Final Report

Marine inquiry MO-2018-203
Grounding of container ship *Leda Maersk*

Otago Lower Harbour, 10 June 2018

Approved for publication: September 2019

Transport Accident Investigation Commission

About the Transport Accident Investigation Commission

The Transport Accident Investigation Commission (Commission) is a standing commission of inquiry and an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas. The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. Its purpose is not to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. The Commission carries out its purpose by informing members of the transport sector and the public, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

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Photographs, diagrams, pictures

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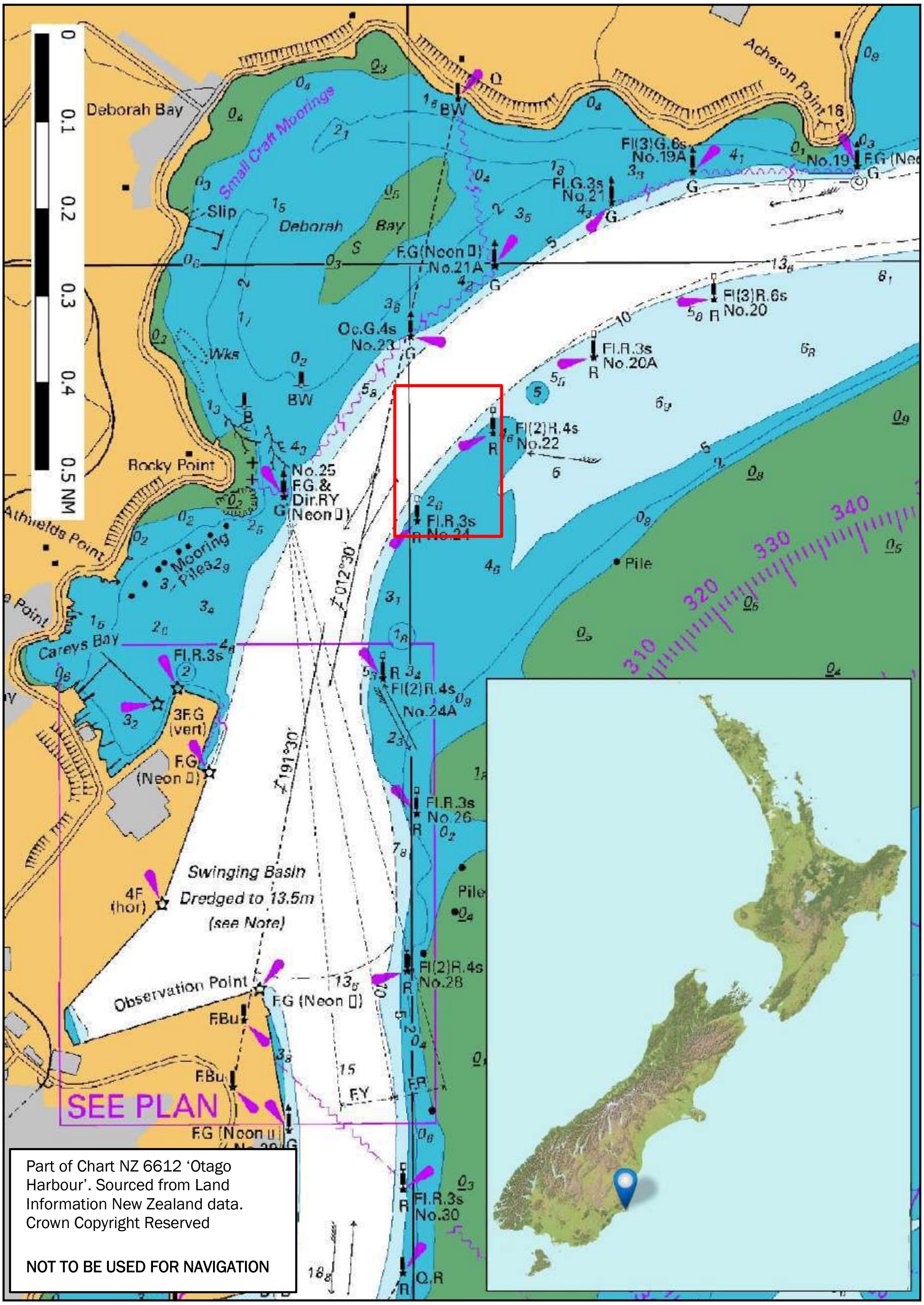
Verbal probability expressions

The expressions listed in the following table are used in this report to describe the degree of probability (or likelihood) that an event happened or a condition existed in support of a hypothesis.

Terminology (Adopted from the Intergovernmental Panel on Climate Change)	Likelihood of the occurrence/outcome	Equivalent terms
Virtually certain	> 99% probability of occurrence	Almost certain
Very likely	> 90% probability	Highly likely, very probable
Likely	> 66% probability	Probable
About as likely as not	33% to 66% probability	More or less likely
Unlikely	< 33% probability	Improbable
Very unlikely	< 10% probability	Highly unlikely
Exceptionally unlikely	< 1% probability	

The *Leda Maersk*



Location of accident

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Abbreviations

ECDIS	electronic chart display and information system
GPS	global positioning system
ISM Code	International Safety Management Code
PPU	portable pilot unit
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers

Glossary

bow	the forward part of a ship
cable	a unit used in measuring distances at sea, equal to 185.2 metres
conn	to control the speed and direction of a ship
forward	towards the bow of a ship
knots	nautical miles per hour. One knot is equal to one nautical mile per hour or 1.852 kilometres per hour
leading lights	a pair of navigation marks that, when in line, indicate to a pilot that the ship is on track
L-class ships	the *Leda Maersk* and other ships of the same design such as the *Lars Maersk* and the *Lica Maersk*
off-track alert	an electronic chart display and information system alert that is triggered when a ship departs its planned track by a pre-designated distance
passage plan	a ship's navigation plan that can be executed from the departure port to the arrival port in a safe and efficient manner with respect to both the ship and the environment
pilotage	the process of directing the movements of a ship by visual and/or electronic observations of recognisable landmarks and navigation marks
port	the left-hand side of a ship when facing forward
portable pilot unit	a portable computer device that hosts a self-contained navigation system
starboard	the right-hand side of a ship when facing forward
stern	the rear part of a ship
voyage data recorder	equipment that records information sourced from various on-board systems, including bridge microphone recordings

Data summary

Vehicle particulars

Name:	*Leda Maersk*
Type:	container ship
Class:	Lloyd's Register
Limits:	unlimited
Classification:	Lloyd's Register
Length:	265.84 metres
Breadth:	37.30 metres
Gross tonnage:	50,688
Delivered:	August 2001, Odense Steel Shipyard (Lindoe), Denmark
Propulsion:	Samsung MAN B&W 10K90MC, MARK VI 52870 BHP
Service speed:	20.9 knots
Owner/Operator:	Maersk Line A/S
Port of registry:	Ebeltoft
Crew:	24

Date and time[1]	10 June 2018 6:28 PM
Location	Lower Harbour, Otago
Persons involved	master, chief officer, harbour pilot
Injuries	nil
Damage	light hull paint abrasion

[1] Times in this report are New Zealand standard times, UTC (Coordinated Universal Time) + 12 hours.

1. Executive summary

1.1. On 10 June 2018, the Danish-registered container ship *Leda Maersk* arrived off the Port of Otago, embarked a harbour pilot, and proceeded up the Lower Harbour channel at about 1800, during the hours of darkness. The master, officer of the watch and helmsman were on the bridge, with the harbour pilot directing the course and speed of the ship.

1.2. The ship was rounding the final bend in the channel before reaching its berth, when a combination of factors caused it to deviate from the planned track in the centre of the channel, and ground on the left channel bank. Nobody was injured and damage to the ship was confined to scraping of the paintwork on the hull.

1.3. The Transport Accident Investigation Commission (Commission) found that neither the harbour pilot nor the ship's bridge team recognised that the *Leda Maersk* was deviating from the planned track. This was because they were all primarily navigating using visual cues outside the ship, rather than fully using the electronic navigation aids, all of which clearly showed the ship deviating from the centre of the channel.

1.4. The Commission also found that the standard of bridge resource management on the bridge of the *Leda Maersk* fell short of industry good practice and that the *Leda Maersk* bridge team were not fully following the company policies and procedures for navigating in pilotage waters.

1.5. The Commission also found that, at the time of the grounding, Port Otago's policies, procedures and compliance monitoring of pilotage operations fell short of meeting good industry standards outlined in maritime rules and the New Zealand Port and Harbour Marine Safety Code.

1.6. The Commission recommended that the Chief Executive of Maersk Line A/S review the implementation of the company's safety management system across its fleet with respect to navigation and pilotage and take the necessary steps to ensure a high standard is achieved by all crews on all its ships.

1.7. The Commission also recommended that the Chief Executive of Port Otago continue to take the necessary action to ensure its pilotage operations meet good industry practice and the guidance provided in the New Zealand Port and Harbour Marine Safety Code.

1.8. The Commission **repeats** three key lessons made in a previous report:

- there must be an absolute agreement and shared understanding between the vessel's bridge team and the pilot as to the passage plan and monitoring against that plan
- vessels' bridge teams must actively promote and use the concept of bridge resource management, including the incorporation of pilots into the bridge teams, to manage voyages properly
- a vessel's electronic chart display and information system is an important system for monitoring the progress of the vessel and warning the bridge team when things could go wrong. It is essential that it be configured correctly for the phase of navigation and the proximity to navigation hazards.

1.9. The Commission identified one new key lesson:

- portable pilot units can be useful aids to navigation and their accuracy is well suited to allowing pilots an independent means of monitoring the progress of large ships in narrow channels. However, if pilots are to use them, they should be fully trained and proficient in their use, and there should be a robust system for ensuring the accuracy of the equipment.

2. Conduct of the inquiry

2.1. Maritime New Zealand notified the Transport Accident Investigation Commission (Commission) of the grounding on 10 June 2018. The Commission opened an inquiry the same day under section 13(1)b of the Transport Accident Investigation Commission Act 1990, and appointed an investigator in charge.

2.2. On 11 June two investigators and one data recovery specialist travelled to Port Chalmers and boarded the *Leda Maersk* to conduct interviews and collect evidence. The ship had been subject to an underwater hull inspection that morning and no significant damage had been found. Following an inspection by a Lloyd's Register surveyor, the *Leda Maersk* was able to depart later that same day.

2.3. On 12 June the investigators interviewed the harbour pilot and collected evidence from their portable pilot unit (PPU).[2]

2.4. On 22 June further documentation was requested from the operator and Port Otago.

2.5. On 10 July the Commission received the Maersk Line A/S internal investigation report.

2.6. On 24 July two investigators travelled to Port Otago to conduct a follow-up interview with the pilot, and to interview the General Manager of Infrastructure and Marine and also the Chief Information Officer. An electronic copy of the Harbour Control recording from the time of the incident was also obtained.

2.7. On 23 September the Commission received the Port Otago internal investigation report.

2.8. On 18 April 2019 the Commission approved a draft report for sending to eight interested persons for comment.

2.9. The Commission received five responses, which included two submissions. The Commission considered the submissions, and changes as a result of these have been included in the final report.

