Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Marine Occurrence Investigation No. 248
Final

Independent investigation into the grounding of the Australian registered bulk carrier

Endeavour River

at Gladstone, Queensland
2 December 2007

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Figures 4 and 12 are provided courtesy of Maritime Safety Queensland.

Figure 14 is taken from the Nautical Institute's 'Tug use in port – a practical guide'.

Abstract

On the afternoon of 2 December 2007, the Australian registered bulk carrier *Endeavour River* grounded in Gladstone harbour while attempting a mid-tide berthing at the South Trees Wharf.

The master was attempting to berth the ship on a flood tide, with a following wind, and was unable to position the ship correctly for its approach to the berth. Even with the use of two attending tugs, he was unable to counteract the tidal influence. Throughout the berthing manoeuvre, only the master, the chief mate and the deck cadet were on the bridge.

The ship grounded in the vicinity of A1 beacon at the entrance to the Auckland Channel, destroying the beacon in the process. Despite the assistance of all five of the port's tugs, the ship could not be refloated at that time.

On 7 December, *Endeavour River* was successfully refloated on the morning high tide and manoeuvred with the aid of tugs to South Trees Wharf.

The investigation found that bridge resource management principles were not practiced by the bridge team and that no monitoring of the passage took place during the time leading up to the grounding. In addition, the bridge team lost situational awareness prior to the grounding. They became fixated on trying to berth the ship and were not responsive to other cues which would have alerted them that the ship was being set down into an area of shallow water.

The report identifies a number of safety issues and acknowledges safety actions which have been taken by ASP Ship Management and Maritime Safety Queensland to address those issues.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

TERMINOLOGY USED IN THIS REPORT

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, risk controls and organisational influences.

Contributing safety factor: a safety factor that, if it had not occurred or existed at the relevant time, then either: (a) the occurrence would probably not have occurred; or (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious; or (c) another contributing safety factor would probably not have occurred or existed.

Other safety factor: a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report.

Other key finding: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which 'saved the day' or played an important role in reducing the risk associated with an occurrence.

Safety issue: a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

Safety issues can broadly be classified in terms of their level of risk as follows:

- **Critical safety issue**: associated with an intolerable level of risk.
- **Significant safety issue**: associated with a risk level regarded as acceptable only if it is kept as low as reasonably practicable.
- **Minor safety issue**: associated with a broadly acceptable level of risk.

EXECUTIVE SUMMARY

On the morning of 2 December 2007, the Australian registered bulk carrier *Endeavour River* was anchored outside Gladstone harbour. The ship had arrived from Weipa two days earlier with a cargo of bauxite and was scheduled to berth at about 1400[1].

At 1057, the anchor was weighed and at 1200 the ship passed the Fairway Buoy, entering the South Channel. Shortly afterwards, the ship entered the Gatcombe Channel. The pilotage-exempt master had the conduct of the ship, with the chief mate controlling the engine telegraph and monitoring the actions of the helmsman and the cadet.

At about 1303, while *Endeavour River* was transiting the Gatcombe Channel, the cape-sized[2] Japanese registered bulk carrier *Kamisu Maru* was preparing to depart Clinton Number One coal berth for sea. The *Kamisu Maru* had a maximum draught of 17.25 m, the deepest allowable for the height of tide and had a harbour pilot on board.

At 1313, *Endeavour River*'s master began to turn the ship onto the Auckland Channel leads.

Shortly after entering the Auckland Channel, *Kamisu Maru*'s pilot noticed that the inbound *Endeavour River* was approaching its berth. He could clearly see the ship at the south-eastern end of the channel. He considered that the ship would be clear of the channel by the time *Kamisu Maru* was at the end of the channel.

At about 1339, *Endeavour River*'s master and chief mate began to notice that the tide and wind appeared to have taken control of the ship's stern and started to push it up towards the entrance to the Auckland Channel. The ship was now coming beam-on to the full effect of the flood tide. The master tried to stop the stern's movement to starboard. As the ship moved further away from the berth the master continued the attempt to turn the bow to port which, at 1342, was about 600 m from its intended berth.

At 1350, *Kamisu Maru*'s pilot contacted *Endeavour River* by VHF, advising its master that *Kamisu Maru* was passing Barney Point. He asked if *Endeavour River* was clearing the channel or was the master experiencing difficulties. *Endeavour River*'s master replied that he was but that the ship would hopefully be clear in time for *Kamisu Maru* to exit.

Endeavour River's master then decided to abort the berthing and concentrate on turning the ship to port in the swing basin and then heading out of the harbour. The strong flood tide continued to push the ship bodily towards the northwest and the entrance to the Auckland Channel.

At 1352, even though the engine was still being used, *Endeavour River*'s Global Position System (GPS) speed had fallen to below one knot[3]. The ship was in a

1 All times referred to in this report are local time, Coordinated Universal Time (UTC) + 10 hours.

2 Dimensions larger than that allowable for transit of the Panama Canal.

3 One knot, or one nautical mile per hour, equals 1.852 kilometres per hour.

position obstructing about half of the Auckland Channel's southeast entrance, about 80 m from A1 beacon.

In an effort to clear the Auckland Channel, *Endeavour River*'s master continued to use a combination of engine movements, both ahead and astern, and the tugs in an attempt to turn the ship's bow to port. By 1420, *Endeavour River* had moved sufficiently clear of the centre of the channel to enable *Kamisu Maru* to pass about 20 m ahead of its bow, and the same distance from A2 beacon. At 1513, the starboard side of *Endeavour River*'s hull, just aft of amidships, collided with, and destroyed, A1 beacon. The ship was now firmly aground and could not be refloated that day.

On Friday 7 December, the ship was refloated on the morning high tide, with the assistance of the port's five tugs. *Endeavour River* was then towed to South Trees Wharf where a thorough underwater inspection was carried out. Apart from some scratches to the ship's paint, no significant damage was observed to the hull, propeller or rudder.

As a result of the investigation into the grounding, the ATSB identified a number of safety factors, which are summarised below.

When in the Auckland Channel, *Endeavour River* was to starboard of the planned route where, in order to berth the ship, the master needed to present more of the ship's port side to the effects of the flood tide and wind. The master did not use propeller thrust effectively while manoeuvring towards the berth and he did not place the tugs in the most effective positions for the anticipated manoeuvre. In addition, he had not received sufficient training in recovering from the situation when the ship was bodily across a flood tide.

The bridge team did not apply any bridge resource management principles during the passage. *Endeavour River*'s master did not discuss any aspect of his passage plan from the anchorage to the berth with any member of the bridge. Both the master and chief mate were very familiar with the passage to the berth in Gladstone. This familiarity probably resulted in them being complacent during the operation and led to the failure to adequately monitor the ship's progress during the passage. Overall manning on the bridge was insufficient to manage the risks associated with the pilotage while the ship was under the conduct of an exempt master.

No positions were put on the charts and radar was not used to monitor the passage. The bridge team began to lose situational awareness as the ship passed the Boyne Wharf.

ASP Ship Management had no competency audit or 'check pilot' system in place. Pilotage-exempt masters in Gladstone were not actively engaged by ASP Ship Management and Maritime Safety Queensland to enable them to participate in port-centred pilotage development activities to better manage the risk to the port.

Finally, ASP Ship Management had not implemented the majority of the recommendations contained in the internal investigation report into the 2003 grounding of *Endeavour River*. Had the company actioned these findings and recommendations, the risk of a grounding reoccurring in similar circumstances probably would have been significantly reduced.

The report identifies a number of safety issues and acknowledges safety actions which have been taken by ASP Ship Management and Maritime Safety Queensland to address those issues.

1 FACTUAL INFORMATION

1.1 *Endeavour River*

Endeavour River (Figure 1) is an Australian registered bulk carrier engaged in carrying bauxite between the Queensland ports of Weipa and Gladstone, through the Great Barrier Reef Inner Route.

Built by Italcanterieri at Monfalcone, Italy in 1983 as *TNT Carpentaria*, it was renamed *Endeavour River* in 1995. The ship is owned by Toll Holdings, Australia and managed and crewed by ASP Ship Management (ASP), Australia. It is classed with Lloyd's Register (LR).

Figure 1: ***Endeavour River***

Endeavour River has an overall length of 255.0 m, a breadth of 35.3 m and a deadweight of 82 422 tonnes at its summer draught of 13.2 m.

The ship is a 'coal-fired' steamship and was purpose built for the bauxite trade. It has four cargo holds forward of the accommodation which are serviced by eight hatches. Immediately aft of number four cargo hold is a coal bunker, used to store coal used to fire the ship's main boiler.

Endeavour River's navigation bridge is equipped with a range of navigational equipment in accordance with SOLAS[4] requirements. This includes two Racal-Decca BridgeMaster Automatic Radar Plotting Aid (ARPA) radars, a Leica MX 412 Differential Global Position System (DGPS) unit, a Simrad echo sounder and a Sperry Marine VoyageMaster II simplified voyage data recorder (S-VDR).

Propulsion is provided by a single coal-fired boiler supplying steam to a General Electric double reduction steam turbine producing 13 000 kW at 85 shaft revolutions per minute (rpm). The turbine drives a single, right-handed, fixed pitched propeller which gives the ship a service speed of about 14 knots.

4 The International Convention for the Safety of Life at Sea, 1974, as amended.

The standard rpm used for ahead and astern settings are:

Ahead		**Astern**	
Dead slow	15	Dead slow	15
Slow	30	Slow	30
Half	45	Half	40
Full	60	Full	50

At the time of the incident, *Endeavour River*'s crew comprised 22 Australian nationals. All the mates and engineers held the necessary qualifications.

The master held an Australian master class one certificate of competency and had 29 years of seagoing experience. He had been on the Weipa to Gladstone bauxite trade since 1993 and had been master since 2004. He had commanded *Endeavour River* for 3½ years prior to the incident and held the necessary pilotage exemption for Gladstone. Since getting a Gladstone pilotage exemption, he had completed more than 50 pilotages into Gladstone.

The chief mate started his seagoing career with the Royal Australian Navy, where he served from 1987 until 1999. He obtained a second mate's certificate of competency in 2001, and then joined ASP. His first ship was *Endeavour River* where he completed three periods of duty in 2001. Following service on various ships with ASP, he returned to *Endeavour River* in April 2005 as chief mate. In December 2006, he gained his master class one certificate of competency, and had rejoined the ship following this period of study.

The deck cadet on the bridge at the time of the incident had been at sea since May 2007 following a period of three months pre-sea training at the Australian Maritime College (AMC), Tasmania. He joined *Endeavour River*, his second ship, on 18 September 2007.

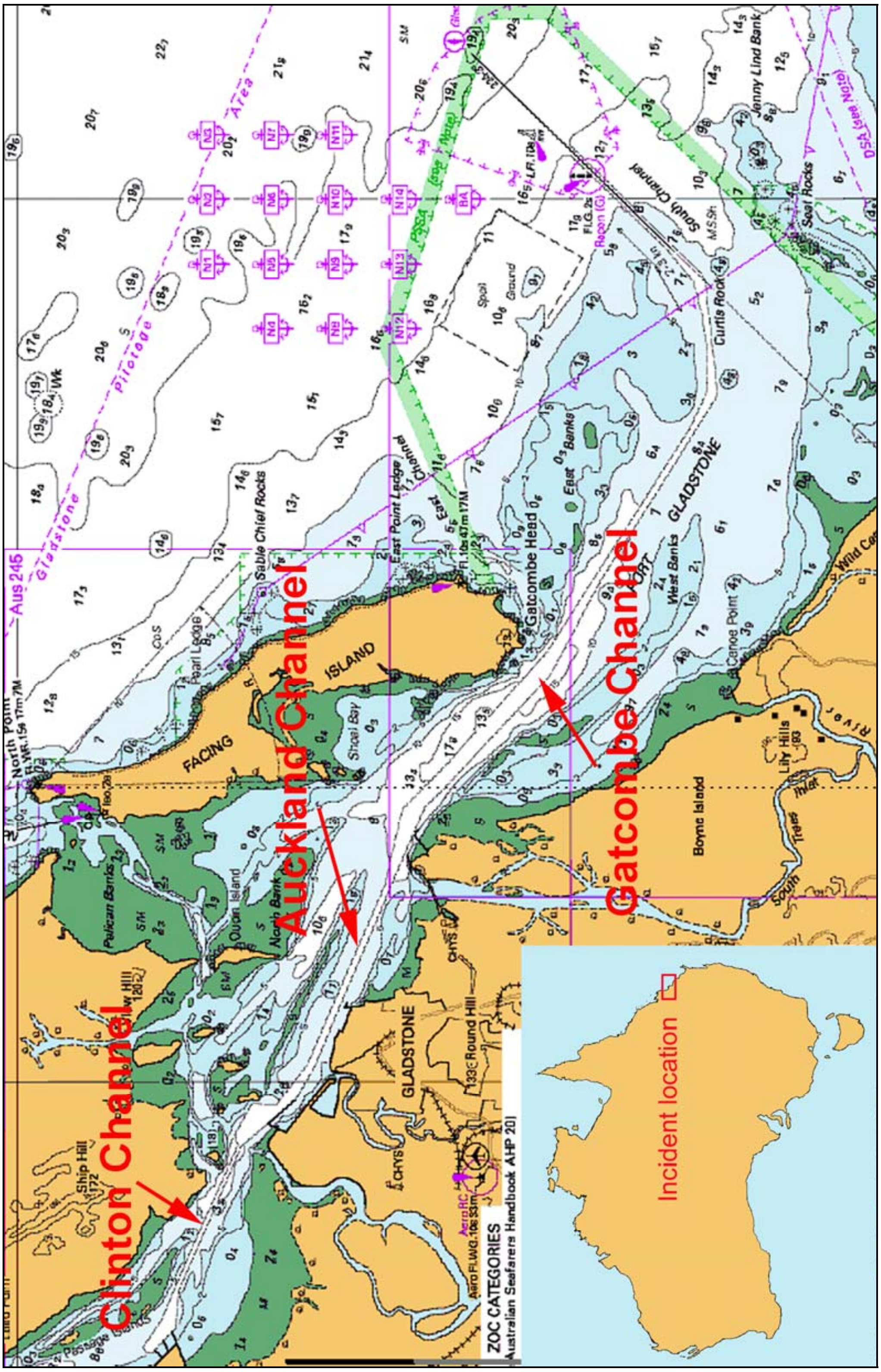
The harbour pilot on board the outbound ship, *Kamisu Maru* had been a Gladstone pilot since 1997 and had piloted ships in Wyndham, Western Australia, and the United Kingdom following a seagoing career. He was the senior pilot in Gladstone, a position he had held for about eight years.

1.2 Gladstone

The port of Gladstone is located on the central coast of Queensland (Figure 2). Its natural harbour forms one of the largest and safest ports in Queensland. Gladstone is one of Australia's major coal export ports and is centrally situated to serve the rich mining areas of central Queensland[5]. The city of Gladstone and all berthing areas are on the south-western side of the harbour.

5 Admiralty Sailing Directions, Australia Pilot Volume III (NP 15), tenth edition 2005, p. 163.

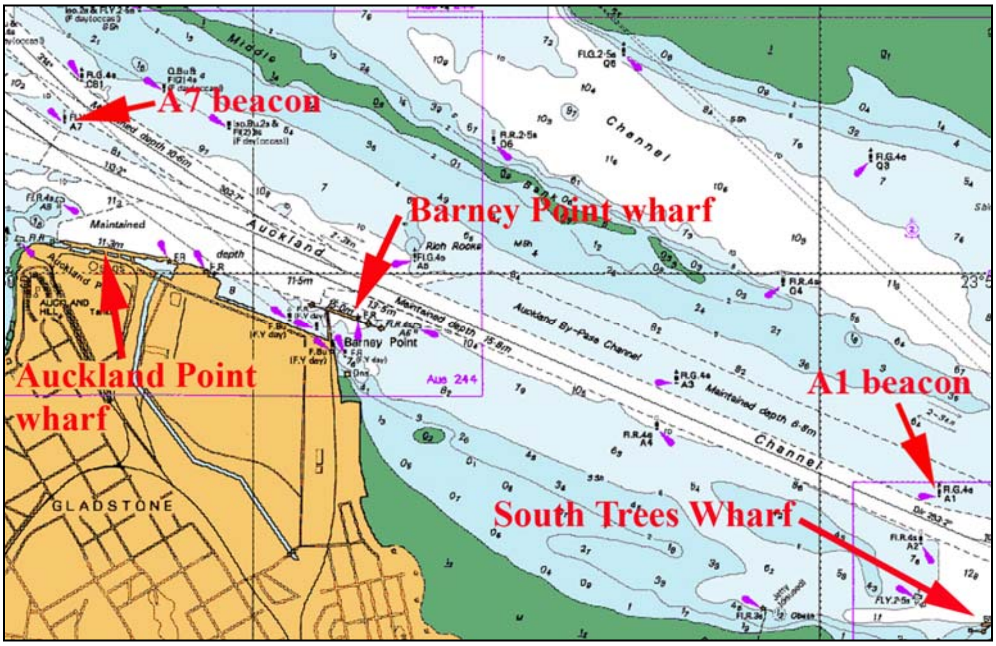
Figure 2: Section of navigational chart Aus 366 showing Gladstone



The harbour is entered through South and Gatcombe Channels leading from sea to the outermost berths at South Trees Point. From there, Auckland, Clinton and Targinie Channels together lead nine miles[6] further west-northwest giving access to the berths at Barney Point, Auckland Point, Clinton Wharves and Fishermans Landing respectively.

