Interim Report Marine inquiry 11-204: Containership MV Rena grounding on Astrolabe Reef 5 October 2011

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Interim Report

Marine inquiry 11-204

Containership MV Rena grounding on Astrolabe Reef

5 October 2011

Transport Accident Investigation Commission

About the Transport Accident Investigation Commission and this report

The Transport Accident Investigation Commission (Commission) is 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, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

It is not permissible to use this interim report to pursue criminal, civil or regulatory action against any person or agency. The Transport Accident Investigation Commission Act 1990 makes this interim report inadmissible as evidence in any proceedings. A full report will be released on completion of the inquiry.

Commissioners

Chief Commissioner:	John Marshall, QC
Deputy Chief Commissioner:	Helen Cull, QC
Commissioner:	Captain Bryan Wyness

Key Commission personnel

Chief Executive:	Lois Hutchinson
Chief Investigator of Accidents:	Captain Tim Burfoot
Investigator in Charge:	Robert Thompson
General Counsel:	Rama Rewi

Email:	inquiries@taic.org.nz
Web:	www.taic.org.nz
Telephone:	+64 4 473 3112 (24 hrs) or 0800 188 926
Fax:	+64 4 499 1510
Address:	Level 16, AXA Centre, 80 The Terrace, PO Box 10 323, Wellington 6143, New Zealand

Important notes

Nature of this interim report

This interim report sets out the facts and circumstances of the *Rena* accident that the Commission has established at this point in its inquiry. It does not contain an analysis of those facts or any findings or recommendations. These matters will be addressed when the Commission prepares its final report.

Ownership of interim report

Citations and referencing

Information derived from interviews during the Commission's inquiry into the occurrence is not cited in this interim report. Documents that would normally be accessible to industry participants only and not accessible under the Official Information Act 1980 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

Photographs, diagrams, pictures

Unless otherwise specified, photographs, diagrams and pictures included in this interim report are provided by, and owned by, the Commission.

The MV *Rena* aground on Astrolabe Reef (photograph taken 6 October 2011)

Location of accident

Contents

Figures

Tables

Abbreviations

GPS	global positioning system
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978
VHF	very high frequency (radio)

Glossary

able-bodied seaman	an ordinary seaman who has been trained in certain skills
automatic identification system	a system used to locate and track vessels electronically. The system works by a vessel electronically exchanging data with nearby vessels and base stations via very-high-frequency (VHF) radio
autopilot	a system used to maintain a vessel's heading without assistance from a human being
bearing	a geographical direction given in degrees notation
differential global positioning system	an enhancement of a global positioning system (GPS) that yields improved accuracy on position
digital selective calling	a standard for sending predefined digital messages via maritime radio systems
global maritime distress and safety system medium frequency/high frequency (radio)	a set of radio equipment and communication protocols used to increase safety and to help rescue distressed vessels
global positioning system (GPS)	a navigational system that uses data from a satellite network to give a geographical location. The system uses the change in location over time to give other navigational information, such as speed and direction
ground track	a vessel's track in relation to the seabed
gyrocompass	a type of non-magnetic compass that uses gyroscopic principles to find geographical direction automatically
gyro heading	gyro heading is the direction of the vessel as read on its gyrocompass
heading	the direction in which a vessel is pointing, taken as parallel to the centreline of the vessel and expressed in degrees notation
Inmarsat	a global satellite network that provides mobile satellite communication
interested person	a person or an organisation whose conduct is referred to in this report as being relevant to the occurrence, or any other person or organisation that the Commission believes may have a significant

	interest in matters relating to its inquiry
parallel index	Offset electronic navigation line(s) set up on a the radar screen parallel to a ship's heading
screenshot	an image captured from an electronic display screen that is a copy of what was on the screen at that time
second mate	referred to on the *Rena* as the second officer (navigating)
third mate	referred to on the *Rena* as the second officer (safety)
voyage data recorder	a device on board a vessel that records data from various sensors. The inputs include (but are not limited to) time, audio from the bridge, GPS positions, vessel speed and gyro heading, and radar screenshots
watchkeeper	a crew member whose role is to assist the officer of the watch to keep watch and keep lookout

Data summary

Table 1:
Vessel particulars

Name:	*Rena*
Type:	container
Class:	American Bureau of Shipping
Limits:	unlimited
Classification:	✠A1[1], ℮[2], ✠AMS[3], ✠ACCU[4]
Length:	224.5 metres
Breadth:	32.2 metres
Gross tonnage:	37 209 tonnes
Built:	1990
Propulsion:	single fixed-pitch propeller driven by one Sulzer 8RTA76 (21 680 kilowatts)
Maximum service speed:	20 knots
Owner:	Daina Shipping Co.
Manager:	Ciel Shipmanagement S.A.
Port of registry:	Monrovia

Table 2:
Incident particulars

Date and time:	0214[5] on 5 October 2011
Location:	Astrolabe Reef, Bay of Plenty, New Zealand 37° 34.1' S 176° 19.1' E
Persons involved:	vessel's crew
Injuries:	nil
Damage:	the hull was severely damaged during the initial grounding. The hull girder structure subsequently failed, leading to the vessel breaking in 2. The aft section moved off the reef and partially sank. Approximately 350 to 400 tonnes of heavy fuel oil were lost to the sea. At the time of this report's publication, containers were still being removed from the *Rena* and it had yet to be determined how many had been lost to the sea

[1] Hull and equipment built to survey under American Bureau of Shipping.
[2] Anchors and chain cable of the vessel were in compliance with American Bureau of Shipping.
[3] Machinery, boiler and systems built to survey under American Bureau of Shipping.
[4] Shipboard automation systems built to survey under American Bureau of Shipping.
[5] All times in this report are New Zealand Daylight Time (universal co-ordinated time + 13) and expressed in the 24-hour mode.

