# Report 98-209

# fishing trawler *San Rakaia*

# grounding

# Ninepin Rock

# 13 August 1998

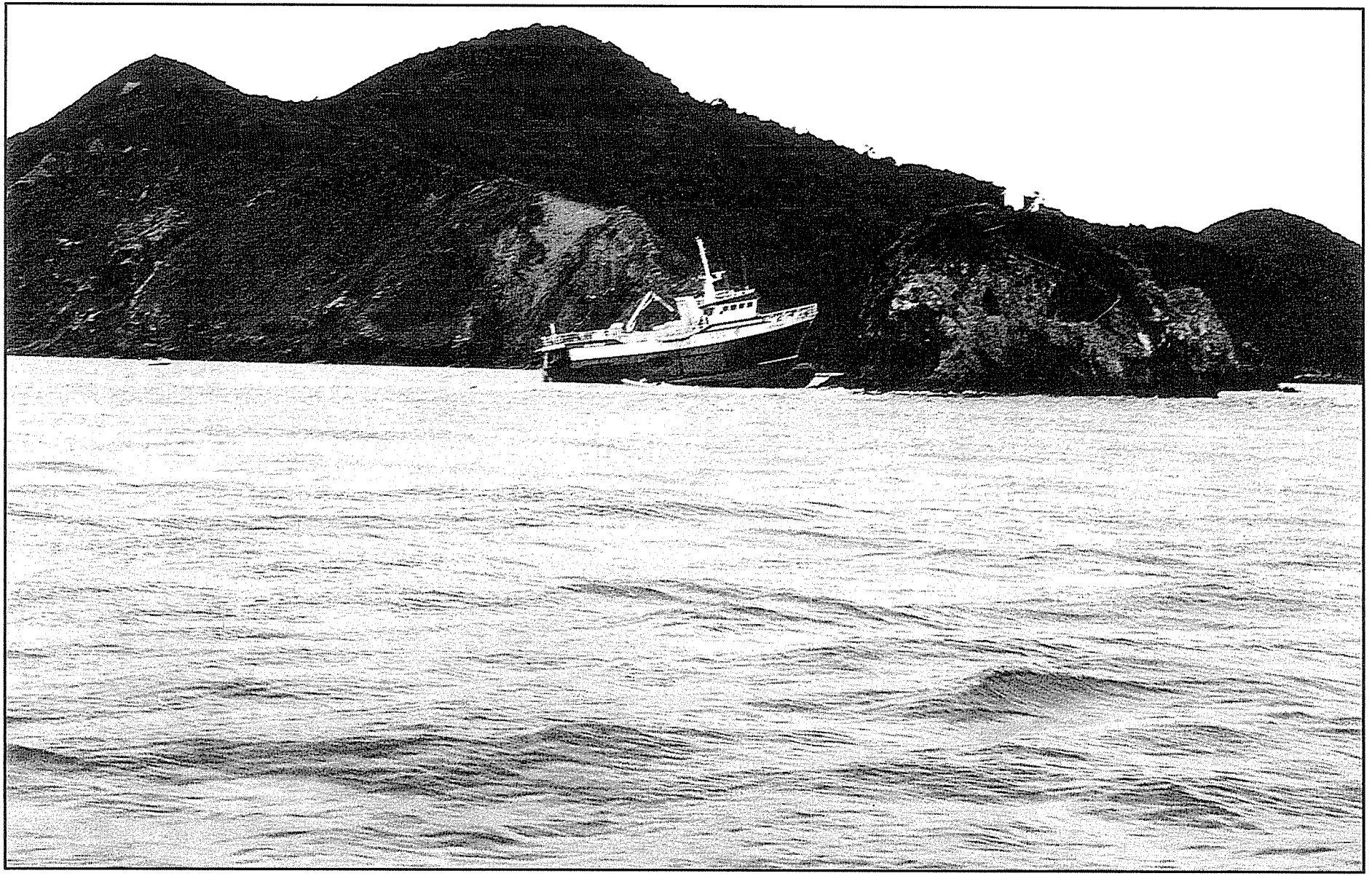
## Abstract

On Thursday, 13 August 1998, at about 0120, the fishing vessel *San Rakaia* grounded on Ninepin Rock at the entrance to Pelorus Sound. The vessel had been on passage from Nelson to the Cook Strait fishery with seven persons on board. There were no injuries. With assistance of other vessels the *San Rakaia* was refloated on the next high tide.

Safety issues identified included:

- inadequate management of the crew working routine, leading to fatigue
- under utilisation of available navigation aids
- lack of a watchkeeper monitor alarm for single-handed bridge operation
- lack of mechanical assistance for stowage of catch.

Safety recommendations were made to the Group Fleet Manager of Sanford Limited and to the Director of Maritime Safety to address the safety issues.



***San Rakaia* aground on Ninepin Rock**

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## Glossary of abbreviations

| | |
|---|---|
| GPS | global positioning system |
| IMO | International Maritime Organisation |
| kW | kilowatt |
| m | metres |
| mm | millimetres |
| NZST | New Zealand Standard Time (UTC + 12 hours) |
| STCW | International Convention on Standards of Training, Certification and Watchkeeping, IMO |
| STCW-F | International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel, IMO |
| UTC | universal time (co-ordinated) |
| VHF | very high frequency |

## Glossary of terms

| | |
|---|---|
| abeam | direction at right angles to the length of a ship |
| aft | rear of the vessel |
| beam | width of a vessel |
| bilge | space for the collection of surplus liquid |
| bridge | structure from where a vessel is navigated and directed |
| class | category in classification register |
| conduct | control of the vessel |
| conning | directing the course and speed of a ship |
| gross tonnage | a measure of the internal capacity of a ship; enclosed spaces are measured in cubic metres and the tonnage derived by formula |
| knot | one nautical mile per hour |
| nett tonnage | derived from gross tonnage by deducting spaces allowed for crew and propelling equipment |
| port | left hand side when facing forward |
| sounding | measure of the depth of a liquid |
| starboard | right hand side when facing forward |
| stability | property of a ship by which it maintains a position of equilibrium, or returns to that position when a force that has displaced it ceases to act |

# Transport Accident Investigation Commission

## Marine Accident Report 98-209

**Vessel particulars:**

| | |
|---|---|
| Name: | *San Rakaia* |
| Registered: | Auckland |
| Official Number: | 876202 |
| Type: | Trawler |
| Classification: | Bureau Veritas |
| Class: | Fishing vessel. Deep sea |
| Limits: | Unrestricted |
| Construction: | Steel |
| Propulsion: | One 1051.5 kW Caterpiller model 3516 diesel engine driving, via a Volda model ACG56-450 reduction gearbox, a single controllable-pitch four-bladed propeller |
| Built: | In 1997, Astilleros Armon SA, Navia, Asturias, Spain |
| Owner/Operator: | Sanford Limited |
| Length overall: | 32.00 m |
| Breadth: | 10.00 m |
| Gross tonnage: | 498 |
| Net tonnage: | 149 |
| Normal operating speed: | 10 knots |

**Location:** Ninepin Rock, Chetwode Island, entrance to Pelorus Sound
40° 55.0' South 174° 03.3' East

**Date and time:** 13 August 1998 at 0120 hours[1]

**Persons on board:**

| | |
|---|---|
| Crew: | 7 |
| Passengers: | nil |

**Injuries:** Nil

**Nature of damage:** Forward 4 m section of box keel heavily indented and cracked. Echo sounder pod distorted

**Investigator-in-Charge:** Captain John Mockett

[1] All times in this report are in NZST (UTC + 12 hours) and are expressed in the 24 hour mode.