Auckland Channel (Figure 3) is the main shipping channel leading from Gatcombe Channel and the South Trees Point area to the main port of Gladstone berths. It is approximately three miles in length, 182 m wide and has a charted depth of 15.8 m. Auckland channel starts at A1 and A2 beacons (northwest of South Trees Point) and runs in a direction of approximately 293° (T). It ends at A7 beacon, just to the north of Auckland Point. To facilitate passing, a smaller by-pass channel, which has a charted depth of 6.8 m, is dredged alongside the Auckland Channel for part of its length.

Figure 3: Section of navigational chart Aus 244 showing Auckland Channel



The Australia Pilot (NP 15) describes tidal streams within the South Channel and harbour as generally turning at the time of high water at Gladstone. The tidal streams generally run southeast on an ebb tide and northwest on a flood tide. Wind can affect these streams which may set very strongly through the channels. Predicted directions and maximum rates are shown on the charts. Areas within the harbour can experience tidal streams of up to four knots.

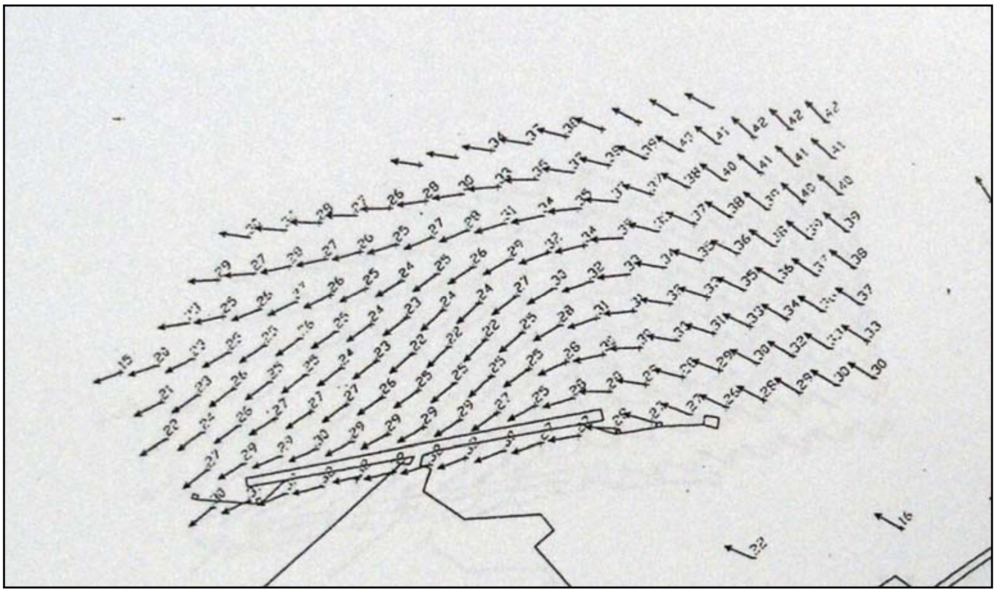
Tidal streams passing South Trees Wharf can be up to three knots (without wind influence) and therefore can have a major influence on the ability to safely handle a ship in this area. This is particularly important on a flood tide, when a ship can be pushed up towards the shallow area of the harbour if its entire length is presented to the full effects of the tidal stream.

A transmitting tide gauge capable of recording tidal height data is located at the Auckland Point wharf and Gladstone Vessel Traffic Services officers can, when

6 A nautical mile of 1852 m.

requested, access the data for harbour pilots and pilotage-exempt masters. However, there is no such gauge in the vicinity of South Trees Point.

Figure 4: Recorded tidal flows (flooding) at South Trees Wharf



The results of surveys conducted in the vicinity of South Trees Wharf by the Central Queensland University for Maritime Safety Queensland (MSQ) are shown in Figure 4. The data was collected three hours before high water on a 2.1 m tidal range and at a depth of six metres, about half the draught of *Endeavour River*. The arrows indicate direction of flow and the figures are in cm/s (50 cm/s equals about 1 knot).

1.2.1 Gladstone pilotage exemptions

Maritime Safety Queensland is the Queensland government agency responsible for maritime safety and marine pollution matters for Queensland coastal waters. Pilots in the port of Gladstone are licensed by MSQ and limited pilotage exemptions are available for masters of Australian ships using the port. Pilotage exemptions are regulated by MSQ and subject to certain qualifying criteria. Pilotage exemptions for Gladstone are issued for certain areas within the port, and only for a ship or class of ship operating in the port.

According to MSQ’s guidelines for issuing pilotage exemptions, an applicant must have: a valid master’s certificate which enables the applicant to be the master of a class of ship that the person would have the conduct of; appropriate ship handling ability to have conduct of the ship as a pilot; and a detailed knowledge of the pilotage area, or part of the pilotage area, for which the exemption is sought.

Before being issued with an exemption for Gladstone, an applicant must complete at least six inbound and six outbound pilotages as an observer with a licensed pilot or exempt master. No more than half of these may be with an exempt master. If a night exemption is required, not less that six pilotages must be during the hours of darkness.

In addition to these pilotages as an observer, the applicant must:

- complete, under scrutiny, at least one arrival and one departure from each of the berths within the port for which the exemption is being sought;
- pass a written and oral examination;
- have attended an ARPA and radar simulator course;
- observe and undertake passing manoeuvres within the port;
- correctly 'fill in' a blank chart of the port (buoy and beacon positions, depths, etc);
- complete one pilotage with a 'check pilot'; and
- have a current Australian Maritime Safety Authority (AMSA) medical certificate.

When MSQ is provided with a pilotage assessment report by a check pilot, recommending that the applicant be issued with an exemption, an Exemption from Pilotage licence and/or Pilotage Area Endorsement for the specific pilotage area or part of the pilotage area, may be issued[7].

1.2.2 Gladstone Vessel Traffic Service

The role of the Vessel Traffic Service (VTS) in Gladstone is to provide a monitoring and information service to ships operating within the port. VTS also ensures the safe, efficient and compliant movement of ships and the protection of the environment.

In order to fulfil the overall role, a VTS operator's responsibilities include delivering the prescribed port VTS, including responses to marine incidents, related emergencies and natural disasters in accordance with port regulations, procedures and instructions.

1.3 Mid-tide berthing at South Trees Wharf

Mid-tide berthing, on either an ebb or flood tide, was introduced at South Trees Wharf (Figure 5) to increase vessel throughput and the resultant supply of bauxite for the Queensland Alumina processing plant. Mid-tide berthing also reduces the impact of other harbour movements on fully laden coal ships that can only sail on high tide.

Given the significant tidal stream flows in the vicinity of South Trees Wharf, mid-tide berthings are restricted to those occasions when the tidal range is not more than two metres for a flood tide berthing and not more than three metres for an ebb tide berthing.

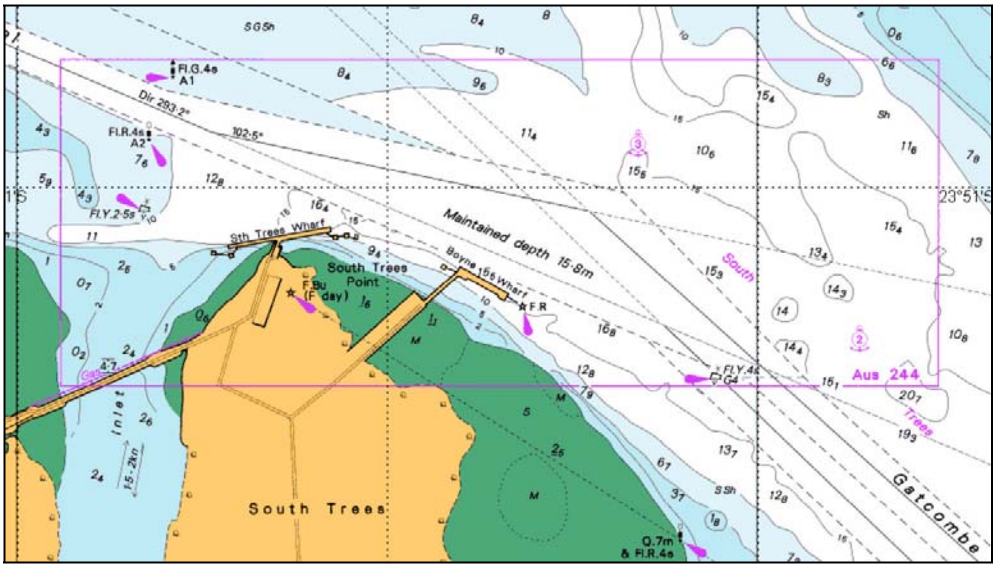
Gladstone pilots and exempt masters who may be in charge of vessels for a mid-tide berthing at South Trees Wharf are required to undergo a three day training course in the mid-tide manoeuvre/operation on the Australian Maritime College's

7 *Guideline for Issuing Exemptions from Pilotage.* Version 3 MSQ, 2003.

shiphandling simulator. The training is conducted by former ASP masters who have held exemptions for the port.

Endeavour River's master had attended the simulator training seven years prior to the incident.

Figure 5: South Trees Point area



1.4 The incident

On the morning of 2 December 2007, *Endeavour River* was anchored at the designated anchorage position 'N11' outside Gladstone harbour (Figure 2). The ship had arrived from Weipa two days earlier with a cargo of bauxite and arrival draughts of 12.23 m forward and 11.3 m aft. The ship was scheduled to berth at about 1400.

On 2 December, a low water of 1.6 m was predicted at 0945, and a high water of 3.5 m at 1550. The tidal range, at 1.9 m, was just inside the limit for a mid-flood tide berthing and the master would be required to carry out a mid-tide berthing on the flood tide.

At 0800, winds in the anchorage were recorded in the ship's deck log book as south-easterly force five[8] (17 to 21 knots).

At 1000, the ship's bridge equipment was tested and, with the exception of the engine data logger, was found to be in order. At 1057, the anchor was aweigh and at 1200, the ship passed the Fairway Buoy. The propeller's (shaft) speed was set to 50 rpm and the ship's speed[9] was 10.3 knots. The master, the second mate, a deck cadet and a helmsman were on the bridge. The wind was recorded as south-easterly force five to six (17 to 26 knots).

8 The Beaufort scale of wind force, developed in 1805 by Admiral Sir Francis Beaufort, enables sailors to estimate wind speeds through visual observations of sea states.

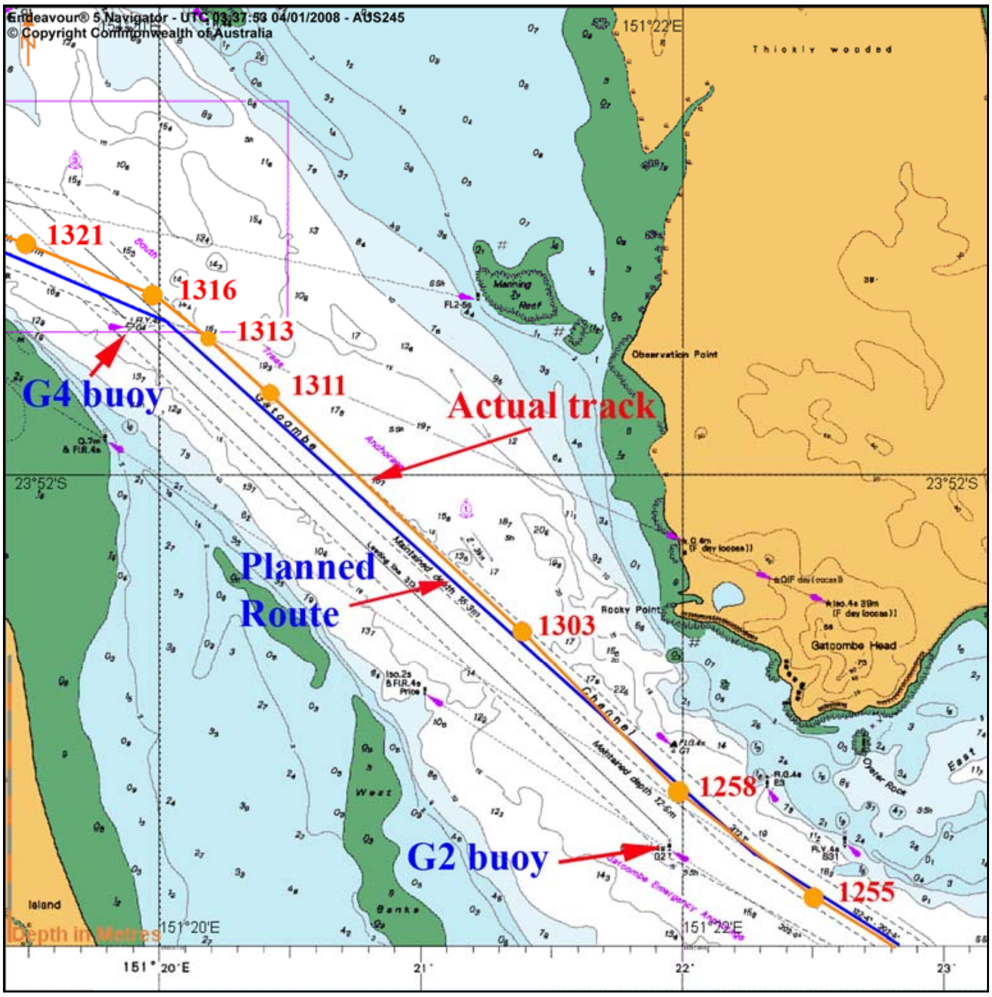
9 All speeds referred to in this report are 'made good / over the ground'.

At about 1258, while the ship was transiting the Gatcombe Channel, on a heading[10] of about 312°, the chief mate relieved the second mate. The second mate made his way to the poop deck to prepare for his arrival duties. The master had the conduct of the ship, with the chief mate controlling the engine telegraph and monitoring the actions of the helmsman and the cadet, who was making entries in the movement book.

At 1303, while transiting the Gatcombe Channel (Figure 6), the ship's speed was 9.7 knots, with the shaft speed at 30 rpm. The master was satisfied with the ship's progress.

At about this time, the Japanese registered bulk carrier *Kamisu Maru* was preparing to depart Clinton Number One coal berth for sea. *Kamisu Maru*, with an overall length of 269 m and a breadth of 43 m, was fully laden. The ship had a maximum draught of 17.25 m, the deepest allowable for the height of tide. The harbour pilot on board the ship advised Gladstone VTS that *Kamisu Maru* was ready for its scheduled departure. He was updated with vessel movements within the port, including that *Endeavour River* was inbound and approaching the G4 buoy in the Gatcombe Channel.

Figure 6: Section of navigational chart Aus 245 showing *Endeavour River*'s passage through Gatcombe Channel

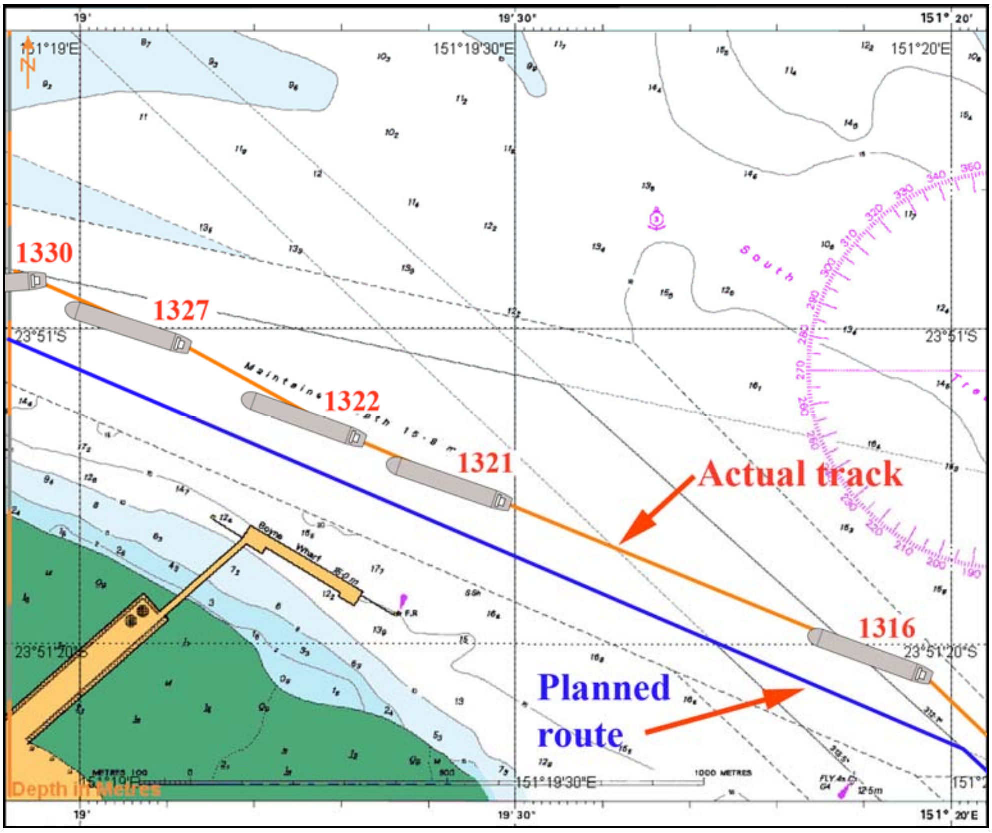


10 The ship's heading referred to in this report are in degrees gyro, with negligible error.

As *Endeavour River* neared the G4 buoy at a speed of about 7.5 knots, two tugs were made fast. At 1311, the tug *Beltana* (an ASD tug[11] with a rated bollard pull[12] of 60 tonnes) was made fast to the ship's starboard shoulder. At 1312, the tug *Wistari* (an ASD tug with a rated bollard pull of 47 tonnes) was made fast on the starboard side of the ship's main deck immediately forward of the coal bunker, about 55 m from the ship's stern. Both tugs then accompanied the ship up the remainder of the Gatcombe Channel, taking no weight on their lines.

