OYSTER REEFS

17 FEBRUARI 2016

CREATING THE FUTURE OF DELTA AREAS

CONTENT

What is known

Implementation of oyster reefs at the Roggenplaat

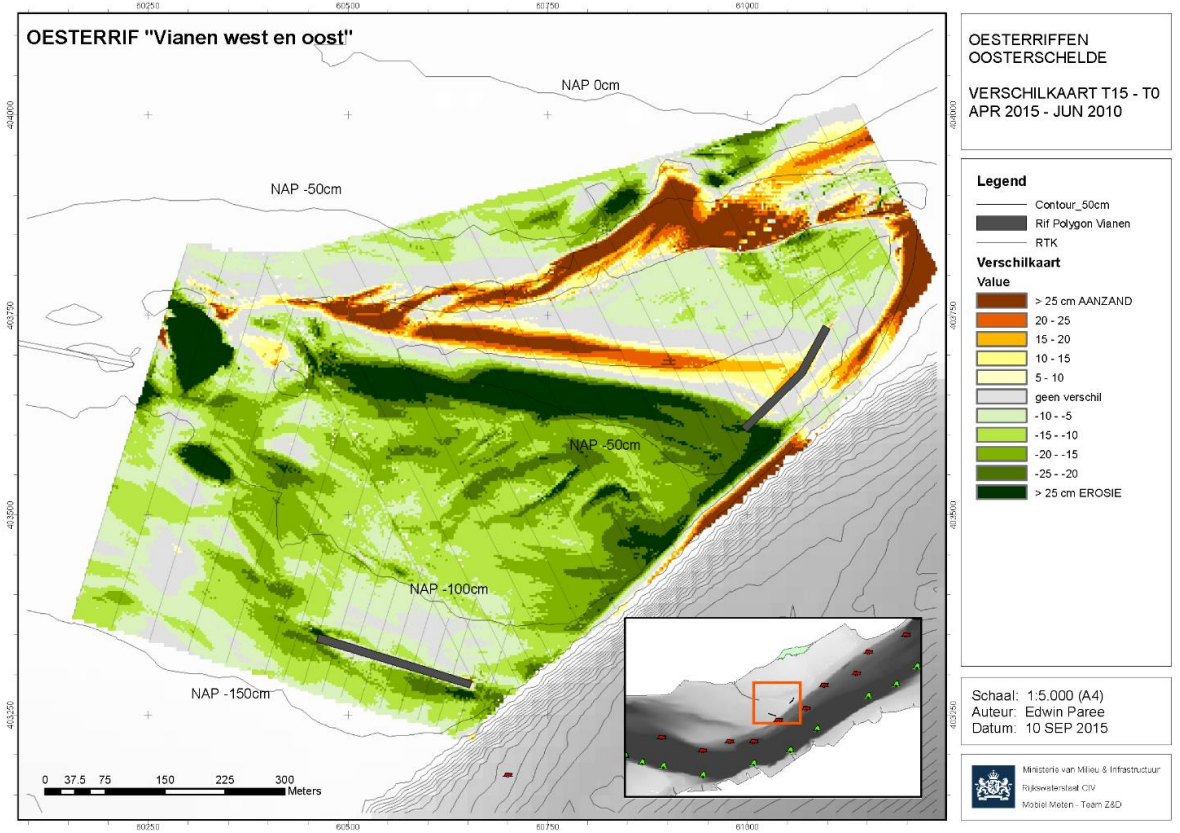
Conclusions

WHAT IS KNOWN

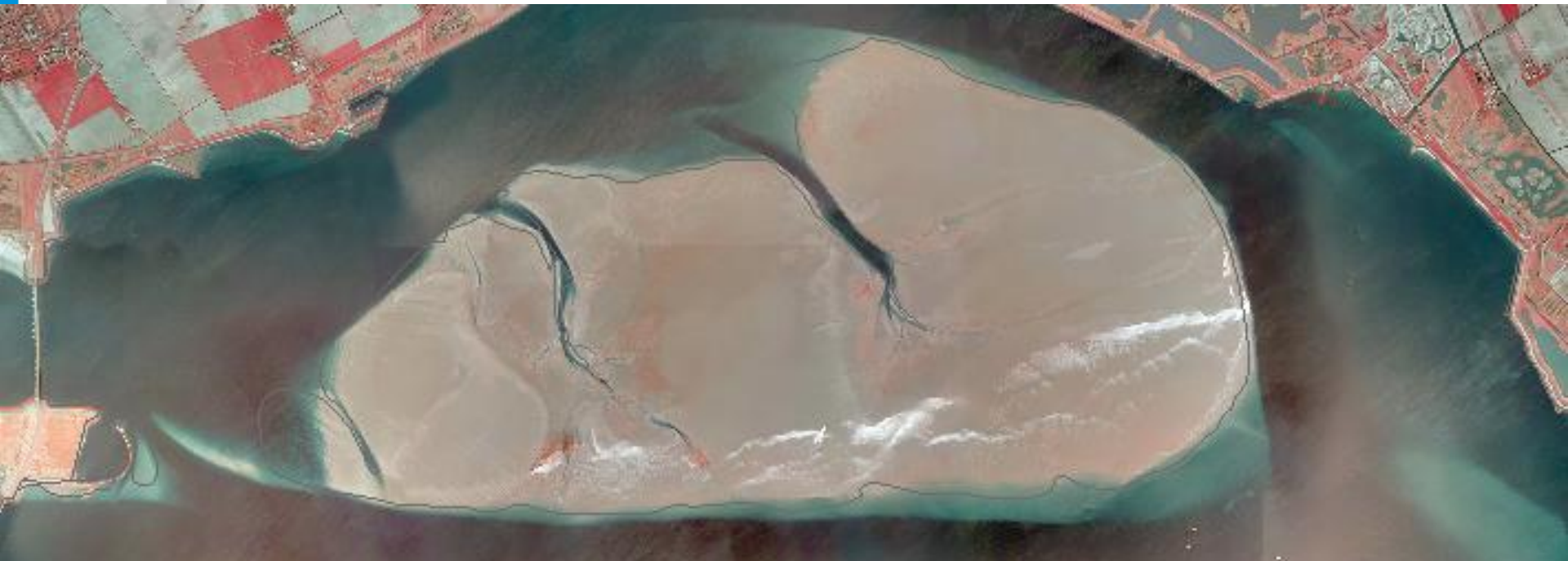
Reefs are able to stabilize the adjacent areas;

Best Location: 20-40% emersion time (Walles et al., 2016).