1. Conduct of the inquiry

1.1. The *Rena* ran aground on Astrolabe Reef at about 0214 on 5 October 2011. The Rescue Coordination Centre New Zealand notified the Transport Accident Investigation Commission (Commission) of the grounding at 0237 the same day. The Commission immediately opened an inquiry into the accident under section 13(b) of the Transport Accident Investigation Commission Act 1990 and appointed an investigator in charge. The accident was a "very serious casualty" as defined in the International Maritime Organization Casualty Investigation Code.

1.2. Throughout the first day the Commission gathered information through the Maritime New Zealand Emergency Response and Rescue Coordination Centres. Once it had been established that access to the stricken vessel was possible, the chief investigator and investigator in charge travelled to Tauranga to start the site investigation that same day, 5 October.

1.3. The State of registry for the *Rena* was Liberia. The Commission notified the Liberian International Ship & Corporate Registry of the accident and offered to conduct the "marine safety investigation" on behalf of Liberia. The International Maritime Organization Casualty Investigation Code required that a "marine safety investigation" be conducted into every "very serious casualty". Liberia elected to appoint an investigator to conduct its own investigation and requested assistance from the Commission. The Commission provided whatever assistance it could under New Zealand law.

1.4. Both the Director of Maritime New Zealand and the Chief Executive of Bay of Plenty District Council requested permission to conduct their own investigations at the site of the *Rena* grounding. The Commission granted permission under section 14(3) of the Transport Accident Investigation Commission Act 1990 to the Director on 5 October and to the Chief Executive on 7 October 2011.

1.5. The Commission's investigators boarded the *Rena* on 6 October 2011 and interviewed the master, the second mate and the watchkeeper (the crew who were on the bridge at the time the *Rena* grounded). The investigators re-boarded the *Rena* on 7 October and removed documents and the computer and portable data module from the voyage data recorder.

1.6. The crew were evacuated from the *Rena* on Tuesday 11 October. On Thursday 13 October 2 Commission investigators returned to Tauranga and conducted second interviews with the master, the second mate and the watchkeeper. They also interviewed the third mate.

1.7. While salvage operations were underway to remove oils from the *Rena*, environmental conditions were weakening the vessel's structure, so on Saturday 22 October the Commission's investigators re-boarded the vessel and removed a significant number of documents and equipment that were pertinent to the inquiry. Maritime New Zealand was conducting its own inquiry into the grounding independently of the Commission. The exercise to remove the documents and equipment was observed by an investigator from Maritime New Zealand to allow Maritime New Zealand and the Commission to record formally the chain of custody of the documents and equipment.

1.8. The voyage data recorder that had been removed from the *Rena* earlier was undamaged and valid data was successfully downloaded. On 10 November 2011, 2 investigators interviewed the master and second mate of the *Rena* for a third time.

1.9. This interim report includes information from the crew interviews, information retrieved from the voyage data recorder, information from the log books and other documents either removed from the *Rena* or supplied by the *Rena*'s owners, and information retrieved from the automatic information system. Raw automatic identification system data is transmitted from the vessel and recorded by several shore stations. The raw automatic identification system data used in this report was provided by a maritime consultant, Marico Marine NZ Limited, and was verified with data from the voyage data recorder.

1.10. On 9 December 2011 the Commission approved a draft interim report for circulation to interested persons. The interested persons were the master of the *Rena*, the second mate of

the *Rena*, the third mate of the *Rena*, the watchkeeper on watch at the time of the grounding, the vessel's owners, the vessel's charterers, Maritime New Zealand, Bay of Plenty Regional Council, Port of Tauranga and Crown Law. The draft report was assessed and amended with respect to the submissions received from the *interested persons*. The submissions raised a number of matters more relevant to the final analysis that are not addressed in this interim report but will be addressed in the Commission's full report. This interim report was approved for publication on 23 February 2012.

2. Factual information

2.1. Note on terminology

2.1.1. A number of terms are used in this report to describe the direction in which a vessel travels and the direction in which a vessel is pointing. A brief description of these terms is given below.

2.1.2. From any position on the Earth, true north is in the direction of the geographical north pole. True north is aligned to the lines of longitude on a nautical chart and true course is expressed in degrees relative to true north.

2.1.3. Gyro heading is the direction of the vessel as read on its gyrocompass (a compass in which the direction of true north is maintained by a gyroscope). If there is no gyrocompass error, the gyro heading and the true heading will be the same.

2.1.4. The wind and the sea can cause a vessel to move sideways through the water, giving a resultant water track that is different from its actual heading. The difference between actual heading and a vessel's water track is called leeway.

2.1.5. Additionally, the body of water through which a vessel is tracking can be moving due to current and tides, causing the vessel's resultant track in relation to the seabed (ground track) to differ from its water track. The difference between a vessels' water track and its ground track is called set.

2.1.6. The difference between a vessel's gyro heading and its ground track will be caused by any *set*, leeway and gyrocompass error.

2.1.7. The *Rena* was being steered by autopilot for most of the voyage from Napier, including for the whole period from midnight to the time of the grounding. The *Rena*'s autopilot operated off its gyrocompass. The *Rena*'s global positioning [navigation] system recorded the vessel's position in relation to the ground and thus calculated the *Rena*'s ground track. This interim report is concerned with the difference between the *Rena*'s gyro heading, to which the autopilot was referenced, and the ground track. These 2 sets of data were obtained from the voyage data recorder and the automatic identification system. A description of these can be found in the glossary.

