



Australian Government

Australian Transport Safety Bureau



ATSB TRANSPORT SAFETY REPORT  
Marine Occurrence Investigation No. 241  
Final

Independent investigation into the grounding  
of the Antigua and Barbuda registered bulk carrier

# Enterprise

Grassy Harbour, King Island, Tasmania

10 May 2007



**Australian Government**  

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**at Grassy Harbour, King Island, Tasmania**

**10 May 2007**

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Figure 3 is reproduced from the Admiralty Sailing Directions, Australia Pilot Volume II (NP 14), Tenth edition, 2007.

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### Abstract

At about 1045 on 10 May 2007, the bulk carrier *Enterprise* grounded briefly as it was being manoeuvred in the confined waters of Grassy Harbour, King Island, Tasmania. The ship was under the conduct of the pilot, who was following the pilotage plan he usually used for the ship when it called at the port.

Prior to the ship's entry to the port, its after draught had been reduced to 5.0 m so that a minimum under keel clearance of 0.5 m could be maintained alongside the berth. At that draught, the ship's controllable pitch propeller was not fully submerged. However, neither the pilot nor the master adequately considered the effect that the reduced draught would have on the efficiency of the propeller and therefore, the ship's manoeuvrability.

While manoeuvring off the berth, the pilot was forced to maintain astern pitch for longer than he had planned. As a result, the ship was subjected to the effects of the propeller's transverse thrust on its stern for longer. The transverse thrust combined with the starboard thrust of the bow thruster, which was being used to maintain the ship's heading, resulted in the ship moving bodily to starboard and grounding on rocks at the southern end of the main breakwater. The ship's propeller was damaged but *Enterprise* was not disabled. No pollution resulted from the grounding.

The ATSB has issued one recommendation to address a safety issue identified in the report.

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# THE AUSTRALIAN TRANSPORT SAFETY BUREAU

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The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Infrastructure, Transport 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.



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## TERMINOLOGY USED IN THIS REPORT

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**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.



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## EXECUTIVE SUMMARY

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At 1953<sup>1</sup> on 8 May 2007, the Antigua and Barbuda registered self-discharging bulk carrier *Enterprise* anchored in Sea Elephant Bay off the east coast of King Island, Tasmania. While at anchor, the master and the Grassy Harbour pilot, who had joined the ship at its previous port of call, Geelong, Victoria, decided on the pilotage plan for Grassy, the ship's intended port of call. In accordance with that plan, water ballast was discharged to reduce the ship's after draught to 5.0 m in preparation for berthing in the small port, about 15 miles<sup>2</sup> to the south of the anchorage position. At a draught of 5.0 m, the ship's propeller was not fully submerged, resulting in a loss of efficiency. However, the pilot and the master did not consider that the reduced efficiency of the propeller would have a marked effect on the ship's manoeuvrability.

By 0908 on 10 May, *Enterprise* was underway and at 1020, when the ship was about 1.5 miles from Grassy Island, the master handed over conduct of the ship to the pilot. The ship was in hand steering, with a south-westerly wind and the swell on the port beam. The tide was flooding and the ship would be berthing without the assistance of a tug.

At about 1035, with Grassy Island abeam, the pilot started a 100° turn to starboard to bring the ship onto the line of the inner harbour leads. However, as a result of the propeller's reduced efficiency, the ship's speed before the turn was less than the pilot thought and consequently, he initiated the turn early. This resulted in the ship being to starboard of the line of the leads and close to the main breakwater after the turn. As *Enterprise* approached the inner breakwater, the wind and tidal forces, now acting from astern, combined with the reduced efficiency of the propeller. The ship's speed did not reduce as the pilot expected and in order to slow the ship, he used astern propulsion for longer than he had planned.

*Enterprise* is fitted with a single right-handed, controllable pitch propeller, which tends to move the ship's stern markedly to starboard when astern propulsion is applied at low speed. Therefore, as the ship's speed dropped, *Enterprise* began to move further to starboard, closing on the breakwater.

At 1041, the ship was moving bodily to starboard at about 1.0 knot<sup>3</sup>. The ship's position after the turn and its pronounced movement to starboard in the confined area made it evident to the pilot that the pilotage plan was not succeeding. The pilot and master decided to abort the approach and take the ship, stern first, out of the harbour.

The pilot endeavoured to manoeuvre the ship back onto the leads using astern propeller pitch and the bow thruster. In trying to take the ship out of the harbour using the engine and bow thruster, everything the pilot wanted to achieve required an astern movement on the engine. As a result of the propeller's transverse thrust on the stern and the pilot's use of starboard thrust on the bow thruster to keep the ship's bow in the channel, the ship's bodily movement to starboard increased.

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

2 A nautical mile of 1852 m.

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

At about 1045, *Enterprise* briefly grounded on rocks at the southern end of the main breakwater. Following the grounding, the pilot was able to regain control of the ship and he completed the berthing without further incident. The ship suffered minor damage, mainly to the propeller but it was not disabled. No pollution resulted from the grounding.

This report identifies the following safety issues:

- The pilot had received no training in how to use anchors to assist him with handling a ship in the confined approaches to Grassy. As a result, he was not comfortable with using the ship's anchors to assist him with manoeuvring the ship in the close confines of the approaches to the inner harbour.
- The port authority had not undertaken a thorough assessment of the risks associated with, and the suitability of, *Enterprise* calling at Grassy several years before the incident on 10 May 2007. As a result, the only pilot licensed for the port had to carry out a risk assessment each time the ship intended to call at the port.
- The Tasmanian Ports Corporation did not provide any clearly defined guidance to assist its pilots in assessing and mitigating the risks involved in the Grassy pilotage. As a result, *Enterprise's* pilot did not adequately consider the handling characteristics of the ship, and the reduced efficiency of its propeller, when he decided to berth the ship without the assistance of a tug.
- *Enterprise's* pilot had been conducting pilotage in Grassy 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.

The ATSB acknowledges the safety actions taken by the Tasmanian Ports Corporation to address these and has issued one recommendation associated with one outstanding safety issue involving training in the use of anchors.

## 1.1 *Enterprise*

*Enterprise* is an Antigua and Barbuda registered self-discharging bulk carrier (Figure 1). At the time of the incident, it was owned by Zweite Belt Shipping, Germany, and managed by AJ Ship Management, Germany.

The ship was built in 1985 by Mitsubishi Heavy Industries, Japan, and is classed with Det Norske Veritas (DNV). It has an overall length of 113.01 m, a moulded breadth of 20.21 m and a depth of 9.48 m. The ship has a deadweight of 8709 tonnes at its summer draught of 8.27 m.

**Figure 1:** *Enterprise* berthed in Grassy



*Enterprise*'s four cargo holds are located forward of the accommodation superstructure which extends above the raised poop deck. Cargo is discharged via a series of conveyor belts through a boom that is fitted forward of the number one cargo hold. The boom can swing to either side of the ship.

Propulsive power is provided by a single Pielstick 6PC2-5L-400 four stroke, single acting non-reversing, medium speed diesel engine developing 2582 kW. The main engine drives a single, right-handed, 5.2 m diameter controllable pitch propeller (CPP) which gives the ship a service speed of 15 knots. The ship is also fitted with a 520 kW bow thruster.

*Enterprise*'s navigation bridge is equipped with navigational equipment consistent with SOLAS<sup>4</sup> requirements. This includes a Tokyo Keiki gyro compass and two radars, a JRC JMA-850-7 and a Kelvin Hughes Nucleus 3, which is equipped with ARPA (automatic radar plotting aid) and input from the global positioning system (GPS) unit. Other equipment includes a JRC automatic identification system (AIS) unit and a Furuno echo sounder that is fitted with a recorder, a digital indicator and

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

an alarm unit. Indicators for the rudder angle and propeller pitch are fitted inside the bridge and on both bridge wings.

At the time of the incident, *Enterprise* had a crew of 15 Australian nationals comprising the master, three mates, four engineers, four integrated ratings, two catering crew and a trainee rating. While at sea and during cargo operations alongside, the mates maintained a watchkeeping routine of four hours on, eight hours off.

The master began his seagoing career in 1982 and held an Australian master's certificate of competency, first issued in 1999. He had sailed on *Enterprise* for six years, initially as chief mate before being promoted to master in 2004. He held pilotage exemption certificates for a number of ports that the ship regularly visited. He did not hold a pilotage exemption for Grassy, which he had visited only once, about five months before the incident.

The chief mate first went to sea in 1975 and he also held an Australian master's certificate of competency. He had sailed at different ranks, including master, on various types of ships. He first joined *Enterprise* as second mate in 2005. He too had visited Grassy once, about a year before the incident.

The second mate had five years of seagoing experience and held qualifications for his rank. He first joined the ship 10 months before the incident as third mate and was making his first visit to Grassy.

*Enterprise's* pilot started his seagoing career in 1970 and began piloting in 1987. In 1998, he started piloting in Hobart, and in a number of regional Tasmanian ports. During his time as a Hobart pilot, he had been harbour master in Hobart for three years. At the time of the incident, he was the only licensed pilot for Grassy. The pilot was familiar with *Enterprise*, having handled the ship on numerous occasions in Hobart. He had also piloted the ship on its infrequent calls to Grassy since 2005.

## 1.2 Grassy

The township of Grassy is situated on the southeast coast of King Island, which is located at the western entrance to Bass Strait (Figure 2). King Island is part of the state of Tasmania and has a population of approximately 1800 permanent residents, of which 800 reside in the township of Currie situated on the west coast. There are also two other small towns on the island, Naracoopa on the east coast and Grassy to the southeast. The island is 64 kilometres from north to south and 27 kilometres from east to west.

