Regulation for the upstream and downstream navigation of 8,000 and more TEU container vessels to the port of Antwerp with a maximum draught of 145 dm

1. In general

In order to gain an insight into the impact of the new generation of container ships on shipping traffic on the Western Scheldt, the Shipping Assistance Division has commissioned a study of the accessibility of the Scheldt for 8,400 and more TEU container vessels with a maximum draught of 145 dm..This study has been conducted by Flanders Hydraulics Research (FHR- Antwerp) in cooperation with Ghent University – Maritime Technology division.

When a vessel sails in open waters with large water depth, the pressure distribution around the vessel will only be influenced by the vessel characteristics. However, a vessel sailing in a restricted environment or confined water will be influenced by different factors, whereby this changed pressure distribution at the hull will influence the forces acting on the vessel.
The impact of the environment can be broken down on the one hand into the influence of under keel clearances and on the other hand the influence of banks that restrict the fairway in vertical and horizontal direction respectively. Apart from permanent factors such as banks and bottom, the environment can also be temporarily influenced by the presence of other vessels. The interaction forces which these vessels exercise on each other may have an important impact on the vessel's manoeuvring behaviour. Except for the impact of the environment on the vessel, the impact of current and wind on the vessel's behaviour also needs to be modelled. Figure 1 gives an overview of the influence factors on a vessel sailing in a restricted waterway.

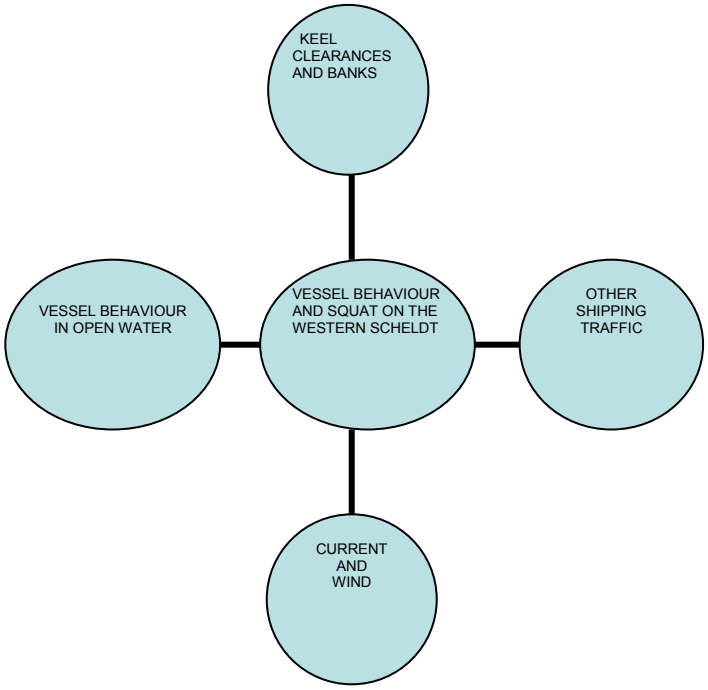


Figure 1: Overview of the factors influencing the sailing behaviour of a vessel sailing in shallow waters, such as the Western Scheldt.

2. Method of operation

Considering the aforementioned elements, the study was broken down into five sub-studies. The first four sub-studies pertained to the modelling of the aforementioned influence factors. In the last sub-study the results of this modelling were applied to assess the behaviour of the studied container vessels. The following sub-studies were performed in 2006 and 2007:

- Sub-study 1: **Squat**
- Sub-study 2: **Manoeuvring behaviour in open water**
- Sub-study 3: **Bank effects**
- Sub-study 4: **Interaction between vessels**
- Sub-study 5: **Assessment of upstream and downstream navigation**

3. Characteristics of the vessel models used

The prediction of ship's behaviour on the Western Scheldt has been based on thousands of model tests with a scale model of an 8000 TEU containership with at scale a length over all of 4.36 m (see Table 1).

In order to be in line with the future vessels that will be provided by shipping companies, the vessel model that was originally used has been **scaled up to the container vessels** of the respective shipping companies **which may be expected in the future.**

Table 1 – Characteristics after scaling of model U and based on ordered and built container vessels of different shipping companies.