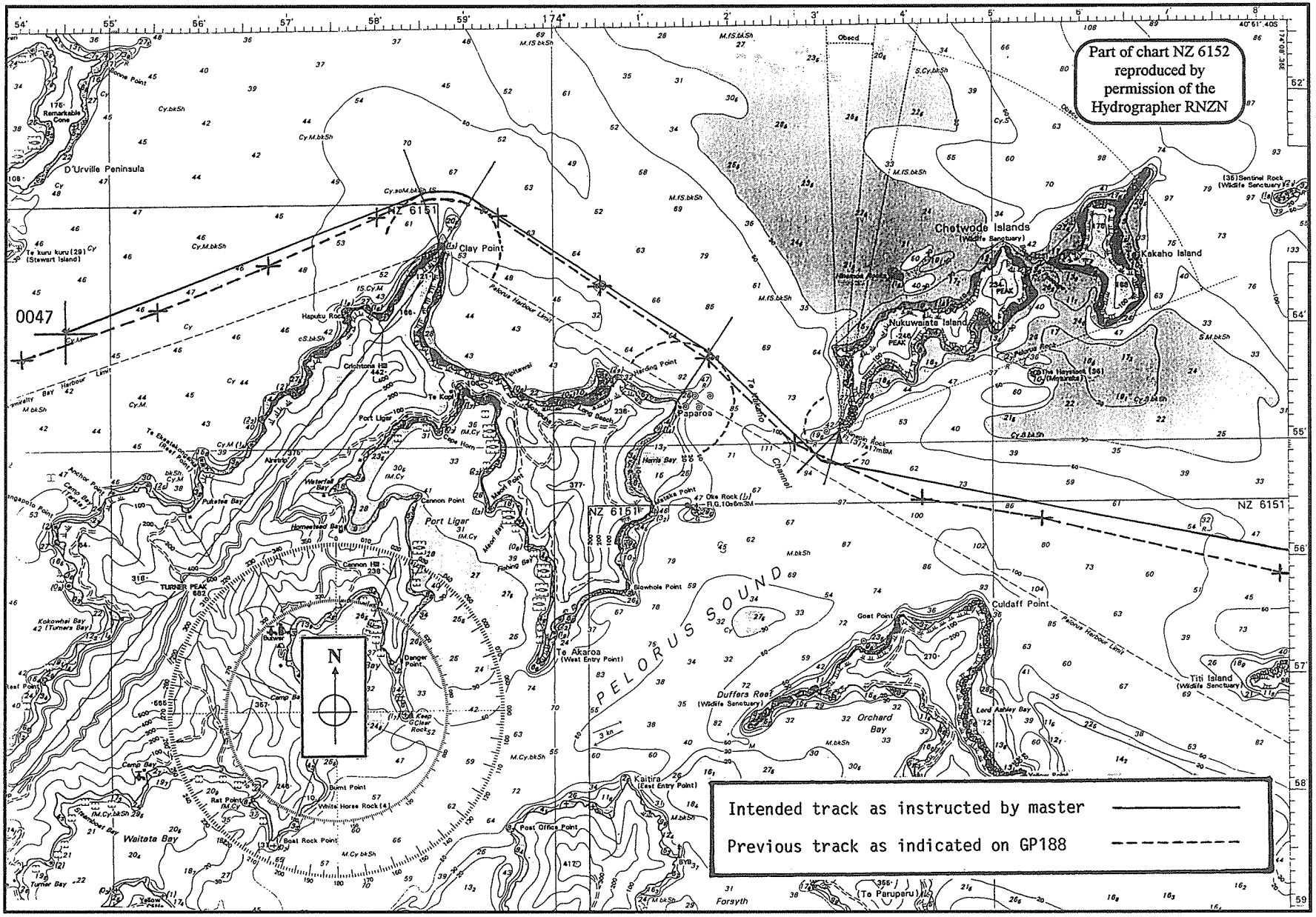


**Figure 1**
**Extract of chart NZ 6152 showing intended route**

# 1. Factual Information

## 1.1 History of the trip

1.1.1 The *San Rakaia*, a trawler owned and operated by Sanford Limited (the company), left Nelson at 2100 on 12 August 1998. The vessel was returning to the Cook Strait fishery via French Pass, having been in Nelson for repairs to its fishing equipment and to discharge a part load of fish.

1.1.2 Prior to departure from Nelson, the crew were engaged in preparing the repaired trawl gear for fishing in Cook Strait the following day. After letting go from the wharf, the crew returned to this task.

1.1.3 The master conned the *San Rakaia* out of Nelson. At about 2140, once the vessel was settled on passage, he instructed the mate that the deckboss and the deckhand were to stop work on the nets with the deckboss to report to the bridge and the deckhand to retire in order to take a bridge watch later. The mate and two general hands continued work on the nets.

1.1.4 The master passed the conduct of the vessel to the deckboss having satisfied himself that the deckboss was conversant with the position of the vessel, course and intended track and then retired at 2150. He left instructions that the deckboss was to call him if any problems were experienced and in any case to wake him when the vessel was at the entrance to Current Basin on the approach to French Pass.

1.1.5 The deckboss called the master at 2355 as the vessel entered the Current Basin. The master took over the conduct of the vessel at 2400. At 0010 on 13 August the deckboss woke the chief engineer, who then stood by in the engine-room for the passage through French Pass.

1.1.6 The master conned *San Rakaia* through French Pass, transiting the narrows at 0025, with the deckboss acting as lookout. Since leaving Nelson two generating sets had been running and for the transit of French Pass two steering motors were operating. Once clear of the narrows of French Pass, the master switched off one steering motor and instructed the chief engineer to reduce to one generating set. The chief engineer was then stood down.

1.1.7 At about 0035, the deckboss was released from the bridge watch and instructed to wake the deckhand. The deckhand arrived on the bridge at about 0040 and received a briefing from the master with regard to position, course and the intended track to Cook Strait. The deckhand charted the position of the vessel at 0047 (see Figure 1) using the latitude and longitude figures read out by the master from the global positioning system (GPS). The master double-checked the position by noting a sounding of 45 metres and the position of the vessel relative to Te kuru kuru Island on the port beam at a distance of about 0.75 nautical miles. No positions were charted subsequent to the 0047 position.

1.1.8 The intended track on which the master briefed the deckhand was that he should go around Clay Point keeping at least 0.5 nautical mile off, then pass Harding Point abeam to starboard keeping at least 0.5 nautical mile off and then pass Ninepin Rock abeam to port keeping at least 0.3 nautical mile off before proceeding onwards to Titi Island, Cape Jackson and the Brothers. (See Figures 1 and 2.)

1.1.9 The master asked the deckhand if he felt all right to stand the watch, to which the deckhand replied that he did. The master left the bridge and retired at 0050. He left instructions that the deckhand was to call him if any problems were experienced and in any case to wake him when the vessel arrived in the area of The Brothers light in about two hours time.

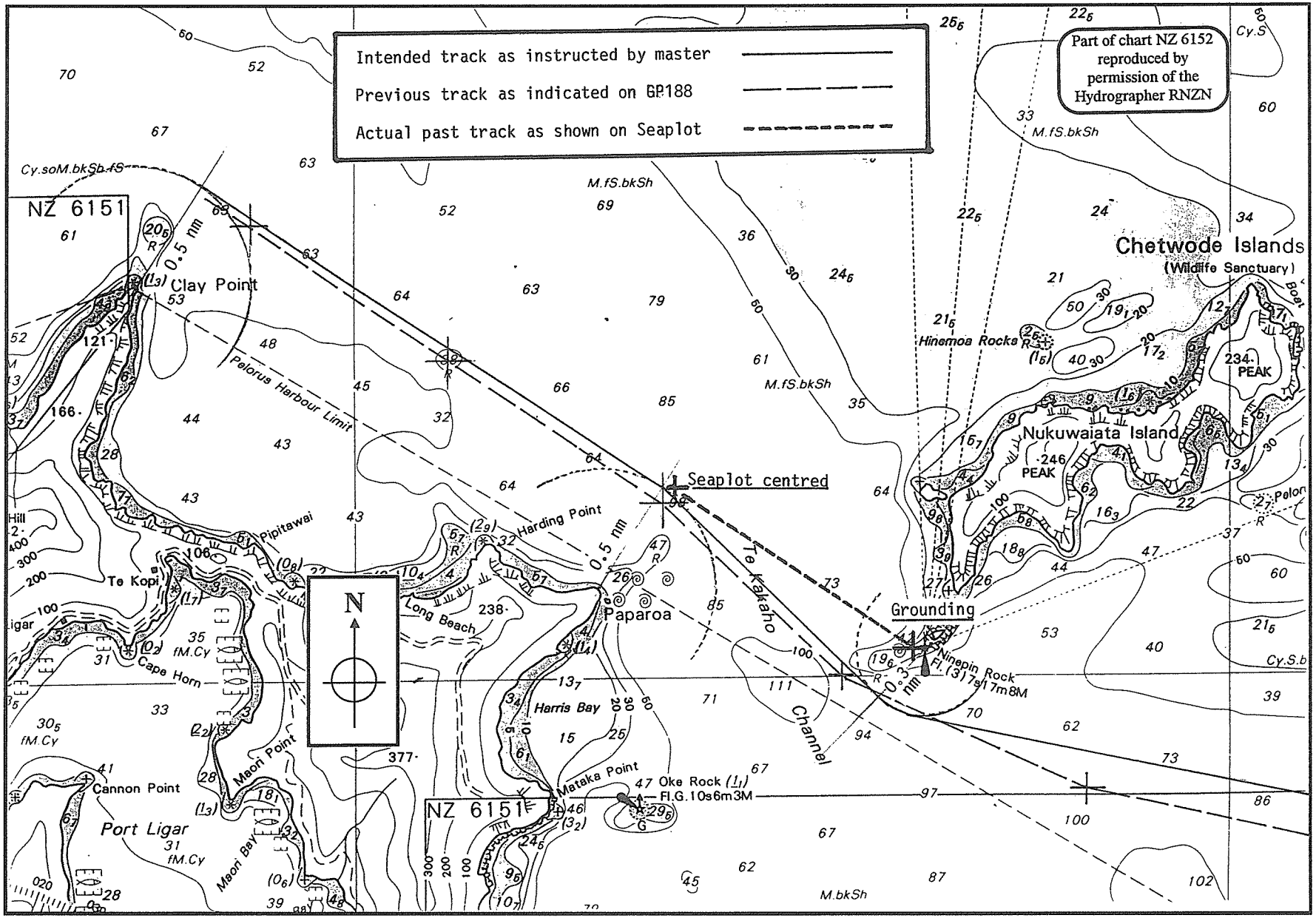


**Figure 2**
**Extract of chart NZ 6152 showing actual track to grounding**

1.1.10 The vessel was operating in autopilot steering. The radar was running and the master had left a variable range marker set at just under 0.5 nautical mile to assist the deckhand in keeping the minimum distances off the points of land. The Seaplot, an electronic chart display, was running and showed the area being navigated but no waypoints or courses were identified or displayed.

1.1.11 The GP188, a GPS plotter, showed the area being navigated but no waypoints and courses for the particular trip being undertaken were entered or displayed. The GP188 did however show the track of a previous passage that the vessel had made through the area and which conformed closely to the master's requirement. The record of the previous trip showed as a red line on the plotter and the master had told the deckhand that he should expect to be on or close to the displayed red line.

