



Ecobeach

A sustainable beach by drainage



Brouwersdam, 3-10-2014

Bas Reedijk

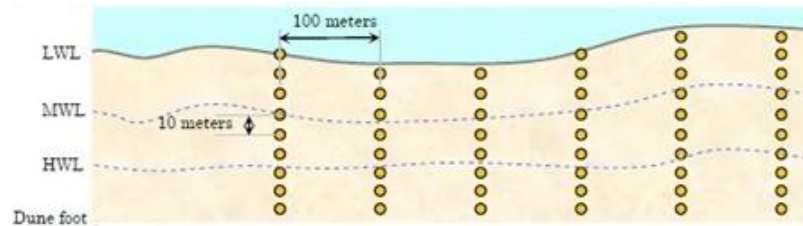
Head of Coastal Department BAM Infraconsult



Contents

- What is Ecobeach
- Experience with Ecobeach in Egmond
- Application of Ecobeach in Brouwersdam

What is Ecobeach



- Ecobeach is a vertical beach drainage
- Passive drainage, so no CO₂ emission
- Vertical drainage tubes are placed in a row pattern
- These rows are placed perpendicular to the coast
- A row of drainage tubes are located every 100 meter along the coast
- Average 10 tubes each row, installed every 10 m between low and high waterline (dune foot)
- The tubes are installed below the beach surface (not visible)

What is the aim of Ecobeach



- Increase the natural accretion of the beach
- Let nature bring sand from the foreshore to the beach
- Reduce beach erosion
- Provide a wide and dry beach, suitable for recreation
- Extend the lifetime of nourishments
- Transport of sand from foreshore replenishments to the beach

