

Danish innovation and improvement of environmental drainfilter solutions

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SEGES

Promilleafgiftsfonden for landbrug

STØTTET AF



Today's agenda

- 1) Background and purpose
- 2) Approved and pending Danish drain filter solutions
- 3) SEGES innovation - development of improvement of nitrogen drain-filter solutions
- 4) SEGES innovation - development of phosphorus drain-filter solutions
- 5) New ideas in a Danish context

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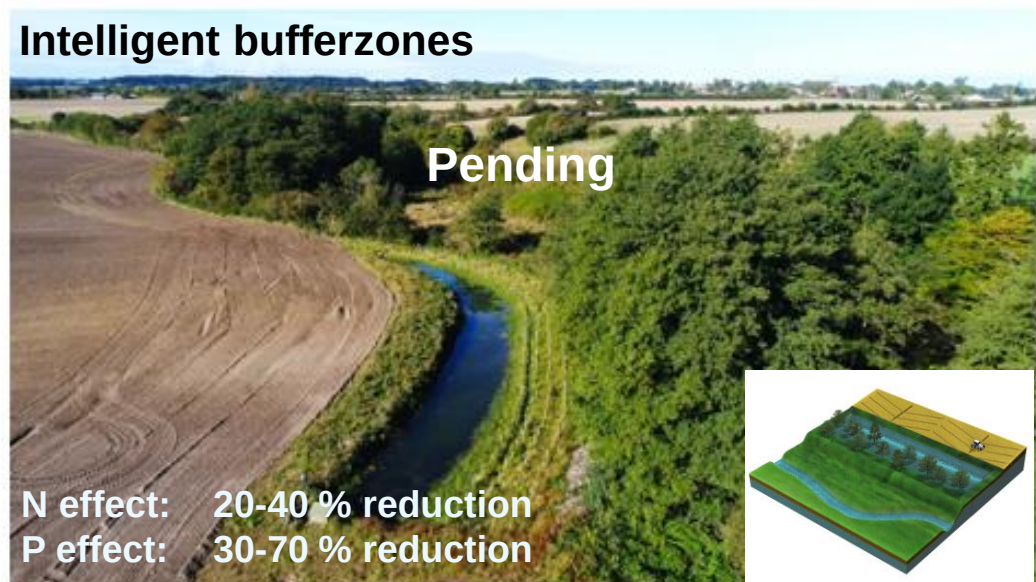
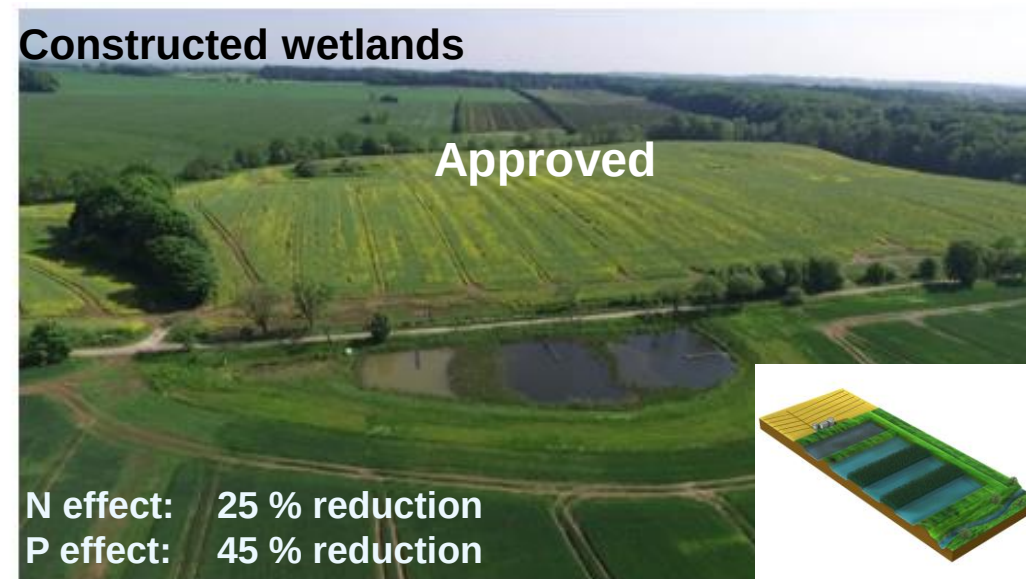
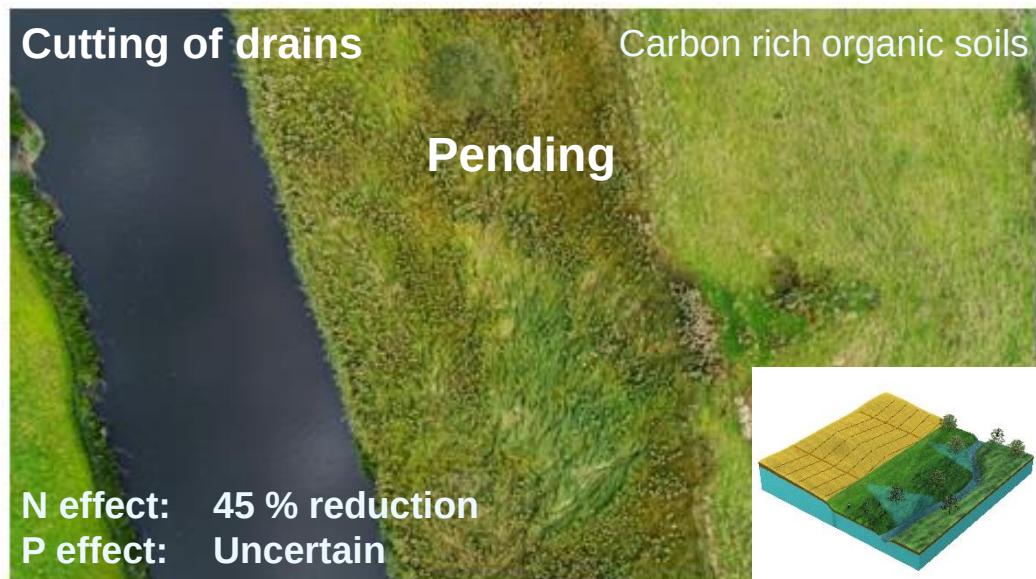


