

Marine Operations Guidelines for Liverpool Container Terminal 2

The Mersey Docks and Harbour Company Limited

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Marine Operations Guidelines for Liverpool Container Terminal 2

1. Introduction

- 1.1 The Mersey Docks and Harbour Company Limited (the statutory harbour authority and competent harbour authority for the Port of Liverpool) has produced these Guidelines following consultation with Liverpool Pilotage Services Limited and The Mersey Docks and Harbour Company (L2) Limited (the operator of Liverpool Container Terminal 2).
- 1.2 These Guidelines are offered as a guide to best practice for marine operations and pilotage procedures. They should not be seen as binding on any parties, as circumstances may, after consultation between the relevant parties, necessitate divergence from these Guidelines.
- 1.3 These Guidelines must be read in conjunction with the Directions, Byelaws, Notices to Mariners, and other Guidelines produced from time to time by The Mersey Docks and Harbour Company Limited. Notwithstanding, the provisions of the Directions, Byelaws, and Notices to Mariners will prevail.
- 1.4 Nothing in these Guidelines will relieve any party from their obligations in accordance with—
 - (a) The Mersey Docks and Harbour Company Limited’s Statutes, Directions, Byelaws, Notices to Mariners, and terms and conditions in force from time to time; and
 - (b) any terms and conditions issued from time to time by The Mersey Docks and Harbour Company (L2) Limited relating to the use of Liverpool Container Terminal 2.

2. Interpretation

Unless the context otherwise requires, in these Guidelines—

“LCT2” means Liverpool Container Terminal 2, the main characteristics of which are detailed in Annex 1;

“LPSL” means Liverpool Pilotage Services Limited;

“MDHC” means The Mersey Docks and Harbour Company Limited;

“Mersey VTS” means the vessel traffic service for the Port of Liverpool operated by MDHC (callsign MERSEY VTS);

“pilot” means an authorized Liverpool pilot;

“Port” means the Port of Liverpool;

“Shipping Line” means the owner or operator (or their agent) of a vessel;

“Terminal Operator” means The Mersey Docks and Harbour Company (L2) Limited; and

“VLCS” means a very large container ship which, for these Guidelines, will be any vessel arriving at, departing from, or alongside LCT2 that meets or exceeds one or more of the following parameters:

Overall length:	300m
Moulded breadth:	42m
Actual draught:	13.5m
TEU capacity:	8,000 TEU.

Unless the context otherwise requires, words implying the singular include the plural and vice versa, and words importing gender will include any other gender.

3. Vessel documents and acceptance

3.1 For a vessel that has not previously called at LCT2, at least seven days before the vessel is scheduled to arrive at LCT2, the Shipping Line must provide MDHC, LPSL, and the Terminal Operator with copies of the vessel’s—

- (a) general arrangement plan (including DWG or DXF formats if available);
- (b) mooring arrangement plan;
- (c) pilot card;
- (d) wheelhouse poster (including deep- and shallow-water squat calculations); and
- (e) indicative lateral windage area calculations.

3.2 The typical minimum acceptable characteristics for vessels calling at LCT2 are:

- Overall length: 200m
- Moulded breadth: 32m
- Minimum freeboard: 5.5m

3.3 Vessels that do not meet one or more of the minimum acceptable characteristics may be accepted by MDHC and the Terminal Operator to berth at LCT2 but subject to conditions, such as, but not limited to, time alongside being subject to a minimum height of tide at low water.

4. Mooring plans and mooring management

4.1 MDHC will produce an indicative mooring plan for each vessel that, as far as circumstances permit, will be provided to the relevant stakeholders at least 24 hours before the vessel’s arrival.