Reef crest at this emersion time for optimal reef growth (reef growth up to 14.6 mm.year^{-1} at Viane)

Design:Low crested reef (H_{reef}: 0.25 m)
Length: 200 m
Width: 8-10m
Gabions filled with oysters



IMPLEMENTATION OF OYSTER REEFS AT THE ROGGEPLAAT



SUITABLE LOCATIONS

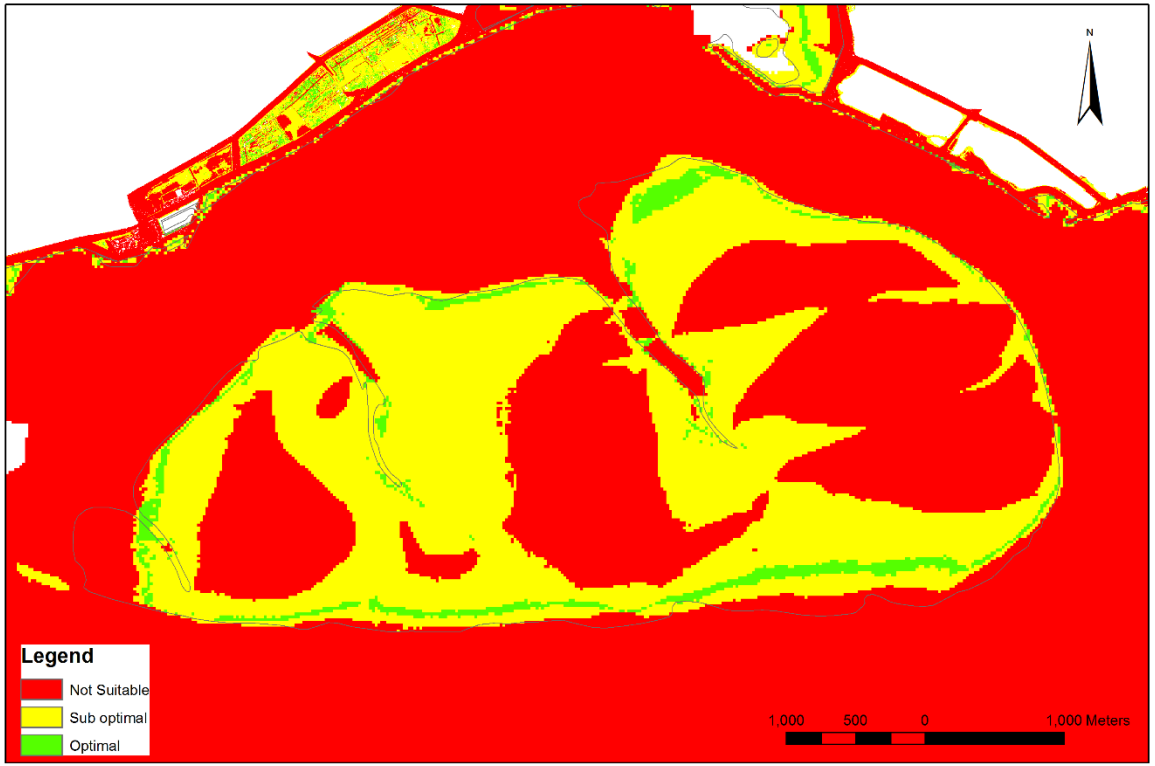
Green – Suitable locations
(reef crest between 20-30% emersion, which includes a growth potential)