Why BAM and Ecobeach

Before installation of Ecobeach



During the test of Ecobeach



After removal of Ecobeach



- Danish invention
- Results in Denmark triggered the interest of BAM

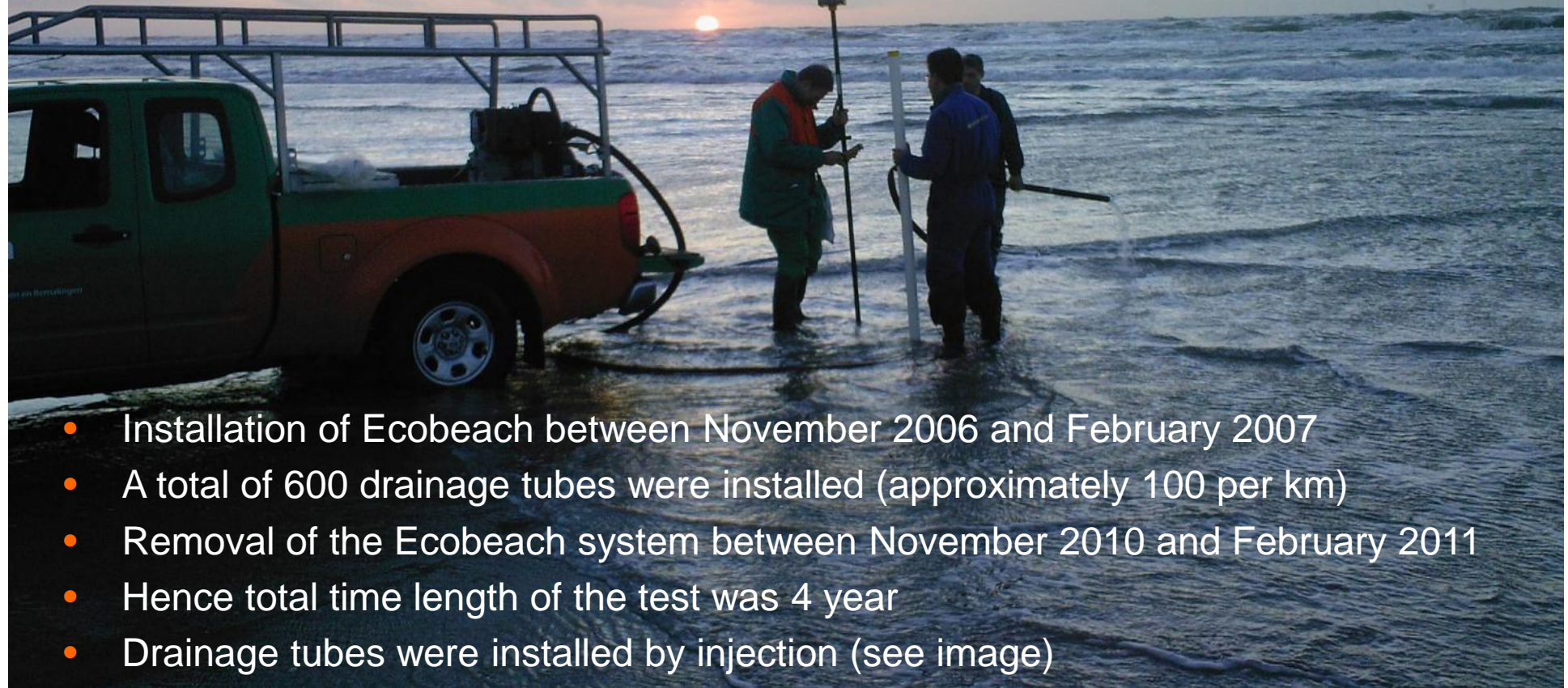
Ecobeach test in Egmond



- BAM proposed to the Dutch Department of Public Works to carry out a test in Egmond
- Two test areas with a length of 3 km each
