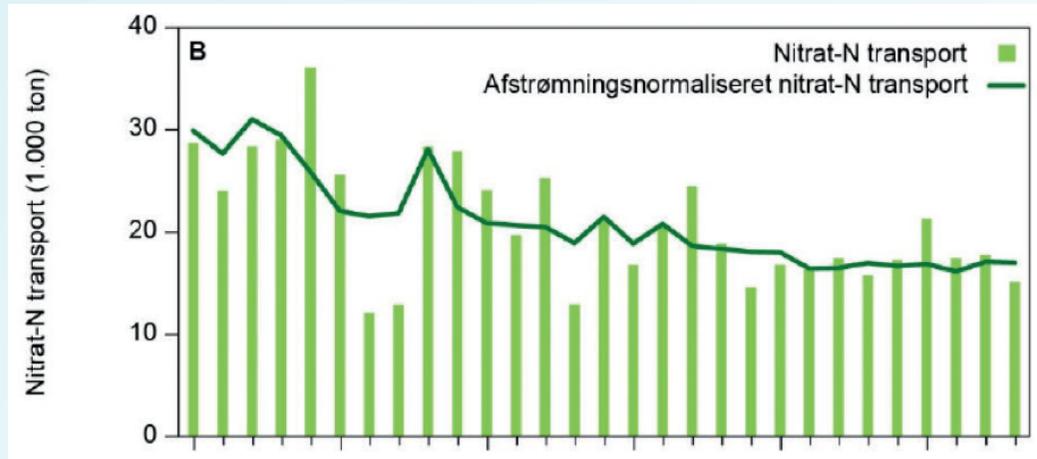


# Odense Fjord: WATERDRIVE Case Area in Denmark

**Frank Bondgaard, Anne Sloth**  
SEGES

# Leaching of nutrients has not decreased much in the last 10 years in Denmark

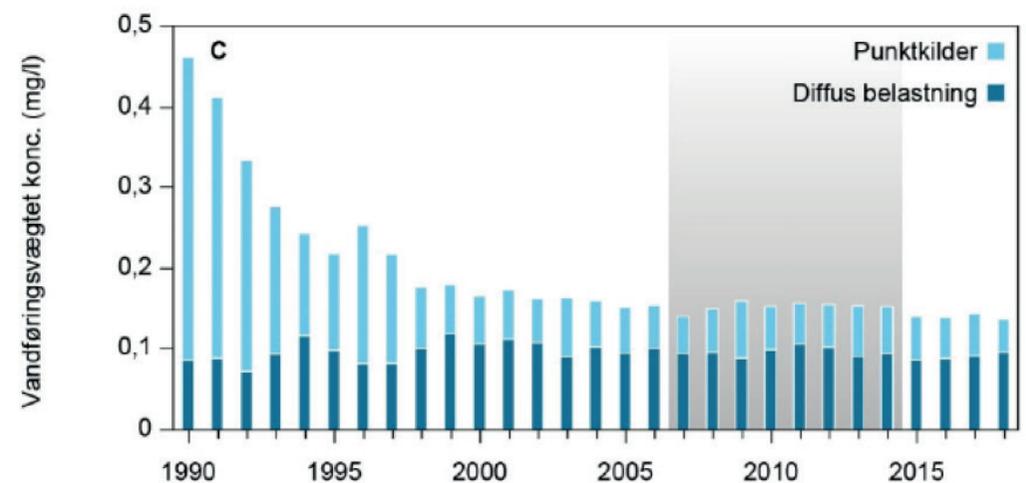
Reduction of nitrate from 1990-2018



Development of measured sea load catchments (sum of 77 catchments) as calculated annual sum for nitrate-N transport (light green bars) and runoff normalized nitrate N-transport (green line)

Source: Thodsen, H, Tornbjerg, H, Rasmussen J.J, Bøgestrand, J., Larsen, S.E., Ovesen, N.B.; Blicher-Mathiesen, G., Kjeldgaard, A. & Windolf, J. 2019. NOVANA. Aarhus Universitet, DCE  
– Nationalt center for Miljø og Energi, 72 s.  
– Videnskabelig rapport 353

Reduction of phosphorous from 1990-2018



Water flow weighted phosphorus concentration for 1990 to 2018. Phosphorus inputs from diffuse sources (dark bars) and effluent discharges from point sources (light bars)

