WORKSHOP SERIES No 19

Hulls, Hazards and Hard Questions

Shipping in the Great Barrier Reef : Reducing the Risk of Spilling Oil and Other Hazardous Substances

Proceedings of a Meeting of Experts held in Canberra, Australian Capital Territory 14-15 April 1993.

Edited by Peter Ottesen

Organised by the Great Barrier Reef Marine Park Authority and the Australian Maritime Safety Authority

Great Barrier Reef Marine Park Authority

AMSA
Australian Maritime Safety Authority

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EDITOR'S COMMENTS

The possibility of ecological damage to the Great Barrier Reef (GBR) is an issue that has attracted considerable discussion and expenditure of money, even before the Great Barrier Reef Marine Park (GBRMP) was created.

In the early 1970s the possibility of oil exploration, drilling and mining on the Reef led the Commonwealth and Queensland Governments to establish joint Royal Commissions which investigated the exploration and production drilling for petroleum in the GBR. They reported in 1974.

In recognition of this concern, the *Great Barrier Reef Marine Park Act (1975)* was passed with support of all political parties. It banned oil drilling or production in that part of GBR Region (an area defined by the Act) which was to later become the Marine Park. Regulations were also later introduced to extend this ban to those small areas of the GBR Region not included in the Park. This was a significant event because the Marine Park is a multiple-use protected area: that is, it is not an area set aside for only nature conservation but rather it is an area where a range of activities are permitted consistent with an overall objective of conservation.

During the 1980s most energy was directed towards developing an oil spill contingency plan, the first version of which was finalised in 1987. It has been since tested twice and revised. The Marine Park Authority also employed for the first time an officer to work almost full time on oil-related issues.

Towards the end of that decade there was a growing recognition of the need to also consider how spills could be prevented. IMO introduced a recommendation that ships carry a pilot in the northern waters of the Marine Park. This had partial success but in 1990 the Australian Government gained the support from the maritime nations to establish the GBRMP as the world's first *"particularly sensitive area"* and to allow Australia to require ships travelling through parts of the Reef and in international waters, to carry a pilot. This was a significant diplomatic achievement by Australia. Pilotage of certain vessels in parts of the Reef was made compulsory by an amendment to the Marine Park Act 1991.

Despite these developments, there has been an undercurrent of public concern about a spill, which surfaces whenever there is a large shipping accident or spill elsewhere. In the last four years there have been well publicised spills including the *Exxon Valdez* off Alaska, the *Haven* off Italy, the *Kirki* off Western Australia, the *Aegean Sea* off Spain and the *Braer* off the Shetland Islands. These events have raised concern in Australia to such a level that the Marine Park Authority decided to focus even more on prevention, recognising that the effectiveness of action after a spill is very limited. There were public and industry claims that changes to ship construction and operation would reduce the risks of spills but the Marine Park Authority was not in a position to assess these claims.

In February 1993, the Australian Maritime Safety Authority (AMSA) agreed to organise jointly with the Marine Park Authority, as a matter of urgency, a meeting of experts in ship design, construction, operation, safety, maritime law and the GBR. It would be by invitation, would focus explicitly on the GBR and the output would be views and ideas that could be used as a basis for recommendations to the Government from AMSA and the Marine Park Authority.

There was immediate and enthusiastic support by all invited participants, who are listed in Appendix B. The program is in Appendix A.

There was a strong co-operative spirit during the meeting and many participants mentioned that it was the first time that they had all met together to discuss this issue. The five workshop sessions highlighted many useful points, with the following two

forming the basis of a media release issued by the Marine Park Authority:

- the most effective way of reducing the risk of oil or toxic cargo spills in the Marine Park is through accelerating the development and introduction of Electronic Chart Digital Information System (ECDIS) and related Differential Global Positioning System (DGPS) and through undertaking a DGPS pilot project in the Marine Park; and
- the Exclusive Economic Zone (EEZ) should be established as soon as possible to improve the enforcement of existing laws that aim to prevent or minimise pollution from oil and toxic cargoes.

Other key point that arose from the meeting can be summarised as:

- the average size of ships transiting the Marine Park is increasing, but more vessels are choosing to go outside the Marine Park;
- an area of great concern is Torres Strait, where Australia's ability to control shipping is less than that for the GBRMP;
- banning ships from the Marine Park is not a realistic option;
- accident can be reduced if the survey of Reef waters is extended to identify and rank areas suitable for navigation by smaller vessels, and the data that are be collected be in such a form as to be useable when electronic charting technology becomes available;
- the risk of accident can be reduced through better education and training of crews, and provision of information, to minimise the human-error element in accidents;
- making mandatory the use of double hulls before the rest of the world is not feasible and this technology may be ineffective in high energy groundings or collisions;
- a traffic separation scheme should be investigated;
- Australia should work actively with other maritime nations to pursue initiatives including the introduction of compulsory ship reporting systems and higher crew competency standards;
- waste facilities in some ports adjacent to the Marine Park are inadequate and therefore it is difficult to encourage ships to not discharge operational oil waste at sea; and
- Australia should investigate the feasibility of seeking to have the IMO recommend a safe outer route to assist those ships that choose to go outside the Marine Park.

These points have been drawn from the workshop and do not necessarily represent the policies of the GBRMPA or AMSA.

This report comprises three sections: the first records all papers presented and the questions and answers that followed each paper, the second records the outputs of the five workshops and the third section is the Appendices.

The participants agreed to the release of a media statement, which is in Appendix C. Also included is a bibliography of papers written by Authority staff and research project reports commissioned by the Authority on oil-related matters (Appendix D).

It is hoped that this report will be a source-document that will contribute to the development of policies to reduce risks of shipping related spills.

The organisation of such an event is a challenge that sometimes seems to equal the complexity of the issue being considered by the meeting. Laurie Mayer (AMSA) in particular, Colin Trinder and Denyse Freedman (Canberra Office, GBRMPA) and Malcolm Weatherup (Townsville Office, GBRMPA), provided valuable assistance.

Peter Ottesen
Director
Canberra Office
Great Barrier Reef Marine Park Authority

INTRODUCTORY ADDRESSES

GRAEME KELLEHER
Chairman
Great Barrier Reef Marine Park Authority

So far the Great Barrier Reef Marine Park (GBRMP) has been spared from oil spills of the scale that we have witnessed elsewhere and which have attracted considerable media attention. However, the reality is that a large spill is inevitable if we do not act to minimise risks.

This is a sobering thought to begin this meeting, but it needs to be said because the GBR is a very special and valuable asset and the transport of oil and other toxic substances in or near the Reef seems unavoidable.

The GBRMP is recognised as one of the world's most important natural environments.

