Rijkswaterstaat
*Ministerie van Infrastructuur en Milieu*

# The Sand Motor

## Looking back at 2,5 years of building with nature

Anne-Marie Svoboda
Rijkswaterstaat Sea and Delta

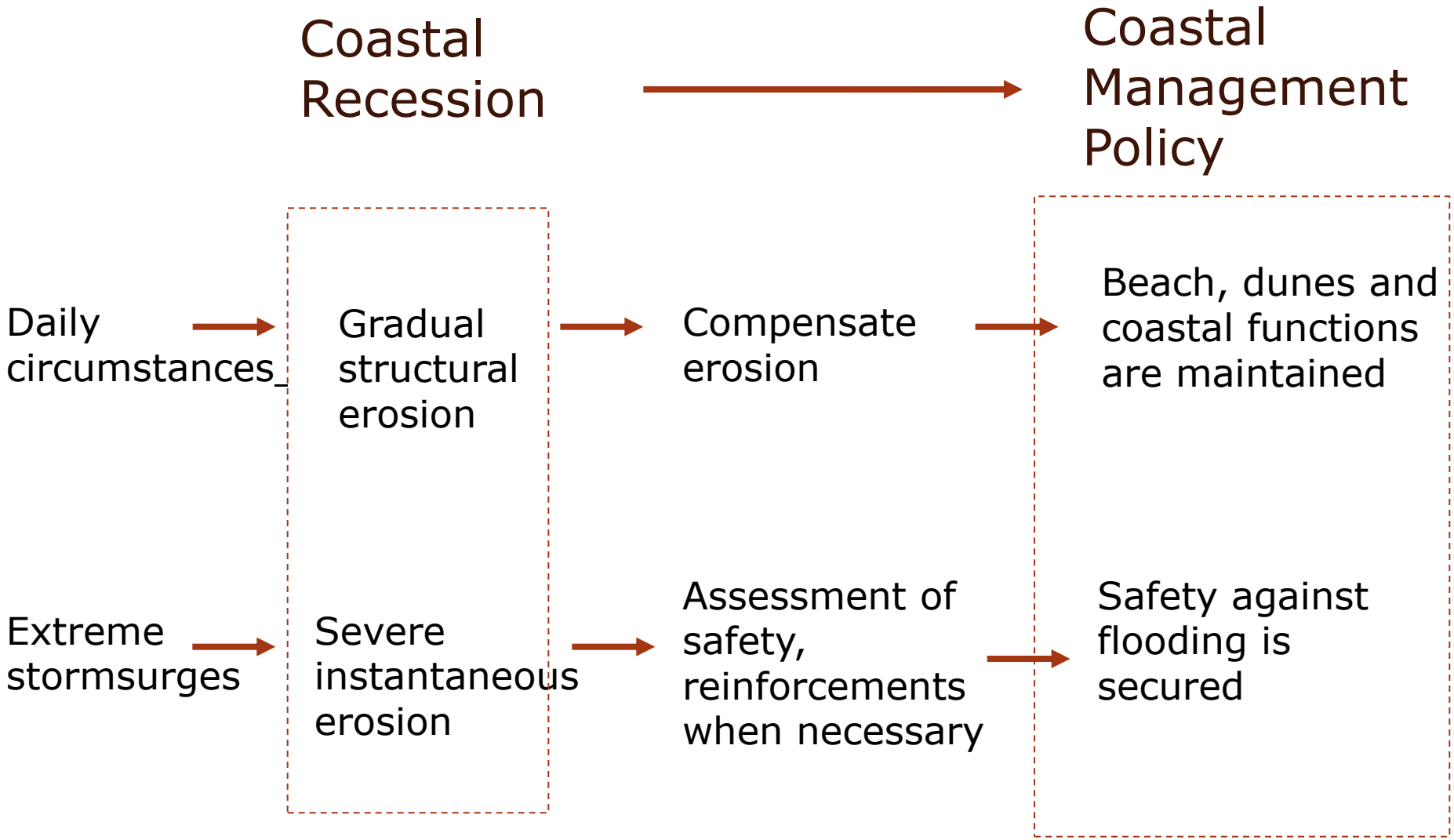
# Overview

- RWS and USACE
- Coastal nourishment strategy
- Coastal vision
- The Sand Motor:
  - Design
  - How does it work?
- Research and Monitoring
- Preliminary results

# RWS and USACE, Memorandum of Agreement

- USACE and Rijkswaterstaat collaborate together under a MoA (signed by Stockton and Dronkers).
- Current topics are:
  - Levee Safety (primarily USACE-RMS and ERDC)
  - Asset management
- Collaboration through:
  - Meetings twice a year
  - Staff exchange
  - Peer review
  - Joint research
- Colloboration on coastal issues is possible on a one to one basis. Example Dutch MSc student working at Stevens uni, supervised by RWS and TU Delft.