1.1.12 The deckhand conned the vessel using mainly the GP188 although he was observing the Seaplot and the radar. By placing the cursor of the GP188 on the next required alter course position, the deckhand was provided with a display showing the course and distance to go to that position.

1.1.13 The Seaplot showed relevant sections of navigational charts and the vessels position was depicted on the screen by a ship-shaped icon that moved across the chart. The vessels course line was shown on the chart projecting ahead of the icon. The vessels past track was recorded as a dotted line. The past track indication remained on the screen until such time as the display was "centred" to depict the area ahead as the passage progressed.

1.1.14 The deckhand conned the vessel around Clay Point, keeping at least 0.5 nautical mile off the land. He then placed the cursor of the GP188 on the next alteration position. He set the required course of 122 degrees on the autopilot. He observed that the vessel was close to the red line on the GP188 and that the position of the vessel and projected course shown on the Seaplot and the radar conformed with the instructions left by the master.

1.1.15 The course alteration position to which the deckhand was working was 0.5 nautical mile off Paparoa. In his briefing to the deckhand, the master had described this position as 0.5 nautical mile off Harding Point, but there was no confusion as both men had understood the reference to Harding Point to have actually meant Paparoa.

1.1.16 The deckhand had been walking around the wheelhouse in the early part of his watch but once past Clay Point he sat in the wheelhouse chair. From this position he was able to see the GP188, the Seaplot and the radar displays.

1.1.17 He said he remembers observing an indication on the GP188 that there was a distance to go to the alteration position of 0.3 nautical mile. He also remembers centring the Seaplot display "at some stage". The past track history depicted on the Seaplot, indicated that this centring was done at or about the intended alteration position off Paparoa (see Figure 3). The deckhand does not remember altering the course.

1.1.18 At about 0120 *San Rakaia* struck Ninepin Rock and grounded at the bow. The impact jolted the watchkeeper to full alertness and he instinctively pulled the engine control levers back to take power off the engine and reduce the pitch. The impact woke the master, who shouted up to the watchkeeper to take all power off the engine and he then ran to the bridge.

1.1.19 The master assessed the situation and realised that the vessel was hard aground at the bow. The remainder of the crew were instructed to take soundings around the vessel and to inspect the internal compartments to determine the extent of the grounding and any damage. The inspection showed that *San Rakaia* was still watertight and not leaking any oil but hard aground forward, over about one third of its length.

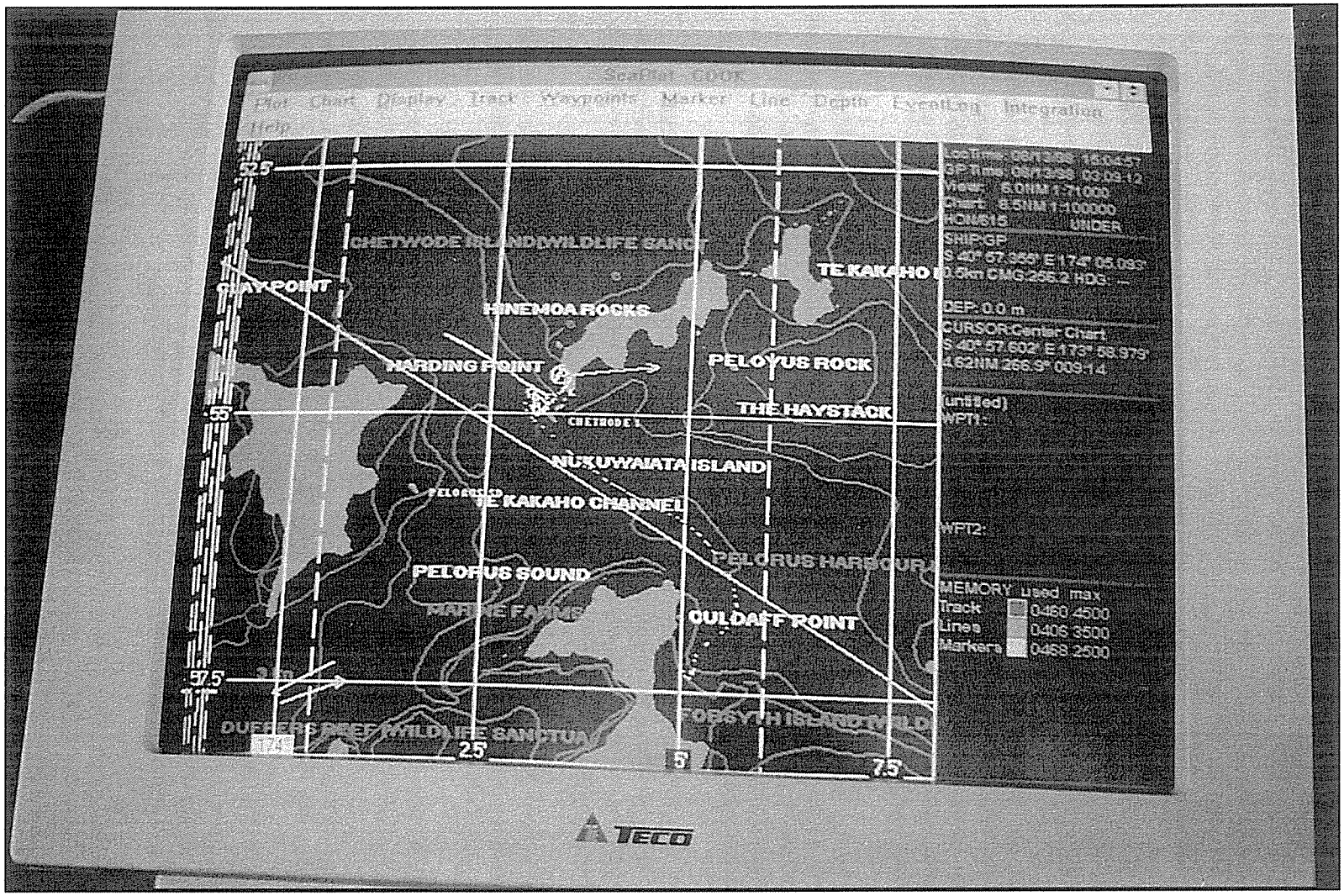


**Figure 3**
**Past track history as depicted on Seaplot Chart Monitor**

1.1.20 Using very high frequency (VHF) radio channel 16, the master advised D'Urville Maritime Radio of the grounding, the vessels position and status. He also advised the company management personnel by mobile telephone.

1.1.21 The vessel had grounded at about 0120 and high tide had been at 0027. The master realised that the falling tide would preclude any immediate attempt to refloat the vessel. He instructed the chief engineer to pump fuel from the forward tanks to aft tanks in case the hull should be penetrated as the vessel settled.

1.1.22 The company arranged an initial underwater inspection by divers, which confirmed that the vessel had suffered only minimal damage but appeared to have remained watertight. The assistance of other company vessels was arranged and the *San Rakaia* was refloated on the next high tide at about 1220 on 13 August. The vessel steamed slowly to Guards Bay and anchored for further inspection by divers and ship staff.

1.1.23 The weather at the time of the grounding was reported by the master and the deckhand to have been good with clear visibility. The weather comment in the vessels logbook for noon on 12 August simply said "calm". No logbook entry was made with regard to the weather for the evening of 12 August.

## 1.2 Voyage history

1.2.1 The *San Rakaia* had been employed fishing for orange roughy up to late July 1998. The master and mate rejoined the vessel after rotated time off, and several other crew joined the vessel in Napier on 1 August 1998. At this time the company instructed that the vessel was to proceed to the Cook Strait hoki fishery. The vessel had been bottom trawling for the orange roughy and the hoki required mid water trawling which necessitated a change of trawl equipment.

1.2.2 On completion of discharge of the orange roughy catch, the vessel left Napier at about midnight on 1 August and proceeded to Wellington arriving at 2300 on 2 August. While on passage, the crew had commenced the operation of changing the trawl equipment with the limited amount of gear that was already on board. An appropriate net had been transported to Wellington to await the arrival of *San Rakaia*.

1.2.3 In Wellington the mid water trawl net was loaded aboard and fitted. Also loaded were the fish storage bins that were to be used for hoki. During the port stay one general hand left the vessel and another joined. The *San Rakaia* was ready for hoki fishing on 3 August and departed Wellington at about 1430 that day for the Cook Strait fishery.

1.2.4 *San Rakaia* remained in the Cook Strait fishery until 0600 on 6 August at which time the vessel had a full load. The net had been shot 12 times for varying size catches totalling 84.5 tonnes. The master had experienced problems with the electronic net monitor which made the fishing more difficult than usual and longer than normally expected.

1.2.5 The company instructed that the catch was to be delivered to Timaru, where the vessel arrived at 0600 on 7 August. The catch was discharged during that day.

1.2.6 During the port stay, several crew changed. On 7 August the regular deck boss returned, relieving the temporary deck boss. Two general hands also left the vessel that day. On 8 August two new general hands were employed and the chief engineer was relieved. *San Rakaia* stayed in Timaru until 1800 on 8 August because the incoming relief chief engineer was delayed. While in Timaru, the crew were employed for about 3 hours each day on routine maintenance of the vessel and trawling equipment.

1.2.7 Also during the Timaru port stay an electrical technician was employed to service the net monitor that had been malfunctioning during the fishing in Cook Strait. Although some faults were found, no spare parts were available and the technician adjusted the unit as best he could.