2.2. Narrative

2.2.1. The *Rena* departed Singapore on 5 September 2011 and called at Fremantle, Melbourne and Sydney before arriving at Bluff in New Zealand on 28 September. The vessel then called at Port Chalmers, Lyttelton and Wellington before arriving at Napier in the early morning of 3 October.

2.2.2. At 0620 cargo operations commenced in Napier. Cargo operations had not been completed by the time another vessel that had a priority booking for the *Rena*'s berth arrived off the port. The *Rena* moved to anchor off the port, where it lay for about 13 hours before it could return to the berth and resume cargo operations.

2.2.3. Cargo operations in Napier were completed by 0920 on 4 October. The vessel sailed immediately, with the pilot disembarking the vessel at 1020.

2.2.4. The master had asked the second mate for an estimated time for the passage to Tauranga, which the second mate had calculated using the vessel's passage plan. The master told the shipping agent that the vessel would arrive at Tauranga at 0230. The calculation was based on a vessel speed of 17 knots and keeping to the passage plan.

2.2.5. The master modified the vessel's planned passage on the chart to shorten the distance around Mahia Peninsula, as seen in Figure 1. The master handed control of the *Rena* to the third mate at 1100 as the vessel approached Mahia Peninsula. The passage plan that was in use during the voyage required that the vessel's position be plotted hourly, which was typically done using co-ordinates from the GPS. At times during the voyage the position was plotted more frequently than hourly.

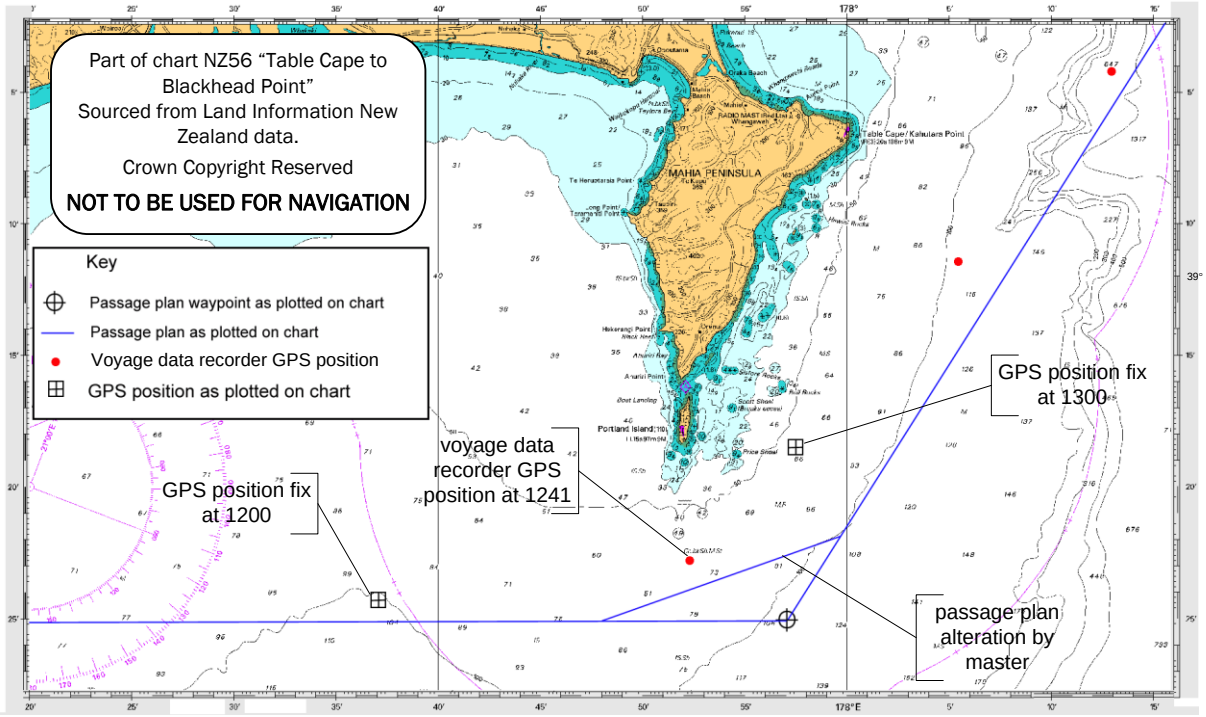

Figure 1
Part of chart NZ56 showing passage plan, plotted positions and GPS positions obtained from the voyage data recorder on passage around Mahia Peninsula

2.2.6. At 1200 on 4 October the second mate took over the bridge watch from the third mate. The master returned to the bridge shortly afterwards and told the second mate to proceed on the inshore side of the course lines plotted on the chart that showed the passage plan around Mahia Peninsula. He said this in order to assess the strength and location of any unfavourable current (currents were known to flow generally in a southward direction in this area). The master also instructed the second mate to navigate the *Rena* either side of the course lines on the chart while steaming up the east coast in search of the least unfavourable current. The master did not tell him how far from the planned course he could deviate.

2.2.7. The *Rena* rounded Mahia Peninsula at about 1300 and proceeded up the coast. The plotted positions were inshore of the course lines. A position plotted on the next chart used in the passage (NZ55) included a position at just over 5 nautical miles inshore of the planned passage.

2.2.8. The chief officer took over the watch at 1600, and the vessel altered course to round East Cape at 1730. The third mate took over the watch again at 2000.

2.2.9. At about 0001 on 5 October the second mate took over the watch again from the third mate. The second mate was supported by a watchkeeper, an able-bodied seaman. The gyro heading of the vessel at the time of handover was about 272 degrees. During the handover discussion the third mate reminded the second mate that the passage plan would require an alteration of course a few minutes later.