2.10. Between 26 June 2019 and 25 September 2019 the Commission liaised with Port Otago to clarify recommendation 006/19 and subsequently received a formal response on 25 September 2019.

2.11. On 7 October 2019 the Commission approved the final report for publication.

[2] A portable computer device that hosts a self-contained navigation system.

3. Factual information

3.1. Background

3.1.1. The *Leda Maersk* is a fully cellular 'L class'[3] container ship, registered in Denmark and operated by Maersk Line A/S (Maersk). The ship was operating on a regular service between Malaysia, Singapore, Australia and New Zealand.

3.1.2. At the time of the accident the *Leda Maersk* carried a multinational crew of 24.

3.1.3. The vessel departed Lyttelton on 9 June 2018 bound for Port Chalmers. The coastal passage to the Otago Harbour pilot station was routine, the weather was fair and the ship had no reported defects. The vessel's arrival draught[4] was 10.8 metres on an even keel[5].

3.1.4. The predicted time of low water at Port Chalmers on 10 June was 1842 at a height of 0.4 metres. The predicted time of sunset was 1659.

3.2. Narrative

3.2.1. At 1720 on 10 June, the *Leda Maersk* arrived at the Port Otago pilot station 'Alpha'. The bridge team comprised the master, the chief officer and the helmsman.

3.2.2. The pilot boarded the ship at 1735 and was taken directly to the navigation bridge to join the bridge team. The pilot was carrying a PPU. Before it could be used for the pilotage[6], it was required to be set up using information from the ship's automatic identification system. The pilot set up the PPU and then exchanged information with the master (this is referred to as the master/pilot exchange). The pilot explained each item on the Port Otago master/pilot exchange form, which included: the planned inward transit of the Lower Otago Harbour; the berthing plan; the use of tugs; and the manoeuvring characteristics of the *Leda Maersk*.

3.2.3. The pilot encouraged the bridge team to challenge them if they had any concerns with the piloting and explained that the ship's crew were still responsible for monitoring the ship's progress against the passage plan.[7] The ship's passage plan was displayed on the electronic chart display and information system (ECDIS). The Port Otago passage plan was displayed on the pilot's PPU. Both plans were similar in that they broadly required the ship to stay near the centre of the narrow channel, but there were subtle differences in the radius of the turns in the channel.

3.2.4. The pilot then took the conn[8] and at 1754 the *Leda Maersk* entered Otago Harbour. The sun had set and it was dark, but meteorological visibility was good.

3.2.5. Between 1806 and 1810, when the ship was lined up with the Cross Channel leading lights[9] (see Figure 1), the pilot's PPU indicated that the ship was slightly off track. The pilot checked the settings on the PPU and found that there was an 18-metre offset to starboard[10] to allow for the position of the PPU aerial in relation to the ship's centreline. The offset was causing the PPU to indicate that the ship's position was 18 metres, approximately half the ship's breadth, further to port[11] than it really was. The pilot was unable to remove the offset so decided to discontinue using the PPU for monitoring the ship's progress. Instead the pilot

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[3] The *Leda Maersk* and other ships of the same design such as the *Lars Maersk* and the *Lica Maersk*.
[4] How deep a ship sits in the water.
[5] The draught at the bow and the stern are the same.
[6] The process of directing the movements of a ship by visual and/or electronic observations of recognisable landmarks and navigation marks.
[7] A navigation plan that can be executed from the departure port to the arrival port in a safe and efficient manner with respect to both the ship and the environment.
[8] Control of the speed and direction of a ship.
[9] A pair of navigation marks that, when in line, indicate to a pilot that the ship is on track.
[10] The right-hand side of a ship when facing forward.
[11] The left-hand side of a ship when facing forward.

conned the ship visually and used the ship's radar as an aid. The pilot did not tell the rest of the bridge team that he had stopped using the PPU.

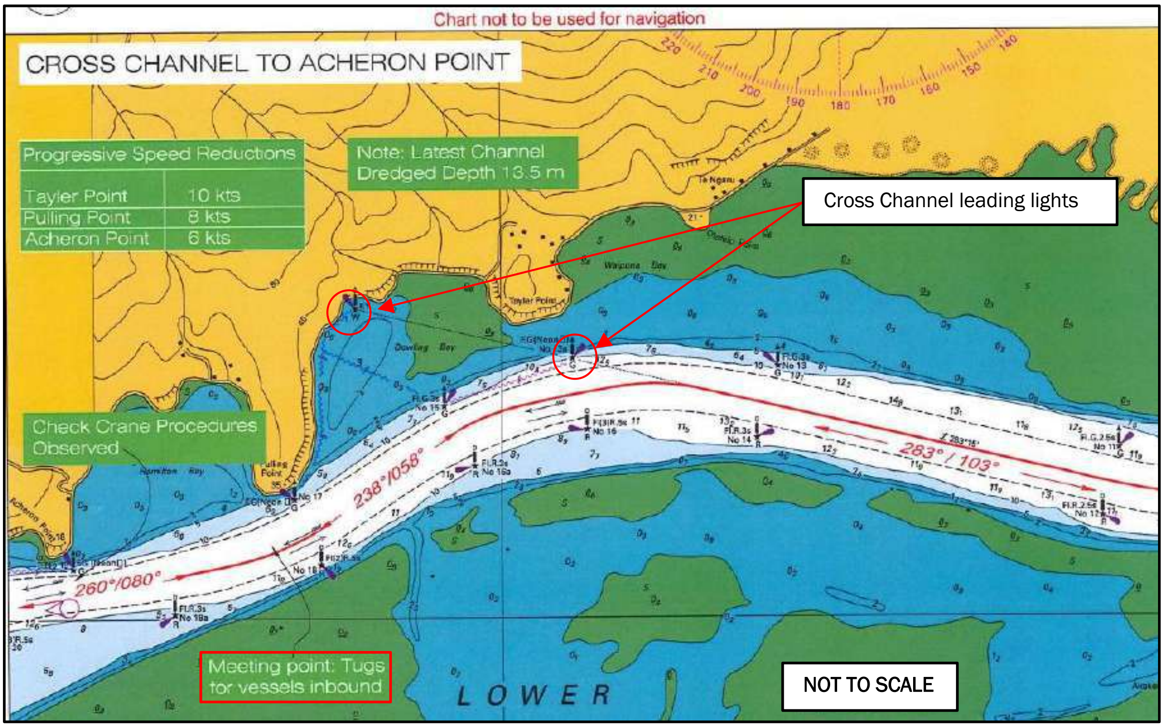

Figure 1
Page from the Otago Lower Harbour Pilotage Guide showing the Cross Channel leading lights

3.2.6. The port tugs *Otago* and *Taiaroa* met the *Leda Maersk* between Acheron Point and Pulling Point (see Figure 1). In order to proceed at an appropriate speed for securing[12] the tugs, the pilot requested dead slow ahead on the ship's engine. At 1819 the *Taiaroa* was secured to the *Leda Maersk*'s stern[13] and at 1824, just after the *Leda Maersk* had passed Acheron Point, the tug *Otago* was secured on the starboard bow.[14]

3.2.7. The passage plan required the *Leda Maersk* to follow the centre of the channel as it curved to the left (to port) after Acheron Point. The speed of the ship was about six knots[15] at that time. As the ship made the turn to port it started to move left of the planned track and was no longer in the centre of the channel (see Figure 2).

3.2.8. In spite of the ship already being left of the planned track, the pilot gave a succession of large helm orders to port (between 20 and 35 degrees' rudder angle). As the *Leda Maersk* responded to the port rudder, the deviation left of the planned track increased, causing the off-track alert[16] on the ECDIS to activate. The ECDIS log recorded that the off-track alert had activated and that a member of the bridge team had acknowledged it. However, the information was not passed on to the other members of the bridge team.

3.2.9. The *Leda Maersk*'s speed gradually slowed as it made the turn to port and deviated further left of the centre of the channel. At approximately 1828 the speed decreased to 2.5 knots when the bridge team felt the ship heel over to starboard. At that point the master asked the pilot why the engine was still on dead slow ahead. The pilot responded by ordering the engines to increase to slow ahead. However, the ship continued to lose speed, and by 1829

[12] To secure a tug, the ship takes a line from the tug and secures it to the bitts (a pair of posts on the deck of a ship for fastening cables and ropes).
[13] The rear part of a ship.
[14] The front part of a ship.
[15] Nautical miles per hour. One knot is equal to one nautical mile per hour or 1.852 kilometres per hour.
[16] An ECDIS alert that is triggered when a ship departs its planned track by a pre-designated distance.

the ship had come to rest on the port side of the channel between beacons 22 and 24 (see Figure 3).

3.2.10. The pilot saw that the ship was quite close to the port-side beacons and mentioned this to the master. The master then realised that the ship had probably run aground, and stopped the engine.

3.2.11. The pilot radioed the tugs and gave instructions for them to pull the *Leda Maersk* back into the centre of the channel. With the aid of the ship's bow thruster[17], the tugs were able to pull the ship clear of the seabed and the pilot repositioned the *Leda Maersk* to mid-channel.

3.2.12. The pilot reported the grounding to harbour control, then continued to manoeuvre the ship to its container terminal berth without further incident. The *Leda Maersk* was all secure at its berth at 1930.

3.2.13. The following morning a diver made an inspection of the hull of the *Leda Maersk* and noted superficial scrapes and scratches in the hull paint. The propeller and the rudder were undamaged.

[17] A propeller mounted through the bow of a ship to assist with manoeuvring the bow sideways.