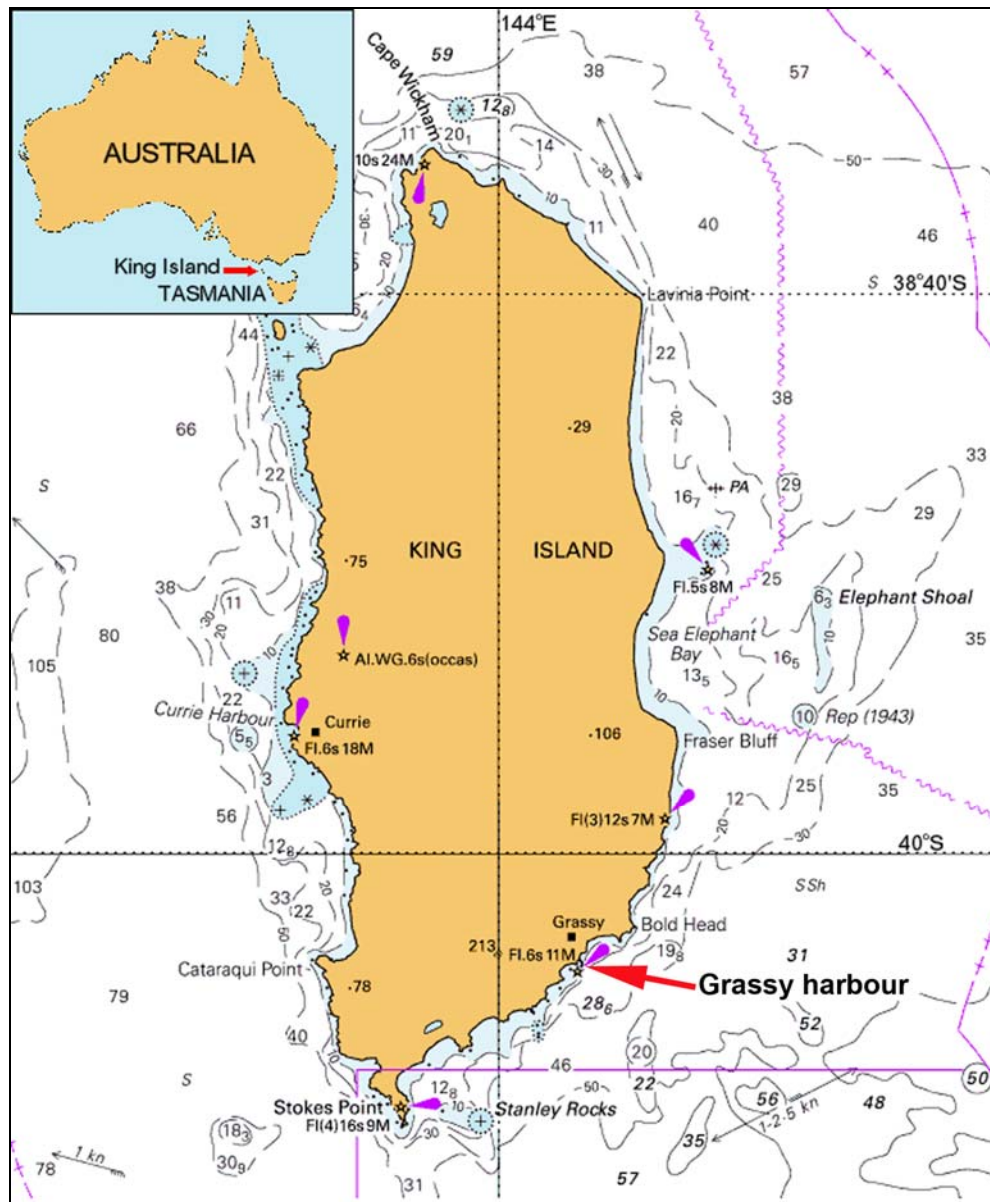
The King Island Ports Corporation, which is a fully owned subsidiary of the Tasmanian Ports Corporation (Tasports), owns land and operates port infrastructure at Currie and Grassy.

King Island exports approximately 16 000 tonnes of cargo per annum, including a variety of dairy and meat products, kelp and livestock. Imports to the island approximate 15 000 tonnes per annum and include bulk and containerised fertiliser, general cargo, bulk fuels, timber and agricultural products. Over 95 per cent of King Island's trade passes through Grassy<sup>5</sup>.

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<sup>5</sup> Tasmanian Ports Corporation Annual Report 2006 – 07.

Figure 2: Section of navigational chart Aus 487 showing King Island



A significant part of this trade is carried by a 118.8 m long roll-on/roll-off (ro/ro) general cargo ship that operates a weekly service between the Australian mainland, Tasmania and Grassy. Occasionally, small cargo or passenger ships call at the port and, during the two years preceding the incident, *Enterprise* had called there four times.

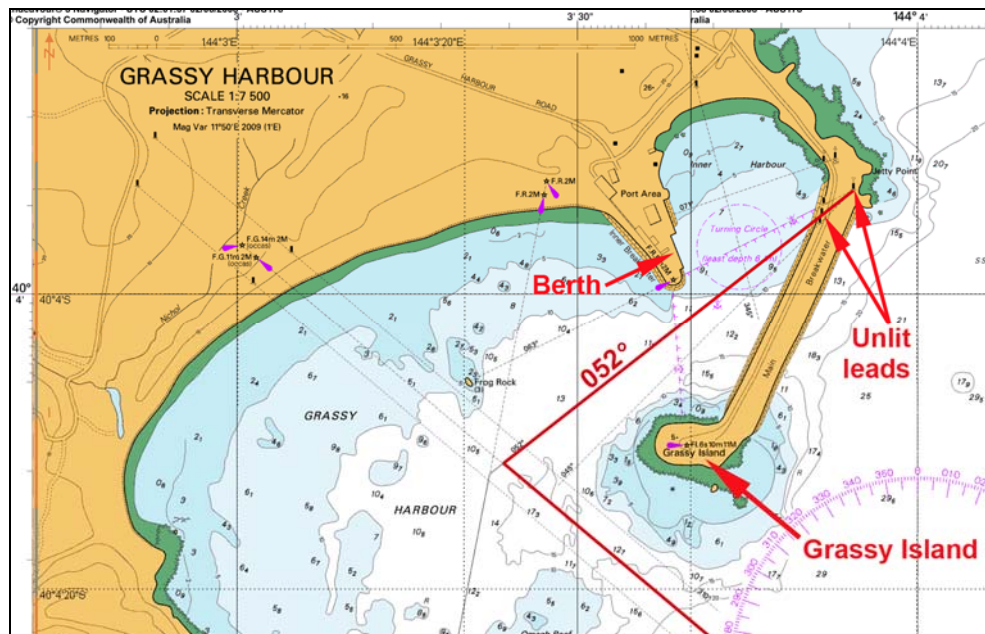
At Grassy Harbour (Grassy), the swell is predominantly from the southwest and the wind direction generally varies between either southwest or northeast. Two man-made breakwaters afford Grassy's inner harbour some protection from the weather (Figure 3).

**Figure 3: Aerial photograph of Grassy harbour**



The inner harbour is entered along a line of leads on a 052° (T) alignment indicated by two unlit beacons on the main breakwater (Figure 4). The entrance to the inner harbour is about 200 m wide. An area where anchoring is prohibited, indicated on the chart, keeps the entrance clear for traffic. There is a 183 m diameter turning area for ships inside the inner harbour, which has a charted minimum depth of 6.1 m.

**Figure 4: Section of navigational chart Aus 178 showing Grassy Harbour**



Grassy's port area and its only berth lie on the north-eastern side of the inner breakwater. The berth is 80 m long and has a designated depth alongside of 5.5 m. There is a ramp for ro/ro operations at one end of the berth but there are no shore cranes.

The exposure to weather and the limited sea room in the harbour presents a challenge for ship handling. With the inner lead beacons and some other marks in

the port unlit, ship's arrive and depart in daylight only and rarely remain alongside the berth during hours of darkness.

Tasports provides a pilotage service for Grassy and all ships over 35 m in length are required to use a pilot unless the master holds a pilotage exemption for the port. There is no pilot boat or pilot boarding ground at Grassy and no pilot is stationed there. Ships requiring a pilot must embark a licensed pilot at a suitable previous port of call.

There are no tugs situated on King Island. The nearest tugs are based in Burnie, about 140 miles away on the northwest coast of Tasmania.

### 1.3 The incident

At 0630 on 8 May 2007, *Enterprise* sailed from Geelong, Victoria, with the Grassy pilot on board. The ship had completed a partial cargo discharge and was bound for Grassy where the remaining cargo of bulk fertiliser was to be discharged. The departure draughts were 6.4 m forward and 6.7 m aft.

During the 12 hour passage to King Island, the pilot and the master discussed the pilotage plan for berthing the ship in Grassy. They agreed to use the same plan that they had used on the ship's last visit in December 2006, which was similar to the plan that the pilot had used on each occasion that he had berthed the ship in Grassy. To allow better wharf access to the cargo following discharge, they planned as on past occasions to berth *Enterprise* port-side-to the wharf.

The plan for the pilotage was to approach along the 310° outer leads with *Enterprise* passing position 1 (Figure 5) at a speed<sup>6</sup> of about seven knots. The ship would then be turned to starboard onto the 052° inner leads and pass position 2 with its speed reducing. Astern propulsion would be used to stop the ship in position 3 and a stern line would be passed quickly to the berth using the port's mooring line boat. With this line holding the stern, the bow would be swung to port using the bow thruster thus bringing the ship alongside the wharf in position 4, where it would be made fast. By following this plan, no tug would be required and the use of astern propulsion would be kept to a minimum.

The master and pilot agreed that there would be a 'point of no return', three cables<sup>7</sup> from Grassy Island as the ship approached along the outer leads. The port anchor was to be ready for emergency use once the ship was past that point.