At 1312, *Kamisu Maru*'s last line was let go and the ship started its outward passage. The pilot released the two tugs which then made their way to another ship waiting off the Clinton Wharf to berth. The pilot put the engine to dead slow ahead and began the passage down the Clinton Channel, increasing to slow ahead as the ship passed Clinton Number Two berth. When the pilot was satisfied with the ship's steerage and position in the centre of the channel, he instructed the last of the tugs be let go. He then increased the engine to half ahead and advised VTS that the ship was proceeding on its passage. When *Kamisu Maru* reached A7 beacon, it was making good a speed of about 4.5 knots. The pilot turned the ship into the Auckland Channel and steadied the ship on the centreline of the channel, a heading of about 113°.

Figure 7: Section of navigational chart Aus 244 showing *Endeavour River*'s planned route and actual track - images (to scale) of the ship, aligned to its heading at various times, have been superimposed on the actual track



11 Azimuth Stern Drive tug – A multi-purpose tug, with azimuthing propellers aft.

12 The pulling power of a tug, expressed in tonnes.

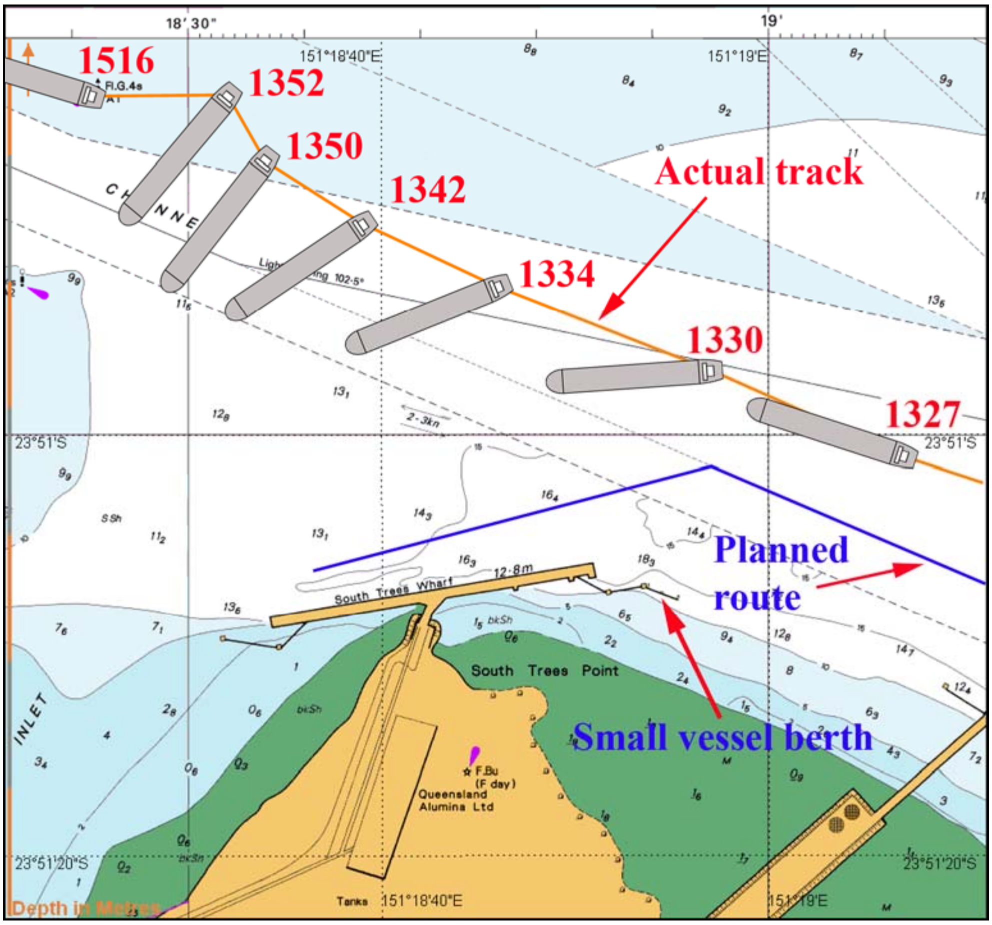
Meanwhile, at 1313, *Endeavour River*'s master ordered the helm to be put hard-to-port to turn the ship onto the Auckland Channel leads (293° (T)). At 1315, he ordered the rudder midships and then hard-to-starboard to stop the port swing. At 1317, he ordered the shaft speed to be reduced to 10 rpm ahead and midships on the helm.

At 1319, with the ship on a heading of 288°, the master ordered starboard 20 and at 1320½, he ordered the helm to be brought back to midships. At 1321 (Figure 7), the ship passed the west arm of the Boyne Wharf, about 90 m to starboard of the planned track, at a speed of five knots. At 1322, the master ordered 20 degrees of port helm.

There was a ship berthed on the eastern arm of South Trees Wharf, so the master felt that his approach to the western arm berth needed to differ slightly from the standard approach. He decided to delay slightly his final turn to port to ensure that *Endeavour River* cleared the outboard swung cranes on the berthed ship.

Shortly after entering the Auckland Channel, *Kamisu Maru*'s pilot noticed that the inbound *Endeavour River* was approaching its berth. He could clearly see the ship at the south-eastern end of the channel. He didn't think too much about *Endeavour River* at that time as it was where he expected it to be. He considered that the ship would be clear of the channel by the time *Kamisu Maru* was at the end of the channel.

Figure 8: Section of navigational chart Aus 244 showing *Endeavour River*'s planned route and actual track - images (to scale) of the ship, aligned to its heading at various times, have been superimposed on the actual track



At 1325, *Endeavour River* approached the small vessel berth, just to the east of South Trees Wharf's east arm (Figure 8). The master began his intended turn to port, ordering the helm to be put hard-to-port and slightly increasing the ship's shaft speed to 20 rpm to assist the turn. At this time, the ship was making good 298° (T) at about three knots.

At 1328, the master ordered 10 rpm astern to slow the ship. At 1330, this was increased to 40 rpm astern. The ship's speed was still about three knots and while its heading had changed from about 288° to 266°, the course made good had only changed from 298° (T) to 290° (T). At 1331, in an effort to stop the ship's swing to port, the helm was put amidships and then hard-to-starboard.

At about this time, the master, as was his usual practice, stood the helmsman down so that he could assist on deck. This left the master, the chief mate and the cadet on the bridge. The chief mate, who had been operating the engine telegraphs, monitoring the VHF radios, the internal telephones and the cadet, was now also responsible for executing any helm orders.

At 1332, the master, satisfied that the approach was proceeding as planned, requested that both tugs 'square up' to *Endeavour River* so that they could assist in maintaining the ship's heading relative to the flood tide.

At 1334, *Endeavour River* was in position 23°50.9'S 151°18.8'E, on a heading of 248° and at a speed of 1.7 knots, making good a course of 293° (T). At 1338, the master ordered 20 rpm astern.

At about 1339, the master and chief mate began to notice that the tide and wind appeared to have taken control of the ship's stern and started to push it up towards the entrance to the Auckland Channel and that the ship was now coming beam-on to the full effect of the flood tide.

The master tried to stop the stern's movement to starboard using the ship's propeller and the after tug pushing up at 100 per cent while using the forward tug to hold the bow in position. As the ship moved further away from the berth (Figure 8), the master continued the attempt to turn the bow to port.

At 1342, *Endeavour River* was in position 23°50.8'S 151°18.6'E, on a heading of 236°. The ship was making good 285° (T) at a speed of 0.7 knots, and was about 600 m from its intended berth.

At 1345, the master ordered 30 rpm astern and this was followed at 1347 by an order of 40 rpm astern.

At 1348, as *Kamisu Maru* passed the Barney Point coal wharf, its pilot noticed that *Endeavour River* was not progressing towards its berth as he had anticipated. Concerned, he called VTS on VHF Channel 13 and asked if *Endeavour River* was clearing the Auckland Channel towards its berth. The VTS operator replied that the ship was not moving quickly and that it was across the Auckland Channel. The pilot reduced *Kamisu Maru*'s speed to allow more time for *Endeavour River* to clear the channel.

At 1349, *Endeavour River* was still in position 23°50.8'S 151°18.6'E, on a heading of 223°.

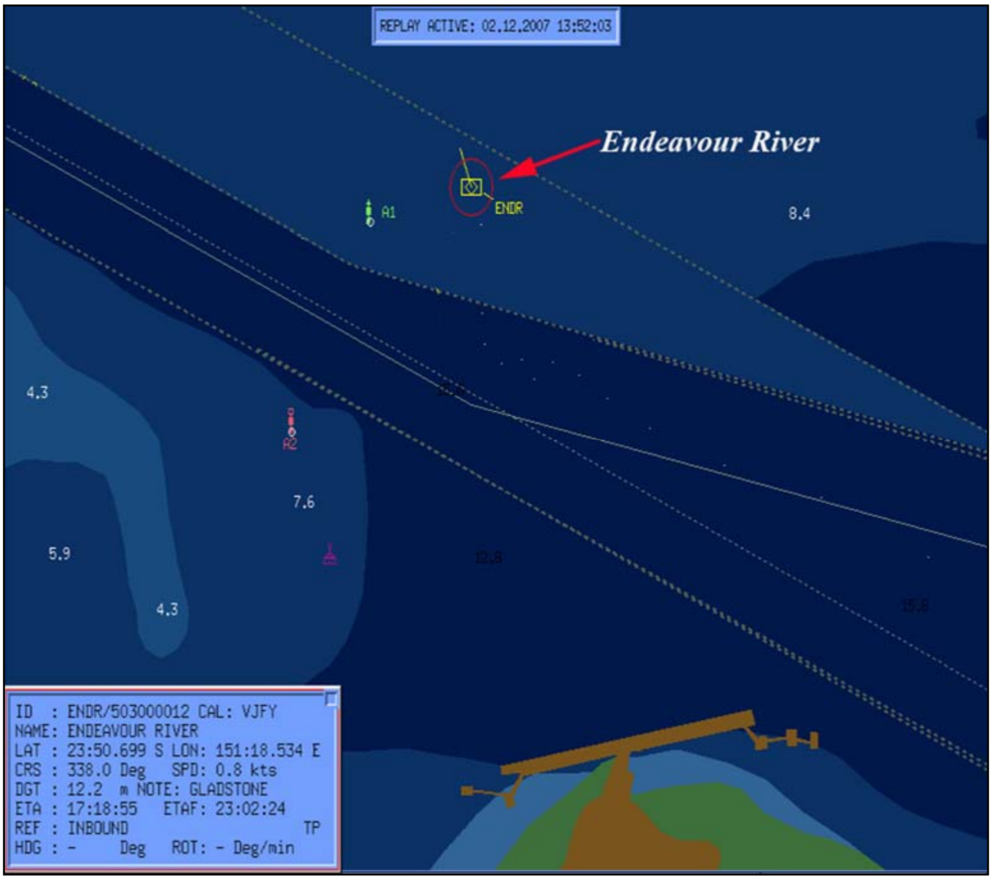
At 1350, *Kamisu Maru*'s pilot contacted *Endeavour River* by VHF, advising its master that *Kamisu Maru* was passing Barney Point. He asked if *Endeavour River* was clearing the channel or was the master experiencing difficulties. *Endeavour*

River's master replied that they were 'in a bit of a spot at the moment, having trouble getting the arse around'. The pilot asked him if he could come ahead on the engines and clear the channel, informing him that *Kamisu Maru* was at maximum draught and had no tugs available to assist. The master replied that he was not able to clear the channel at the time but would hopefully be clear in time for *Kamisu Maru* to exit.

The master then decided to abort the berthing and concentrate on turning the ship to port in the swing basin and then heading out of the harbour. The strong flood tide continued to push the ship bodily towards the northwest and the entrance to the Auckland Channel. At about 1351, he ordered 30 rpm astern and at 1352, he ordered 40 rpm ahead and the helm to be put hard-to-port.

At 1352, even though the engine was still being used, *Endeavour River*'s speed remained below one knot, with the ship still about 80 m from A1 beacon (Figure 9).

Figure 9: Gladstone VTS AIS display showing the position of the ship at 1352



Realising that there was a potentially serious situation unfolding, *Kamisu Maru*'s pilot had brought the ship's engine speed back to dead slow ahead as it passed A5 beacon. Because *Kamisu Maru* was at maximum draught and restricted to navigating within the Auckland Channel, the pilot began to consider what options were available to him in the event that *Endeavour River* did not clear the channel. He requested that an anchor party be on stand-by on the forecastle head. He also considered that a tug could be used to hold the ship's stern in the channel if anchoring was deemed necessary.

In an effort to clear the channel, *Endeavour River*'s master continued to use a combination of engine movements, both ahead and astern, and the tugs in an attempt to turn the ship's bow to port.

At 1352, *Kamisu Maru*'s pilot asked VTS if the port's fifth tug, *Clontarf*, was available. The VTS operator confirmed that it was and some time later, the tug was dispatched to assist. The tug skipper called both *Kamisu Maru* and *Endeavour River* on VHF Channel 13 and *Endeavour River*'s master replied that he did not need additional tug assistance, stating 'we should be right at the moment thanks'. *Kamisu Maru*'s pilot then told the tug's skipper that 'we're in a bit of a predicament here' and requested that the tug make its way to his ship.

At 1356, *Kamisu Maru*'s pilot asked *Endeavour River*'s master if his ship could maintain its current position or possibly go astern so that *Kamisu Maru* could pass ahead. He also stated that his ship was on minimum speed and that he did not have many options available to him. He was advised that *Endeavour River* was still 'trying to turn to port' and if it couldn't, the master would go astern.

Two minutes later, *Kamisu Maru*'s pilot again contacted *Endeavour River*'s master and informed him that *Endeavour River*'s foremast was in line with the centreline of the Auckland Channel. *Kamisu Maru*'s pilot again requested that *Endeavour River*'s master go astern on the ship's engine or get the forward tug to push the bow to port and attempt to move it clear of the channel so that *Kamisu Maru* could pass. *Kamisu Maru*'s pilot then stopped his ship's engine. However, as the ship's speed reduced, it began to lose steerage and the engine was returned to dead slow ahead. *Endeavour River*'s master told *Kamisu Maru*'s pilot that he was 'now coming astern on the engines and that the tug was pushing up'.

Kamisu Maru's pilot considered three options that were available to him to avoid a collision with *Endeavour River* if it did not fully clear the channel. He could continue and exit the channel through a large enough gap left between *Endeavour River* and A2 beacon ahead. He could also anchor the ship in the channel with the assistance of the tug until there was enough room for *Kamisu Maru* to pass between *Endeavour River* and A2 beacon, or exit the channel before the beacons. The last option would result in *Kamisu Maru* grounding, blocking the channel and the upper part of the port.

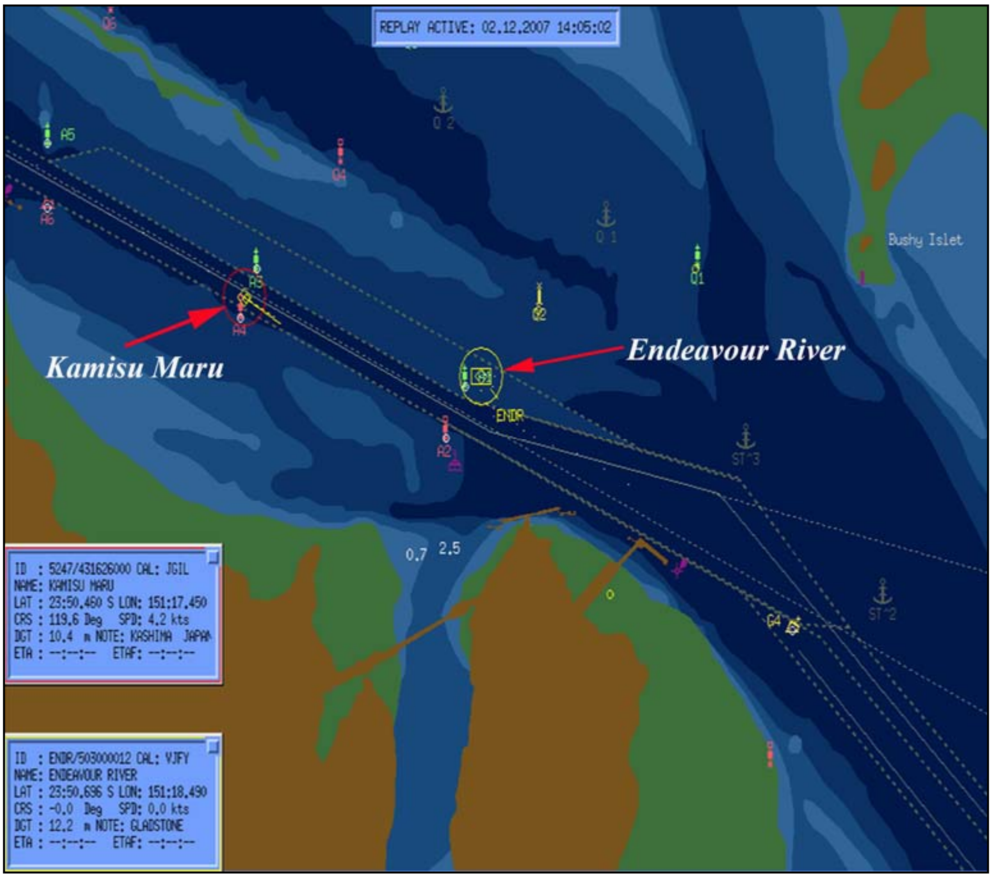
At 1400, *Endeavour River* was still in position 23°50.8'S 151°18.6'E, on a heading of 220°. The master was still trying to manoeuvre the ship clear of the channel, but it was stationary.