Yellow – Suboptimal
(reef crest between 0-20% and 30-55%)

Red – not suitable
(reef crest lower than 0% and higher than 55%)

>55% growth ceiling

<0% predation/fouling



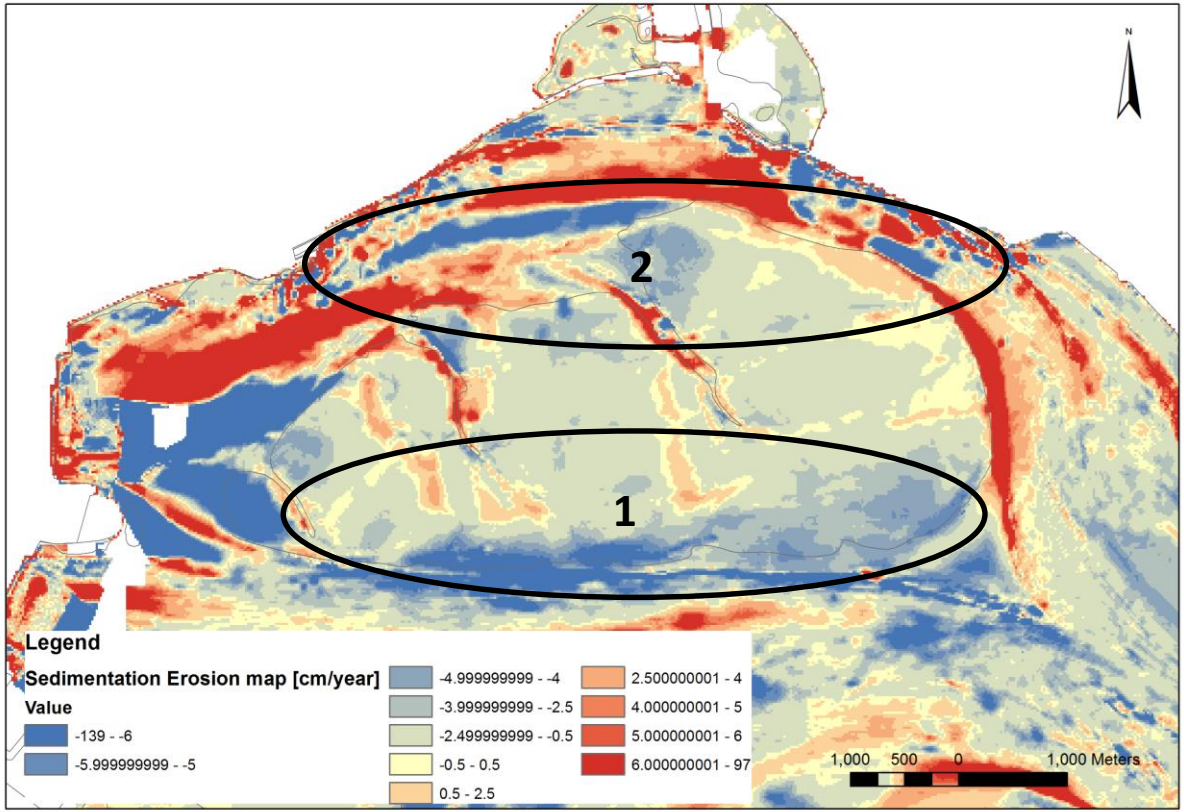
SUITABLE LOCATIONS

Oyster reefs can be used in 2 ways:

1. To reduce wave action, providing sediment stability
2. To capture sediment

Based on waves and erosion/sedimentation patterns we restricted the study to the south part

Shear stress at pilot study Viane exceeds values at Roggeplaat therefore similar construction should hold.