Source: Thodsen, H, Tornbjerg, H, Rasmussen J.J., Bøgestrand, J., Larsen, S.E., Ovesen, N.B.; Blicher-Mathiesen, G., Kjeldgaard, A. & Windolf, J. 2019. NOVANA. Aarhus Universitet, DCE  
– Nationalt center for Miljø og Energi, 72 s.  
– Videnskabelig rapport 353

# Odense Fjord in The Baltic Sea Region

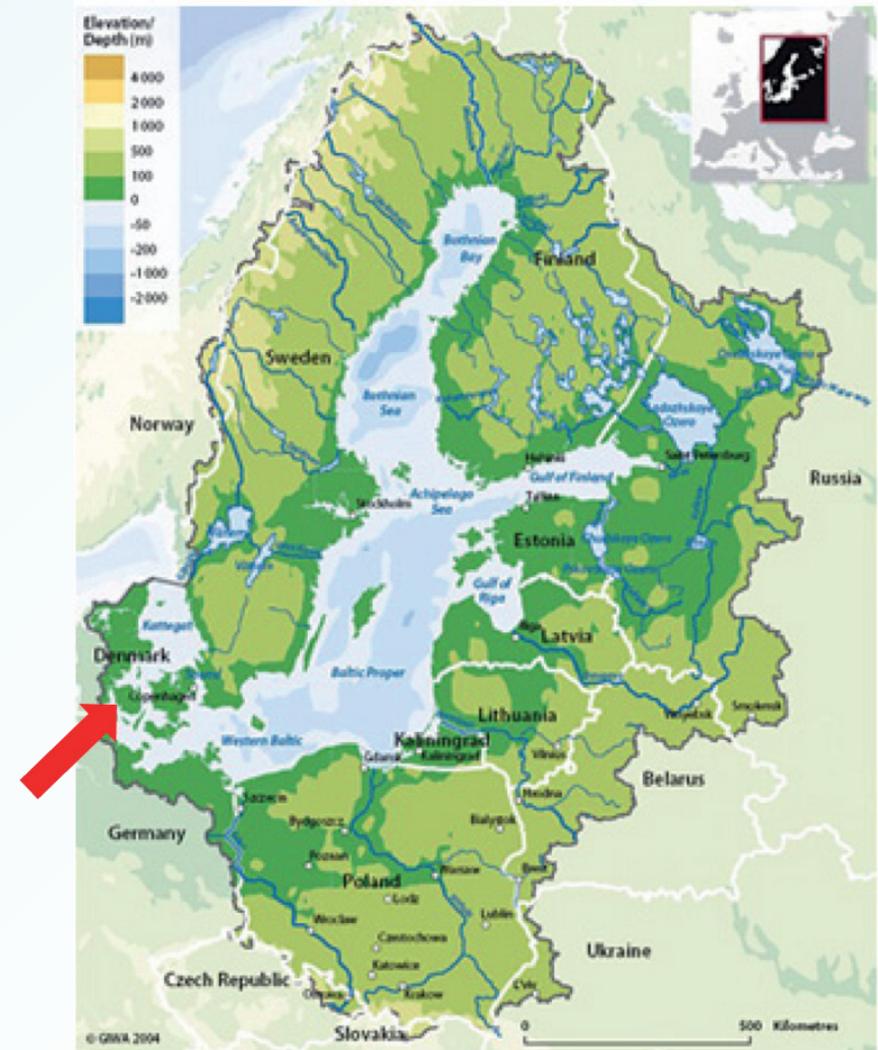
The catchment area of Odense Fjord is a part of the main water catchment area of Odense Fjord and constitutes an area of 105.600 ha of which the agricultural area constitutes approximately 63.960 ha.

In the Waterdrive project, the catchment area of Odense Fjord has been selected as a case area.

In the catchment to Odense fjord 2 subcatchments have been selected.

In Denmark they are called ID15 because each of them covers around 1.500 hectares of arable land.