# Coastal nourishment strategy



# Structural Erosion

Beach 1945

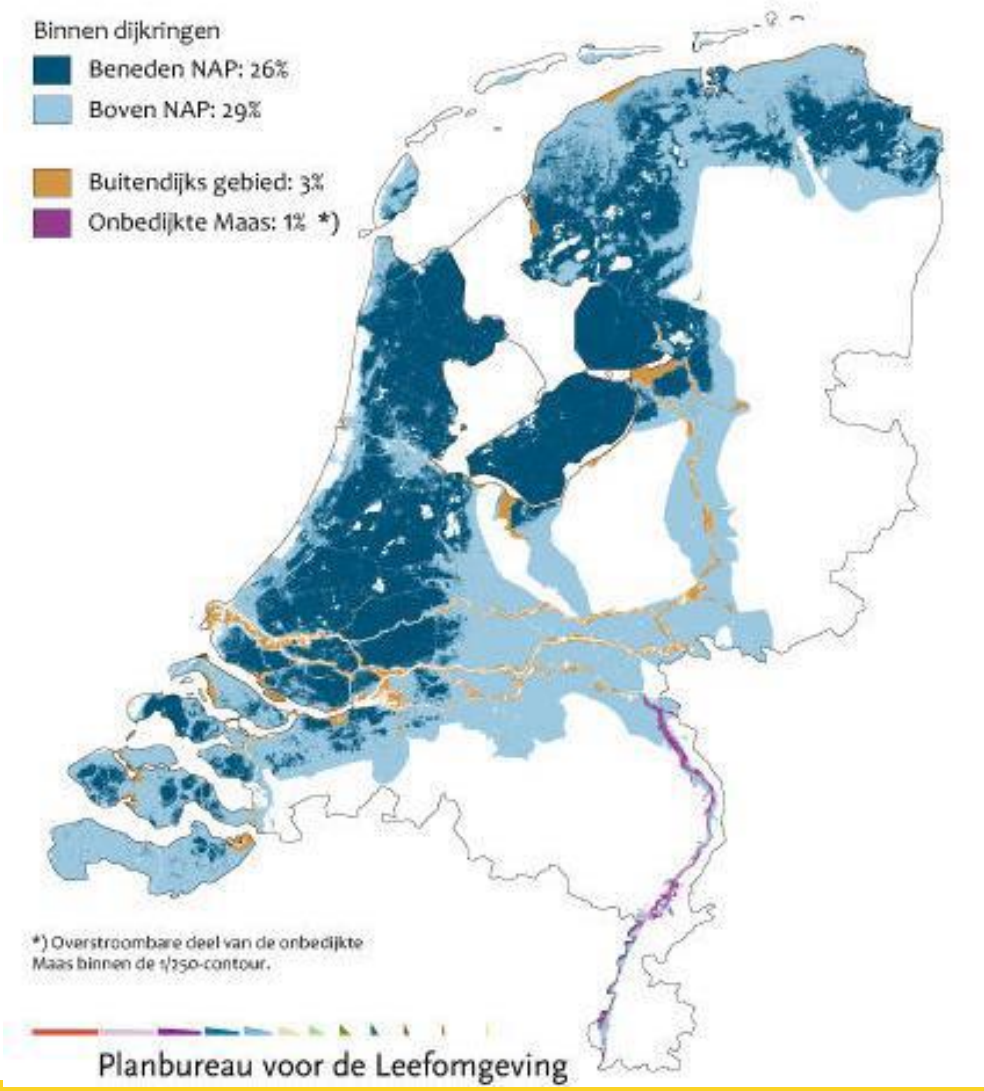
Beach 1990 / present

World War II bunkers

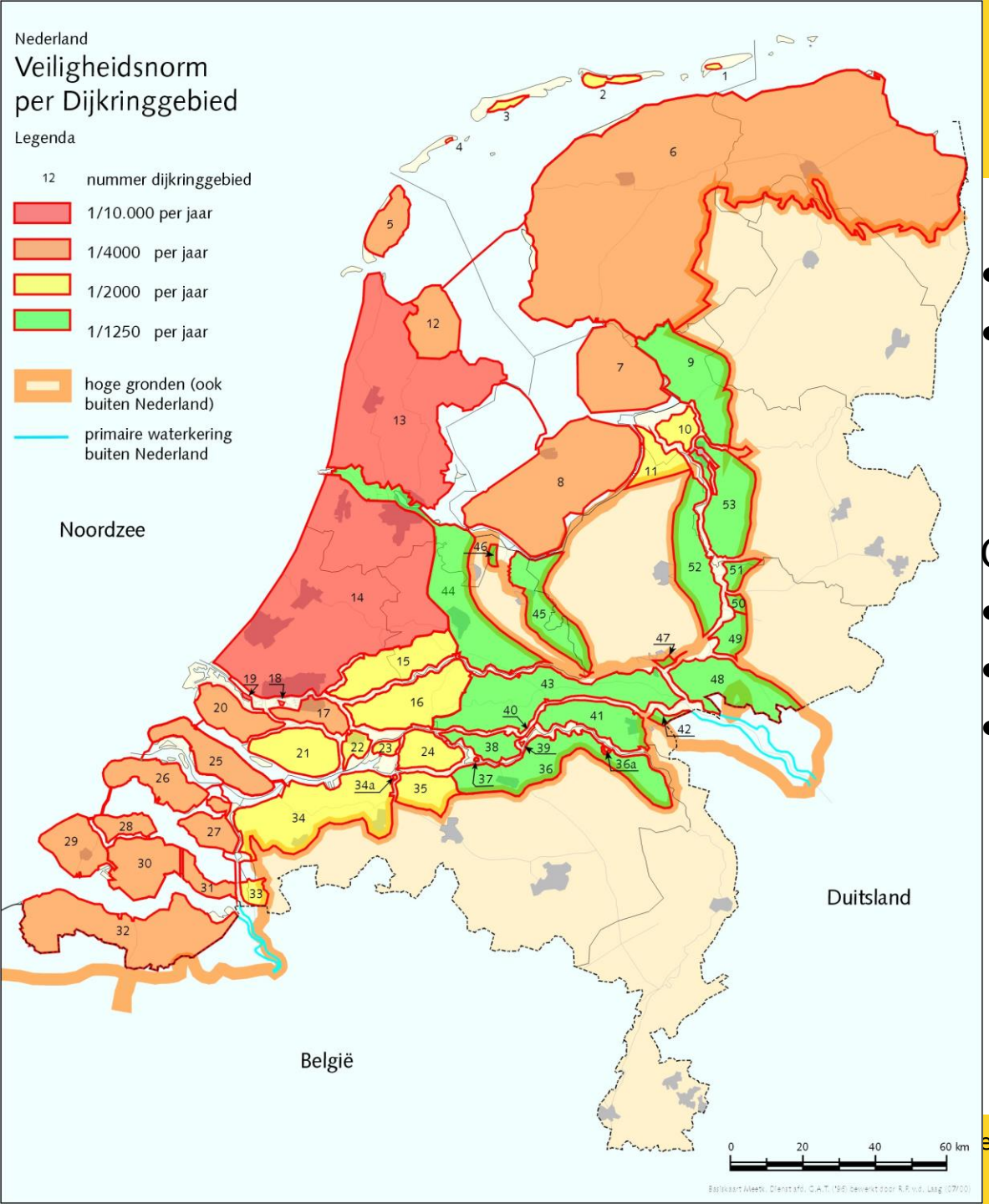
Rijkswaterstaat - 8 november 2005 - 14.56 uur