The pilot and the master also discussed the allowable conditions for berthing. The pilot's maximum limits for weather were 25 knots southwest winds, 3 to 4 m swell and a surge in the harbour (due to swell) of less than 0.5 m at the berth. They agreed that, even though the propeller would not be fully submerged, in order to fulfil the under keel clearance requirements alongside the berth with a surge in the harbour, the ship needed to have a maximum draught of 5.0 m for berthing. The pilotage plan was then incorporated into the ship's passage plan.

At 1953 on 8 May, the ship arrived off King Island and anchored in Sea Elephant Bay, about 15 miles to the north of Grassy, with the intention to berth the following

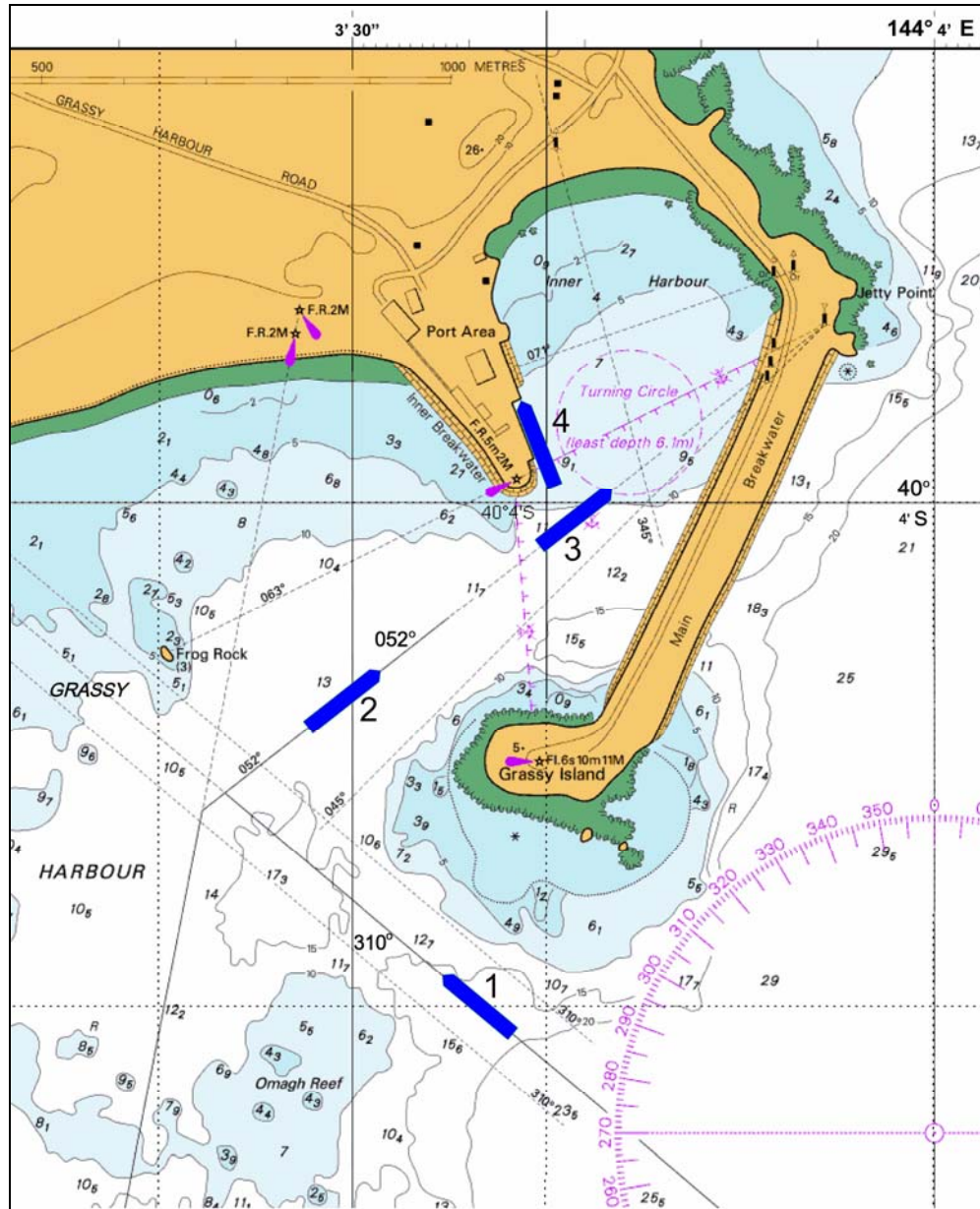
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<sup>6</sup> All ship's speeds referred to in the report are speeds 'made good / over the ground'.

<sup>7</sup> One cable equals one tenth of a nautical mile or 185.2 m.

day if conditions were suitable. After anchoring, most of the ship's water ballast was discharged to reduce the ship's draughts to 4.7 m forward and 5.0 m aft in preparation for berthing.

**Figure 5:** Section of navigational chart Aus 178 showing *Enterprise's* anticipated positions during the planned passage, ship images to scale



On the morning of 9 May, the weather conditions exceeded the planned limits for berthing. The conditions remained unfavourable throughout the day and the berthing was postponed until an assessment could be made the next morning.

At 0600 on 10 May, the port supervisor told the pilot that there was a 0.5 m surge at the berth and that this was reducing in the improving weather conditions. By 0830, the surge was reported to be 0.2 m, the wind was from the southwest at 15 knots and the swell was 3 to 4 m. With the weather conditions within the pilot's limits, the pilot and the master decided to berth the ship. The ship's bridge equipment was tested and the crew then started to weigh the anchor.

By 0908, *Enterprise* was underway and the master conned the ship southwards towards Grassy.

Shortly after 1000, the pilot and the master reviewed the berthing plan; this time with all three mates on the bridge. The importance of passing a stern line ashore quickly was again impressed upon the second mate who then left to join the crew on the poop. The chief mate remained on the bridge while the third mate went forward.

At about 1015, the ship's course was altered to 310° (T), to bring it onto the line of the outer leads and the propeller pitch was reduced to half ahead. At 1020, when *Enterprise* was about 1.5 miles from Grassy Island, with its speed about seven knots, the master handed over conduct (con) of the ship to the pilot. The ship's heading<sup>8</sup> was 300° and, with the southwest wind and the swell on the port beam, the helmsman was using slight port helm to keep the ship's head steady.

After taking the con, the pilot reviewed the 'point of no return', increasing it to five cables off Grassy Island. For reference, the chief mate then set up the radar variable range marker accordingly. The pilot ordered the port anchor be prepared and then contacted the shore supervisor to confirm that the swell/surge conditions inside the harbour had not worsened.

The supervisor reported that the wind direction and speed were 250° (T) at 17 knots and that the surge was less than 0.2 m. He also reported that the height of tide was 0.7 m. With a predicted high tide of 1.4 m at 1712, the supervisor's comments confirmed that the tide was flooding. On a flood tide, the tidal stream off Grassy sets northeast along the coast. To counteract the set and also the leeway due to the wind, the pilot ordered the ship to be steered on headings between 303° and 305°.

At 1025, the pilot was advised that the ship's port anchor was ready for letting go. At 1027, when the pilot ordered the propeller pitch be reduced to slow ahead, the ship's speed was 6.7 knots. By 1033, the speed had decreased to 5.4 knots and the ship was slightly to the northeast, or starboard, of the line of the outer leads.

The pilot was visually monitoring the ship's position and heading. He was conning the ship from both inside the wheelhouse and the bridge wings. His laptop computer, with an electronic chart and GPS input, was set up inside the bridge for reference as a back-up and to monitor the ship's speed. The master remained with the pilot and monitored his orders and their execution. The chief mate stood-by inside the bridge to execute propeller pitch and bow thruster orders, monitor the helmsman's actions, the ship's speed and the radar. He also made entries, including the ordered pitch settings, in the bell book.

Soon after 1035, when Grassy Island light was abeam (Figure 6), the pilot started to turn the ship onto the inner leads. At 1036½, the propeller pitch was reduced to the minimum ahead and 30 seconds later, to zero.