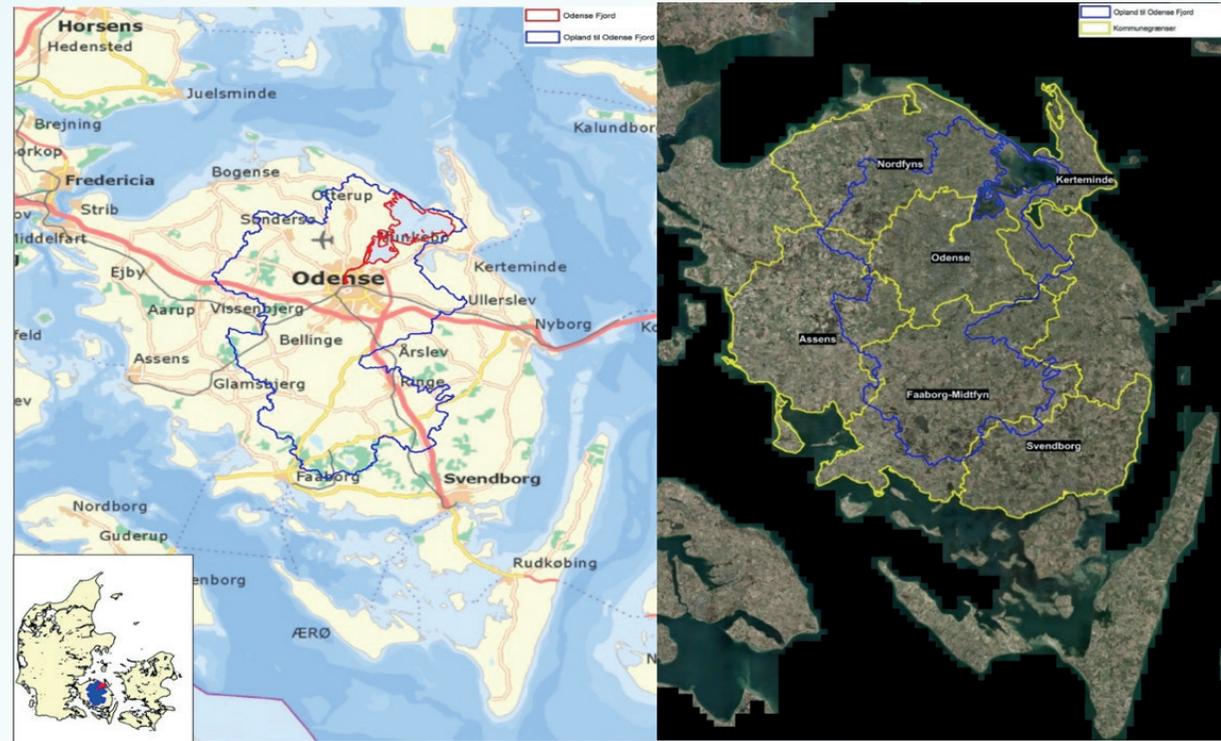
There is approximately 3.000 ID15 subcatchments in Denmark.



# Odense Fjord

According to the River Basin Management Plan, nitrogen emissions to Odense Fjord must be reduced by a total of 549,3 tonnes N on 63.960 ha agricultural area.

Of this, a reduction of 345,8 tonnes N has to be reached by 2021. The remaining reduction requirement has been postponed to the third Water Plan period.



# Constructed wetlands for reduction of nitrate

The effect of a constructed wetland is calculated using 1,1% of the catchment area as the area of wetland, since that is the size I normally use.

**Example:** If the catchment area are 100 hectare.  
Then the famer need to allocate 1,1 hetare of land to the constructed wetland.

The costs of the wetland are calculated using 1% of the catchment area as area of the wetland, since that is the size from which the grant is calculated.

[Source: Technical details in the Danish guideline for constructed wetlands in Denmark 2020]

