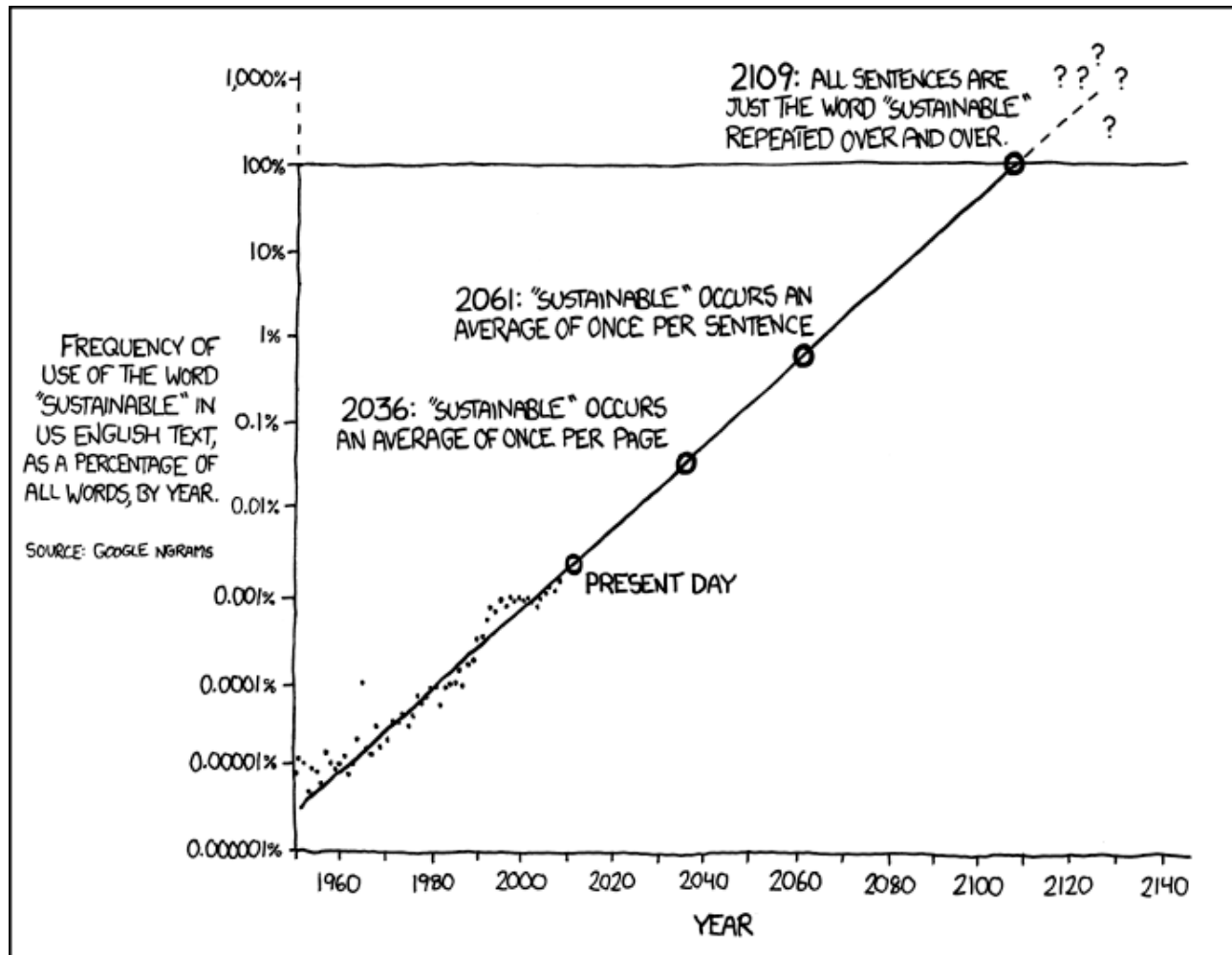
