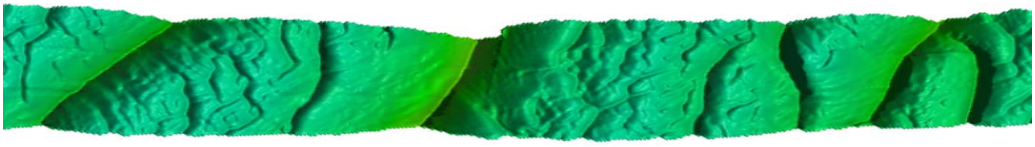
# Experience record of W+B and ACRB alliance

Since 2002 Witteveen+Bos cooperates with ACRB (Advanced Consultancy Romke Bijker) in a strategic alliance on all her submarine pipeline projects. The alliance developed significant experience on various submarine pipeline issues. The combined experience includes technical, environmental, forensic and stakeholder engineering.

**2008 - date** **Project: 36" Bacton - Balgzand gas pipeline**
**Client: BBL Company**

Study and advice on the span remediation requirements for the 36" Balgzand-Bacton gas pipeline from The Netherlands to the United Kingdom. Study focuses on the interaction between the pipeline and the surrounding dynamic seabed and establishes the cause of spans and exposures. Includes, among other things, an assessment of the morphological dynamic sand wave area the pipeline crosses.



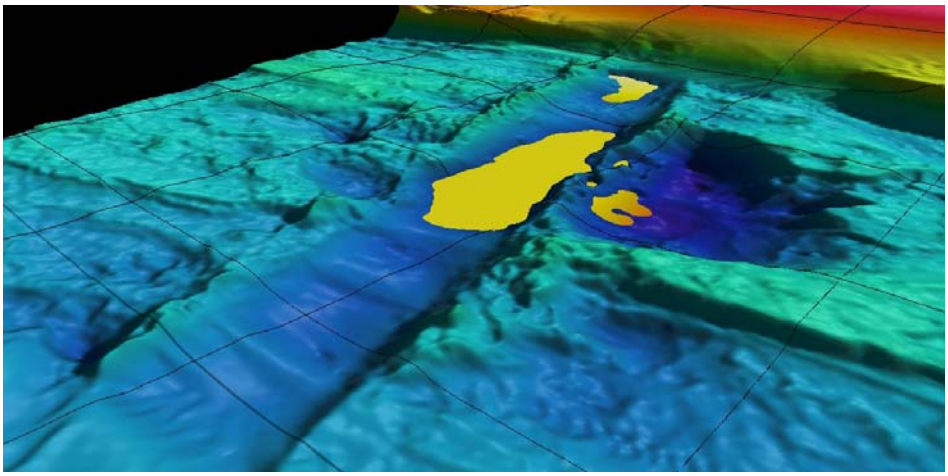
*The BBL pipeline crosses a dynamic sand wave area.*

**2008-2009** **Project: Malampaya, Philippines**
**Client: Oil company**

Design of specific pipeline protection against extreme current velocities (~5 m/s) at deep water (400 m) against turbidity currents. Performed extensive risk assessment of pipeline failure due to unwanted seabed-pipeline interaction resulting from these turbidity currents.

**2007-2009** **Project: Eemszinker**
**Client: N.V. Nederlandse Gasunie**

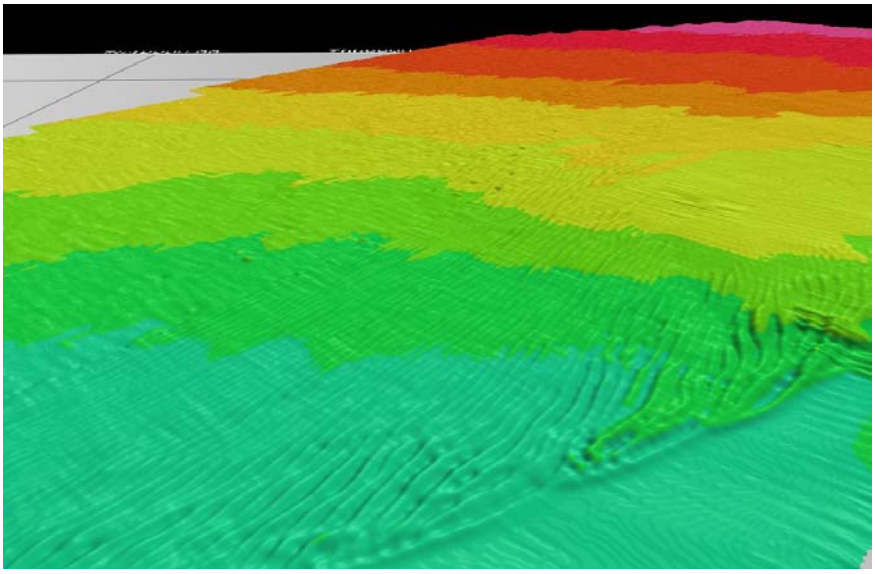
Study and advice to mitigate exposures and free spans of the 42" gas pipeline crossing tidal estuary between Germany and The Netherlands. The work included recommendations on immediate mitigation as well as the design of several pipeline protection covers balancing the technical as well as environmental requirements.