1.2.8 On the way back to the Cook Strait fishery, the master suspended the passage at the Pegasus fishery off Banks Peninsula at about 0500 on 9 August. He spent some time searching for marks and shooting the nets but by 1400 had not located any hoki, so he proceeded on to the Cook Strait.

1.2.9 *San Rakaia* arrived at the Cook Strait fishery and the net was first shot at about 0200 on 10 August. The master had continuing problems with the net monitor and although he shot the net several times, caught little or no fish. He contacted the company and ascertained that a replacement monitor was available in Picton. At about 0800 he left the fishery and proceeded to Picton.

1.2.10 The *San Rakaia* arrived in Picton at 1230, picked up the replacement net monitor and departed at 1300. The new net monitor was fitted and *San Rakaia* arrived back at the fishery at about 1700 and commenced fishing immediately.

1.2.11 The net was shot twice during the evening of 10 August for a total of 31 tonnes. The net was shot again at about 0200 on 11 August. When hauling the net back aboard, one side of the main warp parted. The tangled equipment and net, together with about 16 tonnes of fish, took until about 0700 to retrieve. The master then proceeded to Nelson for repairs to the trawl and to discharge the part load of fish. *San Rakaia* arrived in Nelson at 1830 that evening and berthed at McGlashon wharf.

1.2.12 None of the crew felt inclined to prepare a meal on board after the long and arduous day, so at about 1900, they all went ashore for a meal and drinks at a local restaurant. The deckhand said that he had consumed four beers with his meal and had left the restaurant at about 2300, walked back to the vessel by about 2330, while the others remained ashore until various times between 0100 and 0200 on the morning of 12 August.

1.2.13 The crew commenced work at about 0630 on 12 August to assist the local rigging company remove the broken equipment. The vessel was shifted to the company wharf at about 1000 for discharge of the fish, which took until about 1800. Repairs to the trawl equipment continued throughout the day, although each of the crew was given some time off to go ashore and attend to personal errands.

1.2.14 By early evening the repaired warp was in place and two new nets had been put on board. Work continued readying the equipment for fishing.

1.2.15 At about 1900, the skipper, mate, deckboss and engineer took some time off and went to a nearby bar where they reportedly had two beers each. They returned to the vessel at about 1945. During this time the deckhand and two general hands continued work on the nets, but took a short break for a meal.

1.2.16 Due to tidal limitations at the company wharf in Nelson, *San Rakaia* did not depart until 2100 on 12 August.

## 1.3 Company and vessel routines

1.3.1 It was the policy of the company to appoint each master and leave the selection of crew to them. However the company had input regarding the appointment of the chief engineer and also retained the right to veto the employment of any individual.

1.3.2 The company did not pay wages or salaries but instead each of the crew received a percentage of the value of the catch. Thus earnings were directly proportional to both the quality and quantity of fish caught.

1.3.3 The vessel was operating under a Marine & Industrial Safe Ship Management system. Additionally the company had the following policy procedures in place:

- instructions to masters
- watchkeeping
- stability
- bilge/fishroom pumping
- discharges procedure
- shipboard marine oil spill contingency plan
- hazard document.

1.3.4 The company laid down that it was the duty and responsibility of their masters to understand and be totally familiar with all relevant laws, regulations, rules and notices which affected their vessel and the fishing activities which they were undertaking at any time.

1.3.5 It was the responsibility of the master to:

1. Properly and adequately supervise the vessel and its crew;
2. Implement instructions;
3. Ensure compliance with legal requirements;
4. Report maintenance and vessel requirements;
5. Generally maintain safe navigation and seamanship practices on board and ensure that crews are provided a safe working environment.

Should any uncertainty arise, it was the master's responsibility to contact the company for clarification. Instructions to this effect appeared frequently throughout the Instructions to Masters manual.

1.3.6 The guidelines given by the company in the Instruction to Masters were divided into four categories:

a) General Management;
b) Navigation;
c) Collision Avoidance;
d) Fishing Operations.

1.3.7 The company instructions and guidelines supplied to masters were extensive in their scope and placed the responsibility for the operation of the vessel with regard to safety and legislative requirements with the master. The terminology of the instructions and guidelines was to give the master a required result rather than to give specific instruction as to how that result should be achieved. Each of the company masters could have differing yet satisfactory individual methods of achieving the same ends.

1.3.8 The master's standing orders, which were posted on the bridge, were as follows:

- Keep a good lookout
- Keep at least 3 miles off all land, unless specific orders allow
- When changing watch indicate to oncoming watchkeeper
  - our ships position on chart
  - our course and speed
  - any other vessels within 15 miles and their movements
  - night orders
- If alarm rings call engineer or master as appropriate

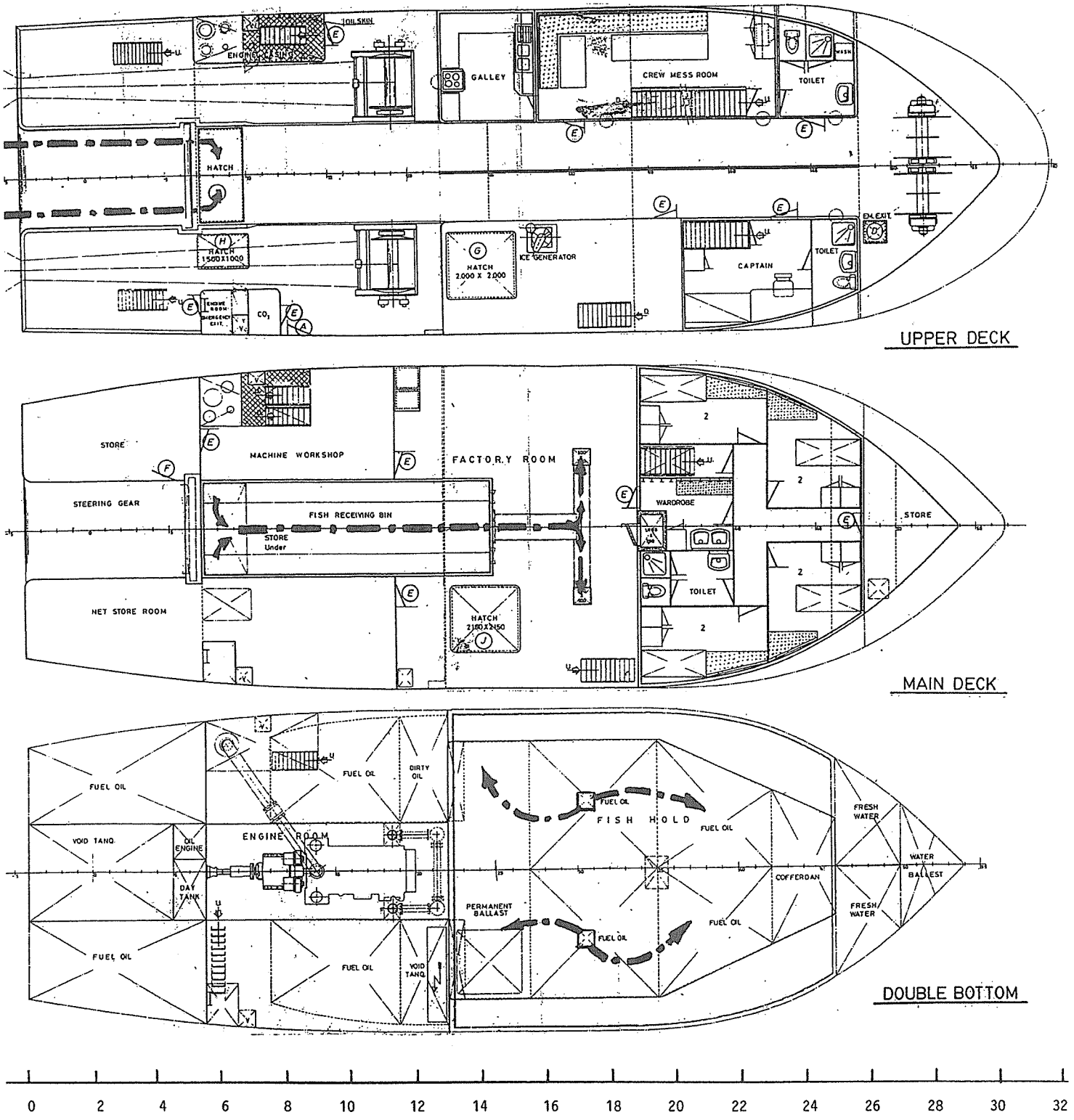


**Figure 4**
**General arrangement of *San Rakaia***

- Call master if
  - unsure of our position
  - unsure of another vessels intentions within 6 miles of us
- Change radar ranges occasionally 6 < > 12 < > 24
- Check factory deck and engine at change of watches - besides video check
- Plot position on chart every hour
- When closer than 6 miles from land plot position every 20 minutes
- In restricted visibility reduce speed if radar reception impaired. Call another lookout if necessary
- Do not leave the bridge unattended, especially when within 5 miles of coast, in restricted visibility or vicinity of other traffic. Call master or another watchkeeper if necessary
- Remove steering from Nav mode when within 2 miles of another vessel, if on auto be ready to go to manual before a close quarters situation can develop
- Maintain a listening watch on Channel 16 VHF.

1.3.9 *San Rakaia* carried a crew of seven comprising master, mate, chief engineer, deckboss, deckhand and two general hands. With regard to bridge watchkeeping, the master used himself, the mate, the deckboss and the deckhand. One of the general hands was suitably qualified to stand a watch but was new to the vessel and unknown to the master. The chief engineer was also suitably qualified to stand a bridge watch but the master preferred his work time to be fully utilised on engineering tasks.

