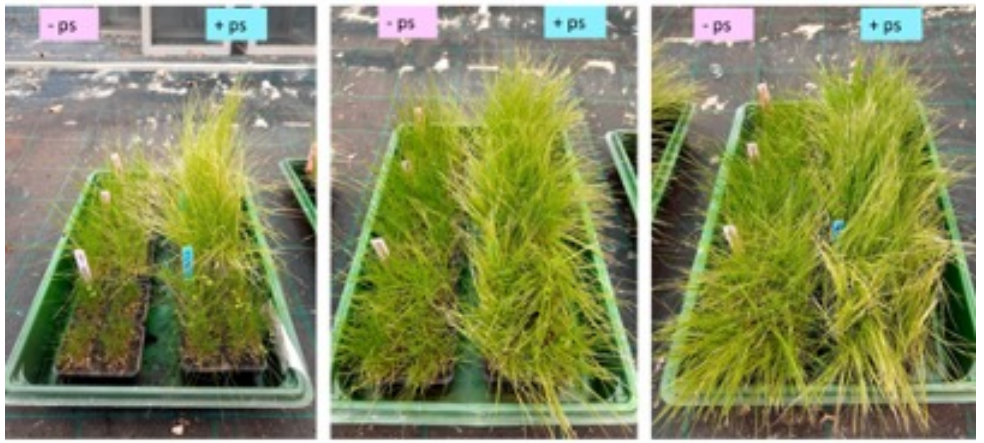
Feasibility study



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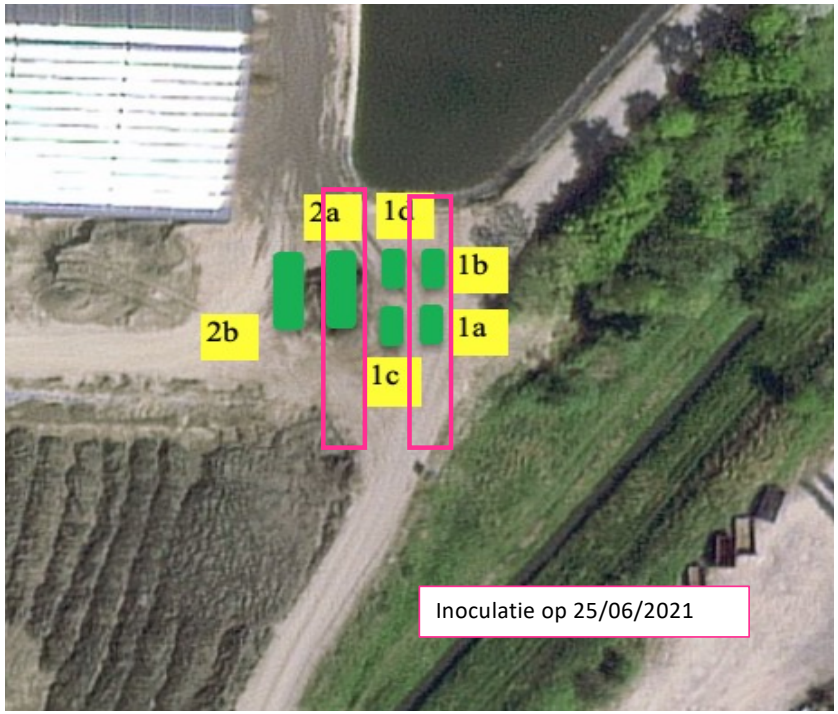
Pilot 3: phytopiles

Creation of phytopiles 1/10/2020

Envisan, Ghent

- 2 larger phytopiles, 2 conditions:
  - inoculation
  - without inoculation / without aeration
- 4 smaller phytopiles:
  - inoculation
  - without inoculation
  - Seeds coated
  - Without aeration



Envisan ENVIRONMENTAL SOLUTIONS

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Pilot 3: phytopiles

Inoculation and monitoring

- Visual inspection grasses
- Samples rhizosphere for qPCR (UHasselt)
- Almost all piles well rooted to +/- 35cm deep (at 6 months)
- Multi line of evidence