# Compensate Structural Erosion

- Basic Coast Line (BKL) is norm for maintaining the coastline
- Climate change: coastal foundation should ‘grow’ with sea level rise
- Nourish the coast -> yearly 12 million m3 regular nourishments


Binnen dijkringen
Beneden NAP: 26%
Boven NAP: 29%
Buitendijks gebied: 3%
Onbedijkte Maas: 1% *)
*) Overstroombare deel van de onbedijkte Maas binnen de 1/250-contour.
Planbureau voor de Leefomgeving


Bevolkingsdichtheid in Nederland per provincie in 2006
(gebaseerd op gegevens van het CBS)
Groningen 246
Friesland 192
Drenthe 183
Noord-Holland 976
Flevo-land 261
Overijssel 335
Utrecht 851
Gelderland 397
Zuid-Holland 1.227
Noord-Brabant 491
Zeeland 213
Limburg 526
> 1.000 inw./km2
tussen 750 en 1.000 inw./km2
tussen 500 en 750 inw./km2
tussen 250 en 500 inw./km2
< 250 inw./km2



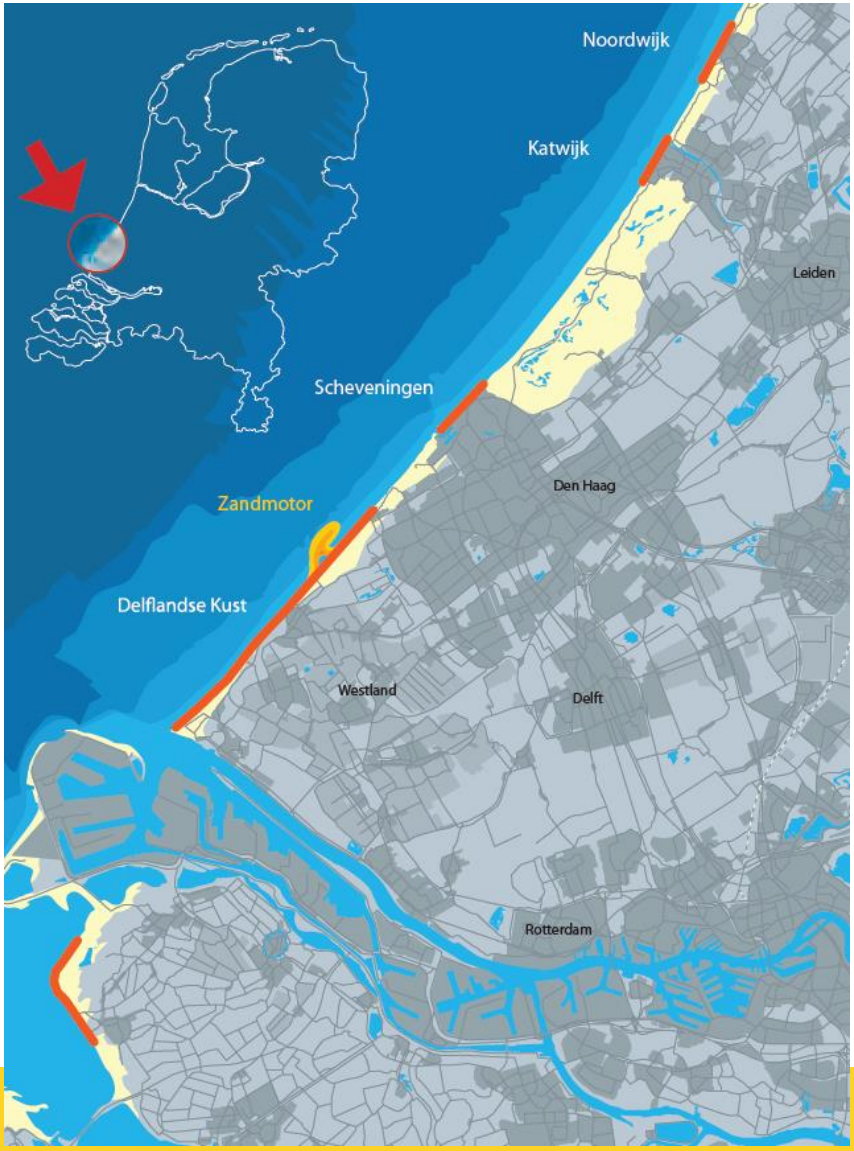

- Safety standards
- A flood defense should be able to with stand the fixed standard

Current standards

- 1/10.000 central Holland
- 1/4.000 rest of the coast
- 1/2000 and 1/1250 inland rivers

# Safety standards

- In 2003 it became clear that several stretches along the coast didn't meet the safety standards.
- Reason: increased knowledge of the expected wave conditions on the North Sea during a 1/10.000 storm event.
- The expected wave conditions were: higher waves but more important longer waves (long in terms of the distance from the wave crest till the next wave crest)
- This means that more energy is reaching the flood defence during a extreme storm and that some flood defences didn't meet the safety standards. These locations become known as the “weak links”