This was recognised in a tangible way by Australians in 1975 when the Commonwealth Parliament passed legislation to create an Authority, with extraordinary powers, to plan and manage what was and still is the world's largest Marine Protected Area.

This importance was recognised by the rest of the world in 1981 when the Great Barrier Reef region was inscribed on the World Heritage List and reinforced in 1990 when the International Maritime Organisation designated the GBR, in their terminology, as the world's first and so far only *Particularly Sensitive Area.*

The GBRMP is also one of Australia's most important economic regions.

It supports a domestic and international tourism industry and a commercial fishing industry that together contribute more than $1000 million to our economy each year and employ thousands of Australians.

The Commonwealth and Queensland Governments have invested significant resources in managing the Reef and industry has large investments, all of which must be protected.

Spills of oil or other hazardous substances, whether the result of accident or ship operation, threaten the natural qualities of the Reef and therefore put at risk these investments, jobs and revenue.

We do have a contingency plan called *Reefplan*, and compulsory pilotage requirements which are commendable and of a high standard compared to other parts of Australia, however, the reality is that they have a limited capacity to prevent or clean-up spills. As most of you know, *Reefplan* would have trouble coping with a spill of 1,000 tonnes, and even then only under benign conditions, and having a pilot on board a vessel is no guarantee that accidents will not happen.

Australians have a very high expectation that the Reef will be protected.

As custodian of the Reef, the Marine Park Authority has an obligation to prevent spills, to clean them up if they occur and to minimise any environmental damage. It also has an obligation to set a standard at least equal to any where else in the world. As a consequence we must always be searching for ways to improve the way we do things and to adopt new technology as it becomes available.

We can improve *Reefplan*, which will assist in cleaning-up and minimising environmental damage. This is happening.

But it is also important and probably more cost effective in the longer term to focus on prevention. We now read and hear often about new developments in ships, design, construction and operation that will reduce the risk of accidents; there are calls from the public for government to exclude ships from the Reef, to extend or toughen compulsory pilotage requirements. However, by ourselves, we are not in a position to identify all these developments and ideas and perhaps of greatest importance, we cannot determine whether they are sensible.

AMSA has expertise and a responsibility for ship safety in Australia, and I am very pleased that they are working with us on this problem. However, both agencies recognise that there is considerable expertise in the shipping industry which we should tap. That is why you are here. Governments and their agencies are not the source of all knowledge and the successful implementation of rules and standards by government requires all those who have knowledge, or might be affected, to work together. We always apply this consultative and co-operative model in managing the Marine Park.

What do we want from this meeting?

Our ultimate aim is to advise the Government on what action, it might take to reduce further the risks of spills in the GBR Region. AMSA and the Marine Park Authority believe this will take some time and many organisations will have to be consulted. This meeting is an important step. As you were advised in our invitations, we want your ideas and views that we can take away with the aim of developing and applying practical measures to reduce both the risks of spills and their consequences. This comprises a part of our comprehensive program to ensure protection of the Reef.

I am looking forward to our discussions - I am sure they will be stimulating - but I will end on a note of caution which I am sure we in this room understand completely: it is not possible to reduce the risk of accident and spills to zero. Even if all vessels carrying fuels or other hazardous substances - including fishing and tourist vessels - were banned from the Reef (which is not a realistic solution), there would still be a risk from those vessels travelling outside the Marine Park. There are no quick or magic solutions.

PAUL MCGRATH
Chief Executive
Australian Maritime Safety Authority

Ladies and gentleman, I welcome you to this meeting which will focus on marine safety and environmental issues in the Great Barrier Reef area. It is being held in response to the increased public and government sensitivity to matters concerning the threat of marine pollution in the great barrier reef. You are all aware of the recent overseas pollution incidents and the public and government reaction to those issues. Our aim is to reduce to the lowest practical level the risk of a shipping disaster and, hence, a pollution incident in the Great Barrier Reef.

This meeting provides an excellent opportunity for the various professionals associated with the protection of the Reef and with maritime transport to discuss and exchange ideas and to re-focus their attention on maritime safety issues with special emphasis on pollution prevention.

The Australian Government and AMSA's commitment to the protection of the maritime environment has never been stronger. This commitment is evidenced by:

- The recently published House of Representatives report entitled "Ships of Shame".
- The recently completed review of the national plan to combat pollution of the sea by oil which in June will be placed before the Australian Transport Advisory Council Ministers for acceptance and endorsement.
- The focusing of activities on port state control with the re-allocation of resources to more adequately address the deficiencies of visiting foreign flag ships.
- AMSA's full support of IMO initiatives for the construction of double hull tankers or their equivalent and the increased severity of surveys of existing tankers due to come into force in July this year as an amendment to the MARPOL convention.
- The active role AMSA plays in the certification issues of Australian and foreign flag ships to ensure that;
  - . the requirements of international conventions and codes are met
  - . the crews are adequately trained, and
  - . those ships are safely manned.

Shipping in the Torres Strait and the Great Barrier Reef plays a vital role for the well being of the Australian economy and way of life. AMSA believes that both activities can, with proper management and co-operation, co-exist in an environmentally friendly way. In this regard AMSA looks to other parties to assist in the management process. The Australian Hydrographic Service, the pilotage services, the Great Barrier Reef Marine Park Authority, industry and all levels of government make substantial and positive contributions to safety and pollution prevention with in the reef.

In closing, I wish you all a most successful and fruitful two days of discussions and I will look forward to reading the report of this meeting.

PAPERS PRESENTED

SHIP SOURCED OIL POLLUTION IN THE GREAT BARRIER REEF: CAUSES, FREQUENCY, RESPONSE AND PREVENTION

Steve Raaymakers
Research and Monitoring
Great Barrier Reef Marine Park Authority

Abstract

Ship sourced oil spills are discussed in the context of the Great Barrier Reef, including Torres Strait which falls within the REEFPLAN Area. The oil spill threat is analysed and identified as being primarily from shipping, with about 2000 large ships transiting the inner route of the Great Barrier Reef annually, approximately 100 of which are tankers. The frequency of oil spills is discussed, with no major spills from shipping accidents having occurred since the "Oceanic Grandeur" in Torres Strait in 1970. However there have been numerous large-ship incidents with significant pollution potential, including 19 collisions and 24 groundings, since 1979. In addition oil pollution from operational discharges from large ships is a common occurrence, with over 30 reports in the REEFPLAN Area since 1990, the largest being estimated at around 10t. There have also been a number of spills from bunkering and other operations in ports. Discharges from and accidents with small vessels are also a source of oil pollution, with about 350 collisions, sinking's, fires and other incidents having occurred in the Reef Region since 1980. The impacts of oil on the tropical marine ecosystems found in the Reef Region, including mangroves, seagrass beds and coral reefs, are discussed. These are generally found to be detrimental, with real-life spills indicating impacts more severe than what would be expected based on the results of experiments. However the nature and extent of impacts from a major spill can not be predicted with any accuracy, due to the large number of variables involved. Arrangements for the prevention of oil spills in the Great Barrier Reef are covered, these primarily being the regulation of discharge of oil from vessels and regulation of vessel design, construction and operation, the provision and maintenance of navigation aids and the implementation of compulsory pilotage. Opportunities to improve preventative measures are identified. Arrangements for the response to oil spills are also discussed with a breakdown of REEFPLAN, concluding that due to the nature of oil on water and the practical limitations of oil spill response, authorities can not guarantee prevention of substantial environmental damage and economic loss in the event of a major oil spill on the Great Barrier Reef. Efforts must therefore concentrate on prevention of oil spills.

