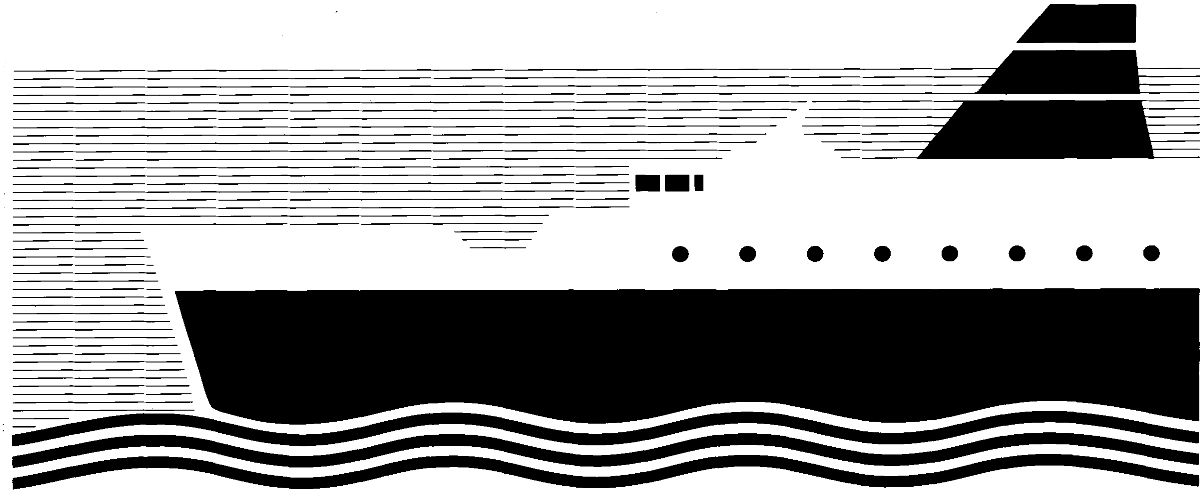

MARINE OCCURRENCE REPORT

05-208 **Passenger freight ferry *Santa Regina*, near grounding, Tory Channel eastern entrance** **9 June 2005**

TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

Report 05-208

passenger freight ferry
Santa Regina

near grounding

Tory Channel eastern entrance

9 June 2005

Abstract

On Thursday 9 June 2005 at about 2011, the passenger freight ferry *Santa Regina* was entering Cook Strait from the Tory Channel when the ship departed from the designated passage plan, coming close to grounding on the rocks and islets at East Head. Avoidance action taken by the Mate/Master, who had the con of the ship, prevented the ship grounding and brought it back onto the designated course.

Safety issues identified included:

- bridge resource management
- training and use of modern retro-fitted bridge equipment.

Safety recommendations were made to the Managing Director, Strait Shipping to address these issues.

Photograph courtesy of Strait Shipping

The *Santa Regina* underway in the Marlborough Sounds

Contents

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Abbreviations

°	degrees
AIS	automatic identification system
ARPA	automated radar plotting aid
BRM	bridge resource management
Colregs	International Regulations for Preventing Collision at Sea, 1972 (as amended)
DWR	deck watch rating
ENC	electronic nautical chart
GMDSS	global maritime distress and safety system
GPS	global positioning system
ISM	International Safety Management
kn	knot(s)
kW	kilowatt(s)
LMC	Lloyds machinery certificate
m	metre(s)
nm	nautical mile(s)
NZOW	New Zealand offshore watchkeeper
STCW-95	The International Convention on Standards of Training, Certification and Watchkeeping, 1978 as amended in 1995
T	true (usually used as °T: degrees true)
TCECNZ	Tory Channel entrance controlled navigation zone
UMS	unmanned machinery space
UTC	coordinated universal time
VHF	very high frequency

Glossary

apogee	the point in a body's orbit at which it is furthest from the Earth
aphelion	the point in the orbit of a planet, comet etc, at which it is furthest from the sun
ARPA	automated system to plot and monitor targets on radar. Used by a watchkeeper to assist in collision prevention
autopilot	a device that automatically controls the steering of a ship on a selected course
bollard pull	a measure of the static pull a vessel can exert
bow thruster	a small athwartships propeller mounted in a tunnel at the forward part of a ship, used to manoeuvre a ship at slow speeds
con (conduct)	direct the course and speed of a ship
course	direction steered by a ship
deckhead	a ceiling on a ship
Doppler log	a device that uses the Doppler effect to measure a ship's speed
flood tide	rising of water level due to tide
gross tonnage	a measure of the internal capacity of a ship; enclosed spaces are measured in cubic metres and the tonnage derived by formula
heading	direction in which a ship is pointing at any moment
helm	the amount of angle that the rudder is turned to port or starboard to steer the ship
ISM code	International Management Code for the Safe Operation of Ships and for Pollution Prevention adopted by IMO by resolution A.741(18), as amended from time to time
knot	one nautical mile per hour
lubber line	Vertical line on the fore side of the inside of a compass bowl, and in the fore and aft line of the ship
Navtex	the Navtex system is used for the automatic broadcast of localised Maritime Safety Information (MSI) using Radio Telex (also known as Narrow Band Direct Printing, or NBDP)
neap tide	tidal undulation that has the highest low water, and lowest high water, in a series
parallel indexing	the use of a line drawn either manually or electronically on the screen of a radar through a fixed target parallel to the intended track of a vessel at a distance equal to the planned passing distance. Any displacement of the fixed target from the index line indicates that the ship is off track
perigee	the point in a body's orbit at which it is nearest the Earth
port	left-hand side when facing forward
spring tide	tidal undulation that has the lowest low water, and highest high water, in a series
starboard	right-hand side when facing forward
tidal stream	the horizontal movement of the water due to tide

Data Summary

Vessel Particulars:

Name:	*Santa Regina*
Type:	passenger freight ferry
Class:	100 A1, RoRo Passenger Ship/WineTanker LMC. UMS.
Limits:	unrestricted
Classification:	Lloyds Register
Length:	136.00 m
Breadth:	22.50 m
Gross tonnage:	14588
Built:	Ateliers et Chantier du Havre, France 1984
Propulsion:	2 x SEMT Pielstick PC 2.6, 9 L 400 in-line non-reversible diesel engines driving 2 controllable-pitch propellers through clutches and reduction gearboxes
Service speed:	18 kn
Owner/operator:	Strait Holdings Limited/Strait Shipping
Port of registry:	Wellington
Minimum crew:	20 – 27 depending on passenger numbers

Date and time:	9 June 2005 at about 2011[1]
Location:	Tory Channel eastern entrance
Persons on board:	crew: 32 passengers: 57
Injuries:	crew: nil passengers: nil
Damage:	nil
Investigator-in-charge:	Captain Iain Hill

[1] Times in this report are New Zealand Standard Time (UTC + 12 hours) and are expressed in the 24-hour mode.