1.3.10 There was no set watch routine. The master generally kept the majority of daylight bridge watch and was mostly alone on the bridge during shooting or hauling nets. The other watchkeepers were assigned watches, usually of two to three hours duration, depending on circumstances and which of them the master thought to be most rested.

## 1.4 Fishing operations

1.4.1 Using echo-sounding equipment, shoals of fish were found and "marked". The vessel was then manoeuvred to the appropriate position and the net shot over the shoal. The master was normally on the bridge alone during this operation with the mate, deckboss, deckhand and two general hands handling the trawl equipment. The net monitor was a crucial item of equipment used to properly position the trawl to maximise the catch.

1.4.2 The crew waited on deck during the initial trawling operation. When the net was recovered the catch was emptied from the net into the fish receiving bin. The trawl net was readied again and might be shot if the "mark" was still active. Alternatively the master might have had to search for another "mark". Meanwhile the crew commenced stowing the catch.

1.4.3 The fish was moved, via a hatch in the forward end of the receiving bin, to the factory room, where the target species, in this case hoki, was separated from other species (the by-catch). The hoki was handed either to port or starboard and down through a hatch into the fish hold. From the hatch, the fish landed onto a work table and was placed, together with ice, into plastic bins for storage. The by-catch was temporarily stowed in the factory room for stowage in the fish hold later. (See Figure 4.)

1.4.4 The filled bins, each holding 27 to 28 kilos of fish, had to be manhandled throughout the fish hold and stacked between retaining pond boards. The hold was 12 m long, 9.5 m wide and 3.25 m deep, making the stowing of the catch a physically demanding task. There was no mechanical assistance available in the fish hold to reduce the workload. At the time of the grounding a conveyor system for *San Rakaia* was at the design and discussion stage.

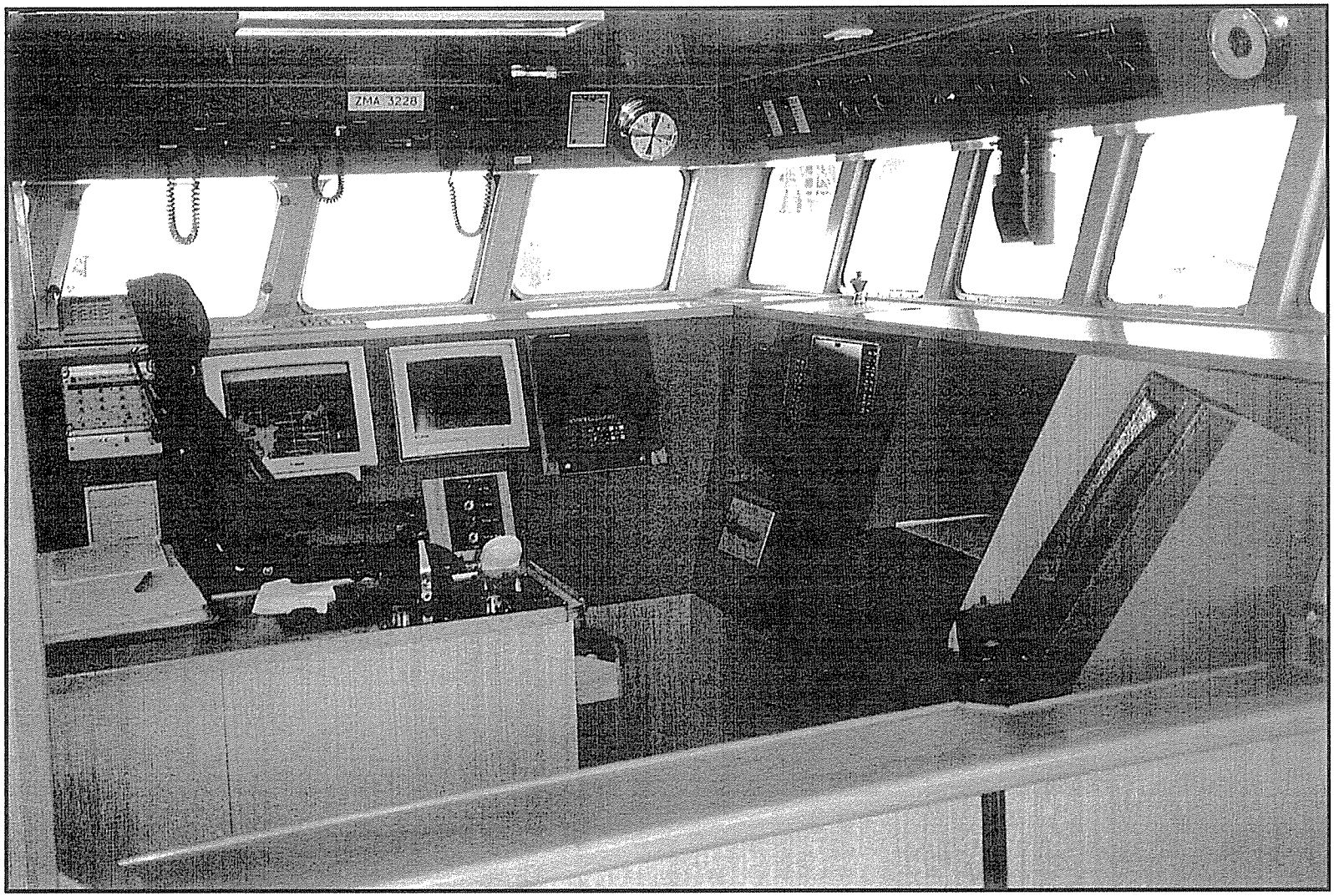


**Figure 5**
**View of the wheelhouse of *San Rakaia***

1.4.5 The plastic bins, specifically used for hoki, were stowed four high before a false decking was placed on top and then a further stack of four bins was stowed. A complete stow of hoki consisted of about 3000 bins up to 14 high. The master stated later that he considered between 2700 and 2850 bins to be a normal load.

1.4.6 When fishing for hoki in the Cook Strait fishery, the catch was landed at either Nelson or Timaru dependent on company requirement for the distribution of each catch.

## 1.5 Personnel information

1.5.1 Under the Shipping (Manning of Fishing Boats) Regulations 1986, the minimum manning of *San Rakaia* was master, mate and three others of which two must be qualified fishing deckhands. If the master did not hold an engineering certificate then one other of the crew must do so. Under the safe ship management system in operation, the normal manning was master and five crew.

1.5.2 At the time of the grounding and under normal conditions, the *San Rakaia* had a crew of seven comprising master, chief engineer, mate, deckboss, deckhand and two general hands. Although the company was the crew's employer, the master selected the crew and he normally recruited those familiar to him. The master, mate and deckboss had sailed together regularly on *San Rakaia*. The relief chief engineer and the deckhand were both known to the master. The two general hands who had just joined in Timaru on 8 August were temporarily employed to make up numbers.

1.5.3 The master held certificates of competency as Skipper of a Deep Sea Fishing Boat and First Class Diesel Trawler Engineer. He had been employed by various operators in the fishing industry since 1977 and then exclusively on Sanford vessels from 1992. He had been master of *San Rakaia* since May 1997 when the company took delivery of the vessel.

1.5.4 The deckhand held a Commercial Launch Masters Certificate. He had been at sea since 1969, initially in the United Kingdom, having his own fishing vessel from 1985 until 1991, after which he emigrated to New Zealand. He had worked for various operators and then exclusively on Sanford vessels from 1995, mostly as deckhand but sometimes as relief mate in coastal operations.

1.5.5 The deckhand was making his first tour of duty on *San Rakaia* but had regularly sailed for the previous two years on *San Vestman*, a similar class of vessel. Much of the bridge equipment was common to the two vessels and he was conversant with its operation. While serving on the *San Vestman* he had frequently kept watch on the passage from Nelson to Cook Strait and was familiar with the general area. He and the master had sailed together on *San Vestman* when the master was relieving on that vessel.

## 1.6 Vessel information

1.6.1 The *San Rakaia* was 32 m stern trawler constructed in steel and powered by one 1051.5 kW Caterpillar diesel engine driving via a reduction gearbox a single controllable-pitch four bladed propeller. The vessel was part of the company ice vessel fleet.

1.6.2 The fish hold of *San Rakaia* was of simple design, being a basically square hold with pond board divisions to secure the stowed catch. Depending on the species targeted, the catch was stowed either in bulk with a mixture of fish and ice retained behind the pond boards or in bins between the pond board divisions. Hoki was required to be stowed in bins, which were shifted around the hold by hand as there was no mechanical assistance in the form of a conveyor system. The crew were able to stow the catch a rate of about 3 tonnes per hour. (See Figures 4 and 6.)