Background and purpose

- Danish agriculture are facing a substantial nitrogen load reduction demand of 13.100 ton nitrogen (equivalent to approx. 22 % reduction) before 2027 in order to achieve good ecological status in all waterbodies (specific concerning the fjords/estuaries)
- Environmental measures (such as natural wetlands) and drain filter solutions plays a key role in achieving these goals
- Development of new solutions and improvement of existing are crucial for Danish agriculture's license to produce in the future

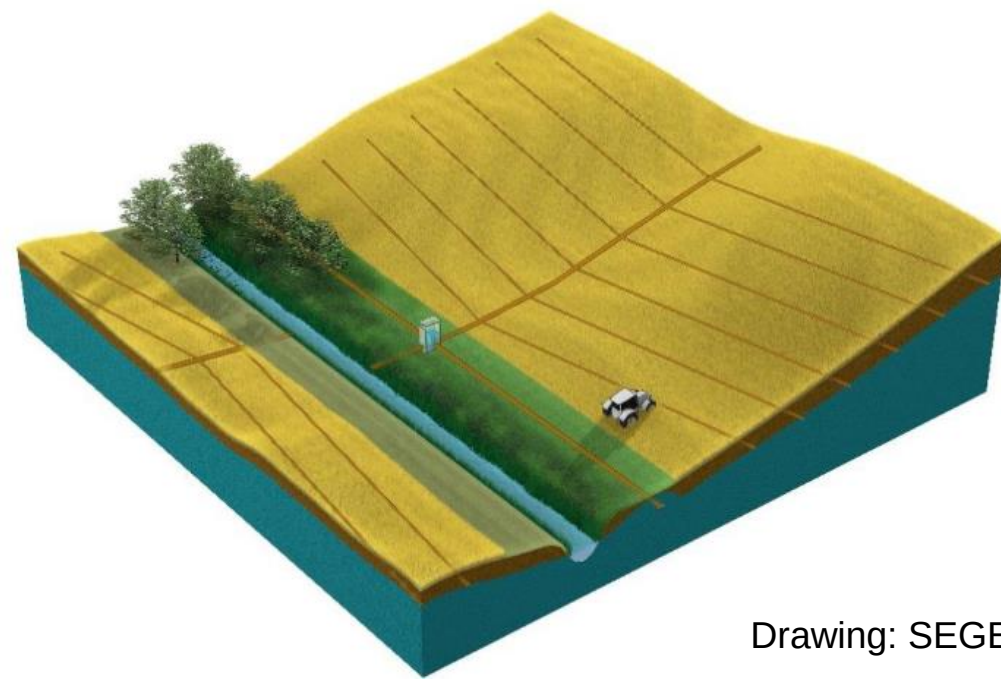
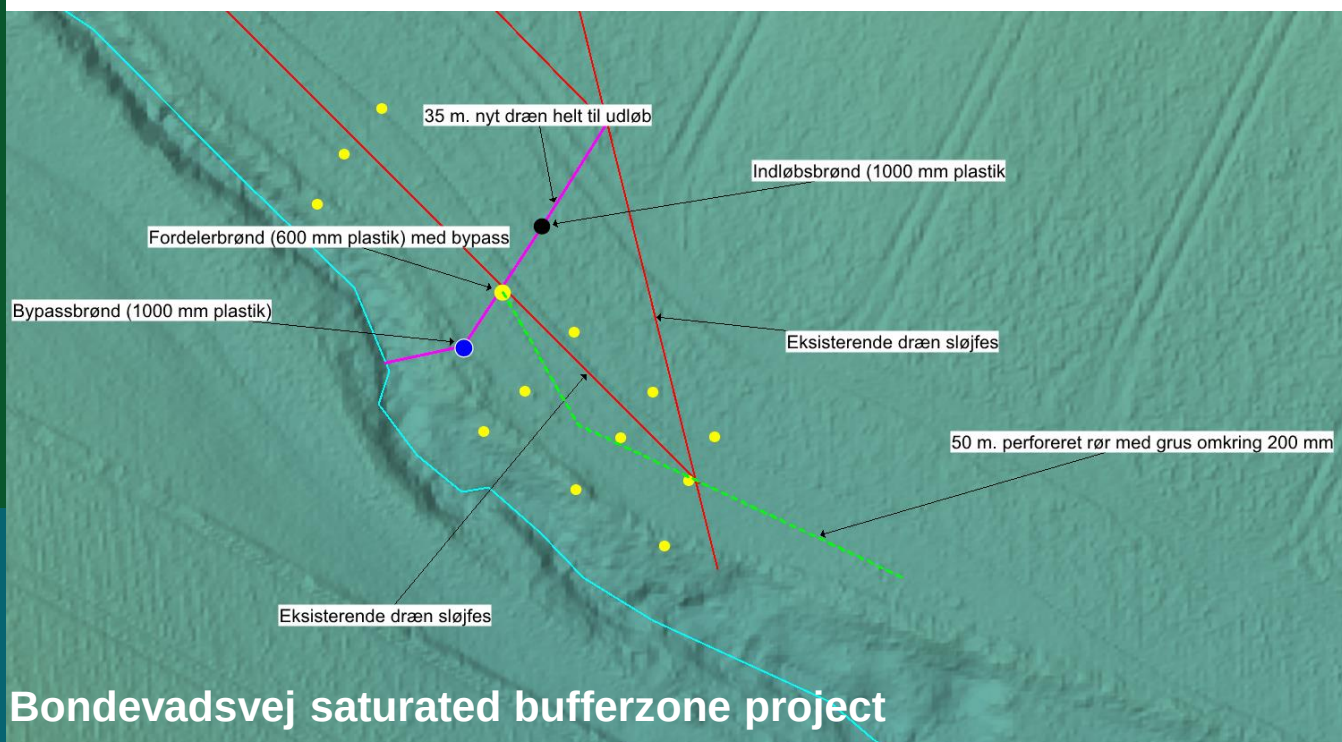
Aftale om grøn omstilling af dansk landbrug
af 4. oktober 2021 mellem regeringen, Venstre, Dansk
Folkeparti, Socialistisk Folkeparti, Radikale Venstre,
Enhedslisten, Det Konservative Folkeparti, Nye Borgerlige,
Liberal Alliance og Konsensuspartierne.

