15 YEARS (LOWERED) SUSTAINABLE LOCATION AREAS AT SEA AND A PERSPECTIVE TO THE FUTURE

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History sustainable location

Sustainable location of sediment at sea:

1961 - 1996 location area North

every year approx 12 mio m3, clean sediment located

The capacity of area North was completely used, the seabed level rised to the allowed depth,

A search for a new alternative was necessarry

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History sustainable location

Outcome:

A combination of an area for sustainable location on the seabed and a lowered area

- Area for sustainable location Northwest
- Area for lowered sustainable location
  - Combined sand mining and location area
  - 6 pits 1250 m length x 500 m wide x 10 m depth

Partnership between Port of Rotterdam Authority and Ministry of Infrastructure and the Environment

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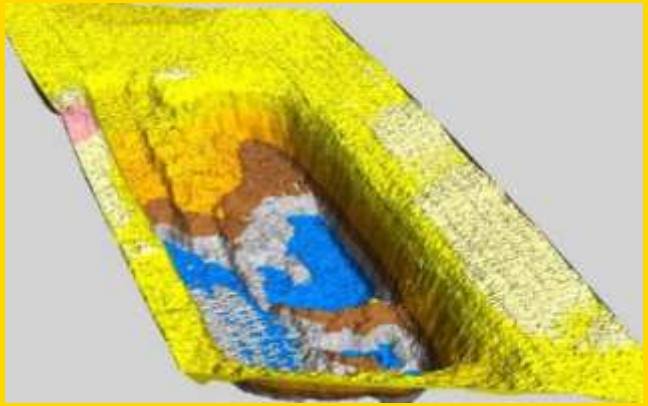
History sustainable location

Why now a combination of 2 locations?

Constructing a pit a pit takes more time then to fill the pit. In the mean time sediment will be located at area Northwest

Permit: Allows for only 2 pits at the same time in use



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History sustainable location

Comparision locations:

- Backstream off sediment to the port will be less (30 % North, 24% NW and 10% lowered)
- Sailing distance (4 miles miles North, 10 miles NW, 5 miles Lowered area sites)
- Empty sailing hoppers back from sea, costs money

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History sustainable location

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History sustainable location

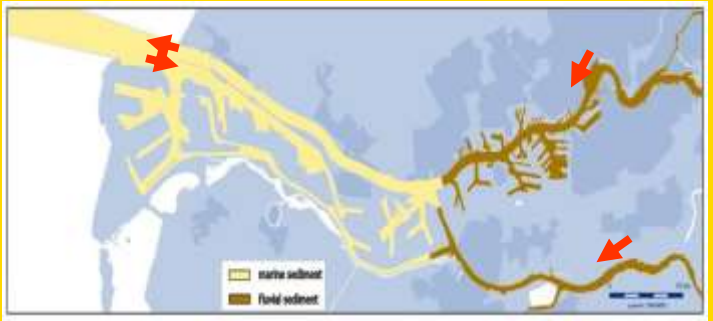
The policy for sustainable location has changed

At first the pits were seen as a disposal site

- fill the pit, an natural expected covering with sand and ecological recovery will be possible

In 2009, it was seen as a sustainable location area

- Bringing back the marine sediment to the sea
- Moving fluvial sediment forward to the sea
- Lowered location will feed the sediment river along the Dutch coast.



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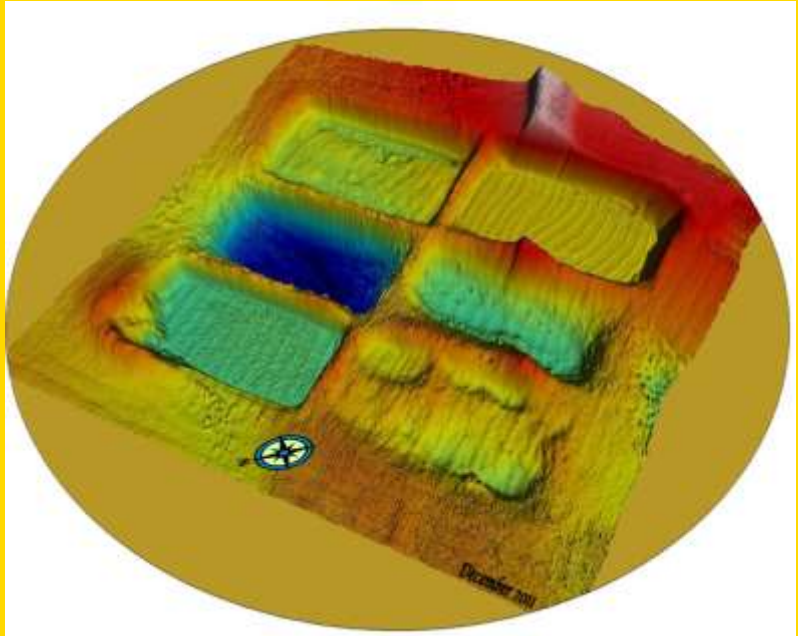
Monitoring