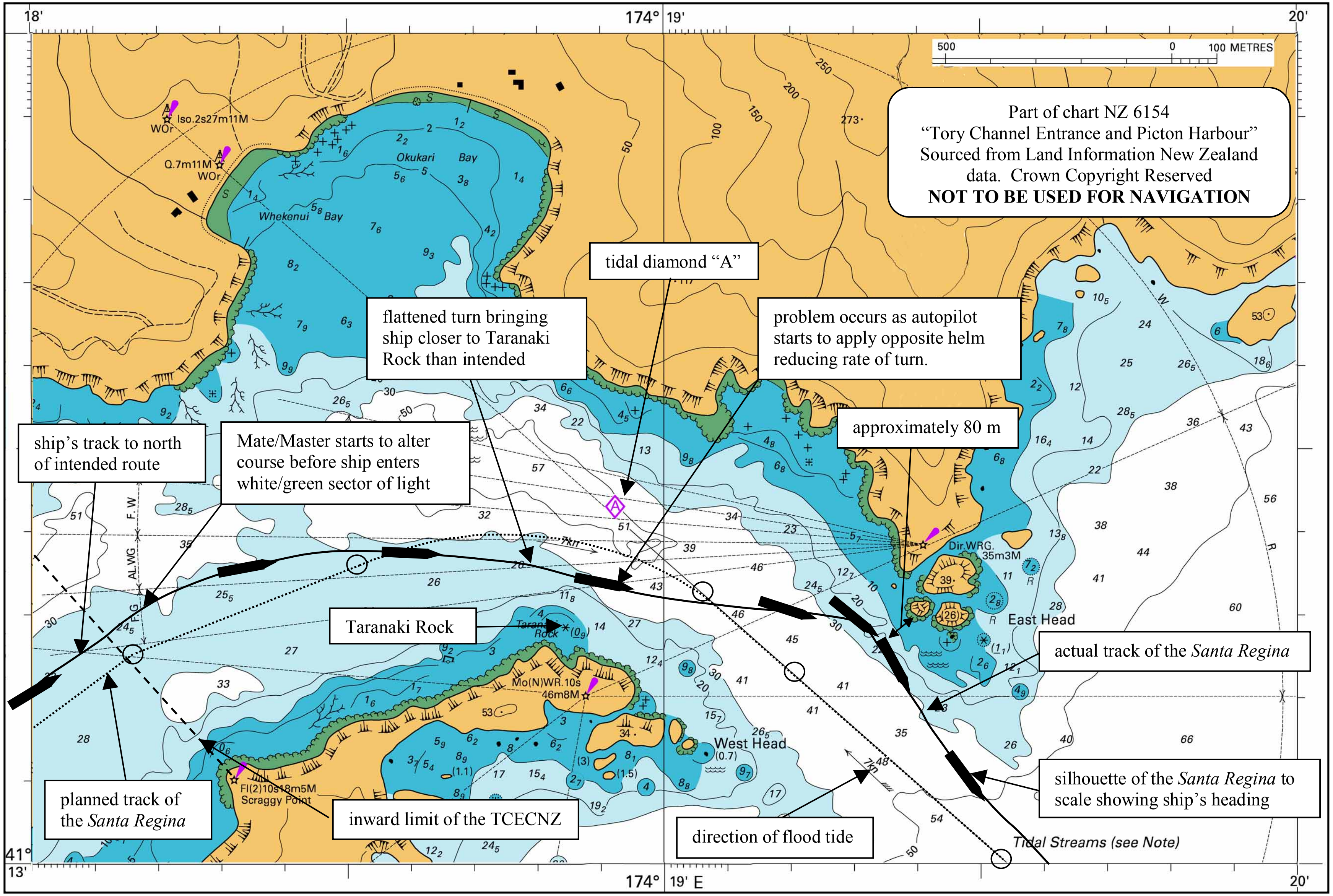


Figure 1
General area of the accident showing the *Santa Regina*’s actual track and heading

1 Factual Information

1.1 Narrative

1.1.1 On Thursday 9 June 2005 at about 1900, the *Santa Regina* departed Picton ferry terminal with 57 passengers and 32 crew on board. The bridge team consisted of the Mate/Master, Second Mate and 2 ratings. After departing the berth the autopilot was engaged and the vessel was under the con of the Mate/Master.

1.1.2 At about 1936, the *Santa Regina* passed Dieffenbach Point and entered Tory Channel. At about 1958 as the ship passed Clay Point, the Second Mate transmitted the required 10-minute call for transiting the Tory Channel entrance controlled navigation zone (TCECNZ).

1.1.3 As the *Santa Regina* entered the TCECNZ the ship was to the north of the intended track (see Figure 1). The Mate/Master was conning the vessel from the helm station located on the centreline towards the rear of the wheelhouse. He started adjusting the course of the ship to starboard on the autopilot, conning the ship into the alternating white/green sector of the East Head sector light.

1.1.4 The Second Mate was standing next to the Mate/Master at the helm station, and the 2 ratings were acting as lookouts, one each at the port and starboard extremities of the wheelhouse.

1.1.5 Still using the autopilot the Mate/Master continued to con the ship to starboard until the ship was passing Taranaki Rock at a distance of about 120 m. The Second Mate stated later that the Mate/Master said that he thought that he was too close to Taranaki Rock and had allowed the amount of starboard helm to reduce. However, the Mate/Master could not remember saying this.

1.1.6 Later, the Mate/Master stated that at about this time he needed to adjust the electronic nautical chart (ENC) display system located at the conning station at the front of the wheelhouse. He consequently stepped forward, adjusted the display and stepped back to the helm position.

1.1.7 The Second Mate stated later, that when the Mate/Master had moved forward he had noticed that the amount of starboard helm being applied by the autopilot reduced to zero, and then increased to port as the autopilot steadied the ship on the set course. The Second Mate stated later that he advised the Mate/Master that the ship was not swinging quickly enough to starboard to make the turn.

1.1.8 On his return to the helm position the Mate/Master applied another course alteration to starboard on the autopilot and observed the helm indicator showing that starboard helm was being applied. After a few seconds he noted that the ship's head, from observation of the autopilot lubber line, was not altering as quickly as he had anticipated.

1.1.9 The Mate/Master said that he rationalised that the ship's head was being affected by the incoming tidal flow. He switched the steering system into manual non-follow-up control and applied first 20° then 30° of starboard helm.

1.1.10 By this time the Second Mate had made his way to the port bridge wing, looked aft and seen that the rocks of East Head appeared to be very close. He shouted to the Mate/Master at the helm controls to straighten the ship up; otherwise, he said, he thought that the stern of the ship would have clipped the rocks.

1.1.11 The Mate/Master reduced the amount of starboard helm to reduce the swing of the *Santa Regina* and brought the ship slowly back onto the designated course. The ship completed the remainder of the crossing to Wellington without further incident.

1.2 Vessel information

1.2.1 The *Santa Regina* was a passenger and freight ferry operated by Bluebridge, a division of Strait Shipping. The *Santa Regina* was built in 1984 in France. Strait Shipping purchased the vessel in 2002. The ship was certificated to carry a total of 367 passengers and was capable of carrying vehicular cargo. The ship was in class with Lloyds Register of Shipping. The minimum number of crew varied with the number of passengers carried, ranging from 20 to 27 appropriately qualified personnel. The ship traded on a scheduled service between Wellington and Picton with a service speed of 18 knots.

1.2.2 The *Santa Regina* was powered by 2 SEMT Pielstick PC 2.6, 9 L 400 in-line non-reversing diesel engines producing a total of 11 322 kW driving 2 controllable-pitch propellers through clutches and reduction gearboxes. Two rudders provided steering, one aft of each propeller. The *Santa Regina* also had 2 bow thrusters, each with a maximum power rating of 500 kW, giving a combined bollard pull of about 13.5 tonnes.