*Design of special protection cover above gas pipeline in complex seabed environment.*

**2008** **Project: Oceânico**
**Client: Oil company**

Study and advice on free spanning pipelines and scouring issues around several PLEMS on a subsea field development in Campos Basin, Brazil. Analysis of hydrodynamic and morphological conditions to advice on remediation requirements.



*Mobile deep water bedforms.*

**2007-date** **Project: Nord Stream**
**Client: Nord Stream AG**

Advisory services for technical and EIA issues for the Nord Stream pipelines, two parallel 1220 km, 48" diameter gas transport pipelines from Russia to Germany, crossing the Baltic Sea. Support was provided on:

- General submarine pipeline EIA process;
- Sediment and contaminants spreading due to construction activities;
- Specific hydrodynamic issues such as potential pipeline blocking and internal waves;
- Impact assessment of munitions clearance;
- Impact assessment on fishing, including test and risk assessment support.


*Route of Nord Stream pipelines from Vyborg in Russia through the Baltic Sea to Greifswald in germany.*

**2007 - date** **Project: Several gas transport pipeline in Wadden Sea, The Netherlands**
**Client: Oil companies**

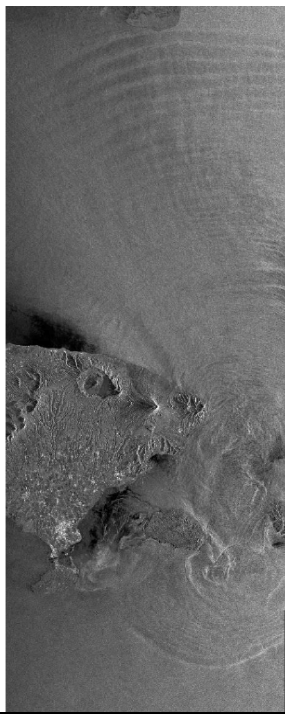
Study and advice on the present condition and future operation and maintenance of several gas pipelines from the Dutch main land to the Wadden isles, to reduce the maintenance cost and the environmental impact. Gain insight in historical behaviour of channel migration and prediction future developments to optimise maintenance decisions. All pipelines are within the ecological sensitive and morphologically active nature reserve Wadden Sea.

*Pipelines crossing the ecologically sensitive Wadden Sea requires specific expertise and experience*

.

**2006 - 2007** **Project: East Java Gas Transport Pipeline**
**Client: Consultant**

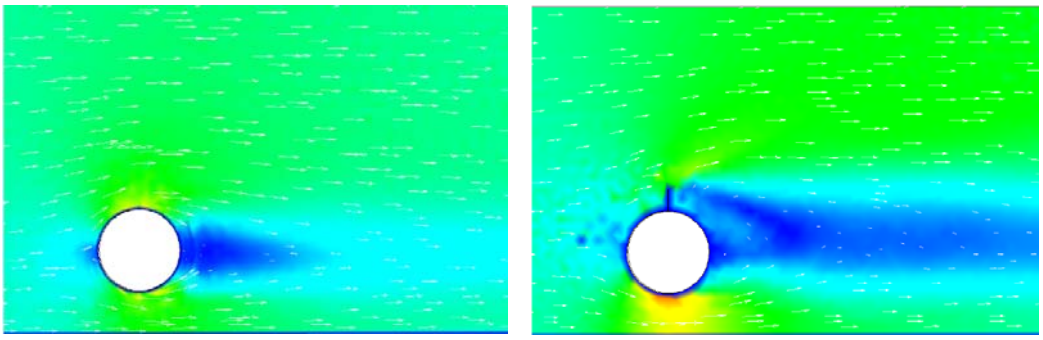
Study on pipeline scouring and stability issues of the East Java Gas Transport Pipeline. Based on an assessment of the potential of seabed mobility and seabed scour the most likely cause of spans and long-term effects of proposed rectification solutions have been determined. Study included an assessment of global sediment transport processes (large scale morphology) and an assessment of the effect of sediment transport on local pipe-seabed interaction (small-scale morphology). The magnitude and frequency of design currents caused by solitons/internal waves generated in the Lombok Strait have extensively been studied as one of the specific mechanisms of the pipe/seabed interaction process.