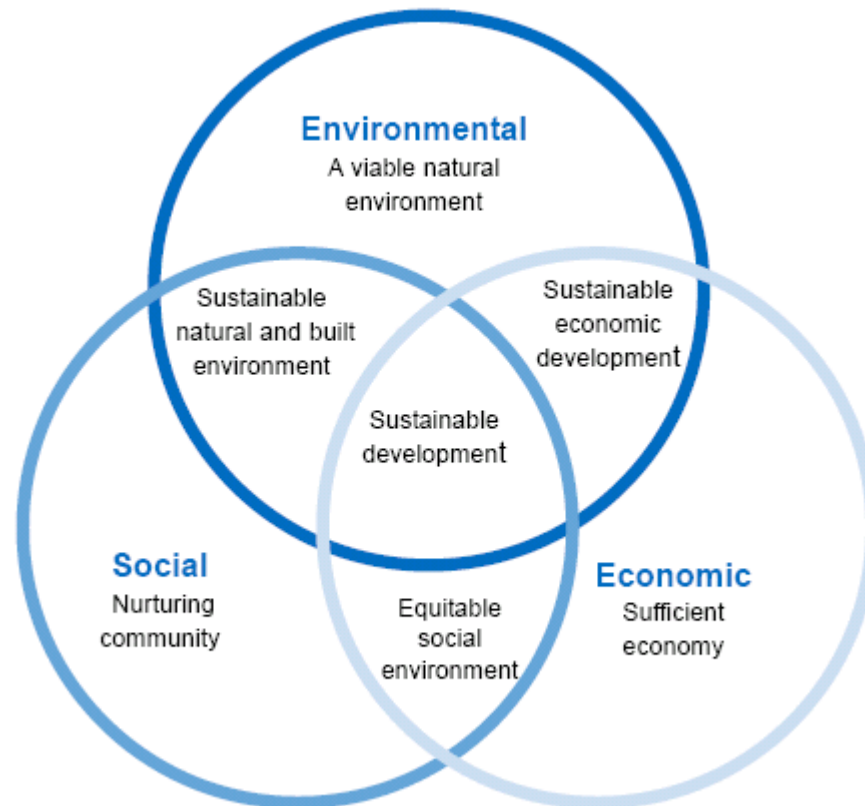