Introduction

It is possible to claim that the existence of the Great Barrier Reef Marine Park is a direct result of the fact that spilt oil can have severe impacts on the marine environment. Widespread public concern over the possibility of damage to the Great Barrier Reef from oil drilling was a major factor in the push for greater protection of the Great Barrier Reef during the early 1970s, which culminated in the passing of the *Great Barrier Reef Marine Park Act* in 1975. As a result of this Act, oil drilling is now prohibited throughout the Great Barrier Reef Region.

Nevertheless, with major shipping lanes running the entire length of the Great Barrier Reef and a variety of vessels plying Reef waters the possibility of a major oil spill remains one of the major challenges facing the managers of the Great Barrier Reef Marine Park.

In this paper I will discuss, in relation to the Great Barrier Reef, including Torres Strait, the oil spill threat, the impacts of oil pollution, arrangements in place to prevent oil

pollution, with an emphasis on the limitations of oil spill response and the need for increased efforts in prevention.

The Oil Spill Threat

Shipping Incidents - Collisions, Groundings and Sinkings

Approximately two thousand ships navigate the inner route of the Great Barrier Reef each year, about one hundred of which are tankers. The most important cargo carried is bauxite from Weipa to Gladstone in vessels of about 70 000 dwt and coal exported from Central Queensland in vessels of up to 200 000 dwt. These vessels can carry up to 10 000 tonnes of fuel oil. Carriage of general cargo through the Reef has declined in recent years. Oil carried through the Reef is increasing and can be divided into two categories; refined product being shipped from Brisbane refineries to Queensland ports in tankers of up to 60 000 dwt, and crude oil from Indonesia and Australia's Timor Sea fields to Brisbane and Sydney refineries in tankers of 70 - 90 000 dwt (DoTC, 1990). In addition there are several companies which operate fuel barges carrying refined product to communities and the fishing fleet along the coast of Cape York.

Shipments of oil through the Great Barrier Reef are likely to increase with more crude shipments from Indonesia and the Timor Sea compensating for the decline of Bass Strait reserves, as population growth in Central and Northern Queensland increases demand for refined product and if the Central Queensland oil shale deposits are developed.

With 2900 reefs, 300 cays, 600 high islands, numerous submerged reefs and shoals, narrow, shallow shipping lanes, strong trade winds, strong tidal currents, occasional cyclones and incomplete charts, the possibility of one of the 2000 vessels transiting the reef each year experiencing an incident resulting in oil spillage is distinct.

Since the grounding of the "Oceanic Grandeur" in Torres Strait in 1970 which spilt 1 400 to 4 100 tonnes of crude oil, we have been lucky enough to have escaped a major oil spill on the Great Barrier Reef. However shipping incidents still remain the single most significant oil spill threat at this time. Incidents involving large ships and with significant pollution potential continue to occur. Since 1979 there have been 24 groundings in the Reef Region, 9 within port limits and 15 on the Reef itself (Table One). There have also been 19 collisions since 1979, 11 with structures in ports and 8 with fishing vessels in Reef waters (Table Two). Some of these incidents have resulted in minor pollution (source: AMSA, QDoT and GBRMPA).

A study by consultants Global Maritime (Evanson and Potts, 1990) indicates that relative to total shipping numbers, the collision rate per unit shipping for the inner route of the Great Barrier Reef is considerably higher than even for the Dover Strait, the busiest shipping lane in the World!

A risk analysis by the Bureau of Transport and Communications Economics (BTCE, 1991), entitled "Major Marine Oil Spills - Risk and Response" concluded that the probability of one or more major spills (over 1370 tonnes) occurring in Australian waters, from tankers, could be as much as 49% in any five year period and 84% in any twenty year period. The report also found that shipping accident rates per unit shipping are highest on the Inner Route of the Great Barrier Reef. The findings of the report were qualified with the caution that the practicality of the risk analysis is limited because it relied heavily on overseas data and cannot provide meaningful expectation of the economic and environmental costs of a spill occurring.

In addition to incidents involving large ships, a minor source of oil pollution is accidents occurring with small vessels such as fishing trawlers, tourist vessels, barges etc. Since 1980 there have been over 350 collisions, groundings, sinkings, fires and

other incidents with small vessels, many resulting in release of oil or fuel (source: QDoT and GBRMPA).

Operational Discharges
Ships can generate significant quantities of waste oil from a variety of sources. These include lubricating oil from engines and motors, residual oil lining fuel or cargo tanks and general leakage from engine spaces into the bilge.

Under the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) all discharges of oil from all vessels are prohibited within the Great Barrier Reef. Ships other than tankers may not discharge any oil within 12 nautical miles of the outer edge of the Reef and tankers must not discharge any oil within 50 nautical miles of the outer edge of the Reef, as defined by MARPOL. Any discharges outside this area must be less than 60 litres per nautical mile or a concentration of 100 parts per million. Waste oil is supposed to be stored on board in a slops tank and discharged to appropriate reception facilities onshore.

Despite MARPOL, and implementing Australian legislation (the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*) with fines of up to $1 million, discharges of waste oil occur frequently in the Great Barrier Reef Region. Since 1990 GBRMPA has received 30 reports of oil slicks in the Great Barrier Reef Marine Park than could only be caused by discharges from large ships, the largest estimated to contain around 10 tonnes of oil. In some cases ships have been clearly implicated by Coastwatch aircraft photographing the incident, while in most cases there is no sign of the culprit. Recreational and tourist beaches have been impacted on a number of occasions, there have been some near misses where substantial slicks have passed close to sensitive sites such as Low Isles, and tar balls and pools of oil have even been observed by Marine Parks patrols on offshore sand cays.

In addition to discharges from large ships, GBRMPA receives an average of one report per week of oil discharges from small vessels, particularly fishing trawlers.