AMOUNT OF SEDIMENT STABILIZED

Assumptions:

- Slope (I_b): 0.002 (based on transects of the southern area of Roggenplaat)
- Significant wave height (H_s): 0 - 0.2 m
- Reef Height (H_{reef}):0.25 m
- Reef height accretion: 14.6 mm.year^{-1} (observed for a natural reef at Viane)
- erosion rate of 5 cm.year^{-1}
- Cost of sand: €7,- per m^3
- Cost of reef: €45,- per m^2

Two Scenarios:

- Stabilization
- Reduction of erosion (from 5 to 1 cm.year^{-1})

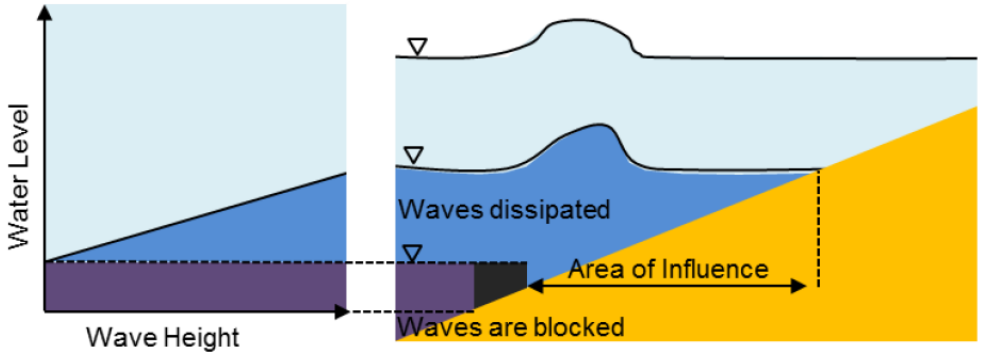
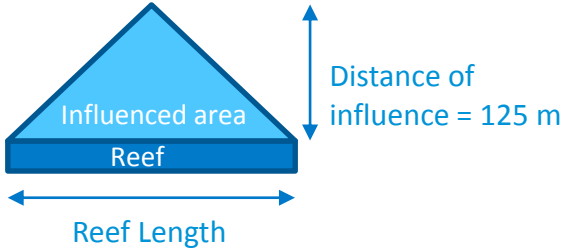


Figure 6.1. Water level, wave height and reef height influences the period in which waves are dissipated or blocked by a reef. For small wave over water depth ratios, waves pass the reef without losing energy (Bram van Prooijen pers. comm).

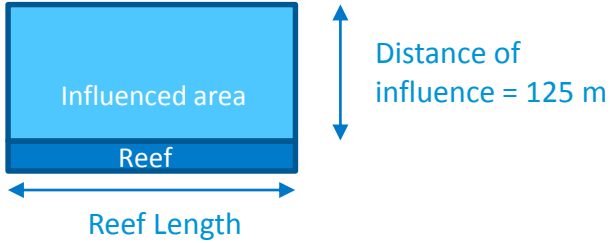
AMOUNT OF SEDIMENT STABILIZED

min. area of influence

(due to wave dissipation and directional spreading)