	MODEL U	MAERSK	CMA-CGM	MSC	MAERSK
Schaal	**1**	**80.8**	**85.1**	**88.3**	**91.6**
TEU	-	8400	11400	13230	14000
L_{OA} (m)	4.36	352.0	365.5	381.0	397.6
L_{PP} (m)	4.106	331.8	349.5	362.4	376.0
B (m)	0.53	42.8	48.4 (45.1)	51 (46.8)	56.4 (48.5)
T_1 (m)	0.181	14.61	15.41	15.98	16.57
T_2 (m)	0.168	13.61	14.30	14.83	15.38
T_3 (m)	0.15	12.16	12.77	13.24	13.74

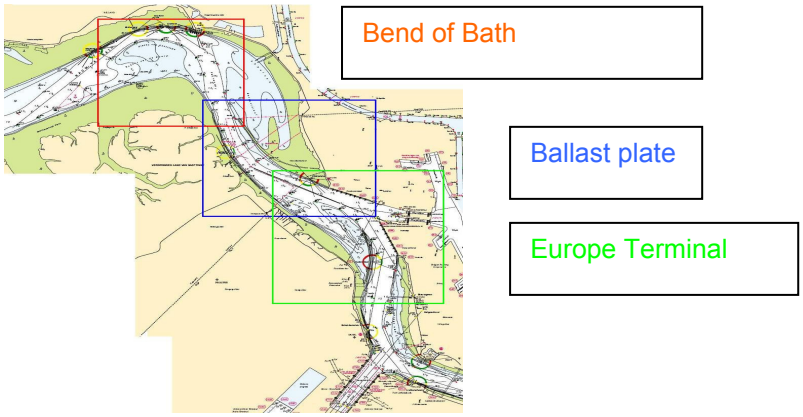
4. Assessment

In sub-study 5 of the research the results of the other sub-studies were used to assess the accessibility of the port of Antwerp to the studied vessels.

This **assessment** was performed using **two methods**:

A) A **desk study** was developed by Flanders Hydraulics Research and Ghent University, Maritime Technology Division.

B) A **large series of real time simulations** were performed on the **ship manoeuvring simulators** of Flanders Hydraulics Research in Antwerp **at three critical locations** on the river:



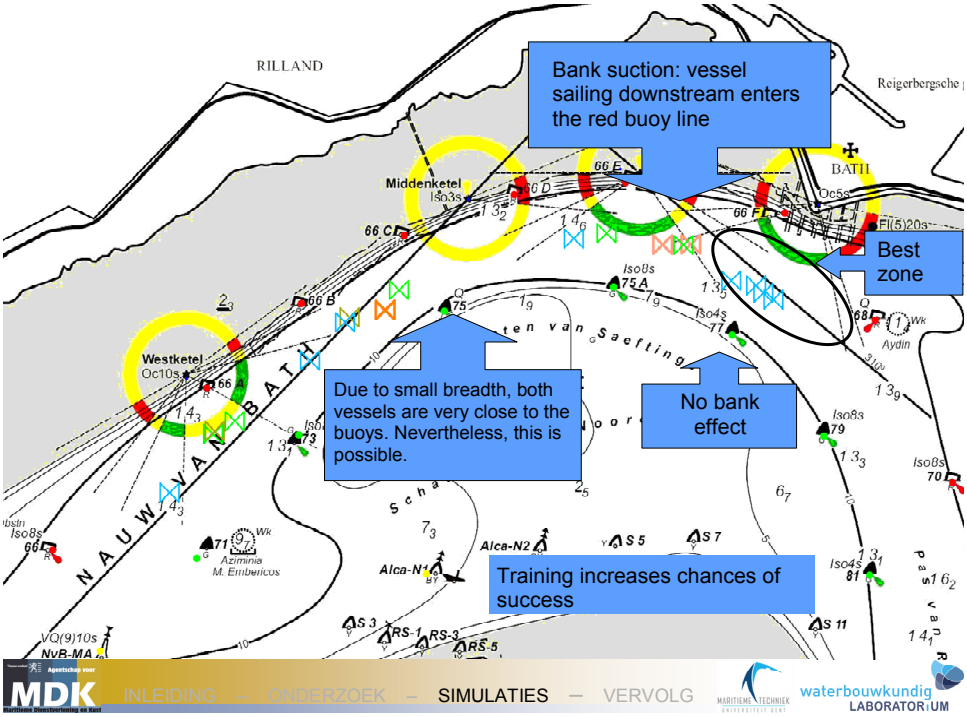
In the three critical locations **112 simulation runs** have been performed on **two *combined* ship manoeuvring simulators,** at maximum flood or ebb current. The aim was to examine whether encounters at these locations were feasible or advisable. The following **elements** were measured to this end:

- **distance between the vessels**
- **minimum distance to the buoys**
- **wave generated at the Europe Terminal by a passing vessel.**