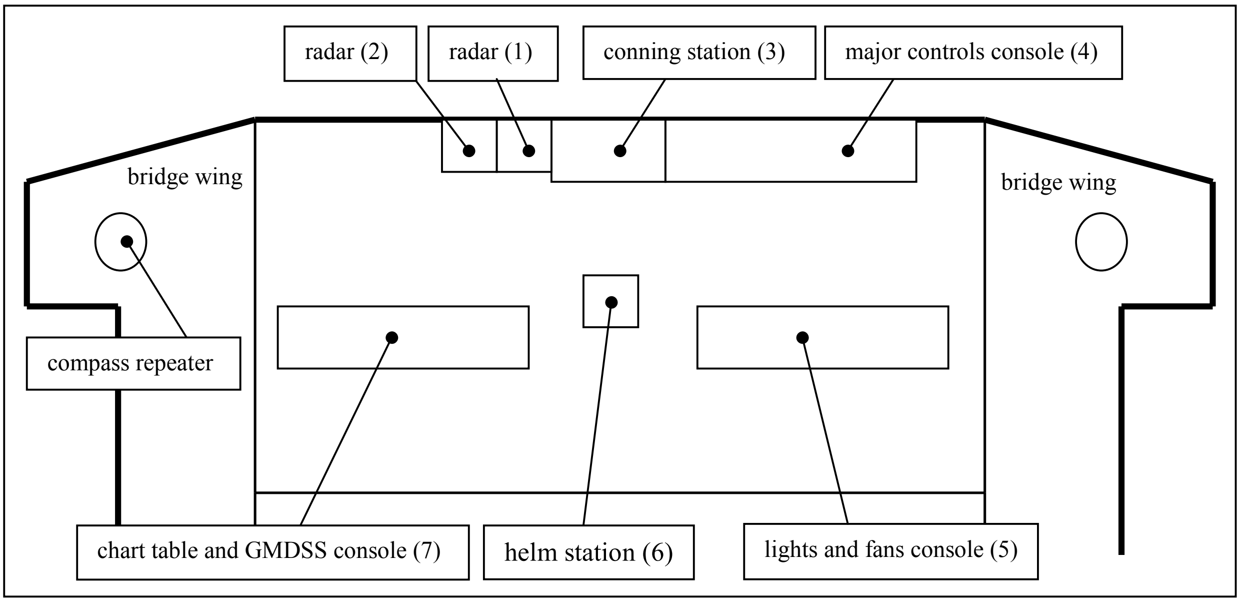


Figure 2
Bridge layout diagram (not to scale)

1.2.3 The navigating bridge of the *Santa Regina* was equipped with:

- a Decca S2690 B/T radar with ARPA function (1)
- a JRC JMA 7000 radar (2)
- 2 global positioning systems (GPS), one Racal (7), one Leica (3)
- a Sailor global maritime distress and safety system (GMDSS) (7)
- 2 Simrad echo sounders (7)
- a Sailor RT 5022 very high frequency (VHF) radio transceiver (3)
- a Sailor KDU 1905 automatic identification system (AIS) (3)
- a Navtex receiver (7)
- a Doppler log (7)
- an ENC display system running Endeavour 5 software (3)
- portable searchlights.

The bridge was also equipped with the controls for:

- controllable-pitch propellers (4)
- main engines and generators (4)
- steering gears (4)
- whistles (4)
- navigation lights (5)
- car deck fans (5)
- watertight doors
- fire-detection and pumping arrangements.

1.2.4 The design of the navigating bridge was that the major controls for controllable-pitch propellers, engines, bow thrusters, whistles etc. were located on a console to starboard at the bridge front (position 4 Figure 2). The 2 radars were located to port at the bridge front with a retrofitted conning station amidships at the bridge front. The main helm station was on the centreline in the middle of the bridge. There was a console for fans and lights to starboard and the chart table, echo sounders and communications centre to port.

1.2.5 The retrofitted conning station amidships (position 3 Figure 2) on the bridge front was intended to provide access to all the equipment and displays while conning the ship in a "cockpit" style environment. The station was equipped with the Leica GPS receiver, AIS readout, ENC display system and a Plath LMP HSC autopilot (switched from the helm station) capable of track following, steering designated courses and following radiused curves. One of the radars was visible to port of the conning station, a VHF radio was to starboard and a helm indicator was located in the deckhead above (see Figure 3).

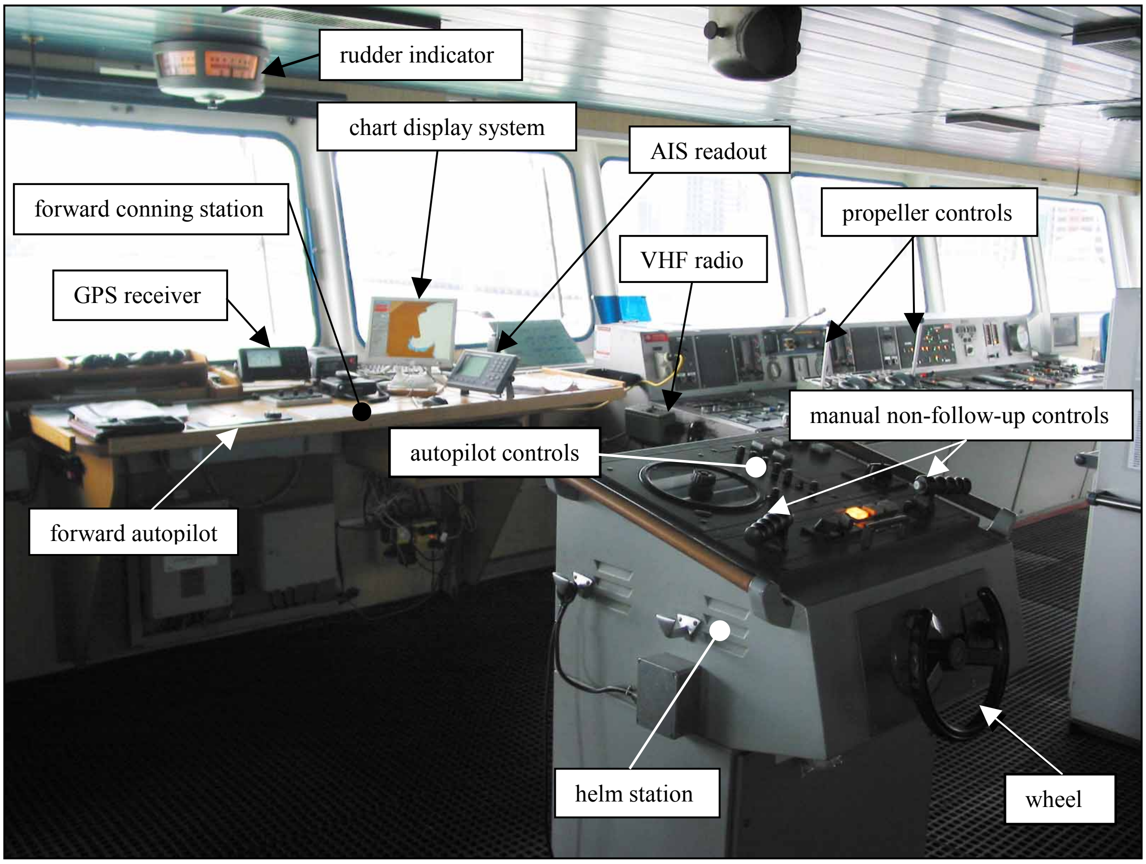


Figure 3
Helm station and conning position on board the *Santa Regina*

1.2.6 The ENC display system was interlinked to the GPS to provide accurate positional information allowing an accurate representation of the ship's position to be displayed on the appropriate chart. The information was supplied from the GPS in a National Marine Electronics Association 0183 interface standard format. The information supplied to the chart system included not only positional information but also date, time, speed and heading information. However, for timing, the ENC display system relied on the computer system to generate the time input and was therefore subject to the inaccuracies associated with computer clocks. At the time of the incident the difference between the displayed time and the time received from the GPS was 5 seconds.

1.2.7 Other marine equipment could also be interfaced with the chart system to provide supplemental information such as wind and AIS information to enhance the display. This data was stored by the ENC computer in a readily downloadable format. After the incident the data pertaining to the incident was downloaded and the Commission engaged the manufacturer of the chart display programme to produce a video playback of the *Santa Regina*'s track.

1.3 Navigational information

1.3.1 The Admiralty Sailing Directions New Zealand pilot (NP51) 16th edition described Tory Channel as:

> Tory Channel, separated from Queen Charlotte Sound by Arapawa Island is entered from Cook Strait between East Head (41°12'.7S 174°19'.4E) and West Head, 3½ cables WSW, whence the route leads generally W for about 9 miles into Queen Charlotte Sound.