- Northern test area nourished every 5 year
- Southern test area is relatively undisturbed
- Argus cameras are available at both test areas
- Annual JARKUS measurements since 1965
- Test was performed in agreement with all the stakeholders:

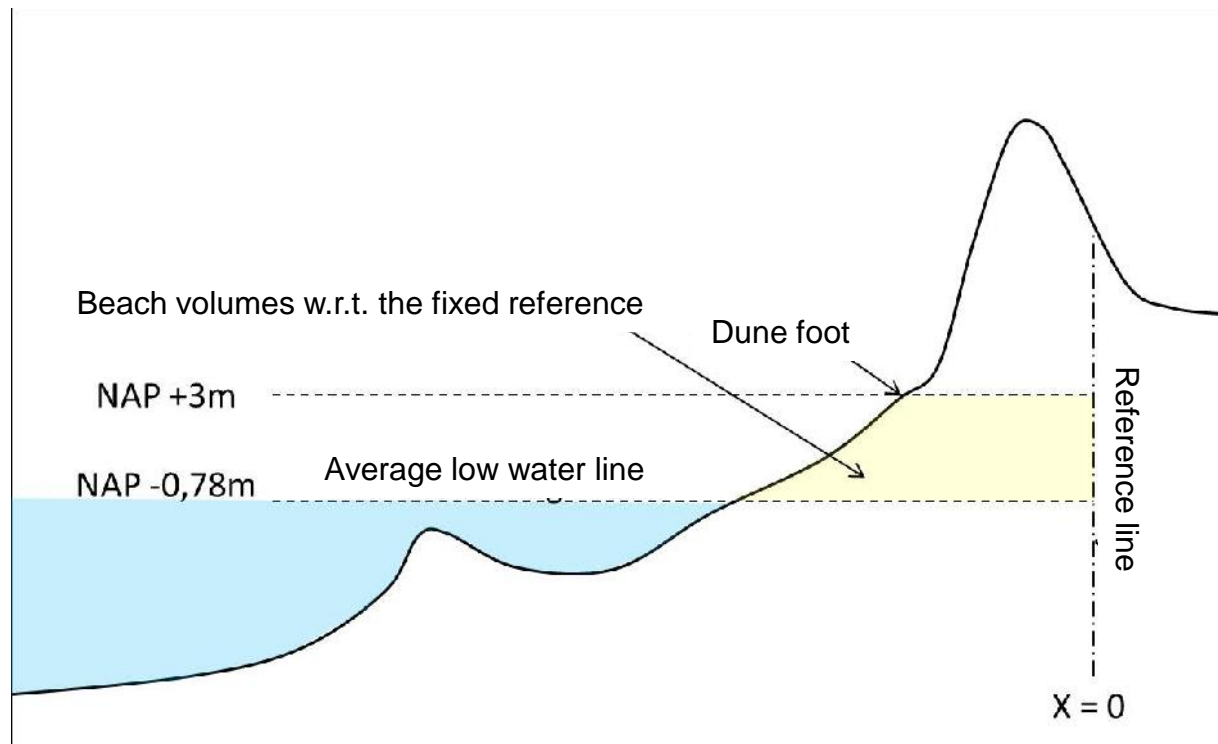
Dutch Department of Public Works (Rijkswaterstaat), waterboards, municipalities, beach restaurants, coast guard