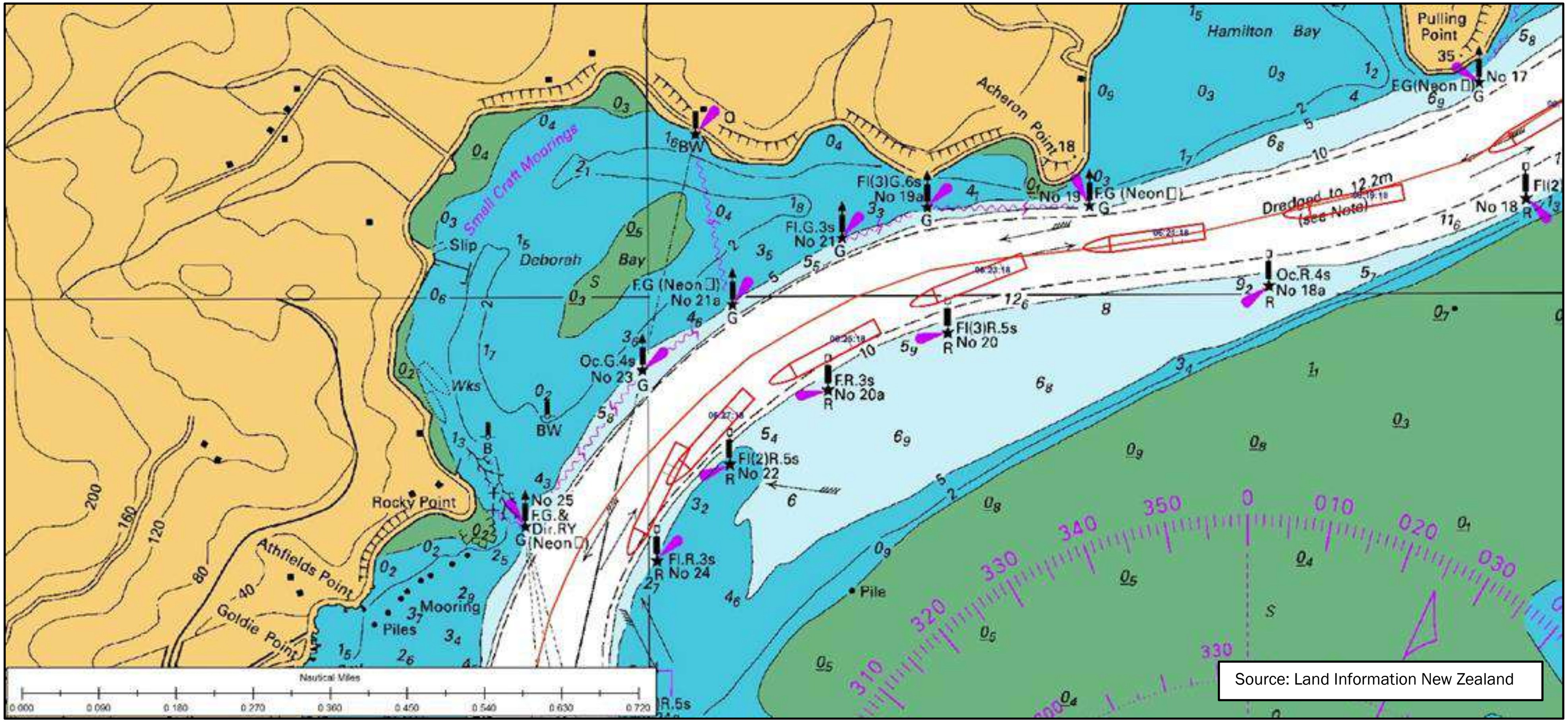

Figure 2
The *Leda Maersk*'s track in relation to the channel centreline
(ship outlines drawn to scale)

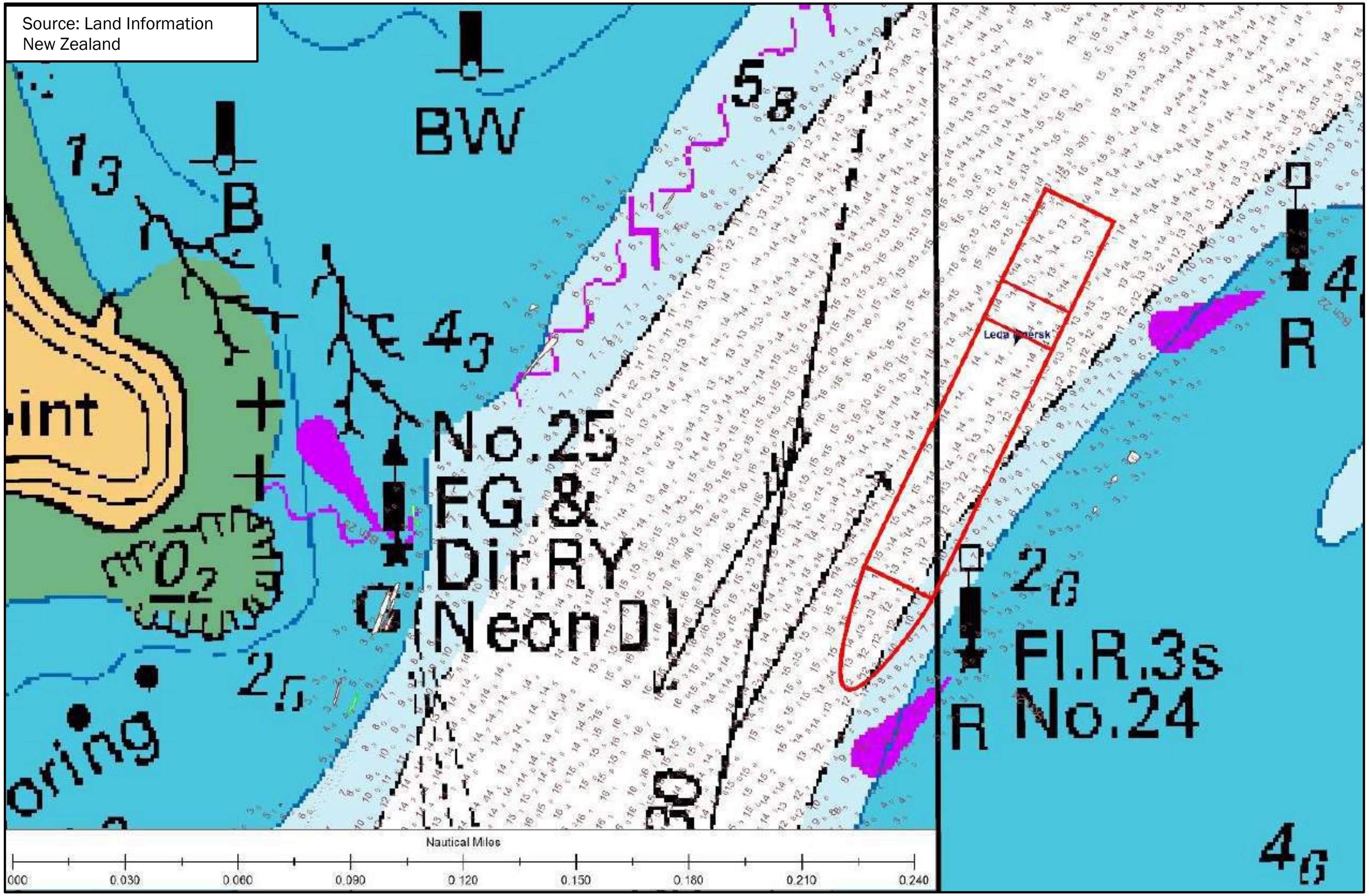

Figure 3
Position where the *Leda Maersk* grounded with depths (in metres) added

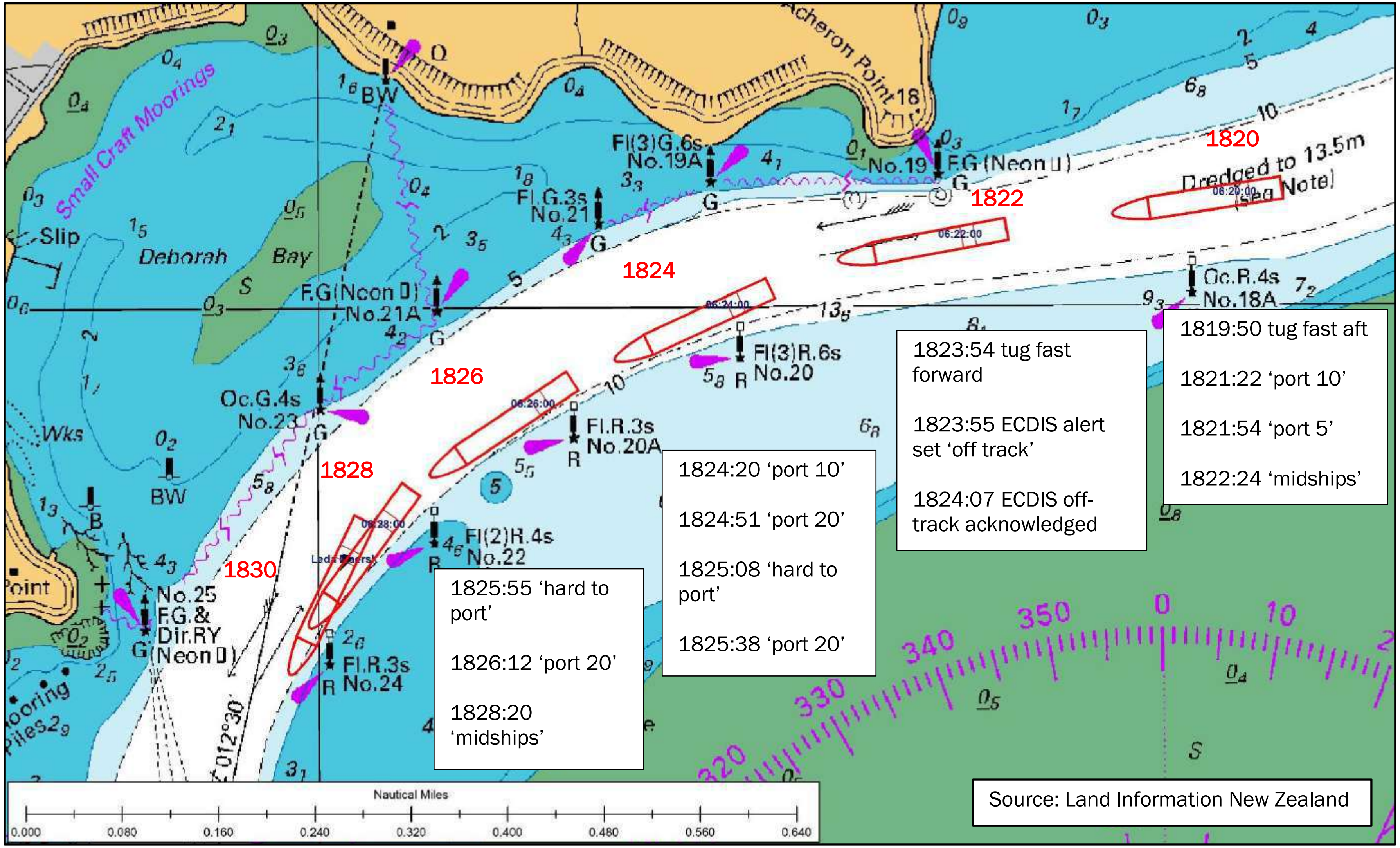

Figure 4
Events and helm orders immediately before the *Leda Maersk* grounded (ship outlines drawn to scale)

3.3. Personnel

3.3.1. The master held an unlimited master mariner's certificate of competency, issued under the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). The master's sea-going career exceeded 20 years, all on container ships, with the previous six years in the rank of master.

3.3.2. The chief officer had recently achieved an unlimited master mariner's certificate of competency issued under STCW. The chief officer kept the 1600 to 2000 watch when the ship was at sea and was the officer of the watch for the *Leda Maersk*'s arrival at Port Chalmers.

3.3.3. The master and the chief officer had sailed together on the *Leda Maersk*, on the same Asia, Australia, New Zealand service for the previous two years. Both the master and the chief officer were familiar with transiting the Lower Harbour to Port Chalmers.

3.3.4. The pilot held an unlimited master mariner's certificate of competency and an Otago Harbour unrestricted pilot licence. The pilot had been a Port Otago harbour pilot for 19 years. Prior to being employed by Port Otago the pilot had been a pilot-exempt master on ships that regularly called at Dunedin.

3.4. Otago Harbour and Port Otago

3.4.1. Port Chalmers lies on the northern side of Otago Harbour and is accessible from the sea via a navigable channel through the Lower Otago Harbour. Maritime Rules Part 90 (Pilotage) requires vessels over 500 gross tonnes (GT) to carry a '*pilot who holds a current, appropriate pilot licence*' when entering Otago Harbour.