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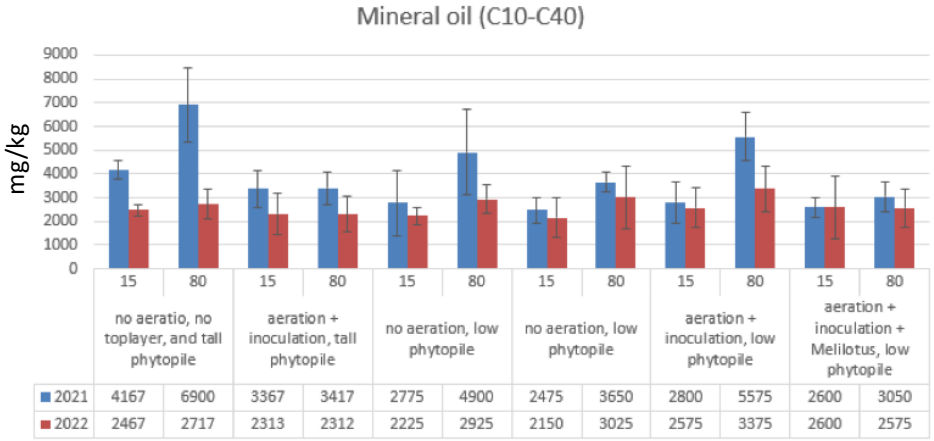
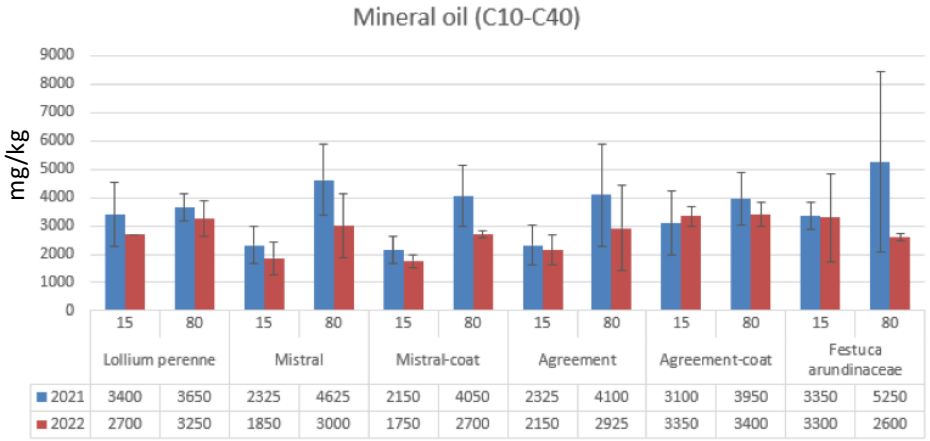
Pilot 3: phytopiles



	15	80	15	80	15	80	15	80	15	80	15	80
	no aeratio, no toplayer, and tall phytopile		aeration + inoculation, tall phytopile		no aeration, low phytopile		no aeration, low phytopile		aeration + inoculation, low phytopile		aeration + inoculation + Melilotus, low phytopile	
2021	4167	6900	3367	3417	2775	4900	2475	3650	2800	5575	2600	3050
2022	2467	2717	2313	2312	2225	2925	2150	3025	2575	3375	2600	2575



	15	80	15	80	15	80	15	80	15	80	15	80
	Lollium perenne		Mistral		Mistral-coat		Agreement		Agreement-coat		Festuca arundinaceae	
2021	3400	3650	2325	4625	2150	4050	2325	4100	3100	3950	3350	5250
2022	2700	3250	1850	3000	1750	2700	2150	2925	3350	3400	3300	2600