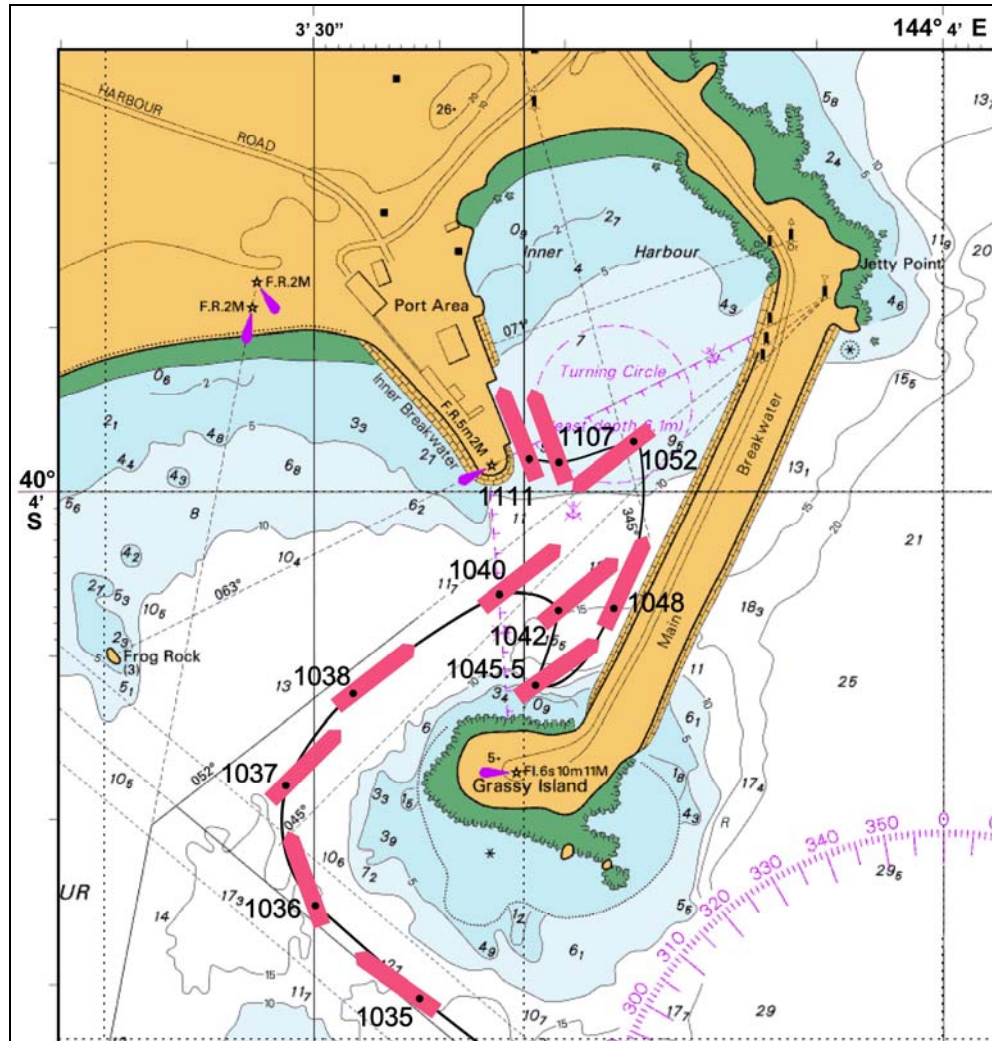
At about 1037, with the ship steady on a heading of 052°, and with the wind almost astern, the pilot ordered full starboard helm so as to generate some starboard swing on the ship. At 1037½, he ordered half astern and half starboard thrust on the bow thruster. The ship's speed was now 4.4 knots and its position was to starboard of the line of the leads. At 1038½, observing little reduction in speed, the pilot ordered full astern, full starboard thrust on the bow thruster and the rudder midships.

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<sup>8</sup> All ship's headings in the report are in degrees by gyro compass with negligible error.

By 1040, the ship's speed had reduced to two knots and at 1041, the pilot ordered half astern. The stern was more than a ship's length off the berth and moving away from it, too far for the mooring line boat to take the stern line ashore.

**Figure 6: Section of navigational chart Aus 178 indicating the ship's track with scale images, aligned to its heading, superimposed**



Realising that the berthing was not going as planned, the pilot and the master agreed to take the ship out of the inner harbour stern first so that they could make another attempt to enter.

By 1042, the ship was making sternway and the pilot reduced the propeller's pitch to zero. The main breakwater was about half a ship's length (55 m) to starboard and closing. The second mate and the third mate began reporting distances off the breakwater from their respective stations. The mooring line boat was called to assist getting *Enterprise* back into the centre of the channel, by pushing on the ship's starboard quarter but, with the rocks in close proximity, it was not able to maintain its position there.

At 1042½, in order to try and stop the ship's stern from making contact with the rocks on its starboard quarter, the pilot ordered half ahead and hard to starboard. The ship's heading swung to about 070°, but the relative wind direction did not change to the starboard quarter as the pilot hoped it would and the bow closed on

the breakwater. At 1043, the pilot ordered the propeller pitch to zero, and at 1043½, he ordered emergency full astern.

At 1044, with the bow of the ship still closing on the main breakwater, and the stern moving towards the rocks, the pilot ordered the propeller pitch set to zero. He also ordered the bow thruster setting changed from full starboard thrust to full port thrust. By this time, *Enterprise* was making good about one knot in a south-south-easterly direction towards the rocks off its starboard quarter, which the second mate reported to be only 25 m away. At 1044½, the pilot ordered full ahead and hard to starboard. Soon afterwards, the second mate saw the rocks disappear under the ship's stern.

At 1045½, *Enterprise* grounded in position 40° 04.11'S, 144° 03.68'E. The second mate saw the water at the ship's stern get 'muddier', felt vibrations and heard the propeller blades striking the rocks. On the bridge, the master also heard the 'clunk-clunk' sounds and felt the vibrations for a period of about five seconds.

Immediately after making contact with the rocks, the ship's bow swung to port and the ship moved ahead. The pilot ordered slow ahead and midships and kept the thruster setting at full port. He advised the master that he would try everything to clear the breakwater by using the engine, bow thruster and rudder. The pilot continued to con the ship, discussing his intentions and actions with the master. During the course of the manoeuvres, the bow came within a couple of metres of the breakwater before finally swinging clear.

At 1047, the ship's speed had increased to about three knots and propeller pitch was again set to zero. At 1047½, to slow the ship's headway, pitch was set to full astern and the port anchor was let go, with two shackles<sup>9</sup> on deck. By 1048, the ship was making good 033° (T) and had started to move away from the breakwater.

At 1048½, with the ship's speed reducing, the propeller pitch was set to zero. At 1050, the ship moved further towards the harbour's turning area, dragging the anchor along the bottom, with the pitch at dead slow ahead. By 1052, the propeller's pitch had been set to zero and the ship was riding to the anchor on a heading of 232°. The wind had reduced to a light breeze and the pilot and the master decided to berth the ship, using the starboard anchor to assist manoeuvring.

At 1054½, with the ship in the port's turning circle, the port anchor was weighed and at 1059½, the starboard anchor was let go with one shackle on deck. The pilot then manoeuvred *Enterprise* towards the berth, paying out the starboard anchor cable in the process. At 1107½, with two shackles of cable on deck, a stern line was run ashore and by 1142, the ship was all fast at the berth.

Soundings of the ship's tanks and compartments indicated that the hull was intact. The Australian Maritime Safety Authority (AMSA) detained the ship pending an underwater inspection and an assessment of damage by the ship's classification society.

Having been told of the incident by the pilot, Tasports dispatched the tug *Sirius Cove* from Devonport to stand by the ship while it was detained. Another senior Tasports pilot also arrived in Grassy to offer advice and support to *Enterprise's* pilot, who remained on board the ship.

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<sup>9</sup> One shackle equals 90 feet or 27.43 m.

At 1100 on 11 May, *Sirius Cove* arrived and anchored in Grassy.

On 12 May, divers carried out an inspection of *Enterprise*'s hull and assessed the damage. All four of the propeller blades were damaged with extensive gouging, chipping, bending and cracking on their leading edges. One blade was missing 250 mm of its tip (Figure 7). There was slight damage to the rudder and only small areas of the bottom hull plating aft were set in, the most serious being about 35 mm deep over an area of about 400 mm by 250 mm.

A DNV surveyor attended the ship and, based on the damage assessment, two conditions of class were imposed. Under the conditions, the ship was permitted to proceed to its next port at reduced power and any excessive vibrations were to be reported. Repairs to the propeller were to be completed by 12 June 2007 and all other required repairs by the end of 2007.

On 12 May, a test with the main engine operating at its service speed and the propeller at zero pitch revealed minimal vibrations. At 1930, the ship was released from detention by AMSA.

At 0700 on 13 May, *Enterprise* departed from the berth assisted by *Sirius Cove*. The ship was piloted out of Grassy without incident and the pilot then disembarked onto the tug. The ship increased speed and no excessive vibrations were observed. At 0920, *Sirius Cove* was stood down and the ship sailed for Adelaide, South Australia.

**Figure 7: Most damaged blade**



**Figure 8: Most bent blade**



## 2.1 Evidence

On 12 May 2007, two investigators from the Australian Transport Safety Bureau (ATSB) attended *Enterprise* in Grassy. The pilot, the ship's master, the chief mate, the second mate and the helmsman at the time of the incident were interviewed. Copies of relevant documents including log books, bell book, ship's certificates and procedures were taken. Data from the pilot's electronic charting system (ECS) was downloaded from his laptop computer.

*Enterprise* was not fitted with a voyage data recorder or a course recorder. The ship's headings used in the report are based on interviewee accounts and the ECS data. Transmissions from the ship's automatic identification system (AIS) unit were not recorded by any shore base station.

Other information was obtained from Det Norske Veritas (DNV) and ASD Contractors, the diving company that conducted the in-water damage survey. The Tasmanian Ports Corporation (Tasports) also provided information relevant to the incident and pilotage related procedures.

## 2.2 Ship's manoeuvring characteristics

The passage into Grassy on 10 May was to be completed in a relatively confined area and was dependent on the ship completing a series of turns without the assistance of a tug.

*Enterprise*'s manoeuvring characteristics diagram was displayed on the bridge and it provided a summary of manoeuvring information for 'normal' loaded and ballast conditions, which included turning circle diagrams, stopping distance tables and the propeller pitch/speed table. It also contained a warning that the ship's response may be different to that shown on the diagram if the ship's loaded/ballast state varied from the 'normal' ones.

Additional manoeuvring information, such as the minimum speed required to maintain steerage and the power of the bow thruster, was provided on the ship's pilot card.

*Enterprise*'s controllable pitch propeller (CPP) differed from the majority of CPPs in that it was right-handed. Left-handed CPPs, under astern propulsion, tend to move a ship's stern to port whereas right-handed CPPs will tend to move the stern to starboard when astern propulsion is used.

To this end, the ship's pilot card contained a warning, advising that 'the vessel cuts rapidly bow to port when the engine is run astern at a speed of less three knots'. This refers to the fact that the bow appears to cut to port when conning the ship from the bridge at the after end of the ship, whereas it is the stern that is actually moving to starboard. The pilot was aware of this particular manoeuvring characteristic.

Disregarding the draft restrictions at the berth, in a 'normal' loaded or ballast condition, *Enterprise* was capable of making the 100° turn to starboard onto the inner leads at Grassy and stopping off the berth using astern propulsion. The pilot

had executed the manoeuvre in the past and had successfully countered the effect of the transverse thrust when using astern pitch settings during the ship's other visits to the port.