# Coastal vision South Holland:

## 1. Weak Links

- Noordwijk
- Katwijk
- Scheveningen
- Delfland Coast
- Voorne
- Flaauwe Werk

## 2. Sand Motor pilot

## 3. Integral development Delfland Coast

# In conclusion..

- Eroding coastline NL coast
- 12 Mlln m³ sand nourishments per year
- Sea level rise
- Weak links
- Highly inhabited area
- Innovation: building with nature

- added value for nature and recreation

# The Province of South Holland and Ministry of Infrastructure & the Environment work together:

- **Province South Holland**
  - Working on seaward coastal development: Delfland coast and South Holland Delta
  - More room for recreation and nature

- **Ministry I&E**
  - Integral spatial development looking into the future
    - Building with nature
    - Long-term safety

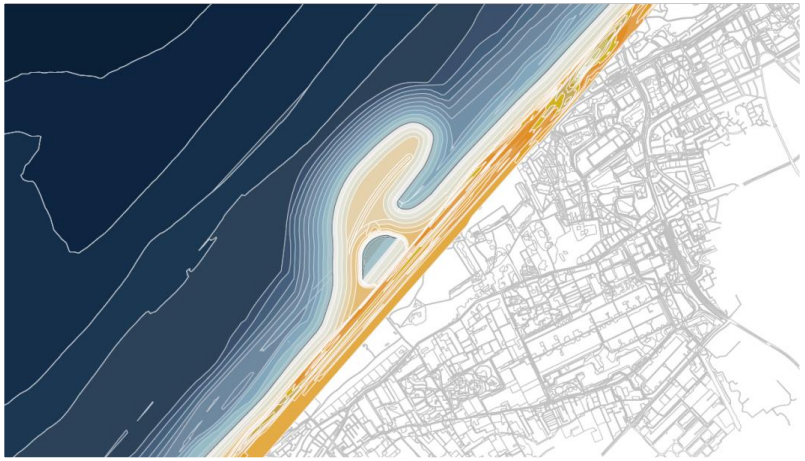
# Goals

- Innovative coastal upgrading and coastal maintenance
- Strengthening weak links for ensuring safety for next 50 years
- Generate knowledge development and innovation
- More room for nature and recreation

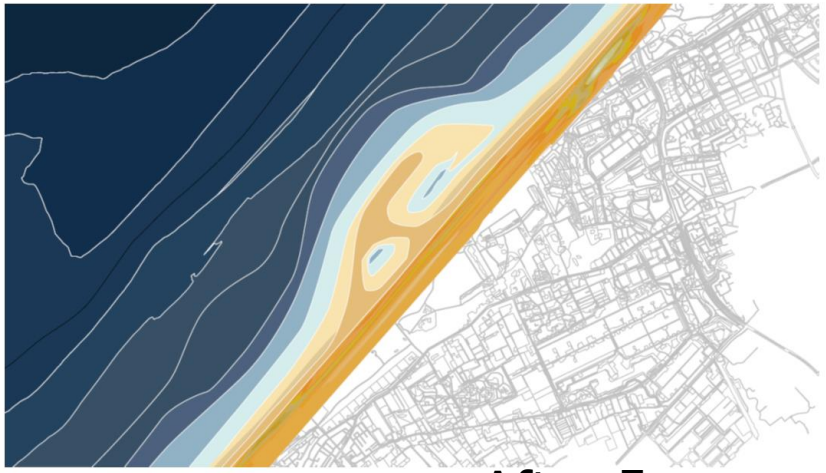
# Sand Motor Delta Dune: design

- 21.5 million cubic metres of sand (8000 swimming pools)
- Hook completed in October 2011
- Dune lake
- Shallow embankments
- 100 hectares upon construction (200 football fields)

