We provide extracts from the design reports and navigational studies conducted on vessel parameters:

The parameters of the design vessels are estimated using PIANC 75% confidence limit and are shown in Table 5.3.

Table 5.3: Vessel Paramaters

Parameters	Unit	Bulk Carrier -18mCD	Oil Tanker -18mCD	Future Oil Tanker -21mCD
Deadweight	t	100,000	100,000	166,000
Displacement	t	118,000	129,000	209,200
LOA	m	255	263	310
LBP	m	246	254	300
Beam	m	39.2	42.5	49.6
Depth	m	21.1	22.5	27
Max draft	m	15.2	15.4	18

Source : PIANC Guidelines for the Design of Fenders Systems, Report of Working Group 33, Maritime Navigation Commission, 2002

The guidance in TNPA's Port Engineering Handbook has also been used to estimate the required maintained depth of the entrance and approach channels. For the design vessels in Table 5.3 approximately 3 metres to 6 metres depth of dredging, for the bulk and future liquid product tankers respectively, would be required if the vessels are expected to sail through the approach and entrance channels fully laden 'at all states of the tide' and in the most extreme of the weather conditions. However, in less onerous environmental conditions the depth of the existing channel should be sufficient to accommodate the bulk carriers, whilst additional control measures such as tidal elevation and vessel draught limitations could be imposed so that the proposed future liquid product carriers can be accommodated.

5.4 Navigation simulation

A 'fast-time' navigation simulation study has been carried out using the SHIPMA software. Use of the 'fast-time' navigation software enables vessels to be steered along specified vessel tracks by use of a programmed autopilot to enable environmental conditions and the difficulty of manoeuvres to be determined.

The influences of constant (mean) current, wind and wave forces as well as the influence of banks, water depth, tug handling and vessel performance characteristics are considered by the SHIPMA software. Wind gusts, human and pilot interaction, vessel motion (other than the swept path of the vessel in the direction of navigation), vessel squat (an important consideration when determining required channel depth) and the time taken to reposition tugs (and vessel drift that may occur during tug repositioning) are not considered.

The simulations were run to investigate and confirm:

- That the design vessels will be able to manoeuvre safely within the port in various combinations of site environmental conditions;
- The capacity of the tugs required to safely manoeuvre the design vessels;
- The level of difficulty and potential risks associated with the proposed vessel manoeuvres;
- That the 166,000DWT liquid product tanker will be able to safely navigate within the existing approach channel, and
- The suitability of a 170 metre wide navigation channel for future navigation between Berths 'A' and 'B' following the future landward extension of the berths.

For the purposes of the simulation work it is assumed that;

- Vessels navigate within the approach and entrance channel without tug assistance.
- Tug assistance is provided only when vessels are on the leeward, sheltered, side of the eastern breakwater (inside the port).
- 2 x 70 tonne bollard pull Voith Schneider tractor tugs are available.
- Vessels reduce their speed to 6 knots (or slower) to allow safe tug attachment.
- Tugs connect to the vessel at bow centre and stern centre positions via lines that allow tugs to provide assistance by pull forces only (ie 'shoulder pick up' has not been considered)

Extracts from Numerical Ship Navigational Study which included 120,000 DWT vessels.

The original scope of works included the sailing and berthing of vessels at Berth A100 with a ballast and laden liquid bulk vessel. In light of the likelihood of berthing vessels at the B100 berth prior to the completion of Berth A100, additional simulations were carried out to include manoeuvres to and from this berth. On the recommendation of the Harbour Master and Pilots, it was decided to include the placement of barges on the edge of the turning basin next to the east breakwater to represent the future planned LNG terminal. This did not significantly influence the simulations because the LNG terminal and moored LNG vessel is planned not to encroach on the port's turning basin.

An additional bulk vessel (120 000 DWT) was included in the simulations to investigate how a vessel with similar dimensions but different hydrodynamic properties would influence sailing, berthing, and emergency evacuation manoeuvres.

The holding strength of the tugboats were investigated to determine the operational wind limit at which the tugs can hold the vessels for berthing and de-berthing.

