Sustainable sediment management in a ‘rigid’ river basin, a port’s perspective

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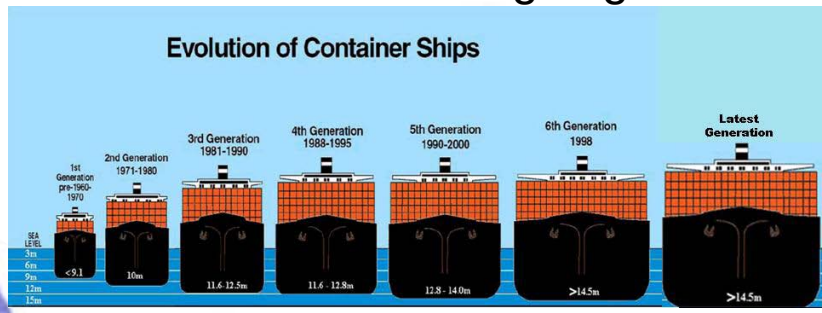
Port of Antwerp

1 Introduction

Ports in a ‘rigid’ river basin

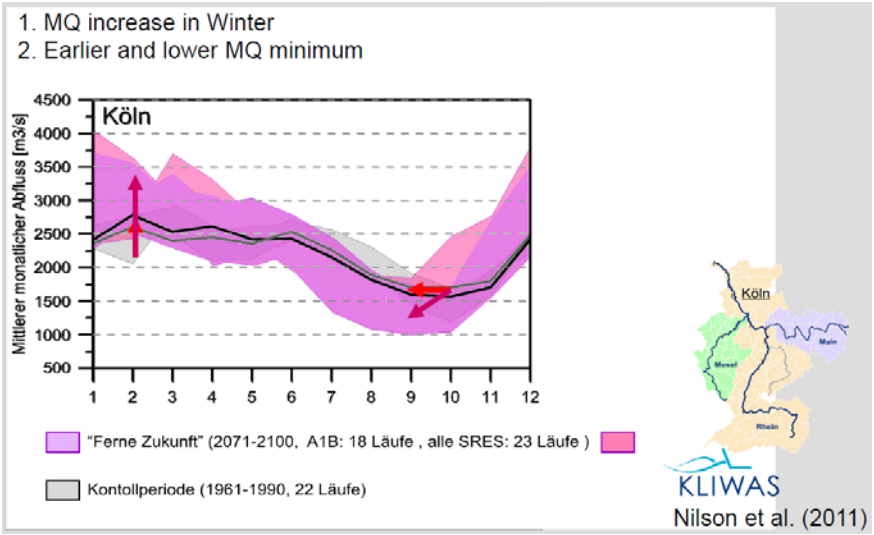
<u>The port a link between hinterland and the rest of the world</u>

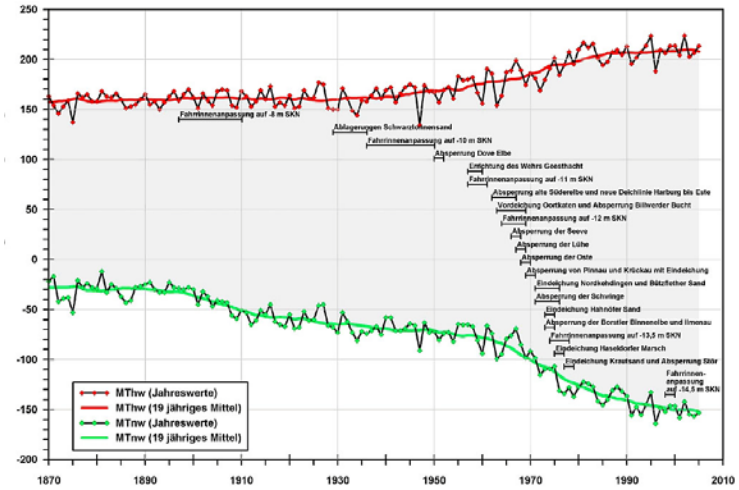
- hinterland/upstream: fast access for barges by channelized waterways
- the port: good accessibility for all sea-going vessels
- rest of the world / downstream: tide-independent and fast access for all sea-going vessels



What if the focus is only on the nautical function?

- Upstream:
  - Increasing low water and peak discharges
- In the port:
  - Accumulation of sediments and contaminants in the port area
  - A waterbody with a poor ecological status
- Downstream
  - Increasing tidal range





Tidal range in the Elbe since 1870 (source: tide-toolbox)

A rigid system with a lot of ‘dynamic’ functions?