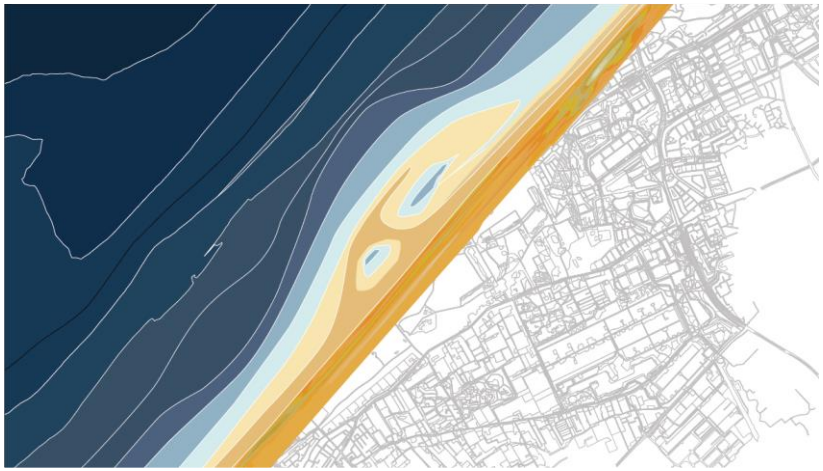
# How the Sand Motor works



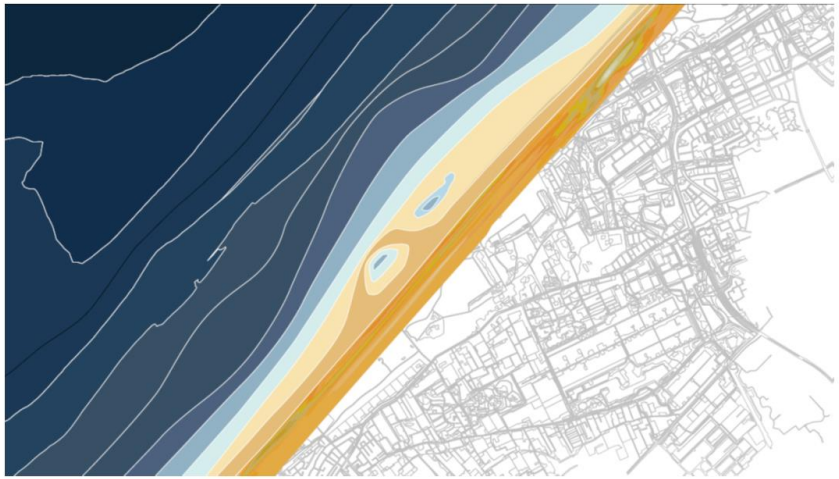
During construction



After 5 years



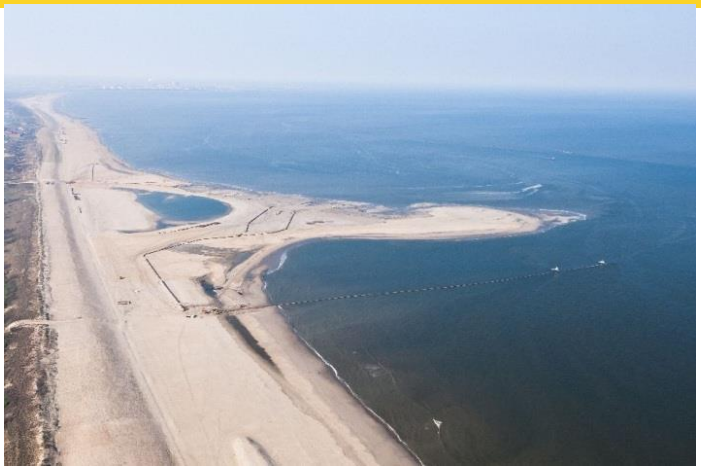
After 10 years



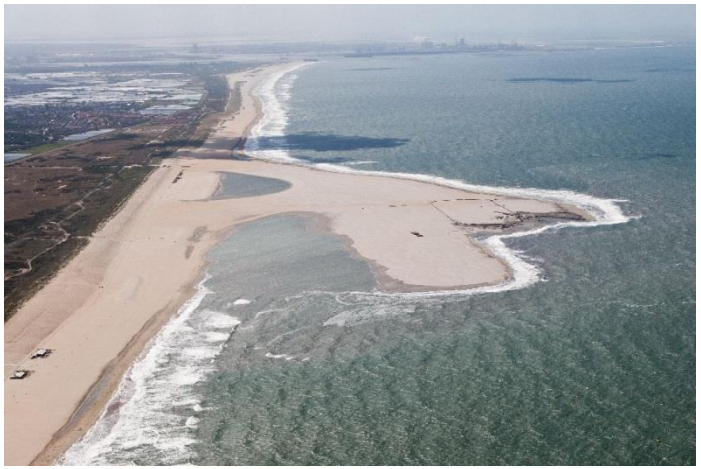
After 20 years

# Construction 2011

March 28th



April 28th



May 24th

June 28th

# As seen from outer space..

Andre Kuipers, March 2012

Oktober
2013

Oktober 2013

# Research and monitoring

- Hydrodynamics
- Morphology
- Groundwater
- Sand and saltspray
- Ecology
- Swimming safety

Deltares
Enabling Delta Life

Witteveen+Bos

IMARES
WAGENINGEN UR

# Research goals

1. Innovative coastal upgrading and coastal maintenance

2. Generate knowledge development and innovation

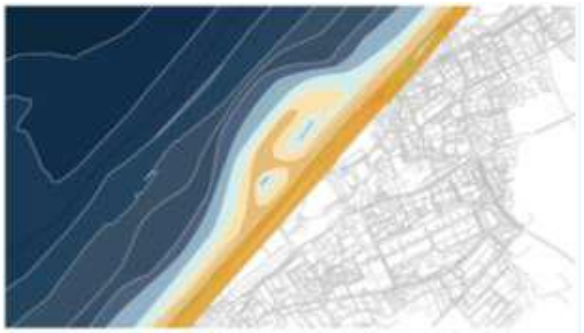
3. More room for nature and recreation

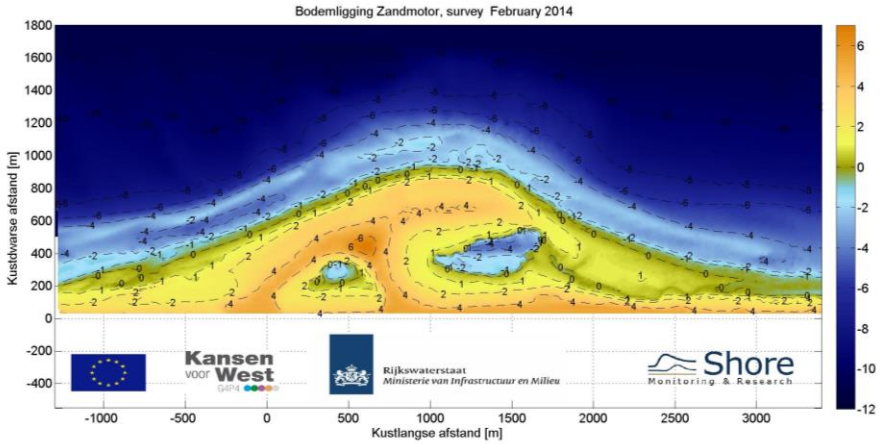
# Goal 1: preliminary results

**Innovative coastal upgrading and coastal maintenance**

- Coastal safety has been enhanced by adding millions of m³ of sand:
  sand balans is positive
  coastal foundation will grow with sealevel rise (medium-term)