Given the relatively small amounts of oil spilt from each operational discharge, the large volume of water of the Great Barrier Reef Region and the biodegradable nature of oil, it would seem that this source of oil pollution is negligible. However, small day-to-day spills over time may produce chronic pollution much larger in volume and possibly more severe in biological consequences than headline-grabbing mega-spills. Numerous studies now indicate that the sub-lethal effects of low-level long-term chronic pollution can seriously impact on marine ecosystems (Loya & Rinkevic, 1980). Studies of the distribution of hydrocarbon-associated bacteria in Great Barrier Reef waters show higher concentrations of these bacteria in areas of greatest shipping activity, presumably indicating that background levels of hydrocarbons are already elevated in these areas (Reicheldt, pers. comm., 1991).

The presence of tar balls and pools of oil on offshore cays certainly compromises the pristine qualities of what is supposedly one of the only remaining areas of relatively untouched coral reefs in the world.

Impacts

Perceptions of the impacts of oil on marine and coastal environments vary greatly. For example the draft report of the 1993 Review of the National Plan to Combat Pollution of the Sea by Oil states:

"There is a good indication that the marine environment is able to assimilate oil . . ." and *". . . oil is a natural substance and natural processes over time will do much to remove it"*

Whereas Sheehy 1991 states:
"The presence of hydrocarbons in the environment is of major concern as even small amounts of hydrocarbons may act as toxins, mutagens and carcinogens. Once in the environment, hydrocarbons spread into inanimate and biological systems. Biological systems will often accumulate (bioaccumulate) rather than metabolise hydrocarbons. Accumulation is not limited to primary ingestion of hydrocarbons but can occur through consumption of biota containing bioaccumulated hydrocarbons. This effect is known as biomagnification and can effect all members of the food web including humans. In general, the longer hydrocarbons persist in the environment the greater will be the risk to the ecosystem and the more difficult they are to eliminate from the area."

Baker (1990) reports that the impacts of oil can range from total devastation of mangrove forests with recovery times in the order of decades through to actual short-term enhancement of growth rates in some marsh plants.

It is not possible to predict the exact nature of impacts that will occur in the event of a spill, as every spill is different and all spills are dynamic. The nature and extent of impacts will be determined by a large number of variables at the time of the spill. The extent of damage done by a spill does not always reflect the quantity of oil spilt. A little oil in a sensitive area can do considerably more environmental and economic damage than a large quantity on a desolate rocky shore.

It is beyond the scope of this paper to provide a comprehensive review of the impacts of oil on the range of marine and coastal ecosystems and resources found in the Great Barrier Reef Region.

It is sufficient to say that a major oil spill on the Great Barrier Reef could have extremely serious short- and long-term impacts on marine and coastal ecosystems, habitats, wildlife and resources with possible significant economic effects. In the *"Exxon Valdez"*, in which around 40,000 tonnes of oil were spilt, over 1,000 kilometres of coastline eventually became oiled. Such a scenario is possible on the Great Barrier Reef and could result in oiling from Cairns to the Whitsunday Islands. The high level of recreational and commercial activity in the Great Barrier Reef Region, combined with the particular sensitivity of mangroves, seagrasses, birdlife and other Reef Region resources, compounds the potential impacts of a major spill on the Great Barrier Reef.

Response
While obviously priorities must focus on prevention of oil spills, accidents can and do happen and marine oil spills are a factor for which government and industry must plan.

The National Plan and REEFPLAN
After the grounding of the *"Oceanic Grandeur"* in Torres Strait in 1970 the Commonwealth Government moved to implement the National Plan to Combat Pollution of the Sea by Oil (the National Plan or NATPLAN), to ensure that Australia had a capability to respond to ship-sourced pollution incidents around the country. NATPLAN was originally set up to deal with spills of up to 1,000 tonnes.

NATPLAN is funded by a levy on ships visiting Australian ports, as prescribed in the *Protection of the Sea (Shipping Levy) and (Shipping Levy Collection) Acts 1981.* The levy rate is set at a maximum of four cents per tonne of a ship's net tonnage per calender quarter. The current rate is set by regulation at 2.2 cents and generates an annual income of around $1.8 million. Approximately 90% of the NATPLAN levy is provided by foreign flag shipping. This is used to cover all NATPLAN operations, including procurement and maintenance of oil spill equipment, training and exercises, salaries and operations of the Marine Environment Protection Unit of the Australian Maritime

Safety Authority (AMSA) - who took over responsibility for NATPLAN from the Department of Transport and Communications on 1 January 1991), and oil spill response operations where recovery from the polluter proves to be impossible.

NATPLAN provides stockpiles of oil spill response equipment at ports around the country, on long term loan to State Authorities. This equipment is supplemented by items provided by the State Authorities themselves and the oil industry, as well as the major industry-funded and operated Australian Marine Oil Spill Centre (AMOSC) in Geelong. AMOSC is a wholly owned subsidiary of the Australian Institute of Petroleum (AIP) and was opened in June 1992. It stocks some $9 million worth of oil spill equipment that can be flown anywhere in Australia in less than 24 hours, and represents a major source of backup to NATPLAN. AMOSC also provides structured oil spill response training courses at a variety of levels to supplement the training provided by AMSA and State authorities under NATPLAN.

NATPLAN is based on a tiered-response philosophy. Tier One spills of less than 10 tonnes are handled using equipment available locally from industry and/or State Authorities, Tier Two spills of between 10 and 1000 tonnes and Tier Three spills of more than 10 000 tonnes are handled using local industry, State and NATPLAN resources, as well as NATPLAN resources transported to the spill site from stockpiles around the country and the AMOSC resources transported from Geelong in Victoria. There are also arrangements in place for the response to Tier Three spills to be supplemented by resources from overseas, in particular the major industry stockpiles at the Tiered Area Response Capability (TARC) in Singapore and the Oil Spill Service Centre (OSSC) in Southhampton, United Kingdom.

In addition to providing equipment and training NATPLAN provides a set of Commonwealth/State Administrative Arrangements which provides a clear definition of the roles and responsibilities of the two levels of Government in oil spill response. Implementation of NATPLAN and responsibility for managing oil spills in Queensland rests with a multi-agency National Plan State Committee. This Committee is chaired by the Queensland Department of Transport (QDoT) and includes representation from AMSA, GBRMPA and the Queensland Department of Environment and Heritage (QDEH).

In recognition of the sensitivity of the Great Barrier Reef Marine Park a marine pollution contingency plan has been developed specifically for the Great Barrier Reef Region, known as REEFPLAN. REEFPLAN is a subset of NATPLAN and relies on exactly the same response arrangements, including a first-strike capability centred on a NATPLAN stockpile in Townsville and a tiered response philosophy allowing resources to be supplemented by other NATPLAN stockpiles around the country, the AMOSC resources in Geelong and overseas assistance. The lead agency for oil spill response in the Great Barrier Reef is QDoT supported by AMSA. AMSA may take over management of the spill response if requested to by QDoT. GBRMPA plays a significant role as the managers of the Great Barrier Reef Marine Park and environmental and scientific advisers. GBRMPA is supported by the QDEH in its role.