*Typical example of a soliton generated at the sill in the Lombok strait, Jackson (2004)*

**2003 - 2006** **Project: Environmental impact assessment 36" Bacton - Balgzand gas pipeline**
**Client: N.V. Nederlandse Gasunie**

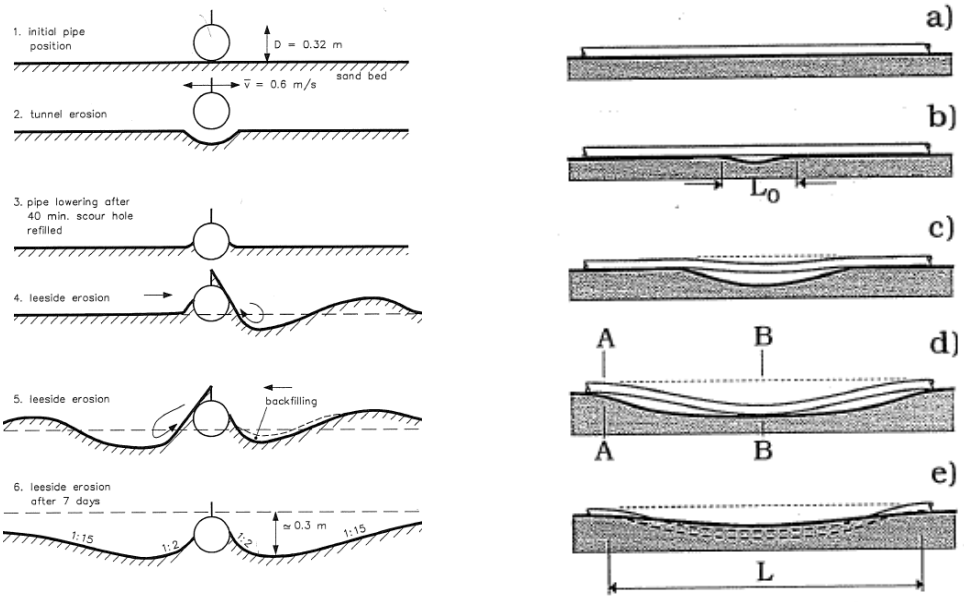
Environmental Impact Assessment (EIA) and supporting technical studies for the 240 km long, 36" Balgzand-Bacton gas pipeline from The Netherlands to the United Kingdom. With sub-consultants Mott MacDonald and Delft Hydraulics. Transboundary EIA with effective merging of EIA and engineering process. The technical support studies were (amongst others) (1) detailed CFD modelling of forces and vortex frequencies as input for VIV assessment (with and without spoiler), (2) extensive sand wave mobility assessment to optimise the initial peak-shaving profile and post-trenching activities to minimise future risk and maintenance cost.



*CFD (Computational Fluid Dynamics) computation to assess the impact of a spoiler on top of the pipeline of hydrodynamic forces and vortex shedding.*

**2002 - 2004** **Project: Several pipeline crossings Hangzhou Bay, China**
**Client: Manufacturer and Sinopec.**

Self-lowering studies for three parallel 50 km long offshore pipelines (10" naphta, 28" and 30" crude oil pipelines) crossing Hangzhou Bay in China. All three pipelines were fitted with spoilers to enhance the self-lowering process in the extreme environmental environment of Hangzhou Bay: extreme currents and complex sediment characteristics. During a site visit in 2003, the successful self-lowering was confirmed.



**2002 - date** **Projects: Submarine pipeline self-lowering and protection studies.**
**Clients: Oil companies, consultants and contractors.**

Many studies on the prediction of the self-lowering of submarine pipelines in the seabed to increase stability and protection. Including plain pipelines as well as pipelines fitted with spoilers (vertical fins) and/or piggy backs. Including crossing active sand wave areas. Many projects with respect to the stability of submarine pipelines. Including the design of protection and stability systems, like rock cover, mattresses etc. Development of various design methods including probabilistic and deterministic approach. For clients and projects in the USA, Australia, China, United Kingdom, Canada and The Netherlands.