SUSTAINABILITY



THE WORD "SUSTAINABLE" IS UNSUSTAINABLE.

SUSTAINABILITY



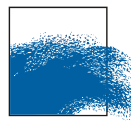


Institute for Agricultural and Fisheries Research

Sustainable disposal of dredged material? An analysis of the Belgian situation



Gert Van Hoey, Devriese Lisa, Dewitte Bavo, Fettweis Michael, Martens Chantal



Flemish government
COASTAL DIVISION



Introduction



Degradation of the
marine ecosystem

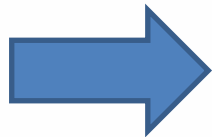
Human activities at sea should be executed in a sustainable way

HOW TO EVALUATE THIS SUSTAINABILITY ?

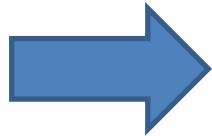
Introduction

SUSTAINABILITY ?

To avoid a subjective debate, the sustainability of those activities has to be evaluated in an objective way.



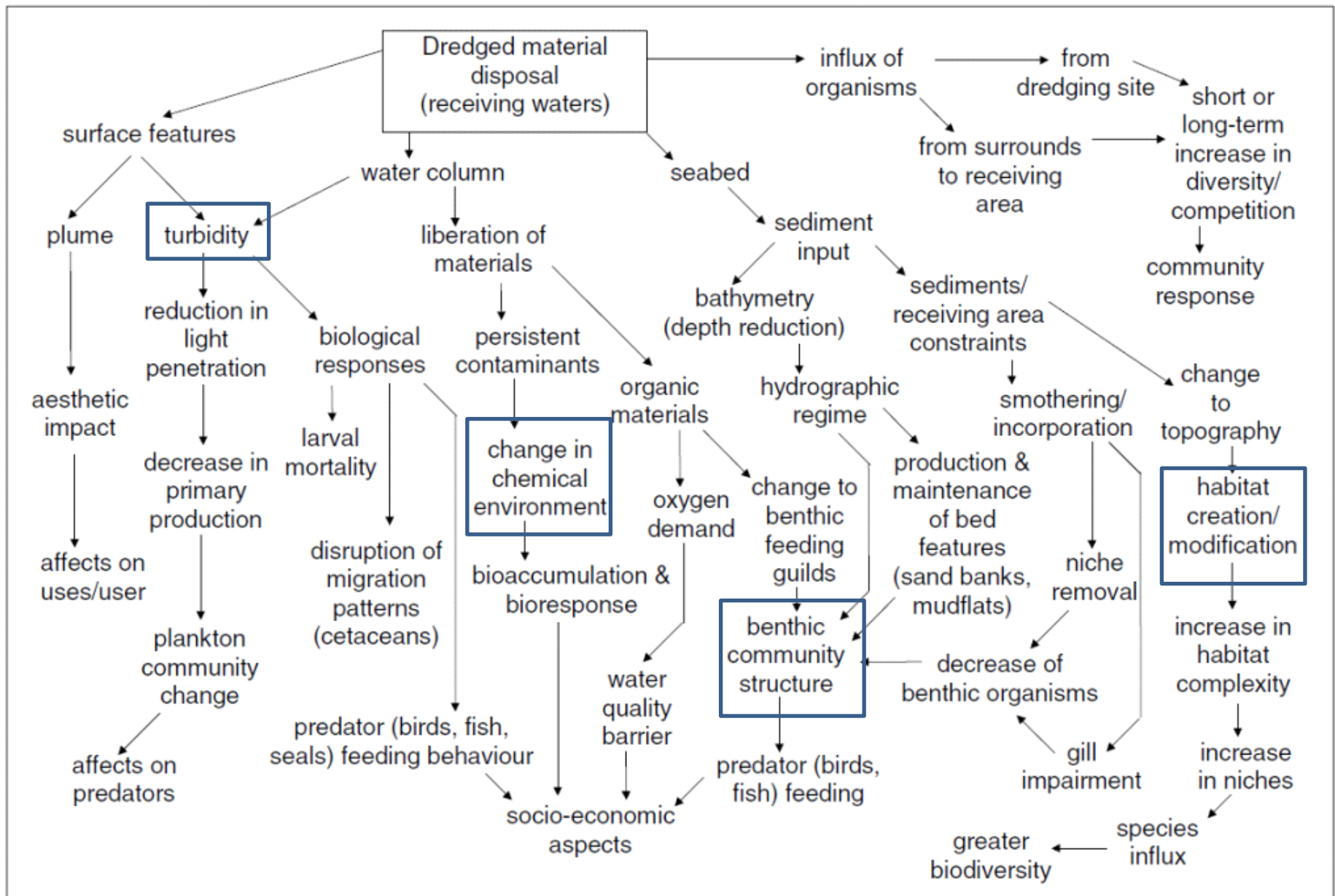
Use existing criteria, indicators, thresholds, ...