4.2 The indicative mooring plan will show the—

- (a) position and orientation of the vessel alongside LCT2;

- (b) recommended number of mooring lines to be sent ashore;
 - (c) shore-side bollards to be used; and
 - (d) use of ShoreTension®, or otherwise.
- 4.3 The vessel's master is responsible for ensuring that the vessel is and remains appropriately moored while alongside LCT2. Given their knowledge of the vessel and its mooring equipment, the master may request amendments to the indicative mooring plan.
- 4.4 Owing to the River Mersey's tidal range, the master should ensure that the crew tends the vessel's moorings throughout its time alongside LCT2. The master should also consider the effects of wind, wave, and swell action on the vessel and its moorings.

5. ShoreTension® dynamic mooring system

- 5.1 To reduce cargo handling downtime, MDHC operates a ShoreTension® dynamic mooring system that may, subject to the master's agreement, be attached to the vessel to dampen its movements whilst alongside LCT2.
- 5.2 ShoreTension® is an addition to and not a replacement for the vessel's mooring equipment. The vessel's master remains responsible for the vessel's safety and the effectiveness of its moorings while alongside LCT2.
- 5.3 ShoreTension® is not designed nor intended to hold the vessel alongside LCT2 in conditions exceeding those specified in section 20 of these Guidelines.
- 5.4 When ShoreTension® is deployed, the time spent mooring and unmooring the vessel may be extended, and the master, pilot, and Terminal Operator should consider this in their respective passage and operational plans.

6. Pilotage arrangements

- 6.1 Under normal circumstances, to enable passage planning and any pre-arrival consultations that may be required, the pilot for a VLCS should be assigned to the vessel at least 24 hours before the vessel's scheduled arrival or departure time.
- 6.2 In addition to the requirements of the Pilotage Directions, the pilot assigned to a VLCS will be accompanied by an assistant pilot.
- 6.3 During the master-pilot exchange, the roles of pilot and assistant pilot should be discussed and agreed upon with the master. Notwithstanding, the assistant pilot assigned to a vessel will have authorization sufficient to enable the assistant pilot to take over the vessel's conduct from the pilot if circumstances require (e.g. the pilot becomes incapacitated).

7. Pilot boarding arrangements

- 7.1 It is recommended that the pilot for a VLCS arriving for the first time should board the VLCS at the Lynas pilot station, which will allow for an extended master–pilot exchange.
- 7.2 Subject to an assessment of a VLCS on its first call to LCT2, the pilot may board that vessel at the Liverpool Bar pilot station for subsequent calls to LCT2.
- 7.3 Subject to weather conditions, pilots should board vessels other than VLCS at the Liverpool Bar pilot station.
- 7.4 Unless prevailing weather conditions determine otherwise, pilots should disembark from all vessels at the Liverpool Bar pilot station.
- 7.5 Pilot boarding arrangements must comply with SOLAS Chapter V Regulation 23 (as amended). Before arrival, Shipping Lines should provide MDHC and LPSL with details of the vessel’s pilot boarding arrangements (particularly trapdoor arrangements) to avoid delays during pilot boarding that may be caused by non-compliant boarding arrangements.

8. Passage planning

- 8.1 In addition to the requirement that the vessel’s master must produce a port-to-port passage plan, the pilot will produce a port passage plan for discussion with the master during the master–pilot exchange. If time permits, the pilot may provide a copy of the port passage plan to the master before the pilot boards the vessel.
- 8.2 The pilot’s port passage plan should consider factors such as, but not limited to:
 - Critical timings based upon the vessel’s draught, required under keel clearance, and predicted height of tide
 - Maximum wind speed limits
 - Towing requirements and characteristics of the assigned tugs
 - Interaction with other vessel traffic
 - Swinging manoeuvres
 - Passage abort positions
- 8.3 Before arrival, the master must provide MDHC and LPSL with details of any unusual handling characteristics or defects the vessel may have. Failure to report any unusual characteristics or defects may result in the vessel not arriving at the intended time.
- 8.4 Failure to report a defect constitutes a breach of the provisions of the General Directions.
- 8.5 As part of the passage planning process and to enable the pilot to calculate the vessel’s towing requirements, the master must estimate the vessel’s frontal and lateral windage

areas for both the arrival and departure conditions. These estimates must be sent to the pilot and MDHC.