Ecobeach test in Egmond



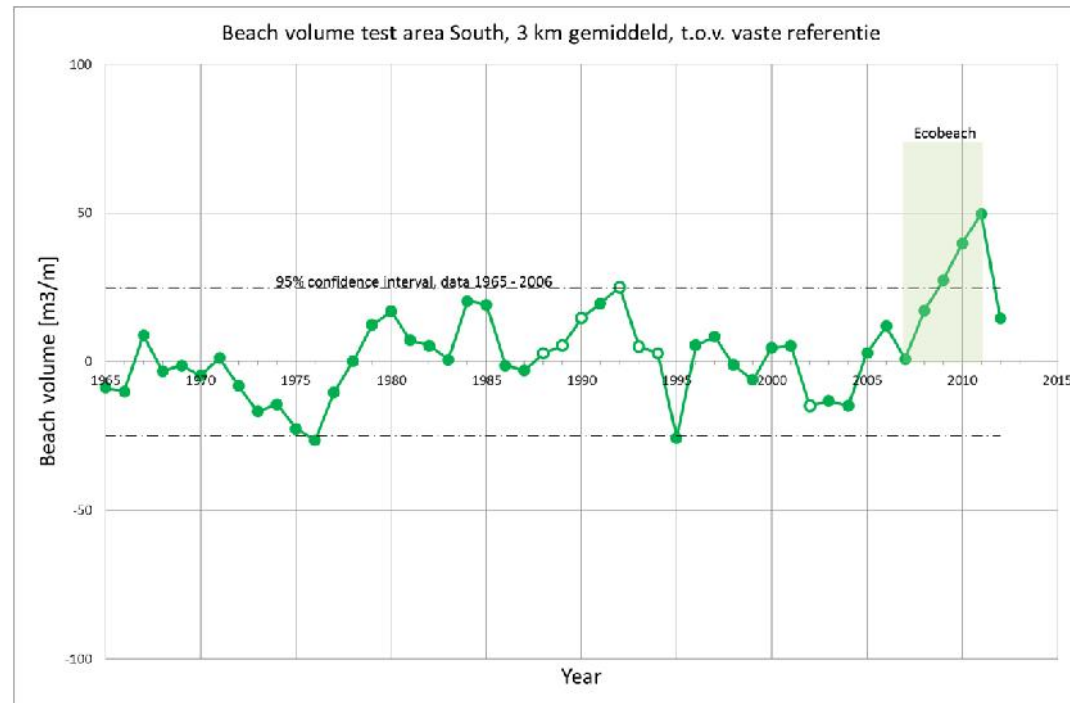
- Installation of Ecobeach between November 2006 and February 2007
- A total of 600 drainage tubes were installed (approximately 100 per km)
- Removal of the Ecobeach system between November 2010 and February 2011
- Hence total time length of the test was 4 year
- Drainage tubes were installed by injection (see image)

Determination of the effect of Ecobeach



- Coastal State Indicators
- Monitoring of beach volumes
- Annual coastal measurements by Rijkswaterstaat (JARKUS)
- Beach volumes from 1965 up to now