Functions such as:
-Water retention
-Sediment retention
-Habitat
-Biodiversity
-Savety
-Etc.

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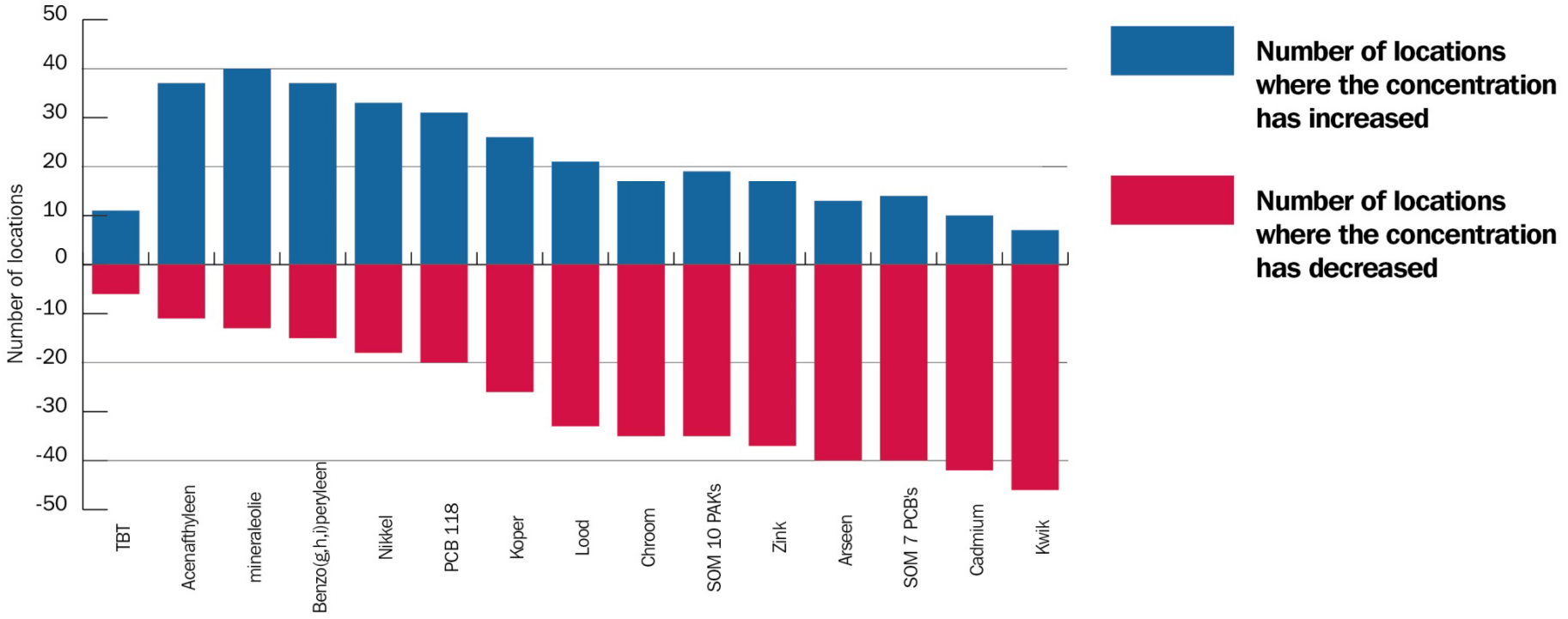
‘Upstream’ / sources