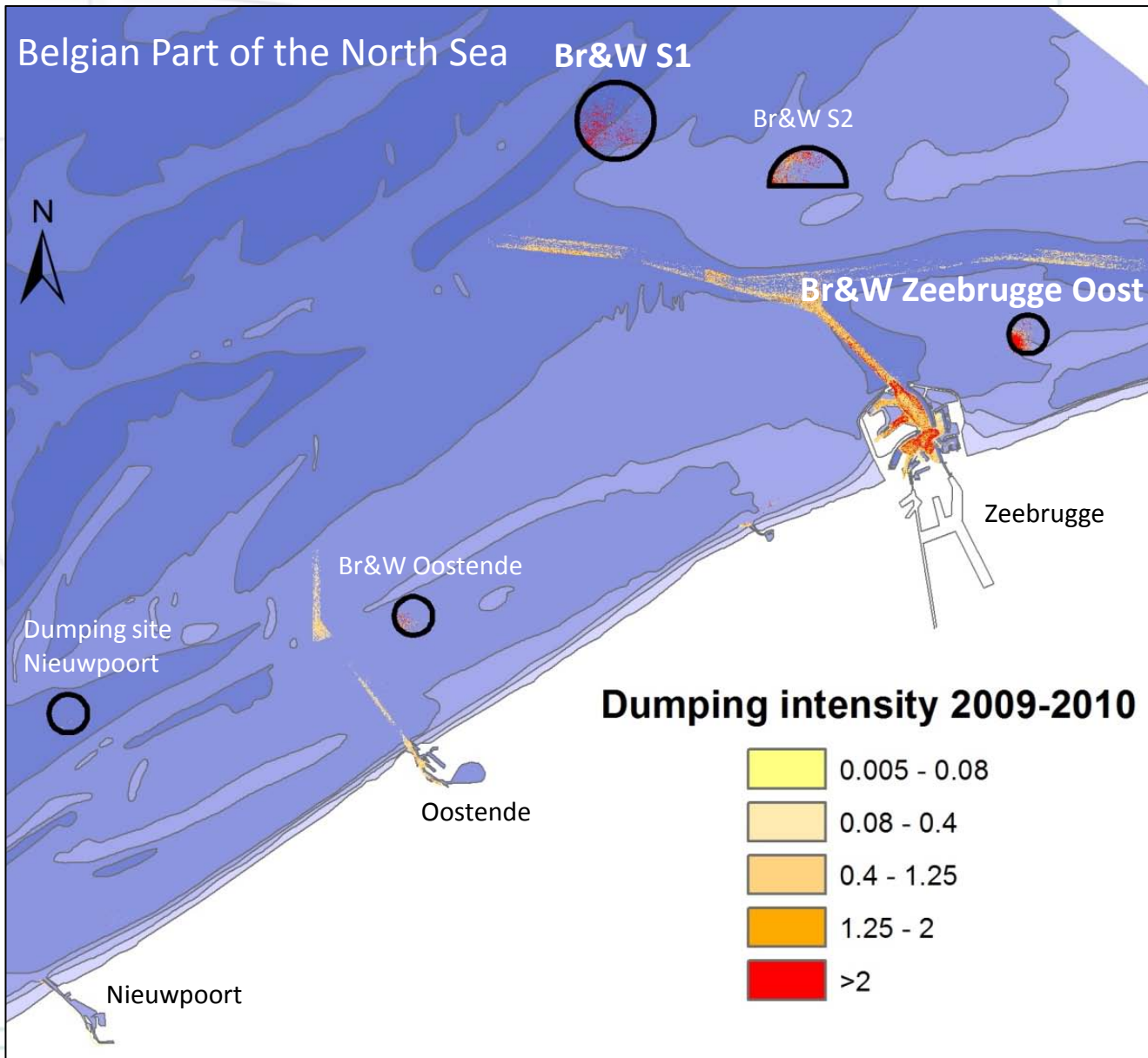
Integrated assessment

Marine Strategy Framework Directive





The Belgian situation



Main dumping sites:
Br&W Zeebrugge
Oost and Br&W S1

Dumping quantity:
Ranged from a few
10.000 to 6.000.000
tonnes dry matter a
year



STEP 1

The identification of relevant MSFD descriptors, criteria and Good Environmental Status (GES) indicators in relation to the activity.

Descriptor		Relation
1, 4 and 6: Biodiversity, food webs and sea floor integrity		Habitat and sea-floor morphological changes
2: Non indigenous species		Introduction of species towards another area
3: Commercial fish species		Occurrence of species/ loss of fishing area
5: Hydromorphological changes		Turbidity changes? Bottom typology
7: Eutrophication		Changes/release of nutrients
8: Chemical Pollution		Changes in chemical environment
9: Sea food safety		Chemical substances uptake in the food web
10: Marine Litter		Re-allocating marine litter from dredging sites
11: Underwater noise		Ship movements

STEP 1

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7: Eutrophication		Changes/release of nutrients
8: Chemical Pollution		Changes in chemical environment
9: Sea food safety		Chemical substances uptake in the food web
10: Marine Litter		Rubish from the dredging areas
11: Underwater noise		Ship movements

STEP 2

The filling in of the indicators, accompanied with their thresholds per relevant descriptor, based on the collected data

e.g.

Descriptor	Indicator	Threshold
1, 4 and 6: Biodiversity, food webs and sea floor integrity	The ecological quality index, determined by the benthic indicator BEQI (Benthic Ecosystem Quality Index, www.beqi.eu).	EQR > 0,6