Ecobeach at an undisturbed beach area



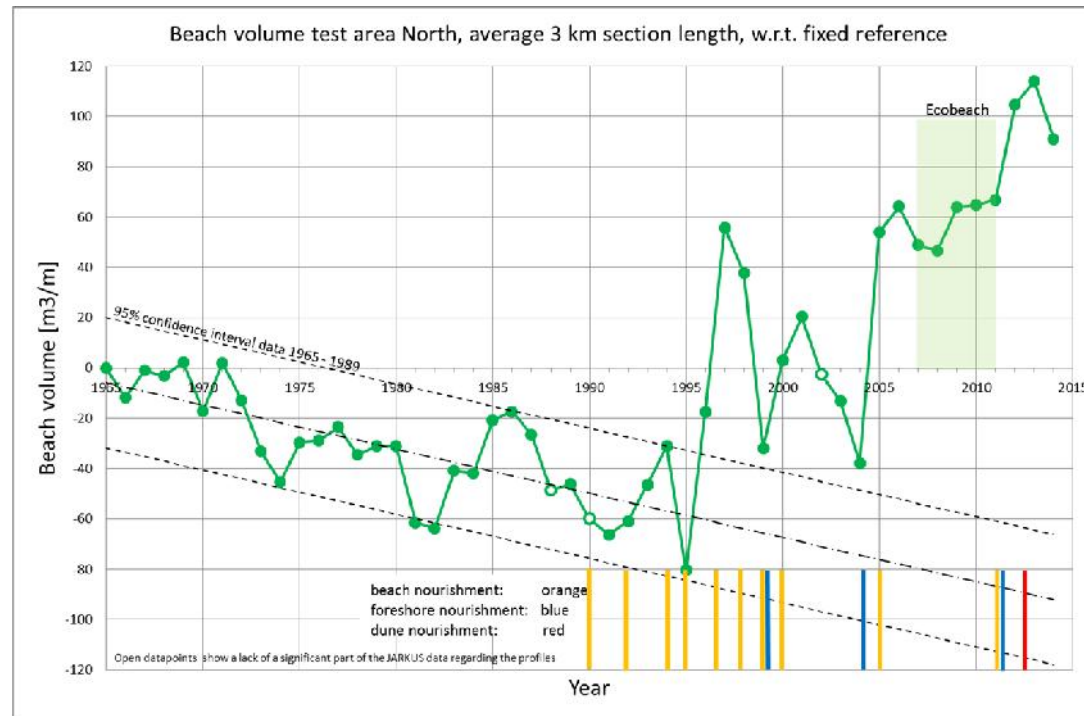
- Beach volumes variation w.r.t. long-term average
- From 1965 to 2007 a natural variation of the beach volume around the average
- Variation includes effects of storms, embankment and nourishments outside the area
- Beach accretion of 50 m³/m during Ecobeach; 150.000 m³ in 3 km section
- Highest beach volume ever measured in 2011, since 1965
- Nearly back to long-term average in 2014, despite of adjacent nourishments

Ecobeach at a nourished beach

- Beach nourishment in Egmond started in 1990
- Both beach and foreshore nourishment
- Replenishment of 486.000 m³ at the beach of Egmond (216 m³/m) in April/May 2005
- Installation of Ecobeach started in Egmond in November 2006
- Ecobeach installed at the nourished area



Ecobeach at a nourished beach



- Until 1995 decrease of beach volumes
- After 1995 recovery after nourishments
- Lifetime of beach nourishment approximately 5 years
- Beach volume increases during Ecobeach test, does not decrease
- In January 2011, 6 years after nourishment, highest beach volume since 1965
- Beach nourishment of March 2011 largely eroded in 2014