Monitoring was mainly an obligation of our permits and was targeting the lowered sustainable location area on:

- Impact at benthic fauna
- Quantities of extracted sand and spreaded sediment
- Impact of stormy weather
- Backstream of sediment to the port



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Benthic fauna

Monitoring

- took place every 2 years.
- Samples every time taken on the same location
- In pits and at reference locations (surrounding areas)

Conclusions

- There is a link between abiotic factors (habitat) and the presence of species
- Density and biomass varies through the years, for each pit and at the reference locations, due to a natural fluctuation

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Overview quantities

Pit	1	2	3	4	5	6
M3 mined sand (x 1.000)	5	6.1	5.7	4.7	5.9	6.1
M3 dredged material (x1.000)	24.1	28.5	23.3	20.1	19	17

Explanation of different quantities:

- Volume: In situ m3 vs ex situ m3 (sediment)
- Los of sediment expected 50%, but in real 75%
- Seabed isn’t at the same level everywhere, difficult to extract sand with the available equipment (sandminig)
- Loss while locating 4%, loss immediatly after locating 15%

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Stormy weather

Impact

Theoretical outflow was expected to be 35%

- A regulary survey (4 times a year)
- A survey direct after each storm

Conclusion:

Outflow of the pits as a result of a storm was minimal.

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Backstream to the port

Backstream 1999 – 2016

- Sediment disappear from the pits
- Quantify backstream was difficult with available methods .
- The dredged amounts in the port area were not significantly higher than before
- Conclusion: there was no backstream

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Backstream to the port

2017 new insights

Study Deltares / RHDHV backstream was calculated at 36%.

With the use of an adapted model to define backstream

Possible explenation: a due to changes at the north sea (reclamation of the port, sand engine)

More research is needed

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Evaluation

Evaluation objective to approve the concept, mainly important for ourselves

- Economic aspects
- Construction of the pits (Sandmining)

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Economic effects

Benefits were:

- Sailing distance was less(er) than reallocation area Northwest (about 5 miles vv)
- Less distance sailing means less emissions of NO, SOX, CO2
- Economic benefit about € 0,25 /m3 (totally € 27 mio)

- Return trip with sand, which is sold. But needs to be arranged in the dredging contracts!

- Project costs (studies) were about €1.2 mio

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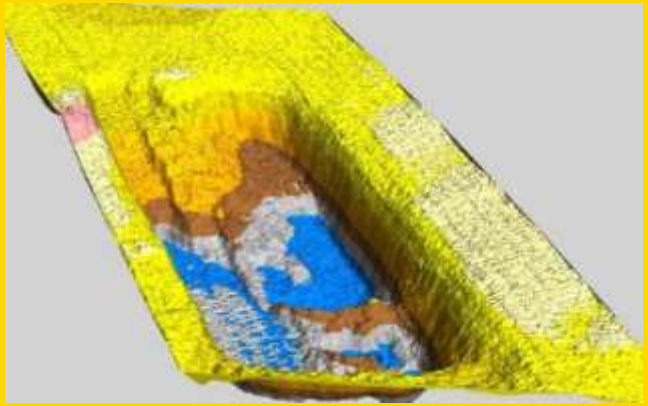
Construction

Evaluation Construction

- Seabed is about – 20 m depth, sandmining till – 30 meters, availability suitable hoppers (hoppers suitable for maintenance dredging in the port area)
- Diamond shape, right angles – difficult for sandmining in every corner
- Lenght of a pit was to short for a full hopper in 1 track



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Perspective to the future

The concept of (lowered) sustainable location area proved itself, and will get a follow up

- Multiple use of the seabed
- Costeffecient
- Backstream to the port is less

Next steps:

- What’s the ideal location for new lowered sustainable location areas
- Improve the lay out with the knowledge from the latest 15 yrs

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