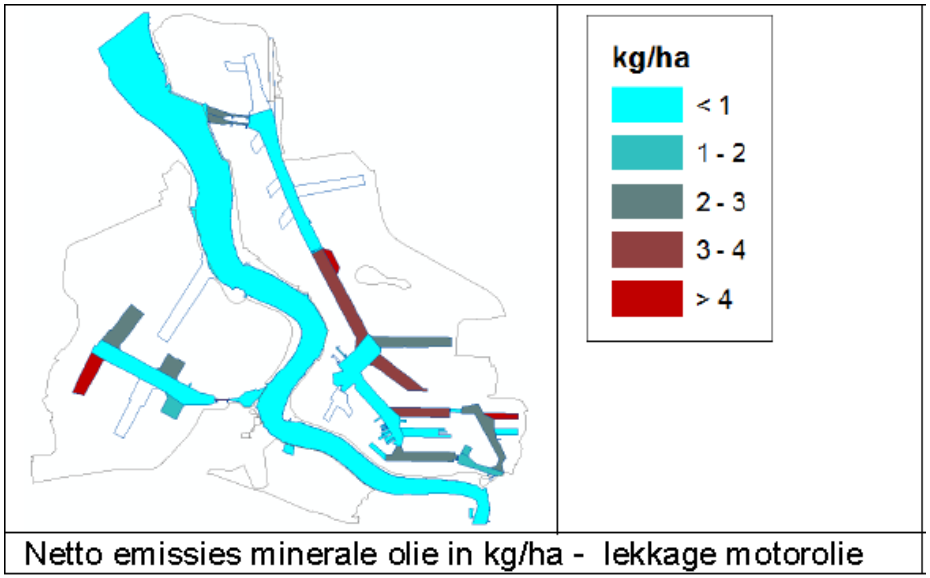
Changes in sediment quality in the port



Sources of contaminants

Significant sources for PAHs	EIW	acenafteen	acenaftyleen	antraceen	benzo[a]anthracee	benzo[a]pyreen	benzo[b]fluoranth	benzo[g,h,i]peryle	benzo[k]fluoranth	chryseen	dibenzo[a,h]anthr	fenantreen	fluorantheen	Fluoreen	indeno[1,2,3-	naftaleen	pyreen	PAK16
Atmospheric deposition on land and water	VMM	0	0	30	50	70	74	65	74	63	40	38	72	10	74	0	53	46
Chemical industry	VMM	5	37	14	2	6	5	4	3	3	3	3	5	9	3	8	5	7
households	VMM	7	5	1	1	2	4	1	2	2	18	3	7	5	1	5	2	4
Production in the refineries	VMM	13	5	17	36	13	3	14	4	18	12	20	3	25	2	3	28	14
Coating of barges	GHA	7	5	6	4	4	4	2	4	2	19	1	1	5	18	14	2	5
Oil spills	GHA	59	41	20	1	1	0	0	0	1	1	22	4	36	0	43	2	14
Corrosion of constructions in the water	GHA	2	1	3	0	0	0	0	0	0	0	5	0	5	0	20	0	3
Road traffic: tyre wear	GHA	2	3	5	3	3	8	9	11	10	5	2	6	1	1	2	5	5
Totaal (kg)		7,6	12	6,7	14	12	13	13	5,7	17	2,9	30	26	11	10	23	29	234

Sources of mineral oil



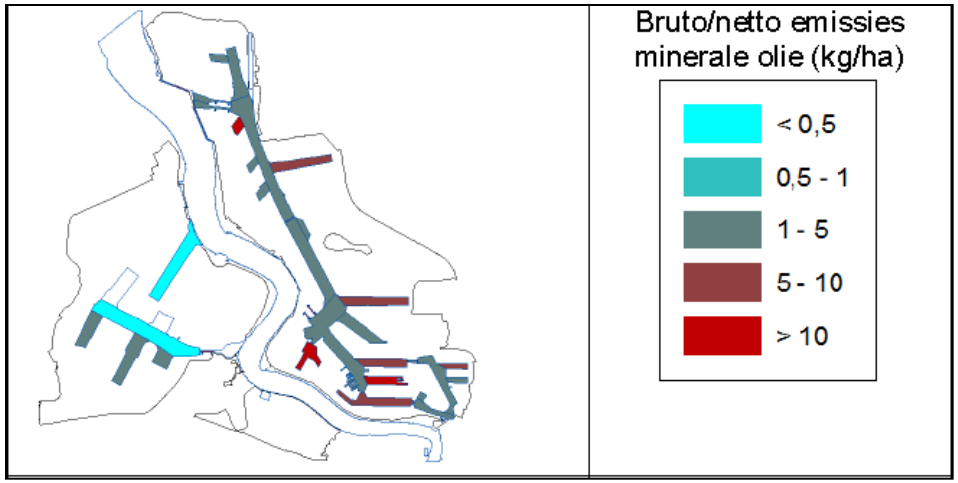
Netto emissies minerale olie in kg/ha - lekkage motorolie

(including port related traffic and second hand car storage)

Do the sources explain the increase in the sediment?
Supposing:
- 1 m^3 sediment = 200 kg d.w
- All emission remains in the surface 10 cm of the sediment

=> 10 kg/ha/y => increase of 50 mg/kg d.w.

