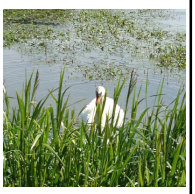
Long-term effects, maintenance and costs for wastewater treatment wetlands in Sweden





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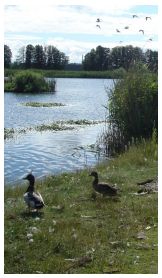
Linda Flyckt
MSc project at Linköping university for WRS Uppsala AB

Content of presentation

- Background
- Wetlands
- Treatment results
- Maintenance
- Costs
- Questions, discussion



Background

- Seven wetlands for polishing of wastewater
  - Treatment results over time (Tot-N, NH4-N, BOD_7, Tot-P)
  - Wetland maintenance
  - Cost efficiency

Ekeby - Eskilstuna

Foto: Eskilstuna Energi & Miljö

- 1998
- Nitrogen treatment
- 28 ha

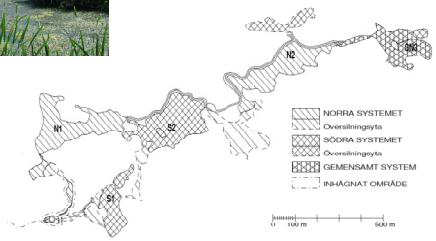
Alhagen - Nynäshamn

Foto: Nynäshamns kommun

- 1997
- Nitrogen treatment
- 28 ha
- SBR operating since 2001

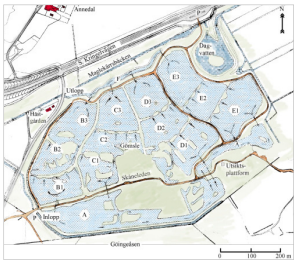
Brannäs - Oxelösund

- 1993
- Nitrogen treatment
- 23 ha
- SBR operating since 2005



Ritning: WRS Uppsala AB

Magle - Hässleholm



Ritning: Hässleholms kommun

- 1995
- Phosphorus- and nitrogen treatment
- 20 ha

Trosa - Trosa

Foto: Trosa kommun

- 2003
- Nitrogen, BOD, pathogens
- 5,3 ha

Vagnhärad - Trosa

Foto: Trosa kommun

- 2001
- Nitrogen, phosphorus, BOD, pathogens
- 2,3 ha

Örsundsbro - Enköping

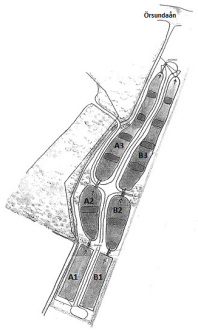


Bild: Enköpings kommun

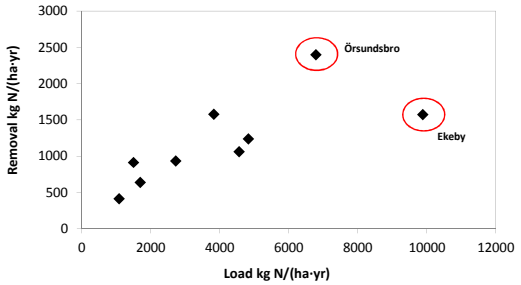
- 1999
- Phosphorus and BOD_7
- 1,6 ha

How large Nitrogen removal has been achieved?

- The average total-N removal was 1232 kg/(ha·yr) representing about 30 % of the load
- The total-N concentrations were reduced from an average 22 to 13 mg/l
- The ammonium-N concentrations were from 14 to 7.5 mg/l.

		Eskilstuna Ekeby		Nynäshamn Alhagen		Oxelösund Brannäs		Hässleholm Magle	Trosa Trosa	Trosa Vagnhärad	Enköping Örsundsbro	
		99-01	02-09	99-02	03-09	94-04	07-09	96-09	03-09	03-09	01-04	05-09
Total wetland area	*ha*	28	28	28	28	23	23	20	5,3	2,3	1,6	0,8
Inflow	m^3/d	44 606	44 963	4550	5218	4603	4396	12 369	1703	1442	706	766
Hydraulic load	*mm/d*	159	161	16	19	20	19	62	32	63	44	96
Retention time	*d*	6	6	14	14	7	7	7	7	5	7	4
Concentration (mg/l)												
Tot-N	*In*	18	17	37	22	24	16	20	23	21	22	20
	Out	14	14	11	6,8	15	10	15	16	16	15	13
NH_4-N	*In*	4,7	5,9	37	16	17	12	6,7	21	6,6	17	12
	Out	2,6	4,5	9	4,5	12	7,7	5,8	13	4,1	12	8

Wetlands with a higher area specific load had a higher removal of total-N



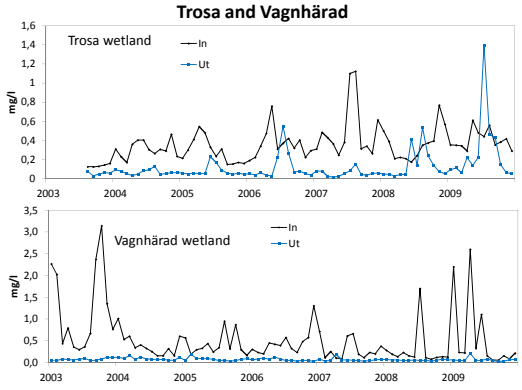
How well has phosphorus and BOD_7 been removed?