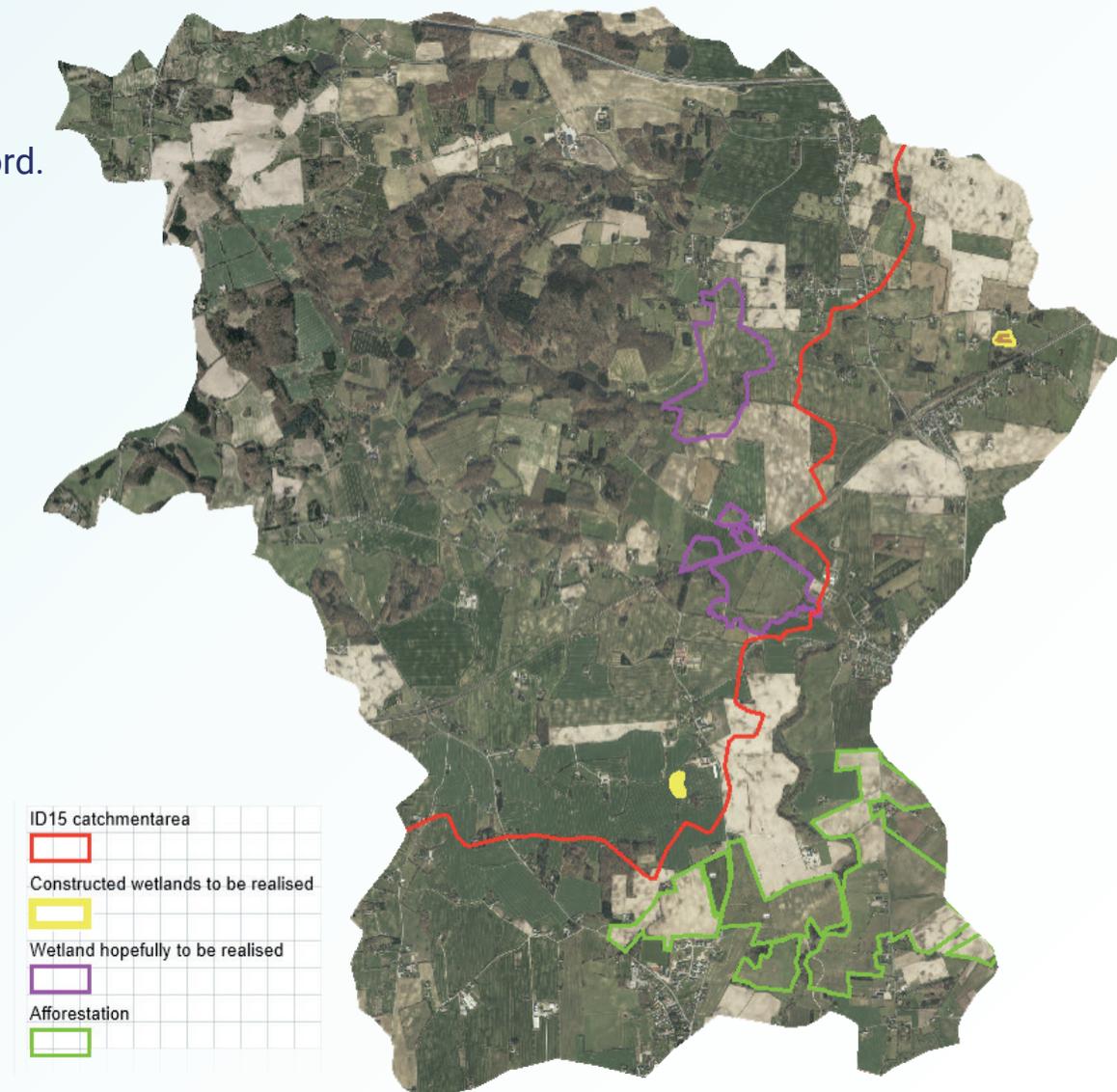


# Constructed wetlands

The expected effort with constructed wetlands is according to Water Plan 2 (2015 – 2021) 67,7 tonnes of nitrogen per year in the catchment area of Odense Fjord.

A constructed wetland has an N-effect of approx. 580 kg N/hectare/year in average. This means that 117 hectares of constructed wetlands (67.700 kg : 580 kg/ha) should be established before 2021.

One ID15 catchment area is defined as 1500 hectares of arable land, so there should be around 43 ID15 catchment areas in the catchment of Odense Fjord, which means 3 hectares of constructed wetland/ID15 --catchment area before 2021.



# Catchment officer and Main Actors

Establishment of the catchment officer scheme try to facilitate implementation of environmental measures at the local level.

The work is done by the agricultural advice service in Denmark because the trust already is established here.