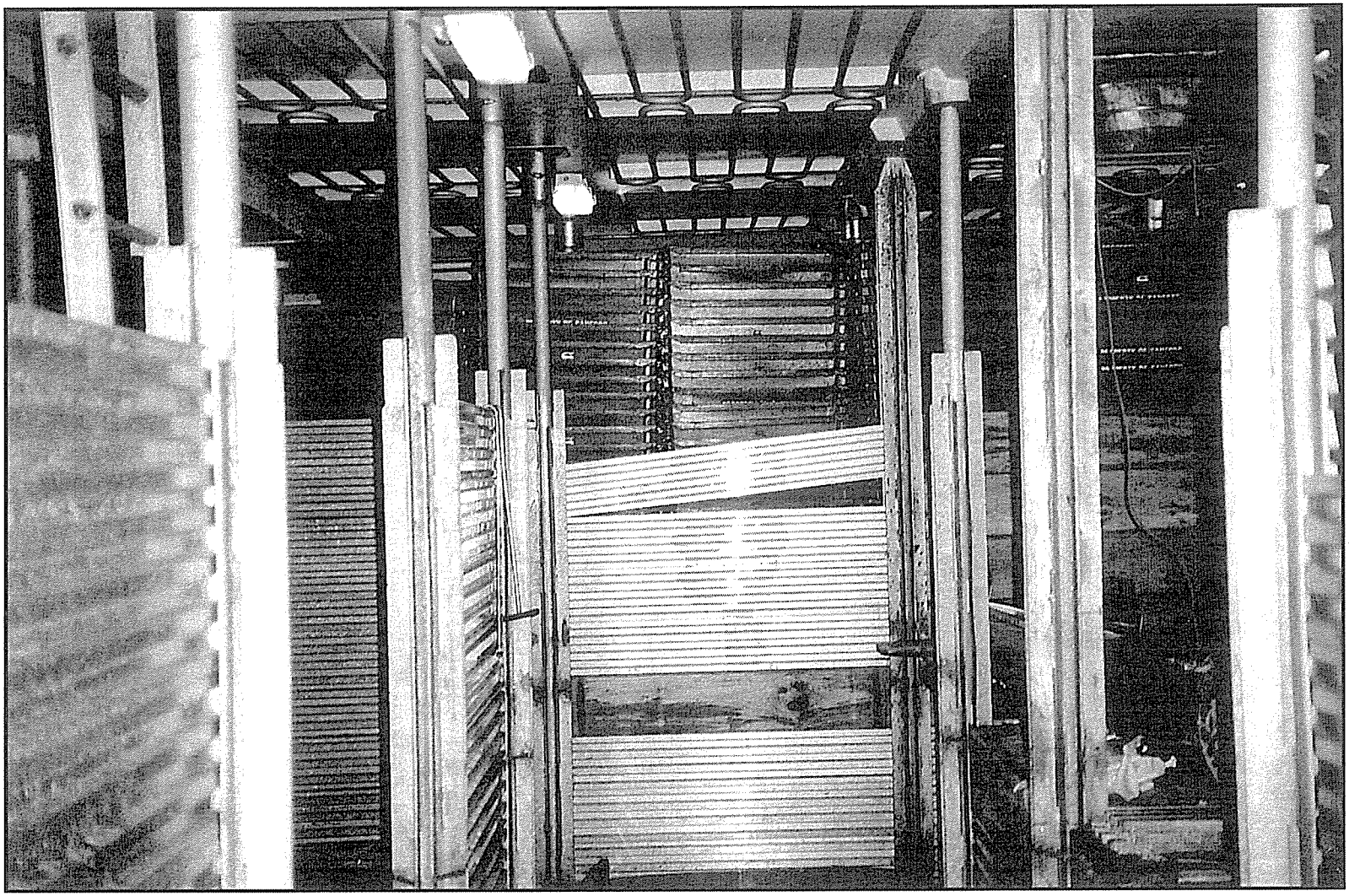

**Figure 6**
**View of fish hold of *San Rakaia***

1.6.3 Bridge equipment included:

- Radar FR 2110 20 inch. Daylight screen
- GP188 GPS plotter
- Seaplot electronic chart monitor
- RGC50 gyro compass
- CN22 net monitor.

1.6.4 The wheelhouse was laid out to give the watchkeeper clear vision forward and to either side. The items of navigational equipment were mounted on the insides of a central console, around which there was a walkway. Positioned centrally in the console were the engine and steering controls with a wheelhouse chair beside them. The chair was located such that the controls and the navigational aids were within easy reach should the chair be used by the watchkeeper. (See Figure 5.)

1.6.5 The GP188 GPS plotter was capable of being programmed for a specific passage with required waypoints, courses and distances being entered. The data for frequently transited passages could be stored on a computer disk and utilised whenever required. The unit could be programmed to alert the watchkeeper when the vessel was at a pre-determined distance away from a waypoint course alteration or if the vessel had deviated from the planned route.

1.6.6 The Seaplot chart monitor was similarly capable of being programmed with passage information and alarm features to alert the watchkeeper to errors of navigation.

1.6.7 The radar was of the "daylight viewing" type, with a video-like monitor that had vertical orientation. The screen was visible from the conning position being to starboard and forward of the chair. It was possible to set guardzones at pre-set distances such that any radar target coming within the set distance would produce an audible alarm.

1.6.8 The bridge was designed for one person operation, but was not fitted with a single-handed-watchkeeper monitoring alarm system (deadman alarm). Under such a system a watchkeeper must periodically reset a timed alarm. Should the watchkeeper fail to do so, an audible alarm would sound. If that alarm was not acknowledged by the watchkeeper, the alarm would be transferred to another position to alert other personnel.

## 1.7 Fatigue

1.7.1 There are varying definitions for fatigue and no universally accepted one. The extent to which any individual may be affected by a given set of circumstances will vary. The definition most widely accepted by the shipping industry was that used by the International Maritime Organisation (IMO), namely:

> A reduction in physical and/or mental capability as the result of physical, mental or emotional exertion which may impair nearly all physical abilities including strength; speed; reaction time; co-ordination; decision-making, or balance.

1.7.2 The IMO International Convention on Standards of Training, Certification and Watchkeeping, 1995 (STCW-95) prescribes specific minimum hours of rest for watchkeepers. STCW-95 does not apply to fishing vessels. However, the IMO International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel, 1995 (STCW-F) requires watchkeeping in the deck department to be arranged so that personnel are not impaired by fatigue but no minimum hours of rest are prescribed.

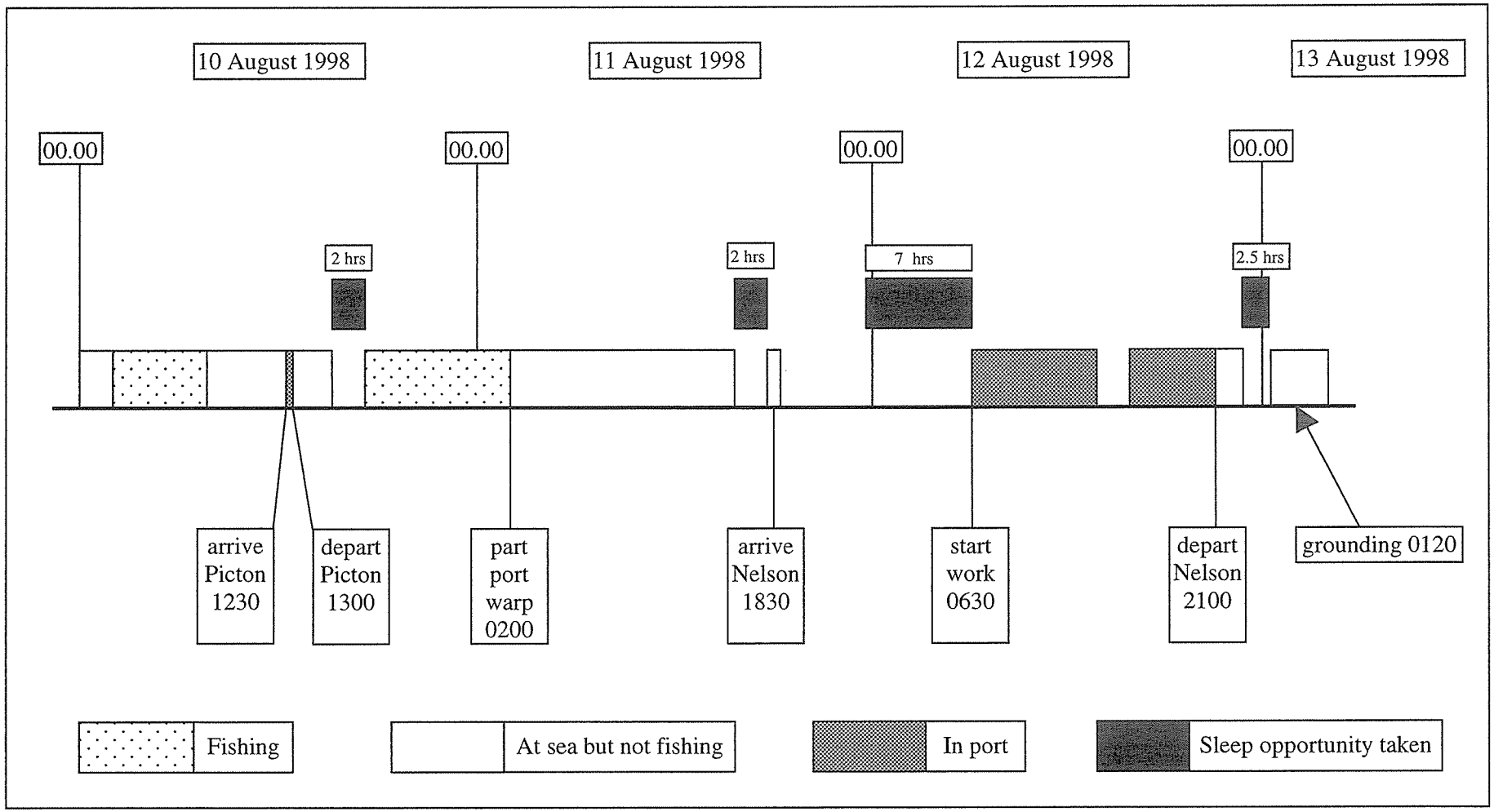


**Figure 7**
**Deckhand's duty history for the 72-hour period before the grounding**

1.7.3 At the time of the grounding, a discussion paper on Seafarer Fatigue in the New Zealand Shipping, Offshore Servicing, Restricted Limits and Fishing Industries, issued in May 1998 by the Maritime Safety Authority, was circulating around the New Zealand shipping community for comment. The objective of the paper was to provoke discussion on how best to manage the risk of fatigue among seafarers on New Zealand ships.