3.4.2. A programme of regular and targeted dredging ensured that the channel maintained a depth of 13.5 metres. Admiralty Sailing Directions New Zealand Pilot states that:

> The dredged channel through Lower Harbour is marked on both sides by light beacons some of which stand up to ¼ cable[18] outside the channel. Their positions and characteristics can be seen on the chart.[19]

3.4.3. Port Otago provides port facilities and services such as pilots and tug boats in Otago Harbour.

3.4.4. Otago Regional Council is responsible for the safety of navigation in the region's waters. In early 2016 Otago Regional Council appointed a consultant to carry out a strategic review of maritime safety in Otago Harbour. After 30 years without a full-time harbourmaster the review recommended the need for change, and as a result a full-time harbourmaster was appointed in 2017.

3.5. The New Zealand Port and Harbour Marine Safety Code

3.5.1. The New Zealand Port and Harbour Marine Safety Code is a voluntary national standard for the safe management of marine activities in ports and harbours. The code is intended to apply, as a minimum, to any harbour area or commercial port with compulsory pilotage. It covers all activities associated with the safe movement of ships entering, leaving and navigating within ports and harbours.

3.5.2. The code is administered by a secretariat that engages with industry stakeholders and Maritime New Zealand to monitor the implementation of, and compliance with, the code. A panel of peers from ports, harbours and Maritime New Zealand determines whether a port meets the standards of the code by reviewing the port's safety management system. At the time of the *Leda Maersk*'s accident the panel considered that Otago Harbour and Port Otago had more improvements to make before they could be considered compliant with the code. Port Otago has since attained the required standard for code compliance.

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[18] One cable is 185.2 metres, so ¼ of a cable is approximately 46.3 metres.
[19] NP51 19th Edition 2015 Admiralty Sailing Directions: New Zealand Pilot.

3.6. Electronic navigation equipment

3.6.1. The *Leda Maersk* held a valid Cargo Ship Safety Equipment Certificate and was fitted with the navigation equipment required by the International Convention for the Safety of Life at Sea.

3.6.2. The ship's primary navigation system was an ECDIS. It was fitted with two independent Transas Navi-Sailor 4000 ECDIS units, which meant the ship was not required to carry paper charts. The ECDIS units were continually supplied with satellite-derived positions from two independent global positioning system (GPS) units. In addition to GPS fixing, the equipment allowed the officer of the watch to fix the vessel's position using lines of position derived from visual bearings and radar ranges.

3.6.3. The master and chief officer had both completed approved training specific to the Transas ECDIS units fitted on board.

3.6.4. The *Leda Maersk* was also fitted with two radars.

3.6.5. The pilot carried a Navicom Dynamics ChannelPilot PPU, which showed the vessel's predicted path on its own electronic chart display. The equipment's main benefit is that it enables pilots to navigate any ship using navigation equipment they are familiar with, rather than rely on the various types and makes of equipment found on board modern ships. This type of PPU is initially plugged in to a ship's automatic identification system in order for it to synchronise with the ship's navigation systems. The PPU establishes the ship's heading and stabilises its own internal gyroscopic compass. Once the compass has stabilised, it operates independently of the ship's compass and displays the ship's actual and predicted positions based on its own internal GPS and gyro heading.

3.6.6. A PPU is not mandatory equipment. In 2017 Port Otago provided ChannelPilot PPUs to all its pilots. Before then the pilots had had access to two HarbourPilot PPUs, earlier models than the ChannelPilot. The pilots had been trained to use the HarbourPilot PPUs, but Port Otago left it to the pilots' discretion on whether to use them. When the ChannelPilot PPUs were provided, Port Otago encouraged its pilots to use them, but no additional training was given.

3.7. Navigation with a pilot embarked – regulations and standards

3.7.1. In addition to gaining their STCW certification, maritime pilots are trained in ship handling and tug management. Pilots must also retain profound knowledge of all navigational aspects of the pilotage area and port facilities. A pilot effectively becomes part of the bridge team for the act of pilotage. Their specialist skills and local knowledge of the pilotage area enhance the capability of the bridge team. However, their presence does not relieve the master and crew of their duties and responsibilities for the safe navigation of the ship.

3.7.2. The International Maritime Organization's Resolution A.960[20] states that:

> masters and bridge officers have a duty to support the pilot and ensure that his/her actions are monitored at all times
>
> and that:
>
> the master, bridge officer and pilot share a responsibility for good communications and understanding of each other's role for the safe conduct of the vessel in pilotage waters.

[20] International Maritime Organization Resolution A.960: Recommendations on Training and Certification and Operational Procedures for Maritime Pilots other than Deep-Sea Pilots, January 2004.

3.7.3. The International Chamber of Shipping is the principal international trade association for the shipping industry. It develops best practice and guidance for ships' bridge operations and publishes them in the International Chamber of Shipping's Bridge Procedures Guide[21], which is used by ship operators globally. It stresses that effective co-ordination between the bridge team and the pilot is essential for safe pilotage. It also states that:

> the presence of a Pilot does not relieve the Master or the Bridge Team from their duties and responsibilities for the safe conduct of the ship.

3.7.4. Under the International Safety Management Code (ISM Code), ship operators must have approved safety management systems that include explanations of how their policies and procedures will ensure compliance with all relevant rules and conventions. The operator's policy for navigating with a pilot on board (Appendix 1) explained the requirement for the master and the officer of the watch to maintain responsibility for the safe conduct of the vessel.

3.7.5. The Otago Lower Harbour Pilotage Guide states that the ship's bridge team are required to continue their duties of maintaining a proper lookout, plotting the ship's position, ensuring that the pilot's helm and engine orders are followed correctly and challenging the pilot if they are uncertain of the pilot's orders or intentions. This requirement is referred to in the master/pilot exchange checklist.

[21] Bridge Procedures Guide, Fifth Edition, International Chamber of Shipping, 2016.

4. Analysis

4.1. Introduction

4.1.1. Historically, planning a ship's voyage primarily focused on the pilot-to-pilot leg of the voyage – between when a pilot disembarked at the departure port to when a pilot embarked at the arrival port.

4.1.2. In recent years there has been industry acknowledgment that the portion of the voyage that carries the biggest risk is when the ship is navigating confined waters, characterised by navigation hazards, shallow water, restricted sea room and high traffic density. The requirement to carry a maritime pilot is a safety measure to reduce the risk of navigational accidents in designated pilotage areas.

4.1.3. Voyage or passage planning and its principal elements – appraisal, planning, execution and monitoring – are fundamental in ensuring the safety of a vessel whilst on passage. Voyage planning is now required to be conducted from berth to berth, which encompasses the pilotage operation.

4.1.4. In New Zealand it is compulsory for large ships to carry marine pilots in designated pilotage areas.[22] A significant challenge for the industry is to change a culture whereby ships' crews often relax when a pilot embarks and put too much faith in the pilot getting it right. The goal is to achieve consistency in standards and operating procedures for the ship operator and the pilotage provider, in order for the people to merge and work as one team when a pilot is on board.

4.1.5. The Commission has published four accident reports[23] in the past five years involving ships that have run aground, all due in part to poor standards of bridge resource management and the pilots and bridge crew not sharing the same concepts of the passage plans. This grounding has similarities.

4.1.6. The following analysis considers how and why the *Leda Maersk* ran aground whilst under the conduct of an experienced, qualified pilot working with an experienced, qualified bridge team. It also discusses the following safety issues:

- Port Otago's safety management system fell short of achieving good industry standards for pilotage operations
- The bridge operations on board the *Leda Maersk* fell short of achieving good industry practice for both planning and executing the passage under pilotage and bridge resource management.

4.2. What happened

4.2.1. The ship was entering Port Otago in darkness, proceeding at slow speed into the last of the ebb tide.

4.2.2. The pilot was standing at the front of the bridge, just to port of the ship's centreline. Having discounted the positional information provided by the PPU, the pilot was navigating primarily by visual means, using the channel beacon lights and sets of leading lights along the shore to judge the ship's position in the channel. The pilot was, however, still referring to the PPU from time to time to monitor the ship's rate of turn.

4.2.3. The *Leda Maersk* passed Acheron Point where the channel began curving left (see Figure 4). At this point the navigable channel was approximately 185 metres across. The *Leda Maersk*'s beam of 37.5 metres left only about 73.8 metres of safe water either side of the ship when it was in the centre of the channel.

[22] Maritime Rules Part 90.
[23] MO 2016-202 *Azamara Quest*, MO 2016-204 *Molly Manx*, MO 2017-201 *L'Austral*, MO 2017-201 *L'Austral*.

4.2.4. The *Leda Maersk* was proceeding at a speed of about six knots at Acheron Point, which was in accordance with the recommended speed profile contained in the Otago Lower Harbour Pilotage Guide. The pilot's previous experience with 'L-class' vessels was that it would be difficult to turn the ship unless the ship was carrying sufficient speed.

4.2.5. The *Leda Maersk* was in the centre of the channel and on track when the left turn commenced. It was the pilot's intention to keep the ship in the centre of the channel through the turn. The pilot's expectation was that a large amount of port helm would be required to make the turn. However, the ship started to move left of the intended track. There are a number of factors that could have contributed to this:

- the influence of the port rudder being applied
- any residual ebb tide pushing the ship from right to left
- interaction between the ship's hull and the seabed and/or channel banks (sides)
- a combination of some or all of these factors.

4.2.6. The ECDIS display (Figure 5), the radar display (Figure 6) and the pilot's PPU (Figure 7) clearly showed this drift towards the left bank of the channel.