max. area of influence



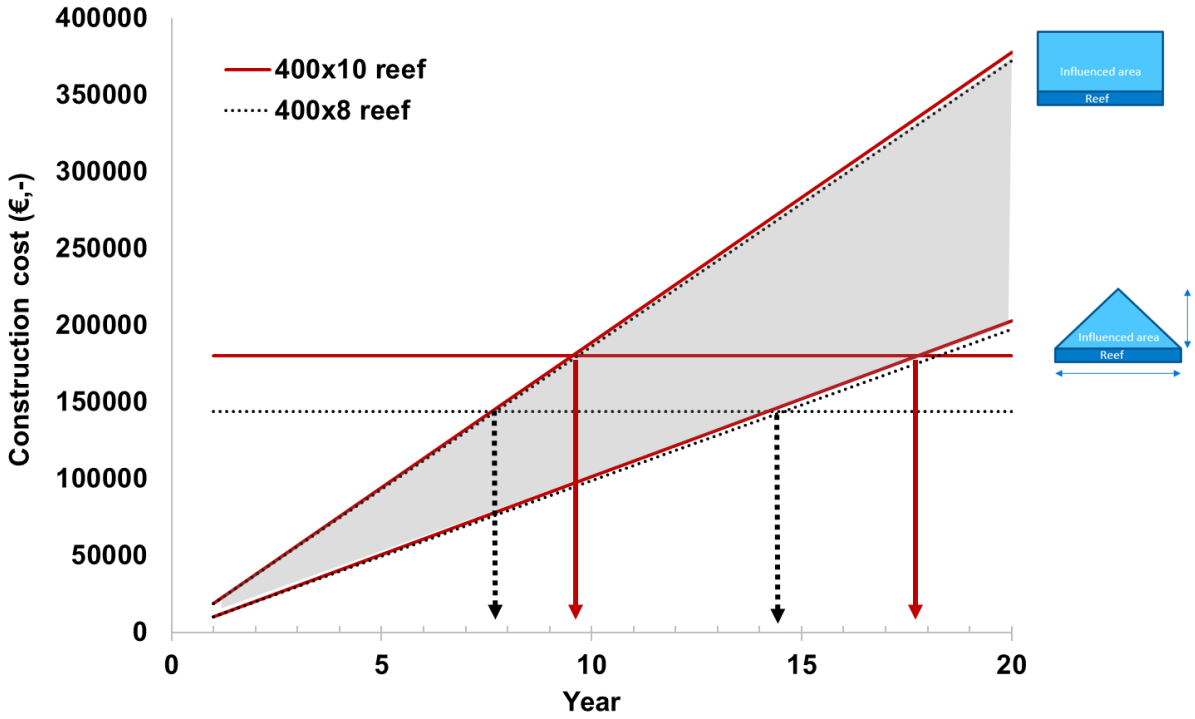
Distance of influence = 125 m(i_b=0.002 and H_{reef}=0.25m)	Reef length							
	100		200		300		400	
	min.	max.	min.	max.	min.	max.	min.	max.
Area influence including foot print [m^2]	7250	13500	14500	27000	21750	40500	29000	54000
Stabilized sand over 10years: stabilization [m^3]	3625	6750	7250	13500	10875	20250	14500	27000
Stabilized sand over 10years: Reduction [m^3]	2900	5400	5800	10800	8700	16200	11600	21600
Value over 10 years:stabilization [€]	25375	47250	50750	94500	76125	141750	101500	189000
Value over 10 years:reduction [€]	20300	37800	40600	75600	60900	113400	81200	151200
Oyster reef cost [€]	45000		90000		135000		180000	

Cost-efficiency depends on reef dimensions.

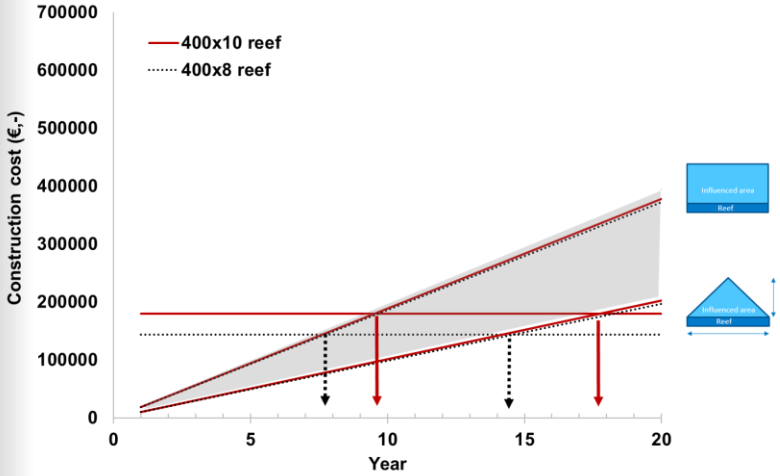
Stabilization provided by a reef of:

- 400 m x 10 m (like Viane) will be cost-efficient between 9 and 18 years

- 400m x 8 m (like Oesterdam) will be cost-efficient between 8 and 14 years

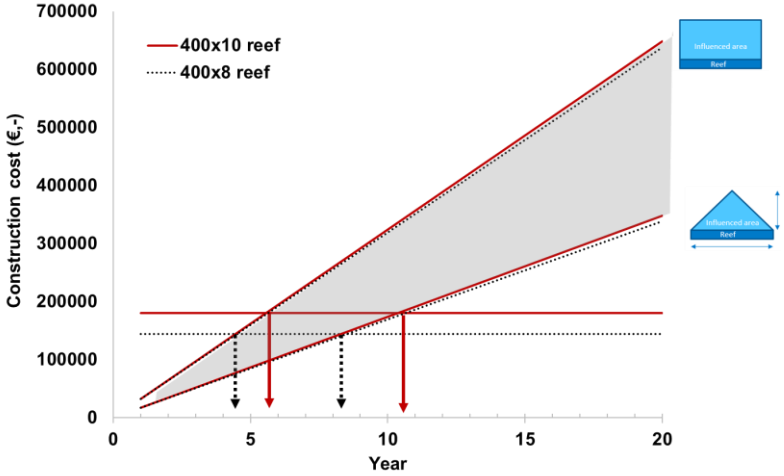


€7,- m^3



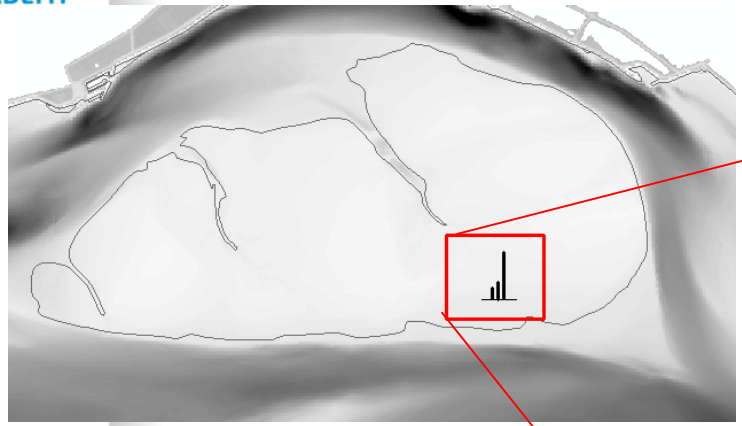
400 x 10 m: 9 - 18 year
400 x 8 m : 8 – 14 year