9. Under keel clearance

- 9.1 The minimum required under keel clearance at any time for a vessel navigating within the Port and arriving at or departing from LCT2 should be at least 1.0m or 10% of the vessel's draught, whichever is greater.
- 9.2 Considering the strong tidal flow in the River Mersey and the influence of waves and swell, the minimum required under keel clearance for vessels alongside LCT2 is 1.0m or 10% of the vessel's draught, whichever is greater.

10. Towage

- 10.1 Annex 2 provides guidance on the towage requirements for vessels calling at LCT2.
- 10.2 In certain circumstances, it may be possible for the pilot to deviate (e.g. use fewer tugs) from the recommended towage requirements detailed in Annex 2. The Port of Liverpool Towage Guidelines provide details of the consultation and evaluation process that should take place to support any deviation from the recommended level of towage.
- 10.3 In certain circumstances, tidal or weather conditions, vessel characteristics, or defects may dictate that more tugs are needed than specified in the recommended towage requirements detailed in Annex 2.
- 10.4 As part of the passage planning process, the pilot should have determined the vessel's abort points and the number of tugs required to assist the vessel if it passes beyond each of those points. Accordingly, following the liaison between the pilot and the Shipping Line, the Shipping Line must order the relevant number of tugs to be available in the River Mersey by the times stipulated in the pilot's port passage plan.
- 10.5 Notwithstanding the requirements of paragraph 10.4, for a VLCS, all required tugs must be available in the River Mersey before the vessel passes two miles west of Q1 buoy (i.e. the final abort position for vessels of this category).
- 10.6 Under normal circumstances, vessels should not require escort towage (either active or passive) when arriving at or departing from LCT2.

11. Timing of transits

- 11.1 For a vessel that is navigating at or close to the maximum acceptable draught for a specific tide, the following are the indicative timings for the passage relative to the predicted time of high water (HW) at Gladstone Lock:

(a) Inward-bound

Buoy or location	Port side-to	Starboard side-to
Lynas Boarding	HW – 3h 50m	HW – 4h 35m
Bar Light Float	HW – 1h 20m	HW – 2h 05m
Q1	HW – 0h 55m	HW – 1h 55m
Formby	HW – 0h 45m	HW – 1h 40m
Crosby	HW – 0h 15m	HW – 1h 10m
Burbo	HW	HW – 0h 50m
C22	HW + 0h 15m	HW – 0h 30m
LCT2	HW + 0h 25m	HW

(b) Outward-bound

Buoy or location	Port side-to	Starboard side-to
Depart from LCT2	HW – 1h 15m	HW – 1h 00m
C22	HW – 0h 30m	HW – 0h 30m
Crosby	HW – 0h 05m	HW – 0h 05m
Formby	HW + 0h 20m	HW + 0h 20m
Q2	HW + 0h 25m	HW + 0h 25m
Bar Light Float	HW + 0h 40m	HW + 0h 40m

11.2 It is important to note that for outward-bound vessels, the stated departure time is when the vessel must start to break away from the berth—it is **not when the Terminal Operator finishes cargo operations or when tugs or line handlers arrive at the vessel**. Cargo operations must be completed, and tugs and line handlers must attend in sufficient time to allow the vessel to break away at the planned departure time.