Government approved and pending drain filter solutions



SEGES innovation and test of saturated bufferzones

- Tile drains are intercepted and drainage water allowed to infiltrate in the buffer zone
- First Danish projects 2018-2022 (SEGES, AU University)
- Measurement of denitrification rates and P-retention
- Construction of 3 saturated bufferzones. One on mineral soil (Ulvskov) and one on peat soil (Gylling) in 2018. Construction of 1 saturated bufferzone on mineral soil (Bondevadsvej in 2021)

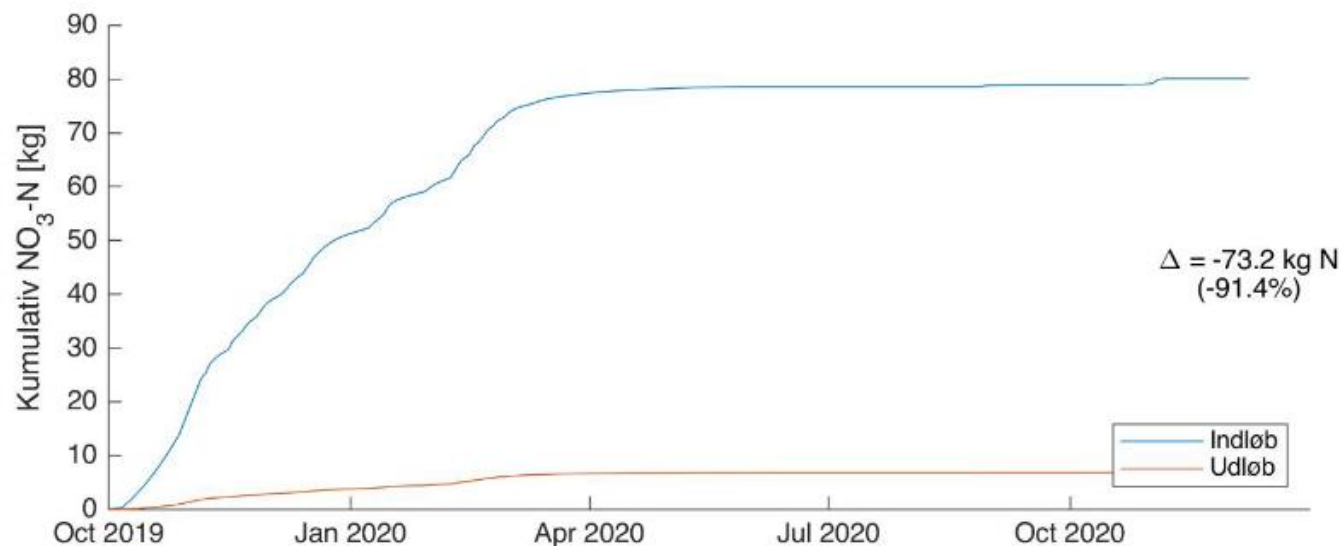


SEGES Innovation platform for drain filter solutions 2018-2020

Results saturated bufferzones randzoner:

Location Ulvskov – 80-90 % N-reduction and high P-reduction

Lokation Gylling – 0 % N-effect and release of P



Ulvskov – Zak et al (2020)



Ulvskov. Foto: Frank Bondgaard

SEGES innovation and test of saturated bufferzones

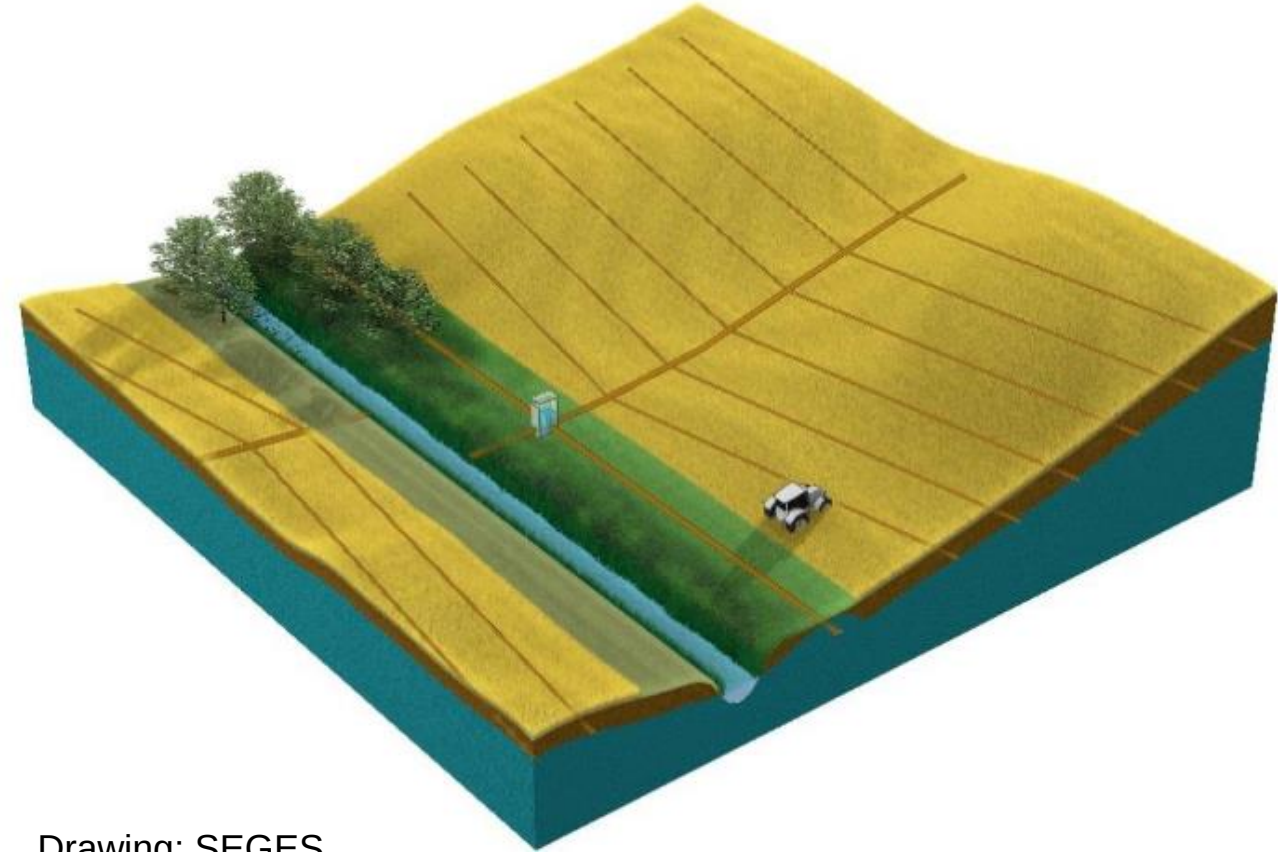
Mid-term conclusion

Pros:

- High N and P efficiency
- Low cost
- Minimum landscape disturbance

Cons

- Site specific requirements (terrain and soil type)
- Uncertain knowledge regarding ration between catchment size and infiltration size



Drawing: SEGES

SEGES innovation and test optimized constructed wetlands

2018: Test and trial with optimization of constucted wetlands

- Hypothesis: Better contact between sediment and drainage water would increase N-effect.