At 1400, *Kamisu Maru*'s pilot advised *Endeavour River*'s master that *Clontarf* was enroute to *Endeavour River* as he believed that would be the best use of the tug. He also told *Endeavour River*'s master that *Kamisu Maru* needed half the width of the Auckland Channel to successfully clear it. *Endeavour River*'s master replied that his ship's engine was operating astern and that the ship's bow appeared to be slowly clearing the channel.

At about 1405, the bows of the two ships were less than one mile apart (Figure 10). *Endeavour River*'s master informed *Kamisu Maru*'s pilot that astern power was not having the desired effect and that he intended to put his engine ahead to drive the ship around to port and 'will get clear of you as soon as it can'. *Kamisu Maru*'s pilot immediately replied 'negative to that, best option is to let the bow swing down towards the beacon (to starboard) and stop the forward tug until we are clear of the channel'. *Endeavour River*'s master said that he would 'give it a go'.

Between 1405 and 1414, while *Kamisu Maru* was in the vicinity of A3 beacon, *Endeavour River*'s bow was just to the north of the Auckland Channel's centreline. *Kamisu Maru*'s pilot's suggested course of action appeared to be beginning to take effect. *Endeavour River*'s heading changed from 220° to 233°, opening the channel enough for *Kamisu Maru* to pass ahead of *Endeavour River*. As *Endeavour River*'s heading was changing to starboard, *Kamisu Maru*'s pilot began moving the ship to the starboard side of the channel and increased the engine speed to slow ahead, to improve steerage.

Figure 10: Gladstone VTS AIS display showing the positions of the two ship's at 1405



At 1408, *Clontarf* arrived alongside *Endeavour River* and was positioned between midships and aft on the starboard side, forward of *Wistari*.

At 1419, *Endeavour River*'s master told the chief mate that once *Kamisu Maru* had passed, it was his intention to push the bow around to starboard, into the channel, and then back the ship towards the berth.

At 1420, *Kamisu Maru* passed about 20 m ahead of *Endeavour River*'s bow (Figure 11), and the same distance from A2 beacon. When clear, the ship's pilot increased engine speed to harbour full ahead, altered course to 102° (T) and continued outbound.

At 1425, the Gladstone regional harbour master (harbour master), who had been advised at 1356 by the VTS operator that *Endeavour River* was experiencing difficulties berthing, spoke with *Endeavour River*'s master on VHF radio. The harbour master asked *Endeavour River*'s master if he wished to use two additional tugs. The master replied that he didn't need them at that time. At about 1432, the master called VTS to request the two tugs and received no reply. He did not repeat his request to VTS.

Between 1433 and 1500, the master tried to move the ship to starboard and into the Auckland Channel, using the tugs and the ship's propeller, ordering shaft speeds of between 10 and 50 rpm ahead. During this time, the ship's heading changed from 235° to 253°, but the stern remained stationary.

Figure 11: Photo of *Kamisu Maru* passing ahead of *Endeavour River*, taken from the break of the raised forecastle

At about 1442, the harbour master informed the master that he had instructed the remaining two tugs to attend the ship and stand-by as required. At 1449, the harbour master informed the master that the tugs were to remain with his ship and a scheduled ship departure at 1530, which would have required the tugs, had been cancelled.

At 1455, the harbour master contacted the master again and asked him if he required a pilot on board to assist. The master replied that he did not.

At 1504, in an effort to assist the bow's movement to starboard, the master repositioned the forward tug *Beltana* to the port bow. The effect of the tug's manoeuvring started the ship's bow swinging to starboard. By 1511, the ship's heading had changed to 260° with the rate of turn increasing. At about 1512, in an attempt to arrest the starboard swing, the helm was put hard-to-port. However, the ship continued to pivot to starboard and at 1513, the starboard side of the hull, just aft of amidships, collided with, and destroyed, A1 beacon (Figure 12). The master recorded in the ship's official logbook that *Endeavour River* had grounded at 1513 when it collided with A1 beacon.

By 1516, the swing to starboard had stopped, with the ship in position 23°50.8'S 151°18.4'E, on a heading of 287°. The ship was on the north-eastern side of the

Auckland Channel, with its bow facing up the channel, towards the Barney Point wharf.

By 1518, all five of the port’s tugs were in attendance, and at 1522, the master contacted the harbour master and requested a pilot. Arrangements were quickly put in place, and at 1546, a pilot boarded by helicopter. At 1550, the pilot took over the conduct of the grounded ship.

Figure 12: Photo of A1 beacon following contact with *Endeavour River*

At 1639, tank soundings were taken and these indicated that no tanks had been breached. There was no pollution. The ship’s rudder and propeller appeared to be unobstructed and operating normally.

During the next 70 minutes, the pilot made several changes in the positions of the tugs in an attempt to refloat the ship. The tide was now ebbing and the pilot concluded that *Endeavour River* could not be moved.

By 1753, all the tugs had been released and were returning to their berths. At 1809, the pilot left the ship by helicopter. At 1825, the starboard anchor was walked back to one shackle in the water, to hold the ship’s bow clear of the channel.

Endeavour River’s managers negotiated with a salvage company and on 3 December, a Lloyd’s Standard Form of Salvage Agreement (LOF) was signed. On Friday 7 December, the ship was refloated on the morning high tide, with the assistance of the port’s five tugs. *Endeavour River* was then towed to South Trees Wharf where a thorough underwater inspection was carried out. Apart from some scratches to the ship’s paint, no significant damage was observed to the hull, the propeller or rudder.

The underwater inspection was followed subsequently by a scheduled dry docking of the vessel. An underwriters report to the ship’s managers as a result of an examination of the hull in dry dock found that:

> Significant hull damage was sighted at the starboard side bottom radius plating in way of frames 138 to 149. Indents of up to approximately 40 mm deep in between

framing were clearly noticeable. This area was estimated to be in the region of 8.5 m x 4.5 m x 20 mm thickness steel curvature plating.

Remaining damage observed were mainly damage to the ship's bottom coating by abrasive wear. Abraded areas were noted to be approximately in the region of up to 80% of the starboard side bottom hull area and up to 30% on the port side bottom hull area, from forward to aft.

2 ANALYSIS

2.1 Evidence

On 4 December 2007, two investigators from the Australian Transport Safety Bureau (ATSB) attended *Endeavour River* while the ship was aground in Gladstone. The ship's master, chief mate and deck cadet were interviewed and copies of relevant documents and records were taken. The evidence included the course recorder chart, a copy of the navigational chart used, copies of log books, bell books, passage plans, running check lists and various procedures. The ship's simplified voyage data recorder (S-VDR) data was also taken.

On 4 December, the investigators interviewed the harbour master and obtained downloads from the Gladstone Vessel Traffic Service's (VTS) radar and automatic identification system (AIS), VHF radio and closed circuit television (CCTV) systems. Copies of other documents were also taken, including the port's pilotage exemption requirements.

On 5 December, the investigators interviewed the Gladstone pilot manager and the pilots who were on board *Kamisu Maru* and *Endeavour River* on 2 December.

2.2 The grounding

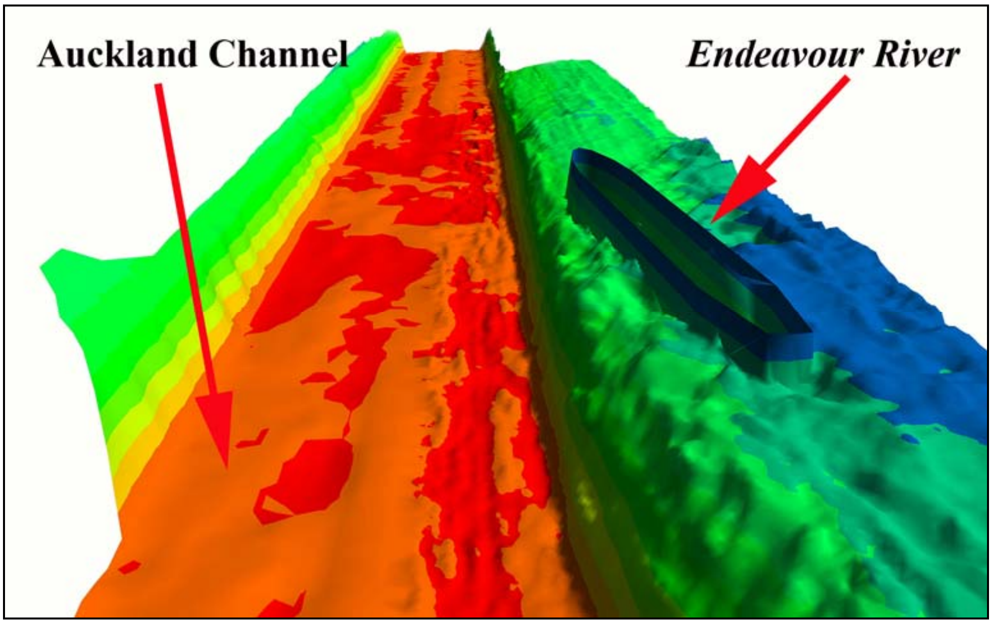
On 2 December 2007, *Endeavour River* grounded in the entrance to the Auckland Channel (Figure 13) while attempting a mid-tide berthing at South Trees Wharf. The tide was flooding and the wind was from astern, southeast, at about 22 knots. The ship was initially attended by two tugs with a combined bollard pull of 107 tonnes, although this number was augmented by an additional three tugs as the situation developed.

When the ship was in the Gatcombe Channel and passing the western arm of the Boyne Wharf, the master started his approach to the berth. While he and the chief mate stated that they were 'happy' with the approach angle and the ship's heading, they were unaware that the ship was to starboard of the planned route (the leading line in the Gatcombe and Auckland Channels). The master did not compensate for this by turning the ship onto the Auckland Channel leads earlier than he would have had to if the ship had been on the planned route. Consequently, the ship turned too late, moving further to starboard of the planned route and, while the master was manoeuvring the ship towards the berth, the entire port side of the hull was exposed to the effects of the strong flood tide and wind.

The master was aware of the risks associated with the ship lying across the tide but realised too late that the ship was exposed to the tide and he was not able to overcome its influence. Consequently, the ship was set up towards the entrance to the Auckland Channel.

During the approach to the berth, the bridge team comprised the master, the chief mate and the deck cadet. The chief mate was occupied with other duties and was unable to provide the master with a reasonable level of support during the berthing operation.

Figure 13: Sonar image of *Endeavour River*'s final grounding position



The evidence obtained from on board recordings shows that *Endeavour River* was aground for about 90 minutes prior to the time the bridge team logged that it was aground. Recordings indicate that both the master and chief mate may have suspected the ship had grounded about 40 minutes prior to their recording that fact in the ship's log.

While the master had attended the required simulator training in the mid-tide berthing manoeuvre prior to gaining his pilotage exemption, the training was not sufficient to enable him, or any other master in similar circumstances, to cope with a reasonably foreseeable situation that might occur if the ship was exposed to the full effects of a flood tide and wind. Therefore, he had not practised any manoeuvre which he could have used to help him recover from the situation he found himself in as the ship lay across the flood tide. This resulted in him trying to turn the ship in the same unsuccessful way he had previously observed first hand.

2.3 Previous incident

At about 0330 on 10 July 2003, during a mid-tide berthing on a flood tide, *Endeavour River* destroyed A2 beacon and subsequently grounded in the vicinity of the entrance to the Auckland Channel. The exempt master piloting the ship at the time had the assistance of two tugs. The ship was refloated a short time later with the assistance of three tugs and was eventually made fast at South Trees Wharf. There was no damage to the ship and no pollution ensued.

The circumstances which led to the grounding were remarkably similar to those which contributed to the ship's grounding on 2 December 2007. The ship, while attempting to berth on a flood tide, was beam-on to the tide and the power of the two assisting tugs was not sufficient to overcome the force of the incoming tide. The ship was pushed towards the Auckland Channel's entrance and, in an effort to stop the ship grounding, the master tried to turn the ship to port.

The master on board *Endeavour River* on 2 December 2007 was the chief mate, on the ship's bridge, when it grounded in 2003.

An internal investigation of the 2003 incident was carried out by ASP Ship Management (ASP) shortly after the grounding.

The investigation led to a number of recommendations being made, which included that the master attend mid-flood tide berthing simulation training at the Australian Ship Handling Centre (Port Ash), Newcastle, and a bridge resource management (BRM) refresher course. However, of the crew on board *Endeavour River* when it grounded, only the master attended these training courses. To be of any real benefit, all those on the bridge at the time of the grounding should have attended the BRM refresher training, as it is the role of all those on the bridge to practice BRM principles (see section 2.5 of this analysis).

The report also recommended that a framework for a common passage plan be developed by certain senior pilotage-exempt masters, for Gladstone and Weipa, for use on board all applicable vessels (see section 2.5.2 of this analysis).

Another recommendation was that the installation of an Electronic Chart System (ECS) be considered (see section 2.5.3 of this analysis).

It was also recommended that a review be undertaken to see how the chief mate could be released from his bridge duties at Gladstone, to enable him to become a more effective member of the bridge team in conjunction with pilotage-exempt masters (see section 2.5.4 of this analysis).

The final recommendation was that the relevant parties study the feasibility of fitting a transmitting tide gauge in the vicinity of South Trees Wharf to provide advanced warning of actual tidal streams in the area (see section 2.4.3 of this analysis).

The ASP internal investigation yielded some valuable lessons. However, the company had not implemented all the recommendations and findings contained in the report. Where they had, they had not taken into account the wider benefits of applying those recommendations to other personnel associated with the grounding or to other ships in their fleet.

2.4 Shiphandling in current and wind

2.4.1 Engine and helm movements

During *Endeavour River*'s passage to the berth, the wind and flood tide were in the same direction and acted as a combined force on the ship.

Information obtained from the Australian Ship Handling Centre (Port Ash) states that:

> A small current acting on a large deep ship will exert a surprisingly large load. Figures indicate that a ship is affected as the square of the speed of the current, i.e. a current of two knots – load factor of four; current of three knots – load factor of nine, more than twice the effect.
>
> However, knot for knot, current loads are many times more powerful than wind forces due to the greater density of water. Where both wind and currents are involved, the equation becomes highly complex and a great deal of experience is required to properly deal with things.

When manoeuvring with a current astern, the induced pivot point[13] of a ship will be well aft and therefore the rudder will be less effective as a result of a short turning lever.

At 1313 (Figure 6), the master ordered hard-to-port when he wanted to start the turn from Gatcombe Channel onto the leads of the Auckland Channel. At that time, the ship was well to starboard of the planned route and was actually on the leads of the Auckland Channel. The S-VDR data shows that the ship was slow to respond to the rudder movement, indicated on the bridge by the sound of the gyro compass 'ticking' as the ship turned. Two minutes later the helm was ordered midships and then hard-to-starboard. By 1316, the ship had travelled 460 m from the 1313 position and, following the turn, was 100 m to starboard of the planned route – the Auckland Channel leads. Following the turn, the master settled the ship onto the new heading of about 290°.

At 1317 (Figure 7), he then ordered a reduction in the shaft speed to 10 rpm ahead. At 1319, with the ship on a heading of 288°, he ordered 20° of starboard rudder. However, at 1320½, the helm was put back to midships although no change in heading had been effected. The ship was making good a course of 291° (T) at this stage.

At about 1322, when he thought he was in a position to turn to port for the approach to the berth, the master then ordered 20° of port rudder. The S-VDR data shows that there was no change in heading after the rudder was put to port. At about 1325, he ordered minor increases in shaft rpm (from 10 to 20 rpm). This was followed by a full port rudder order.

The S-VDR data shows that it was at 1322, with the ship well to starboard of the Auckland Channel leads and the master starting his port turn to approach the berth, that the ship started to be adversely influenced by the flood tide and wind.

At 1322, the ship's heading was actually 290° and its speed about four knots. With the tide astern at up to three knots, the speed of the ship through the water was about one knot. The effect of the induced pivot point, which had moved aft, would have reduced the rudder's effectiveness. This reduction resulted in the ship being slow to respond and then being set in the direction of the current (and wind) flow.

A ship's rudder is effective in exerting a turning moment on the ship only when there is a flow of water over its surface. The accelerated water flow from the propeller directly over the rudder blade enhances the manoeuvrability of the ship, even at slow speeds. Therefore, had the master used a substantial 'kick ahead' by increasing shaft rpm, the ship would probably have turned in the direction he wished it to.