Average concentration increased with 40 mg/kg d.w. in the period 2002-2010



Netto emissies minerale olie in kg/ha - oliecalamiteiten

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The port area

Risk assessment of polluted sediments with regards to the ecological status

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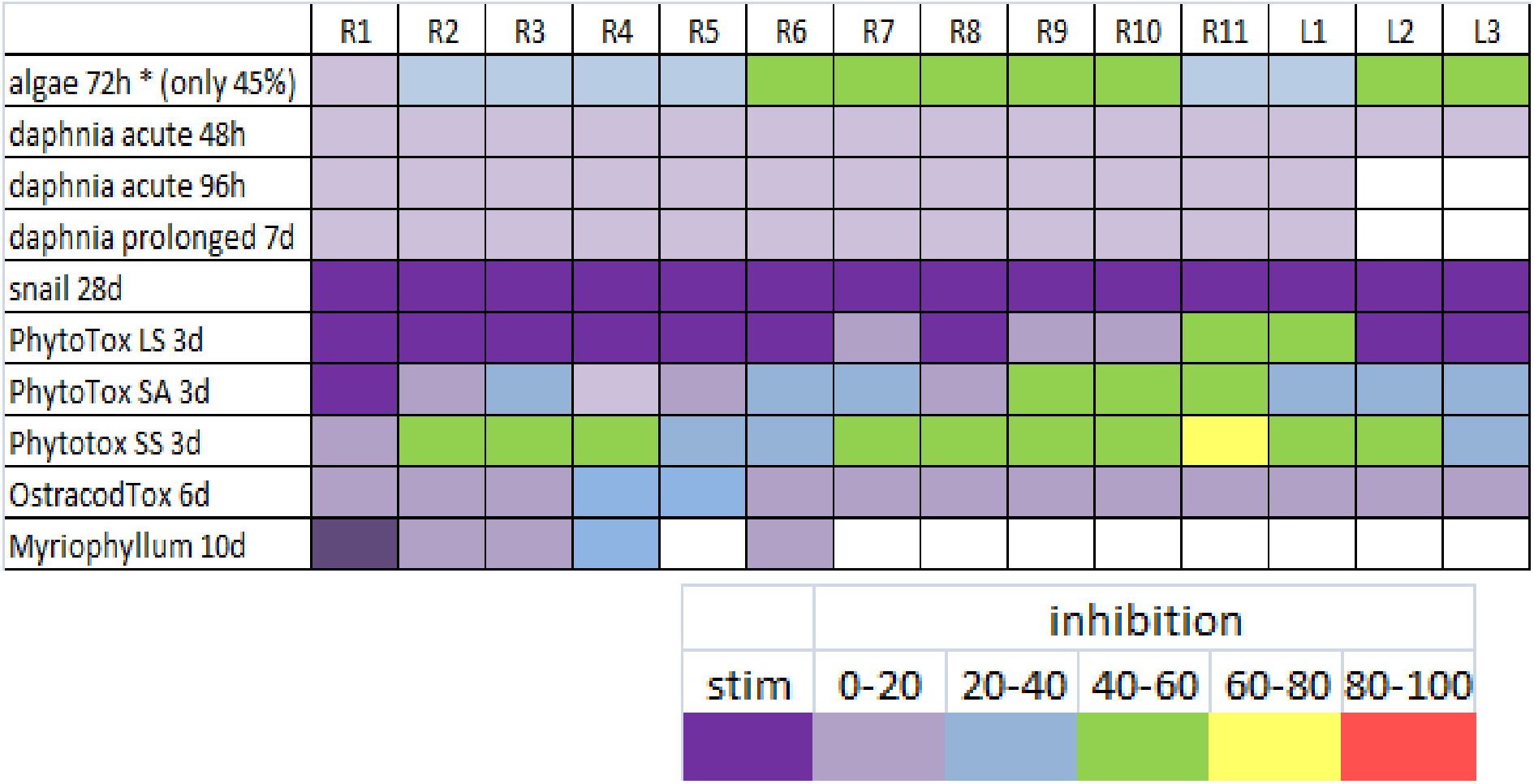
Sediments of 14 locations exposed to different trophic levels



Does the risk increase due to resuspension?