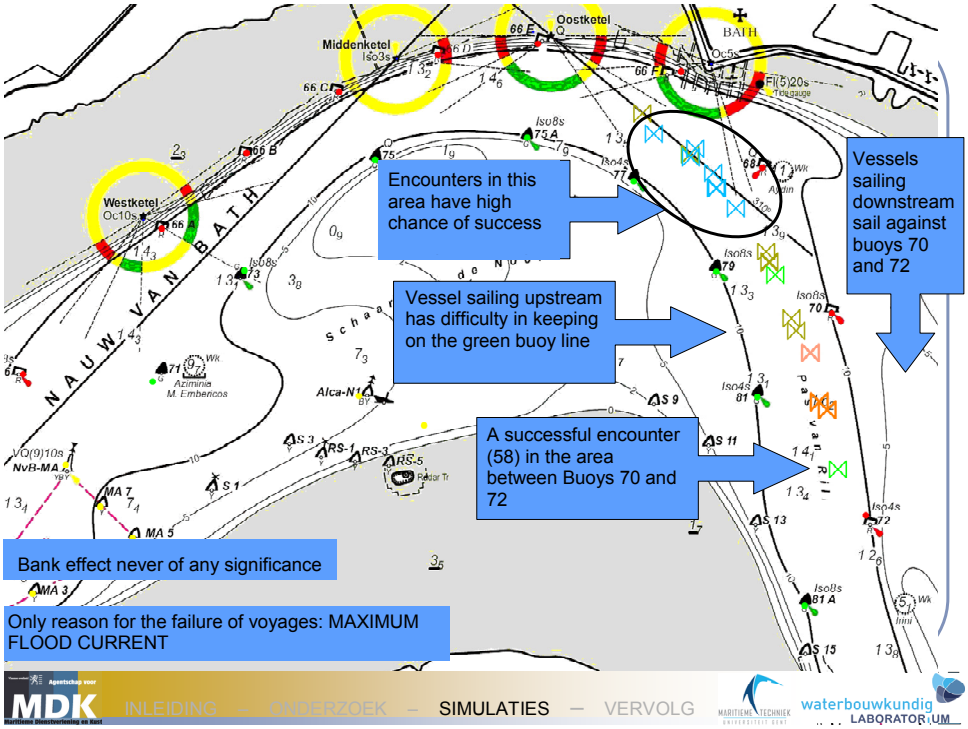
5. Conclusions

The experienced difficulties are summarized in the six figures below:

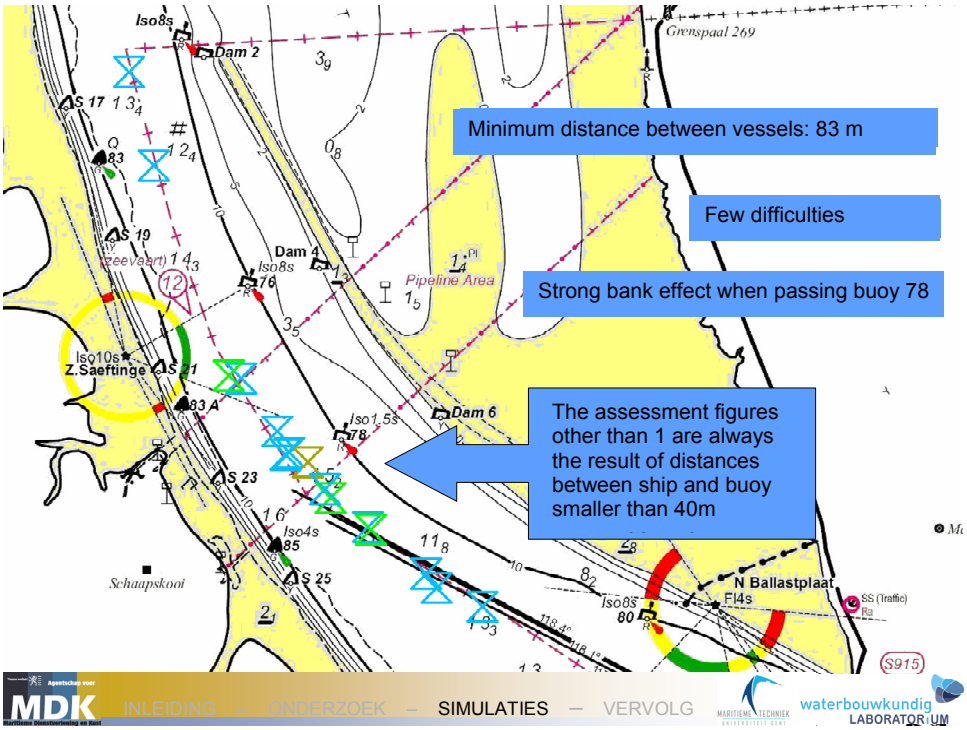
5.1 **Bend of Bath at maximum ebb current**