Possible working mechanism

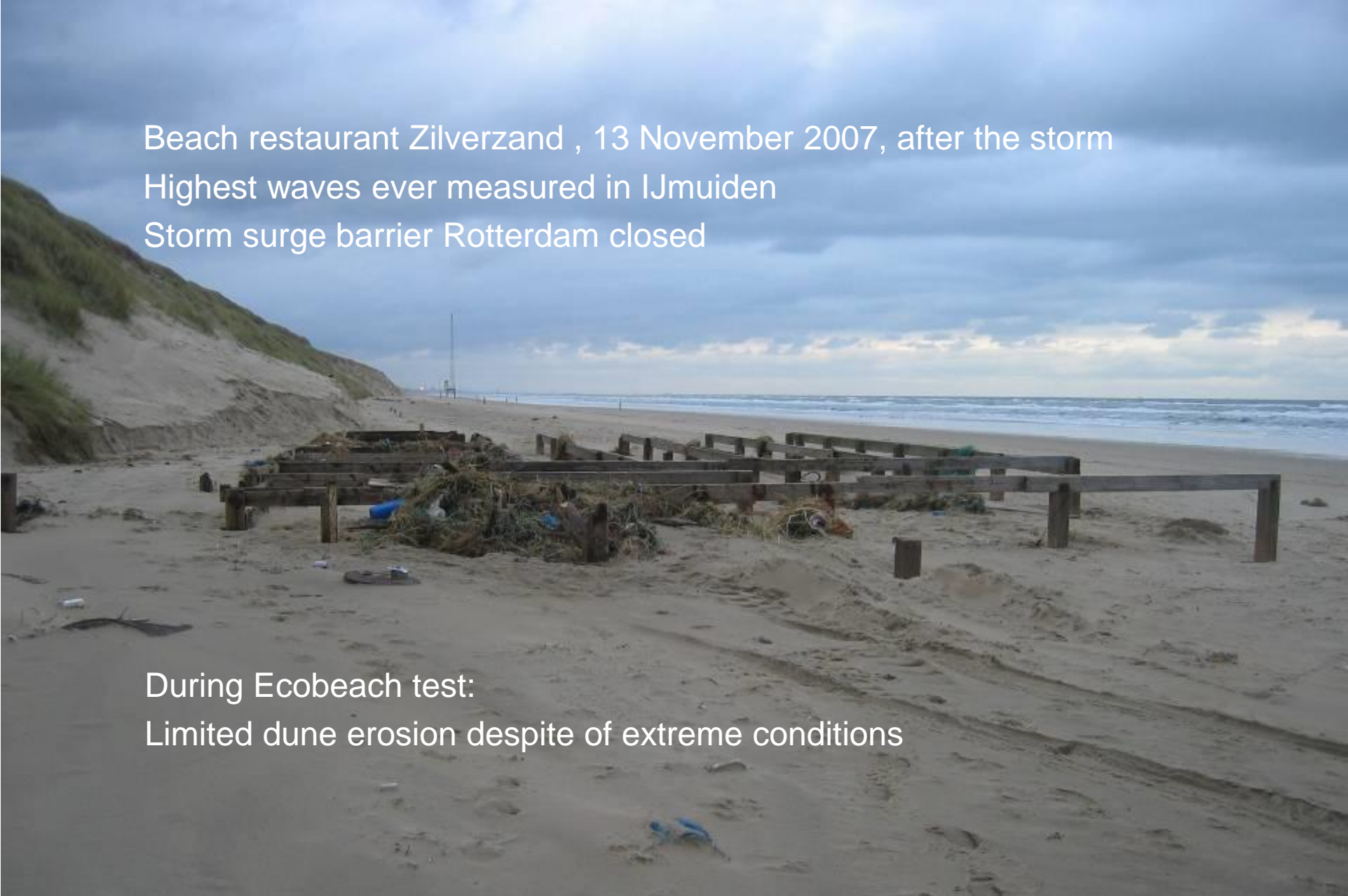
- Many scientific investigations have been done
- Observation of a coarser beach at the 2 m toplayer
- Observation of higher packing density of sand at the 2 m toplayer
- Observation of fresh water outflow from the drainage tubes during ebb

- Ecobeach provides a dryer beach due to vertical drainage
- The drainage tubes connect highly permeable layers by running through impermeable layers
- The beach dries faster after a wave run-up and during ebb condition
- Aeolian transport of fine sediments toward the dunes is promoted
- Leading to a coarser beach
- The beach becomes more permeable and stable

What can be observed at the beach?