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Vlaanderen-Nederland

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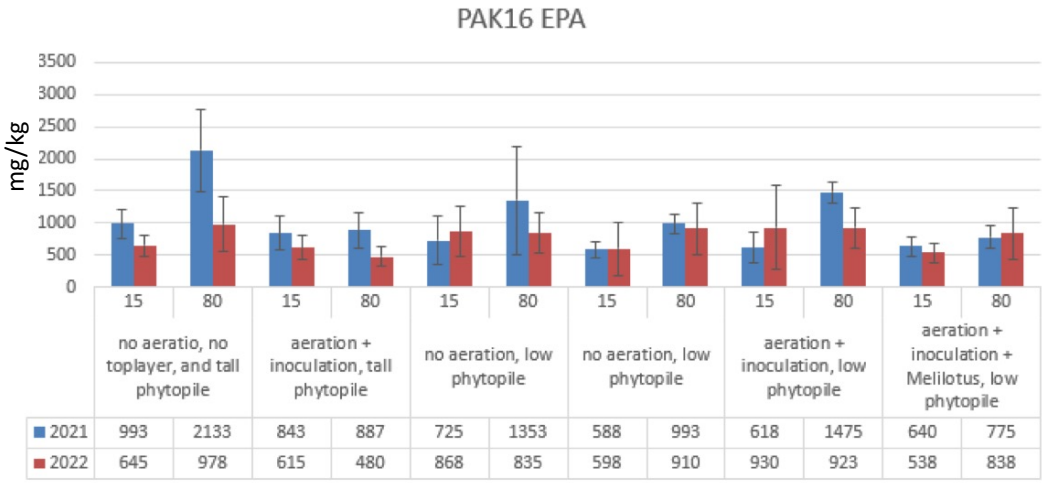
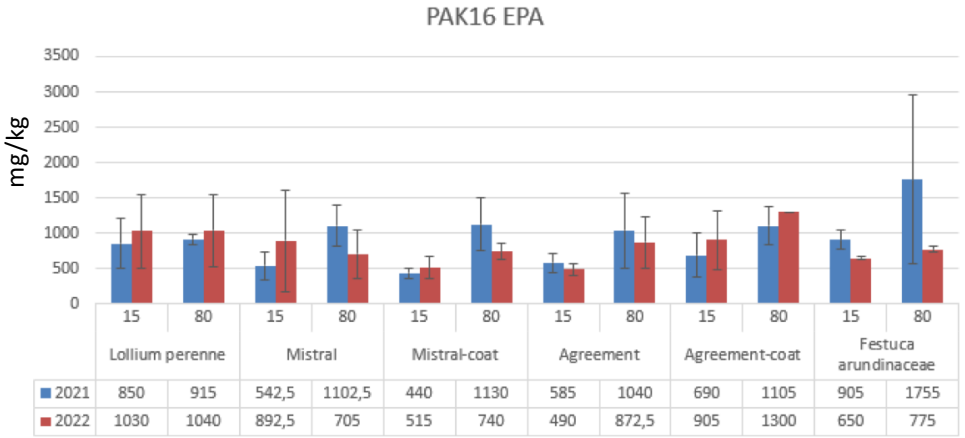
Pilot 3: phytopiles



	15	80	15	80	15	80	15	80	15	80	15	80
	no aeratio, no toplayer, and tall phytopile		aeration + inoculation, tall phytopile		no aeration, low phytopile		no aeration, low phytopile		aeration + inoculation, low phytopile		aeration + inoculation + Melilotus, low phytopile	
2021	993	2133	843	887	725	1353	588	993	618	1475	640	775
2022	645	978	615	480	868	835	598	910	930	923	538	838



	15	80	15	80	15	80	15	80	15	80	15	80
	Lollium perenne		Mistral		Mistral-coat		Agreement		Agreement-coat		Festuca arundinaceae	
2021	850	915	542,5	1102,5	440	1130	585	1040	690	1105	905	1755
2022	1030	1040	892,5	705	515	740	490	872,5	905	1300	650	775