1.3.2 The passage plan in use for the journey from Picton to Wellington was an authorised Strait Shipping document and formed part of the International Safety Management (ISM) Code documentation (see Appendix 1). The document contained comprehensive details of course, alter course positions, parallel indexing distances and off-track limits; and details of dangers, radio requirements and other navigational requirements.

1.3.3 The course approaching the radiused turn needed to exit Tory Channel was shown as being 067°T, and after the turn as 132°T. Approaching the radiused turn the parallel index distance was shown at 0.17 nm off Scraggy Point and after the turn the parallel index distances were shown as 0.14 nm to starboard off West Head and 0.15 nm to port off East Head (see Appendix 1).

1.3.4 The Mate/Master was navigating the ship around the radiused turn using a series of small discrete alterations rather than one continuous turn.

1.3.5 The Mate/Master stated later that he knew that he was setting to the north as he had the variable range marker set on 0.12 nm. He used the set distance as a guide to his closest distance off to starboard when performing the radiused turn into the exit from Tory Channel. This distance was greater than the minimum distance stated in the passage plan.

Bylaws

1.3.6 Marlborough District Council navigation bylaws 2002, stated in Part 3 Ships, Masters and Pilots, section 3.2 Directions for transiting Queen Charlotte Sound, paragraph (i) (c) that:

> For the purposes of these Bylaws, that part of Queen Charlotte Sound forming Tory Channel, from Dieffenbach Point to East Head, shall be deemed to be a narrow channel in accordance with Maritime Rules Part 22.9 – Collision Prevention, Narrow Channels and the provisions of that Rule shall apply.

1.3.7 Marlborough District Council navigation bylaws 2002, stated in Part 3 Ships, Masters and Pilots, section 3.5 General requirements that:

> (i) The master of every commercial ship shall ensure, when navigating within harbour limits, that:

(a) automatic steering 'pilot' devices, if fitted, are not to be used, unless a helmsman is standing by, to take over manual steering immediately on this being required, in the immediate vicinity of the helm or wheel

Maritime Rules

1.3.8 The International Regulations for Preventing Collision at Sea, 1972 (Colregs) apply to all vessels upon the high seas and in all waters connected therewith navigable by seagoing vessels. In New Zealand, Maritime Rules Part 22 gives effect to the Colregs. Part 22 provides the steering and sailing rules for ships, as well as standards for the installation, performance and use of lights for collision avoidance and the sound and light signals used for communication of safety information. There are minor editorial changes between the Colregs and Part 22, but the changes do not alter the meaning of the rules pertaining to this occurrence.

1.3.9 The paragraph of Maritime Rules Part 22 relevant to this investigation is:

> 22.9 Narrow Channels
>
> (1) A vessel proceeding along the course of a narrow channel or fairway must keep as near to the outer limit of the channel or fairway which lies on its starboard side as is safe and practicable.

1.3.10 The International Convention on Standards of Training, Certification and Watchkeeping, 1978 as amended in 1995 (STCW-95) contained requirements (amongst others) for the basic principles, guidelines and responsibilities of navigational watchkeeping. Maritime Rules Part 31A, Amendment 1 Crewing and Watchkeeping Unlimited, Offshore and Coastal (Non-Fishing Vessels) implemented New Zealand's obligations under STCW-95 for these principles, guidelines and responsibilities.

1.3.11 The paragraphs of Maritime Rules Part 31A, Amendment 1 relevant to this investigation are:

> **31A.21 Duty of Officer in Charge of a Navigational Watch**
> An officer in charge of a navigational watch on a ship must -
> (a) verify each course to be followed before using it; and
> (b) carry out his or her navigational watchkeeping duties in accordance with the directions of the master; and
> (c) in carrying out watchkeeping duties -
> (i) when the ship is at sea, have regard to the requirements and operational guidelines for navigational watchkeeping set out in Appendix 1; and...
>
> **Appendix 1 - Navigational Watchkeeping at Sea**
> (1) The master of every ship must ensure that watchkeeping arrangements are adequate for maintaining a safe navigational watch. Under the master's general direction, the officers of the navigational watch are responsible for navigating the ship safely during their periods of duty, when they will be particularly concerned with avoiding collision and stranding.
>
> (8) Performing the navigational watch
> (b) The officer in charge of the navigational watch must, during the watch, check the course steered, position and speed at sufficiently frequent intervals, using any available navigational aids necessary, to ensure that the ship follows the planned course.
> (c) The officer in charge of the navigational watch must have full knowledge of the location and operation of all safety and navigational equipment on board the ship and must be aware of and take account of the operating limitations of such equipment.
> (e) Officers of the navigational watch must make the most effective use of all navigational equipment at their disposal.
> (l) The officer in charge of the navigational watch must bear in mind the necessity to comply at all times with the steering gear requirements in Part 23. The officer of the navigational watch must take into account -
> (i) the need to station a person to steer the ship and to put the steering into manual control in good time to allow any potentially hazardous situation to be dealt with safely; and

(ii) that with a ship under automatic steering it is highly dangerous to allow a situation to develop to the point where the officer in charge of the navigational watch is without assistance and has to break the continuity of the look-out in order to take emergency action.

1.4 Climatic and tidal conditions

1.4.1 At the time of the incident it was 2 days after a new moon and the weather was reported in the log book as being overcast with a 25 knot north-northeasterly wind. Due to the age of the moon and the overcast there was very little ambient light to illuminate the surrounding topography.

1.4.2 The nautical chart for Tory Channel Entrance, NZ 6154, sourced from Land Information New Zealand data, contained a reference to tidal streams in the eastern entrance to Tory Channel. That reference stated:

> Mariners should refer to the New Zealand Nautical almanac for the daily timetable of directions of tidal streams. Weather conditions may considerably affect the tidal streams in the Cook Strait.

1.4.3 The Admiralty Sailing Directions New Zealand pilot (NP51) 16th edition stated in relation to the tidal streams in the Tory Channel:

> Tidal streams are strong in Tory Channel and very strong in the entrance, as indicated on the charts. Tide-rips form in the approaches, also indicated on the charts. For the latest information see the daily timetable in *New Zealand Nautical Almanac*.

1.4.4 The predicted tides for Wellington as detailed in the New Zealand Nautical Almanac for 9 June 2005 were:

Wellington							
High Water		Low Water		High Water		Low Water	
0645	1.5 m	1246	0.8 m	1855	1.6 m	(10th) 0131	0.8 m

1.4.5 The range of tides tabulated in the New Zealand Nautical Almanac for Wellington was 1.03 m for the spring range and 0.93 m for the neap range. The range at the time of the occurrence was 0.8 m and could be considered to be a neap tide. However, as the incident occurred 2 days after a new moon, one of the times when a spring tide occurs, the tide would have been a spring tide. The moon being near apogee and the Earth being near aphelion reduced the range of the tide.

1.4.6 Tidal stream rates were shown on the chart for specific geographical positions designated by a magenta diamond shape enclosing a letter, known as a tidal diamond. The rates shown are for average spring or neap tides referred to high water at Wellington. If the tidal range is greater than normal (e.g., full or new moon coinciding with perigee) the rates will be increased roughly in proportion. The spring rates for diamond "A" in Tory Channel entrance as shown in Figure 1 were:

Position	Time	Direction	Rate
Diamond "A"	1855	301°T	6.6 kn
	1955	307°T	5.6 kn
	2055	300°T	3.9 kn

1.4.7 The New Zealand Nautical Almanac also contained tabulated data for the Tory Channel giving the general direction of flow and the commencement of flow in that direction. The data for 9 June 2005 was:

Time/Dir.	Time/Dir.	Time/Dir.	Time/Dir.
0347/westerly	0957/easterly	1548/westerly	2241/easterly

1.4.8 The effect of the tidal stream was to push the *Santa Regina* to the north of the intended track whichever way the tide was flowing; this was to port when the ship was entering Cook Strait from Tory Channel.