The philosophy of NATPLAN and REEFPLAN is that if the oil is not impacting or likely to impact sensitive resources then the most environmentally sound response option is to leave the oil to degrade naturally at sea, while monitoring its movement and behaviour. Should sensitive resources be threatened then action needs to be taken to prevent oil from impacting those resources.

The most effective option available at this time is to use chemical dispersants to disperse the oil while it is still in open water and therefore accelerate the natural degradation process. There are a number of significant limitations on the use of

dispersants. Many oils are not amenable to dispersant and there may be logistical obstacles with getting dispersants from the closest established stockpiles to the scene of the spill, which in the Reef situation may be thousands of miles away. In some cases the use of dispersant may cause greater ecological impact than non-use, due to the toxic effect of the dispersant itself and the fact that dispersing oil results in increased hydrocarbon concentrations in the water column. Use of dispersant must be subject to scientific advice and careful consideration of the impacts that will occur if they are used compered with the impacts that will occur if they are not used. It may be necessary to accept impacts on one resource in order to minimise impacts on a more valuable resource. Under REEFPLAN priority is given to natural habitat followed by rare and endangered species then commercial, cultural and amenity resources.

Unfortunately at this point in time it is difficult for environmental authorities and scientific advisers to provide comprehensive objective advice on the use of dispersants, as the impacts of dispersants vary greatly between dispersant type, oil type and environment type and very little research has been conducted in Australia. There is a need to develop a national research program which tests the ecosystem effects of the various combinations of dispersant, oil and environment for the main dispersant types stockpiled in Australia, the main oil types transported through our waters and the main ecosystems and environments in the Reef Region.

It is also possible to deploy booms to deflect oil away from limited areas of sensitive resources and into pockets where it can be recovered. However the reality is that due to the nature of oil on water and the limitations of oil spill response prevention of impact to marine and coastal resources can not be guaranteed. The nature and extent of any impact will be determined by the variables at the time and in any major oil spill with an onshore wind and/or current oiling of the shoreline will not be avoided. Response operations will consist largely of shoreline clean-up, oiled wildlife operations and post-spill rehabilitation.

The limitations of oil spill response are exemplified by the following statements:
". . . large-scale marine oil spills are not manageable, not in any stretch of the imagination are they manageable" (Schouwenberg, cited in Public Review Panel on Tanker Safety and Marine Spills Response Capability, 1990).
"A realistic appraisal of US and in fact, world wide response to major spills will recognise that no effective containment of such a spill has ever been accomplished" (Murray, cited in BTCE, 1991).
". . . with the current technology, the best that can typically be expected after a major spill is to recover 10-15 percent of the oil" (United States General Accounting Office Report to Congress, 1989).
Despite the above it must be remembered that the effectiveness of oil spill response must be measured by the amount of environmental impact that is avoided rather than the quantity of oil that is recovered. While the obstacles are almost insurmountable there is no doubt that by planning and preparing for major marine oil spills the chances of minimising environmental and economic impact will be increased. With this in mind the Australian Government, in conjunction with the States and industry, carried out a review of NATPLAN in 1992. The report of this review is soon to go to Government and it is likely that it will result in substantial improvements to NATPLAN and REEFPLAN. These will include greater cooperation between industry and government, with an integration of AMOSC and other industry resources into NATPLAN , upgrading from a 1000 to a 10 000 tonne response capability, increasing the first-strike rapid response capability in the Great Barrier Reef Region, enlarging the scope of NATPLAN to deal with all marine oil pollution incidents, regardless of source, and education of government, the media and the community of the limitations of oil spill response and the fact that other than in exceptional circumstances, current

technology does not exist to guarantee prevention of environmental damage and economic loss in the event of a major oil spill.

Prevention

Conventions & Legislation

A significant component of oil spill prevention efforts in Australia is the legislation implementing the MARPOL Convention and other International Maritime Organisation (IMO) Conventions regulating the design, construction and operation of ships and the discharge of oil from ships.

Overall reponsibility for marine oil pollution Conventions and legislation in Australia rests with the Australian Maritime Safety Authority (AMSA). AMSA carries out a port state inspection program where surveyors board vessels in port to check for compliance with Convention requirements. However it should be noted that port state control inspections are a secondary measure designed to supplement flag state regulatory control. Internationally agreed procedures are based on the assumption that the flag state ensures compliance with all Convention requirements. Detailed inspection and classification of ships is carried out by independent, commercial Classification Societies. The 1992 Inquiry into Ship Safety by the House of Representatives Standing Committee on Transport, Communications and Infrastructure, entitled "Ships of Shame", lists a disturbing number of factors that seriously compromise prevention of ship sourced oil spills. These include:

- very poor levels of ship maintenance
- the fact that Classification Societies, who are responsible for survey and certification of ships, are subject to market forces
- the existence of "flags of convenience", with less stringent ship inspections and compliance to convention standards
- poor compliance by member states with IMO conventions
- an aging world fleet
- lack of crew training and experience, reduction in crew sizes and abuse of crew.

The Alaska Oil Spill Commission (1989) compared the *Exxon Valdez* tanker operation to the US airline industry and estimated that 1.5 aeroplane crashes would occur every day in the United States if airline safety were no better than tanker safety. The *"Ships of Shame"*(1992) report tends to support this finding.

Australia's port state control inspection program is also restricted by a lack of resources available to AMSA, with the current target of inspecting 25% of all ships visiting Australian ports only just being achieved.

It is necessary for Australia to take action both through the IMO and through increasing its efforts in port state control of shipping entering Australian waters if safety standards are to be improved.

AMSA use Coastwatch aerial patrols for surveillance and detection of pollution infringements, however investigative and prosecution efforts are seriously inadequate and do little to deter polluters. The chances of polluters being caught are small, of being caught and prosecuted, even smaller. If polluters are prosecuted, the chances of being found guilty are low, and, if found guilty, fines are not likely to be the maximum applicable. There is a need to greatly improve surveillance and enforcement efforts if legislation is going to be effective in preventing spills.

A significant recent development in the design of vessels is a new requirement by IMO, under MARPOL, for all new tankers over 5000 dwt for which the building contract is placed after 6 July 1993 to have double hulls or equivalent protection. There is overwhelming evidence that double hulls or bottoms offer a substantially higher

margin of operational safety (Public Review Panel on Tanker Safety and Marine Spill Response Capability, 1990) and this measure will greatly improve oil spill prevention globally and in the Great Barrier Reef, albeit at considerable cost. Currently only 8% of oil tankers operating world-wide have double hulls or bottoms.
The United States has acted independently of IMO and is unilaterally requiring oil tankers trading to the US to have double hulls by 2015.