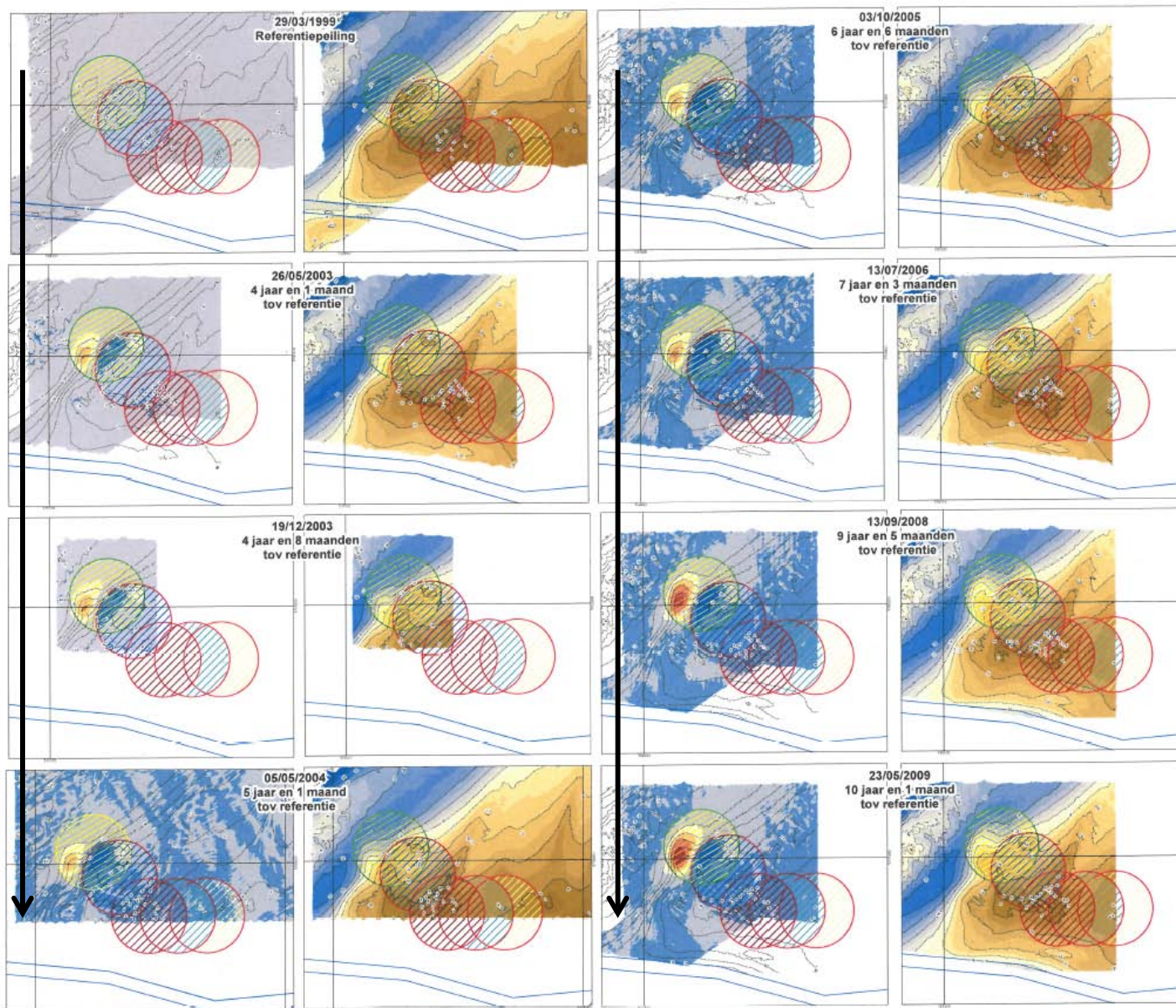
STEP 3

First, attempt to estimate the possible effect of the activity on the GES.

Descriptor 5: Hydromorphology

Descriptor	Indicator + Threshold
Hydro-morphology	<p>An impact needs to be considered when one of the following conditions related to bottom shear stress are reached:</p> <ol style="list-style-type: none"><li data-bbox="369 476 1644 519">1) An increase of more than 10% in average bottom shear stress<li data-bbox="369 534 1804 634">2) The variation of the ratio between time of sedimentation and erosion lays within “-5%, + 5%” range <p>The permanent impact of the activity is within a distance equal to the square root of the occupied surface of the activity and calculated from the inherent ultimate limit.</p>

Descriptor 5: Hydromorphology



Descriptor 5: Hydromorphology

Descriptor	Indicator + Threshold
Hydro-morphology	<p>An impact needs to be considered when one of the following conditions related to bottom shear stress are reached:</p> <ol style="list-style-type: none"><li data-bbox="369 476 1644 519">1) An increase of more than 10% in average bottom shear stress<li data-bbox="369 534 1804 634">2) The variation of the ratio between time of sedimentation and erosion lays within “-5%, + 5%” range <p>The permanent impact of the activity is within a distance equal to the square root of the occupied surface of the activity and calculated from the inherent ultimate limit.</p>



These indicators are not yet ready to use.