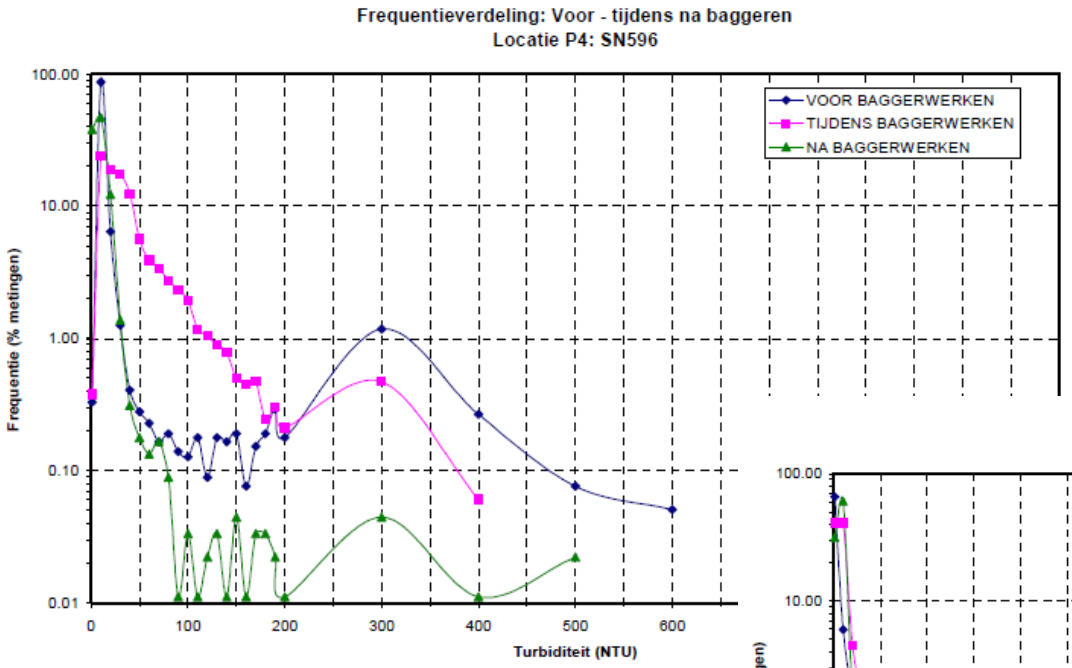
Simulation of resuspension due to dredging and navigation in laboratory conditions

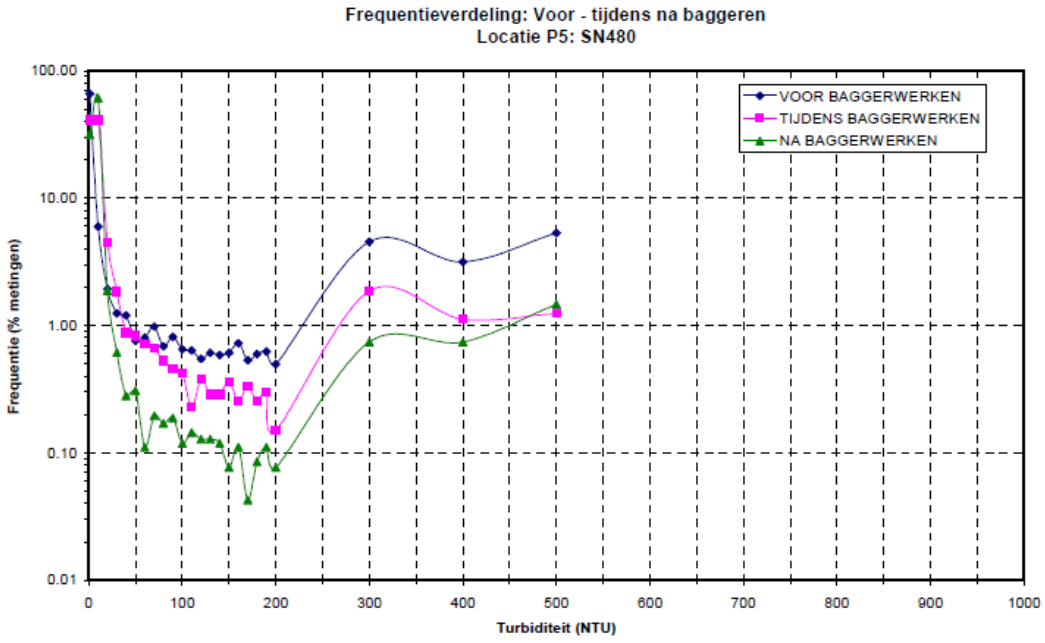
Larger volume 1:20 ratio

– 500 ml sediment to 10L of water (distilled or same salinity), mixing by aeration