1.7.4 It was expected that legislation would be passed in New Zealand in the form of Maritime Rules to manage and combat the effects of fatigue. In July 1998 the company circulated the discussion paper and a memo to all crews around their fleet inviting comments and suggestions from sea staff for consideration by themselves and the Maritime Safety Authority.

1.7.5 The company management had earlier recognised that fatigue was a potential problem within the fishing industry and section 4 of their watchkeeping guidelines to masters stated:

> Fitness For Duty
>
> The watch system shall be such that the efficiency of the watchkeeper is not impaired by fatigue. Duties shall be so organised that the first watch at the commencement of a voyage and subsequent relieving watches are sufficiently rested and otherwise fit for duty.

1.7.6 As with other company requirements, and in common with the STCW-F, there were no specific instructions given to detail how masters were to ensure that watchkeepers were adequately rested. There were no minimum rest periods or maximum hours of work prescribed.

1.7.7 When fishing, the master required all of the crew either handling the trawl equipment or stowing the catch, which did not allow him to have one watchkeeper resting while fishing operations were in progress. He therefore had to select watchkeepers on the basis of which of those available had been most rested and then instruct the others to rest in preparation for subsequent watch periods.

1.7.8 The watchkeeper who was on the bridge on arrival at a fishery would call the master at a pre-arranged time or position. When the master took over the bridge to commence fishing, the watchkeeper was then required to work with the other crew, initially on the trawl equipment and then stowing the catch. During busy periods, the rotation of crew duty and rest periods was a difficult task to balance for both safety and fairness.

1.7.9 Whatever the targeted species and method of stowage, the work involved in stowing the catch was physically demanding and time consuming. With hoki, the catch had to be first placed with ice in bins and then moved through the fish hold manually to the stowage position. The rate of stowage of hoki was estimated to be about 3 tonnes per hour.

1.7.10 Additional to the normal fishing operations, the work involved in the recovery, sorting and repair of the damaged trawl equipment was physically demanding.

1.7.11 Figure 7 shows a duty history for the deckhand during the 72-hour period before the grounding. Working times are indicated by shaded blocks showing times of various tasks. Times of fishing are indicated separately. The periods when the vessel was at sea but not fishing include tasks such as watchkeeping, stowing the catch, retrieving the damaged trawl, clearing and cleaning decks, and food preparation. Gaps in the block diagram indicate where off-duty periods were granted but the sleep opportunities taken within those periods are shown above the baseline.

1.7.12 An individual is often the worst judge of their own tiredness which may explain why the deckhand told the master that he felt all right to stand the watch. However, he later stated:

> "I can only conclude that I must have been more tired than [I was] aware, and I must have dozed off for a few minutes, which I can only put down to lack of sleep over the previous three days and the strenuous work involved in casing hoki in the fish hold and the repair of our damaged fishing gear."

### 1.8 Fatigue study information

1.8.1 There is considerable scientific evidence, from workplace and laboratory studies, to indicate that work-related fatigue has three main causes:

1. how long and how hard a person works (time-on-task fatigue and workload)
2. inadequate sleep
3. working and sleeping at inappropriate times in the daily cycle of the circadian biological clock.

1.8.2 To be alert and able to function well, each person requires a specific amount of nightly sleep, the average for an adult being seven to eight hours. If the individual "sleep need" is not met, the consequences are increased sleepiness and impaired performance. For most people, getting two hours less sleep than they need on one night produces an acute sleep loss and is enough to consistently impair their performance and alertness the next day. The reduction in performance is particularly marked if less than five hours sleep is obtained.

1.8.3 Short sleep would usually means long periods of time awake. Laboratory studies consistently show that the longer a person stays awake, the sleepier they become and the more slowly and inaccurately they perform any type of work.

1.8.4 The effects of several nights of reduced sleep accumulates into a "sleep debt", with sleepiness and performance becoming progressively worse. Recovery of the lost hours of sleep need not be on an hour-for-hour basis but it typically takes two good nights sleep to return to normal after sleep loss.

1.8.5 Sleep is not equally possible across the 24-hour day. How quickly a person can fall asleep and how long they remain asleep are regulated by their circadian clock. This can be visualised in terms of competing sleep and wake "drives". The sleep drive is highest in the early hours of the morning when the urge to fall asleep is most overwhelming and can be completely uncontrollable. There is a secondary increase in the sleep drive in the mid-afternoon. The wake drive is highest towards noon.

1.8.6 This in-built variation in sleep propensity means that daytime breaks provide less opportunity for sleep than night-time breaks of the same length. Additionally, environmental factors that can disturb sleep, such as light and noise, are often greater during the day. In order to better simulate night-time conditions, the crew cabins on *San Rakaia* had no portholes. The cabins were also positioned as far as practicable from the engine-room to reduce the noise level.

1.8.7 Not only the amount of sleep but also the quality of sleep can have important effects on wake-time functioning. Sleep that is restless and fragmented by frequent awakenings leaves a person sleepy and at increased risk of making errors. Sleep can be disrupted by a wide variety of factors including physical sleep disorders and other health problems, changing work and rest schedules, poor sleep habits and ill-informed attitudes about increasing wake-time activities by cutting back on sleep.

1.8.8 Environmental factors can have an important effect on sleep quality. For crew sleeping on board such factors as noisy or cramped quarters and rough sea conditions can be expected to reduce sleep quality.

## 2. Analysis

2.1 The nature of a fishing operation makes the master's task in predicting work patterns difficult. In the case of *San Rakaia* all the crew were required when fishing; employed either in handling the trawl equipment or stowing the fish. The length of time taken to fill the vessel was always an unknown factor with the trawling times and size of each haul being unpredictable.

2.2 The master had chosen a crewing level of two above legislative minimum requirements and one over safe ship management normal level. In addition to qualification requirements he also had to ensure the complement was sufficient for the fishing operations and to provide a maximum number of potential watchkeepers. An additional general hand would have given the master greater flexibility in rotating his qualified watchkeepers.

2.3 The remuneration arrangement also coloured the masters decision on crewing levels. With payment made only as a percentage of the value of the catch and shared proportionally among the crew, any additional crew numbers meant a reduction in pay for all. In this respect the master discussed with the crew the crewing levels for each fishery to achieve what was perceived as an appropriate balance between allowable minimums and physical operational requirements.

2.4 The remuneration arrangement put pressure on the master and his crew to keep port times to a minimum, maximising the time at the fishing grounds and filling the vessel as fast as possible with high quality fish. Although restricted by quotas, it was nevertheless true that crews earned more money by filling the vessel with quality fish as quickly and as often as possible. The value of the catch would be maintained by the proper and efficient stowage of the catch.

2.5 Since rejoining the vessel in Napier the master had experienced equipment problems which increased the number of trawl shots and the time taken to fill the fish hold when first at the hoki fishery. Although hauling small quantities of fish each time while the net monitor was not functioning properly, the workload on the crew was not necessarily diminished but arguably increased, although spread over a longer period of time. For a given tonnage of fish, for example the 84.5 tonnes discharged at Timaru, the work involved in stowing the catch remained the same. If, as in this case, 12 hauls were required rather than, say, 6 larger hauls, the additional handling of the trawl equipment increased the workload.

2.6 Having had the net monitor serviced in Timaru, the master attempted to make up the catch by trying the fishing grounds at Pegasus on the way back to Cook Strait. Although this resulted in no fish being caught, the crew nevertheless were involved with handling the trawl equipment.

2.7 Once back at the Cook Strait fishery, the trawl was shot several times, each for little or no fish. The crew were again required to work lengthy hours handling the trawl. Continuing problems with the net monitor forced the master to abandon fishing and proceed to Picton for a replacement monitor.

2.8 The replacement worked well with reasonable catches being hauled. However, once the trawl warp parted the crew worked extended hours engaged in the difficult task of recovering the tangled heavy equipment and then completing the stowage of the catch while on passage to Nelson. After the catch was stowed they continued working to clear and clean the deck area to expedite the repairs in Nelson the following morning.

2.9 The hours worked by the whole crew were extensive and the work was physically demanding. The duty history, shown in Figure 7, has been compiled for the deckhand because he was on watch at the time of the grounding. However, the master stated later that the deckhand had done no more work or watches than any of the other crew. If this were the case, then it is possible that they could have been experiencing similar acute and cumulative sleep debts.

2.10 The master had no established routine of selecting which of the crew would take navigational watches when steaming to and from the fishing grounds. As a consequence, none of the available watchkeepers had adequate advance warning of a forthcoming watch schedule.

2.11 As the vessel approached a fishery, the crew member standing the last watch prior to arrival at the fishing grounds was then expected to continue work on the trawl equipment. It would have been prudent practice for the master to ensure that that crew member was adequately rested before taking the watch or that his services were not required on the initial shot of the net.