1.5 Damage

1.5.1 The *Santa Regina* did not sustain any damage during the incident.

1.6 Bridge resource management

1.6.1 Bridge resource management (BRM) is the use and co-ordination of all the skills and resources available to the bridge team to achieve the established goal of optimum safety and efficiency.

1.6.2 The use of BRM helps eliminate the potential for one-person error, and aids the flow of information between members of the bridge team, and between the bridge team and the outside world. Part of the flow of information between members of the bridge team is challenge and response and the use of closed-loop communications to ensure that orders and information are heard and understood.

1.6.3 Closed-loop communications require that all orders and information are called out by the instigator, and repeated by the receiver to show that it has been heard and understood correctly. The instigator can then answer in the affirmative or negative to show that what the receiver heard was or was not correct. When challenge and response is encouraged, the other members of the bridge team can reasonably challenge an order or information to ensure that it is correct and the most suitable option available has been chosen.

1.6.4 When used effectively, BRM ensures that all the bridge team members share a common view of the intended passage, maintain situational awareness, anticipate dangerous situations, acquire all relevant information and act upon it in a timely manner, avoid an error chain being formed, and aims to prevent preoccupation with minor problems.

1.6.5 BRM training emphasises the need to recognise "hazardous thoughts" and replace them with opposite "safe thoughts". Three hazardous thoughts and their opposite safe thoughts, as used in BRM concepts, were relevant to the Mate/Master of the *Santa Regina* when they entered the TCECNZ.

Hazardous Thought	Safe Thought
I can do it	Why take chances?
It won't happen to me	It could happen to me
We've always done it this way	It's about time we changed

1.7 Human factors

1.7.1 Human factors is that branch of science and technology that includes what is known and theorised about human behavioural, cognitive and biological characteristics that can be validly applied to the specification, design, evaluation, operation and maintenance of products, jobs, tasks and systems to enhance safe, effective and satisfying use by individuals, groups and organisations[2].

1.7.2 Humans can suffer from hazardous attitudes from which hazardous thoughts develop and affect the standard of their decision-making. These attitudes depend upon an individual's characteristics and the type of environment in which they are operating. Factors that can influence decision-making are commercial pressure, peer pressure and the corporate environment in which the decisions are made.

[2] Christensen, Topmiller, and Gill 1988. Human factors definitions revisited. *Human Factors Society Bulletin, 31, 7-8.*

1.7.3 One aspect that can have a large impact on human behaviour is the risk of having an accident. However, the accuracy of an individual's risk perception is often poor and when dealing with familiar tasks in familiar environments, it appears that an individual operates with a "zero" level of risk perception[3]. That is, the individual does not believe there is any chance of an accident occurring by doing the task that way.

1.7.4 Almost all teams require some degree of authority gradient, which can be defined as the balance of decision-making power or the steepness of command hierarchy in a given situation, otherwise roles are blurred and decisions cannot be made in a timely fashion. However, members of a crew or organisation with a domineering, overbearing or dictatorial team leader experience a steep authority gradient where expressing concerns, questioning or even simply clarifying instructions requires considerable determination on the part of the team members who perceive their input as devalued or unwelcome. Conversely, members of a crew or organisation where the authority gradient is too low or "flat" have a more relaxed attitude toward cross checking each other's actions or confirming other information. Effective team leaders consciously establish a command hierarchy appropriate to the training and experience of the team members.

1.7.5 Local conditions are conditions associated with the immediate context or environment in which operational events occur. In terms of individual actions, these conditions include characteristics of individuals, the task and/or the environment. When such conditions are safety issues or increase accident risk, they can be termed local hazards or local threats. Local conditions can influence incident development by increasing the likelihood of a particular individual action or increasing the likelihood of another local condition.

1.8 Personnel information

1.8.1 The Mate/Master first went to sea in 1974 and after working for several New Zealand and foreign companies gained his Master's certificate of competency in 1983. He had served on ships on the New Zealand coast from 1984 and commenced employment with Strait Shipping in 1992. The Mate/Master had attended a BRM and an Advanced Marine Pilotage course in late 2004. The Mate/Master had received no formal training in the use of the advanced features of the autopilot fitted into the conning station at the bridge front.

1.8.2 The Second Mate commenced working for Strait Shipping in January 2003 after serving in overseas vessels from 1992. He gained his STCW-compliant Master's certificate of competency in 2004. Since joining Strait Shipping he had served on both the company's vessels and had served as Mate/Master for a period of 4 months on board the *Kent*. The Second Mate had attended a BRM and an Advanced Pilotage course in late 2004. The Second Mate had received no formal training in the use of the advanced features of the autopilot fitted into the conning station at the bridge front.

1.8.3 One lookout had held an inshore fishing skipper's certificate of competency since 1982 and had been working as a merchant seaman for the previous 5 years. He held a deck watch rating (DWR) certificate and a certificate as an able seaman. He later stated that at the time of the incident he understood that he was present on the bridge as a lookout not as a helmsman.

1.8.4 The other lookout started work on fishing boats in 1993 and held certificates as first mate of a deep sea fishing vessel, a New Zealand offshore watchkeeper (NZOW) and a qualified fishing deck hand. His NZOW certificate had equivalency to a DWR certificate. Strait Shipping had employed him on a relieving basis since February 2005. He later stated that at the time of the incident he understood that he was present on the bridge as a lookout not as a helmsman.

[3] Summala, H. 1988. Risk control is not risk adjustment: The zero-risk theory of driver behaviour and its implications. *Ergonomics, 31*, 491-506.