Navigation Aids
Safe navigation is essential to prevention of oil spills, and the provision and maintenance of navigation aids such as lights, markers and beacons is a vital component of ensuring safe navigation. Such facilities in the Great Barrier Reef are provided by AMSA, funded by a levy on shipping calling at Australian ports, and by QDoT.

The production and updating of navigation charts by the Royal Australian Navy Hydrographic Service is also vital to safe navigation. However, many of the charts currently in use for the Great Barrier Reef are still based on surveys originally conducted in some instances in the 1800's, as the process of updating charts is extremely time consuming.

Two recent developments with considerable potential for increasing accuracy of charts is the use of satellite imagery and Laser Airborne Depth Sounding (LADS). The RAN Hydrographic Service is very active in utilising these technologies in the ongoing updating of navigation charts, but limitations in resources significantly restrict the rate of work that can be achieved. Only one aircraft is available for LADS work for the whole of Australia.

Another major development is Electronic Chart Display and Information System or ECDIS uses three technologies to reduce the incidence of errors in navigation by largely removing the human element. These technologies are Global Positioning System, Electronic Chart Database and Computer Graphics. These technologies combined in ECDIS provide the mariner with continuous, real time, high accuracy position superimposed on an electronic chart display with audible warnings of impending danger.

North American statistics indicate that 90% of ship groundings are caused by navigation error, and 70% of these may be avoided with the use of ECDIS. The RAN Hydrographic Service allocated $300 000 and two staff positions to the development of ECDIS in Australia in the 1992/93 financial year (Leech, 1992).

Increasing safety of navigation is one of the most effective ways of reducing the risk of ship-sourced oil spills. There is a need to substantially increase the resources available to the RAN Hydrographic Service if timely advances are to be made in this area.

Pilotage
In 1987 the IMO recommended that vessels carry a pilot when navigating the inner route of the Great Barrier Reef. This was a voluntary scheme with roughly 90% of vessels complying. With over 2000 vessels transiting the Reef each year, two hundred of which are tankers, this still left a reasonable risk.

Since 1987 there have been calls from many quarters to replace recommended pilotage with compulsory pilotage. An analysis by consultants Global Maritime (1990) indicates that groundings of non-piloted ships occur 31 times more frequently than piloted ships in the Great Barrier Reef inner route. However under International Law of the Sea coastal States are obliged to provide *"right of innocent passage"* to all vessels through their waters. For Australia to have unilaterally declared compulsory pilotage through

the Great Barrier Reef would have contravened these international obligations with possible ramifications for Australian shipping overseas. It would have also set a potentially dangerous precedent for unilateral action by coastal States adjacent to strategic shipping routes.

The Australian Government therefore opted for an international campaign to gain international consensus and endorsement from the IMO and this successfully and commendably culminated with the IMO identifying the Great Barrier Reef Region as a *"Particularly Sensitive Area"* in November 1990, the first such area in the world to receive greater protection under this new IMO classification.

As a result the Australian Government could proceed with introducing compulsory pilotage and this was achieved through an amendment to the *Great Barrier Reef Marine Park Act (1975)* in October 1991. All ships 70 metres in length and over and all loaded oil tankers, chemical carriers and liquefied gas carriers, irrespective of size, are required to carry pilots when navigating the hazardous northern part of the Reef (north of Cairns) and Hydrographers Passage (off Mackay). Pilotage is not compulsory for the rest of the Great Barrier Reef, the Torres Strait and Great North East Channel. However ships transiting the inner route normally pick up their pilots at the western entrance to Torres Strait so most ships transiting Torres Strait and the Great North East Channel are piloted.

The introduction of compulsory pilotage has substantially decreased the risk of ship groundings in the Great Barrier Reef. However it does not eliminate the risk (the *"Oceanic Grandeur"* was piloted when it grounded on an uncharted rock) and it does not address spills from collisions, structural failure and operational discharges.

Reception Facilities

A crucial component in preventing pollution of the Great Barrier Reef from operational discharges is the provision of adequate waste oil reception facilities in ports. Provision of such facilities is obligatory for signatory states to MARPOL. Waste contractors with vacuum trucks are available to take waste oil from ships in the ports of Cairns, Townsville and Gladstone, however no reception facilities are available at Cape Flattery, Lucinda, Abbott Point and Hay Point, which together handle a very significant proportion of Reef shipping. This situation undoubtedly contributes to the frequency of discharges of oil from ships observed throughout the Great Barrier Reef.

Conclusions

Oil Spill Frequency and Risk

- There have been no major oil spills on the Great Barrier Reef since the *Oceanic Grandeur* in 1970.
- However the threat remains with 2,000 large ships transiting the Reef each year, about 100 of which are tankers.
- There have been 24 groundings and 19 collisions involving large ships in the Reef Region since 1979, some resulting in minor pollution and most having significant pollution potential.
- Operational discharges from large ships continue to be a regular cause of oil pollution in the Great Barrier Reef, with thirty ship-sourced slicks being reported to GBRMPA since 1990.
- Incidents with small vessels are also a source of oil pollution, with over 350 collisions, groundings, sinkings, fires and other incidents occurring in the Reef Region since 1980.
- A recent risk analysis indicates the probability of one or more major spills (over 1370 tonnes) occurring in Australian waters, from tankers, could be as much as 49% in any five year period and 84% in any twenty year period (BTCE, 1991).

- The report found that shipping accidents per unit shipping are greatest for the inner route of the Great Barrier Reef.
- Australia faces a major challenge in that one of its most sensitive areas is also one of the highest risk areas - the Great Barrier Reef.
- The risk of a major ship- sourced oil spill in Australia is compounded by the fact that many ships visiting Australian waters are poorly maintained and operated (Ships of Shame, 1992)

Impacts of Oil

- The impacts of oil spills are not predictable and will depend on a large number of variables at the time of the spill.
- Oil spills have the potential to cause severe acute and long-term environmental and economic impacts, including destruction of habitat such as mangrove forests, seagrass beds and coral reefs, reduced abundances of species inhabiting these habitats, reduced productivity and contamination of fisheries and disruption of tourism and recreational activities. It is possible for the costs of a single major spill to amount to billions of dollars.
- The sub-lethal long-term impacts of low-level chronic oil pollution may be of greater concern than the impacts of single event major spills.