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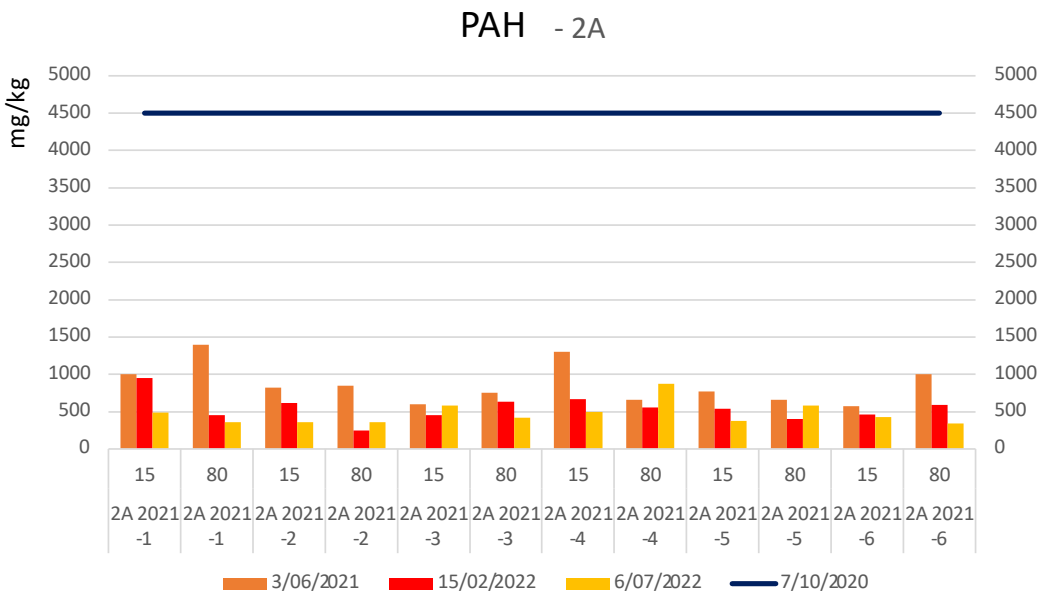
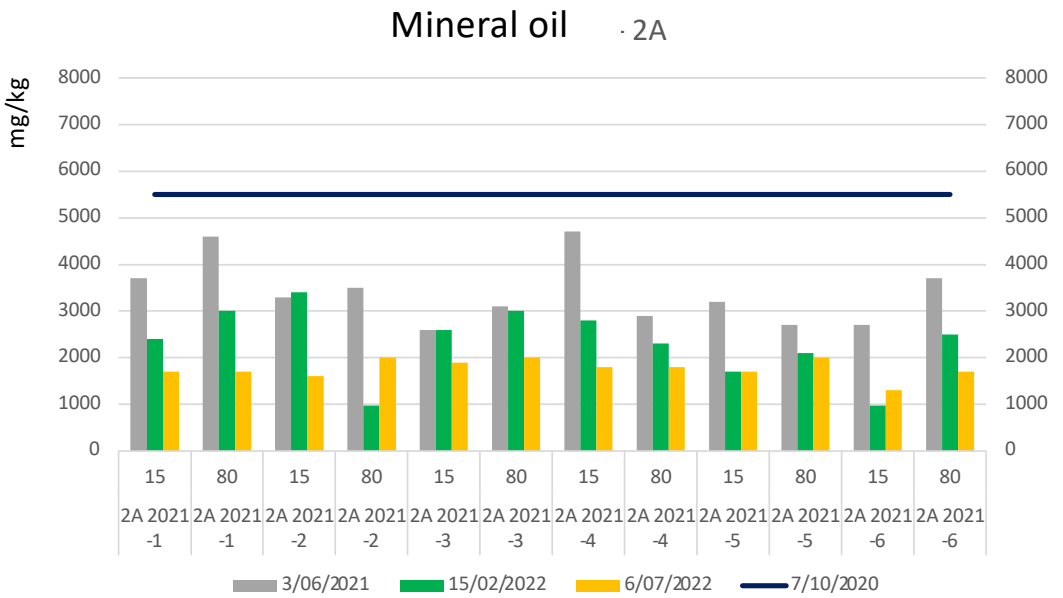
Pilot 3: phytopiles