2.2.10. At about 0014 the *Rena*'s gyro heading was altered to about 263 degrees. The ground track at this time was about 262 degrees. The vessel's course was progressively altered during the following 30 minutes to bring it to a gyro heading of 267 degrees and a ground track of about 265 degrees. In other words the vessel was making 2 degrees to the south of the vessel's gyro

heading under the influence of set, leeway and gyrocompass error. The automatic identification system data showed that the *Rena* was making about 2 degrees to the south of the vessel's gyro heading from at least midnight to when it grounded on Astrolabe Reef. The *Rena*'s ground track was approximately parallel to, and about a quarter of a nautical mile to the south of, the planned passage until about 0130.

2.2.11. At 0015, Tauranga Harbour Control called the *Rena* on VHF radio to discuss the vessel's estimated time of arrival and pilot boarding time. The *Rena* told Tauranga Harbour Control that its estimated time of arrival at the pilot station was 0300. Tauranga Harbour Control advised the *Rena* that 0300 was the end of the time window for pilotage, and also requested the *Rena* to make best speed for the pilot station.

2.2.12. Tauranga Harbour Radio called the *Rena* again at 0059 to confirm its estimated time of arrival at 0300 and ask for the *Rena*'s arrival draft.

2.2.13. Figure 2 shows the *Rena*'s gyro heading and ground track and the difference between the 2. This data was taken from the automatic identification system and includes any error from that system. For clarity the data scatter was "smoothed" by taking an average over several data points. The bottom axis shows the time of day beginning at 0043 on 5 October 2011 and ending at around 0215 the same day. The vessel's gyro heading and ground track are read from the left-hand axis, which shows the gyro heading as recorded by the automatic identification system. The difference between the gyro heading and the ground track of the vessel is read from the right-hand axis. Some points in the narrative have been superimposed on the data for reference.

2.2.14. At about 0101 the course was altered to the south by about one degree as seen in Figure 2. Between 0120 and 0150 the gyro heading and ground track altered a further 10 degrees to the south, resulting in a gyro heading of about 255 degrees at about 0150.

2.2.15. Positions were plotted on the chart at 0100 and again at 0120. These positions were taken from the GPS and plotted by the watchkeeper able-bodied seaman. Vessel positions plotted by the able-bodied seaman were then checked by the second mate. The 0100 position was marked on chart NZ54 and the 0120 position was marked on the larger-scale chart NZ541, as seen in Figure 3 (Mayor Island to Okurei Point). Neither of the positions was marked on both charts. In other words no position was transferred from one chart to the other when changing charts. The *Rena*'s gyro heading was 266 degrees at that time and the ground track was about 264 degrees, indicating the *Rena* was making about 2 degrees to the south of the gyro heading towards Astrolabe Reef ahead. Both of the plotted positions were already south of the passage plan plotted on the chart.