However, on 10 May, *Enterprise's* after draught had been reduced to 5.0 m. This fact, when combined with the prevailing weather and tidal conditions, resulted in the ship's manoeuvrability differing from that which the pilot and master expected and differing significantly from the 'normal' conditions information displayed on the manoeuvring diagram.

## 2.3 Propeller immersion and efficiency

The efficiency of a ship's propeller relies largely on it being fully submerged. Generally, a fully submerged propeller (i.e. the blades, at the top of their rotation in still water, remain submerged) is considered necessary to avoid manoeuvring problems as insufficient propeller immersion can reduce its efficiency and consequently affect a ship's handling.

A propeller generates thrust by accelerating the mass of water that passes over its blades. When a propeller is not fully submerged (Figure 9), the mass of the water that can pass over its blades is reduced and this results in the thrust generated by the propeller decreasing. Furthermore, when the rotating blades break out of the water, air is drawn down into the water column (aeration), thus causing a further reduction in the water mass. The quality of water flow across the blades is also decreased as the air bubbles disturb the laminar flow<sup>10</sup> of the fluid. As a result, the efficiency of the propeller is decreased further.

Recent research<sup>11</sup> has described aeration and related processes that affect propeller performance as follows:

Ventilation (aeration) may occur when a propeller is operating in the proximity of the free surface. If the propeller loading is sufficiently high, the low pressure on the propeller blades may create a funnel through which air is drawn from the free surface. This phenomenon is connected with co-orientation of the energy in the surrounding water. The propeller sets up a rotating flow which causes the free surface to deform, and a vortex starts to develop. Unless the rotating flow is disturbed, this is a self-amplifying process, and the vortex develops into a funnel. Air cavities then spread on the propeller blades, reducing their lift and drag. A fully ventilated propeller may lose as much as 70-80% of its thrust and torque.

Propeller aeration should not be confused with propeller cavitation. Cavitation is a physical phenomenon, which is caused by the collapse of air bubbles due mainly to an excessively high relative velocity between seawater and an adjacent surface, like a propeller's blades<sup>12</sup>. Cavitation often occurs when the propeller is fully submerged and can significantly reduce a propeller's power and efficiency and cause physical erosion/deterioration of the propeller blades.

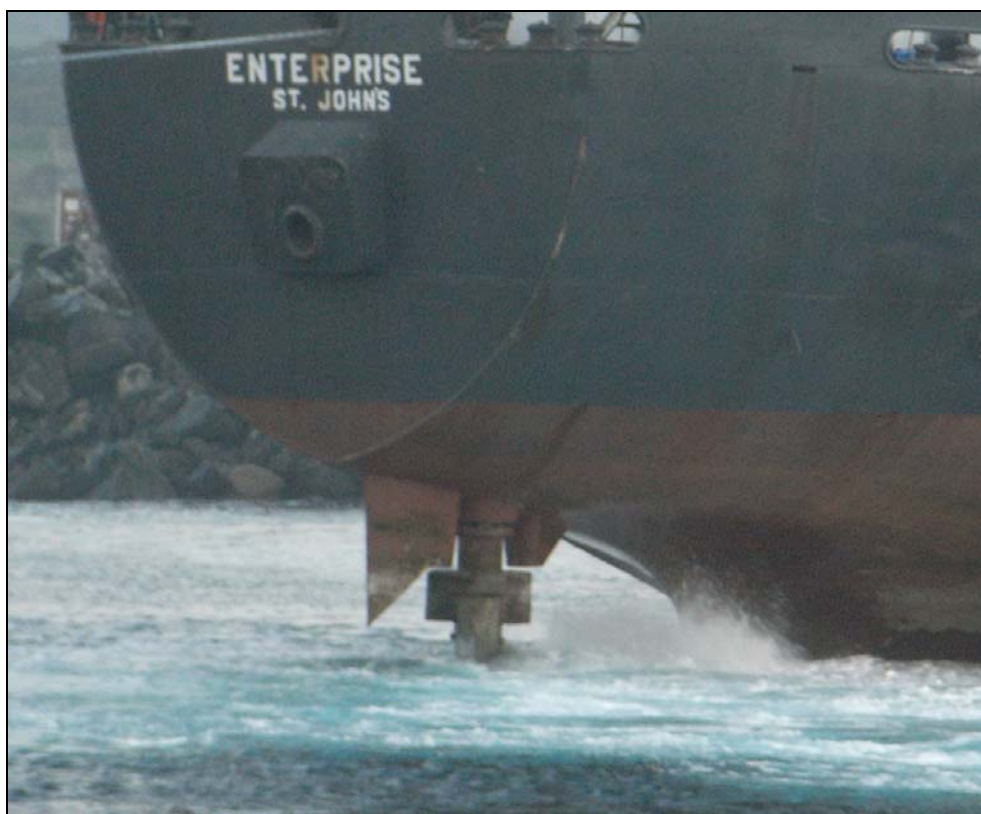
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10 The smooth, uninterrupted flow of a fluid over a surface.

11 Smogeli, O N, *Control of Marine Propellers: from normal to extreme conditions*, Norwegian University of Science and Technology, Trondheim, Norway, September 2006, p 33.

12 Hughes, C. *Dictionary of marine technology*, London, 1997, p45.

**Figure 9: Enterprise's propeller not fully submerged on departing Grassy**



Because propeller immersion is a very important factor to be taken into account when considering a ship's manoeuvrability, ship stability books provide mariners with all the necessary information to calculate propeller immersion.

There were no specific requirements in *Enterprise's* safety management system (SMS) that dealt with propeller immersion. However, the SMS procedures did require draughts to be taken into consideration when preparing the passage plan. In addition, the SMS directed that checks of restrictions in draught/trim and, if necessary, the rearranging of cargo/ballast was to be completed before entering port. On 10 May, *Enterprise's* passage plan and port entry checklist for its entry into Grassy indicated that these checks had been completed.

The height of tide in Grassy at low water during the daylight hours on 9 and 10 May was predicted to be 0.3 m and 0.4 m respectively. The designated depth of water at the berth is 5.5 m, the shallowest part of the passage. The pilot and master agreed that in order to maintain a minimum under keel clearance of 0.5 m during any surges in the harbour, a maximum draught of 5.0 m would be 'prudent'.

According to *Enterprise's* stability book, an after draught of 5.32 m, with the ship on an even keel, was necessary to ensure that the propeller was fully submerged. However, the master and the pilot mistakenly believed that the propeller was fully submerged at an after draught of 5.2 m, the diameter of the propeller. Therefore, despite this error, both the pilot and the master were aware that, at the planned after draught of 5.0 m, the ship's propeller would not be fully submerged and that there would be a reduction in its efficiency.

The pilot and master did not appropriately consider the adverse effect a partially submerged propeller would have on the ship's manoeuvring characteristics when they decided to reduce the ship's after draught to 5.0 m.

In submission, the pilot stated:

Had we been aware of the probable massive loss of propeller efficiency astern then we certainly would not have entered the port with the propeller exposed in any way. Interestingly it was not obvious to a significant extent when running the engine ahead in manoeuvring either before or after the grounding. This is perhaps the fundamental point. Astern power was reduced by more than 80% - and in my view perhaps 95% - whilst ahead power was not significantly reduced.

## 2.4 Manoeuvring on 10 May

According to the ship's propeller pitch/speed table, the ship's speed at half and slow ahead in ballast condition should be 9.5 and 7.0 knots respectively. At 1027 on 10 May, prior to *Enterprise* approaching the outer leads, at half ahead propeller pitch, the ship's speed was 6.7 knots, almost 3 knots less than the tabulated value. The pitch was reduced to slow ahead and by 1035, just before the turn onto the inner leads was started, its speed had decreased to 5.2 knots, almost 2 knots less than the tabulated value. Before the turn, the wind and current were abeam, so this lower speed could be attributed almost entirely to the loss in propeller efficiency.

The pilot expected the ship's speed to reduce by one or two knots during the turn onto the inner leads, which he usually started at a speed of about 7.0 knots. However, neither he nor anyone else on the bridge noticed the lower approach speed on the outer leads before the turn to starboard was started. This was possibly because slow ahead was ordered earlier than usual to avoid excessive speed in case it became necessary to increase the pitch to assist the turn.

