Surveying the Scheldt

The Flemish Hydrography is responsible for surveying the river Scheldt on Flemish territory up to the lock of Wintam. On the Dutch Western Scheldt Flemish Hydrography surveys only to check the dredged depths in the fairway. On the Flemish Sea Scheldt overall surveys are done for regular national and international charting purposes, besides surveys for very specific projects, such as the maintenance of dredging works. National and international paper charts and digital products (for example ENCâ€™s) are produced for the common user but also for the dedicated users as pilots, engineers, port authorities, shipping companies and research institutes.

The river Scheldt rises at a level of about 100m in the department of l'Aisne near St.Quentin in the North of France and drains a catchment basin of 20,000km^2 situated in Flanders (Belgium) and the province of Zeeland (the Netherlands). After a course of 430km, it flows into the North Sea at Vlissingen (the Netherlands) in a large estuary.
On its way to the sea it passes major cities as Courtrai, Ghent and Antwerp. Downstream of the city of Ghent the river is subject to the tides and it is known as the Sea Scheldt, further downstream on Dutch territory as the Western Scheldt. The influence of the North Sea, by successive inundations, formed the Western Scheldt and transformed the landscape of Flanders and Zeeland.

Economically, the Scheldt forms the maritime access to the major seaports of Flanders, such as Antwerp and Ghent, but it is also the access to the harbors of Vlissingen, Terneuzen and Brussels. From the North Sea, three channels lead to the mouth of the Scheldt at Vlissingen. In the West, the channels are the Wielingen and Scheur, in the North ships can navigate true the Oostgat. Between the channels lies a large area of sand banks.

About 20,000 seagoing ships per year are using the main fairway. In addittion, 50,000 inland ships per year use this waterway on their way to France, the Netherlands, Belgium, Germany and further into Europe.

Morphology

Despite the appearance of an irregular estuary, the Western Scheldt presents a continuous profile for navigation. This profile loops from one bank to the other, passing in between over a section with reduced depth, called a bar. This main navigation channel is the ebb channel. The flood channels are normally not navigable for sea ships. Large shallow areas with sand banks, emerging at low water, are situated between the main channel and the flood channels. The bottom of the fairway here consists mainly of sand and fine sand. On the Flemish part, the Scheldt becomes more a river and the bottom consist of fine sand, silt and clay.

The influence of the tide coming from the North Sea is very important. The tidal amplitude of mean tide is about 4m at Vlissingen and more than 5m at Antwerp. More important however are the volumes of (sea)water that the flood brings in: about 1000 million m^3 over a of 6-hours intervalle at Vlissingen. Just a bit more leaves the river during the ebb.

The movement of such large quantity of water loaded with sediments and with rather high velocity passing over a bottom of fine sand, silt and clay is responsible for considerable erosion and sedimentation processes in different parts of the river.

The ebb channel in general follows the rules which Fargue described in the beginning of the previous century. In fact this French engineer published his studies on the river Scheldt at Antwerp in a report in 1900.

From the mouth of the river upstream to Antwerp there are about twenty critical areas in the river such as the formation of bars, banks which move into the navigational channel, ridges and transvers ripples.
And then there are of course numerous man-made constructions for shipping, such as locks, quay walls, jettys, locks, cables and (road)tunnels. As well as numerous wrecks as a relict of the power of natural elements on unlucky ships.

Survey & charting

Since the natural depth in the navigational channel is too low - the depth over the bars would vary between 5 and 9 metres - maintenance dredging is necessary. On average, annually 10 million m^3 is dredged and dumped back into the river.

While the oldest known bathymetric survey campaign was set up by the French at the end of the 18th century. This was a survey for exploring and charting the navigational channels. Since, at rather irregular intervals, surveys were undertaken and charts of the river were made. Most well-known hydrographers in the 19th century were Beautemps-BeauprÃ©, Blommendal, Stessels, Petit and Rochet.