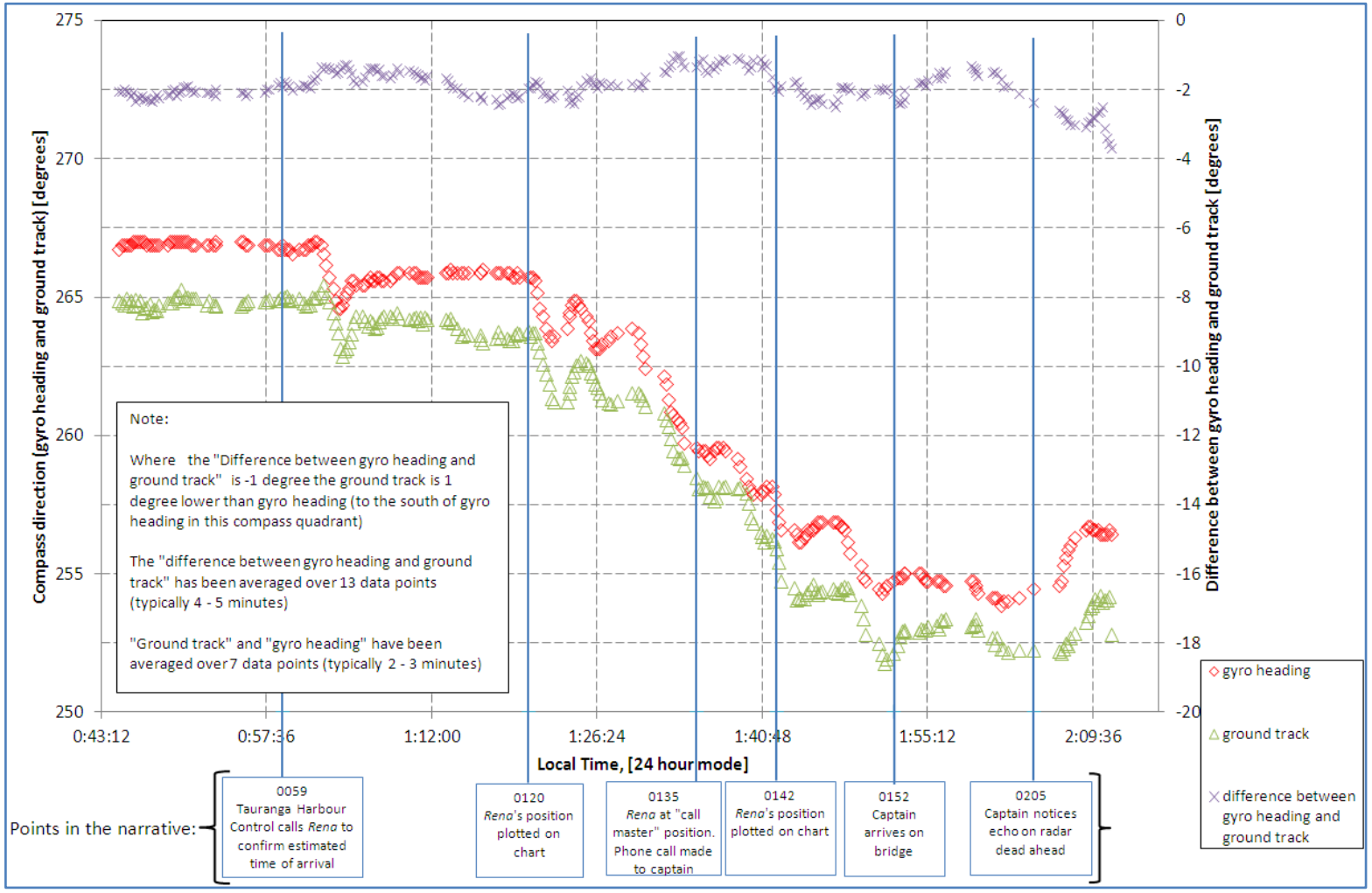

Figure 2
Automatic identification system data showing vessel gyro heading and ground track and the difference between the 2. Some points of the narrative have been overlaid on the plot (automatic identification system data provided by Marico Marine NZ Limited)

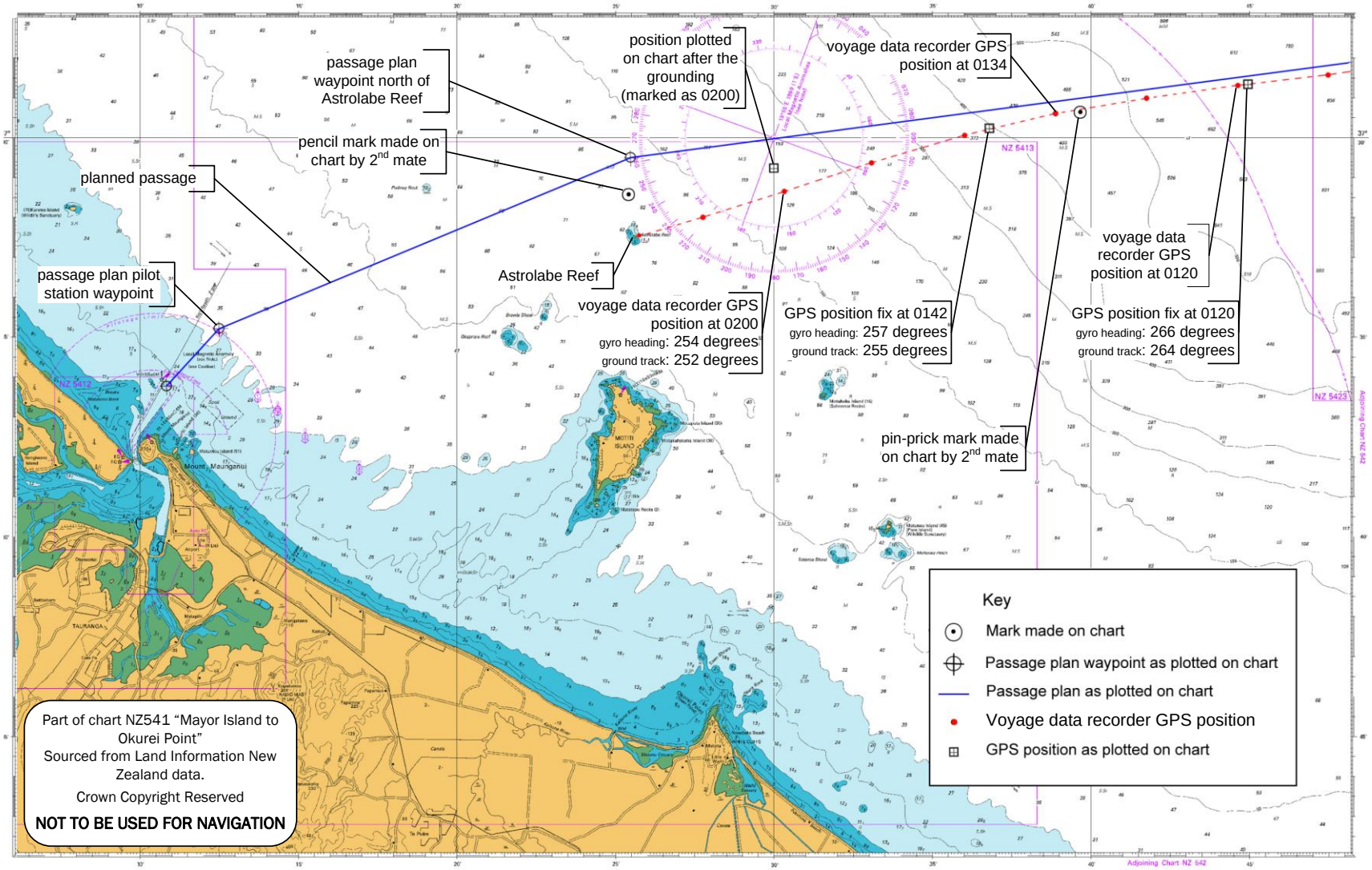

Figure 3
Part of chart NZ541 showing passage plan, plotted positions and voyage data recorder GPS positions on approach to Tauranga

2.2.16. The master had placed a mark on the chart, with a written instruction for the second mate to call him when the *Rena* reached that position. At 0135 the vessel reached the marked position and the second mate called the master on the telephone. During the discussion the second mate confirmed that the vessel would be at the pilot station by 0300 and also discussed an alteration of course that would shorten the distance to the pilot station, to which the master agreed. The second mate had already begun to progressively make that alteration to course.