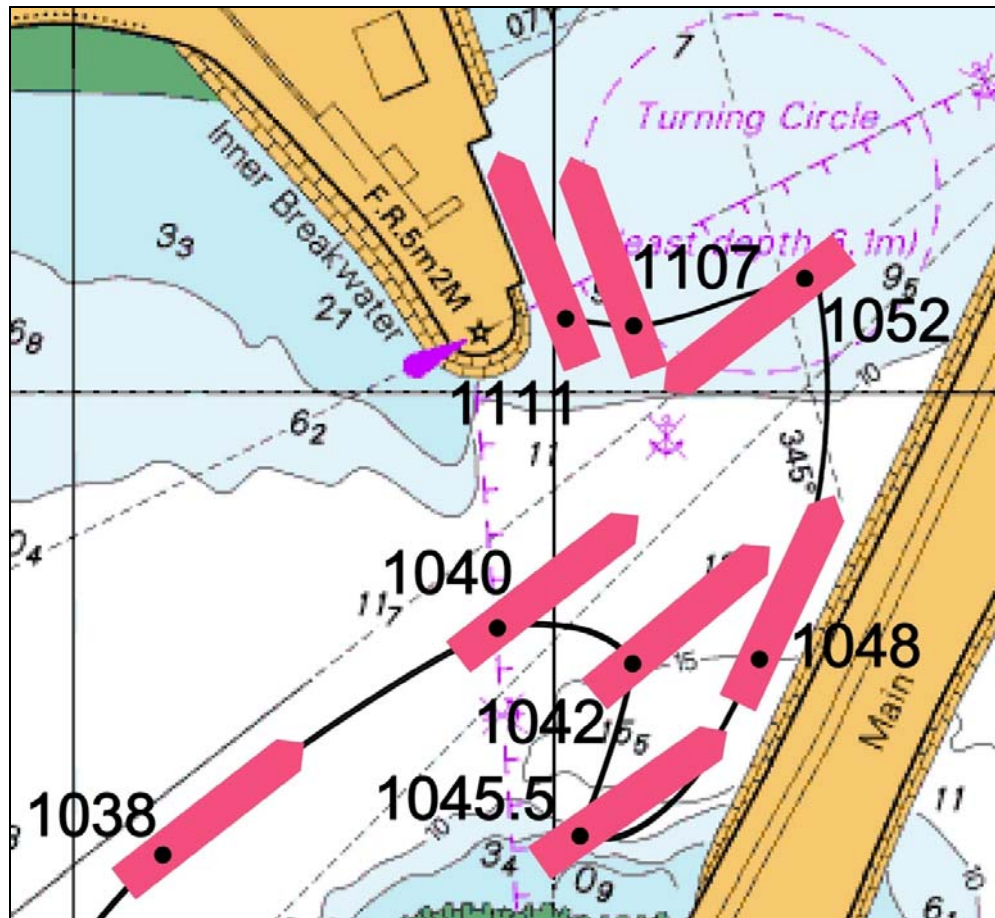
As per the pilotage plan, the turn was started when Grassy Island light was nearly abeam. However, when the turn began, the ship was to starboard of the line of the leads due to the northerly setting tidal stream. Although maximum rudder was not used throughout the turn and pitch was reduced, the turn was completed at 1037, with the ship about 65 m to starboard of the planned track, the line of the leads. Because the pilot was not aware of the ship's lower speed while it was approaching the turn onto the inner leads, he initiated the turn earlier than he should have, given the speed at which the ship was actually travelling.

No limits had been set during the planning for the pilotage. As a result, those on the bridge were unaware of what speed was expected during the approach and how far the ship was allowed to be on either side of the line of the leads before and after the turn. Therefore, during the passage, the fact that the ship was not on the leads as it should have been was not brought to the attention of the pilot. Had it been, he could have taken appropriate action to bring the ship into position on the leads when it was clear of any dangers to starboard.

In addition, *Enterprise*'s speed during the turn did not reduce as much as the pilot and master expected, and at 1037, was still 4.4 knots. In an attempt to reduce the speed as the ship approached the inner breakwater, the pitch was reduced to zero and then to half astern. Half starboard thrust on the bow thruster was also ordered to maintain the bow's position in the channel, and to avoid putting the wind onto the ship's port quarter, which might have increased the stern's 'cut' to starboard.

However, by 1038, the ship was still moving forward at the same speed (Figure 10). Any speed reduction due to the turn had probably been counteracted by the wind and tidal stream, both of which were now astern.

Figure 10: *Enterprise's* berthing on 10 May, ship images to scale



At 1038½, the pilot ordered full astern and, in a continued attempt to maintain the bow's position in the channel, ordered full starboard thrust on the bow thruster. By 1040, the ship's speed had fallen to 2.0 knots, which then made the bow thruster and propeller's transverse thrust more effective and the ship started to move bodily to starboard. It was at this time that the ship's lateral movement became readily apparent to the master and pilot.

At 1041, the ship was moving bodily to starboard at about 1.0 knot. The fact that the ship was to starboard of the leads after the turn now compounded the problem, as there was an even smaller margin for error in relation to the breakwater that was to starboard of *Enterprise*. The ship's position and pronounced movement in the confined area probably made it evident to the pilot that the plan would not succeed. As a result, the pilot and master decided to abort the approach and take the ship, stern first, out of the harbour.

The pilot endeavoured to manoeuvre the ship back onto the leads using astern propeller pitch and the bow thruster. However, in doing so, the sideways movement of the ship continued and *Enterprise* moved closer to the main breakwater.

By this stage, everything the pilot wanted to achieve required an astern movement on the engine. As a result of the ship's movements, due to the starboard transverse thrust, each action exacerbated the situation. There was insufficient sea room available to starboard of the ship to continue with this course of action. There were no contingency plans in place, so the rapidly developing situation meant that the

pilot and master were probably fixated only on the use of astern thrust alone, as they did not have the time to develop a plan on the run.

At interview, the pilot described the ship's slow response when astern pitch was applied as though it 'was on ice'. Similarly, he found that 'the ultimate of transverse thrust' was experienced when the propeller behaved like a 'paddle wheel on a paddle steamer'. While there is no doubt that the ship's response surprised both the pilot and the master, it can be explained by the propeller's loss of efficiency and the transverse thrust produced by the right-handed CPP. Therefore, the ship's response to astern thrust was reasonably foreseeable and should have been allowed for during the pilotage planning.

In submission, the pilot stated:

The difference between this occasion (5.0 m aft) and previous evolution (5.4 m) at Grassy certainly was a great surprise. The ship went from being quite controllable on previous occasions to being unable to generate any sternway and all stern power applied seemed to result in pure 'cut'.

On 10 May, in order to stop the ship as it approached the inner breakwater, the pilot had to order larger and more prolonged astern movements. This action, combined with the propeller's pronounced transverse thrust during astern movements, and the use of starboard thrust on the bow thruster in the confined approaches to Grassy's inner harbour, resulted in the ship's bodily movement to starboard and its eventual grounding.

## 2.5 Anchors as an aid to manoeuvring

It was not until after *Enterprise* had grounded that the pilot used the anchor, which had been ready for letting go while the ship was still outside the harbour approaches, to assist him in berthing the ship. At interview, he stated that 'unfortunately the understanding of the effect of astern power and use of anchors was realised too late to avoid grounding at the stern'. He was referring to the dredging of an anchor rather than using astern pitch to control headway. The master, who had never used anchors in this manner, had similar thoughts in this regard.

Too often anchors are seen only as a means of securing a ship's anchor cable to the sea bed, or as a tool of 'last resort' to be used only in emergency situations<sup>13</sup>. However, they are an effective aid, often used in some areas and rarely used in others, which can be used when manoeuvring a ship.

When berthing or manoeuvring in confined areas, and in difficult wind and tidal conditions, dredging an anchor/s can be very useful, particularly if tugs are not available. At times the practice can be more effective than using a tug and for this reason, the anchor has been referred to as a 'poor man's tugboat'.

Dredging is the term used to describe the towing of an anchor at a short stay. When a ship dredges two anchors, the pivot point<sup>14</sup> moves forward to a position between

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13 MacElrevey, D. H. & MacElrevey, D. E. *Shiphandling for the mariner*, Cornell Maritime Press, Maryland, 4<sup>th</sup> Edition, 2004, p 191.

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

the two windlasses. This provides an excellent steering lever when the propeller and rudder are used.

According to the Nautical Institute's *The Shiphandler's Guide*<sup>15</sup>:

The drag of the anchors checks headway and ahead propulsion can be used without excessively increasing the speed of the ship.

Even while maintaining dead slow revolutions, the ship may even slow down and stop. This in turn ensures that the pivot point remains forward and that lateral resistance, which would otherwise oppose turning ability, is also kept low throughout.

The net result is an ability to keep the speed down, but at the same time use main engine power more efficiently, when controlling heading with kicks ahead. The bow can virtually be driven on the anchors, to the desired position and, more to the point, it will remain there. At the same time, the old enemy speed, is kept down.

When a single anchor is dredged, only half the effect that dredging two anchors is achieved and it is not possible to use anything like the same amount of power for positioning the bow and the speed is not as easy to control. With only one anchor dredged, the pivot point moves out to the ship's side, creating a turning moment which needs constant counter helm to correct.

In other words, dredging provides a braking effect, which enables those conning the ship to use the helm and engine to move the ship forward with good control while only making low speed over the ground.

*Enterprise's* pilot had not dredged an anchor while berthing in Grassy on previous occasions but stated that he had used an anchor to assist in heaving the ship's bow off the berth on departure from the port. He was however, aware that his predecessor had regularly used anchors in the turning circle at Grassy. The pilot's reason for not using an anchor in a similar manner was that he had reservations about the use of anchors if they were not let go in the required position, or if too much cable was run out. He was concerned that, being unable to generate sternway with the ship's engine, the ship would 'very likely swing onto the outer breakwater under the effect of the wind acting on the port quarter when the existing forward momentum was arrested by the anchor'.

Regardless of this, he had not considered using the anchors in his plan for berthing *Enterprise*, even as a contingency and he did not understand the principle of dredging anchors. At about 1040, when it became apparent to the pilot that the pilotage was not proceeding as he had planned, had he dropped the anchors, he could have regained control over the ship and manoeuvred it into a position from where he could have restarted the approach to the berth.

It was not until the ship was actually anchored in the inner harbour that the pilot and master realised the effectiveness of having an anchor on the sea bed. The pilot and the master then dredged the starboard anchor and successfully berthed the ship without further incident.

The use of the ship's anchors to assist in slowing or manoeuvring the ship in the channel prior to its grounding, when things were not going according to plan, should have been considered and should have formed a part in any contingency

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15 Rowe, Captain R. W. *The Shiphandler's Guide*, The Nautical Institute, 1996, p 51 - 53.

plan developed for the entry. Relying solely on the use of the ship's bow thruster and astern propulsion resulted in the ship moving bodily sideways towards the main breakwater and grounding.

## 2.6 Pilot's training and experience

Before being able to conduct pilotage in Grassy, a pilot must hold an 'unrestricted' (no ship size, class, time or area restrictions) licence in one of the four 'principal port' pilotage zones in Tasmania. Only a full time 'senior pilot', who has more than two years experience, can hold 'unrestricted' status.