Figure 5
The *Leda Maersk*'s position at 1824 from the ECDIS replay

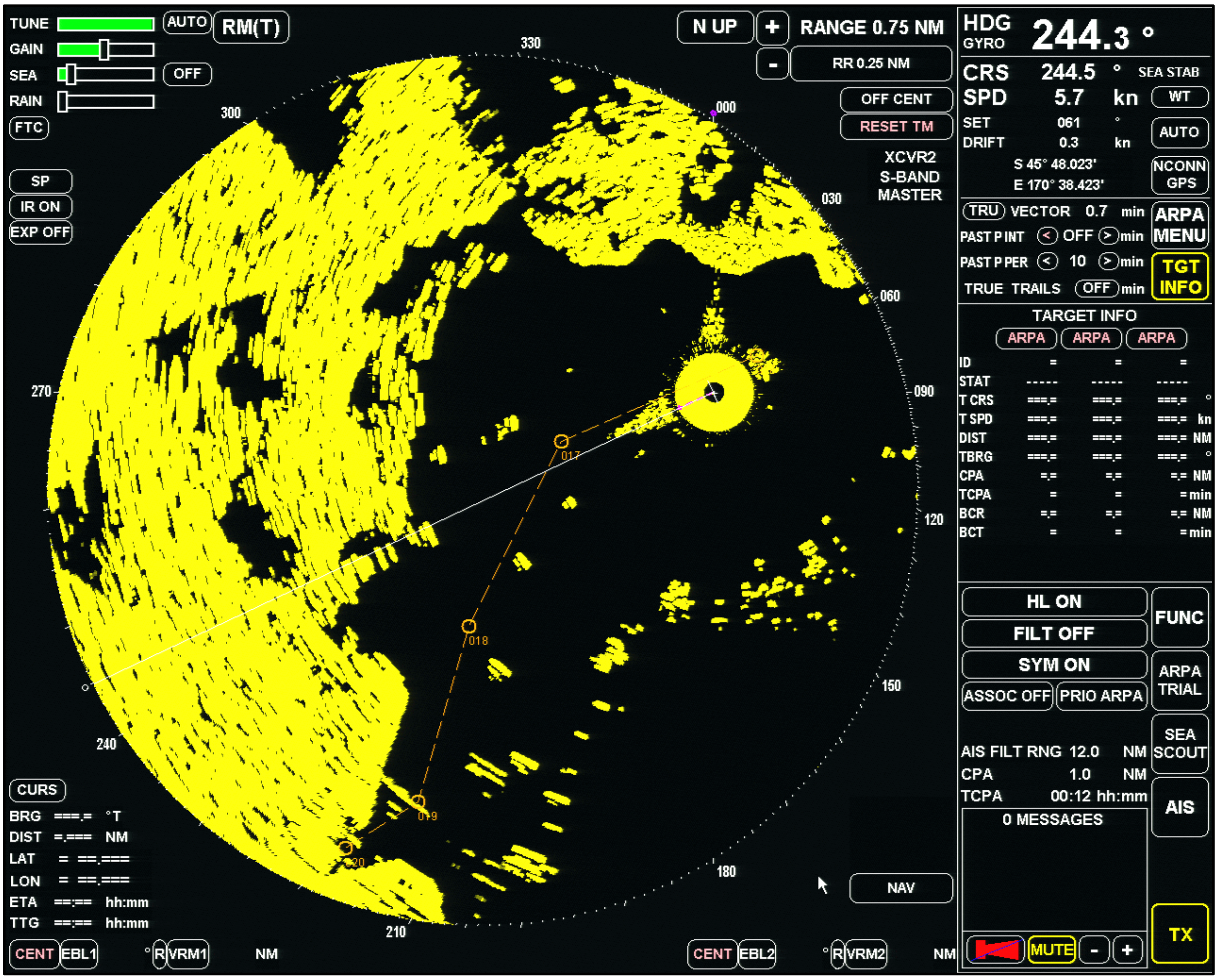

Figure 6
Radar screenshot showing the *Leda Maersk* to port of the planned track

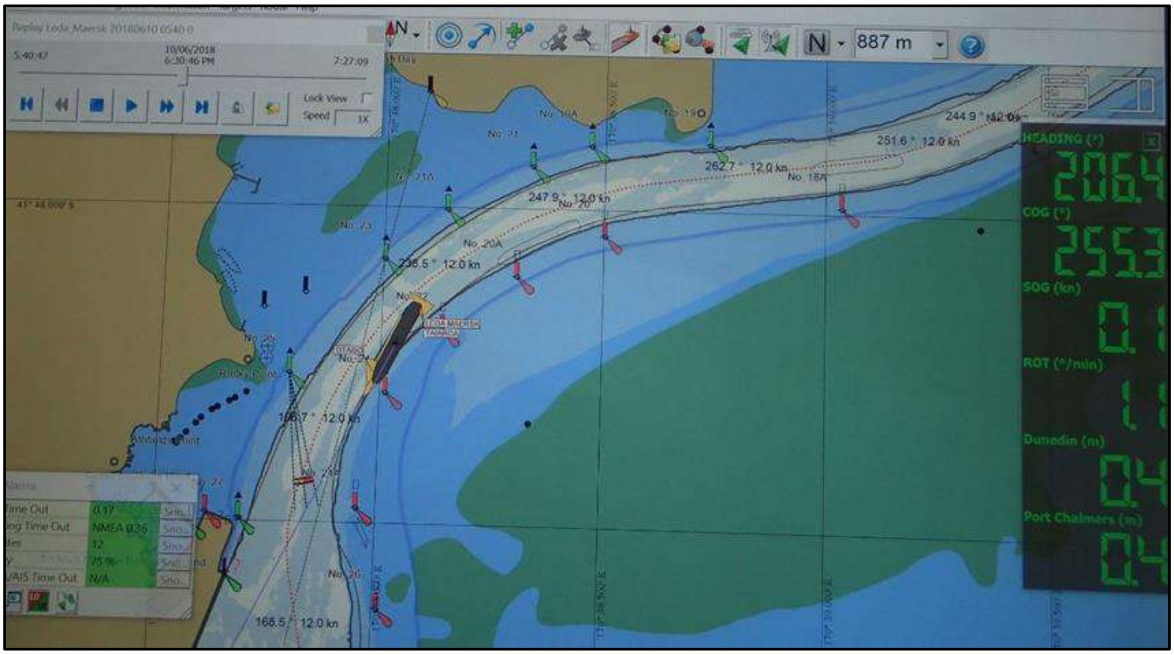

Figure 7
The *Leda Maersk*'s position displayed on the PPU at 1830, with past positions

4.2.7. As the left turn continued, a large amount of port helm was being applied (Figure 4). The heading of the ship changed marginally to port and the ship continued moving further left of the planned track. When it had deviated approximately 55 metres left of the planned track, the ECDIS off-track alert activated. The alert was informing the bridge team that the ship had reached the pre-set cross-track limit.[24] However, this important information was not brought to the attention of the master or the pilot.

4.2.8. As the heading of the ship altered to port, the ship moved further left of the planned track and went very close to the left bank of the channel. Once the ship came close to the left bank, at about beacon 20A, it is about as likely as not that a suction effect was created around the underwater mid-section and towards the stern. This is an example of a phenomenon known as interaction. It is the result of a ship displacing water as it moves forward in a narrow channel. The water increases in velocity as it is forced through the narrow gap between the hull and the left bank. The increase in water velocity causes a suction effect, drawing the hull into the side of the bank. The pilot was expecting to need high rudder angles to make the turn. However, it is likely that the pilot would also have been unknowingly having to overcome any forces drawing the ship's stern into the left bank.

4.2.9. When the ship initially started to swing to port, the bridge was still travelling out near the centre channel. However, the bow, 190 metres forward of the bridge, was already angled towards and closing with the left channel bank. The pilot was standing on the bridge focused mainly on the beacons either side of the channel and a set of leading lights ahead of the ship in the vicinity of the swinging basin.[25]

4.2.10. Additionally, containers had been stacked six tiers high near the extremities of the ship. On the L-class container ships this was known to cause bridge teams to lose sight of channel beacons passing close by the ships. As the ship drew closer to the left bank, from where the pilot was standing the pilot would have lost sight of the left bank channel markers below the container stacks. Figure 8 shows an example of how containers stacked in this manner can affect visibility.

[24] A user-defined maximum deviation either side of the planned route.
[25] Wider part of the channel where a ship can be turned before reversing onto its berth.

Figure 8
Example of an L-class ship where the beacon is about to be lost from view and the breakwater is obscured by the containers stowed six high
(Photo courtesy of Port Otago)

4.2.11. In the dark and navigating only by visual means, the bridge team and the pilot appeared to have lost awareness of the factors affecting the progress of the ship, until the ship heeled to starboard and stopped in spite of its propeller still turning ahead.

4.2.12. The grounding is an example of why it is not appropriate to use visual navigation alone (often referred to as line-of-sight navigation) when manoeuvring large ships in narrow channels, and in the dark. With so little margin for error, it would have been appropriate to utilise fully the accuracy of electronic navigation aids such as PPUs and ECDIS. Had the pilot done so, the ship's departure from the intended track would have been readily apparent in time to avoid the grounding.

4.2.13. Equally, had the ship's crew been monitoring the ship's passage, they could have alerted the pilot immediately to the ship departing from the agreed passage plan. These aspects are covered in the following sections.

4.3. Bridge resource management and human factors

4.3.1. The International Chamber of Shipping Bridge Procedures Guide describes an effective bridge team as one that "will manage efficiently all the resources that are available and promote good communication and teamwork". An effective bridge team will be able to plan and complete a passage from berth to berth and anticipate and respond to any dangerous situations and emergencies that may arise during the passage.

4.3.2. By sharing information through good communication, members of the bridge team can support situational awareness and ensure that everybody knows what is happening. Developing a good bridge resource management system will not only spread the workload on the bridge, but promote an environment that accepts that errors will happen. Maritime professionals who have bridge resource management training are taught to identify such errors and act appropriately before they can develop into accidents.

4.3.3. The pilot had been incorporated into the bridge team through the usual exchanges of information that occur when a pilot boards. The master, the chief officer and the pilot had all been trained in bridge resource management techniques. During the pilot/master exchange, the pilot encouraged the bridge team to challenge "always" if they had any issues with the pilotage. The master and the chief officer later said they were confident that they would have spoken up had they been aware of the developing problem, but everything had "looked fine". The fundamental reason for everything "looking fine" to every member of the bridge team as the ship deviated from the planned track and ran aground is discussed in more detail below.

4.4. Passage plan

4.4.1. The passage plan on the ship's ECDIS was broadly the same as that which the pilot had loaded on the PPU, but not identical. In this case the passage plan was uncomplicated, keeping the ship in the centre of the channel. Therefore, the differences between the two plans were not a factor in the grounding.

4.4.2. Nevertheless, it is important for all acts of pilotage that there is a single agreed passage plan. If there is no agreed plan there is a danger that the pilot and the ship's crew will have differing mental concepts of how the pilotage will be performed. If there is no agreed passage plan, the pilot and ship's crew have no basis for monitoring the ship's progress and raising interventions if the ship deviates from the intended track. The Commission has published several reports where not working to agreed plans contributed to ships running aground. There are several examples published by other investigation agencies as well. This issue is the subject of several open recommendations, and influenced the Commission to place accidents under pilotage on its watch list.

4.5. Human behaviour

4.5.1. In order to understand what went wrong on the bridge of the *Leda Maersk* that night, it is worth considering a series of marine guidance notes published by the United Kingdom Maritime and Coastguard Agency aimed at providing guidance to the maritime industry on human behaviour. Marine Guidance Note 520 (M) – Human Element Guidance: The Deadly Dozen – 12 Significant People Factors in Maritime Safety aimed to raise awareness of 12 of the most prevalent human factors that contribute to maritime accidents. Identified through the Confidential Human Factors Incident Reporting Programme, these factors and corresponding mitigating actions are summarised in the marine guidance note, which has been reproduced on many maritime industry websites. Figure 9 shows a poster that encapsulates these 12 factors.