SEGES innovation and test optimized constructed wetlands: 2018

Results from optimized constructed wetlands

Tabel 1. Total kvælstof(TN)transport og reduktion i Fillerup-minivådområdet#. Perioden 07/17-12/17 er resultater fra tidligere projekt og før design-optimering af minivådområdet.

Moniterings- periode	TN-dræn Kg/ha	TN-indløb Kg	TN-udløb Kg	TN-reduktion Kg	TN-reduktion Kg/ha	TN-red %
07/17-12/17	16,9	642	475	167	560	26
02/19-06/19	5,4	206	193	13	44	6,3
07/19-12/19	18,9	717	631	86	289	12
01/20-06/20	11,5	438	367	70	235	16

Data er fra monitoringsrapporten Hoffmann & Petersen, 2020

Tabel 3. Total kvælstof (TN) transport og reduktion i Fensholt-minivådområdet#. Perioden 07/17-12/17 er resultater fra tidligere projekt og før design-optimering af minivådområdet.

Moniterings- periode	TN-dræn Kg/ha	TN-indløb Kg	TN-udløb Kg	TN-reduktion Kg	TN-reduktion Kg/ha	TN-red %
07/17-12/17	17,1	563	456	107	437	19
02/19-06/19	10,5	347	295	52	212	15
07/19-12/19	18,6	615	535	80	327	13
01/20-06/20	12,3	405	328	77	314	19

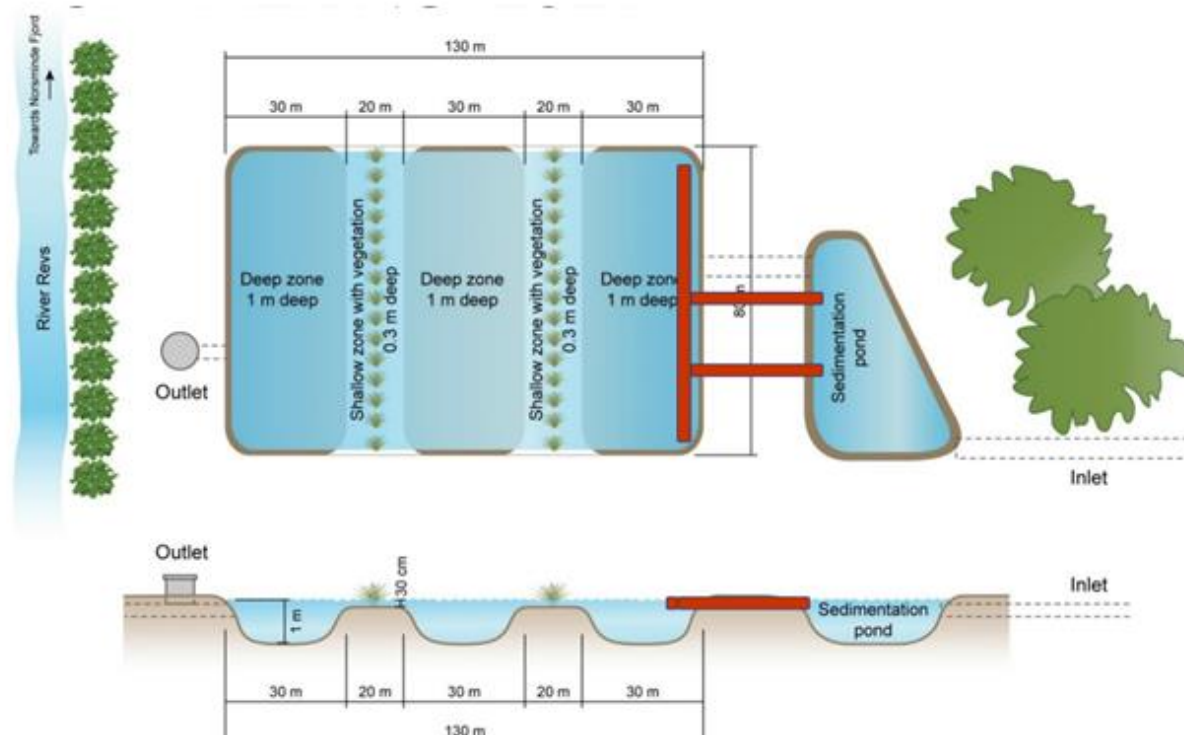
Data er fra monitoringsrapporten Hoffmann & Petersen, 2020