Nowadays, the river on the Flemish part, up to the lock at Wintam, is completely surveyed every other year. These overall surveys are used for national and international chart compilation. The results are pre-sented on paper charts at a scale of 1/5,000. However the navigational charts are on scales from 1/10,000 up to 1/50,000. ENCs from the Sea Scheldt are distributed by IC-ENC and are compiled for a usage band 5. The overall surveys are also used for modeling purposes and studies; often done by the governmental institute 'Flanders Hydraulics' at Borgerhout (Belgium).

Surveys: Instruments and Vessels
There are about twenty critical areas in the navigational channel to the main Flemish ports on the Scheldt where maintenance dredging on a regular base is necessary. These places are situated from downstream the Kallolock to Vlissingen and this intensive and very expensive work is done by two or three dredging ships working five days and nights a week. As a follow-up of these tremendous dredging efforts, these dredged places are surveyed at a frequency of once every fortnight up to twice a year. But also when no maintenance dredg-ing is necessary in parts of the river, the fairway will be surveyed on the same regular basis to be able to inform the pilots continuously of the available depths.

As a standard all our four survey vessels, operating from Antwerp, have a single beam echo sounder on board and the depth always is measured simultaneously with two frequencies, 210kHz and 33kHz. At this time, an Odom MKIII is used. Single-beam echo sounding is done in those areas were a silt layer is expected. Such areas are the entrances to the locks and the newly constructed Deurganckdok. Also at some of the large container terminals, situated on the river, the sedimentation is followed up by repeatedly surveying with two frequencies. A single-beam echo sounder with sub-bottom functionality also is used.

Two ships have a multi-beam echo sounder. One Simrad EM3002D and one Simrad EM3000D are used for those regions were a more complex bottom structure is expected.

For normal bathymetric surveys there is one surveyor on board. The measurements are processed on the return trip. Indeed, the survey ships mostly return to their moorings every day. Processing is done by the QPS' Qinsy-software.

The results of the daily surveys are distributed as paper charts and they are used by the engineers respon-sible for the dredging works, the pilots (Flemish and Dutch), the people working at the Vessel Traffic Centers, the port authorities and shipping companies.

Besides the paper charts all the results of the surveys are kept in a database which can be consulted by an online application. This 'Schelde-ECS' project is a joint effort of the Dutch RijksWaterStaat and the Flemish Hydrography. For the moment, it is only meant to be used by the professional users of the Scheldt region and the pilots.

The Flemish Hydrography also gives logistic support or works together with other institutes or private companies when special measuring campaigns are set up.
Such special campaigns are for instance:

- density measurements with a navitracker
- sampling of bottom and water for a wide variety of reasons
- bottom recognition
- side scan
- magnetometric searches
- sound velocity measurements

The Flemish Hydrography is responsible for an own RTK/GPS-positioning chain with Thales/Aquarius base stations. These stations are the same as those which the Dutch authorities use in the Western Scheldt region. So there is one RTK-system that can be used from Wintam up to Vlissingen and even further at sea along the Belgian coast.

All the surveys are done by four ships, of which two are about 12m long and 4m wide with a draught of 1.2m, and two larger ships with a length of about 25m and with a draught of 1.8m.

Besides the echosounders and positioning system all ships have also receivers (PC, GPRS, internet connection) on board which make it possible to follow up a variety of parameters from more then 20 gauges along the river and at sea. The measured parameters differ for all stations but are for instance: tide at 1' and 10' interval, windspeed, wind direction, watercurrent velocity, watertemperature, salinity and turbidity. As a backup the data of this network can also be consulted at the office over internet. As the positioning chain and many other systems (VTS, radar), this 'Hymedis' monitoring system is also set up by our organisation in cooperation with the Dutch authorities.

Surveys: Archives & Databases
All the data that is gathered has to be preserved for the future. The archives that hold the paper charts is now extended with a hydrographic database system to store the digital data. This database should be very easy accessible, also for users from outside our own organisation.