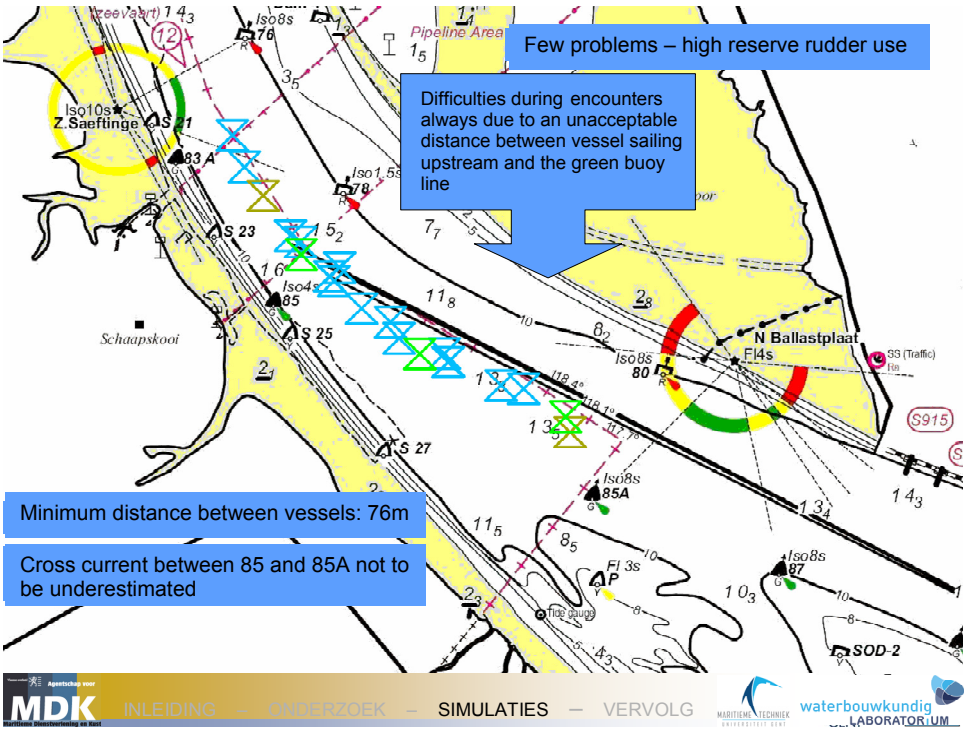
5.2 **Bend of Bath at maximum flood current**



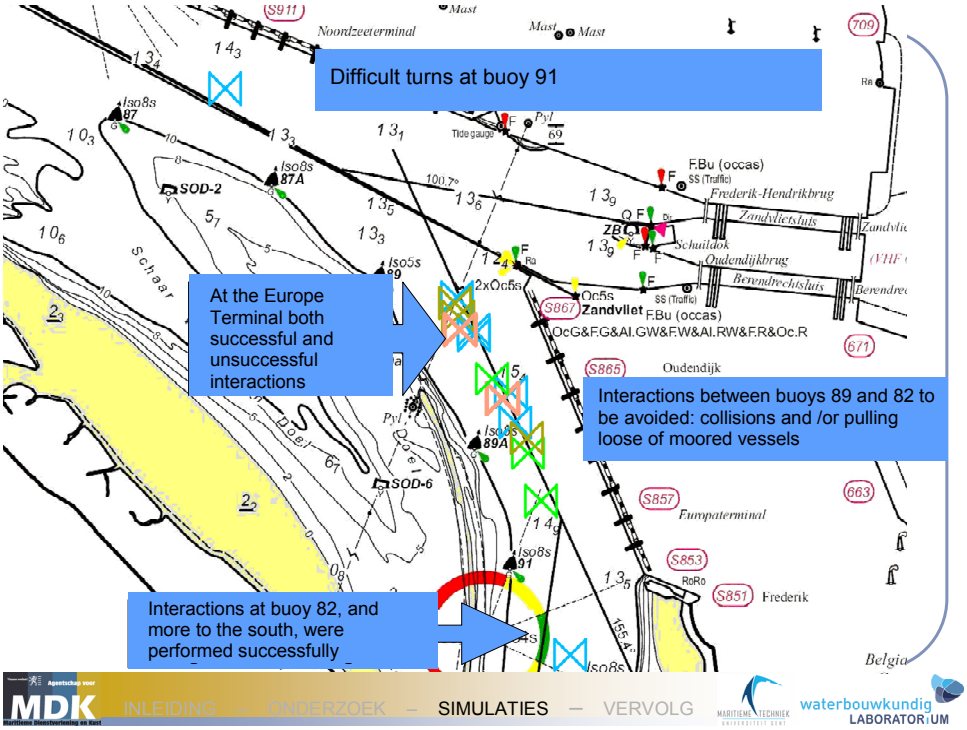
5.3 **Ballast plate at maximum ebb current**