Foto: Charlotte Kjærgaard

SEGES innovation and test optimized constructed wetlands: 2021

- Experiment with better flow distribution (improved residence time)
- Distribution pipe installed across the first bassin
- Monitoring of denitrification and P-retention (Aarhus University)



Fotos: Astrid Ledet Maagard, AU

SEGES innovation and test optimized constructed wetlands: 2021

- Test and trial of boosting natural denitrifying bacterias
- Experiments runs from September 2021 to May 2022
- Aarhus University in charge for the monitoring



SEGES innovation and test optimized constructed wetlands: 2021



Foto: Charlotte Kjærgaard



Foto: Sebastian Zacho

SEGES test and innovation of P-filter solutions

- Test and trial of P-filter for drain water treatment (particular and dissolved) two component system

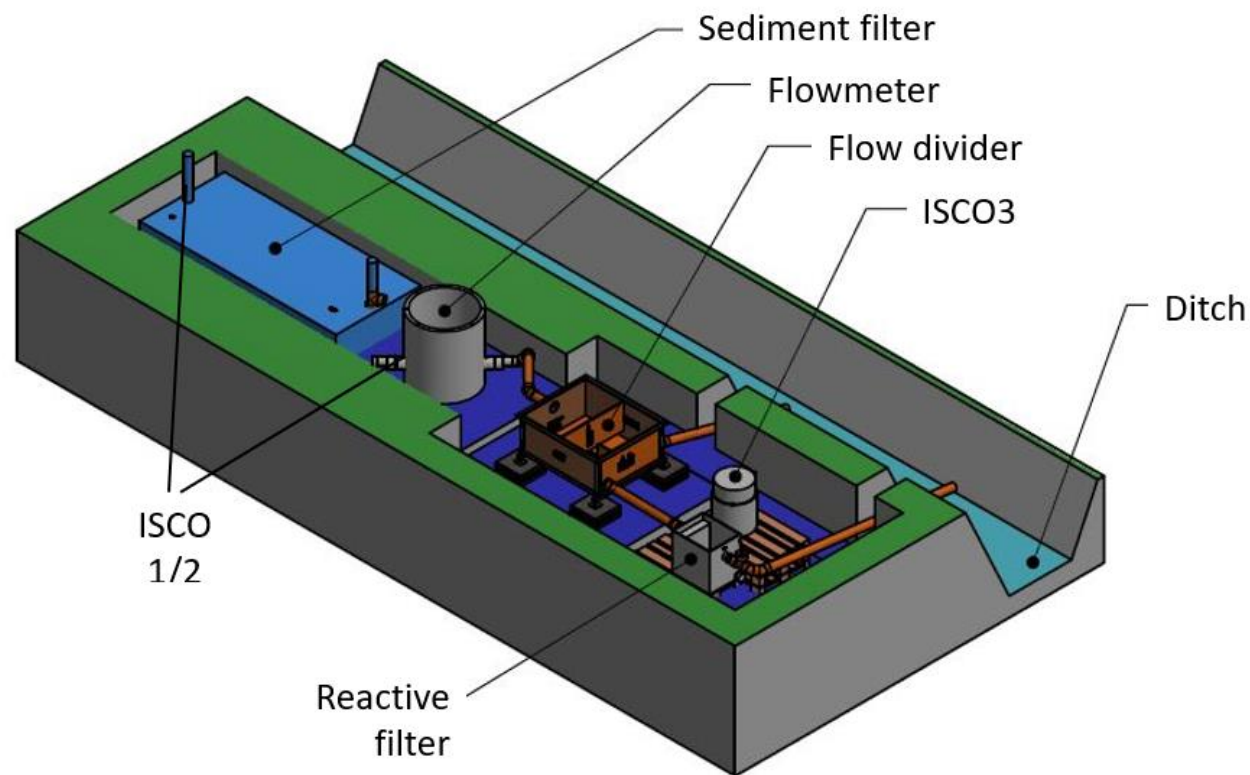


Foto: Line B Nørgaard



Foto: Line B Nørgaard

SEGES test and innovation of P-filter solutions

WaterCare DPF filter							
Month	Q (m3)	TP load (g)	TP removal (%)	TDP load (g)	TDP removal (%)	PP load (g)	PP removal (%)
dec-19	718	61	9	42	4	19	44
jan-20	1089	97	15	48	-11	49	66
feb-20	531	78	-7	28	-35	50	26
mar-20	1598	77	-71	59	-105	18	-31
apr-20	1054	106	5	68	-14	38	54
maj-20	316	70	-55	56	-72	14	22
jun-20	228						
jul-20	98						
aug-20	88						
sep-20	108						
okt-20	613	243	30	190	23	53	56
nov-20	1299	276	31	207	16	69	75
dec-20	1798	448	28	250	2	197	75
jan-21	2133	253	48	74	20	180	75
feb-21	1825	13	35	17	16	5	67
mar-21	3245	463	31	228	10	235	69
apr-21	1904	463	13	108	2	25	60
maj-21	2678	581	6	403	-7	178	42

Incomplete data

Particular-filter

ICS filter							