Table 3.6: Vessels for simulation runs

ID	DESCRIPTION	LOAD STATE
3303	110 000 DWT	Ballast
3385	110 000 DWT	Laden
3600	120 000 DWT	Laden

Ship id	3303	
Ship Particulars	**Value**	**Unit**
LOA	244.6	[m]
Beam	42.0	[m]
Draught for/aft	5.0/7.0	[m]
Displacement	46 386	[m^3]
Frontal wind area	1 167	[m^2]
Lateral wind area	4 676	[m^2]
Block coefficient	0.79	
Engine particulars		
Number of blades	4	
Propeller Diameter	7.10	[m]
Pitch ratio	0.635	
Area Ratio	0.5675	
Shaft Power	15544	kW
Ship id	3385	
Ship Particulars	**Value**	**Unit**
LOA	244.6	[m]
Beam	42.0	[m]
Draught for/aft	15.5/15.5	[m]
Displacement	125 155	[m^3]
Frontal wind area	812	[m^2]
Lateral wind area	2 452	[m^2]
Block coefficient	0.825	
Engine particulars		
Number of blades	4	
Propeller Diameter	7.10	[m]
Pitch ratio	0.635	
Area Ratio	0.5675	
Shaft Power	15 544	kW
Ship id	3600	
Ship Particulars	**Value**	**Unit**
LOA	250	[m]
Beam	45.0	[m]
Draught for/aft	12.5/12.5	[m]
Displacement	110 045	[m^3]
Frontal wind area	1 005	[m^2]
Lateral wind area	3 247	[m^2]
Block coefficient	0.822	
Engine particulars		
Number of blades	4	
Propeller Diameter	7.10	[m]
Pitch ratio	0.635	
Area Ratio	0.5675	
Shaft Power	15 544	kW

Figure 5.6 illustrates how the turn of the vessels vary depending on the wind conditions during the manoeuvre. The tracks indicate that the vessels stay well clear of port structures namely the breakwaters, jetty and ACB breakwater. The only potential additional concern is that pilots must stay mindful of the shallow water area directly to the east of Berth A100. If the berth is re-orientated and rotated more towards shore, the vessels need to stay clear of the shallower water between Berth A100 and the ACB. Shallow water marker buoys are recommended to indicate the edge of the -18 m PD dredged area.

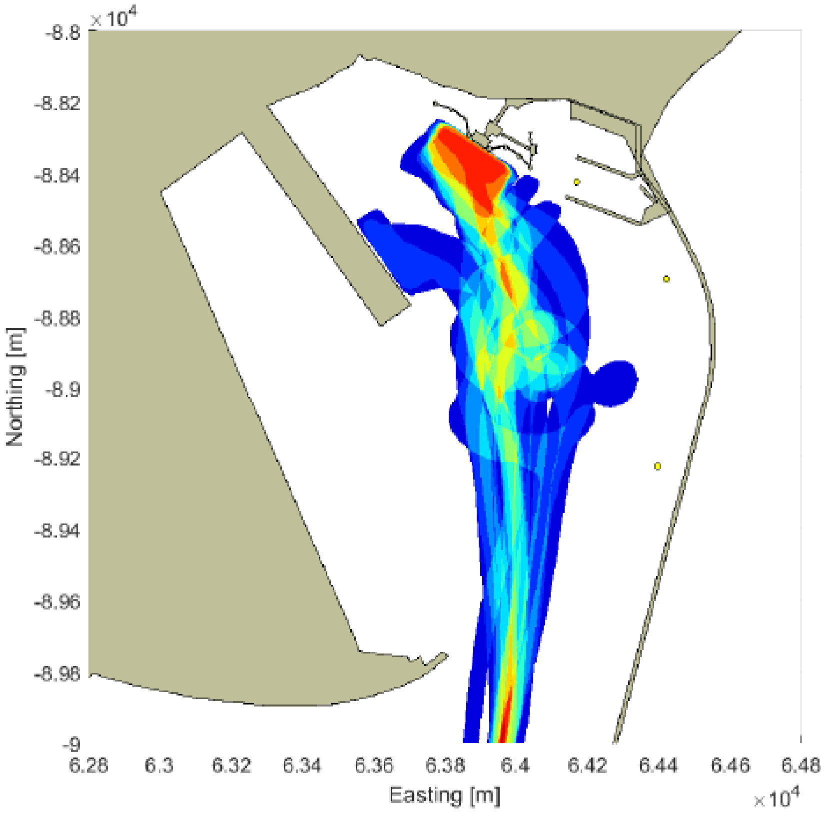

Figure 5.6: Track overlay plot of all laden vessel (3385 and 3600) simulations carried out at SAMTRA (view of the port basin)