12. Berthing speeds

The recommended maximum berthing speeds, assuming a berthing angle of 6° to the berth face, for assorted sizes of vessels, are:

Vessel dimensions	Displacement (tonnes)	Berthing speed (ms⁻¹)
399m × 59m	250,000	0.09
366m × 49m	158,000	0.11
305m × 42m	96,000	0.13
294m × 32m	76,000	0.14
200m × 32m	48,000	0.17

13. Abort procedures

- 13.1 Abort locations should be identified as part of the passage planning process and covered during the master–pilot exchange.
- 13.2 If the pilot decides to abort the inward-bound passage, the pilot must inform Mersey VTS of this decision as soon as it is safe to do so. If the abort point is inwards of Q1 buoy, tug assistance will likely be required to swing the vessel.
- 13.3 For an inward-bound VLCS, there is effectively only one unassisted abort position: two miles west of Q1 buoy.

14. Terminal readiness

- 14.1 Before a vessel passes inwards of Q1 buoy, the following tasks should have been performed (in chronological order) and confirmations given:
- (a) At least 24 hours before the scheduled berthing time, the Terminal Operator will advise MDHC of the required berthing position.
 - (b) At least 24 hours before the scheduled berthing time, the Shipping Line will advise MDHC of the vessel’s berthing time, draught, and assigned pilot.
 - (c) In accordance with section 4 of these Guidelines, MDHC will produce an indicative mooring plan and circulate it to the Terminal Operator, the Shipping Line (for onward transmission to the master), the pilot, and the line handlers.
 - (d) At least three hours before the scheduled berthing time, the Terminal Operator will confirm to Mersey VTS that—
 - (i) all gantry crane booms are raised;
 - (ii) gantries are moved clear of the intended positions of the vessel’s bow and stern flares;
 - (iii) the terminal is ready in all respects to receive the vessel; and
 - (iv) the berth marks have not changed from those shown on the mooring plan.
 - (e) At least three hours before the berthing time, the Terminal Operator will also advise Mersey VTS whether the vessel should rig its accommodation ladder upon

arrival or if the Terminal Operator will supply a shore-side gangway that will be available when the vessel arrives.

- (f) At least three hours before the berthing time, MDHC's line-handling superintendent will confirm to Mersey VTS that the necessary line handlers have been assigned and will be available.
- (g) After the pilot has boarded the vessel and initial VHF R/T contact has been established, Mersey VTS will relay to the pilot the confirmations received in accordance with sub-paragraphs (d) and (f) and the information provided in accordance with sub-paragraph (e).

14.2 Any change to the readiness status of either LCT2 or the line handlers must be notified by the relevant party, without delay, to Mersey VTS for relay to the vessel.

15. Simultaneous arrivals and departures

Arrivals and departures on the same tide should be deconflicted via the relevant vessels' passage planning processes so that only one vessel is mooring, letting go, or manoeuvring at any one time within the defined Swinging Zone off LCT2 (refer to paragraph 17.1 of these Guidelines).

16. Traffic management

16.1 Traffic management within the Port is usually achieved through the prudent seamanship of those charged with navigational conduct, adherence to MDHC's Directions and relevant Guidelines, and coordination between vessels and Mersey VTS.

16.2 The pilot's port passage plan should consider interaction with other vessel traffic during the inward- and outward-bound transit. Critical areas for the planning and management of interaction with other vessel traffic are:

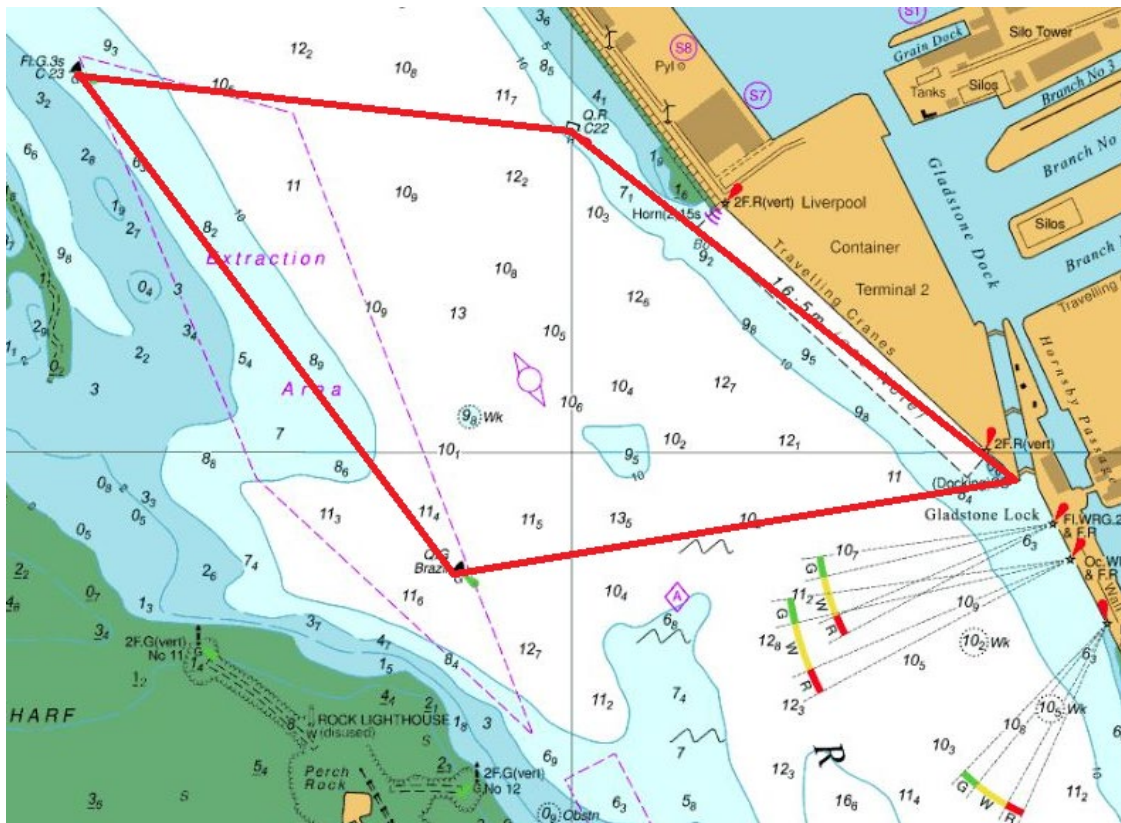
- Between the Liverpool Bar pilot station and the entrance to the Queens Channel
- Between Formby buoy and Crosby buoy with the constraints imposed by the implementation of one-way traffic control for large vessels (i.e. "a clear bend")
- Within the defined Swinging Zone off LCT2 (refer to section 17 of these Guidelines)

16.3 If a scheduling conflict cannot be resolved by those responsible for the navigational conduct of the vessels involved, the Harbour Master (via Mersey VTS) may issue a Special Direction to one or all vessels involved to deconflict the situation.

17. Swinging zone

17.1 Owing to the sea room required to swing a VLCS, especially when swinging on departure from LCT2, a defined "Swinging Zone" has been established as:

So much of the area of the Port as is bounded by an imaginary straight line drawn from C23 buoy to Brazil buoy; thence by an imaginary straight line drawn to the outer west bullnose of Gladstone Lock; thence by an imaginary straight line drawn to C22 buoy; and thence by an imaginary straight line drawn to C23 buoy.



- 17.2 Whilst a VLCS is swinging within the Swinging Zone, no other vessels (except for Liverpool pilot launches and the VLCS's assisting tugs) should enter the Swinging Zone, unless agreed to the contrary by the VLCS pilot, until the VLCS has completed its swing.
- 17.3 Mersey VTS and the VLCS pilot will coordinate the timing of establishing and abolishing the Swinging Zone restrictions. Mersey VTS will manage the enforcement of the Swinging Zone restrictions.
- 17.4 Before passing inwards of Q1 buoy, the pilot of a VLCS that will swing on arrival should provide Mersey VTS with the vessel's ETA at the Swinging Zone. This notification is in addition to the reporting requirements for large vessels swinging (required in accordance with the General Directions).
- 17.5 The pilot of a VLCS that will swing on departure should advise Mersey VTS of the intended manoeuvre during the pre-departure report (required in accordance with the General Directions).