2.2.17. The second mate's plan was to navigate closer to Astrolabe Reef. He said he placed a mark on the chart about one nautical mile north of Astrolabe Reef (shown in Figure 3), which was the point to which he intended to navigate the *Rena* before making the final course adjustment to the pilot station. The master has stated that the mark made on the chart one nautical mile north of Astrolabe Reef was put there after the grounding. The contradicting statements from the master and the second mate will be the subject of further consideration within the Commission's final report.

2.2.18. The second mate said that, following the discussion with the master, he took the *Rena*'s position from the GPS and marked this point with a "prick" using a drawing instrument. He did not mark this position in pencil on the chart. The pin-prick mark on the chart was not immediately obvious to anyone other than the person who had made it.

2.2.19. The *Rena*'s position was taken again from the GPS at 0142 and plotted on the chart. This position was plotted by the watchkeeping able-bodied seaman. At this time the gyro heading of the vessel was about 257 degrees, but the ground track was about 255 degrees, meaning the vessel was still making about 2 degrees southward towards Astrolabe Reef.

2.2.20. The second mate had set up a parallel index on one of the *Rena*'s radars at 0142. He had set it up on the northern tip of Motiti Island. The purpose of a parallel index is normally to monitor a vessel's progress as it tracks along its course. In this case if the vessel had deviated from the intended course the second mate would have been able to detect this as a relative movement between the line on the radar and the radar image of Motiti Island. By 0150 the *Rena*'s ground track was about 255 degrees, a shift of about 11 degrees from the *Rena*'s heading at 0120, towards Astrolabe Reef. At 0150 the ground track averaged about 252 degrees, still making 2 degrees towards Astrolabe Reef. At this point the *Rena* was making directly for the reef.

2.2.21. The voyage data recorder captured a screenshot of the *Rena*'s radar at about 15-second intervals. Figure 4 shows a radar screenshot captured at the time when the parallel index (referencing Motiti Island) was set up. The screenshot has been annotated with labels to identify the vessel, its course vector, Motiti Island, parallel index lines and the passage plan course alteration waypoint north of Astrolabe Reef.

2.2.22. The master arrived on the bridge[6] at about 0152. The master and the second mate had a discussion over the radar picture, after which the next waypoint that the GPS was monitoring was moved from the one just north of Astrolabe Reef to the one over the pilot station (shown in Figure 3). At 0158 the master removed the parallel index lines from the radar because he thought they were cluttering the radar screen. The master and the second mate then moved into the chartroom behind the wheelhouse and were discussing preparations for the Tauranga arrival. While they were having this discussion, the watchkeeper able-bodied seaman came into the chartroom with the intention of plotting the *Rena*'s 0200 position. The able-bodied seaman read the position off the GPS in the chartroom and recorded it in the position log book. The master and second mate were leaning over the chart as they talked, so rather than interrupt them the able-bodied seaman did not plot the 0200 position on the chart. The 0200 position was plotted after the grounding and was plotted in a position further north than the *Rena*'s position at the time. The position written in the position log book by the watchkeeper able-bodied seaman was amended to match the 0200 position later plotted on the chart.

[6] The bridge included the wheelhouse and the chartroom. At night the chartroom was normally curtained off to preserve the night vision of those keeping a lookout.