To qualify for a Grassy licence, a minimum of six pilotage voyages on ships of more than 35 m in length are necessary. One of these must be a check pilotage. Practical, written and oral examinations must also be completed before the check pilot can recommend the issue of a licence to the candidate.

In 2003, the pilot on board *Enterprise* at the time of the incident, and three others from Hobart, completed ship handling simulator training, of which one session was entirely devoted to Grassy. A total of nine exercises (arrivals or departures) were completed. A model of the ship which most frequently calls at Grassy, a ro/ro ship which has twin propellers, twin rudders and a bow thruster, was used for the simulations.

In addition to this training, *Enterprise's* pilot had made most of his qualifying voyages on the same ro/ro ship used in the simulation training. Having completed the required number of pilotages, and after having passed the check pilotage examination, he was issued with a pilotage licence for Grassy.

In 2005, following the retirement of the pilot who had trained him for pilotages in Grassy, the pilot on board *Enterprise* at the time of the grounding started conducting all the pilotages in Grassy. Since becoming the only licensed pilot for Grassy, he had piloted three passenger ships, a container ship and *Enterprise* on the ship's last four visits, both in and out of the port.

The pilotage plan he developed to berth *Enterprise* in Grassy was based on his experience with the ship in Hobart where he had berthed the ship on about 30 occasions without tug assistance and with the wind and tide astern. During those occasions, he employed a manoeuvre similar to the one that he intended to use to stop the ship off the berth in Grassy. However, on all the berthings in Hobart, the ship's propeller was fully submerged and the ship berthed starboard side alongside. In that case, the transverse thrust produced by the right-handed CPP assisted the berthing and lessened the need for tug assistance.

The pilot had received no training in how to use anchors to assist him with handling a ship in the confined approaches to Grassy. As a result, he was not comfortable with dredging the ship's anchors to assist him with manoeuvring the ship. Therefore, he did not consider the use of anchors in his pilotage plan.

In submission, the pilot stated:

The lack of training specific to this port (use of anchors to assist manoeuvring) is a very relevant one. Interestingly I have since (received training) and now feel that dredging might have been the best option. However at the time the ship had a working engine, steering and thruster which we tried in various combinations to gain control.

The final sentence in the pilot's submission reinforces the belief that anchors are used only when other operating systems used to control a ship are not functioning.

In submission, Tasports stated:

... whilst training can be provided, unless anchors are used regularly to manoeuvre vessels, an adequate level of skill cannot be maintained. It should be noted that Devonport pilots are confident with this type of manoeuvre as they regularly use anchors to berth small gas vessels at No 5 berth. It is also worth mentioning that Tasports pilots are trained to handle a variety of emergency situations, including the need to perform unscheduled anchoring.

The pilot was very familiar with handling *Enterprise* in normal loaded/ballasted conditions in Hobart. However, he was not familiar with handling the ship in an abnormal loaded/ballast condition in Grassy. His training in preparation for being able to conduct pilotage in Grassy had been on a ship which was much more manoeuvrable than *Enterprise*, and as noted above, he had received no training in the use of anchors to assist berthing a ship in the port.

### **2.6.1 Check pilotage in Grassy**

The Tasports Pilotage Code contains check pilotage requirements which are aimed at 'assessing a pilot's proficiency by an experienced peer to identify further training and professional development needs'. One of the major goals of a check pilot assessment is to identify 'single person errors' and ways to eliminate them. *Enterprise's* pilot had been checked annually in Hobart and, as a check pilot himself, was familiar with the process of improving safety by identifying risks and training needs.

However, as the only licensed pilot for Grassy at the time of the grounding, the pilot had never been, and could never be, assessed in the port to ensure that he was conducting the pilotage in the best possible manner and that the most appropriate risk assessments were being carried out.

Section 13 of the Tasports Pilotage Code (renewal of licences) contains no mention of any requirements that the holder of a Grassy pilotage licence might be expected to meet in order to maintain currency in that port.

Section 19 of the Pilotage Code (renewal of exemption certificates) states that ship masters requiring an exemption certificate renewal must undergo a revalidation trip every two years. As defined in the Pilotage Code, a revalidation trip means:

A pilotage completed by a pilot or exemption holder under the supervision of a 'training pilot' in order to progress toward, or be assessed for, a renewal of a licence of exemption.

At the time of the incident, there was no similar requirement for a Grassy pilot. As a result, *Enterprise's* pilot had been conducting pilotage in Grassy 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.

## **2.7 Pilotage plan**

An effective pilotage plan should consider all the relevant factors that might be encountered during the passage, including an assessment of identifiable risks,

strategies that are employed to overcome those risks and strategies that could be called upon in the event that an unidentified risk is encountered during the passage. This results in a better response to unexpected events and, therefore, an increase in the likelihood of the plan's success. On 10 May, *Enterprise*'s pilot and master probably intended, and believed, that this was the case with their plan.

The pilot and the master had worked together during many pilotages on board the ship. On 8 May, they agreed to the plan, which had been developed and used by the pilot for the ship's last four calls to the port. This included manoeuvring the ship along the leads, through the positions illustrated in Figure 5, and then berthing without using tugs or anchors in the harbour. Certain aspects, such as weather and tidal conditions, were considered in detail. Having an anchor ready for immediate use if necessary, and the identification of a 'point of no return', were also part of the plan. The pilotage plan was then incorporated into the ship's overall passage plan.

At the time of arrival, the weather and tidal conditions, and the minimum under keel clearance, were the focus in planning the pilotage. Other risks, particularly those associated with the ship's manoeuvrability were not appropriately considered.

## 2.8 Pilotage procedures and risk assessment

At the time of the grounding, unlike many port corporations or authorities in Australia, Tasports had no specific requirements for ships calling at Grassy to ensure that their propellers were fully submerged.

The Tasmanian Ports Corporation, through the King Island Ports Corporation, is responsible for the 'provision of efficient and secure operations' in Grassy<sup>16</sup> and, in addition to the compulsory pilotage requirement, advises:

- Designated berth depth is 5.5 metres with zero tide datum – approximately 1.2 metre rise and fall of tide.
- Turning circle depth is 9 metres minimum. [ATSB comment - This is inconsistent with the charted depth of 6.1 m]
- Maximum size vessel that could safely use the present harbour facilities is considered approximately 120 metres.
- It is advised that all vessels using Grassy are fitted with suitable bow thrusters.

Tasports developed these general guidelines from information gained and documented over many years by the pilots for Grassy. It was the experiences of pilots which defined the limits that *Enterprise*'s pilot discussed with the master as part of the pilotage plan and not research or analysis carried out by Tasports.

At the time of the incident, if a ship satisfied Tasports' general guidelines, it was expected that the pilot, in consultation with the ship's master, would complete a risk assessment and prepare a pilotage plan. Given the very small margins for error in Grassy and the lack of readily available tugs, the plan was necessarily specific to a particular ship. Consequently, success relied very heavily on the pilot's experience and training.

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<sup>16</sup> Tasports' internet web page.

On 10 May, neither the pilot nor the ship's master had adequately taken the reduced efficiency of the propeller, the prevailing weather/tidal conditions and the lack of tug assistance into account before they commenced the passage into Grassy. Furthermore, *Enterprise's* successful berthing in the past probably increased the pilot's confidence in the success of his plan for berthing on that day.

Risk assessment should not be the responsibility of the pilot alone. The pilot had recognised the high risk and difficulty involved in pilotage in the port. In 2006, he had strongly recommended that simulator training for pilots and trainees in various conditions at Grassy 'would be most prudent from a risk management perspective'. However, Tasports had not acted on the pilot's recommendation before 10 May 2007.

Thoroughly assessing the risks for a ship calling at Grassy had previously been carried out by Tasports. Prior to the lengthening of the ro/ro ship engaged in the regular freight service to the port, the 'longer' ship had to be modelled and a manoeuvring simulation carried out to ensure that the lengthened ship could safely berth unassisted. However, with regard to *Enterprise* calling at the port, no such detailed risk assessment was undertaken. This was despite the fact that *Enterprise* was of a similar size as the 'longer' ro/ro ship, was less manoeuvrable and its propeller characteristics did not favour berthing port-side-to the wharf.

The port authority had not undertaken a thorough assessment of the risks associated with, and the suitability of, *Enterprise* calling at Grassy several years before the incident on 10 May 2007. As a result, the only pilot licensed for the port had to carry out a risk assessment each time the ship intended to call at the port. Those risk assessments could not be as thorough as one that had been undertaken using the ship modelled in a simulator.

Tasports did not provide any clearly defined guidance to assist its pilots in assessing and mitigating the risks involved in the Grassy pilotage. Guidance as to whether or not a tug should be used to assist a berthing was not provided and consideration had not been given to the manoeuvring characteristics of particular ships. As a result, *Enterprise's* pilot did not adequately consider the handling characteristics of the ship, and the reduced efficiency of its propeller, when he decided to berth the ship without the assistance of a tug.



### 3.1 Context

At about 1045 on 10 May 2007, the bulk carrier *Enterprise* grounded briefly as it was being manoeuvred in the confined waters of Grassy Harbour, King Island, Tasmania. The ship was under the conduct of the pilot, who was following a pilotage plan he usually used for the ship when it called at the port.

Prior to the ship's entry to the port, its after draught had been reduced to 5.0 m so that a minimum under keel clearance of 0.5 m could be maintained alongside the berth. At that draught, the ship's controllable pitch propeller was not fully submerged. However, neither the pilot nor the master adequately considered the effect that the reduced draught would have on the efficiency of the propeller and therefore, the ship's manoeuvrability.

The ship suffered minor damage, mainly to the propeller, but it was not disabled. No pollution resulted from the grounding.