Descriptor 8: Chemical Pollution

Descriptor	Indicator + Thresholds
Chemical Pollution	In water: The concentration of WFD substance are equal or below their EQS (Environmental Quality Standards) (Richtlijn 2008/105/EG).
	In biota: The concentration of Hg, hexachloorbenzeen and hexachloorbutatdieen are equal or lower than their EQS (Directive 2008/105/EG).
	Biota and sediment: Substances wherefore OSPAR ecotoxicological assessment criteria (EAC's) defined , have concentrations equal or below their EAC's (OSPAR JAMP).
	Effects: For visible fish diseases, the fish index lays below the environmental criterea (EAC) as determined in the OSPAR JAMP guidelines (Guidelines for the Integrated Monitoring and Assessment of Contaminants).

Descriptor 8: Chemical Pollution

		Dumping site Nieuwpoort				Br&W Oostende				Br&W S1				Br&W S2				Br&W Zeebrugge Oost			
		2009		2010		2009		2010		2009		2010		2009		2010		2009		2010	
		S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A
		I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C
SEDIMENT																					
OSPAR	Cd																				
	Hg																				
	Pb																				
	Cu																				
MFSD	Cd																				
	Hg																				
	Pb																				
Belgisch Staatsblad	Cd																				
	Hg																				
	Pb																				
	Cu																				
OSPAR	Σ7 CB																				
	pp-DDE																				
MFSD	CB118																				
	CB153																				
Belgisch Staatsblad	CB118																				
	CB153																				
	pp-DDE																				
	pp-DDT																				

¹ OSPAR, Quality Status Report 2000, Region II Greater North Sea

² MSFD Marine Strategy Framework Directive, Task Group 8, Contaminants and pollution effects. *Law et al.* 2010.

³ Belgisch Staatsblad N° 209, vrijdag 9 juli 2010

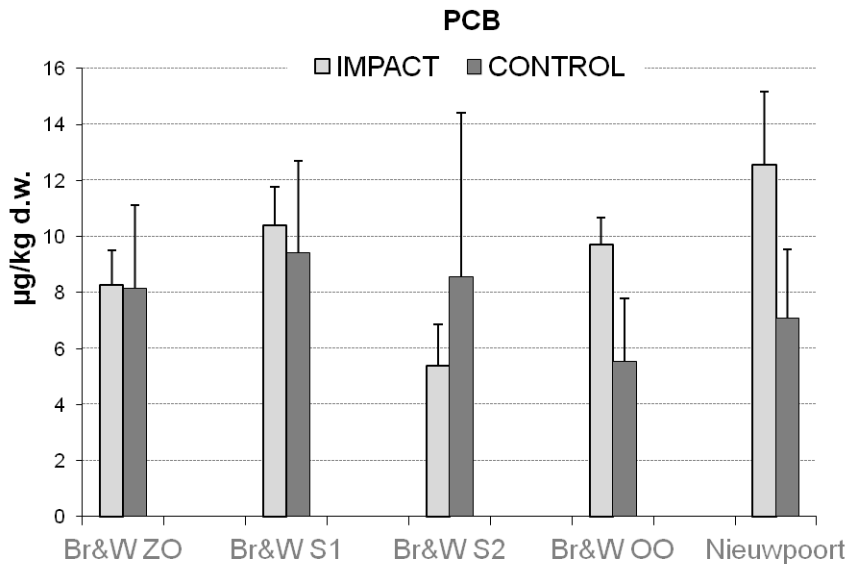
Descriptor 8: Chemical Pollution

IMPACT VERSUS CONTROL ASSESSMENT

Sediment
Biota

No significant difference, no trend

SEDIMENT



Chemical analyses of dredge disposal sites at the Belgian Continental Shelf

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Introduction

The Belgian Continental Shelf (BCS) contains 5 dredge disposal sites. The disposed sludge mainly derives from maintenance dredging works at the ports, harbours and channels near Zeebrugge, Oostende and Nieuwpoort (Fig. 1). The sites nearby Zeebrugge (LS1, LS2, LZO) are intensively used with average dredge deposition amounts of 0.8 to 2.0 ton dry matter (TDM)/m², while dredge deposition at sites nearby Oostende (LOO, 0.35 TDM/m²) and Nieuwpoort (LNP, 0.65 TDM/m²) is less intensive. This presentation summarizes the evolution of the sediment chemical status from 2005 to 2011.