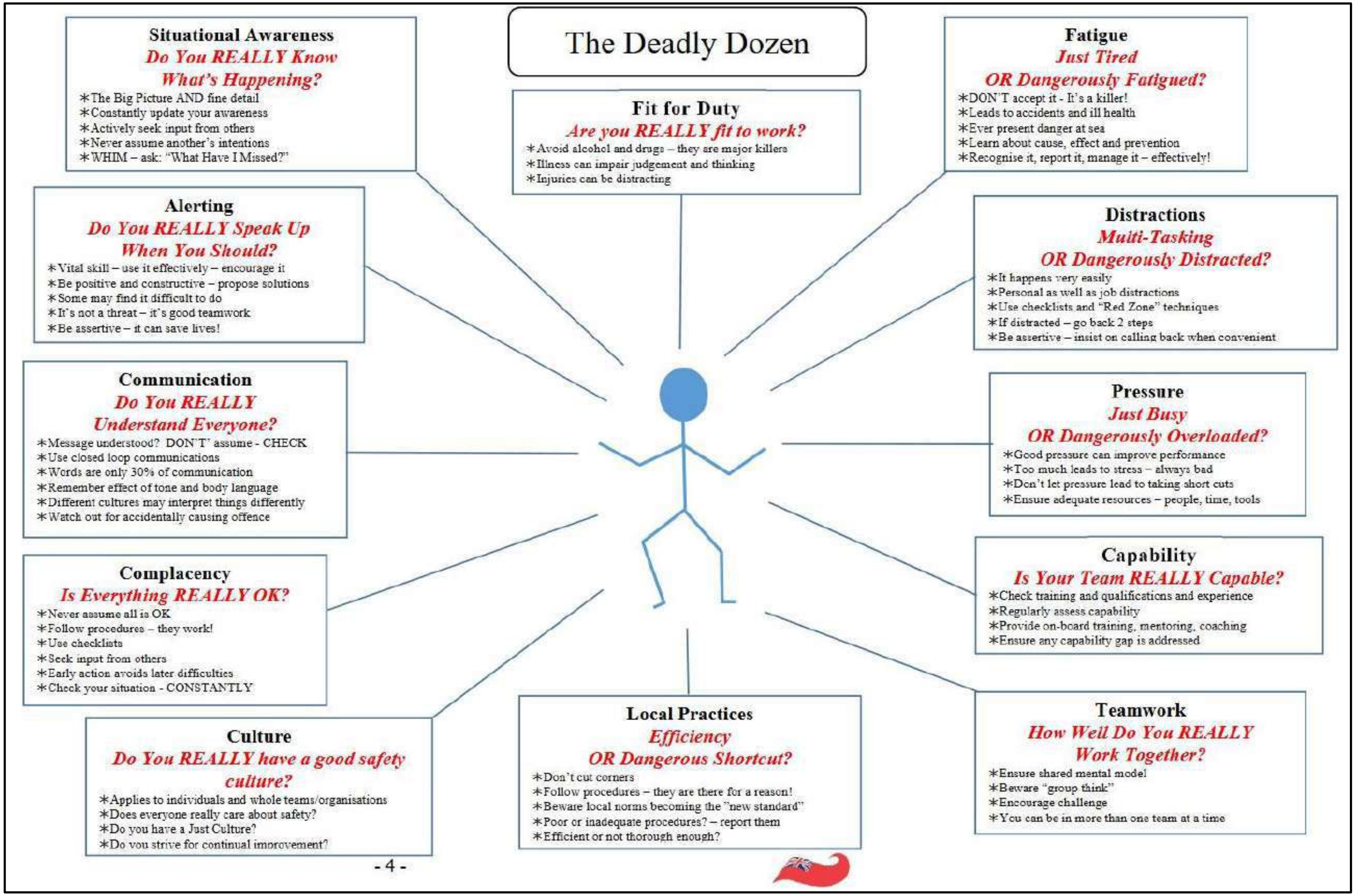

Figure 9
The Deadly Dozen (Marine Guidance Note 520 (M))
(Used with the permission of the Maritime and Coastguard Agency, United Kingdom)

4.5.2. Of these 12 factors, at least five stand out as factors contributing to the grounding of the *Leda Maersk*. In order of development, they are :

- teamwork (How well do you really work together?)
- complacency (Is everything really OK?)
- situational awareness (Do you really know what's happening?)
- alerting (Do you really speak up when you should?)
- culture (Do you really have a good safety culture?).

4.6. Teamwork

4.6.1. Although the pilot and the ship's crew went through the motions of establishing the bridge team, there are some indications that they were not truly working as one team.

4.6.2. It is about as likely as not that the pilot's use of a PPU led the ship's bridge team to believe that the pilot did not need their support because he had his own electronic navigation aid. Evidence in support of this is that none of the ship's bridge team was closely monitoring the radar and ship ECDIS. Had they been, they would not have been so surprised that the ship had run aground. When a PPU is a pilot's own equipment, the ship's personnel have no way of verifying that the PPU is functioning properly unless the pilot tells them. In this case the pilot did not tell the bridge team that there was some uncertainty about the accuracy of the PPU, which is not consistent with the team approach.

4.6.3. Perhaps the most telling point was that on the realisation that the ship had run aground, a member of the bridge team commented to the pilot, "You appear to have run us aground".

4.7. Complacency

4.7.1. Complacency is described as "a misplaced feeling that everything is OK" and can arise from repeatedly carrying out the same task without prior incident.

4.7.2. The *Leda Maersk* was a frequent caller to the Port of Otago and its bridge crew were familiar with the approaches to the port. The fact that none of the bridge team was actively monitoring the progress of the ship on the electronic navigation equipment is indicative of their having relaxed when the pilot embarked and put too much faith in the pilot getting it right. This situation effectively risked the pilot's performance becoming a single point of failure, so when the pilot experienced the not-abnormal human trait of losing situational awareness, this resulted in the ship running aground.

4.8. Situational awareness

4.8.1. Situational awareness can be described as an understanding of what is going on in one's surroundings. If members of a ship's bridge team understand what the ship is doing and what is happening around the ship at any one moment, they can predict the effects of the control inputs applied or assess what control inputs need to be changed.

4.8.2. Situational awareness is a critical aspect of navigation and can be enhanced and degraded by many internal and external influences. It can be enhanced by electronic navigation aids, monitoring and alarm systems, communication and teamwork. Conversely, it can be degraded by a lack of communication and teamwork and improper use of electronic systems.

4.8.3. The ship was at a critical phase of the agreed passage plan, yet none of the bridge team was totally aware of the factors influencing the track of the ship towards the left channel bank.

4.8.4. The bridge team were all primarily navigating by eye and not verifying that what they were seeing correlated with the information in the ship's electronic navigation systems. All of the electronic navigation aids showed that the *Leda Maersk* was off-track and nearing the limit of safe water to port.

4.9. Alerting

4.9.1. Had the bridge team used all the available features of ECDIS and radar to monitor the ship's progress, it is highly likely that they would have seen that the ship was deviating from its track. Likewise, had the ECDIS off-track alert been communicated to the rest of the bridge team, it would have alerted them to the fact that the ship was moving away from its intended track and given them an opportunity to take corrective action before the vessel grounded.

4.10. Safety culture

4.10.1. Culture can be described as the way things are normally done in a group or workplace. For a ship, it is largely driven by the effectiveness of the ship safety management system and the overarching safety system owned by the ship operator. This accident alone does not mean there was a poor safety culture. However, there were a number of indications that the ship's crew were not following the bridge and navigation aspects of the safety management system, and that the safety management system for the port operator had not been fully developed. These aspects are discussed in the following sections.

4.11. Organisational factors

The ship operator

Safety issue – The bridge operations on board the *Leda Maersk* fell short of achieving good industry practice in both planning and executing the passage under pilotage and bridge resource management.

4.11.1. The ISM Code is given mandatory status by Chapter IX of the International Convention for the Safety of Life at Sea. The ISM Code requires that ship operators have structured and documented safety management systems that provide for safe ship operating practices and establish safeguards based on assessments of risks to their ships, personnel and the environment. A safety management system should ensure compliance with mandatory rules and regulations, and observance of codes, guidelines and standards that are applicable to the operator's maritime activities. It should also be a system that is subject to verification and review so that continuous improvement is achievable.

4.11.2. Maersk had established a safety management system that documented how the company expected its crews to operate its ships. The safety management system incorporated the regulatory requirements of international conventions and flag state laws to provide procedures, plans, instructions, guidelines and checklists for relevant shipboard operations. It required regular bridge discipline meetings to be held on board to discuss roles and responsibilities. Masters' own expectations of navigating officers were written in 'Master's Standing Orders', which were signed by all of the bridge officers.

4.11.3. An analysis of the safety management system and the events leading up to the grounding showed that the requirements of several safety management system policies were not followed during the transit of the Lower Otago Harbour. The bridge team were required to monitor the position and movement of the vessel closely, and at all times ensure safe under-keel clearance. Maersk expected its bridge team to pay full attention to the safe navigation of the vessel, verify position fixing by more than one method, monitor the cross-track error[26] and verify correct settings and alarms on the ECDIS.

4.11.4. The operator's procedure for navigating 'under normal circumstances' required the officer of the watch to verify the ship's position by more than one method, if possible, and attend activated alarms and alerts immediately. It specifically stated that the officer of the watch should not rely solely on alarms and their effectiveness. However, when the off-track alert activated and was then acknowledged, the voyage data recorder[27] audio playback revealed that the alert was not communicated to the rest of the bridge team.

[26] The distance a ship is from the planned track.
[27] Equipment that records information sourced from various on-board systems, including bridge microphone recordings.

4.11.5. The *Leda Maersk* was required to undergo three navigational audits each year, with at least one conducted by a superintendent.[28] Two of the most recent navigational audits had been conducted by the master; they had rated the vessel's compliance with navigational aspects of the safety management system at 100%.

4.11.6. The third audit had been conducted by a superintendent in February 2018. The audit had scored the implementation of navigation and bridge resource management aspects highly. However, the audit had identified some areas where shipboard practices fell short of Maersk's expectations – namely lapses in logbook entries, the recording of navigation warnings and knowledge of the ship's ECDIS risk assessment. The audit had rated the *Leda Maersk* at 88%, with a room-for-improvement score of 12% – and it can be seen that the greatest shortfall in compliance was concerned with bridge team management, responsibility and authority. The audit had been conducted while the *Leda Maersk* was operated by a different crew from the one involved in this accident.

4.11.7. A closer look at the February audit identified the areas where the auditor had found that improvement was required. These were: the crew had not been aware of the vessel-specific ECDIS risk assessment; bridge watch handover checklists had been pre-signed; handover information had been limited; and officers had not been recording the at-berth under-keel clearance in the logbook.

Summary of navigation audit checklist – 24-25 February 2018, Brisbane – Tauranga		
Audit item	Level of compliance	Full compliance
Navigation	28	30
Bridge team management – master/crew responsibility and authority	21	30
Navigation equipment – carriage, operation and tests/checks	27	27
Charts and publications – stock, maintenance and usage	7	8
Navigational knowledge sharing	5	5

Table 1
Summary of navigation audit checklist – 24-25 February 2018, Brisbane – Tauranga

4.11.8. Areas where the *Leda Maersk*'s crew showed strong implementation of the company policy were: comprehensive passage planning with optimum ECDIS safety settings; satisfactory position fixing; knowledge of responsibility when navigating with a pilot on board; and procedures for navigation in confined waters. The audit findings were not consistent with what was observed in respect of this accident, in which navigation, watchkeeping and bridge resource management procedures were not carried out to the standard expected by Maersk.

4.11.9. The paper passage plan allowed a maximum distance off-track of 370 metres (0.2 cables) in the channel, whereas the ECDIS off-track alarm was set at 556 metres (0.3 cables). When the ECDIS off-track alert activated, no alarm could be heard on the voyage data recorder audio – so it is about as likely as not that the ECDIS audible alarms had been muted.