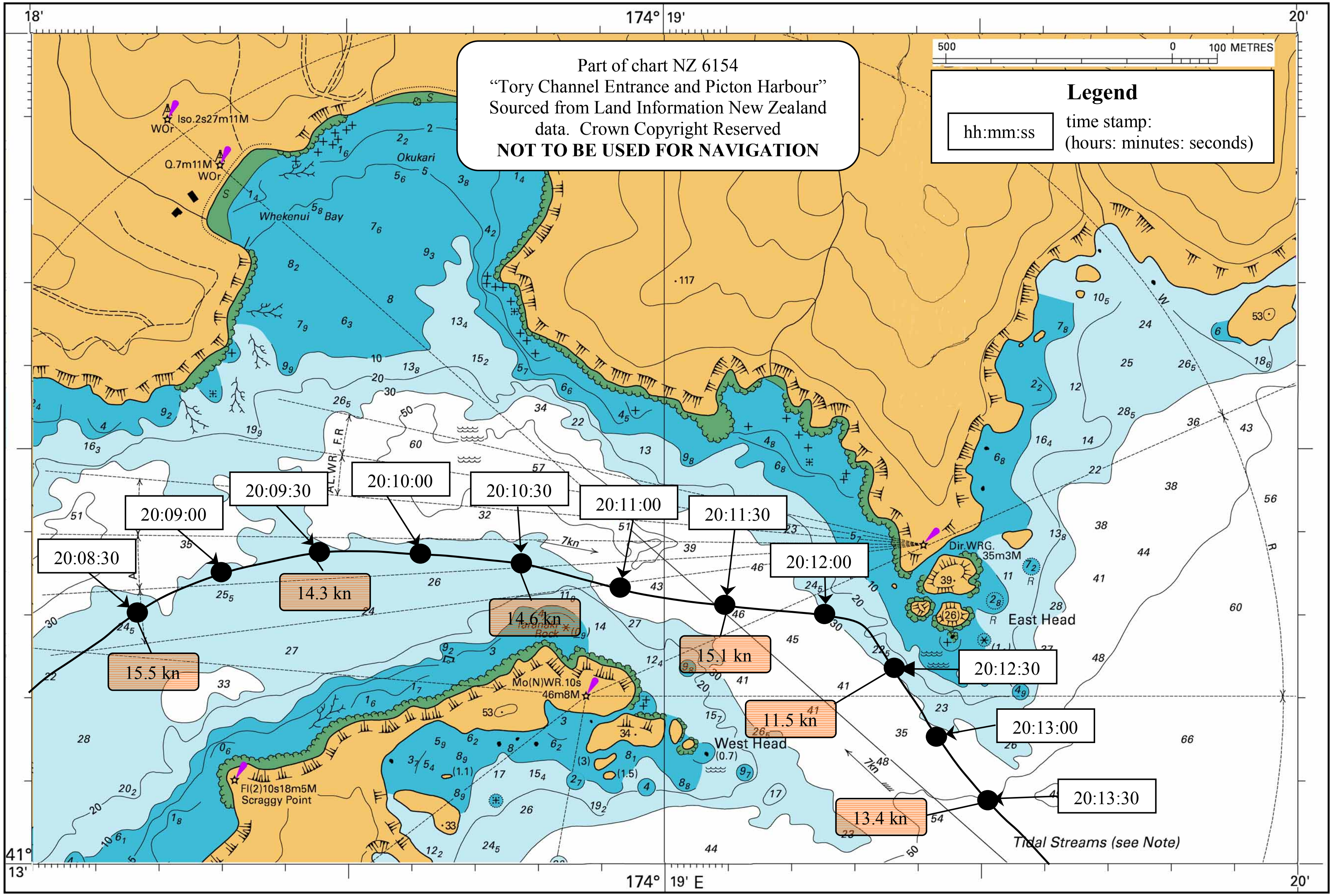


Figure 4
Time and speed track of the *Santa Regina* exiting Tory Channel

2 Analysis

2.1 The effect of the Mate/Master conning the ship in a series of small, discrete alterations of course, rather than one large alteration was to "flatten" the turn, which had the effect of increasing the turn radius. Adjusting the course in this manner also allowed for a greater probability of inclusion of errors as was shown by the Mate/Master becoming concerned that the ship was getting too close to Taranaki Rock. By initially flattening the turn, the ship was subjected to the full force of the tidal stream on its starboard side just as it was required to turn head into the stream. Had the planned track been followed, the *Santa Regina* would have commenced its turn prior to encountering the full force of the stream.

2.2 More prudent action, instead of the small, discrete alterations may have been to have entered the new course of 132°T on the autopilot and then for the Mate/Master to have monitored the ship's progress and rate of turn from the helm position and on the radar as the autopilot altered the course. Alternatively, had the Mate/Master remained at the helm station he could have continued to enter the small alterations of course without allowing the rudder angle to decrease to an extent where the turn radius was compromised.

2.3 When conning the vessel the Mate/Master was affected by 2 different local conditions in the physical environment. The first was the darkness of the night caused by the overcast sky and the age of the moon affecting his spatial orientation in seeing visually how close he was to the sides of the channel. The second was the uncertainty of the strength of the predicted incoming tidal stream.

2.4 Although the incoming tidal stream affected the *Santa Regina*, the strength of the stream should not have been unexpected. Although the tide was a spring tide, the difference between the heights of high and low water, which was proportional to the flow of the stream, was small and was lower than that of a neap tide. However, the flow of the stream would not be consistent throughout the entrance and the ship may have been affected by a stronger-than-average flow within the main general stream.

2.5 The period of time that elapsed from the Mate/Master stepping forward to adjust the ENC controls until the ship exited the Tory Channel was short, about 2½ minutes (see Figure 4). However, as the Mate/Master stepped forward, the autopilot was already reaching the set course and was starting to apply opposite helm, to port, to steady the ship. This had the effect of slowing the rate of turn and also increasing the turn radius. When the Mate/Master returned to the helm station and reapplied starboard helm, the rudders initially had to swing through the zero position before going to starboard. The ship had also to build up the rate of turn again just as it came into the tidal stream that also pushed the ship further to the north.

2.6 The Mate/Master exercised prudent judgement in not attempting to slow the ship when he first realised that the ship was not making the turn as he anticipated. Altering the pitch on the propellers to slow the ship would have taken some time to have any effect such that the incident may have concluded before the ship had noticeably slowed. Had the ship slowed, the rudders would have been less effective and the ship would have been affected by the tidal stream for longer, possibly resulting in the ship grounding on the northern shore.

2.7 Both the Mate/Master and the Second Mate held pilot exemptions for Queen Charlotte Sound including Tory Channel and transited the Tory Channel entrance numerous times in a year. Both were at risk from the routinisation of the passage. With routinisation, operators become more concerned about the mechanics and accomplishment of tasks than their meaning. Thus an operator can underestimate the amount of risk that routine tasks can pose for the safety of the ship. Good BRM ensures that routine tasks are adequately supervised and that appropriate procedures are implemented to minimise the effect of routinisation.

2.8 The organisation of the navigating bridge operation was focused almost exclusively on one person, the Mate/Master. Although responsible for the operation of the team, he did not include other responsible and technically competent personnel in key aspects of the operation. This invited "one-person error" by over concentrating both supervision and decision-making.

2.9 There were 2 ratings present on the bridge capable of acting as helmsmen should the need arise. However, neither of the 2 ratings on the bridge considered that they were present to carry out helmsman's tasks. Each considered that they were on the bridge as the lookout. They had stationed themselves on opposite sides of the wheelhouse where they were afforded a clear view forward. Effective BRM would have included them in the "bridge team", aware of the common view of the voyage and their duties during the voyage.

2.10 To be effective in taking over the helm in an emergency, a designated helmsman would have to be standing at the helm position ready to take over, as required by the Marlborough District Council navigation bylaws 2002 and Maritime Rules Part 31A, Amendment 1. The time required to summon a helmsman from his lookout position, brief him on the required course or rudder angle and switch to manual steering could be longer than the time available in an emergency situation.

2.11 A ship on autopilot would require the officer with the con to be close to the helm console to switch the steering controls to manual. More prudent action may have been for the officer with the con to engage hand steering prior to arriving at such a critical point in the voyage. However, a person manually steering a ship is unlikely, even with considerable expertise gained over many periods on the helm, to be able to emulate the precision with which a modern, correctly adjusted autopilot could steer around a radiused bend.

2.12 This and other incidents involving the less than optimal use of autopilots could possibly lead to the conclusion that the use of autopilots was unsafe. However, it is widely accepted that the diligent use and monitoring of an autopilot as a resource within the bridge management structure allows a vessel to maintain a course more accurately than is possible by manual steering.

2.13 The *Santa Regina* was equipped with an autopilot capable of track following, steering designated courses and following radiused curves either at specified radii or rates of turn. However, this autopilot was retrofitted into the conning station at the front of the wheelhouse where it was physically remote from the necessary switching arrangements to engage the different modes of steering.

2.14 When the ship was built in 1984, the bridge had been designed to a scheme that had been in use for many years consisting of the various pieces of equipment being distributed around the 3 main consoles and helm station. This distribution, although not ergonomically sound, was workable on ships with a large crew. With only a small crew and bridge team available on board the *Santa Regina,* this design was less efficient. The operator had attempted to overcome this problem by grouping some of the controls and readouts from the bridge equipment together at a retrofitted conning station on the bridge front. However, some of these controls, noticeably the autopilot, required operational switching from one of the other consoles to be activated. Some members of the company's bridge teams were reluctant to use this conning position as they considered that it did not give an adequate view of all of the equipment, and being very close to the bridge front did not allow adequate awareness of the way the ship was handling.