18. Communications with line handlers and tugs

- 18.1 VHF channel 74 is the designated channel for communications between a vessel and the line handlers while they are in attendance at LCT2.
- 18.2 The forward and aft line-handling teams must each have a working VHF radio.
- 18.3 Subject to the number and timing of vessels arriving at or departing from LCT2 on a tide, VHF channel 74 may also be used for communications between a vessel and its assisting tugs.
- 18.4 If more than one vessel is arriving at or departing from LCT2 on a tide (subject to the restriction specified in section 15 of these Guidelines), vessels and their assisting tugs must use a channel other than VHF channel 74 for their vessel–tug communications.
- 18.5 Whilst a vessel is in transit, Mersey VTS will relay safety-critical communications between the vessel and the Terminal Operator.

19. Weather conditions for arrival or departure

- 19.1 The expected meteorological conditions for a vessel's passage should be confirmed and sourced from MDHC's 12-hourly Liverpool Bar forecast or, in the case of marginal conditions, from MDHC's contracted duty forecaster.
- 19.2 Particular attention should be given to the likelihood of—
 - (a) winds exceeding 20 knots off LCT2;
 - (b) winds exceeding 20 knots whilst on passage;
 - (c) restricted visibility;
 - (d) meteorological conditions that could cause a cut in the tide; and
 - (e) swell and wave conditions off LCT2.
- 19.3 A VLCS will not usually arrive at or depart from LCT2 if the average wind speed exceeds 20 knots (gusting up to 25 knots). However, this may be reviewed case-by-case for VLCS with reduced windage (e.g. limited on-deck container stowage).
- 19.4 Vessels other than VLCS will not usually arrive at or depart from LCT2 if the average wind speed exceeds 25 knots (gusting up to 30 knots) southerly to westerly, or 30 knots (gusting up to 35 knots) north-westerly to south-easterly and, in both cases, if the significant wave height at Liverpool Bar exceeds 1.6m.
- 19.5 For initial planning purposes, wind speeds should be taken from the Liverpool Bar forecast (50m elevation).

20. Weather conditions whilst alongside LCT2

- 20.1 Depending upon the wind direction, a vessel alongside LCT2 may be affected by wave and swell action and wind forces. Based upon experience and simulations, the

following conditions are considered to be limiting conditions when a vessel should not be alongside LCT2:

- (a) When the wind (irrespective of speed) is from 225° to 015°, the predicted height of the tide exceeds 8.5m, and the predicted significant wave height (Hs) at Liverpool Bar exceeds 2.0m.
- (b) When the wind is from 000° to 090°, and the predicted average wind speed (based on the Liverpool Bar 50m forecast) exceeds 30 knots.

20.2 The master must monitor the weather forecast and, if limiting conditions are forecasted, either delay the vessel's arrival or, in the case of a vessel alongside LCT2, arrange for the vessel to depart. In the case of a vessel departing from LCT2, section 19 of these Guidelines must also be considered.

20.3 When a vessel is alongside LCT2, the Terminal Operator must also monitor the forecast and consult with the master to ensure that, before weather conditions force cargo operations to stop, the vessel is left in a condition that will enable it to depart from the berth if the weather conditions deteriorate further.

20.4 In the event of deteriorating weather conditions, the master of a vessel should consider whether to request a pilot to standby on board the vessel. An assistant pilot may accompany the pilot for such a request for a VLCS.

20.5 Upon receiving a request to stand by a vessel, the assigned pilot may request that the master orders tugs to stand by the vessel as well.

20.6 The use of tugs at LCT2 during adverse weather conditions, especially when the wind is from 225° to 015°, may be severely limited owing to the likely sea state alongside the vessel.