4.11.10. The ECDIS safety settings were not consistent with the settings recommended in Maersk's policy and guidance documents, nor were they optimised to give the bridge team the best

[28] A shore-based manager with the relevant technical experience to manage, supervise and inspect shipboard activities.

representation of the surrounding channel. The diamond hatching in Figure 5, which is known as the shallow pattern, indicates "non-navigable" water that is shallower than the safety contour programmed into the ECDIS. However, the settings were such that there were no navigable areas of water shown on the ECDIS, despite the presence of the navigable dredged channel. Figures 10 and 11 show how the ECDIS display can be optimised to give the bridge team a better understanding of the surrounding navigable and non-navigable waters.

4.11.11. Nothing in the passage plan alerted the ship's bridge team to the fact that the beacons could be up to 46 metres outside the dredged channel, yet this information is available in the prime sources of information when planning a passage to a New Zealand port – the chart and 'Admiralty Sailing Directions: New Zealand Pilot'. The master was under the false impression that the channel marker beacons were located at the edge of the dredged channel. This added to his surprise that the ship had grounded when still inside the line of beacons.

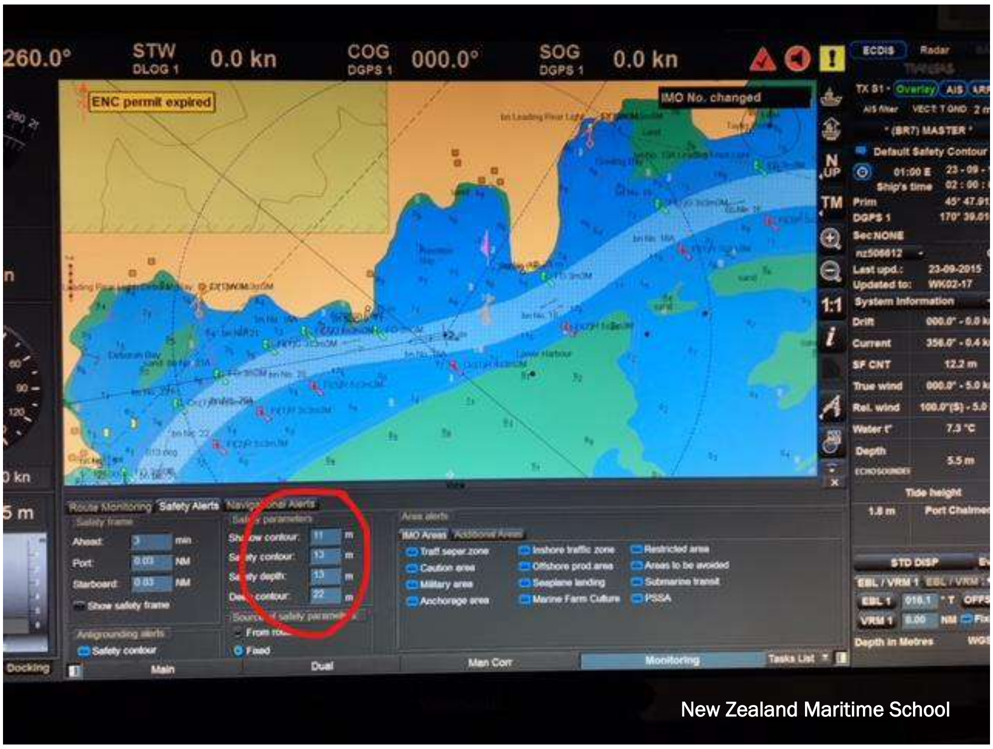

Figure 10
ECDIS safety settings closely aligned with the operator's guidelines[29]

[29] The electronic chart used in this demonstration is the version that was current at the time of the accident. Shortly afterwards a new version of the chart was issued, with the channel depth revised from 12.2 metres to 13.5 metres.

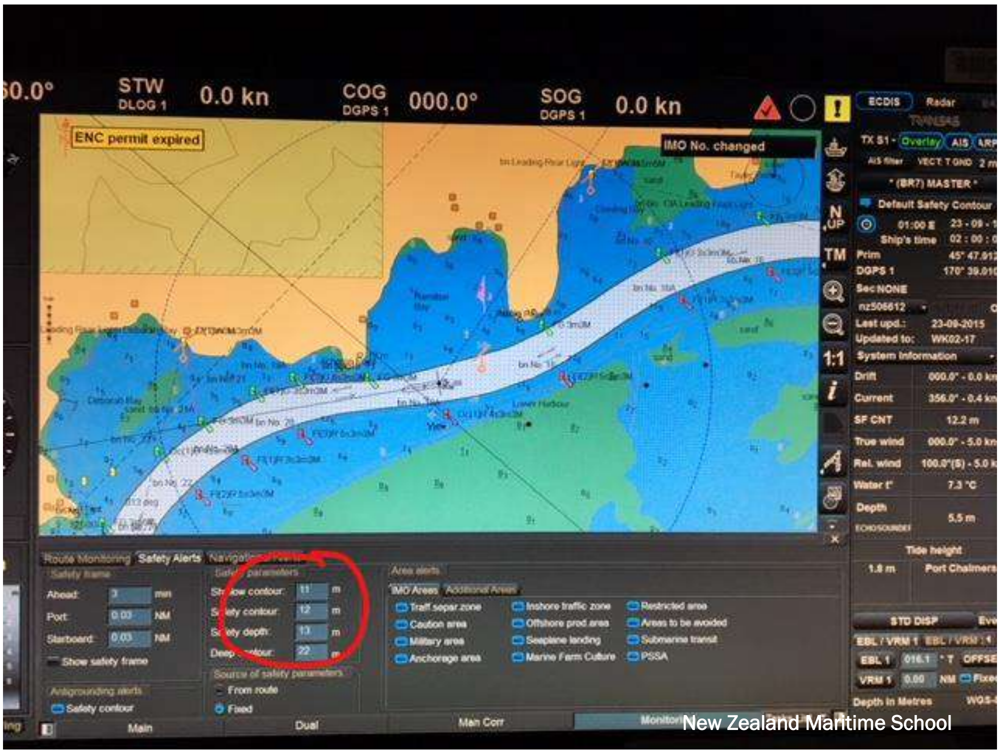

Figure 11
Alternative optimised ECDIS safety settings

4.11.12. An audit provides a snapshot of a ship's operating culture, and the previous crew had scored well in the fields relating to safe navigating procedures when the ship was audited in February 2018. However, there were indicators then that not all policies and procedures were being followed as intended by the operator. This, in combination with the non-adherence to other aspects of the policies and procedures leading up to the grounding, is an indication that the procedural failures may not have been confined to this one accident, and that the operator will need to review the standard of navigation under pilotage for all its crews to ensure that industry good practice is being achieved.

The port operator

Safety issue – Port Otago's safety management system fell short of achieving good industry standards for pilot training outlined in maritime rules, or fully achieving the principles of safety management systems outlined in the New Zealand Port and Harbour Marine Safety Code.

4.11.13. The New Zealand Port and Harbour Marine Safety Code is a voluntary arrangement between Maritime New Zealand, local government councils and port operators. The code sets mutually agreed national standards for marine safety and pollution prevention within the ports and harbours of New Zealand. Under the code, port operators, councils, harbourmasters, Maritime New Zealand and the Ministry of Transport work together to achieve those standards.

4.11.14. The code is based on the underlying principles of safety management systems, where policies and procedures result in hazards being identified and risks being appropriately managed. Safety management systems must result in full compliance with all maritime rules and other mandatory instruments. However, maritime rules are generally regarded as minimum requirements. A good safety management system should strive to meet good, if not best industry standards, which can be found in various industry guidelines. The Port and Harbour

Marine Safety Code contains such guidelines for providers of maritime pilotage services. There are also several other internationally regarded guidelines[30] that offer similar advice.

4.11.15. In New Zealand, each port operator has a duty to safely operate, maintain and service the port and is accountable for the safety of the port's marine operations.

4.11.16. Regional councils have a statutory function to ensure maritime safety within their regions. The Maritime Transport Act 1994 states that regional councils may regulate the ports, harbours, waters and maritime-related activities in their regions for the purpose of ensuring maritime safety. A council can delegate some of the navigation safety functions and powers to council-controlled organisations and port operators.

4.11.17. A regional council may also appoint a harbourmaster to manage maritime safety in its region. Harbourmasters have functions, duties and operational powers to ensure maritime safety. Otago Harbour had not had a full-time harbourmaster for more than 30 years.

4.11.18. Otago Regional Council and Port Otago had been working together to meet the standards set in the Port and Harbour Marine Safety Code. However, at the time of the *Leda Maersk*'s grounding, Port Otago had not yet been considered as meeting those standards. The harbourmaster was new in the position and Port Otago was undergoing operational change following two recent accidents involving its pilots. Policies, procedures and risk assessments were being updated.

4.11.19. Port Otago's pilot training programme was outlined in its pilot training and proficiency plan, as required by Maritime Rules Part 90. However, aspects of the plan, such as annual assessments and pilot peer reviews, were not followed. For example, the pilot on board the *Leda Maersk* had not been subject to an annual assessment or peer review since 2012. Additionally, the pilots were issued with the new ChannelPilot PPUs, but were not given additional training in its use.

4.11.20. Within the space of two years, three of Port Otago's pilots had conducted pilotage on vessels that ran aground. Port Otago had introduced the use of ChannelPilot PPUs as a safety action, but had not at the time of this grounding provided the pilots with in-depth training in their use. Port Otago relied on previous training provided for the older HarbourPilot units. Port Otago chose to delay the ChannelPilot training until the pilots had some more personal experience with the new units. There was no formal policy on the use of the PPUs, nor were there any procedures for maintaining and updating the PPUs.

4.11.21. PPUs can be useful aids to navigation. Their accuracy is well suited to monitoring the progress of large ships in narrow channels, and they provide a useful independent check of a ship's progress. However, if pilots are to use them, there should be a robust system for ensuring their accuracy and the pilots should be fully trained and proficient in their use.

4.11.22. As well as having made the changes in progress at the time of the grounding, Port Otago has taken a number of initiatives in response to the grounding, which are outlined in section 7 of this report. A recommendation has been made to complete the change process to fully meet industry good practice.

[30] Guidelines on the Design and Use of Portable Pilot Units, published by the International Maritime Pilots' Association (2016); Portable Pilot Units; A Best Practices Summary, published by the American Pilots' Association (Oct 2016): International Standard for Maritime Pilot Organizations (ISPO) (Part A), published by ISPO International Users Group (2015); International Maritime Organization Resolution A960, Recommendations on Training and Certification and Operational Procedures for Maritime Pilots other than Deep Sea Pilots (Jan 2004).

5. Findings

5.1. The *Leda Maersk* was negotiating a left-hand turn in the channel when it deviated from the intended track and grounded, under the influence of: tide; helm ordered by the harbour pilot; and interaction between the ship's hull and the left bank of the channel.

5.2. Neither the harbour pilot nor the ship's bridge team recognised that the *Leda Maersk* was deviating from the planned track. This was because they were not fully using the electronic navigation aids, all of which clearly showed the ship deviating from the centre of the channel.