- Morphological development Sand Motor = predictions





# Goal 1: preliminary results

Innovative coastal upgrading and coastal maintenance

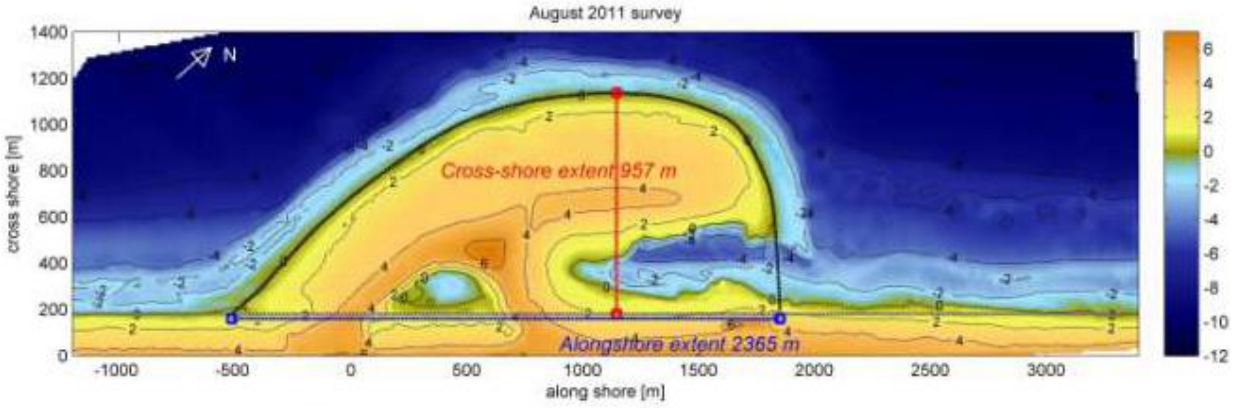
- Changes in volume: after construction ±2,5 million m³

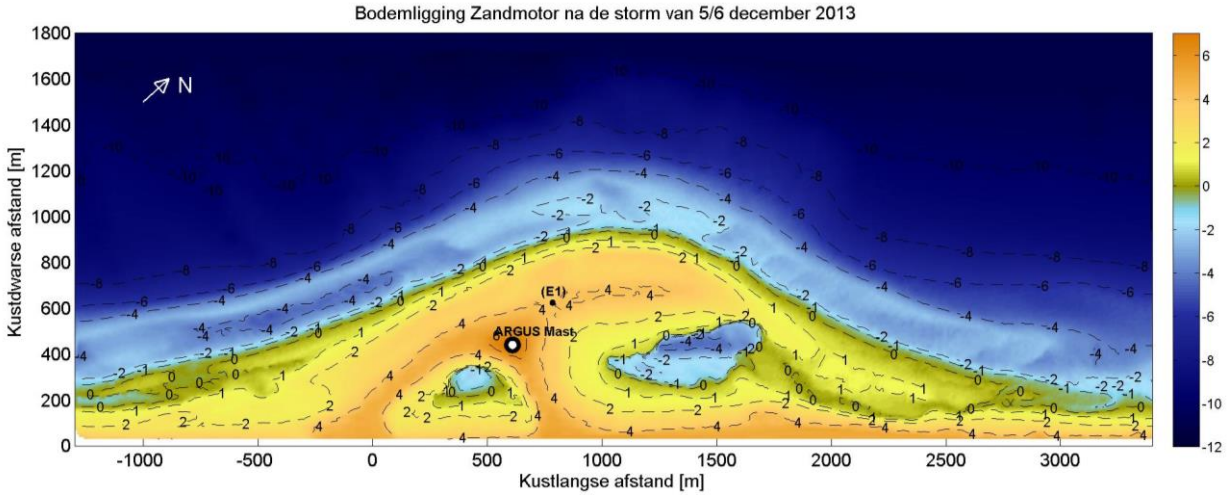
  1,14 million m³ to the north
  680.000 m³ to the south
  740.000 m³ outside monitoring area