21. Shore-side access

21.1 Whilst a vessel is alongside LCT2, it is the master's responsibility to maintain a safe means of access between the vessel and the shore.

21.2 Owing to the tidal range at LCT2, it may not always be possible to use a vessel's accommodation ladder or gangway.

21.3 When it is not possible to use the vessel's accommodation ladder or gangway, the Terminal Operator may provide a shore-side gangway to maintain a means of access between the vessel and the shore; however, in accordance with recognized codes of practice, the supplied shore gangway becomes the master's responsibility.

21.4 The Terminal Operator will, upon request, provide further details regarding shore-side access.

22. Communications whilst alongside LCT2

22.1 Whilst a vessel is alongside LCT2, the master may establish initial communications with shore-side parties as follows:

- Terminal Operator: +44 (0) 151 949 6768, 6329 or 6293
- Harbour authority (MDHC): Call sign Mersey VTS on VHF Ch. 12 or +44 (0) 151 949 6134 or 6649
- MDHC Line handlers: +44 (0) 151 949 6905

22.2 If there is an emergency on board a vessel that requires attendance of the UK Emergency Services, the master or another crew member must call the Emergency Services by telephone by dialling **999** or **112**.

22.3 Upon completion of a call to the UK Emergency Services, the master or a crew member must call the Port of Liverpool Police (+44 (0) 151 949 6999 or 1212) to advise the Port Police of the nature of the emergency and if any of the UK Emergency Services are en route to the vessel.

23. References

The following reference documents (not an exhaustive list) can be downloaded from MDHC's website (<https://www.peelports.com/marine/our-ports/liverpool>):

- General Byelaws
- General Directions for Navigation
- Pilotage Directions
- Navigation Guidelines
- Towage Guidelines
- Terms and Conditions for Ancillary Services
- Standard Terms and Conditions for Container Terminals Operated by Members of the Peel Ports Group

Operative from August 2024

List of Amendments

Ver. No.	Date	Comment
1	August 2024	Original as issued

Annex 1: Main characteristics of Liverpool Container Terminal 2

Position of berth mid-point	53° 27.1533' N 003° 01.4100' W
Berth orientation	134°–314°
Quay length	840m
Berth pocket dimensions	840m x 62m
Constructed berth pocket depth	16.5m below Chart Datum
Number of fenders	44
Centre-to-centre distance between fenders	18.8m
Number of bollard pairs (as built)	52 (+1)
Bollard SWL (per individual bollard)	150 tonnes
Quay height	12.78m above Chart Datum
Height of lowered gantry crane booms	71.28m above Chart Datum
Distance from fenders to offshore ends of lowered gantry crane booms	73m

Annex 2: Towage guidelines for Liverpool Container Terminal 2

These towage guidelines must be read alongside the Marine Operations Guidelines for Liverpool Container Terminal 2 (“the Marine Operations Guidelines”). Terms used in these towage guidelines are defined in the Marine Operations Guidelines.

The recommendations offered in these guidelines are based upon the assumption that the assisted vessel—

- is free from defects affecting its navigation or handling;
- is without excessive trim or list;
- has a stop–start main engine giving a dead slow ahead speed of 6 knots;
- has a standard semi-balanced rudder; and
- has a fully-operational bow thruster (or thrusters, if more than one is fitted).

Furthermore, it is assumed that the weather conditions are favourable (including a significant wave height of less than 2m), tidal conditions are favourable, visibility is not restricted, and there is no adverse local vessel traffic activity.