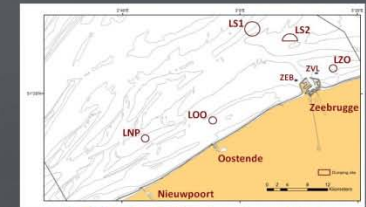


Fig. 1 Map of the Belgian dredge disposal sites

Statistical analysis

- Linear mixed effect model with $R^2 = 2.15.3$, $\alpha = 0.05$
- Factors: season, time, sampling location, zone (impact vs. control zone), time:zone

General conclusions

- Heavy metal concentrations for most compounds significantly decreasing
 - Consistent with OSPAR trends since 1990's
 - E.g. Cd at LOO (Fig. 2A)
- PCB concentrations not decreasing
 - Persistency of PCBs
 - Inputs from ports and Scheldt Estuary
- No trend in PAH concentrations
 - E.g. PAH at LOO (Fig. 2B)
- Limited concentration differences between sludge disposal sites and control zones

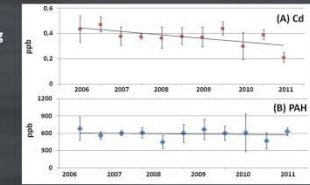


Fig. 2 As and PAH concentrations with 95% confidence level at disposal site LOO

Highlight 1: Zn contamination by antifouling agents?

- Significant increase of Zn concentrations at LOO and LNP, no increase at control zones (Fig. 3)
- Nearby harbours: especially leaseure boats
- Relationship between Zn-based leaseure boat paints and Zn concentration increase?
- Zn on sediment or on paint particles within the sediment?

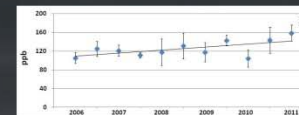


Fig. 3 Zn concentrations with 95% confidence level at disposal site LOO

Highlight 2: the remarkable point ZEB

- Point nearby port of Zeebrugge
- Unexpected low concentration of 16 EPA PAH compared to other nearby points (Fig. 4)
- Unexpected high concentration of perylene (Fig. 4)
- Indication of anoxic environment

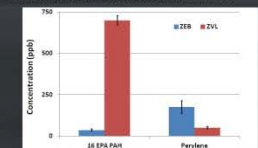


Fig. 4 Average PAH concentrations (2009-2012) at point ZEB and ZVL, normalised to 2.5% TOC, with 95% confidence level

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These indicators are more or less ready to use, but tuning the thresholds is advisable.

Descriptor 1,4 and 6: Biodiversity, food webs and sea floor integrity

Descriptor	Indicator + Threshold
Biodiversity food webs sea floor integrity	The spatial distribution of the EUNIS 3 habitats does not change with more than 5% compared to the initial assessment.
	The ecological quality index, determined by the benthic indicator BEQI is equal or not lower than 0,6 on a scale of 0-1.
	Positive trend in the average density of long-living, slowly reproducing and habitat structuring benthic species.
	The median benthic bioturbation potential index is larger than 100 for the <i>Abra alba</i> habitat type.