Reduction PAH:

15 cm: 60 to 86% ➔ 52 tot 90%

80 cm: 39 to 89% ➔ 62 tot 89%

Reduction Mineral oil:

15 cm: 30 to 61% ➔ 49 tot 70%

80 cm: 9 to 58% ➔ 43 tot 68%

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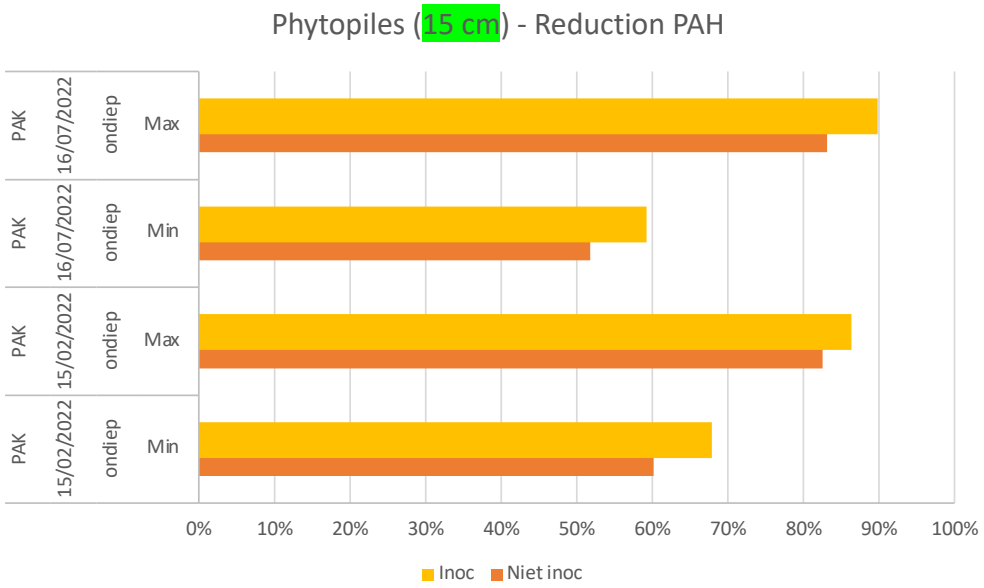
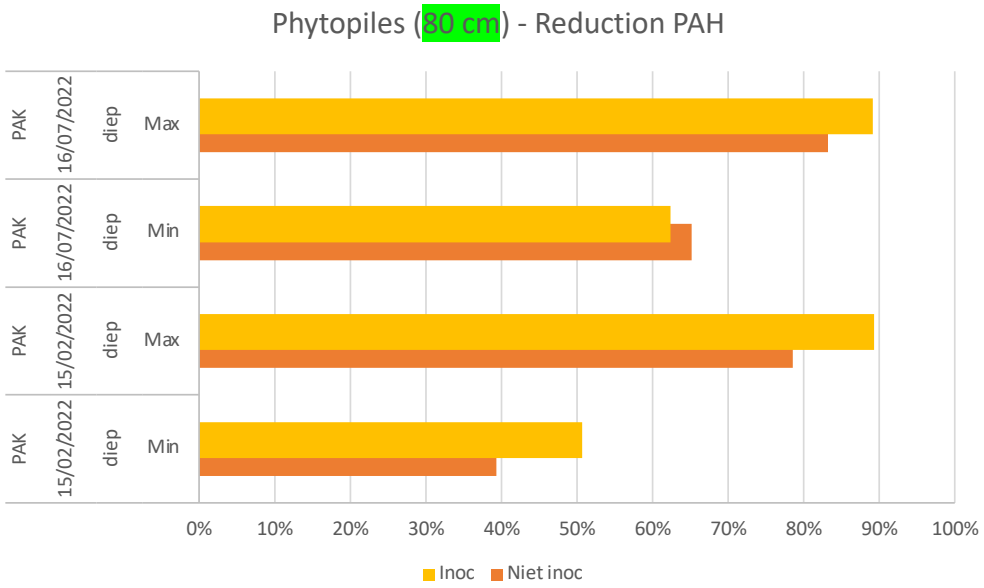
Pilot 3: phytopiles