In the Waterdrive project, catchment officer facilitated the cooperation between landowners from two subcatchments and representatives from Odense and Assens municipalities

## Focus group meetings with landowners and municipalities:



# Catchment officer and Main Actors

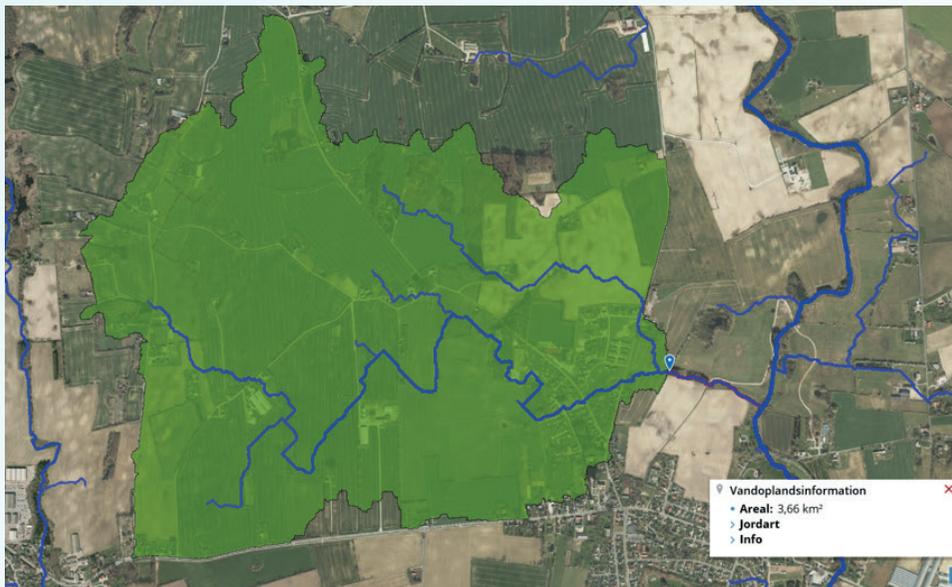
Individual meetings with landowners about drain systems



# Catchment officer and Main Actors

Theory and practice: meetings and field visits with farmers corrected and complemented the data we had on the location of drains and thus the size of the catchment area.

Catchment area estimated in SCALGO



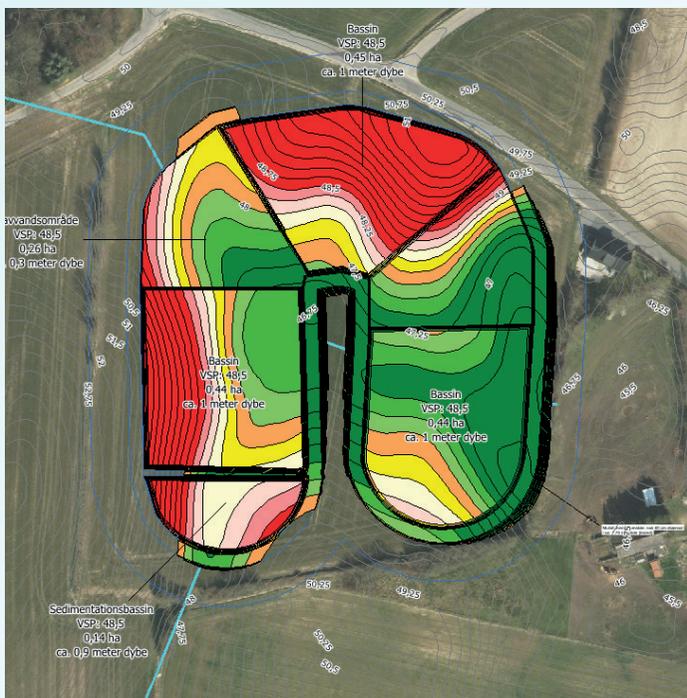
Drain and catchment area done by field visits



## The subsidies for constructed wetlands, 2020

	Basic grants [Euro] 1 € = 7,45 kr.	Price per sqm. water [Euro]
Mandatory parts	20,000	5,10
Establishment of a pump	9,262	1,21
Planting plants	369	0,13
Making a path	1,074	-
Expences for construction consultancy	1,779	-
Authority permits	832	-
Archaeological preliminary investigations	1,584	0,34