2.15 Although the Mate/Master was used to conning the ship using the standard autopilot fitted to the helm station, he most probably knew how to operate the basic functions on the more modern autopilot fitted into the conning station on the bridge front. However, he may have been unsure of the operation and accuracy of the more advanced features of this autopilot that would have allowed him to programme radiused turns that the autopilot would steer with more accuracy than was manually possible. As in many cases when new equipment was retrofitted into a ship, only basic guidance on its use was given. However, on such a busy schedule through mainly confined waters, little time was available for the crews to "discover" the more advanced features by reading manuals and experimentation.

2.16 It would have been more prudent for the Mate/Master to have stayed at the helm station with the ship in autopilot and not to step forward at the time he did. One of the other bridge team members could have adjusted the ENC for him. Alternatively the ENC could have been set to the desired scale and brightness prior to the ship arriving at the eastern entrance.

2.17 Had the Mate/Master conducted a thorough pre-departure briefing that included the settings he required on the bridge equipment and at what points, the other members of the bridge team would have been prepared to adjust the equipment to the required settings. This probably would have prevented the Mate/Master becoming preoccupied with minor problems such as the range and brightness of the ENC.

2.18 Had the Mate/Master fostered a regime of closed-loop communication on the bridge and invited challenge and response from the other members of the bridge team, it is possible that another member of the bridge team would have challenged the Mate/Master's intended actions of adjusting the ENC controls at such a critical time in the voyage.

2.19 Although usual practice was for the Mate/Master to take the con of the ship through the Marlborough Sounds and Tory Channel, he did not include the other members of the bridge team in the common view of the voyage, leaving them to carry out their appointed tasks while he worked in virtual isolation. Effective use of BRM training would have alerted him to the hazardous thought of "we've always done it this way" and replaced it with the opposite safe thought of "it's about time we changed". Working in isolation left him susceptible to one-man error.

3 Findings

3.1 The *Santa Regina* was prevented from grounding at East Head by the Mate/Master applying an extraordinarily large amount of helm for a vessel at full speed after the ship did not complete a turn to starboard as anticipated.

3.2 The standard of BRM was less than optimal.

3.3 The Mate/Master was probably suffering from one-man error exacerbated by the local conditions prevailing at the time of the incident.

3.4 Had a regime of challenge and response been prevalent on the navigating bridge, the Mate/Master's actions would probably have been challenged.

3.5 The Mate/Master and Second Mate probably did not share a common view of the intended passage.

3.6 Two lookouts were present on the navigating bridge, but neither had been briefed that they were present to undertake helmsman's duties, nor had one been positioned in anticipation.

3.7 The time taken to position a helmsman at the wheel and take over the steering would have been too long to avoid grounding after the onset of the incident.

3.8 Had a helmsman already been on the wheel steering the ship, the incident would have been unlikely to occur.

3.9 The Mate/Master was possibly unsure of the advanced operation of the retrofitted autopilot and the accuracy and abilities it afforded him.

3.10 The *Santa Regina* did not suffer any damage that affected its seaworthiness or navigability.

3.11 The *Santa Regina* was correctly certified and manned at the time of the occurrence.

4 Safety Actions

4.1 Since the incident, Strait Shipping has implemented the following actions:

- the acting Marine Manager and a senior Master conducted an internal investigation
- the Second Mate was observed and tutored in BRM techniques under pilotage until assessed as competent
- the Mate/Master was observed and tutored in BRM techniques and not placed in a command position until full confidence in his ability had been regained and his practices reviewed accordingly
- the bridge teams were peer reviewed by the Marine Manager and a senior Master
- further BRM training for the bridge teams on the Auckland ship simulator was arranged
- a lecturer from the New Zealand Maritime School was engaged to oversee and critique the navigational practices on board the company's vessels
- the ISM safety management system documentation was amended to:
  - require the passage plan to be followed to be entered into the deck logbook and be authorised by the Master
  - require the Master and officer of the watch to follow the designated passage plan.

4.2 In view of the actions taken by Strait Shipping, no further safety recommendations covering these aspects have been made to Strait Shipping.

5 Safety Recommendations

5.1 On 12 December 2005 the Commission recommended to the Managing Director of Strait Shipping that she:

5.1.1 implement additional training for all Masters and officers who serve on board the company's vessels to ensure that they understand the full capabilities and limitations of the equipment, especially equipment that may have been retrofitted, and its best use to enhance the navigation and safety of the company's vessels. (113/05)

5.1.2 implement a programme on board the company's vessels to encourage Masters and officers to become familiar with and utilise all the bridge equipment to best advantage. (114/05)

5.2 On 13 January 2006, the Marine Manager for Strait Shipping Limited replied:

> With regard to the above recommendations arising out of the Santa Regina Tory Channel Entrance incident we intend to implement the safety recommendations 113/05 & 114/05 using the following methods:
>
> We will re enforce our BRM techniques by sending all deck officers including trainees through a refresher BRM course, this has already commenced with a course in November another is programmed for the beginning of March and we would hopefully have all officers refreshed so to speak by the end of 2006.
>
> With regard to bridge equipment training, we are making the use of retro fitted bridge equipment a specific item in our type rating competency checklist and will make the demonstration of the use of such equipment a specific item in our internal audit procedures.

Approved on 19 January 2006 for Publication

Hon W P Jeffries
Chief Commissioner

6 Appendix 1

Part of Strait Shipping Limited passage plan Picton to Wellington via Tory Channel

Document	SSL-Sreg-105 & Kent-105	**Issue Date**	31st October 2004
Section No.	5.2	**Issue No.**	2.0
Title:	Picton to Wellington (via Tory Channel)	**Page**	xx of 20