Beach restaurant Zilverzand, 6 November 2007, before the storm

Nearly 1 year of Ecobeach, increase of sand at the dune foot



Beach restaurant Zilverzand , 13 November 2007, after the storm
Highest waves ever measured in IJmuiden
Storm surge barrier Rotterdam closed

During Ecobeach test:
Limited dune erosion despite of extreme conditions



Beach restaurant Zilverzand , 16 January 2008, 2 months after the storm

1 year of Ecobeach test: Dune erosion due to storm is not visible anymore

Argus images



- Every half an hour, a photo of the beach is captured
- The next Argus photos show the situation during low water:
 - 21 September 2006 Just before Ecobeach
 - 21 September 2010 During Ecobeach
 - 21 September 2014 2.5 year after Ecobeach
 - 21 September 2015 3.5 year after Ecobeach

September 21 2006 13:30:03 → just before the Ecobeach test



September 21 2010 10:31:01 → during the Ecobeach test



September 21 2013 13:00:01 → a few years after the Ecobeach test



September 21 2014 10:30:02 → a few years after the Ecobeach test

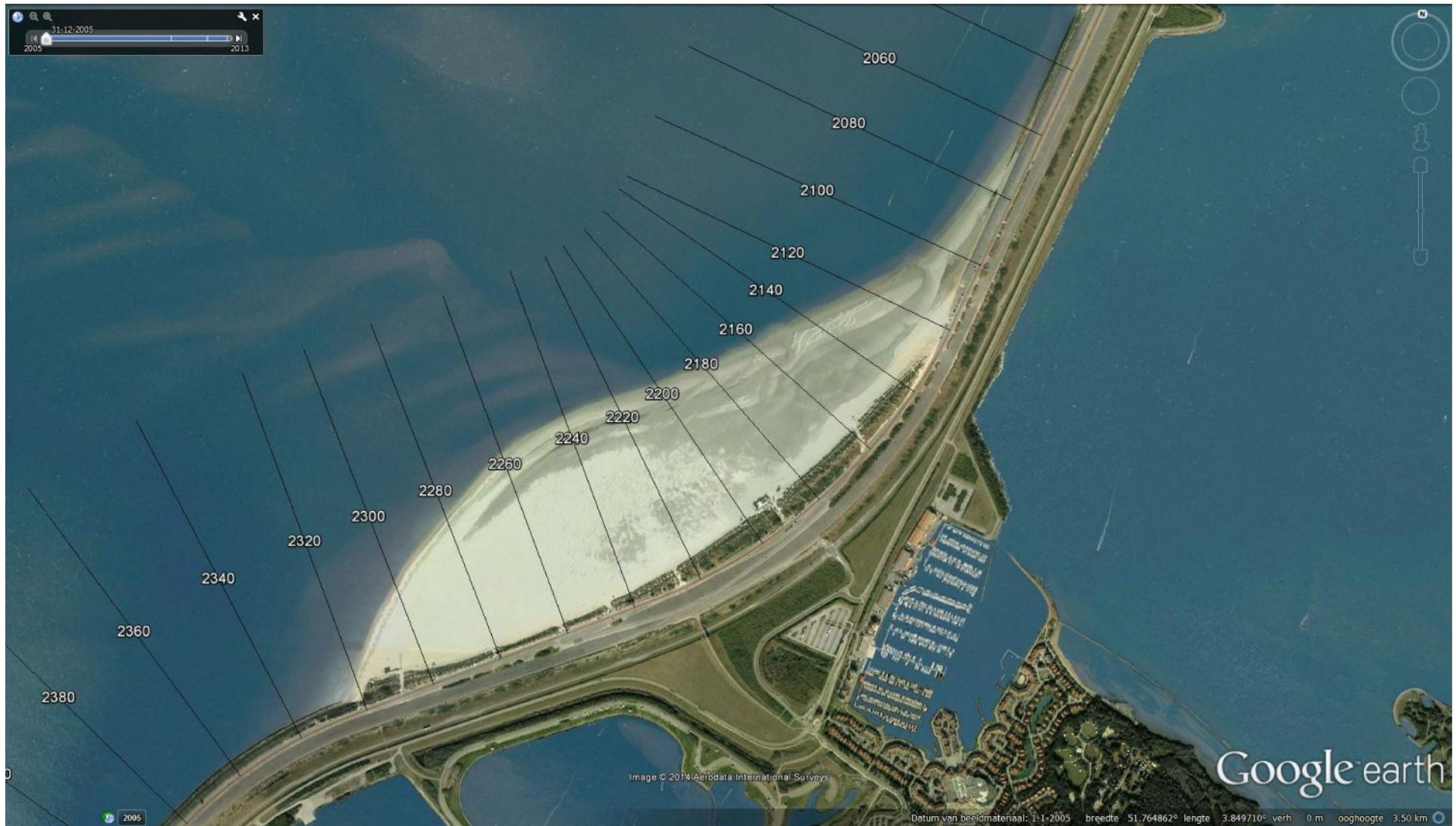


Application Ecobeach Brouwersdam

- Low and wide beach against a dam with an asphalt revetment
 - Beach “moves” toward the North
 - Significant erosion at the South-West area
 - Some accretion at the North-East area
 - Beach surface area decreases
 - Too little space for beach activities
-
- Nourishment of 400.000 to 500.000 m³ is planned for 2015
 - Recovering beach surface area to the situation of 2003