2.12 As the fishing progressed and the fish hold was approaching capacity, it would have been prudent for the master to have selected one of the crew to be the first watchkeeper on the passage away from the fishery and to have stood him down in order to rest prior to taking that watch.

2.13 When *San Rakaia* arrived in Nelson for repairs, all of the crew had worked long hours and were understandably disinclined to prepare themselves an evening meal. A period of relaxation having a meal and drinks together ashore was probably beneficial. However, with the knowledge that they had an early start the next day, it would have been appropriate to have spent less time ashore.

2.14 The master and other crew members had gone ashore to a bar before departure from Nelson. The quantity of alcohol that they were said to have consumed was unlikely to have affected their performances. However, the reduction of manpower on the net repairs meant that the task extended longer than would otherwise have been necessary and involved the deckhand, who was on watch at the time of the grounding, in what might have been unnecessary work after departure from Nelson.

2.15 The master decided on a departure time from Nelson of 2100 due to tidal limitations at the berth. That decision had been made well in advance of the completion of both the repairs and the discharge of the catch. The master had allowed each of the crew some time off during the day to go ashore to attend to personal errands but it would have been prudent for him to have nominated his watchkeepers for the night and stood them down in sufficient time to have been properly rested.

2.16 In view of the extended hours and hard work undertaken by the crew, the master might have considered delaying departure until the following morning in order to rest the entire crew. However, the remuneration system under which the master and crew worked added pressure to return to the fishery as soon as possible to make up the earnings they had lost through the mechanical problems encountered.

2.17 When asked by the master if he felt all right to stand the watch, the deckhand said that he did. Even had he felt too tired, he was reluctant to refuse to take the watch because he felt that his continued employment on the vessel was dependent on the goodwill of the master.

2.18 Had the deckhand not been willing to take the watch he would have known that all of the other crew members had similar duty histories and were likely to have been equally as tired as himself.

2.19 The deckhand plotted the position of the vessel at 0047 when taking over the watch. Thereafter he relied upon the electronic navigational aids and did not plot another position on the chart. Under the masters standing orders he should have been plotting a position every 20 minutes because the vessel was operating within six miles of land. Had he plotted another position 20 minutes after the first one, he would have had to have moved from the wheelhouse chair which might have kept him more alert to the impending requirement to alter course.

2.20 *San Rakaia* was employed on the hoki fishery and the master expected to be in that region for some time and to discharge the catches in either Timaru or Nelson. The master's requirements for those two passages could have been programmed into both the GP188 and the Seaplot. Both those units would then have had safety defences programmed to alert the watchkeeper to the approach to waypoints or to any deviation from the passage plan. Had these defences been in place, either unit might have woken the watchkeeper in time to avert the grounding.

2.21 The grounding occurred at about 0120. At this time of day, the physiological urge to fall asleep is rapidly increasing in strength. This effect is intensified if a person is already carrying a sleep debt.

2.22 After his drinks and meal ashore in Nelson, the deckhand had given himself the opportunity to sleep from 2330 on 10 August until sometime before he had to start work at about 0630 on 11 August. His consumption of alcohol before sleeping could well have affected the quality of his overnight sleep.

2.23 The deckhand had been on watch for 40 minutes at the time of the grounding. Before taking the watch he had the opportunity to sleep for about 2.5 hours, before which he had been awake for about 15.5 hours.

2.24 It was not clear exactly how much sleep and of what quality he obtained in these two breaks. At best, if he had slept well and continuously, he would have had about 7.5 hours of sleep in the 24 hours before the grounding. On the assumption that he needed 8 hours sleep at night to be well rested, he was experiencing the effects of an acute sleep debt of about half an hour.

2.25 The acute sleep debt would be greater if the quality of his sleeps had not been good or if they had been disturbed by environmental factors such as noise or movement of the vessel.

2.26 In the 72 hours before the grounding, the deckhand had accumulated, at best, about 13.5 hours of sleep. Of this, about 4 hours was during daylight hours. On the assumptions that he had slept well and continuously on each occasion and that he needed 8 hours of sleep at night to be well rested, the deckhand was experiencing the effects of a cumulative sleep debt of at least 10.5 hours.

## 3. Findings

The findings and safety recommendations are listed in order of development, and not in order of priority.

3.1 At the time of the grounding *San Rakaia* was crewed above minimum requirements of the Shipping (Manning of Fishing Boats) regulations 1986 and above the normal complement stated in the safe ship management system in operation for the vessel.

3.2 The crew of *San Rakaia* were appropriately certificated for their respective positions on board and the overall requirement for number and grades of certificates was met.

3.3 The deckhand on watch at the time of the grounding was qualified to have charge of a navigational watch.

3.4 The deckhand on watch at the time of the grounding was familiar with the general area being navigated and conversant with the operation of the navigational aids available to him.

3.5 The GP188 plotter and the Seaplot chart monitor were not utilised to their full potential.

3.6 Had a deadman alarm been fitted and used, the watchkeeper might have been awoken in time to avert the grounding.

3.7 The passage plan was not sufficiently documented either on the chart or within the electronic navigational aids.

3.8 The deckhand did not comply with the master's standing orders in that he did not chart the position of the vessel every 20 minutes when it was operating within six miles of land.

3.9 When he took over the watch the deckhand was probably fatigued to such an extent that he was not fit to stand a navigational watch.

3.10 As the watch progressed the deckhand utilised the wheelhouse chair and began to sink into a state of deep lethargy.

3.11 When the deckhand centred the Seaplot chart monitor at the course alteration position, in his state of reduced awareness he probably thought he had made the course alteration.

3.12 The planned alteration of course was not made by the deckhand and resulted in the grounding.

3.13 At the time of the grounding the deckhand was asleep.

3.14 The remuneration system could tempt the master and the crew to work extended hours in the quest for additional earnings, which would not be conducive to safe working practices

3.15 The physical demands on the crew would be reduced by the provision a conveyor system in the fish hold.

## 4. Safety Recommendations

4.1 On 26 March 1999 it was recommended to the Group Fleet Manager of Sanford Limited that he:

4.1.1 formulate a company policy on the management of fatigue to give guidance and advice to masters and crew on the causes, recognition and prevention of fatigue among sea staff. (105/98)

4.1.2 consider the fitting of deadman alarms on the bridges of the company vessels where these are not already fitted. (106/98)

4.1.3 consider the provision of conveyor systems in the fish holds of the company vessels where these are not already fitted and where the dimensions and layout of the hold are such that fitting is practicable. (107/98)

4.2 On 7 April 1999 the Group Fleet Manager of Sanford Limited responded as follows:

4.2.1 **105/98**
Sanford Limited intends to adopt the safety recommendation. In respect of this safety recommendation, Sanford limited already had a draft Company Policy on fatigue, this is currently being updated and we would anticipate having an updated signed off Company Policy by 30th April 1999.

4.2.2 **106/99**
In regards to the fitting of Deadman Alarms to the bridges of Company vessels where these are not already fitted, Sanford Limited intends to implement this safety recommendation. Currently we have invited suppliers to tender for the supply of Deadman Alarm units, we would anticipate the process being completed by 7th May 1999 and a supplier being awarded the contract by 21st May 1999.

4.2.3 **107/98**
In regards to the safety recommendation to consider the provision of conveyor systems in the fish holds of the Company vessels where these are not already fitted and where the dimensions and layout of the hold are such that fitting is practicable, it is our view that we have fitted conveyor systems in the Company vessels that are practicable and we do not intend to adopt this safety recommendation for other vessels in our fleet.

Our reasons for not adopting this safety recommendation are that all our bigger vessels have conveyor systems fitted, and in the majority of instances they only use the conveyor system for carrying fish as the practicalities of carrying fish bins or tubs on conveyors give rise to a whole range of additional safety concerns, both in terms of the operation of the conveyor and in terms of the physical mass of the conveyor that has to be so substantial to maintain the operational strength.

4.3 On 26 March 1999 it was recommended to the Director of Maritime Safety that he:

4.3.1 formulate Maritime Rules for the management and prevention of fatigue among seafarers on New Zealand commercial vessels that are not covered by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW-95). (111/98)

4.3.2 produce an Advisory Circular, to be used in conjunction with the Maritime Rules, that gives owners, operators, masters and crew guidance and advice on the causes, recognition, management and prevention of fatigue among seafarers. (036/99)

4.4 On 1 April 1999 the Director of Maritime Safety responded as follows:

4.4.1 **036/99**

The Authority proposes to publish guidelines on the management and prevention of fatigue for use by employers and seafarers on specific classes of ship. This proposal, which effectively anticipates your final recommendation 036/99, is one outcome of a recent comprehensive review of fatigue among seafarers working on board New Zealand ships. The guidelines will be developed during the course of 1999/2000.

4.4.2 **111/98**

The Authority's review of seafarer fatigue considered extending maritime rules providing minimum hours of rest to watchkeepers on ships not covered by STCW-95 - in effect the Commission's final recommendation 111/98. Our review concluded that the effectiveness of these rules needs to be assessed before any decision is made to widen their application to other categories of seafarer. Such an assessment is to take place in the year 1999/2000. Once this is complete, we will consider whether such controls are an appropriate risk reduction measure in respect of watchkeepers on large freezer trawlers, ships carrying large numbers of passengers in restricted limits, and harbour tugs. A cost benefit analysis will then be undertaken and, on this basis, a decision made on whether to prepare draft maritime rules on behalf of the Minister of Transport. Should it be decided to propose new rules, their development should begin in the latter half of 2000.

Approved for publication, 26 May 1999

Hon. W P Jeffries
**Chief Commissioner**