5.3. The entire bridge team was primarily navigating 'by eye'. Navigating a large ship in narrow channels, at night, using visual (line-of-sight) navigation only increases the risk of the ship grounding owing to the bridge team losing situational awareness.

5.4. The standard of bridge resource management on the bridge of the *Leda Maersk* fell short of industry good practice.

5.5. The *Leda Maersk* bridge team were not fully following the company policies and procedures for navigating in pilotage waters

5.6. At the time of the grounding, Port Otago's policies, procedures and compliance monitoring of pilotage operations fell short of achieving industry standards for pilot training outlined in maritime rules, or fully achieving the principles of safety management systems outlined in the New Zealand Port and Harbour Marine Safety Code.

6. Safety issues

6.1. Port Otago's safety management system fell short of achieving good industry standards for pilot training outlined in maritime rules, or fully achieving the principles of safety management systems outlined in the New Zealand Port and Harbour Marine Safety Code.

6.2. The bridge operations on board the *Leda Maersk* fell short of achieving good industry practice in both planning and executing the passage under pilotage and bridge resource management.

7. Safety actions

7.1. General

7.1.1. The Commission classifies safety actions by two types:

(a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission during an inquiry that would otherwise result in the Commission issuing a recommendation

(b) safety actions taken by the regulator or an operator to address other safety issues that would not normally result in the Commission issuing a recommendation.

7.2. Safety actions addressing safety issues identified during an inquiry

7.2.1. Safety actions taken by Port Otago included the following:

- completing an internal investigation report
- requesting of cargo planners that containers not be stowed six high in the outboard stacks directly forward of the bridges of L-class ships[31]
- allocating particular tasks and monitoring parameters to the bridge team during the master/pilot exchange
- reinstating the annual assessments of the pilots
- training in the use of ChartPilot PPUs by the manufacturer, Navicom Dynamics, was carried out in November 2018.

7.3. Safety actions taken by Maersk Line A/S included the following:

- inserting a port memo for fleet vessels stating that, at Port Chalmers, "shallower depths have been reported in the channel and it is prudent to navigate close to the middle of the channel. Buoys have been place (sic) in shallower waters than is safe for navigation"
- the next master was advised to complete a navigation audit and carry out a bridge discipline meeting for closing any existing gaps in bridge procedures
- the master, chief officer and second officer were to attend a Bridge Team Enhancement Programme prior to joining their next ship.

[31] Subsequent to the accident, the L-class ships were rescheduled and no longer call at Port Otago. The new service uses larger ships that do not have the same visibility problem.

8. Recommendations

8.1. General

8.1.1. The Commission may issue, or give notice of, recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector. In this case, recommendations have been issued to Maersk Line A/S and Port Otago.

8.1.2. In the interests of transport safety it is important that these recommendations are implemented without delay to help prevent similar accidents or incidents occurring in the future.

8.2. Recommendation to Maersk Line A/S

8.2.1. The bridge operations on board the *Leda Maersk* fell short of achieving good industry practice in both planning and executing the passage under pilotage and bridge resource management.

There were indicators from previous audits that not all policies and procedures were being followed as intended by the operator. This, in combination with the non-adherence to other aspects of the policies and procedures leading up to this grounding, is an indication that the procedural failures may not have been confined to this one accident, and that the operator will need to review the standard of navigation under pilotage for all its crews to ensure that industry good practice is being followed.

On 26 June 2019, the Commission recommended to the Chief Executive of Maersk Line A/S that they review the implementation of the company's safety management system across its fleet with respect to navigation and pilotage, and take the necessary steps to ensure a high standard is achieved by all crews on all its ships. (005/19)

On 2 July 2019, Maersk Line A/S replied in part:

1. Maersk Line has identified that training of ship staff is of utmost importance to ensure effective implementation of company procedures and for ensuring safety of navigation, including navigation in pilotage waters. In this regard following measures have been taken:

   - All navigators must undergo mandatory ECDIS training by Seagull A/S
     - ➢ Already commenced in 2019.
     - ➢ Aim is to enhance knowledge of navigators and to ensure optimum use of ECDIS as a tool.
     - ➢ This will be followed up by refresher training at two year intervals so that navigators remain up to date.
   - Further, all navigators are required to undergo Bridge Team Enhancement Programme Training.
     - ➢ The programme focusses on improved bridge team work and optimum use of bridge resources.
     - ➢ In bridge simulator phase of this course navigating officers are put through scenarios which replicate navigation incidents that occur during coastal and pilotage waters.
     - ➢ As we employ over three thousand navigating officers, this process is being undertaken in a phased manner and will be completed in the year 2025.

2. Company procedures pertaining to navigation and use of ECDIS have been revised recently. This has been done so that navigators find them easier to understand, which in turn will increase adherence to these procedures. Overview of revised SMS procedures is attached herewith.

   In accordance with the ISM code internal audit is carried out annually to verify compliance with the requirements of the Safety Management System. [These include navigation audits by a superintendent.] [The] last internal audit for Leda Maersk was conducted in Feb 2019.

8.3. Recommendation to Port Otago

8.3.1. At the time of the grounding, Port Otago's policies, procedures and compliance monitoring of pilotage operations fell short of meeting good industry standards for pilot training outlined in maritime rules, or fully achieving the principles of safety management systems outlined in the New Zealand Port and Harbour Marine Safety Code.

On 26 June 2019, the Commission recommended to the Chief Executive Officer of Port Otago that they note where this report identifies areas where pilotage operations can be improved and continue taking the necessary actions to ensure that pilotage operations fully meet good industry practice and the guidance provided in the New Zealand Port and Harbour Marine Safety Code. (006/19)

On 25 September 2019, the Chief Executive of Port Otago replied:

> Port Otago, as a result of the learnings from the incident, delivered refresher training on PPU's to all pilots, completed in November 2018. Port Otago also instructed Maersk to change stowage plans to improve visibility on the L- Class vessels visiting Port Chalmers and Maersk complied in August 2018.
>
> For the record, the New Zealand Port and Harbour Marine Safety Code SMS review received on 23rd November 2017 identified some improvements to be undertaken by Port Otago and Otago Regional Council; all of Port Otago's actions were completed in early 2018. At the time of the incident, Port Otago was awaiting the Otago Regional Council by-laws to be notified for public submission to close out the review. Port Otago's policies, procedures and compliance monitoring of pilotage operations at the time of the incident through 13th December 2018 were unchanged. Port Otago and the Otago Regional Council New Zealand received notification post another review that the SME was consistent with the requirements of the New Zealand Port and Harbour Marine Safety Code on 13th December 2018.

9. Key lessons

9.1. The Commission repeats three key lessons made in a previous report[32]

9.1.1. There must be an absolute agreement and shared understanding between the vessel's bridge team and the pilot as to the passage plan and monitoring against that plan.

9.1.2. Vessels' bridge teams must actively promote and use the concept of bridge resource management, including the incorporation of pilots into the bridge teams, to manage voyages properly.

9.1.3. A vessel's ECDIS is an important system for monitoring the progress of the vessel and warning the bridge team when things could go wrong. It is essential that it be configured correctly for the phase of navigation and the proximity to navigation hazards.

9.2. The Commission identified one new key lesson

9.2.1. PPUs can be useful aids to navigation and their accuracy is well suited to allowing pilots an independent means of monitoring the progress of large ships in narrow channels. However, if pilots are to use them, they should be fully trained and proficient in their use, and there should be a robust system for ensuring the accuracy of the equipment.

[32] Commission report MO-2016-204, Bulk Carrier *Molly Manx*, grounding, Otago Harbour, 19 August 2016.

Appendix 1: Extracts from Maersk policy ‘Navigation with a Pilot on Board’

1. Personnel and Responsibilities

The Master is responsible for:

- The safety and navigation of the vessel. Also, when a pilot is on board

2. General

- Maersk vessels must utilise pilot service when this is needed for safe navigation
- In ports where pilotage exemption certificates can be obtained, vessels can call without pilot if certificate criteria are fulfilled. A Risk Assessment shall be carried out by the vessel. There will be no bonus payment given to vessel or individual Captain for sailing without a Pilot.

NOTE: The Master is always responsible for the safety of the vessel and the navigation. The presence of a pilot does not relieve the Master or the Officer of the Watch from their responsibilities and duties.

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The responsibility for the vessel's navigation cannot be transferred to the pilot.

Always check verbal orders from the pilot to confirm that they have been carried out correctly.

9. Control of Navigation with Pilot on Board

To guard against faulty operation, the Master or OOW, shall operate the instruments. Not the pilot.

The Officer of the Watch shall closely follow the navigation and check the vessel's position, by plotting with intervals that deviations from the planned track are immediately detected.

Recent Marine Occurrence Reports published by the Transport Accident Investigation Commission

MO-2018-204	*Dolphin Seeker*, grounding, 27 October 2018
MO-2017-204	Passenger vessel *Seabourn Encore,* breakaway from wharf and collision with bulk cement carrier at Timaru, 12 February 2017
MO-2017-203	Burst nitrogen cylinder causing fatality, passenger cruise ship *Emerald Princess*, 9 February 2017
MO-2017-205	Multipurpose container vessel *Kokopo Chief*, cargo hold fire, 23 September 2017
MO-2017-202	Passenger vessel *L'Austral*, grounding, Milford Sound, Fiordland, 9 February 2017
MO-2016-206	Capsize and foundering of the charter fishing vessel *Francie*, with the loss of eight lives, Kaipara Harbour bar, 26 November 2016
MO-2016-202	Passenger ship, *Azamara Quest*, contact with Wheki Rock, Tory Channel, 27 January 2016
MO-2017-201	Passenger vessel *L'Austral* contact with rock Snares Islands, 9 January 2017
MO-2016-201	Restricted-limits passenger vessel the *PeeJay V*, Fire and sinking , 18 January 2016
MO-2016-204	Bulk carrier, *Molly Manx*, grounding, Otago Harbour, 19 August 2016
MO-2016-205	Fatal fall from height on bulk carrier, *New Legend Pearl*, 3 November 2016
MO-2015-201	Passenger ferry *Kea*, collision with Victoria Wharf, Devonport, 17 February 2015
Interim Report MO-2017-203	Burst nitrogen cylinder causing fatality on board the passenger cruise ship *Emerald Princess*, 9 February 2017
MO-2012-203	Fire on board *Amaltal Columbia*, 12 September 2012
MO-2016-203	Bulk log carrier Mount Hikurangi, Crew fatality, during cargo securing operation, 27 February 2016
MO-2014-203	Fatal injury, Purse seine fishing vessel, *Captain M. J. Souza*, 24 August 2014
MO-2015-202	Containership *Madinah*, loss of person overboard, Lyttelton Harbour entrance, 2 July 2015
MO-2016-202	Urgent recommendation: Cruise ship *Azamara Quest*, contact with Wheki Rock, Tory Channel, 27 January 2016
MO-2011-202	Roll-on-roll-off passenger ferry *Monte Stello*, contact with rock, Tory Channel, Marlborough Sounds, 4 May 2011
MO-2014-201	*Dream Weaver*, flooding due to structural failure of the hull, Hauraki Gulf, 23 February 2014
MO-2010-206	Coastal container ship *Spirit of Resolution*, grounding on Manukau Bar, Auckland, 18 September 2010

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