Brouwersdam in 2005

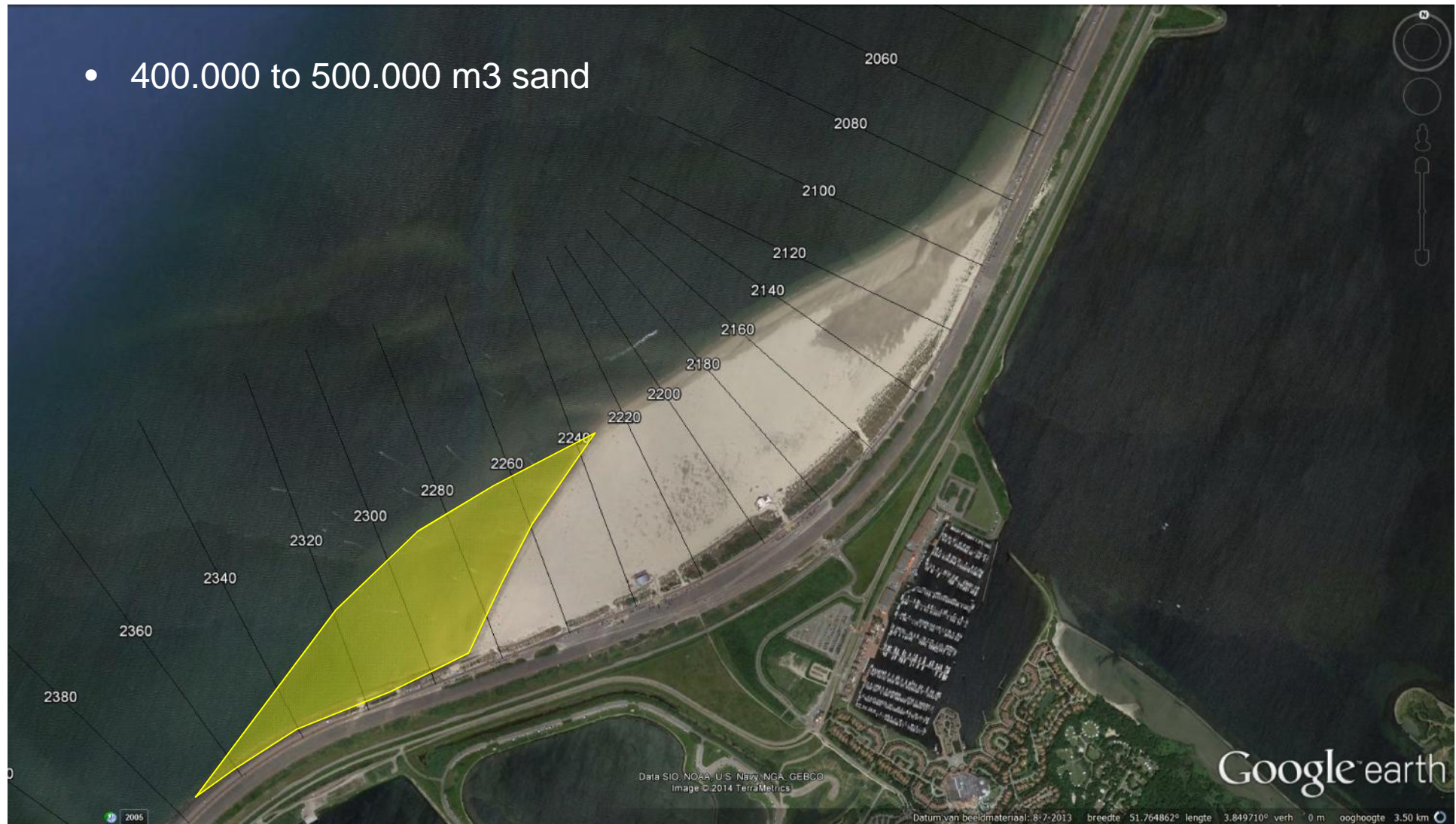


Brouwersdam in 2013



Nourishment

- 400.000 to 500.000 m³ sand



Possible configuration of Ecobeach

- Drainage tubes in nourished beach
- Approximately 200 drainage tubes
- Below the beach surface, not visible



Costs of Ecobeach

Beach nourishment

- Costs beach nourishment: 3 to 4 Million Euro
- Lifetime beach nourishment: approximately 10 year?
- Costs beach nourishment per year: 300.000 to 400.000 Euro

Ecobeach

- Costs installation approximately 30.000 Euro
- Costs monitoring approximately 5.000 Euro/year
- Costs maintenance injection of drainage tubes after report of an administrator/beach restaurant owners
- Subsidy: Possible subsidy for scientific research for instance LIFE (adaptation to climate change)
- Research: Possible collaboration with universities + subsidy
- Usually: License costs/Success fee (PM)

Maintenance of Ecobeach

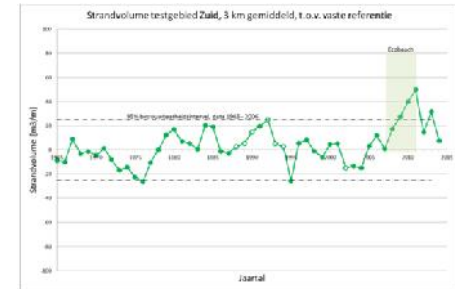
- Passive system, so limited maintenance necessary
- Drainage tubes are made of polyethylene, so not fragile
- After a storm some tubes can protrude the beach surface, usually around the low water line (yellow cap)
- This was reported by beach restaurant owners/coast guard in Egmond
- These tubes are injected up to 25 cm below the beach surface (2 men and a pump)
- Maintenance decreases with time



Ecobeach and beach users

- Users:
 - Beach restaurants
 - Hikers
 - Swimmers
 - Kilters
 - Wind surfers
 - Kite surfers
 - Blokarters
- Drainage tubes below the surface, so no exposure
- Local tubes might protrude the beach surface after a storm
- No disturbance/inconvenience for users in Egmond
- Possibility of additional markings

Monitoring of Ecobeach



- Annual monitoring carried out by RWS JARKUS measurements (Jan-March)
- Jarkus data show the levels of the beach along Jarkus profiles (profiles every 200 m)
- The position of the tide line, beach width and beach volumes can be determined from the Jarkus data
- Possibility of interim monitoring the tide line by using GPS
- Possibility of allowing protrusion of a few tubes to mark locations
- Investigation on sediment sizes and packing density e.g. VU Amsterdam

Information and Publicity

- The beach nourishment in Brouwersdam is a unique nourishment with the main purpose of preserving recreation and promoting it, also for economical importance
- Chance of promoting a sustainable nourishment!
- Sustainable without CO₂ emission

- Information evenings for all stakeholders
- Opening and starting point
- Information signs
- Encourage involvement of the press

Brouwersdam sustainable by Ecobeach

