

# Sediment Transport Analysis at the Shoal of Walsoorden (Western Scheldt)



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**Partners:** GeoXYZ, CEA Saclay

## Assignment:

In 2001 the Port of Antwerp Expert Team proposed an alternative strategy for the disposal of dredged material in view of the long-term morphological management plan for the Western Scheldt estuary (Belgium). Physical scale-modelling, numerical simulations and preliminary field observations of sediment movement indicated that the proposed strategy is likely to be successful.

500,000 m<sup>3</sup> of dredged material at the tip of the shoal with a diffuser at the end of 2004. Subsequently, morphological and ecological changes were systematically and intensively monitored for more than a year. In addition to an extensive bathymetrical survey (with multibeam techniques) and ecological monitoring, an in situ sediment tracer test was conducted to reveal the shoal scouring dynamics and sediment transport pathways.

## Scope of Services:

- In situ sediment tracing experiments
- Morphological analysis of the Shoal of Walsoorden, as part of the Western Scheldt estuary
- Sediment transport synthesis by field sediment tracking

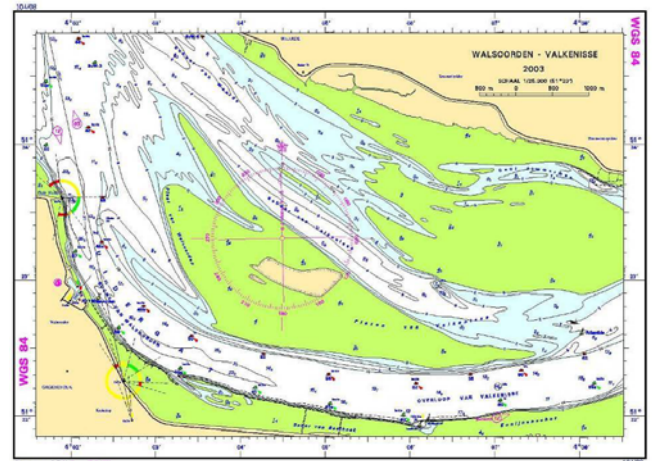
## Technical Description:

In the framework of the above mentioned feasibility analysis on the alternative dredging strategy, field sediment tracer experiments were deployed. Together with a detailed bathymetric and ecological survey of the disposal site and its adjacent area at the Shoal of Walsoorden, the tracer tests should indicate the morphodynamic behaviour of this part of the Western Scheldt estuary in a more detailed and systematic way.



*Shoal of Walsoorden in the Western Scheldt estuary*

The final step to prove the feasibility of this alternative disposal strategy was the execution of a full-scale in situ test by inducing morphological changes at the Shoal of Walsoorden. This test was performed by disposing



*Geographical location of the Shoal of Walsoorden, Western Scheldt*



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A new generation of radioactive tracer techniques was used in this study, i.e. inert radioactive tracers that can be activated in the laboratory. With the use of this new generation of inert activable tracers, the disadvantages of classic tracer techniques were avoided. These activable tracers contain a "sleeping" radioactive Iridium isotope that is fully embedded in the natural quartz matrix of sand grains.

The results of this innovative measurement technique were used to (i) elaborate sediment transport patterns (iso-tracer concentrations) and (ii) develop quantitative sediment balances and sediment transport vectors. The final results could contribute not only to the in situ evaluation of the feasibility of the alternative dumping strategy, but also provide valuable validation data for both ongoing and future physical and numerical modelling of the study area.

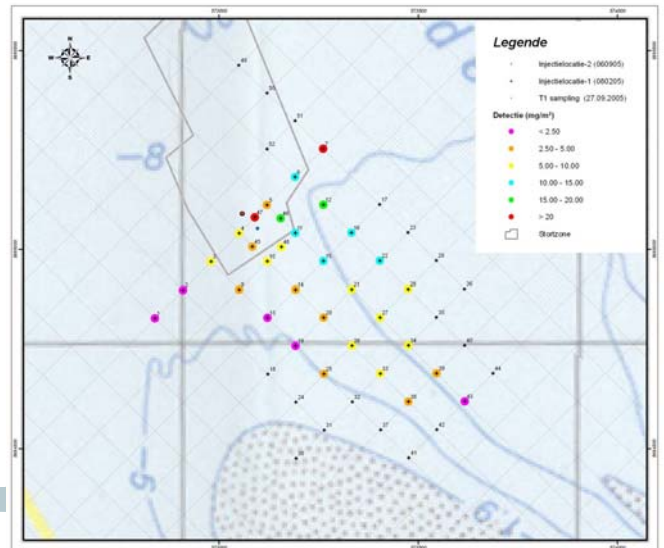
Hence, mobility of the sediment tracers should reveal the general stability (or morphodynamics) of the disposed dredged material at the tip of the local Shoal of Walsoorden. Tracking the sediment tracer could confirm sediment transport paths towards local gullies or identify particular erosion/deposition sites.

About 500 kg of tracer material was injected at a specific location on the test disposal site and monitored on a regular basis during a 16-month period. In total more than 400 bed-load sediment samples of the local sand bottom were collected with a Van Veen sampler.



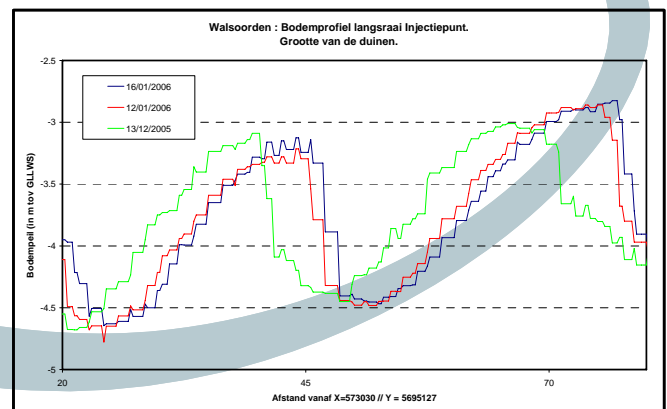
Field injection at the disposal site

However, analysis of the sampled sand reveals less significant morphodynamic information. Preliminary results show, as expected, a landward movement of the tracer towards the tip of the Shoal of Walsoorden. The notified mobility coincides with the flood flow and corresponds with the general volume balance calculated from the detailed multibeam registrations. Since only a very limited amount of tracer was found (less than 1%), final and absolute conclusions cannot be drawn. It seems a lot of tracer material was buried under the explicit dune migration and high local sand bottom dynamics ; even fully suspended (and drifted far away) under severe storm conditions.



Sampling and detection of sediment tracers

Therefore, additional evaluation of boundary data should clarify these initial impressions and confirm the suggested failure mechanisms. Intensive analysis of bottom morphodynamics in the direct neighbourhood of the tracer injection not only indicates a highly dynamic and complex estuarine river bottom, but also a significant sediment mobility due to both bottom transport (dune migration) and selected suspended movement (at maximum flood flow).



Dune migration along the disposal test site

As a result, together with a confirmation of the recorded mobility, potential threats and explanations for the (partial) failure of the sediment tracing experiments can clearly be identified.

In the complex highly dynamic estuarine river morphology of the Western Scheldt, sediment tracing cannot fully visualize sediment mobility in a proper way. But, together with an intensive analysis of additional morphodynamic data, sediment tracer exercises confirm a general morphological trend of stabilization of local shoal and the associated feasibility of the alternative disposal strategy.