Life NARMENA

NAture-based Remediation of MEtal pollutants in Nature Areas to increase water storage capacity

narmena
Ruimte voor schone waterlopen

01/07/19 - 31/08/25+ **3 years After-LIFE**

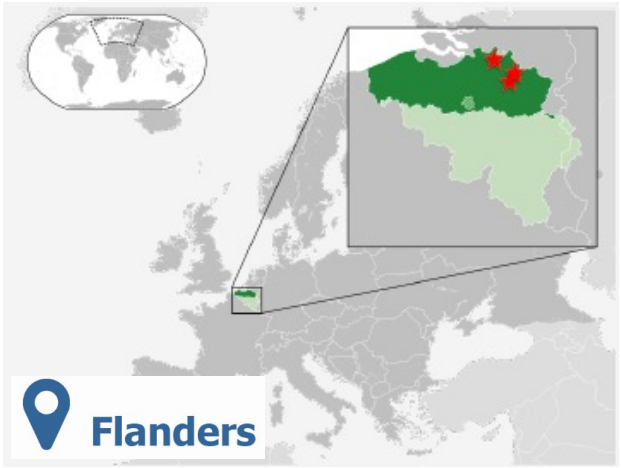
Total: € 4.520.488

55 % EC Co-funding

PROJECT PARTNERS

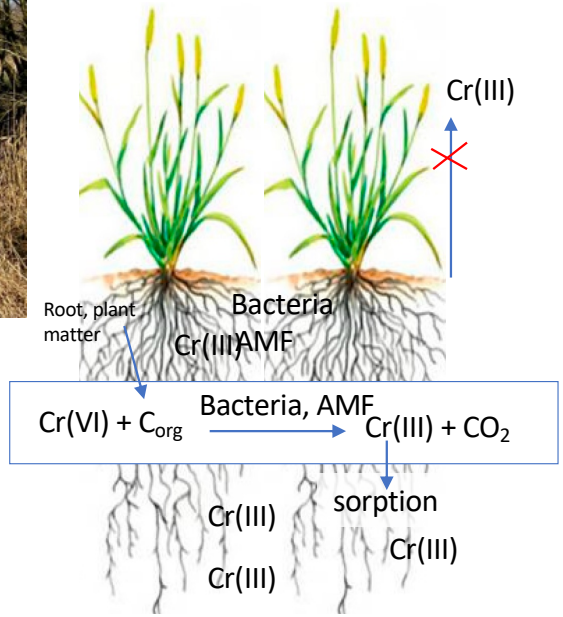
Coordination: OVAM

Associated partners: ABO CONSULTANCY, ARCHE CONSULTING, natuurpunt, VLAAMSE MILIEUMAATSCHAPPIJ, Vlaanderen is natuur, bio2clean



- Grote Calie (Turnhout)
- Winterbeek (Scherpenheuvel-Zichem)
- Grote Laak (Geel-Laakdal)

Life NARMENA



False oat-grass (*Arrhenatherum elatius*)
Hairy willowherb (*Epilobium hirsutum*)
Common reed (*Phragmites australis*)
White willow (*Salix alba*)
Yarrow (*Achillea millefolium*)
Male fern (*Dryopteris filix-mas*)
Broadleaf plantain (*Plantago major*)
Creeping buttercup (*Ranunculus repens*)

https://ovam-english.vlaanderen.be/web/narmena/home

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Thank You !

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Questions ?

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