At 1325, the ship's heading was still about 290° and its speed had fallen to about three knots. The master then ordered full port helm, but no corresponding increase in engine rpm. Again, if the master had ordered a 'kick ahead', the effectiveness of the ship's rudder would have been increased and the ship would probably have turned as he required it to, lessening the ship's aspect to the current and wind, allowing the turn to continue. However, the ship's course and speed made good continued to be towards the Auckland Channel entrance.

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13 The itinerant vertical axis about which a ship rotates during a turn.

The S-VDR data shows that the master appeared reluctant to use propeller thrust, using mainly small astern commands. Only once did he use a shaft speed greater than 30 rpm ahead or astern to assist the ship's manoeuvres until just before the stern grounded at 1352.

Endeavour River's master did not turn the ship onto the Auckland Channel leads early enough, given its position to starboard of the planned route in Gatcombe Channel. This resulted in the ship remaining to starboard of the route in its passage plan in relation to the Auckland Channel leads. The fact that the ship was to starboard of the planned route meant that the ship was in a position where, in order to berth the ship, the master needed to present more of the ship's port side to the effects of the current and wind for a greater period of time than if it had been correctly positioned for the approach to the berth. The master knew the risks of presenting the ship's port side to the elements and, given the strength of the tide and wind, should have used propeller thrust more effectively while manoeuvring towards the berth.

2.4.2 Use of tugs

While *Endeavour River*'s master was trying to turn the ship towards the berth, both tugs were made fast on the starboard side of the ship with the after tug forward of the accommodation. This was the usual positioning of the tugs for the intended berthing manoeuvre and was described in the written passage plan provided to the ship by ASP.

Following the 2003 grounding of the ship, ASP arranged for the ship's master at the time, a senior ASP master and the Gladstone pilot manager to attend Port Ash. Their intention was to attempt to recreate the incident using an appropriate ship model and the facilities at Port Ash and then to arrive at a method of berthing which would reduce the risk of a similar incident occurring in the future.

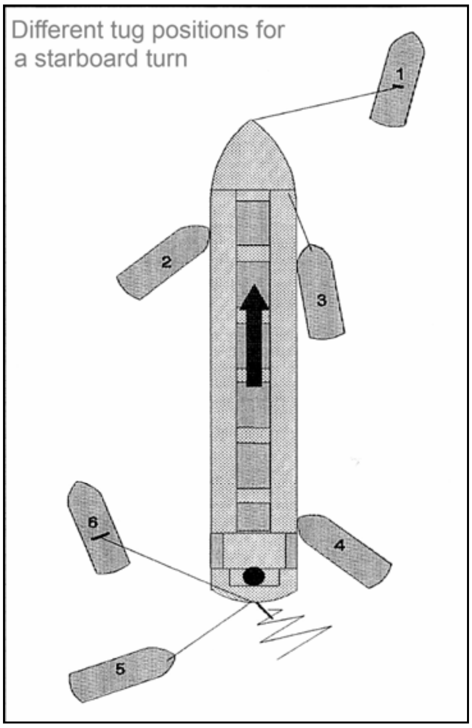
The exercise successfully recreated the conditions which led to the grounding, and the manned model ship grounded in the same way *Endeavour River* did under those conditions. During the exercise, the manager of Port Ash discussed the drawbacks of positioning the after tug forward of the accommodation. He stated that a tug in that position was only useful during an actual berthing operation and not as an escort tug, the role it was being used in at the time of the grounding. He suggested that the tug be made fast through the centre lead aft so that it could be used both as a braking force, and as a more effective steering force on the ship. His views were supported by another experienced pilot and two experienced tugs masters, all of whom were present during the discussions.

This tug positioning was then used successfully in the modelling and prevented the model ship from grounding in the same conditions it experienced when the tug was made fast forward of the accommodation.

In support of the effective positioning of a tug's line through the centre lead aft, as proposed by, and demonstrated at, Port Ash, the Nautical Institute's publication, 'Tug use in port – a practical guide' (p. 68) states:

> Tug No 5 (Figure 14) is in a very effective position. The longest possible lever for steering forces and the transverse forces centred forward contribute to the swing. Also, the tug does not increase ship's speed. On the contrary, the tug also provides retarding forces while applying steering assistance.

Figure 14: Different tug positions



However, despite incurring the expense of the exercise, ASP did not acknowledge that the suggested positioning of the aft tug was more beneficial and would be implemented. They also did not send any other master on any subsequent ship handling course at the Port Ash facility.

Indeed, the only action taken by ASP following the Port Ash exercise was to include one line in the newly developed ASP passage plan. In reading the wording, which says that, ‘on a flood tide, the position of the after tug through the centre lead aft could be considered (for brake effect)’; it actually appears to be an after thought or a draft consideration.

Following the 2003 grounding of *Endeavour River*, ASP thought it important enough to arrange for several senior masters and the Gladstone pilot manager to attend Port Ash to recreate the grounding and were provided with a simple recommendation to reduce the risk of a grounding occurring in the future under similar conditions.

However, they did not implement the suggested changes in the positioning of the aft tug in the guidance provided to their ships’ masters in the passage plan for mid-tide berthing on a flood tide in Gladstone, and a grounding occurred in similar circumstances in 2007.

2.4.3 Tide gauge

While there is a transmitting tide gauge at the Auckland Point wharf, this location is further up the harbour from South Trees Point area. This tide gauge provides only a general idea of tidal conditions elsewhere in the harbour.

Despite the recommendation contained in the report into the 2003 grounding, no transmitting tide gauge, and importantly no current meter, has been fitted in the vicinity of South Trees Wharf. The fitting of such equipment would assist pilots and masters berthing ships in this area by providing accurate, live data on tidal height and tidal stream flow direction and rate. This would forewarn pilots and pilotage-exempt masters of what conditions they might encounter during a pilotage and assist with berthing preparations and planning at South Trees Wharf.

2.5 Bridge resource management

The concept of bridge resource management (BRM) is not new in the maritime industry and training courses to encourage its use have been held in Australia since the mid-1990s.

Also referred to as bridge team management, BRM can be defined as the effective management and utilisation off all resources, human and technical, available to the bridge team to ensure the safe completion of the vessel's voyage[14].

Marine Notice No. 34 of 2002, issued by the Australian Maritime Safety Authority (AMSA) states that:

> BRM should include a clear identification of all the bridge team members at all stages of the voyage, their relative duties and responsibilities, and the line of command including the levels of authority in making, challenging or responding to decisions and instructions.

BRM provides a method of organising the best use of human and other resources on the bridge to reduce the level of operational risk. Its key safety aspect is to put in place defences against 'single-person errors', which can result in a serious casualty.

The ASP Vessel Operations Manual contains the following guidance for ships' masters with regard to the implementation of BRM on board its ships:

> In conformity with Bridge Resource Management principles the Master must ensure that an atmosphere conducive to the free exchange of information is maintained with regard to the bridge navigation team. When personally conning the vessel, the Master must, in order to obtain optimum assistance from the bridge team, keep the other team members appraised of his/her intended manoeuvres as fully as circumstances permit.

The Vessel Operations Manual also contains the following guidance with regard to bridge team operations:

> 9-4.5 Bridge Team Operation
>
> The Bridge Team concept which minimises the risk that an error made by one person will have disastrous consequences must be implemented on all vessels.
>
> At all times when more than one Deck Officer is on duty on the bridge all those present must be aware of the voyage plan in progress and alert to the overall navigational and traffic situation to the maximum extent possible.
>
> There must be a free exchange of information between bridge team members. The conning Officer must keep other bridge team members apprised of intended manoeuvres as fully as circumstances permit. In the event of the conning Officer personally operating the bridge controls, (such as autopilot course changes, changing

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14 *Focus on Bridge Resource Management.* Washington State Department of Ecology, 2007.

> engine control settings, etc.) the practice of announcing the "order" to those present on the bridge must be adhered to. This is imperative to keep Bridge Team Members up to date with a developing situation.
>
> Bridge Team Members who notice any factors, which may influence the safe navigation of the vessel, must not hesitate to call them to the attention of the appropriate team member.

In addition to guidance contained in the ASP Vessel Operations Manual, the company also included, as part of their Gladstone passage plan, a risk management guideline which listed the BRM principles that:

> …. are to be followed by all bridge personnel involved in the navigation of ASP Ship Management vessels at all times, whether there is a pilot on board or whether the master is using a pilot exemption.

These BRM principles include closed loop communications, briefing/debriefing, challenge and response, delegation, situational awareness, and short-term strategies.

The implementation of these principles on *Endeavour River*'s bridge was not the responsibility of the master alone, as all bridge team members had a role to play in the operation of the ship during the pilotage. Both the ship's master and chief mate should have been aware of the need to practise sound BRM principles in shipboard operations. In the years before the incident, the master had attended two BRM courses, one of which he undertook immediately prior to taking command of *Endeavour River* for the first time. He had also attended an Advanced Marine Pilot Training course where passages were planned and conducted, and where case studies of marine casualties were used to reinforce BRM principles. The chief mate had recently obtained his master's certificate of competency and had also attended BRM training in 2005.

However, effective BRM principles were not implemented on board *Endeavour River* on 2 December. The pertinent principles of shared mental models, effective passage plan briefing and monitoring, closed loop communications and situational awareness are examined in this analysis.

2.5.1 Shared mental model

The concept of a shared mental model helps explain one aspect of how teams, regardless of the environment in which they operate, are able to cope with difficult and changing task conditions. Shared mental models serve three critical purposes: they help people to describe, explain and predict events in their environment. Any team that must adapt quickly to changing tasks might draw on shared or common mental models for those tasks. In order to adapt effectively, team members must be able to predict what their team mates are going to do, and what they are going to need to be able to do it[15].

It has been suggested that the manner in which shared mental models operate is related to task demands. Specifically, it is argued that under conditions that allow

15 Cannon-Bowers, JA, Salas, E, Converse, S A (1993). *Shared mental models in expert team decision making*. In Mathieu, J, Heffner, T, Goodwin, G, Salas, E, Cannon-Bowers, J. *The influence of Shared Mental Models on Team Process and Performance*. Journal of Applied Psychology 2000, Vol 85, No. 2, pp. 273-283. American Psychological Association Inc, 2000.

team members to freely communicate with one another - to strategise - shared mental models are not very important. This is because the team can discuss its next moves and does not need to rely on pre-existing knowledge. However, under conditions in which communication is difficult - because of excessive workload, time pressure, or some other environmental feature - teams are not able to engage in the necessary strategising. In this case, shared mental models become crucial to team functioning because they allow members to predict the information and resource requirements of their team mates. Hence, members are able to act on the basis of their understanding of the task demands and how these will affect their team's response. It is this ability to adapt quickly that enables teams in dynamic environments to be successful[16].

A shipboard operational environment, in comparison to the 'fast-moving' aviation environment or some emergency response operational environments, seldom places excessive time pressures on ships' crews. Nevertheless, the importance of teams in the maritime environment having a shared mental model of operations should not be underestimated and communications between team members should not become an issue.

A replay of the S-VDR data shows that at no time was any information given to any member of the bridge team, with regard to what the master's intentions were during the passage (i.e. how the passage was going to be conducted), when the master expected to be challenged, what limits were set, when the team was expected to query the passage plan, or what any contingency plan was.

The master's failure to articulate his plan for the pilotage passage to the other members of the bridge team meant that there could be no shared mental model.

It was the chief mate's experience that pre-arrival, pre-departure and contingency briefings were not conducted on board *Endeavour River* and this was an issue he had learnt to accommodate. As far as he was concerned, he assumed that the passage would be the same as for previous passages to the berth during a flood tide, with a possible slight change to take into account the ship berthed at the eastern arm of South Trees Wharf.

However, he was not able to correctly predict the information and resources that the master might require during the passage. When the bridge team became aware that the passage was not proceeding as it should have been, they were not able to engage in the necessary strategising which might have enabled them to arrive at a contingency plan given the prevailing circumstances.

The chief mate had not participated in any mid-tide berthing training, so he was not fully aware of what mental model the master was following in carrying out the manoeuvre. Therefore, he did not know when the master's plan was going astray. When questioned by the ATSB investigators, the chief mate stated that he would have no hesitation in challenging the master if he considered it necessary.

Furthermore, the S-VDR data shows that throughout the passage from the anchorage until *Endeavour River* grounded, hardly a word was spoken between the master and chief mate. The only time the master discussed any plan of action was

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16 Cannon-Bowers, JA, Salas, E, Converse, S A (1993). *Shared mental models in expert team decision making*. In Mathieu, J, Heffner, T, Goodwin, G, Salas, E, Cannon-Bowers, J. *The influence of Shared Mental Models on Team Process and Performance*. Journal of Applied Psychology 2000, Vol 85, No. 2, pp. 273-283. American Psychological Association Inc, 2000.

when *Kamisu Maru* was about to pass ahead of *Endeavour River*, and that was to say what he intended to do when the ship was clear.

In his submission, the chief mate stated that:

> On the day in question however, there was nothing for me to tell the master as he was aware that the approach to the berth was not working out as he was hoping. I was not in a position to value add to the process and pointing out the obvious to the master would only have elicited a response that would have further distracted us both from our core duties.

The guidance provided by ASP in the Vessel Operations Manual was not followed on board *Endeavour River*. Furthermore, operational communications between the master and chief mate during the passage were virtually non-existent. The lack of communication between the members of the bridge team, and the lack of a shared mental model, contributed to the grounding.

2.5.2 Passage planning

The importance of having a passage plan for pilotage cannot be over emphasised. Without a proper, functional passage plan to follow when piloting, BRM is ineffective. With no passage plan, there can be no shared mental model, no challenge and response opportunities, no real knowledge and understanding of roles and responsibilities of the bridge team members and no limits against which the passage can be assessed.

The master did not discuss any passage plan with any member of the bridge team, so the team could not determine whether he was following any plan at all and, if he was, whether it was the right one to be following.

The passage plan that the master was supposed to be using was based on an ASP plan for use by the four ships engaged in the bauxite trade which berth at South Trees Wharf. The plan was developed in 2003 by two experienced ASP masters with advice provided by several external parties including the manager of Port Ash and was, at the time, considered by some in the industry to be ‘state-of-the-art’ as far as company-derived passage plans went.

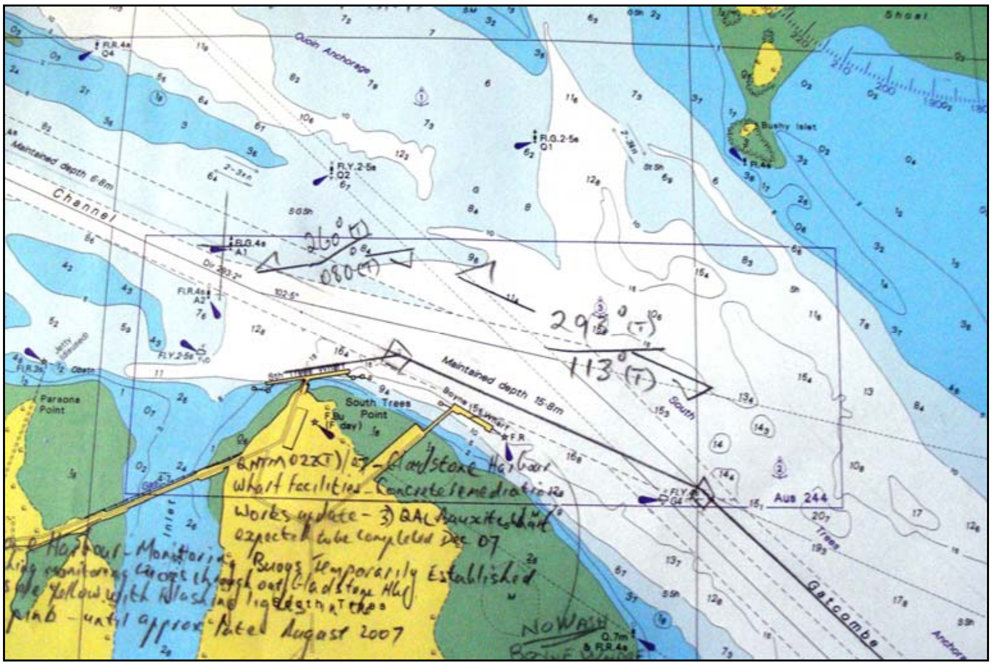
The ASP plan (extracts provided in Appendix D) was, at that point in time, advanced in the guidance it provided to ship’s personnel. It gave the appropriate track for the ship to follow during the inwards passage, listing courses to steer, approximate speeds to be followed, tug movements and wheel over positions. It also provided a graphical indication of the angle the ship should be to the flood tide. This graphical representation was accompanied by a written document stating the passage plan in words, and a standard ‘running’ checklist for the bridge team to complete during the passage. However, the passage plan did not give any guidance with regard to contingency planning.

Some of ASP’s pilotage-exempt masters found that the plan and checklist did not suit their way of piloting and therefore did not use it. Having instigated the preparation of a Gladstone passage plan in 2003, ASP did not follow up its use on board the ships, or its appropriateness for the ships’ operations. Indeed, since the ASP plan’s development, the discipline of passage planning has advanced significantly and the 2003 plan does not fulfil current expectations for passage planning.

Current 'best practice' passage planning includes the effective use of BRM principles, berth-to-berth passage planning, contingency planning, and enhanced master/pilot information exchanges. It also includes engaging a pilot as a member of a bridge team, the efficient use of electronic navigation aids during a passage and the designation of bridge team members to carryout roles and to have responsibilities during a pilotage.

