

**Client:** BASF Antwerpen nv  
**Main contractor:** Smet-Tunnelling nv  
**Execution period:** August 2010  
**Machine:** AVN  
**Pipes:** Reinforced concrete with sheet steel core  
**ID-OD:** 1,600 – 1,870 mm  
**Length:** 510 m

The project consisted of the construction of a new effluent line by a closed pipe jacking from the water treatment plant of BASF to the River Scheldt. The work was partially located within block S100 of the BASF complex and partially on the property of the Flemish Government, in particular the sections under the Scheldt Dike and in the Scheldt River. The area between the Scheldt Dike and the River Scheldt, known as 'Groot Buitenschoor', is classified as a nature conservation area.

### Activities

The project was awarded by tender, after prior selection of a number of suitable potential contractors, in the spring of 2010. The tender specification included the following activities:

- Excavating a jacking pit inside the sheet piling
- Setting up of the drilling equipment
- Performing approximately 500 m of pipe jacking with closed shield
- Hermetically sealing the bore head
- Driving sheet piling in the Scheldt River
- Lifting the bore head out of the Scheldt River
- Fitting an HDPE outlet section
- Placing suitable retaining cages and stone armour on the outlet section

### Jacking pit

A concrete pit was built within the jacking pit excavated inside the sheet piling to serve as an inspection and connection shaft for the existing water treatment plant. The prefab assembled concrete pit and the connection with the existing infrastructure were implemented directly by BASF. The alignment of the drilled



contractor needed to have a new bottom sounding made using a multi-beam system.

The results of this new measurement were made available to BASF in digital form immediately after processing. Based on this new bottom sounding and taking into account his experience with minimal ground cover above the shield, the contractor had to design a new longitudinal profile for the pipe jacking in close consultation with BASF. After this it was decided to extend the pipe jacking until a minimal ground cover of 1 m was reached under the Scheldt riverbed. This allowed the length of the HDPE outlet section to be reduced, which considerably simplified its installation. As a supplementary safety measure against current pressures in the Scheldt River, the last 19 jacking pipes were made autostable and were bonded together at the joints .

### Closed front boring

The drilling equipment was delivered before the summer construction holiday in 2010, and the pipe jacking started immediately after the construction holiday. The line ran with a downward slope and had a horizontal bend. For safety reasons, personnel of the pipe jacking was kept to a minimum by using an unmanned bore head together with automatic betonite lubrica-



pipe jacking is shown in the following figure. Before commencing work in the River Scheldt, the contractor had to request the necessary permits from the relevant authorities. Smet-Tunnelling relied on a specialised marine engineering firm, acting as subcontractor, to recover the bore head from the bed of the River Scheldt and to fit the outlet section at the end of the bore. The RFQ file included a sounding of the River Scheldt at the outlet location of the new line. To determine the proper end point for the new effluent line in accordance with the bed profile, the

tion. The tunnel was permanently ventilated and equipped with suitable oxygen rescue apparatus. The jacking pipes were designed for gravity flow (max. 1 bar internal pressure) and fitted with NBR spigot seals in combination with fully coated and anchored steel sockets. In the past damage incidents occurred in the Port of Antwerp due to bio-chemical corrosion of steel parts exposed to the water of the Scheldt River. A test with an epoxy coating at the pipe supplier



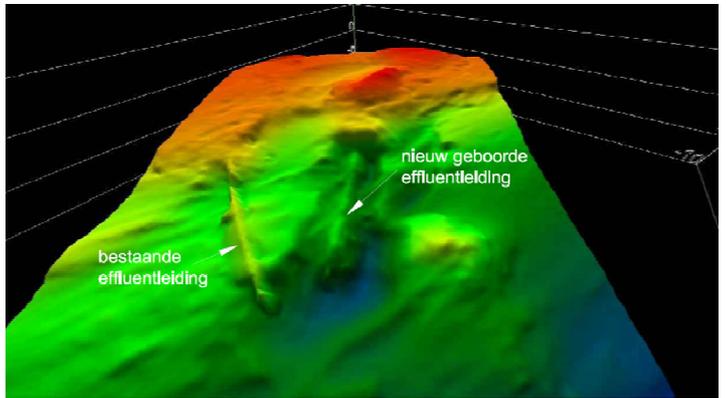
However, after the two sheet piling screens were placed in the River Scheldt and before the bore head arrived at this point, systematic tidal erosion was occurring on the bank-side of these piling walls. After further investigation and in consultation, they decided to carry out additional ground fill in the last metres of the pipe jacking before the exit location. The recovery operation could then start after the bore head had passed this location. A team of divers was used for this operation. The bore head was lifted out, and then the HDPE outlet section was fitted on the end of the pipe jacking. As the navigation channel to the PSA Container terminal was only a few metres away from this point, suitable safety measures with regard to signage, signalling and anchoring of the vessels had to be carefully respected.