Response

- In recognition of the fact that despite preventative measures, marine oil spills can and do occur, Australia has developed the National Plan and REEFPLAN. These plans coordinate the Commonwealth, Queensland and industry to ensure effective response is mounted to marine pollution incidents around the country.
- The technology currently used by Australia and other countries to combat marine oil spills is largely primitive and ineffectual and there is a need for a research and development of new and alternative response technologies, funded by government and industry,
- The nature of oil on water and the limitations of oil spill response dictate that apart from in exceptional circumstances authorities can not guarantee prevention of ecological damage and economic loss in the event of small to large sized marine oil spills.
- However there is no doubt that through proper planning and preparations the chances of decreasing the level of impact are improved, and it is vital that oil spill response plans are developed and improved to complement prevention measures.

Prevention

- Prevention of ship-sourced spills is achieved primarily through international conventions and Australian legislation regulating the design, construction and operation of vessels, the provision of navigation aids and facilities, and special measures such as compulsory pilotage.
- The effectiveness of international conventions and domestic legislation in preventing oil spills is limited by poor compliance with the conventions by signatory states, the existence of *"flags of convenience"*, the commercial nature of classification societies, an ageing world fleet, poor crew standards and difficulties with surveillance and enforcement.
- The effectiveness of navigation aids and facilities in preventing oil spills is restricted by limitations on the availability of funds and resources to ensure the best systems available are in place.
- Special measures such as compulsory pilotage only partially reduce the risk from a specific cause, and must be part of a broader package of integrated preventative measures.
- There is a need to ensure all Queensland ports in the Reef Region provide adequate waste oil reception facilities in order to reduce operational discharges within the Reef.

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Table One Collisions involving ships in the Great Barrier Reef Region, including Torres Strait, since 1979.

Date	Ship/Incident	Location
6/7/79	"AM Carrier" (1 922 t)/"FV Suzie PK".	Heath Reef, Torres Strait
12/5/81	"MV Tokurasa Maru" (44 821t)/wharf	Townsville Harbour
30/4/81	"MV Golden Explorer" (15 470t)/beacon	Gladstone Harbour
2/11/81	"MV Lake Barrine" (12 077)/wharf	Cairns Harbour
18/11/81	"MV Caribbean Blue" (12 077t)/wharf	Gladstone Harbour
18/2/82	"MV Chikoku Maru"(63 287t)/wharf	Gladstone Harbour
22/9/84	"MV Conus"(26 324t)/wharf	Mackay Harbour
9/4/85	"SS River Boyne"(51 035t)/wharf	Gladstone Harbour
20/6/85	"SS River Boyne" (51 035t)/"FV Babirusa"	Piper Reef
6/7/85	"Iron Cumberland" (21 383t)/"FV Saltfjord"	Princess Charlotte Bay
3/1/86	"MV Nishiura Maru (96 968t)/wharf	Hay Point
29/7/86	"TNT Carpentaria (30 144t)/wharf	Gladstone Harbour
29/8/87	"MV Holgh"(25 000t)/wharf	Abbott Point
20/2/88	"MV Carnel Star" (13 021t)/wharf	Cape Flattery
/1/89	"Spartan II"/ unknown FV	off Eel Reef
/8/90	"Pioneer Tween" (11 000t)/"FV Elizabeth J"	off Unison Reef
17/6/91	"Jin Shan Hai"/"FV Kekenni"	off Port Douglas
/9/91	"Khudozhik Ioganson"/zodiac	off Cairns
/12/91	"Fareast"/"Rhonda Lene"	Middle Reef

Total no. collisions: 19
No. collisions with port infrastructure: 11
No. collisions with other vessels: 8
(data sources: AMSA, DoTC. QDoT).

Table Two **Groundings of ships in the Great Barrier Reef Region, including Torres Strait, since 1980.**

Date	Ship	Location
27/1/81	"SS Yarra River" (34 025t)	Gladstone Harbour
26/4/81	"MV Academy Star" (33 442t)	Gladstone Harbour
12/5/81	"MV WM Leonard" (15 470t)	Townsville Harbour
18/7/81	"MV Bulknes" (13 284t)	Quoin Channel, Gladstone
22/1/82	"MV Japan Poplar"(68 098t)	Gladstone Harbour
27/1/82	"SS Curtis Capricorn"(48 947t)	Gladstone Harbour
4/10/82	"MV Ampol ? " (65 024t)	Prince of Wales Channel, T.S.
5/8/84	"MV Oslo Stripe" (20 511t)	Gladstone Harbour
25/10/84	"SS River Boyne" (51 035t)	Gladstone Harbour
25/3/85	"TNT Alltrans"	Lady Musgrave Reef
/8/85	"Maritime Gardenia"	Alert Patches
31/5/86	"MV WM Leonard" (15 470t)	Cairns Harbour
/7/86	"Mobil Endeavour" (19 600t)	Alert Patches
/9/86	"Alam Indah" (9 100t)	Chapman Is Reef
/4/87	"Ruca Challenge" (1 600)	Piper Reef
/5/87	"River Embley" (40 000t)	Alert Patches
/12/87	"Leichardt"	Endeavour Str
/8/88	"Pacific Ace" (13 700t)	Waterwitch Reef
/6/89	"Adele" (11 000t)	Heath Reef
/4/90	"Caraka Jaya Niaga III" (3 200)	South Warden Reef
/1/91	"Gulf Tide"	Endeavour Strait
22/7/91	Unknown ship	Lizard Is. Reef
9/9/91	"Jovian Sloop"	Unison Reef
4/10/91	"TNT Carpentaria"	Prince of Wales Channel

Total no. groundings: 24
No. groundings in ports: 9
No. groundings in Reef areas: 15
(data sources: AMSA, DoTC, QDoT)

QUESTIONS AND ANSWERS *

Steve Raaymakers presentation

Question
In terms of the amount of oil going into the Great Barrier Reef area, to what extent are the smaller vessels, e.g. fishing vessels a problem?

Answer
I haven't done any calculations. It would be a simple exercise to add up all the incidents, although a lot of them do not have the size of spills estimated. We do have about one report per week of very small discharges from small vessels somewhere in the reef. We are talking about minor quantities from aerial observations mainly. It is difficult to estimate the quantities, knowing that one litre of oil can possibly cover about 1 hectare of water.

There is a possibility that in areas of concentration of fishing vessels - for example in the Northern Section where motherships provide fuel for fishing vessels transfer bunkers -there is probably a low level of chronic pollution. Some monitoring should be undertaken to check this.

I am more concerned about the large ships, where it is possible to get a slick of up to 10 tonnes which if it ends up on a reef or beach can do some major damage to that area.

I don't know to what extent small ships add to the pollution in terms of percentage and quantities. They are certainly more frequent but much smaller.

Question
Your first graphic didn't show the passage through the TS and GNEC. Can you confirm that the coast right up to PNG is really an area of interest even if it's not under your jurisdiction?