No electronic charting system (ECS) was installed on *Endeavour River* at the time of the grounding. Following the 2003 grounding, some of the components of such a system had been installed but the ship was due to have the final components installed to make the ECS operational after berthing in Gladstone on 2 December.

Figure 15: Section of navigational chart Aus 244 showing passage information



As the ship was not equipped with electronic charts, the bridge team was relying on paper charts. The only passage planning information on the charts were course lines drawn for both inwards and outwards passages (Figure 15). Wheel over positions and parallel indexing lines, as required by the ASP Vessel Operations Manual for passage plans in pilotage waters, were not indicated on the charts. In addition, there were no cross-track limits set in the ship's GPS unit or indicated on the charts in use, and the ASP checklist was not used.

Without these reference aids on the charts, the bridge team had no defined limits with which to gauge the progress of the ship in the channel and know when to alert the master if the limits were being reached.

The master had served on ships engaged on the Weipa/Gladstone bauxite trade since 1993. All this time on the same route, along with the fact that he had conducted more than 50 pilotages into Gladstone, understandably led him to believe that he was very experienced in the pilotage into South Trees Wharf.

Bengt Schager, in his book 'Human Error in the Maritime Industry – How to understand, detect and cope' (p. 100), discusses 'experience at sea' and 'time gaining that experience', saying:

> … it may be wise to avoid exaggerated emphasis on time only. Parallel with length of time or quantity of experience, we should also emphasise the content or quality of experience.
>
> We seldom refer to the actual content of experience. It is possible that a person, even with long experience, hasn't met many situations from which he/she could benefit professionally, nor faced many critical or hazardous situations. Most work on board a ship involves routine and repetitiveness in such a way that another year in the same position does not necessarily add much to anybody's competence.
>
> Some repetitive experience can also be detrimental, as it induces a sense of routine, safety and normality in an otherwise risky environment. Over time, an officer's respect for what he or she is doing might decrease while the skills and quantity of experience increase.

With the exception of the 2003 grounding, it is probable that even with all his experience, the master had not encountered many critical or hazardous situations which may arise during the pilotage. Most of his experience was likely to have been carrying out the same task in a similar manner and this probably induced a sense in him that the pilotage into Gladstone was routine and safe.

This sense of 'experience in the role' probably resulted in the master building up, over a long period of time, an illusionary feeling which could be called complacency, or a false sense of security.

Schager (p. 101) refers to complacency as:

> being a state of mind. It is an unconcerned attitude, e.g. in connection with the presence of danger and risk, where individuals behave and think in a routine-like mode, anticipating an uneventful and ordinary development of the present situation.

He goes on to say that:

> Complacency is a passive state, not an active one, and no one chooses to be complacent. It creeps into one's mind imperceptibly. Individuals are therefore unaware of being complacent and would, if asked, reassuringly deny it. Instead, individuals would probably justify their state of mind as rational, realistic, reasonable and in line with situational requirements, as well as a sign of experience.
>
> Complacency can lead to such things as disbelief when something unexpected happens. It can lead to a false sense of security as well as a false sense that the situation is under control when it isn't. It can furthermore lead to deficient risk assessment or to repress risks and not paying proper attention to what one is engaged in.

It is probably as a result of this sense of complacency that *Endeavour River*'s master did not discuss any aspect of his passage plan from the anchorage to the berth with any member of the bridge team. The master assumed that it would be the same as it was the last time the ship berthed at South Trees Wharf on a flood tide. As a result, no limits were set or directions given to the bridge team as to when the master expected to be challenged on the ship's position within the channel, its heading or speed or an order he gave or an action he took. It is probable that the entire operation had become so routine that the bridge team, especially the master, had become desensitised to the risks associated with the pilotage.

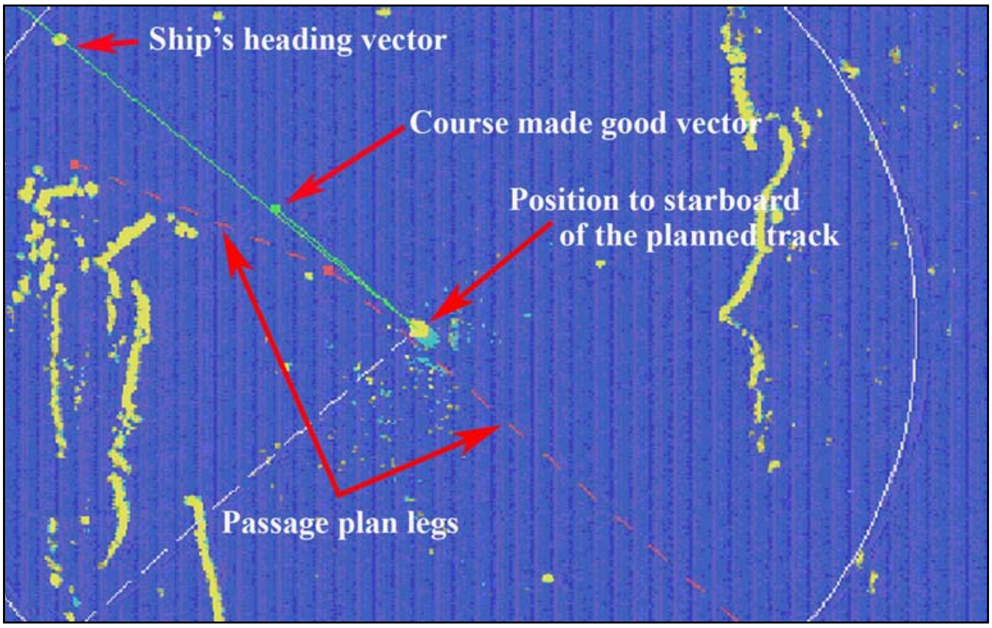
2.5.3 Passage monitoring

ASP's Vessel Operations Manual, used on board *Endeavour River*, contains several sections on vessel position fixing and the roles and obligations of the bridge team members in pilotage waters:

> 9-1.3 Vessel's Position Fixing
>
> The position of the vessel must be fixed at frequent intervals to ensure that the planned track is being maintained.
>
> 9-2.3 Role of OOW
>
> Regardless of who is conning the vessel the OOW must never assume that the Master and/or pilot is aware of any potential hazardous situation. It is the responsibility of the OOW to advise the Master/Pilot if the vessel is "off track". He must never hesitate to convey any doubts that he/she may have with regard to the safe navigation of the vessel.

Only a visual reference time of passing the buoys in the Gatcombe Channel was entered in the movement book. There were no indications on any chart in use on the bridge at the time of the grounding, or in the time preceding it during the passage from the anchorage, that anyone on the bridge was keeping track of the ship's position by any means, including radar, visual bearings and radar ranges or GPS. As a result, even when the master and chief mate thought the ship was becoming increasingly influenced by the flood tide and wind, the bridge team had no accurate picture of where the ship was in relation to the berth or the shallow water outside the manoeuvring area north of South Trees Wharf.

Figure 16: Radar display showing position to starboard of track at 1311

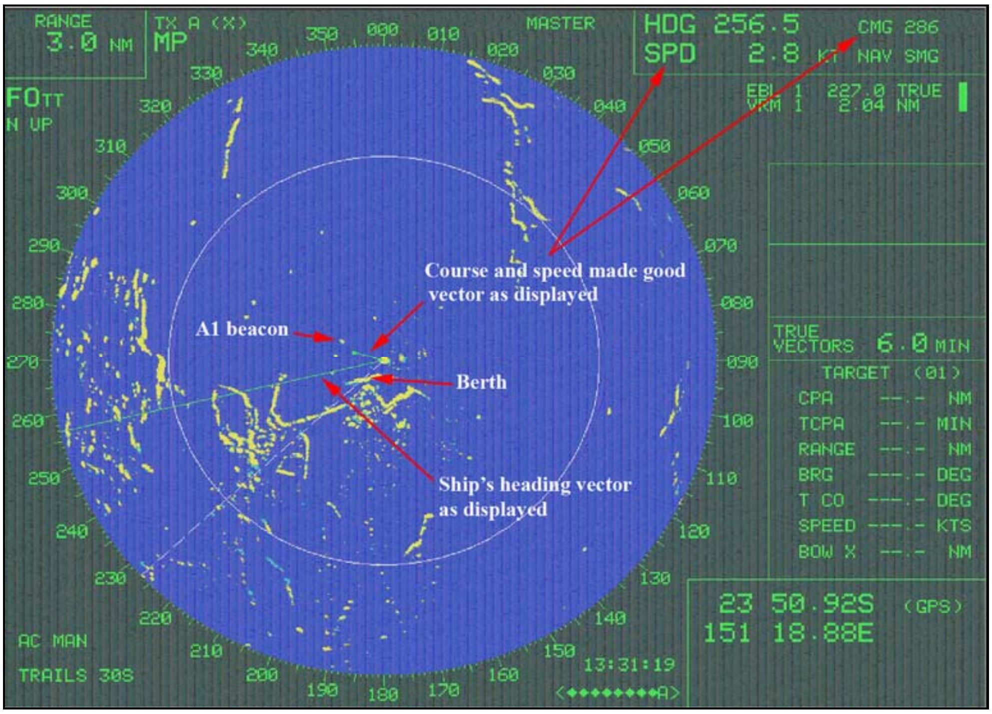


Endeavour River's GPS unit was interfaced with the radars enabling the passage waypoints entered into the GPS unit to be displayed on the radars (Figure 16). The radars were then able to show the current leg of the passage and the leg after the next waypoint, thus allowing anyone observing the radar to get an immediate appreciation of the ship's position in relation to the planned route.

The radar display also showed the ship's heading vector, and, importantly, the vectors for course and speed made good as the ship progressed from the Gatcombe Channel (Figure 17). The display clearly showed that the ship was being set towards the A1 beacon and not progressing towards the berth as the master and chief mate believed.

This real-time monitoring of the ship's position, course and speed was available but not used by anyone in the bridge team in the time leading up to the grounding.

Figure 17: Radar display showing course and speed made good vectors, and ship's heading vector at 1331



On 2 December 2007, no positions were put on the charts and radars were not used to monitor the passage. Therefore, no one on the bridge knew where the ship was in the channel, or with reference to the berth. As a result, when the ship was set towards the entrance to the Auckland Channel, its movement remained undetected until it was too late to rectify the situation.

2.5.4 Bridge manning and single-person errors

For operations with a pilot on the bridge, it is the role of the bridge team to monitor the pilot's actions in addition to performing their own duties. However, for berthings with an exempt master having the conduct of the ship, the number of bridge team members is reduced by one as the master is performing the functions of the pilot. Nevertheless, the same tasks have to be completed as if a pilot were on board.

Section 9-2.2 (Passage planning in pilotage waters) of the ASP Vessel Operations Manual states:

> When proceeding under a pilot's advice, both the Master and the OOW must constantly review the pilot's orders and decisions. Any doubts regarding the progress of the vessel must immediately be brought to the Master and/or pilot's

> attention. If necessary the Master should not hesitate to take the necessary corrective action.

Section 9-12 of the ASP Vessel Operations Manual provides guidance for masters and mates on how to conduct operations (pilot information exchange and monitoring a pilot's actions) with a pilot on board in a manner that will reduce the risks of 'single-person errors' affecting the operation of a ship in pilotage waters.

However, neither section provides guidance for operations under similar circumstances when an exempt master is fulfilling the role of pilot in waters where some of these risks exist.

The Gladstone pilotage plan developed by ASP in 2003 contains a section that refers briefly to risk management and discusses the need to reduce the risk of 'one-person errors'.

At the commencement of the passage to the berth, the helmsman was on the bridge. The master, as was the normal practice, stood the helmsman down as *Endeavour River* completed its final turn to approach the berth. This left the master, the chief mate and the cadet on the bridge to carry out all of the necessary duties, such as helm, engine movements, position fixing and completing the movement book. In addition, the presence of an inexperienced cadet meant that the chief mate had to monitor the cadet as he carried out the duties assigned to him and to explain operations as part of the cadet's training. In carrying out these duties, the chief mate would have been distracted, to some extent, from the role of monitoring the actions of the master.

At no time did either the master or chief mate consider it necessary to supplement the number of persons on the bridge in order to relieve the chief mate of some of his responsibilities, for example, by having the second mate leave the poop deck after making the tug fast, so the chief mate could assist the master more directly.

In his submission, the chief mate stated:

> … I decided that the best support I could provide was to be as efficient as possible in the duties assigned to me. Had I had more ship handling experience or training in mid-tide berthing, or had there been another person on the bridge to relieve me of my duties, it is quite possible that I would have been free to speak up and provide more assistance.

Overall manning on the bridge was insufficient to manage the risks associated with the pilotage while the ship was under the conduct of a pilotage-exempt master. There was no one effectively monitoring the actions of the master in order to eliminate single-person errors, or indeed to give any advice. Furthermore, the chief mate was distracted and overloaded performing other tasks, which prevented him from providing an appropriate level of support to the master.

2.5.5 Situational awareness

Situational awareness can be defined as 'using cognitive processes to develop and maintain a mental model upon which decisions are made. Situational assessment and plan formation are not distinct sequential stages, but rather they are closely interwoven processes with partial and provisional plan development and feedback leading to revised situational assessments'[17].

Neither the master nor the chief mate was aware that the ship was being set down onto the shallow area to the north of the ship's berth until it was too late to overcome the effects of the tide and wind. The master was concentrating on positioning the ship for its approach to the berth and by the time he realised that the ship was being adversely influenced by the tide and, to a lesser extent the wind, he did not have sufficient tug power to counteract the set and drift. The chief mate was not part of the decision making processes. He simply maintained his position inside the wheelhouse, monitoring the cadet's actions with regard to the telegraph movements and completing the movement book, and applying the helm orders.

Because no one on the bridge was monitoring the ship's position, it was not possible for the master and chief mate to maintain the appropriate level of situational awareness. They appear to have been fixated on monitoring the ship's heading and neglected to take into account the ship's course and speed being made good.

This was not helped by the master, and to a lesser extent the chief mate, possibly suffering 'confirmation bias'[18] in the early stages of the berthing manoeuvre.

They both thought that the pilotage was proceeding satisfactorily because they could see the ship's heading change in the direction of the berth. Furthermore, the master thought the ship's speed of approach to the berth was as required.

They did not react sufficiently to the visual cues outside the wheelhouse, or navigation aids such as the GPS, from which they could have gained an overall appreciation of the operation, which may have alerted them to the fact that the ship was not where it should have been. Examples of such cues were the relative positions in this instance of A1 and A2 beacons with regard to the usual approach positions, the distance off the berth or the ship on South Trees Wharf (east arm) or the fact that for over an hour (from 1352 to when they logged the ship as being aground at 1513) the ship failed to move ahead or astern under full ahead and astern propeller movements. Furthermore, they did not receive any information with respect to the observations from the mates who were stationed forward and aft.

This lack of situational awareness also led to the master not fully appreciating the risk that his ship posed to the outward bound *Kamisu Maru*. This was illustrated at 1405 by his comment to the pilot on board *Kamisu Maru* when the two ships were less than one mile apart that astern power (orders up to full astern) was not having the desired outcome and that he was now going to put his engines ahead to drive the ship around to port.

As a result of the loss of situational awareness in the early stages of the berthing manoeuvre, the bridge team realised too late that they were not going to be able to salvage the original berthing plan. By the time they did realise that the ship was not

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17 Woods DD, Cook RI, *Perspectives on human error: Hindsight biases and local rationality.* In: Durso FT, Nickerson RS, Schvaneveldt JD, eds. *Handbook of Applied Cognition*. New York 1999.

18 Confirmation bias, in human factor terms, involves a person unconsciously seeking information to confirm an expectation or assumption and rejecting that information which conflicts with an expectation.

positioned as it should have been, it was too late for the tugs to be able to hold the ship against the flood tide.

2.6 Training

2.6.1 Mid-tide berthing

The mid-tide berthing training on the shiphandling simulator at the Australian Maritime College (AMC) is conducted by experienced ASP masters who hold, or have held, pilotage exemptions for Gladstone. The course is conducted over three days and is usually attended by two or three ASP masters or chief mates. The trainees are put through berthing exercises, starting with favourable weather and tidal conditions which are progressively made more challenging over the course. Following each berthing exercise, a debrief is held to see where improvements can be made.

The ASP mid-tide berthing training has remained unchanged since its inception. The training has little or no structure, it has no stated aims or objectives and no clearly defined training program is followed.

The approach to the berth during a simulation exercise is left to the discretion of the trainee and no particular, proven method is taught. This type of instruction could perhaps be described as ‘hit and miss’. If the trainee successfully berths the ship in all the exercises, regardless of how close they may have come to an incident, they pass the training. Furthermore, the training does not include any instruction on how to recover from an approach to the berth that is likely to result in the tide taking control of the ship.

In the body of the ASP report into the 2003 grounding, the following statement is made in reference to the AMC simulator training:

> Future courses should include a senior experienced exempt Master, who will instruct “personnel in training” the specific mid tide berthing manoeuvres using the ship simulator that should also include training in emergency and abort manoeuvres.

The evidence obtained by the ATSB shows that the training has not been changed to reflect this.

Endeavour River’s master completed mid-tide berthing training seven years prior to the incident on 2 December, three years before he obtained his Gladstone pilotage exemption. He had not undergone any subsequent refresher training in the manoeuvre. Consequently, he is likely to have suffered from some skill deterioration and memory loss before having to apply the training in real life. In addition to this, it is likely that he would have observed practices in the intervening years which might be not be considered best practice with regard to carrying out certain manoeuvres and, as they were more recent experiences, he probably would have remembered these practices in preference to the ones he followed during the training.