# Size and N&P effect calculations are based on a spreadsheet made by SEGES



## Estimation of soil relocation

TEMA ▲	NAVN ▲	Areal, Ha	Areal, kvm	Arealfordeling, %	Afgraves, kbm	Påfyldes, kbm	Volumen, kbm
Bassin	Bassin	1,33	13.311	0,0	55.024	0	55.024
Lavvandsområde	Lavvandsområde	0,52	5.201	0,0	17.311	0	17.311
Sedimentationsbassin	Sedimentationsbassin	0,14	1.426	0,0	6.245	0	6.245
Bassin	-- SUM --	1,33	13.311	66,8	55.024	0	55.024
Lavvandsområde	-- SUM --	0,52	5.201	26,1	17.311	0	17.311
Sedimentationsbassin	-- SUM --	0,14	1.426	7,2	6.245	0	6.245
-- SUM --	-- SUM --	1,99	19.938	100,0	78.580	0	78.580
-- SUM --	-- SUM --	1,99	19.938	0,0	78.580	0	78.580

## N & P reduction

ID15-nummer	42.320.719	1135	ha	LOOP-opland	Fyn (lerjord)			
Sted	Virkemiddel	Drænopland ha	Omdriftsprocent %	Virkemiddel ha	Effekt kg N pr. ha virkemiddel	Effekt af virkemiddel kg N	Effekt af virkemiddel kg P	
83.729	Minivådområde	66	73	0,726	579,4	307	2,4 - 2,8	
83.103	Minivådområde	92	80	1,012	579,4	469	3,4 - 3,9	
82.736	Minivådområde	42	69	0,462	579,4	185	1,6 - 1,8	
82.983	Minivådområde	37	88	0,407	579,4	208	1,4 - 1,6	
82.425	Minivådområde	51	89	0,561	579,4	289	1,9 - 2,1	
76.550	Minivådområde	366	62	4,026	579,4	1446	13,5 - 15,4	
<b>Sum</b>		<b>654</b>		<b>7,194</b>		<b>2904</b>	<b>24,2 - 27,5</b>	

# Possible constructed wetlands (theoretically) and area of afforestation in ID15 42.320.719



➔ Points at the potential places, where the cost is calculated. The other spots are irrelevant in this connection.

## Estimated costs by the catchment area ID15 42.320.719

Location number	Catchment area [hectare]	Constructed wetland area [sqm]	N-effect [kg N/year]	Total cost of the measure [Euro] (1 Euro=7,45 dk)
83.729	55	5.500	284	70.275
82.983	21	2.100	123	47.228
83.103	92	9.200	481	95.356
82.736	42	4.200	201	61.463
82425, adjusted	87	8.700	366	91.966
76550, adjusted	247	24.700	1.023	200.423
<b>Total</b>	<b>544</b>	<b>54.400</b>	<b>2.478</b>	<b>566.711</b>

The total project areas is estimated to 1,75 % of the catchments, which is 9,5 hectare or 60.000 € as a one-time compensation

## Objective causes that stop projects:

- Too little farmed land in rotation in the drainage area – the requirement is 80 % of the drainage area in order to be able to apply for grants.
- The place where the farmer wants to make a measure is not suitable as defined by the state, so he won't be allowed to make a measure on that spot.
- Lack of liquidity. Although the landowners/farmers receive 50 % of the grant before they have had the expenses not everybody has the liquidity to spend money on the costs of establishing the constructed wetland.
- The drains lie too deep, so a pump is necessary. Many farmers are not so keen to use a pump unless they obtain better drained fields at the same time. They don't want to have to pay the operating costs of the pump for the next 10 years, if it is only for the sake of the constructed wetland.
- The drain is not a drain, but a piped stream which means, that some municipalities will not allow us to lead the water through a constructed wetland.



## Suggestions to the future:

- A stronger cooperation between landowners, farmers, catchment officers, municipalities, the nature agency and local authorities. Together they have the skills to protect the environment and the nature.
- Catchment officers is established, but cross-sector catchment teams could be an option
- Longterm funding of catchment officers/catchment teams
- Funding systems in the Rural Development Program (RDP) that can handle and fund multiactor- and cross sector cooperation.
- The RDP that more focus on solving the challenges and not are too fixed, so more agile RDP programs with greater degrees of freedom.
- Change the RDP programs if they don't works, that will make progress more faster.
- Never leave a demonstration/case area without progress.



# Odense Fjord: WATERDRIVE Case Area in Denmark

**Frank Bondgaard, Anne Sloth**  
SEGES