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

### 3.2 Contributing safety factors

- At the ship's planned 5.0 m after draught, the propeller was not fully submerged. This combined with the characteristics of the ship's controllable pitch propeller resulted in the ship not handling as the pilot and master expected.
- The passage plan for Grassy focused only on under keel clearance and the predicted weather and tidal conditions. The risks associated with the ship's manoeuvring characteristics and the use of the anchors to assist the manoeuvre were not adequately considered. Additionally, there were no contingency plans in place.
- The pilot and master did not appropriately consider the adverse effect a partially submerged propeller would have on the ship's manoeuvring characteristics given the conditions that the ship was expected to experience during the berthing in Grassy.
- The pilot had to order larger and more prolonged astern movements in order to stop the ship as it approached the inner breakwater. This action, combined with the effect from the propeller's transverse thrust and the use of the bow thruster in the confined approaches, resulted in the ship's bodily movement to starboard.
- The master and pilot did not consider using an anchor to assist in slowing or manoeuvring the ship in the channel prior to its grounding when things were not going according to plan. Consequently, the pilot relied solely on the use of the ship's bow thruster and astern propulsion and this resulted in the ship's bodily sideways movement towards the main breakwater.
- The pilot had received no training in how to use anchors to assist him with handling a ship in the confined approaches to Grassy. As a result, he was not

comfortable with using the ship's anchors to assist him with manoeuvring the ship in the close confines of the approaches to the inner harbour. *[Safety issue]*

- The port authority had not undertaken a thorough assessment of the risks associated with, and the suitability of, *Enterprise* calling at Grassy several years before the incident on 10 May 2007. As a result, the only pilot licensed for the port had to carry out a risk assessment each time the ship intended to call at the port. *[Safety issue]*
- The Tasmanian Ports Corporation did not provide any clearly defined guidance to assist its pilots in assessing and mitigating the risks involved in the Grassy pilotage. As a result, *Enterprise's* pilot did not adequately consider the handling characteristics of the ship, and the reduced efficiency of its propeller, when he decided to berth the ship without the assistance of a tug. *[Safety issue]*
- *Enterprise's* pilot had been conducting pilotage in Grassy 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. *[Safety issue]*

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the maritime industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

#### **4.1 Safety action by the Tasmanian Ports Corporation**

The ATSB has been advised that the following safety actions have been taken by the Tasmanian Ports Corporation (Tasports) as a result of *Enterprise's* grounding in Grassy Harbour on 9 May 2007.

- Tasports is currently developing a Pilotage Safety Management System for its state-wide piloting operations. An assessment of pilotage at Grassy was undertaken in October 2008 and this included a port inspection, witnessing a pilotage (exempt master) on the ro/ro ship, reviewing all relevant documentation (including past incidents), holding meetings with pilots and exempt masters and conducting a workshop to verify findings. The risks associated with bringing a vessel into and out of Grassy were identified and a threat barrier model developed. The final report contained 15 recommendations and these are being progressively addressed.
- The lack of vessel calls at minor ports in Tasmania and the difficulties experienced in keeping pilots up to date and licensed is an issue that is currently under review. Tasports recognises the need to develop strategies to ensure pilots retain their skills and experience at a number of remote pilotages in the state and are looking at modelling Grassy and Stanley on the Australian Maritime College ship handling simulator. Tasports, in an agreement with Marine And Safety Tasmania (MAST), are also looking at removing the need to provide a pilot at remote areas and this will be largely achieved by restricting vessel access to such areas.
- In relation to having more than one pilot trained for a particular area which will, amongst other things, allow a check pilot process to be achieved, Tasports have for some time been working towards multiple licences for our pilots. It is Tasports' intention is to progressively get as much cross matching as possible which alleviate a number of issues. The only ports in Tasmania with only one pilot licensed are Stanley and Grassy and Tasports is currently working to provide additional licence capability at these locations. In that regard, the Marine Manager travelled to Grassy and spent several days developing standard operating procedures and a training program for two additional pilots identified for this port.

Additionally, under a Deed of Agreement with MAST that was recently revised, the Tasports pilotage code requires check pilotages to be undertaken annually, therefore Tasports have a contractual obligation to ensure the check pilotage process is actually achieved.

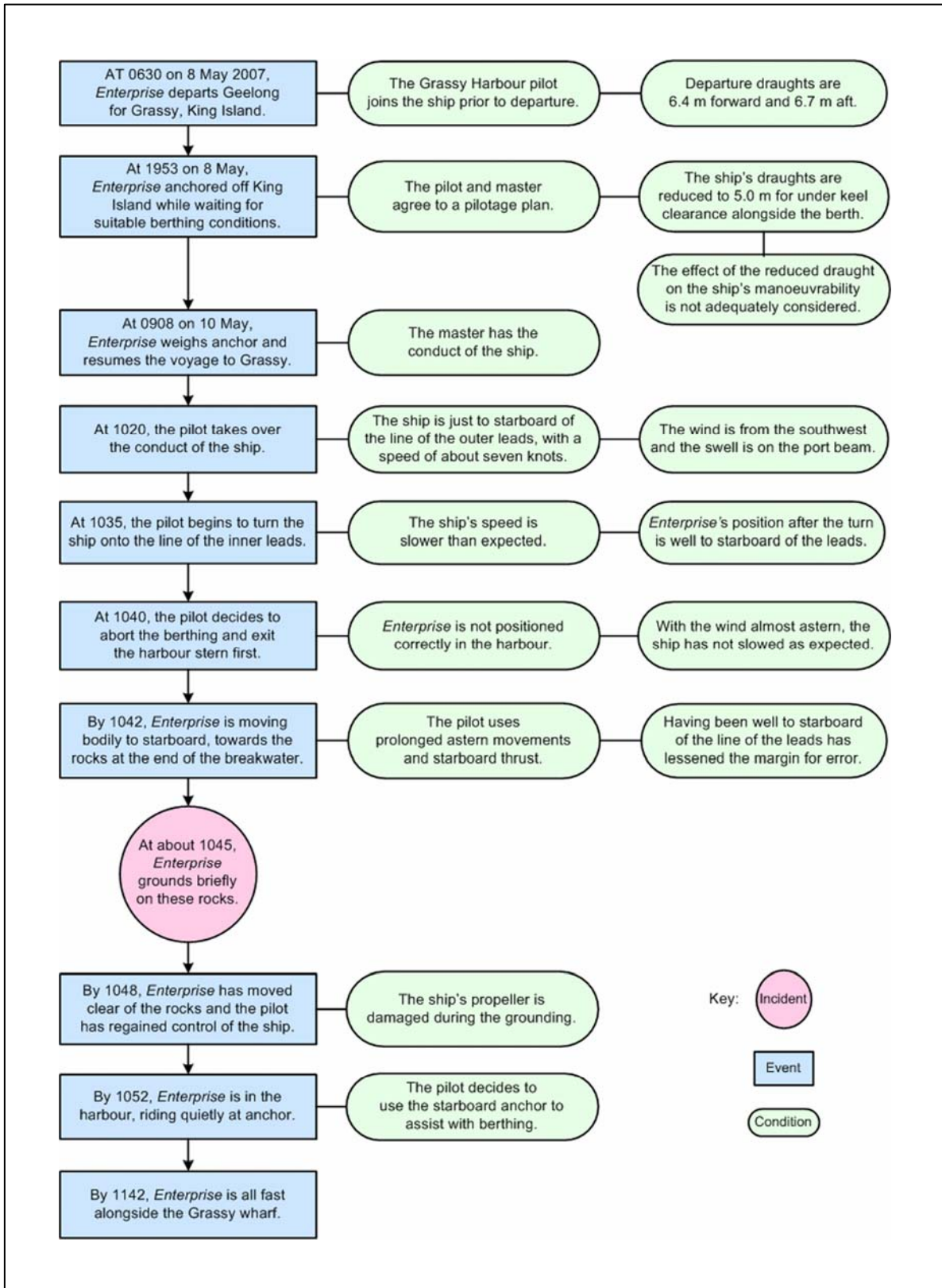
## **4.2 ATSB recommendations**

### **MR20090001**

The pilot had received no training in how to use anchors to assist him with handling a ship in the confined approaches to Grassy. As a result, he was not comfortable with using the ship's anchors to assist him with manoeuvring the ship in the close confines of the approaches to the inner harbour.

The Australian Transport Safety Bureau recommends that the Tasmanian Ports Corporation takes action to address this safety issue.

# APPENDIX A: EVENTS AND CONDITIONS





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## APPENDIX B: SHIP INFORMATION

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### *Enterprise*

IMO Number	8321890
Call sign	V2OL7
Flag	Antigua and Barbuda
Port of Registry	Saint John's
Classification society	Det Norske Veritas (DNV)
Ship Type	Bulk carrier
Builder	Mitsubishi Heavy Industries, Japan
Year built	1985
Owners	Zweite Belt Shipping, Germany
Ship managers	AJ Ship Management, Germany
Gross tonnage	6389
Net tonnage	2946
Deadweight (summer)	8709 tonnes
Summer draught	8.27 m
Length overall	113.01 m
Length between perpendiculars	106.03 m
Moulded breadth	20.21 m
Moulded depth	9.48 m
Engine	Pielstick 6PC2-5L-400
Total power	2582 kW
Crew	15



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## APPENDIX C: SOURCES AND SUBMISSIONS

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### Sources of information

Master and crew of *Enterprise*

The Grassy pilot

The Tasmanian Ports Corporation

### References

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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 *Enterprise's* operators, master and chief mate, the Grassy pilot, the Tasmanian Ports Corporation (Tasports), the Australian Maritime Safety Authority (AMSA), Det Norske Veritas (DNV) and the Inspection and Investigation Division of the Antigua and Barbuda Department of Marine Services and Merchant Shipping.

Submissions were received from *Enterprise's* operators, master and chief mate, the Grassy pilot, Tasports, AMSA and DNV. The submissions have been included and/or the text of the report was amended where appropriate.