Month	Q (m3)	TP load (g)	TP removal (%)	TDP load (g)	TDP removal (%)	PP load (g)	PP removal (%)
nov-20	59	12	76	10	79	2	14
dec-20	225	30	58	23	61	7	18
jan-21	214	17	72	9	72	8	79
feb-21	27	3	82	1	68	2	72
mar-21	272	18	58	15	58	3	68
apr-21	190	11	55	10	57	1	28
maj-21	268	53	30	41	29	12	15

Incomplete data

Reactive filter

SEGES test and innovation of P-filter solutions

Conclusions: Aarhus University

- Compact filter systems have shown good potential for removing particulate-bound and dissolved P from tile drainage
- Technically challenging to develop a filter system with large hydraulic capacity (peak drainage flows) and high P removal efficiencies
- Compact filter system require maintenance during operation
- Both sediment and spent filter material can potentially be recycled on agricultural fields as soil amendment.

New ideas in a Danish context

- Test of various constructed wetland designs (depth, width, size)
- New project (GUDP: Green Development and Demonstration Project) of P-filters for highland soils and riparian lowland carbon rich soils. Runs from apr. 2022 to september 2025
- Perhaps follow your work closely on combining the MBBR-system and Zero valent iron filter?

An aerial photograph of a lush green landscape. In the foreground, there's a large, irregularly shaped pond with dark water, surrounded by green grass and some small trees. Several dirt roads or paths crisscross the fields. The middle ground shows rolling green hills with some yellow patches, possibly wildflowers. In the background, there's a dense line of trees and more green fields under a clear sky.

Thank you for your attention

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