- Development of young, embryonal dunes

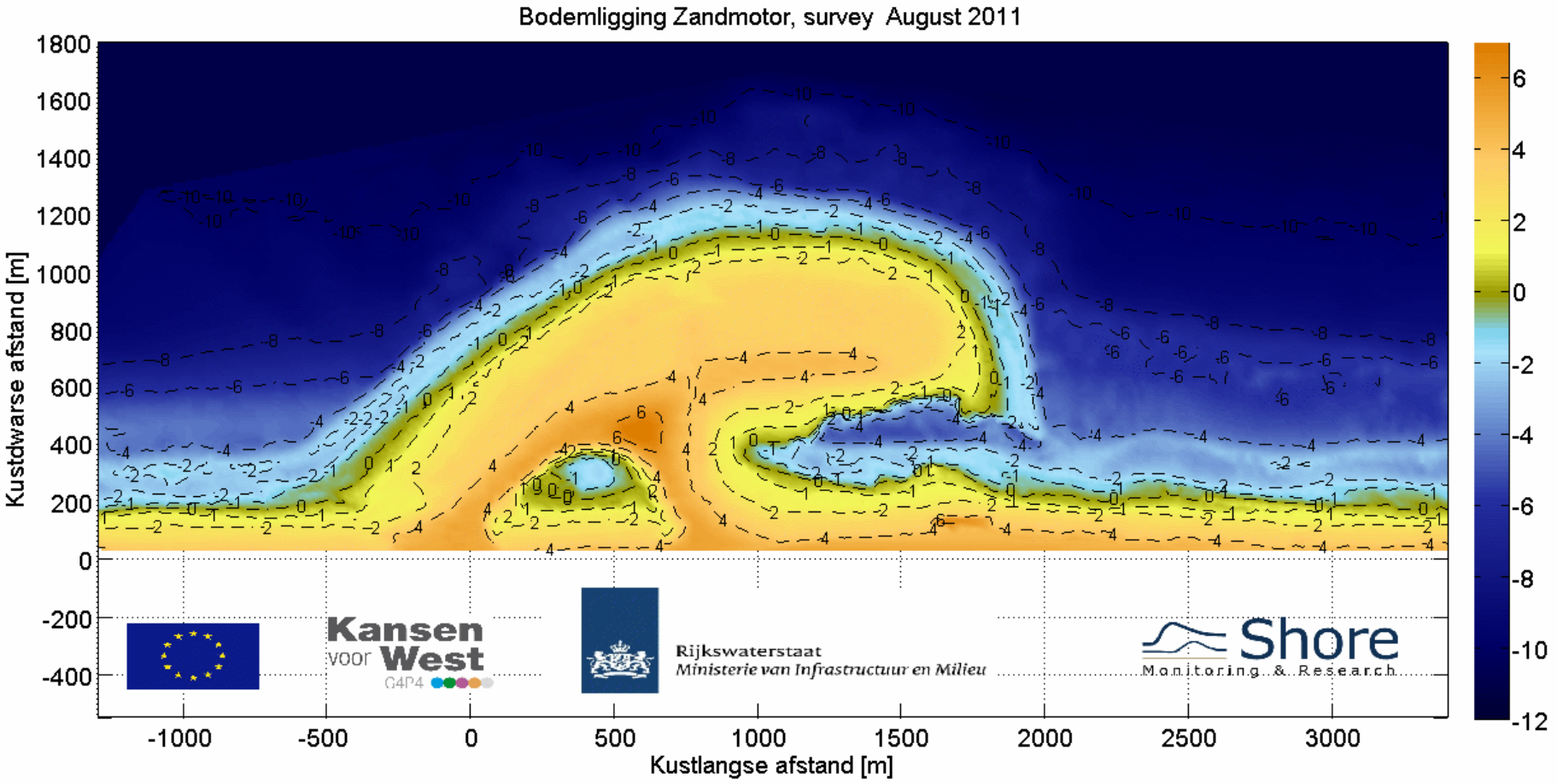
# Goal 1: preliminary results

- Erosion seaside ('tip')
- Sedimentation north and south side
- Spit and trench development near lagune
- Symmetry
- Sand Motor is "crawling" out of monitoring area (feb 2014)



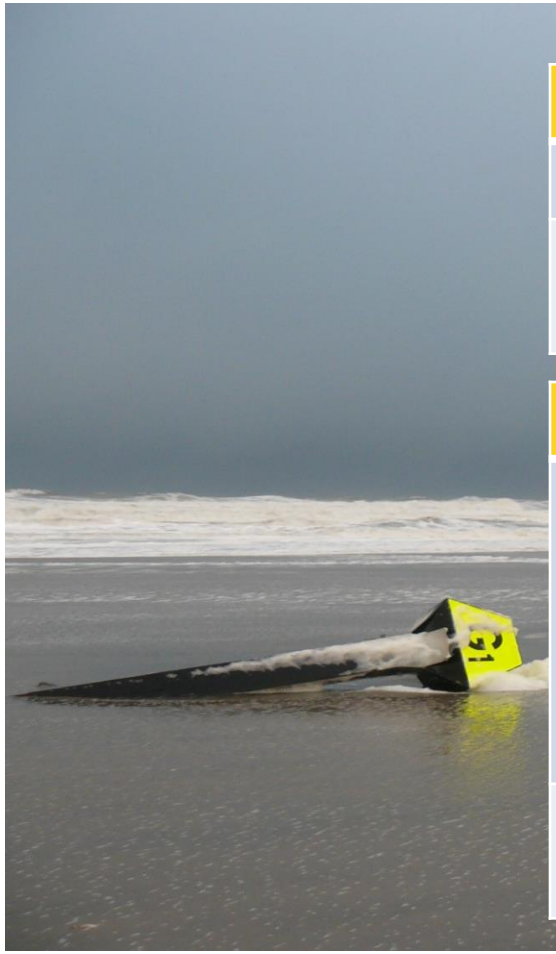



# Morphological development



# Goal 1: preliminary results

## 5 December storm



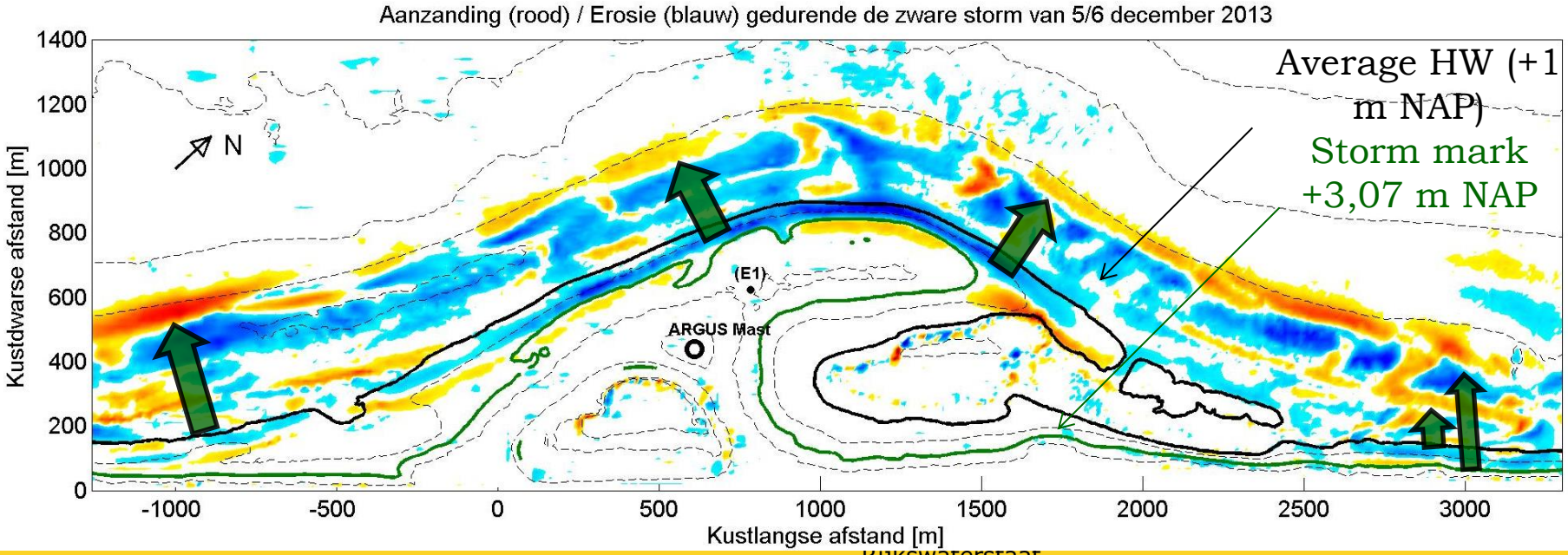
| Wind | |
|---|---|
| Windspeed Hook of Holland | 23 m/s (gusts 35 m/s) |
| KNMI Classification | Heavy storm<br>(60 heavy storms since 1910) |