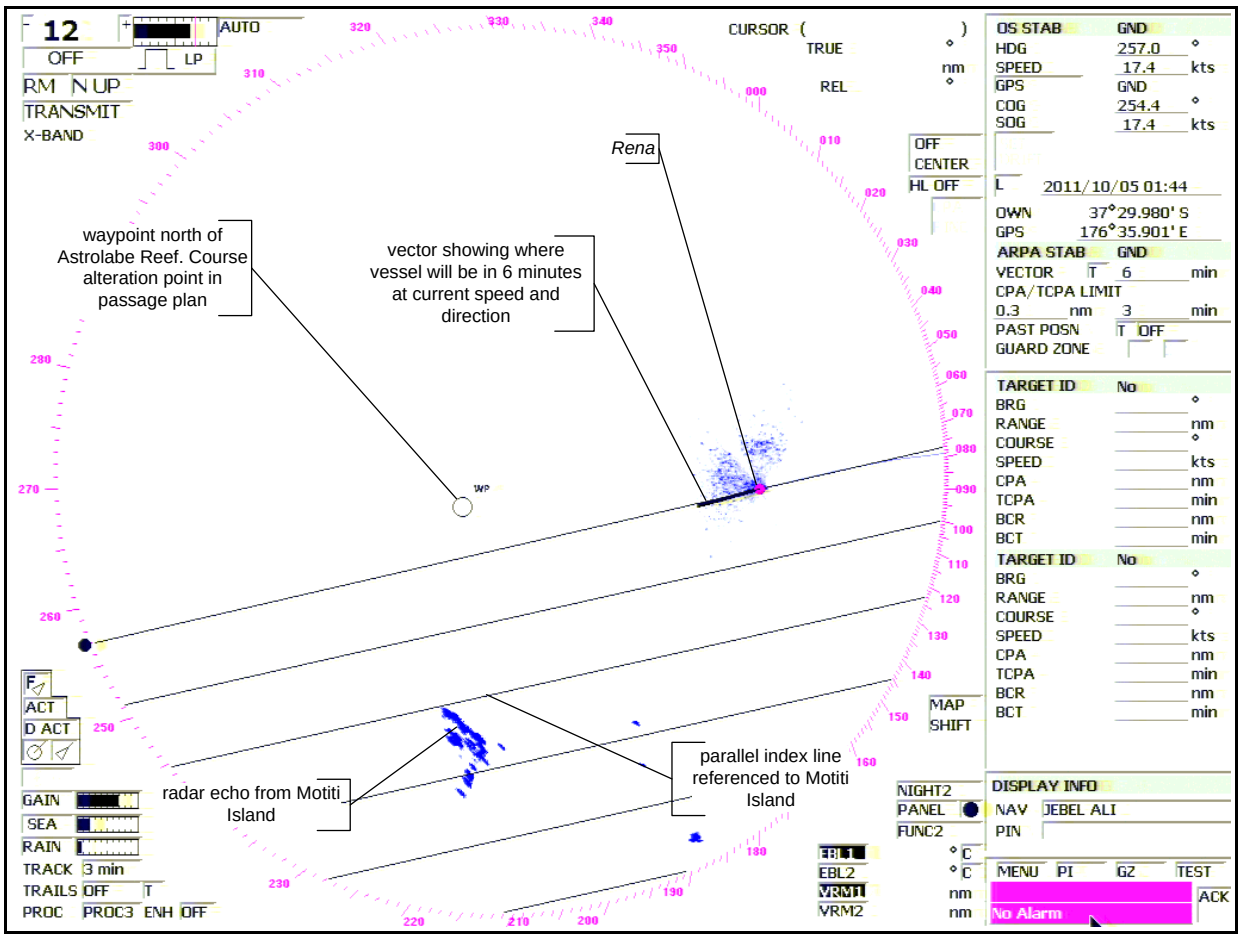

Figure 4
Annotated screenshot of the *Rena*'s radar (colour reversed for clarity)

2.2.23. The master discussed the preparation of the pre-arrival documents with the second mate, then went into the wheelhouse to become familiar with the situation of the vessel and monitor the radar. In his submission on this report the second mate said he showed the master the charts and pointed out the amended (passage) plan, including the mark one nautical mile off Astrolabe Reef. The master said he did not study the charts.

2.2.24. At about 0205 the master noticed an intermittent echo on the radar. The echo was about 2.6 nautical miles dead ahead of the *Rena*. The master showed the echo on the radar to the watchkeeper able-bodied seaman and they used binoculars to look through the windows of the bridge for the cause of the echo. They could not see anything, so they moved to the bridge wing to look from there. When again nothing could be seen the master said that he decided to plot the *Rena*'s position on the chart, so began to walk through the wheelhouse to the chartroom.

2.2.25. At 0214, as the master made his way to the chartroom, the *Rena* struck Astrolabe Reef while travelling at a speed of 17 knots.

2.3. Personnel information

2.3.1. The master held a current certificate of competency as master mariner issued by the government of the Republic of the Philippines in accordance with the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW). He had a licence of competence to a merchant marine officer (master) issued by the Republic of Liberia on 12 December 2007. The master had first signed on as master of a container ship in January 2008, then signed on to the *Rena* as master on 21 November 2010 until 7 February 2011, then signed on again as master on 25 March 2011.

2.3.2. The second mate (the navigating officer) had first signed on as an officer of a container ship in late 2009. At the time of the grounding the second mate held a certificate of competency as officer-in-charge of a navigational watch issued on 28 September 2010 by the government of the Republic of the Philippines in accordance with STCW. He had a licence of competence to a merchant marine officer (navigational watch officer) issued by the Republic of Liberia on 5 November 2010. He had signed on to the *Rena* as an officer in November 2010.

2.3.3. The able-bodied seaman watchkeeper on the bridge at the time of the grounding held a current certificate of competency as Deck Rating issued by the government of the Republic of the Philippines in accordance with STCW.

2.4. Vessel information

2.4.1. The *Rena* was built to American Bureau of Shipping class by Howaldtswerke Deutsche Werft in Germany in 1990. At the time of the grounding the *Rena* was owned by Daina Shipping Co. of Liberia. The International Convention for the Safety of Life at Sea safety management company was Ciel Shipmanagement S.A. Daina Shipping Co. was owned by Costamare Inc, which was incorporated in the Marshall Islands. The vessel was operating under time charter to the Mediterranean Shipping Company S.A.

2.4.2. The *Rena*'s general particulars can be seen in Table 1.

2.4.3. Charts that were relevant to the passage from Napier to Tauranga and in use on board the *Rena* were NZ56, NZ55, NZ54 and NZ541.

2.4.4. The bridge navigation and communications equipment installed on board the *Rena* is listed in Table 3.

Table 3
Navigation and communication equipment installed on board the *Rena*

System	Manufacturer
Global maritime distress and safety system medium frequency/high	Sailor
frequency console	Sailor
Inmarsat "C"	JRC
Inmarsat fleet broadband	Sailor
VHF/global maritime distress and safety system/digital selective calling	Sailor
Automatic identification system transponder	Atlas
RADAR (S-band automatic radar plotting aid)	Electronik
RADAR (X-band automatic radar plotting aid)	JRC
Gyro compass system	Anschutz Kiel
GPS	Furuno
Differential GPS	Koden
Depth sounder	Elac
Course recorder	Anshchutz
Speed log	Kiel
Navigational telex	JRC
Weather facsimile	JRC
Voyage data recorder (simplified)	JMC
	Totem

2.4.5. Of the equipment listed in Table 3, the S-band automatic radar plotting aid radar, course recorder and depth sounder were not in use at the time of the accident.

2.5. Environmental information

2.5.1. The accident happened in the "Plenty" coastal waters forecast area. The New Zealand Meteorological Service (MetService) issued coastal waters forecasts at regular times.

2.5.2. The coastal waters forecast issued on 5 October 2011 at 0027 for the Plenty coastal area was:

> PLENTY
> Northerly 10 knots, tending easterly 15 knots this afternoon. Sea slight.
> Northerly swell 2 metres easing. Fair visibility in a few showers developing this evening.
> OUTLOOK FOLLOWING 3 DAYS: Thursday morning becoming variable 10 knots

2.5.3. MetService said that coastal weather forecasts were valid within 60 nautical miles (about 100 kilometres) of the New Zealand coastline. Because most coastal forecast areas cover some thousands of square nautical miles, the forecast only describes in a general sense the expected weather conditions. In small parts of the forecast area (for example, off a particular headland in a particular wind flow), weather conditions could be significantly different from those forecast.