Resuspension monitoring

Turbidity before, during and after dredging



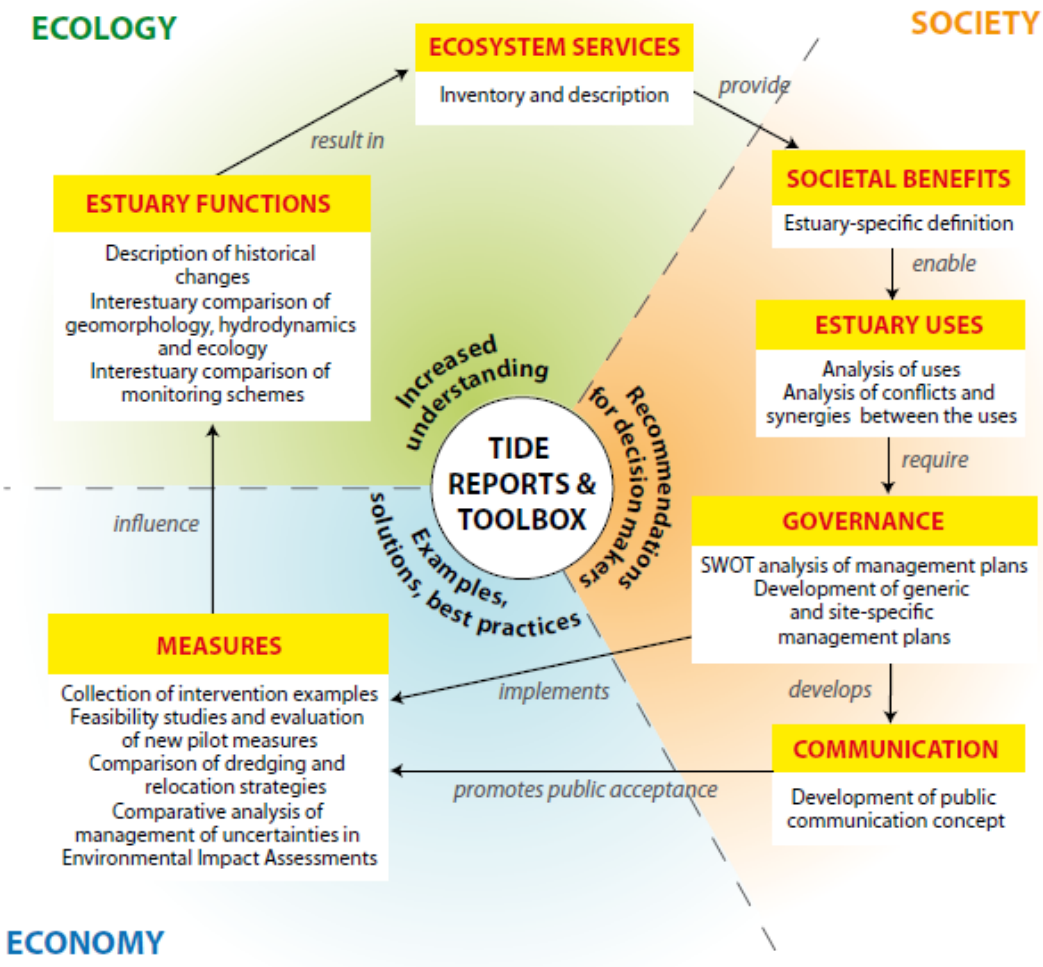


(Source: Antea, 2013)

4 Downstream

Integrated estuarine management

- TIDE Approach



See also presentation of K. Wolfstein

Evaluation of management approaches

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Table 1-1. List of the 17 TIDE managed realignment measures with chosen basic information.

TIDE nr.	Estuary	Measure name	Code	Year of impl.	Size (ha)	Cat. [1]	Zonation [2] (in TIDE-km)			
							F	O	M	P
1	Elbe	Spadenlander Busch/Kreetsand	E-Sp.B.	2012	47	BH	30			
7	Elbe	Realignment Wrauster Bogen	E-Wr.B.	1991	2,2	B	18			
8	Elbe	Compensation measure Hahnöfer Sand	E-Hahn.S.	2002	63	B	57			
9	Elbe	Spadenlander Spitze	E-Sp.Sp.	2002	8	B	32			
13	Scheldt	Lippenbroek FCA-CRT	S-Lip.	2006	10	BH	38			
15	Scheldt	Ketenisse wetland	S-Ket.	2003	30	B			92	
16	Scheldt	Paddebeek wetland	S-Pad.	2003	1,6	B	18			
17	Scheldt	Paardenschor wetland	S-Paard.	2004	12	B			100	
18	Scheldt	Heusden LO wetland	S-Heusd.	2006	10	B	0			
24	Weser	Tegeler Plate – Development of tidally influenced brackish water habitats	W-Tegl.P.	1997	210	B		58		
25	Weser	Shallow water area Rönnebecker Sand	W-Ronn.S.	2002	34	B	32			
26	Weser	Tidal habitat Vorder- und Hinterwerder	W-VorHin	1997	27	B	12			
27	Weser	Shallow water zone Kleinensieler Plate	W-Kl.P.	2000	60	B		57		
28	Weser	Cappel-Süder-Neufeld	W-Cap.S.N.	2002	27	B				90
30	Humber	Alkborough Managed Realignment and flood storage: Creation of ~440 a of intertidal habitat	H-Alk.	2006	440	BH			60	
31	Humber	Paull Holme Strays Managed Realignment: creation of ~80 ha of intertidal habitat	H-PHS	2003	80	B				95
33	Humber	Creation of ~13 ha of intertidal habitat at Chowder Ness	H-Ch.N.	2006	15	B			73	