### Multi-beam measurements

showed that it did not fulfil the requirements for leak-tightness and mechanical strength. Therefore, in consultation with BASf the contractor decided to change to a thermoplastic coating. A new test showed that this coating did fulfil the requested specifications.

After everything was finished with suitable sealings under water, several follow-up multi-beam measurements were carried out by BASf. The photo shows the result of these measurements in 3D.

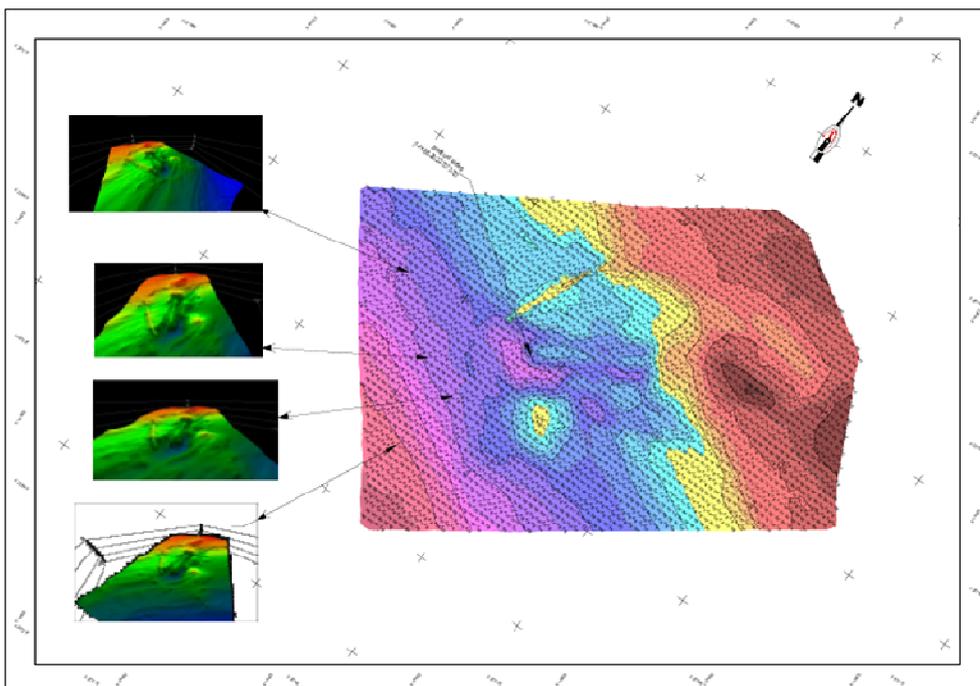
The part of the jacking pipes initially equipped with a sheet-steel core was modified upon the suggestion of the contractor. The jacking pipes could be attached to each other at the joints using a special connection. This avoided time-consuming welding work in the tunnel, which is subject to strict safety regulations. The last 60 m at the end of the pipe jacking under the River Scheldt were anchored together in this way. These jacking pipes were constructed as autostable to prevent them from floating up. The jacking pipes at the landward end were built as a spigot-spigot section for connection to the concrete pit.



### Lifting out of the shield

The bore shield was recovered from the bed of the River Scheldt between two sheet piling screens driven in the longitudinal direction. After all the auxiliary equipment, cables and pipes were removed from the tunnel, the bore head was hermetically sealed. The tunnel was then pumped full of water, and the marine engineering firm, working from a pontoon, could start the job of digging out the shield.

Here you can clearly see the end point of the line in progress, along with the stone armour deposited on the line. The existing effluent line is also visible.



Legende	
0 - 10	10 - 20
20 - 30	30 - 40
40 - 50	50 - 60
60 - 70	70 - 80
80 - 90	90 - 100
100 - 110	110 - 120
120 - 130	130 - 140
140 - 150	150 - 160
160 - 170	170 - 180
180 - 190	190 - 200
200 - 210	210 - 220
220 - 230	230 - 240
240 - 250	250 - 260
260 - 270	270 - 280
280 - 290	290 - 300
300 - 310	310 - 320
320 - 330	330 - 340
340 - 350	350 - 360
360 - 370	370 - 380
380 - 390	390 - 400
400 - 410	410 - 420
420 - 430	430 - 440
440 - 450	450 - 460
460 - 470	470 - 480
480 - 490	490 - 500

**HYDROGRAFISCHE OPMETING**

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Metronomie B.V.  
 Project: ...  
 Datum: ...  
 Schaal: ...  
 Projectleider: ...  
 Uitgever: ...