2.5.4. Port of Tauranga Limited had numerous meteorological sensors around the port, which were used to produce a picture of the conditions within the port and out to "A" beacon. The prevailing conditions at "A" beacon at the time of the accident were light airs, about one knot (0.5 m per second (m/s)) from a south-south-westerly direction, a significant wave height of 1.16 m and a tide of 1.79 m.

2.5.5. On board the *Rena*, the last weather observation recorded in the bridge log book, which was at 0000 on 5 October 2011, remarked that there was a clear sky with a moderate breeze and sea with good visibility. The wind was noted as being force 5 (Beaufort notation) (8.75 m/s to 10.80 m/s) from the northwest.

2.5.6. The New Zealand Nautical Almanac included Tauranga as a standard port for tidal prediction. The National Institute of Water and Atmospheric Research (NIWA) provided an online service to determine the tidal height at any position around the New Zealand coast. This service was used to determine the times of high and low water for the actual accident location. The calculated times for high and low water at Tauranga and Astrolabe Reef for 5 October are shown in Table 4.

Table 4
Table showing tidal heights for 5 October 2011

Date: 05/10/2011		High Water	Low Water	High Water	Low Water
Tauranga	Time Tidal height (m)	0153 +1.7	0800 -0.2	1432 +1.8	1938 -0.3
Astrolabe Reef	Time Tidal height (m)	0121 +0.73	0736 -0.82	1400 +0.80	2015 -0.67

2.5.7. The Bay of Plenty is affected by both ocean currents and tidal streams. The ocean currents and tidal streams to the north and east of New Zealand are complex, as described in the admiralty sailing directions of the United Kingdom Hydrographic Office 2010:

> ... The currents N and E of New Zealand are complex, varying with the seasons; their general movement can best be seen on the diagrams. To the N of North Island the South Sub-Tropical Current setting SW meets a current setting E to NE from the Tasman Sea. To SE of South Island the Southern Ocean current extends ENE, having rounded Stewart Island. Off the E coast of New Zealand, between these two broad developments, secondary eddies are formed. In the N part of this area, some of the water from Tasman Sea sets SE among the offshore islands and along the coast into the Bay of Plenty, before topographical diversion sends some of this water NE into the general oceanic drift. The remainder continues around East Cape, thence S to Hawke Bay and on to the entrance of Cook Strait...

> … Current sets generally S into Bay of Plenty but is not much felt. In the vicinity of East Cape it is SE where part is deflected offshore and the remainder sets generally S to the vicinity of Cape Turnagain…
>
> … Tidal streams along the coast set W with the flood and are greatly influenced by the prevailing conditions, see information on the chart. Off East Island (37°42'S 178°35'E), and in the channel W of the island, the rates of the tidal streams are much greater than off the open coast. On 5 October 2011, sunrise at Tauranga was calculated to be at 0645. Moonrise was at 1150 on 4 October 2011 and moonset was at 0236 on 5 October 2011. The moon was between half-moon and full moon.

2.6. Further lines of inquiry

2.6.1. The Commission is continuing to collate and verify information directly related to the grounding and is also pursuing several lines of inquiry of a wider systemic nature.

Recent Marine Occurrence Reports published by the Transport Accident Investigation Commission

11-204	Interim Report Marine inquiry 11-204 Containership MV Rena grounding on Astrolabe Reef 5 October 2011
09-202	Marine Inquiry 09-202: Passenger vessel Oceanic Discoverer Fatal injury, Port of Napier 19 February 2009
11-201,	Passenger vessel Volendam, lifeboat fatality,Port of Lyttelton, New Zealand, 8 January 2011
10-203	Marsol Pride, uncontrolled release of fire-extinguishing gas into engine room, Tui oil and gas field, 27 May 2010
09-204 and 09-207	Coastguard rescue vessel Dive! Tutukaka Rescue collision with rocks, Taiharuru River entrance Northland, 4 March 2009; Coastguard rescue vessel Trusts Rescue, heavy weather encounter,Manukau Bar, 31 May 2009
10-201	Bulk carrier TPC Wellington, double fatality resulting from enclosed space entry, Port Marsden, Northland, 3 May 2010
09-201	Collision: private jet-boat/private watercraft, Kawarau River, Queenstown, 5 January 2009
08-209	Loss of the rigid inflatable boat Mugwop, off the entrance to Lyttelton Harbour, 28 October 2008
11-201	Interim Factual report - Passenger vessel Volendam, lifeboat fatality, port of Lyttelton, New Zealand, 8 January 2011
08-205	Fishing vessel, *San Cuvier*, dragged anchor and grounded, Tarakeha Point, Bay of Plenty, 27 July 2008
08-206	Passenger ferry Monte Stello, collisions with wharfs, Picton and Wellington, 8 and 9 August 2008
09-205	Stern trawler Pantas No.1, fatality while working cargo, No.5 berth, Island Harbour, Bluff, 22 April 2009
09-203	Jet boat, DRJS-11 grounding and subsequent rollover Dart River, near Glenorchy, 20 February 2009
08-203	Passenger Ferry Monte Stello, Loss of Power, Tory Channel, 2 May 2008
08-207	Commercial Jet Boat Kawarau Jet No. 6, Roll-Over, confulence of the Kawarau and Shotover Rivers, 25 September 2008

Price $23.00

ISSN 1173-5597 (Print)
ISSN 1179-9072 (Online)