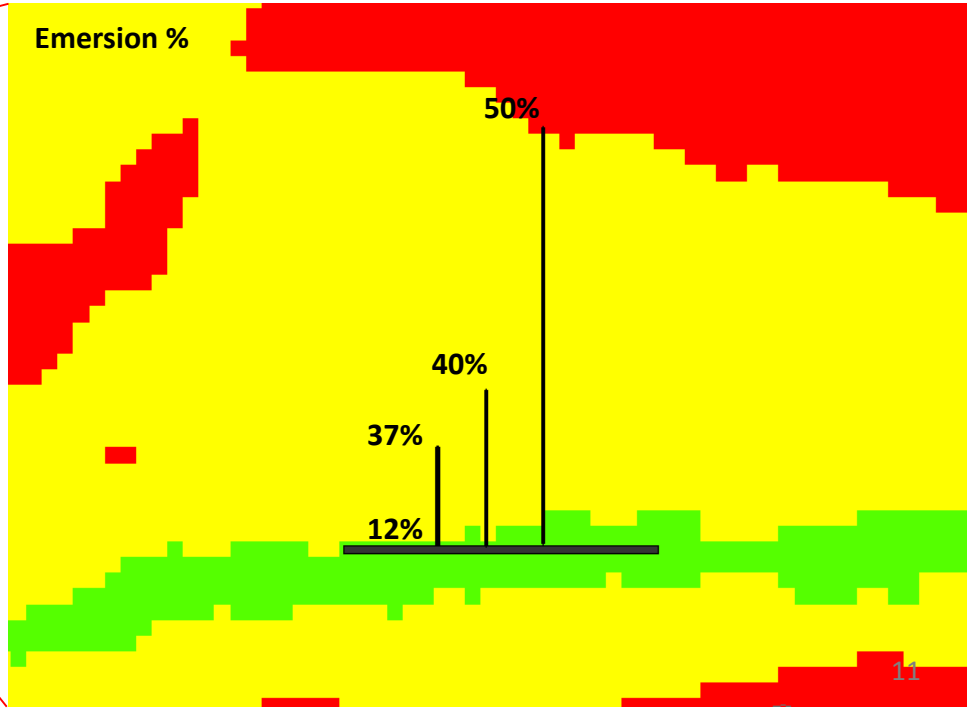
€12,- m^3



400 x 10 m: 4 - 8 year
400 x 8 m : 6 – 11 year

DISTANCE OF INFLUENCE

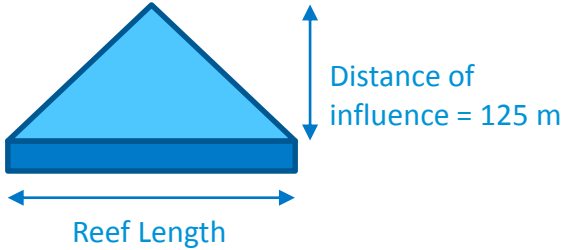




	0 years	5 years	10 years
H_{reef}	0.250	0.323	0.396
Min L (H_s=0m and i_b=0.002)	125.000	161.500	198.000
Max L (H_s=0.2m and i_b=0.002)	458.333	494.833	531.333

AMOUNT OF SEDIMENT STABILIZED WITH INCREASING HEIGHT

min. area of influence



$V_{total} = \sum_{i=0}^{10} Area_{\ i} \times 0.05$, $Area_i$ is the area per year

	100	200	300	400
Min Stabilized sand over 10years [m^3]	4441	8883	13324	17765
Max Stabilized sand over 10years [m^3]	13608	27216	40824	54432
Min Value € for 10years	31089	62178	93266	124355
Max Value € for 10years	95255	190511	285766	381022
Oyster reef cost [€]	45000	90000	135000	180000

CONCLUSIONS

Correct position of the oyster reefs is essential;

Reefs perform better in eroding areas;

Height of the reef is determinant for the length of influence;

Length of the reef is important for cost efficiency;

CONCLUSIONS

Resilience to storms as the reef structure remains;

low disturbance for benthic community

Protect the lower intertidal

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SAND COSTS: 12€ PER M^3

Distance of influence = 125 m(i_b=0.002 and H_{reef}=0.25m)	Reef length							
	100		200		300		400	
	min.	max.	min.	max.	min.	max.	min.	max.
Area influence including foot print [m^2]	7250	13500	14500	27000	21750	40500	29000	54000
Stabilized sand over 10years: stabilization [m^3]	3625	6750	7250	13500	10875	20250	14500	27000
Stabilized sand over 10years: Reduction [m^3]	2900	5400	5800	10800	8700	16200	11600	21600
Value over 10 years:stabilization [€]	43500	81000	87000	162000	130500	243000	174000	324000
Value over 10 years:reduction [€]	34800	64800	69600	129600	104400	194400	139200	259200
Oyster reef cost [€]	45000		90000		135000		180000	

EXAMPLE CALCULATION INCREASING HEIGHT PER YEAR

Reef L= 200m	0 years	1 years	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years
Hreef	0.25	0.2646	0.2792	0.2938	0.3084	0.323	0.3376	0.3522	0.3668	0.3814	0.396
Min L (Hs=0m and ib=0.002)	125.0	132.3	139.6	146.9	154.2	161.5	168.8	176.1	183.4	190.7	198.0
Max L (Hs=0m and ib=0.002)	458.3	465.6	472.9	480.2	487.5	494.8	502.1	509.4	516.7	524.0	531.3
Area Min L [m^2]	12500.0	13230.0	13960.0	14690.0	15420.0	16150.0	16880.0	17610.0	18340.0	19070.0	19800.0
Area Max L [m^2]	45833.3	46563.3	47293.3	48023.3	48753.3	49483.3	50213.3	50943.3	51673.3	52403.3	53133.3
Min Stabilized sand per year [m^3]	625.0	661.5	698.0	734.5	771.0	807.5	844.0	880.5	917.0	953.5	990.0
Max Stabilized sand per year [m^3]	2291.7	2328.2	2364.7	2401.2	2437.7	2474.2	2510.7	2547.2	2583.7	2620.2	2656.7
Min cost per year [€]	4375	4631	4886	5142	5397	5653	5908	6164	6419	6675	6930
Max cost per year [€]	16042	16297	16553	16808	17064	17319	17575	17830	18086	18341	18597
min comulative gain due to sediment stabilization over a period of 10years [€]	4375	9006	13892	19033	24430	30083	35991	42154	48573	55248	62178
max comulative gain due to sediment stabilization over a period of 10years [€]	16042	32339	48892	65700	82763	100083	117657	135487	153573	171914	190511