Refresher training might have enabled him to gain experience in applying any new techniques which he might have developed since his initial training.

In addition, when he did his simulator training, he was not a master and he had little shiphandling experience on which to base the training. He had not had any other shiphandling training and was relying purely on the knowledge he had gained by observing other masters when he was chief mate.

Furthermore, ASP had no system of competency auditing or ‘check piloting’ in place for their pilotage-exempt masters.

Competency auditing is a system that uses a number of techniques, including bridge simulation, to check an individual’s competency in the use of BRM, technical skills, planning, and how efficiently and safely they execute a passage, including the ability to handle realistic emergency situations. This type of audit is used to check whether exempt masters are complying with either their training in the mid-tide berthing manoeuvre or indeed the relevant sections of the company’s operations manual during any pilotage operation.

With regard to ASP pilotage-exempt masters, the only ‘check pilot’ operations they underwent were conducted by Maritime Safety Queensland (MSQ) as part of the pilotage exemption issue, validity and renewal process. The MSQ processes were carried out with different aims and outcomes and therefore did not satisfy a ‘check pilot’/competency audit to ensure compliance with ship or company specific operations or procedures.

International Safety Management (ISM) audits carried out on ASP ships in the time before the grounding predominately dealt with shipboard compliance with the safety management system (SMS) and followed the ‘paper trail’ requirements for the SMS and associated crew member interviews. It is difficult to use this type of audit to monitor an actual shipboard operation, such as carrying out a pilotage or the successful application of BRM principles by the crew. It is for this type of operation where an operational compliance audit, or ‘check pilot’, can be usefully undertaken.

Pilotage-exempt masters on ASP ship’s carrying out mid-tide berthing at South Trees Wharf had not received any training to enable them to effectively recover when they found themselves in the situation where their ship was subjected to the full effect of a flood tide on its port side.

The company did not have either competency auditing or ‘check piloting’ systems in place to ensure the ongoing competency and currency of their masters and that they were following the guidance and instructions provided to them by the company.

2.6.2 Exemption requirements

Endeavour River’s master initially received a pilotage exemption for the ship in September 2004. This was renewed in November 2006, in accordance with section 11.3 of MSQ’s exemption renewal guidelines, which are mainly administrative and require that the applicant has valid medical and eyesight certificates which have been issued in accordance with AMSA Marine Orders.

With regard to ‘check pilot’ assessment, section 11.3.8 of the renewal guidelines states:

> A current pilotage assessment report (refer section 16.3) completed by the check pilot is required if applicant has not used his/her area endorsement regularly and always within the six month requirement (refer section 17.2) or for assessing the ongoing suitability of the exempt master (refer section 17.3).

Therefore, because he had been regularly undertaking pilotage within the required six monthly periods (sections 17.1 and 17.2 of the guidelines), *Endeavour River*'s master was not required to undertake check pilotage assessment.

In comparison, section 17.3 (Exempt masters to be checked every four years) of the MSQ exemption guidelines states:

> Notwithstanding subsection 17.2, every exempt master shall at intervals not exceeding four (4) years, undertake one trip with a check pilot who will assess the ongoing suitability of the exempt master. Such checks must be completed for each port for which the master is exempted.

Therefore, there was no need for the master to undergo assessment in accordance with Section 17.3 of the guidelines until September 2008.

Consequently, *Endeavour River*'s master had been conducting pilotage in Gladstone for three years without any form of 'check pilot' assessment to ensure that he was undertaking the pilotage in the most appropriate way to reduce the risks to the port and the ship.

2.6.3 Risk management and procedurisation of pilotage

It is widely acknowledged that employing the services of a properly trained pilot to assist on the bridge significantly enhances the safety of the ship and reduces the risk of an adverse outcome during a pilotage passage.

Exempt masters are essentially pilots who operate in limited areas within a port and who are employed by the ship owner/operator, not the port. They do, however, have different priorities, which are predominately associated with looking after the financial interests of the ship managers, charterers and cargo owners as opposed to the overall operational interests of the port. However, the risks to the port that they are required to manage are the same as those managed by the port's pilots.

Pilots in most Australian ports choose to undergo revalidation training in order to maintain their professional qualifications. They also attend other forms of professional development, such as Advanced Pilot Professional Development, Advanced Marine Pilot Training and shiphandling training. This additional training is intended to enhance their pilotage/shiphandling skills to allow them to remain abreast of developments in the maritime, and specifically pilotage, environment.

In recent years, in an effort to reduce the risks associated with conducting pilotage operations, ports around Australia have undergone a series of changes so as to standardise the way pilotage is carried out. Pilotage organisations are increasingly changing from a 'pilot-centred approach', which is susceptible to single-person errors, to a 'systems approach'.

In a 'systems approach' to pilotage, the emphasis is moved away from the individual and onto the bridge team, which includes the pilot, and all the operational systems, including the use of BRM principles, available to them to effectively carry out the pilotage.

Furthermore, pilots are also utilising more simulator training and manoeuvring model approaches. This modern approach to training is replacing the older, traditional understudy methods, which poorly prepared pilots to confront the challenges of a changing marine environment[19]. The traditional training methods allowed errors to be passed on to new pilots and did not allow for training using modern methods and established 'best practice' pilotage plans.

Part of this change has seen a move away from pilots following individual pilotage plans to pilots following port procedures in the way they conduct a pilotage passage, that is, a 'standard' pilotage being conducted regardless of the pilot.

However, this trend towards a 'systems approach' is not generally followed by exempt masters operating in Australian ports as they are not part of the port 'system' and therefore not generally party to lessons learnt during port operations.

In submission, MSQ stated that:

> There is and always has been an open invitation for all exempt masters to visit the Harbour Master's Office when their vessels are in Gladstone to discuss any aspects of pilotage and port development including VTS operations etc. This has been conveyed to all the masters and also to senior management of ASP. It would appear that the workload of the Master's is such as to preclude (them) from attending the Harbour Master's office on a regular basis.

Pilotage-exempt masters in Gladstone should have been actively engaged by ASP and MSQ to enable them to participate in port-centred pilotage development activities to better manage the risk to the port, and to ships operating within the port.

2.7 Vessel Traffic Service (VTS)

The stated role of the Gladstone VTS is to provide a monitoring and information service to ships operating within the port. To achieve this, VTS needs to provide timely and accurate information and direction to vessels operating within the port regarding traffic, tugs, berthing and any hazards or obstructions that may affect their operations within the port. As such, Gladstone VTS is a vessel traffic information service, not a vessel traffic control service.

The principal function of any VTS should be to enhance safety and to reduce, as far as possible, the various risks associated with ships operating within the port limits.

Gladstone VTS operators (VTSOs) have, at their disposal, a range of systems (VHF, radar, automatic identification system (AIS) and closed circuit television (CCTV)) which allow them to have an overall view of port operations.

At the time of the incident, it was not until asked by *Kamisu Maru*'s pilot, at 1348, that the VTSO advised him that *Endeavour River* was not progressing towards its berth and was across the channel. Additionally, at 1356, the VTSO was sufficiently concerned about the situation concerning *Endeavour River* that he notified the harbour master.

In submission, MSQ stated that:

> VTSOs cannot and should not interrogate every vessel that appears to be undertaking a manoeuvre which is slightly out of the ordinary in the Port.

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19 Pelecanos, S. (Vice President, International Maritime Pilots' Association). *The modernisation of marine pilotage.* Conference proceedings Natship, Brisbane, 2007.

At about 1338, the VTSO was using a CCTV camera to monitor *Kamisu Maru*'s passage and swung the camera around to look at the progress of *Endeavour River*. The VTSO kept the camera trained on *Endeavour River* for a considerable time, until the ship was confirmed as being aground. This shows that at about 1338, there was a suspicion within the VTSO's mind that something was not right with *Endeavour River*'s berthing, and that the ship was not merely undertaking a manoeuvre which was slightly out of the ordinary.

The VTSO should probably have informed the pilot on board *Kamisu Maru* shortly before 1338 that *Endeavour River* appeared to be having difficulty, or solicited information directly from *Endeavour River*'s master if he was unsure, and not wait for the pilot to ask some ten minutes later.

The pilot could then have made a decision whether to commit to proceeding down the channel or to delay his passage in a part of the port that was more conducive to anchoring the ship (with tug assistance). At 1348, when *Kamisu Maru*'s pilot advised that he was passing Barney Point, he was committed to the passage in the narrowest part of Auckland Channel and the pilot had very few options available to him if *Endeavour River* did not clear the channel ahead.

However, at no time did the master of *Endeavour River* initiate communications with external parties to advise them that he was experiencing difficulties with the manoeuvring of his ship. He only communicated activities associated with his ship when requested to do so by others, such as *Kamisu Maru*'s pilot.

By not initiating these communications early, the master did not allow for external parties, including the VTSO, to put in place any necessary contingency plans with other port operational areas.

3 FINDINGS

3.1 Context

On the afternoon of 2 December 2007, the Australian registered bulk carrier *Endeavour River* grounded in Gladstone harbour while attempting a mid-tide berthing at the South Trees Wharf. The ship grounded in the vicinity of A1 beacon at the entrance to the Auckland Channel, destroying the beacon in the process. Despite the assistance of all five of the port's tugs, the ship was unable to be refloated on 2 December. *Endeavour River* was successfully refloated on the morning high tide of 7 December and manoeuvred to its usual berth.

From the evidence available, the following findings are made with respect to the grounding and should not be read as apportioning blame or liability to any particular organisation or individual.

3.2 Contributing safety factors

- When in the Auckland Channel, *Endeavour River* was to starboard of the planned route where, in order to berth the ship, the master needed to present more of the ship's port side to the effects of the flood tide and wind for a greater period of time than if he had been correctly positioned for the approach to the berth.
- The master did not use propeller thrust effectively while manoeuvring towards the berth, thus exposing the ship to the full effects of the flood tide and wind.
- ASP Ship Management did not provide adequate guidance with regard to the effective positioning of the tugs for the anticipated manoeuvre. Consequently, the after tug could not provide an adequate braking or steering force during manoeuvres. *[Safety issue]*
- The absence of good communications and bridge resource management meant that no one on the bridge had a shared mental model of what the master was attempting to do during the pilotage.
- *Endeavour River*'s master did not discuss any aspect of his passage plan from the anchorage to the berth with any member of the bridge team. As a result, no limits were set or directions given to the bridge team as to when the master expected to be challenged on the ship's position within the channel, its heading or speed or an order he gave or an action he took.
- Both the master and chief mate were very familiar with the passage to the berth in Gladstone. This probably resulted in them having a false sense of security and being complacent during the operation and led to their failure to adequately monitor the ship's progress during the passage.
- No positions were put on the charts and the radar was not used to monitor the passage. Therefore, no one on the bridge knew accurately where the ship was in the channel, or with reference to the berth. Consequently, when the ship was set towards the entrance to the Auckland Channel, its movement remained undetected until it was too late to rectify the situation.

- The bridge team began to lose situational awareness as the ship passed the Boyne Wharf. As a result, they realised too late that they were not going to be able to salvage the original berthing plan. By the time they did realise that the ship was not positioned as it should have been, it was too late for the tugs to be able to hold the ship against the flood tide.
- The chief mate was unable to provide an appropriate level of support to the master during the operation because he had not received any training in mid-tide berthing operations and was overloaded with, and distracted by, tasks that included helm movements, operating the telegraph, monitoring the VHF radios and telephone and supervising the cadet. *[Safety issue]*.
- Overall manning on the bridge was insufficient to manage the risks associated with the pilotage while the ship was under the conduct of an exempt master. *[Safety issue]*
- The master had not received sufficient training in recovering from the situation when the ship was bodily across a flood tide to enable him to effectively manage the developing situation. *[Safety issue]*
- Mid-tide berthing training conducted by ASP Ship Management was not structured, contained no contingency planning training and, despite a 2003 internal report discussing such training, no changes to the training regime had occurred. *[Safety issue]*
- ASP Ship Management had no competency audit or ‘check pilot’ system in place to ensure ongoing compliance with their safety management guidelines for operations undertaken by pilotage-exempt masters. *[Safety issue]*
- The four-year ‘check-pilot’ assessment is insufficient to ensure that pilotage-exempt masters undertake pilotage in the most appropriate way to reduce the risks to the port and the ship. *[Safety issue]*
- ASP Ship Management had not implemented the majority of the recommendations contained in the internal investigation report into the 2003 grounding of *Endeavour River*. Had the company actioned these recommendations and findings, the risk of a grounding reoccurring in similar circumstances probably would have been significantly reduced. *[Safety issue]*

3.3 Other safety factors

- The lack of participation by pilotage-exempt masters in port-centred pilotage development activities increased risk to port operations by exempt masters carrying out pilotage in the port in ways which may not have been best practice. *[Safety issue]*
- Gladstone VTS operators suspected that *Endeavour River*’s berthing operation was not proceeding to plan but did not inform the pilot on board *Kamisu Maru* until the pilot requested information from them.

3.4 Other key findings

- The actions of the pilot on board *Kamisu Maru* were timely, effective and professional given the difficult situation he was faced with.

4 SAFETY ACTIONS

4.1 Safety action by ASP Ship Management

The ATSB has been advised that the following safety actions have been taken by ASP Ship Management as a result of the grounding of *Endeavour River* on 2 December 2007.

In their submission, ASP Ship Management stated:

> In accordance with our own company procedures, ASP carried out a full investigation immediately following the incident and it is correct to state that 'findings' contained within the ATSB report are very much in accord with the conclusions reached by ASP's investigation team which was led by a highly credentialed independent consultant and former senior captain within the ASP fleet.
>
> We take this opportunity to record our actions to date which we believe directly correlate to the ATSB recommendations and safety advisory notices outlined in your draft report.
>
> - A three day workshop was convened at ASP's offices with attendees including representation from the Gladstone harbour master's office, Gladstone pilots, ASP exempt masters and ASP senior management. The workshop was conducted under the stewardship of a highly credentialed independent consultant. During the workshop, the participants analysed the incident (including a review of the existing passage plan and ASP's training and general navigational regimes) and then developed a detailed structural simulation training program and an agenda to ensure much closer liaison between licensed pilots and exempt masters.
> - Two 'best practice' seminars were conducted in March and April of this year with the grounding of *Endeavour River* featuring in a professionally developed case study. Amongst other seagoing personnel, all current Gladstone based masters and the majority of chief officers attended this program conducted at ASP's Melbourne office.
> - Simulator training involving pilots and exempt masters specific to the port of Gladstone was subsequently conducted at the Australian Maritime College facility 22nd through to 24th May 2008. The lessons learned from the exhaustive study feature in a revised passage plan now in use for this port being fully endorsed by pilots and masters alike. A key finding emanating from this program was the critical use of the centre lead aft when engaging tugs to ensure an effective brake can be applied to the vessel when approaching the berth on the flood tide. Please note that adherence to the revised plan is now mandatory for exempt masters and deviation through unforseen local events becomes a reportable incident within ASP's management system.
> - To ensure compliance, ASP has appointed an independent consultant and former exempt senior master to undertake the role of 'check captain' for our Queensland based vessels.
> - The *structured simulator training program* developed in May will be rolled out to all masters and chief officers in the Gladstone fleet to ensure they become fully familiar and comfortable with the revised passage plan. Refresher programs will also be implemented on an annual basis.

- Following this simulator training program, an alternative 'check captain' will be identified to ensure a continuing in house retention of this skill base.

- Notwithstanding the fact that the bridge team on the day had undertaken BRM training, it is evident that there is a continued need to reinforce the principles associated with effective bridge team work. Accordingly, all masters and chief officers will be scheduled to undertake a second generation BRM program identical to that now being conducted with the Queensland pilot service. The training will have the intent of ensuring ASP's programs align completely with the best practices now in place with MSQ. We intend to combine both pilots and exempt masters in programmes held in the port of Gladstone and also facilitate (with the full cooperation of the harbour master's office) greater familiarisation for our captains in port pilotage development.

  In summary, a professional development program for ASP captains which keeps pace with the initiatives adopted by MSQ.

- All ASP vessels now operating in the port of Gladstone have been fitted with electronic chart capability and effective monitoring of the vessels' position throughout the berthing/un-berthing procedure will form part of our 'check captain'/audit regime.

- The adoption of the aforementioned training regimes for both masters and chief officers will we believe generate a pilot/co-pilot culture during high risk sectors of the vessels passage plan and remove any lingering concerns over the BRM principle of challenge and response. Bridge teams will be adequately resourced to ensure associated duties are adequately addressed by personnel other than the master/chief officer.

This concludes our response to the ATSB draft report other than to express our appreciation to MSQ, the harbour master and Gladstone pilots for their ongoing support and cooperation in the development and implementation of this 'action plan'.