Towage matrix

Vessel LOA	Vessel TEU capacity	Wind 15 (Gust 20) knots	Wind 20 (Gust 25) knots	Wind 25 (Gust 30) knots	Wind 30 (Gust 35) Knots
		Minimum tug requirement by bollard pull (tonnes)			
< 250m	< 4,999	2 × 55	2 × 55	3 × 55	4 × 55
≥ 250m	≤ 5,000	2 × 55	2 × 55	3 × 55	4 × 55
≥ 250m	5,001–6,999	3 × 55	3 × 55	4 × 55	4 × 70
≥ 250m	7,000–9,999	4 × 55	4 × 55	4 × 70	No Go
≥ 350m	≥ 10,000	4 × 60	4 × 70	No Go	No Go
≥ 370m	≥ 14,000	4 × 80	4 × 80	No Go	No Go

- This matrix is only a recommendation of towage requirements and should be used to assist in pre-arrival planning.
- For initial planning purposes, wind speeds should be taken from the Liverpool Bar forecast (50m elevation).
- Without consultation with a pilot, where two or more tugs of a specified bollard pull are required, tugs with a bollard pull of not less than 95% of the required per-tug bollard pull may be used, provided that the bollard pull shortfall must be compensated by the other tug(s), e.g.:

Requirement:	3 × 55-tonne tugs = total bollard pull of 165 tonnes
Minimum permitted bollard pull:	95% of 55 tonnes = 52 tonnes
Allowable combination of tugs:	2 × 52-tonne tugs 1 × 61-tonne tug (compensation)

Deviation from the towage matrix

The assigned pilot retains the right to determine, in consultation with the vessel's master, the actual towage requirements for a vessel, considering matters such as, but not limited to, power of working thrusters, draught, wind speed and direction, and available tugs. Further details of this evaluation process can be found in the Port of Liverpool Towage Guidelines.

Wind forces and bollard pull

When handling container vessels with tugs, the force exerted by the wind upon a vessel and its deck cargo is the predominant force that must be overcome. In most instances, given the magnitude of the force that current exerts upon a vessel's hull, most ship handlers will endeavour to use the current to their advantage instead of working against it; although, allowances for moving a vessel against the current are factored into the towage matrix.

Various formulae are available to estimate the wind force that a vessel may experience at any wind speed for a given frontal or lateral windage area. The required bollard pull should be calculated as the wind force + 25%. The 25% margin considers that tugs must be able to move a vessel through the wind and not just hold it stationary against the wind. Furthermore, the 25% margin also considers that at higher wind speeds, tug efficiency may be reduced owing to wave action.

The following table shows the required total bollard pull (i.e. wind force + 25%) for increasing wind speed and lateral windage area. The underlying wind force has been calculated using the formula:

$$F = \frac{1}{2} \times C \times \rho \times v^2 \times A$$

where:

- F = wind force (Newtons)
- C = wind force coefficient (taken as 1.0)
- ρ = density of air (1.28kgm⁻³)
- v = wind speed (ms⁻¹)
- A = windage area (m²)

The Port's primary anemometer is at the Royal Seaforth radar tower, 25m above sea level. However, for initial planning purposes, wind speeds should be taken from the Liverpool Bar forecast (50m elevation).

Indication of required total bollard pull for a vessel of given lateral windage at various wind speeds

	Vessel's Lateral Surface Area (m ²)																			
	5,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000
Wind Speed (knots)	Required total bollard pull (tonnes)																			
5	3	3	4	4	5	5	6	6	7	8	8	9	9	10	10	11	11	12	12	13
10	11	13	15	17	19	22	24	26	28	30	32	34	37	39	41	43	45	47	50	52
15	24	29	34	39	44	48	53	58	63	68	73	78	82	87	92	97	102	107	112	116
20	43	52	60	69	78	86	95	103	112	121	129	138	147	155	164	172	181	190	198	207
25	67	81	94	108	121	135	148	162	175	189	202	216	229	242	256	269	283	296	310	323
30	97	116	136	155	175	194	213	233	252	272	291	310	330	349	369	388	407	427	446	466
35	132	158	185	211	238	264	290	317	343	370	396	422	449	475	502	528	554	581	607	634
40	172	207	241	276	310	345	379	414	448	483	517	552	586	621	655	690	724	759	793	828