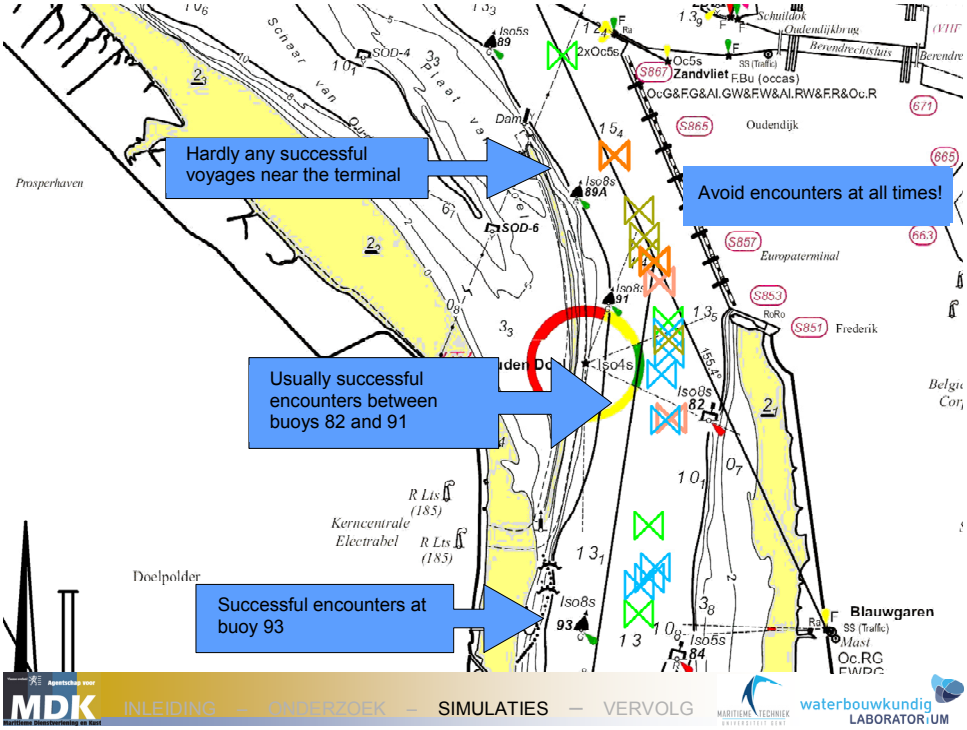
5.4 **Ballast plate at maximum flood current**



5.5 **Europe Terminal at maximum ebb tide**



5.6 **Europe Terminal at maximum flood current**



5.7 **General conclusions:**

- The impact of the ship's dimensions and of the increase in scale of vessels from 366 m LOA till 400 m LOA could not be ascertained from the results of the simulations. The impact of the ship's dimensions on the control of the vessel seemed also on basis of the results of the desk study quite limited. Consequently one can presume that the ship's dimensions within the research area have little impact on the actual manoeuvres. However the manoeuvrability of the ship (resulting from the ship's hull, the characteristics of the propeller and rudder, the conformity of the engine-room telegraph and the number of propeller revolutions) is essential.

- A well-founded new version of the upstream and downstream navigation rules for container traffic to the port of Antwerp should be drawn up in accordance with the present situation. This upstream and downstream navigation should be redrafted after the deepening of the river Scheldt, presently under execution. This regulation is drawn up by the Common Nautical Authority (Gemeenschappelijke Nautische Autoriteit – GNA) which has to find a support from the Dutch side.

- An intensive traffic guidance on all levels is required to manage the interactions and crossing of vessels at specific critical locations, or to avoid them, if tidal conditions should require so. Training of Flemish and Dutch river pilots on the ship manoeuvring simulators will give a valuable contribution in combination with "know how on the job".

- As additional precondition, a number of certainties have to be met, such as for example in connection with the "chain approach", and manoeuvrability of vessels (presence of sufficient tugboats, availability of berth and/or locks, mooring men etc.).Further research will make it possible to evaluate less extreme (and thus more frequent) situations under better tidal conditions and less wind.