4.2 Safety action by Maritime Safety Queensland

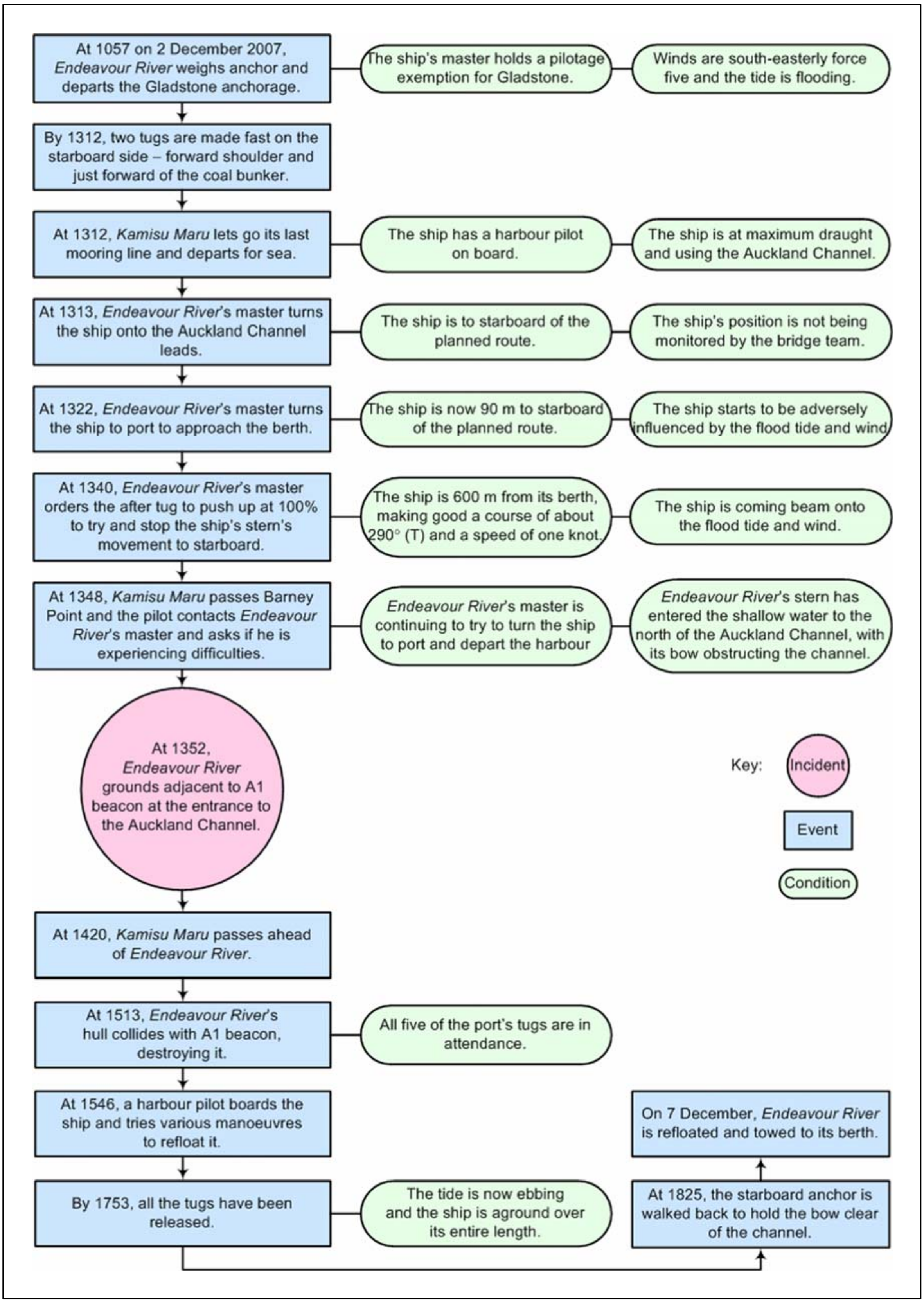
The ATSB has been advised that the following safety actions have been taken by Maritime Safety Queensland as a result of the grounding of *Endeavour River* on 2 December 2007.

- The Gladstone regional harbour master notes the recent simulation exercises conducted by MSQ pilots and ASP. Where appropriate, amendments will be made to the Gladstone Port Procedures Manual to reflect the lessons learned during the simulation exercises.
- The regional harbour master, in conjunction with ASP, is instigating a review of the passage plan for these vessels, the pilotage exemption requirements for potential exempt masters and the checking and renewal of pilotage exemption certificates.

4.3 ATSB recommendations and safety advisory notices

The ATSB acknowledges the safety actions that ASP Ship Management and Maritime Safety Queensland have taken to address all the safety issues identified during this investigation. Because of these actions, the ATSB has not issued any recommendations or safety advisory notices.

APPENDIX A : EVENTS AND CONDITIONS CHART



APPENDIX B : SHIP INFORMATION

Endeavour River

IMO Number	8019007
Call sign	VJFY
Flag	Australian
Port of Registry	Sydney
Classification society	Lloyd’s Register (LR)
Ship Type	Gearless bulk carrier
Builder	Italcanterieri at Monfalcone, Italy
Year built	1983
Owners	Toll Holdings, Australia
Ship managers	ASP Ship Management, Australia
Gross tonnage	50 144
Net tonnage	16 918
Deadweight (summer)	82 422 tonnes
Summer draught	13.12 m
Length overall	255.0 m
Length between perpendiculars	248.5 m
Moulded breadth	35.3 m
Moulded depth	19.2 m
Engine	General Electric double reduction steam turbine
Total power	13 000 kW
Speed	14 knots
Crew	22

APPENDIX C : SOURCES AND SUBMISSIONS

Sources of information

Master and crew of *Endeavour River*

Senior Gladstone Pilot

ASP Ship Management

Maritime Safety Queensland

Electrotech Australia, Gladstone

The Australian Ship Handling Centre

Marine Consultancy Group

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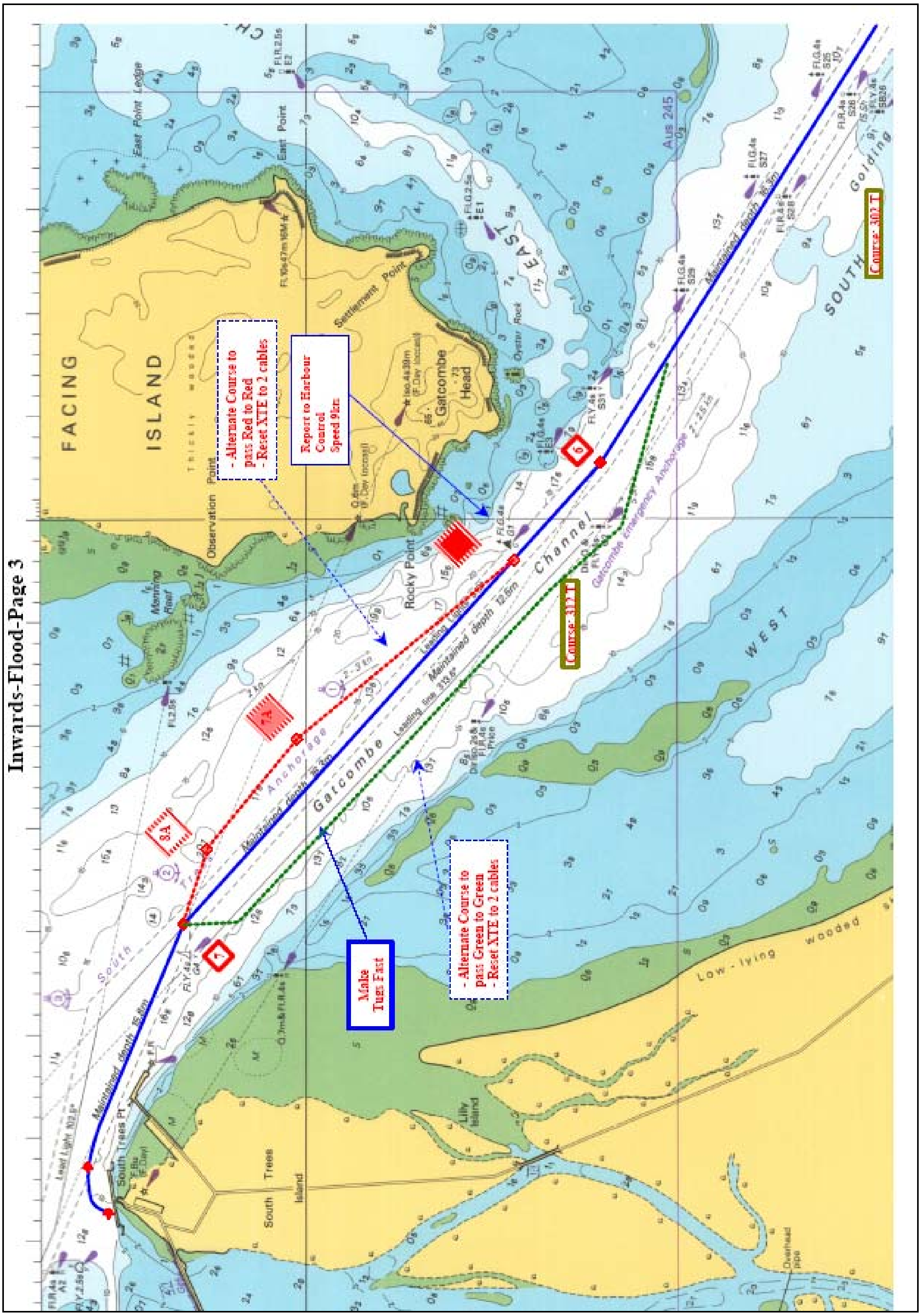
Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003,* the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report

The final draft of this report was sent to ASP Ship Management, the master and chief mate of *Endeavour River*, the Australian Maritime Safety Authority, Maritime Safety Queensland, *Kamisu Maru*’s pilot, *Endeavour River*’s pilot and ASP Ship Management’s senior master in charge of simulator training.

Submissions were received from ASP Ship Management, the master and chief mate of *Endeavour River*, the Australian Maritime Safety Authority, Maritime Safety Queensland, *Endeavour River*’s pilot and ASP Ship Management’s senior master in charge of simulator training. The submissions have been included and/or the text of the report was amended where appropriate.

APPENDIX D : ASP SHIP MANAGEMENT PASSAGE PLAN



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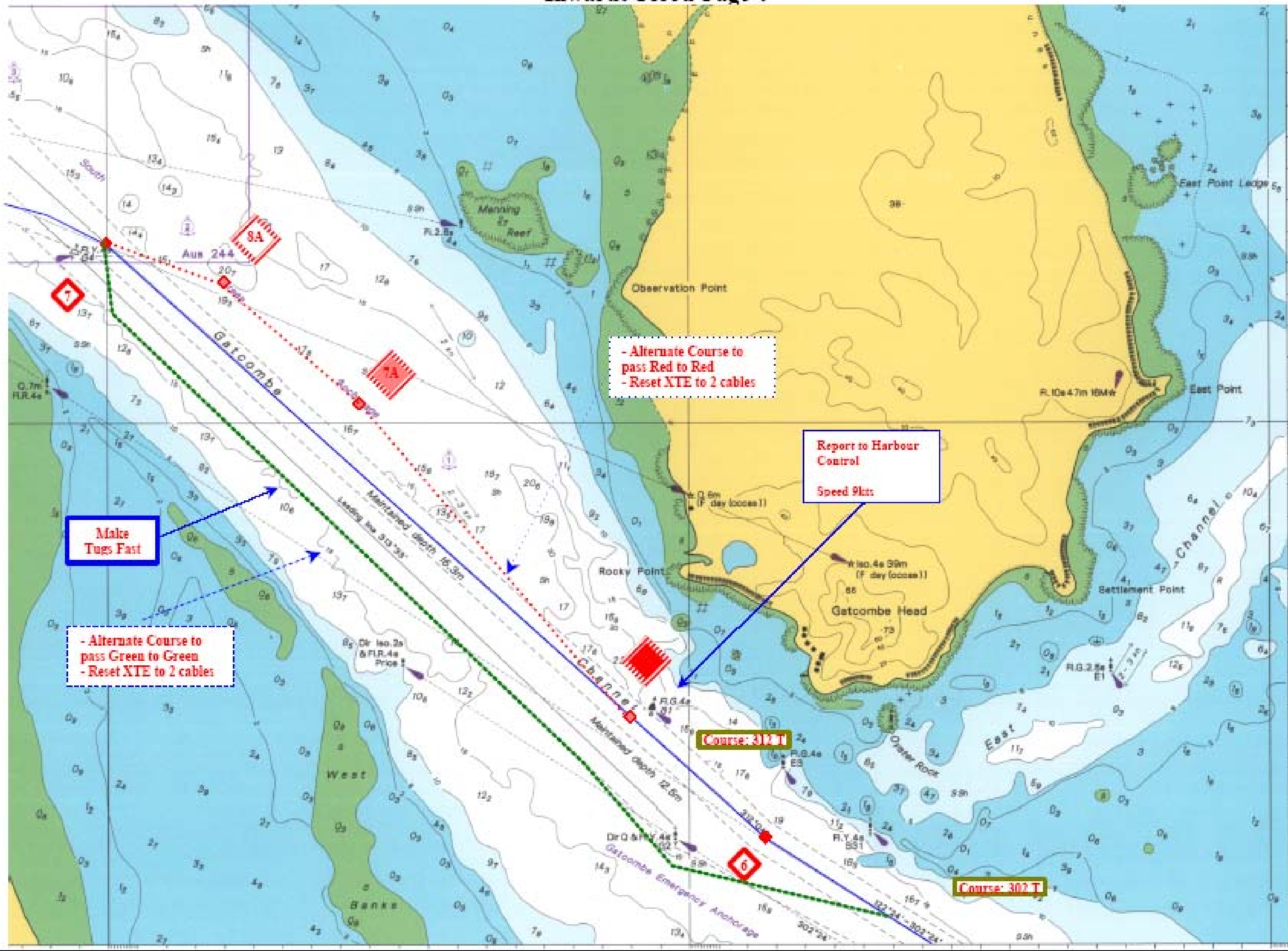

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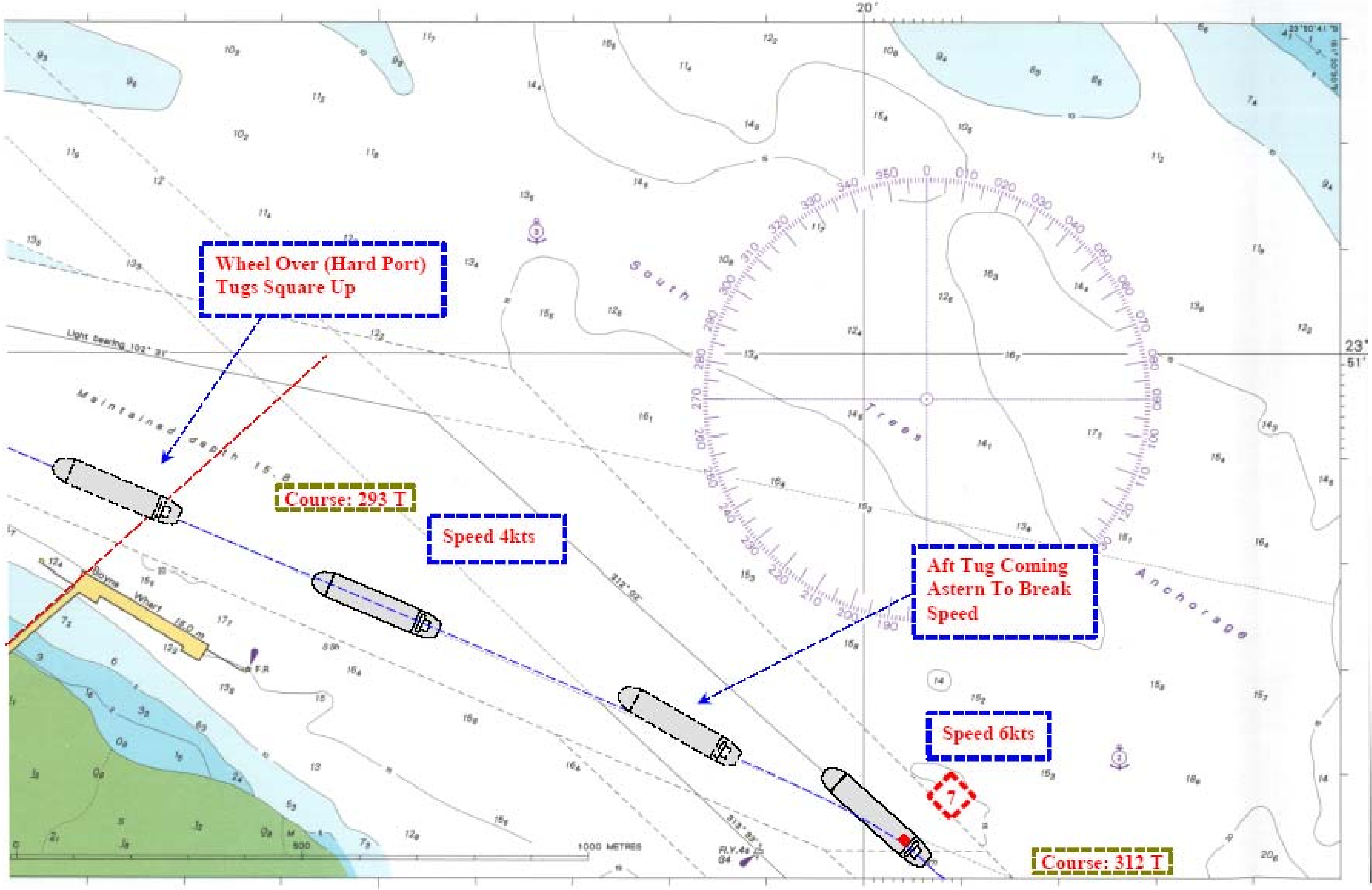

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