| Water hight & waves | |
|---|---|
| Maximum water hight in Scheveningen | **3,07 m above NAP**<br>(on 6 dec 05h15)<br><br>*average Highwater level is 1,03 m above NAP* |
| Wave hight | max 5,1 m off the harbour<br>From western directions |

# Goal 1: preliminary results

## Morphological changes because of storm

- Large local changes ( up till 1 m siltation or erosion)
- General trend: Erosion at waterline, deposition of sand in deeper water

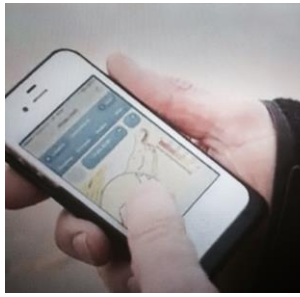


# Goal 2: preliminary results

Generate knowledge development and innovation

- Physical knowledge development in relation to scientific research
  - 15 PhD's and 6 Postdocs (NatureCoast and NEMO)
  - publications
  - (international) presentations
  - 3TU datacenters: sandmotor data lab and helpdesk

- Physical knowledge development in relation to swimming safety
  - development swimming safety model and app
  - evaluations swimming season by Safety Region



- (Ecological) knowledge development in relation to added value SM versus regular nourishments

# Goal 2: preliminary results

Government

Coastline management

Businesscase Int

Usability NL

Int case studies

Industry

PhD’s and post docs

Scientific research

# Goal 3: preliminary results

More room for nature and recreation

Nature

- Increased number of ecotopes and habitats
  - Lee side areas more benthic fauna
    - More diversity benthic fauna

- Increased number of birds and species, especially at lagune
  - Seals and porpoises observations

# Goal 3: preliminary results

More room for nature and recreation

Recreation

Increase in diversity visitors

- Appreciation visitors is high, especially kite surfers
- Sand Motor is highly appealing because of continuously changing landscape: number of excursions on and around SM are still increasing

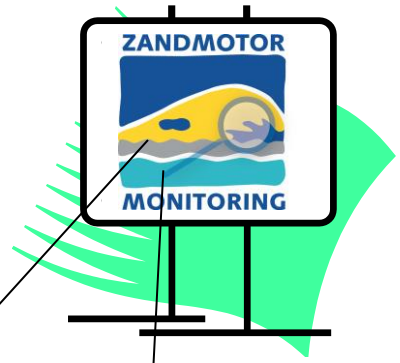
# What is a Sand Motor?

Luna, 6 years:
"..that is a motor with sand on the beach. And then you press a button and the sand goes everywhere…like the sand wizard!"

# And…?

2,5 year Sand Motor is also 2,5 year communication

- Media attention national and international (National Geographic)
- Many presentations en excursions
- Website www.dezandmotor.nl and other social media
- Signs, flyers, centre, lifeguards
- From 1 May safe for swimming!





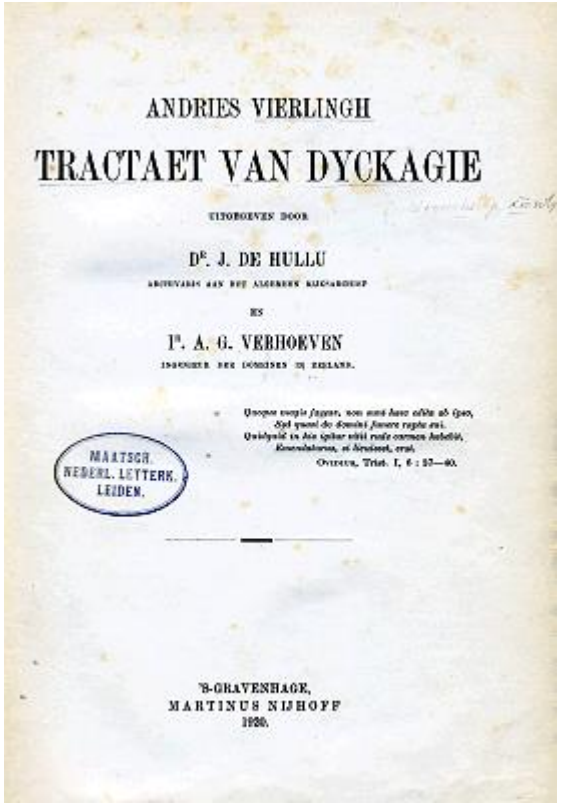
# Building with nature new?

Andries Vierlingh (1507-1579)

Tractaet van Dijckagie (1577)

- "Men moet het water geen fortse aandoen"
- "One should not handle the water with force"

First published in 1920


ANDRIES VIERLINGH

TRACTAET VAN DYCKAGIE

UITGEGEVEN DOOR

Dr. J. DE HULLU

EN

Ir. A. G. VERHOEVEN



'S-GRAVENHAGE,
MARTINUS NIJHOFF
1920.

# Questions?


www.sandmotor.nl

Rijkswaterstaat
*Ministerie van Infrastructuur en Milieu*

This project is a collaboration of:

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

EcoShape
Building with Nature

provincie ZUID HOLLAND

Kansen voor West
G4P4

STW
Nieuwe technologie mogelijk maken