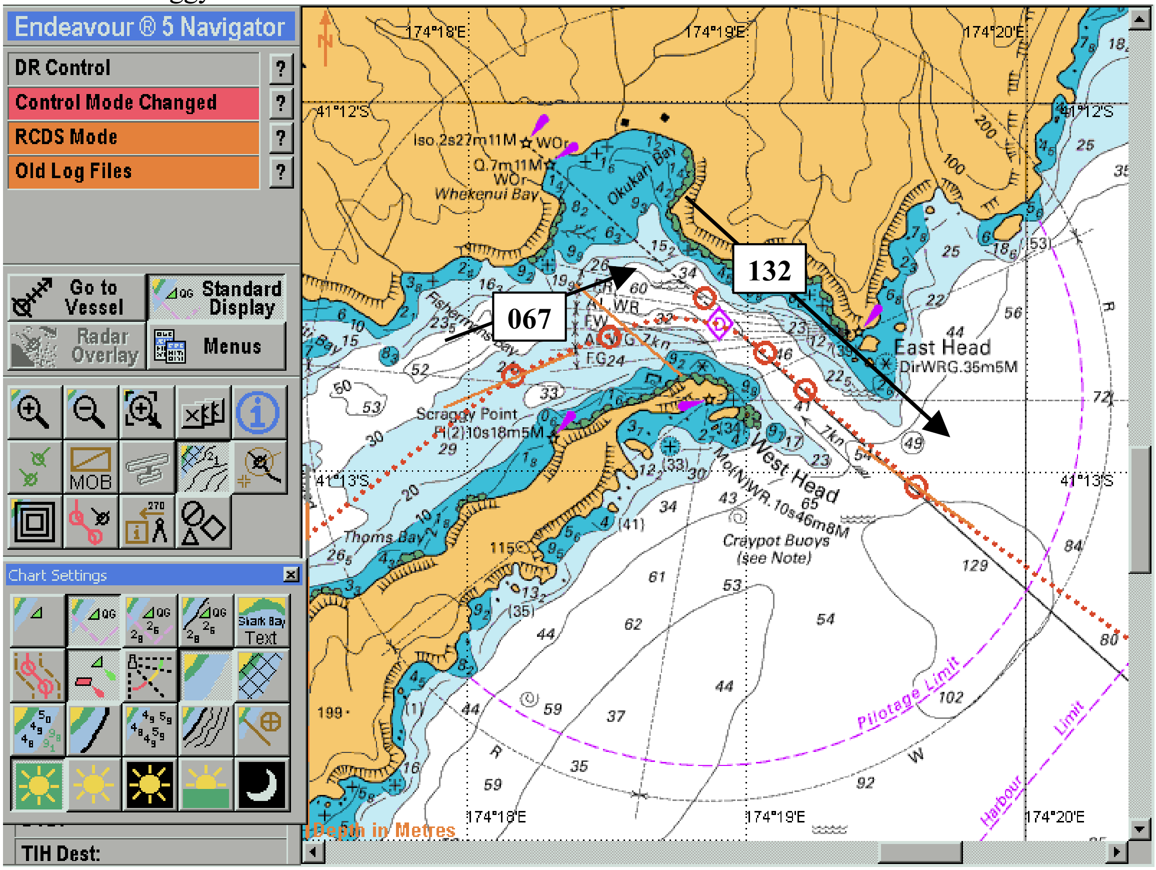
Scraggy Pt. Lt. abeam (140º x 0.187) 41º 12.745 S 174º 18.165 E	068	0.27	// Starboard, min dist off 0.16* // Starboard, max dist. off 0.36*	20
CNZ: The CNZ begins on a line drawn 320º from Scraggy Point Light and ends on the intersection of the line of the leading lights and the seaward arc, radius 0.6 NM centred on West Head Lt. [MDCNB 3.3 (iii)(a) & (b)] **Overtaking:** The Master is prohibited from overtaking another ship (500 GRT or more) in the CNZ [MDCNB 3.3 (xi)] **Passing vessels:** Only one vessel (500 GRT or more) at a time is permitted to navigate within the CNZ [MDCNB 3.3 (vii)]				
West Head Lt. (120º x 0.32) 41º 12.638 S 174º 18.510 E	WO	0.60	Controlled turn to Starboard onto leads Keep East Head Lt fine to Starboard (Check Bearing 132°: When 132° clears West head, ships head should be 090°)	30
Isolated Danger: The leads pass about 1.5 cables NE of Taranaki Rock that uncovers at low water. Charted position 0.35 from the coastline NW of West Head Light **Caution:** The channel leading lights will not be seen until they are nearly in line.				

West Head Lt. (Radiused turn Waypoint)
(176º x 0.27)
41º 12.532 S 174º 18.851 E
	Var		Controlled turn to Starboard
			// Port, East Head NLT 0.10
			// Starboard, West Head NLT 0.10
				30

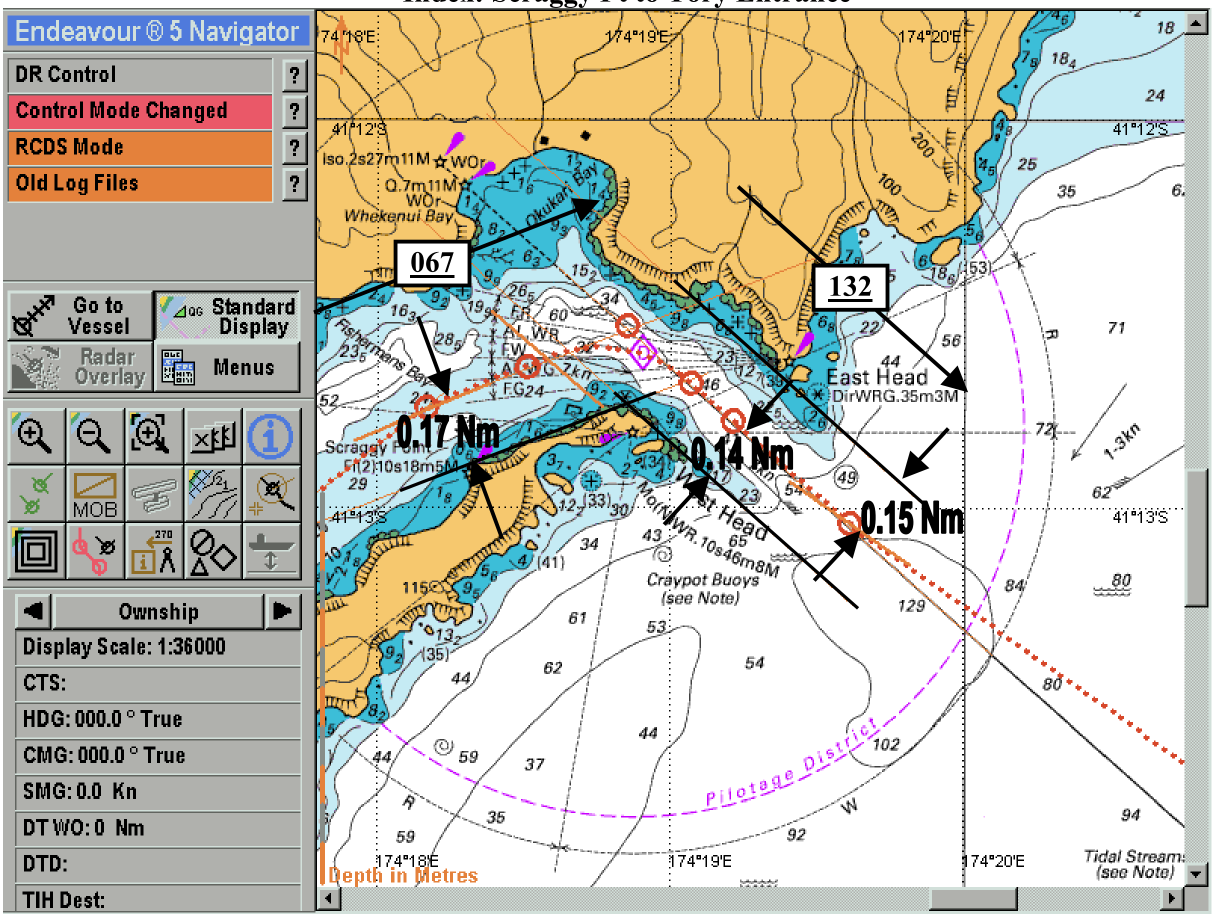
West Head Lt. (230º x 0.18) 41º 12.680 S 174º 19.069 E	132	0.15	// Port, East Head NLT 0.10 // Starboard, West Head NLT 0.10	30
Leads: The Master must ensure that the ship is maintained on the line of the leading lights until 0.5 NM south-east of a line joining East Head Lt. And West Head Lt. [MDCNB 3.3 (ix)] **Caution:** A vessel entering Cook Strait against a flood tide will find that the stream sets NNW onto the Starboard bow. Care must be taken to allow for the effects of the stream.				
East Head abeam (East Head Lt. 042º x 0.185) 41º 12.779 S 174º 19.214 E	132	0.40	// Port, East Head NLT 0.10 // Starboard, West Head NLT 0.10	30
Isolated Danger: The leads pass about 1.5 cables SW of a rock with a depth of 4.9m that lies at the outer end of a reef extending SE from East Head				
CNZ Departure W/P (West Head Lt. 294º x 0.60) 41º 13.043 S 174º 19.608 E	126	16.52		30

[1] Distance off Salient Points. [MDCNB 3.4 (i)]

5.2.15.1 Scraggy Point to East Head



Index: Scraggy Pt to Tory Entrance



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Transport Accident Investigation Commission
P O Box 10-323, Wellington, New Zealand
Phone: +64-4-473 3112 Fax: +64-4-499 1510
E-mail: reports@taic.org.nz Website: www.taic.org.nz

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