Descriptor 1,4 and 6: Biodiversity, food webs and sea floor integrity

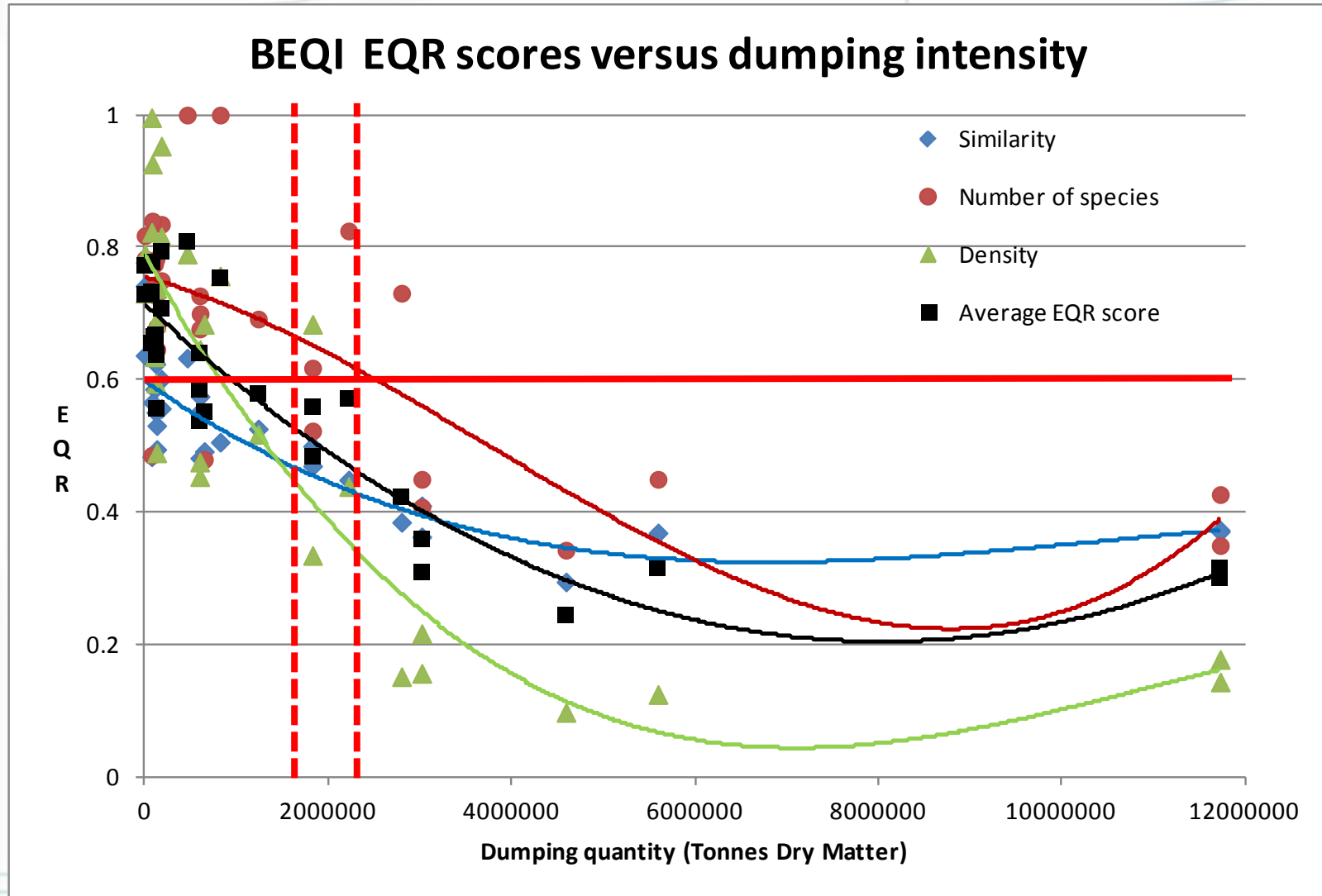
Benthic Ecosystem Quality Index (BEQI) results for 2010

BEQI	Dumping site Nieuwpoort	Br&W Oostende	Br&W S1	Br&W S2	Br&W Zeebrugge Oost
Density	0.37	0.81	0.06	0.75	0.77
Biomass	0.97	0.88	0.08	0.68	0.76
Similarity	0.58	0.66	0.38	0.56	0.49
Species	1	0.73	0.45	1	0.74
Average	0.73	0.77	0.24	0.75	0.68

Benthos at disposal area impacted

Descriptor 1,4 and 6: Biodiversity, food webs and sea floor integrity

The benthic indicator (BEQI) shows a relation with the dumping intensity:



Descriptor 1,4 and 6: Biodiversity, food webs and sea floor integrity

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	Positive trend in the average density of long-living, slow reproducing and habitat structuring benthic species.
	The median benthic bioturbation potential index is larger than 100 for the <i>Abra alba</i> habitat type.



Only one indicator is ready to use, others still need to be explored.

Conclusion

Despite the fact that only a **few MSFD descriptors** and **a minority of the indicators** (mainly chemical thresholds, benthic indicator) could be **directly** assessed based on the **current** collected data, this stepwise plan shows the potential to contribute to an objective evaluation of dredge material disposal.





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Thank you!

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Pictures: @Karl Vanginderdeuren