[1] **Category**: Biology/ecology (B), hydrology/morphology (H), combination of biology/ecology with hydrology/morphology (HB)

[2] **Zonation**: freshwater zone (F), Oligohaline zone (O), mesohaline zone (M), and polyhaline zone (P) [21]

=> Manual for the evaluation of management practices on the ecosystem services in estuaries

Strategic morphological management

- Maintaining the multiple channel system locally

- creating zone in outer bend of the Middelgat channel with large ecological potential

- restore some of the morphological connections

- working with natural evolution

Positive impact on ecological and nautical functioning and on safety

Alternative 2: Improving the Geul van de Molenplaat connection

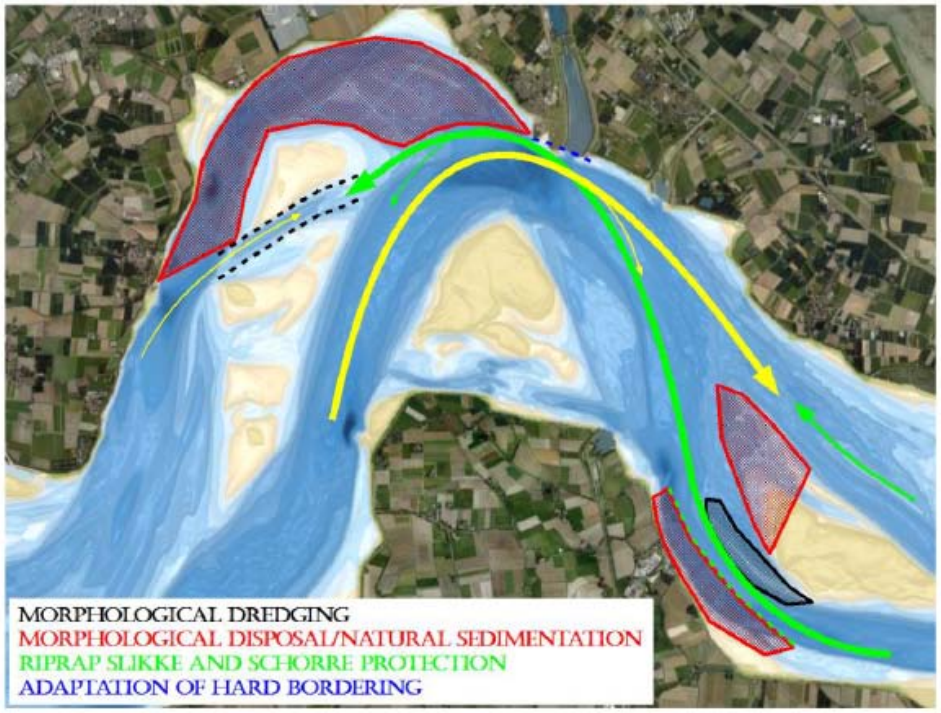
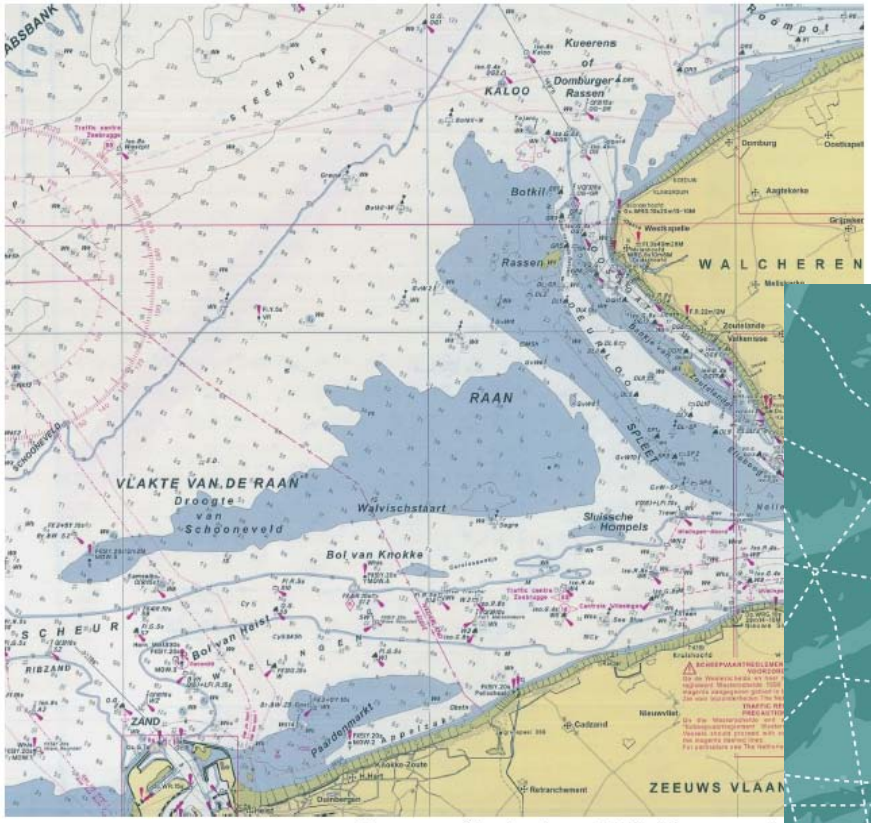