- Phosphorus
  - The average removal was 46 kg/(ha·yr) representing 65 % of the load.
  - Concentrations of total-P were reduced from an average of 0.37 to 0.11 mg/l.
- BOD_7
  - Concentrations of BOD_7 were reduced from an average of 11 to 3.6 mg/l.

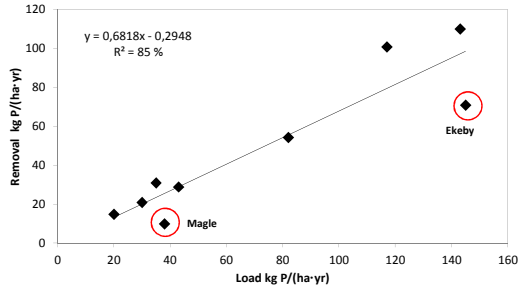
Differences between wetlands in total-P and BOD_7 removal

		Eskilstuna Ekeby		Nynäshamn Alhagen		Oxelösund Brannäs		Hässleholm Magle	Trosa Trosa	Trosa Vagnhärad	Enköping Örsundsbro	
		99-01	02-09	99-02	03-09	94-04	07-09	96-09	03-09	03-09	01-04	05-09
Total wetland area	*ha*	28	28	28	28	23	23	20	5,3	2,3	1,6	0,8
Hydraulic load	*mm/d*	159	161	16	19	20	19	62	32	63	44	96
Concentrations (mg/l)												
Tot-P	*In*	0,23	0,25	0,39	0,30	0,50	0,43	0,17	0,36	0,52	0,49	0,42
	Out	0,1	0,13	0,10	0,06	0,06	0,13	0,12	0,12	0,07	0,19	0,1
BOD_7	*In*	4,6	4,2	35	9,7	22	11	3,0	11	4,0	9,5	9,1
	Out	4,2	4,3	3,9	3,0	3,9	3,2	5,1	3,1	3,0	3,3	2,2

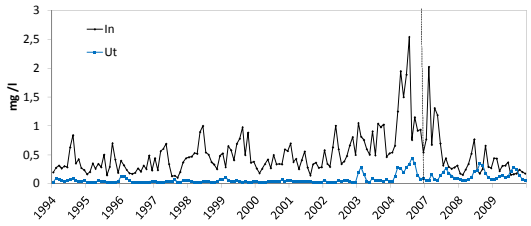
Total-P concentrations in the Inlet and Outlet of the wetlands in Trosa and Vagnhärad



Wetlands with a higher load had a higher removal of total-P



Concentrations of total-P in the inflow and outflow from Brannäs wetland, Oxelösund



Maintenance requirements

- The maintenance needs varied depending on design and main goal
- Removal of plants and sediment from canals/ditches 'on demand' (Alhagen, Brannäs and Ekeby)
- Sediment removal at inlet (annually in Brannäs)
- Plant cutting (annually in overland flow areas and along the shores and paths for recreational purposes)

Costs

- Investment (capital) costs – land, project documents, pumps and pipes, construction. Depreciation time 20 years
- Operation costs (includes monitoring)
- Key figures (Kr/kg N or P removed)

Differences in costs between wetlands

		Eskilstuna Ekeby	Nynäshamn Alhagen	Oxelösund Brannäs	Hässleholm Magle	Trosa Trosa	Trosa Vagnhärad
Year of construction		1998	1997	1993	1995	2003	2001
Weltand area	*ha*	28	28	23	20	5,3	2,3
Capital cost	*Mkr*	16	13,5	5	7	10	5
Capital cost -08	*Mkr*	23	20	8	11	12	7
O&M costs	*tkr/år*	200	400	100	250	210	140
O&M costs (incl. pumping)	*tkr/år*	200	600	275	250	280	200
Pump.costs	*% of total*	0	35	65	0	25	30

		Eskilstuna Ekeby	Nynäshamn Alhagen	Oxelösund Brannäs	Hässleholm Magle	Trosa Trosa	Trosa Vagnhärad
Wetland area	*ha*	28	28	23	20	5,3	2,3
Annual costs	*tkr/yr*	1400	1650	700	830	930	540
O&M total	*%*	14	37	39	30	30	37
Removal N	*kg/yr*	45 500	28 300	12 200	21 300	5000	2 900
Removal P	*kg/yr*	1 700	380	600	200	160	230
Key figure N	*kr/kg*	30	60	60	40	190	190
Key figure P	*kr/kg*	0	2070	550	860	4700	1950

Concluding remarks

- The function of the wetlands has been good
- Small maintenance requirements
- No clear indications of a decreasing actual removal
- Cost-efficient
- Good access for public in all wetlands
- Contribute biodiversity in a dried landscape.
- Occasional release of phosphorus seem related to shift in the type of chemical used in the P precipitation.
- Flow variations are often evened out.


THANKS!
Linda Flyckt
Ragn-Sells Avfallsbehandling AB
Telefon: 08-5277 3128 Mobil: 0709-270023
E-post: linda.flyckt@ragnsells.se