Figure 26: Reach Baarland-Baalhoek: proposal improving Geul van de Molenplaat connection. Schematic distribution of ebb flow (green) and flood flow (yellow).
Source aerial picture: Google Maps

See also presentation on Thursday and poster of Y. Plancke

Integrated vision for the coastal area: Vlakte van de Raan

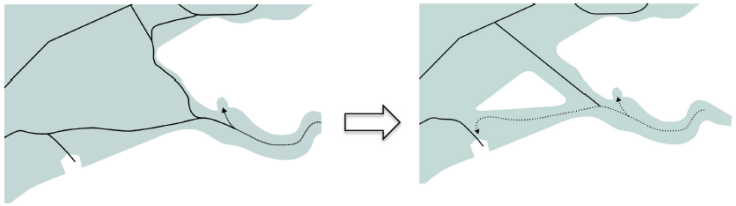


Topografische kaart Vlakte van de

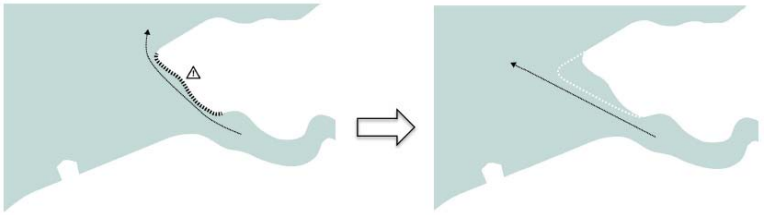
A vision for protection of the coast line against the impact of climate change, eg. sea level rise, increased wave height etc.

Source: Ccaspar project

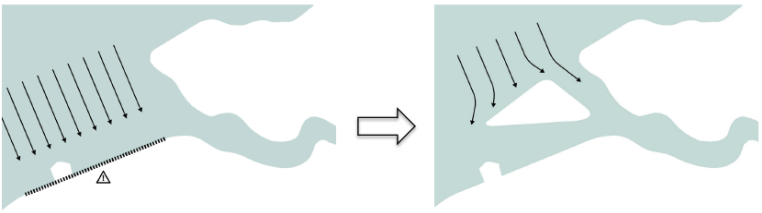
Integrated vision for the coastal area: Vlakte van de Raan



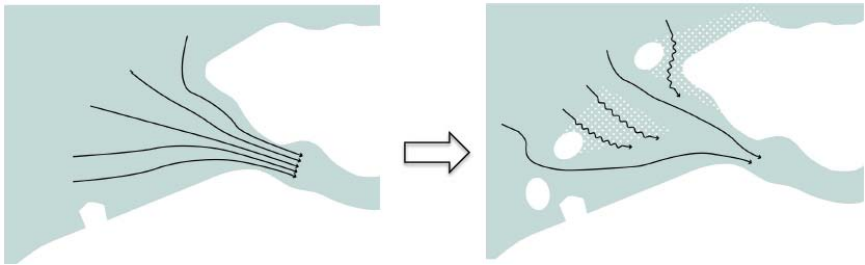
Shorter navigation route / protection of estuarine and inland navigation



Development of shallow water area and prevention of erosion of the Dutch coastline



Protection of the Belgium coastline



Energiedissipation for the Westerschelde / reducing water levels during storm tide

Reuse of dredged material / sand engine

Positive impact on ecological and nautical functioning and on safety

Source: Ccaspar project

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conclusion

Today sediment management by the ports is not only focusing on the accessibility of the largest containerships

It is more and more an integrated management keeping in mind the ecological functioning, safety and nautical purposes