Answer
Yes, it certainly is an area of interest. In fact the REEFPLAN area extends up into Torres Strait.

Question
There is obviously increased amounts of traffic from the Gulf of Papua oil terminals, but it doesn't appear in your traffic pattern.

Answer
Yes that's true. We understand that as a result of the Kutubu Oil Project, I understand there is about an extra 100 tankers a year going through TS.

Question
What's the level of aerial surveillance today in the Reef area?

Answer
There are two types of aerial surveillance:
1: Coast Watch (AMSA and GBRMPA are clients). I don't know what the Coast Watch flying frequency is at present.
2: Marine Parks Surveillance. Flights about one per week per sector with one out of Cairns, one out of Townsville and one out of Rockhampton.

It's as much as can possibly be done within a limited budget, but given the huge area of the region, many would say that it is not providing adequate coverage.

Question
I don't know if you are aware of a report to the US Congress, where it was stated that in any litre of oil there are about 5 - 10 naturally occurring organisms which actually attack the oil. Is that your understanding?

Answer
I don't understand that those organisms are in the oil itself; I'm sure the oil industry itself would be working on the problem or it would be losing a lot of oil. But, certainly there is a large number of organisms occurring naturally in seawater and it is one of the main natural processes that removes oil from the system. It is possible to enhance the process using thing such as bio-remediation and we are trying to get a research program off the ground in this area.

Question
Is there any evidence of natural seepage of oil from the seabed in the Reef region?

Answer
There is no evidence and latest geological research indicates that the region is young and has no projectivity for oil.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

DEVELOPMENTS IN SHIP SAFETY STANDARDS: IMPLICATIONS FOR PROTECTION OF THE GREAT BARRIER REEF

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Preamble

The Torres Strait and Inner Route of the Great Barrier Reef (GBR) are used by an extraordinary variety of ships and boats, ranging from trawlers and pleasure craft to large international tankers and bulk carriers. All but the smallest vessels are confined to a few, well defined routes which are potentially hazardous to navigation, being frequently very narrow, confined by many charted dangers, depth limited and strongly influenced by tides and tidal streams.

In order to safely navigate through these waters and avoid those marine accidents, such as ship collisions and groundings, which could lead to a pollution incident in the sensitive environment of the GBR area, the maritime industry in general must observe acceptable standards of ship operations, crew training and maintenance procedures. Such standards are, to a large extent, internationally agreed and laid down by the International Maritime Organisation (IMO) in the form of conventions and codes; however, the degree of compliance with those standards by some flag states, particularly those offering "flags of convenience" (FOC) registers are frequently questionable and a cause for concern by the more responsible flag states and ship operators.

At the same time, Australian Commonwealth and State agencies with an interest in the safety of the marine environment in the GBR have a responsibility to ensure the provision of the infrastructure (such as accurate and reliable navigational aids and professional pilotage services), guidance and, if necessary, regulation to support, or direct the operations of shipping and commercial and recreational boating in the GBR. The Australian Maritime Safety Authority (AMSA) was established in January 1991 as a government business enterprise with a charter *to enhance efficiency in the delivery of safety and other services to the Australian maritime industry.* This charter devolves into five prime functions:

- to enhance maritime safety
- to provide a national system of navigational services
- to administer programs to combat marine pollution
- to provide services to the maritime industry
- to coordinate maritime search and rescue services

Throughout this workshop you will gain an understanding of how AMSA undertakes these functions and how its activities contribute, both directly and indirectly, to the protection of the marine environment of the GBR.

Introduction

The Ship and Personnel Safety Services Business Unit of AMSA has been tasked with the corporate goal of *ensuring that national and international ships working in Australian waters are seaworthy and operated safely.* In this presentation I wish to look firstly at the general nature of the navigational safety hazards faced by shipping presently transiting the GBR, the characteristics of that shipping including the numbers and types of

[1] The assistance of John Macdonald of AMSA in the preparation of this paper and the associated presentation is acknowledged.

vessels and their flags. A brief look at some cargo and trade statistics, including trade projections for the main Queensland ports in the GBR will also be beneficial.

I then intend to move onto the core issues related to safety of shipping, to identify some of the known problems, such as *lack of observance of safety standards by* some states and ship owners and what AMSA and the international maritime community is doing to redress these issues, all of which have implications for shipping safety in the GBR.

Navigational Safety : Torres Strait and the GBR
Captain Peter Small from the Queensland Coast and Torres Strait Pilot Service, in speaking on a pilot's perspective of the GBR, will provide a more comprehensive picture of the hazards of navigating large ships through "the Reef". However, a brief introductory overview of the geography and oceanography of the Torres Strait and Inner Route of the GBR will serve to bring us all onto the same plane of general navigational awareness of the areas we are addressing here today.

The Western Approaches and Prince of Wales Channel
The recommended western entry to the Torres Strait is currently through Varzin or Gannet Passages (Chartlet 1), leading into the main shipping route to the immediate north of Cape York, the Prince of Wales Channel (PoW). This channel is subject to high rates of tidal stream and tidal patterns are complex due to the confluence of two ocean systems in that area. The maximum allowable draft for ships passing through Gannet Passage is 12.2 metres, which provides an under-keel clearance of just one metre at high stages of the tide. Careful and complex calculations are required by pilots of deep draft vessels to establish the timings of "tidal windows of opportunity" for their passage through the straits.

PoW Channel passes between the fringing coral reefs of Goods, Hammond and Wednesday Islands and is 1,500 metres wide at its narrowest point between Sunk and Mecca Reefs. At the eastern end of PoW Channel the route is between Alert and Herald Patches, where the channel narrows to 800 metres. Both these patches are sand waves. Alert Patches are formed on the southern edge of a rock shelf where the *River Embley* grounded in 1987.

Great North East Channel
The vicinity of Alert Patches acts as the point of divergence for vessels continuing through the Torres Strait and those using the Inner Route of the Great Barrier Reef. Vessels leaving PoW Channel for Papua New Guinea, other South Pacific ports, New Zealand or the American west coast, shape their course to the northeast via the Great North East Channel (GNEC). The critical part of this passage is Vigilant Channel, where depths of 12.8 metres are found and tidal streams can be quite swift, but once through this danger, the passage is *relatively* straight forward for an experienced navigator. Pilots boarding and leaving vessels using the GNEC do so at Dalrymple Island, with pilot launches being based at nearby Yorke Island.

Great Barrier Reef Inner Route
Between Booby Island (western end of PoW Channel) and Low Islets (just north of Cairns) a two way route has been established (Chartlet 2) for use by ships of medium draft, known as the Inner Route of the GBR (IRGBR). Details of this route and explanatory notes are given on the appropriate large scale navigational charts. The passage through these waters involves navigation within confined waters for a long period, normally about two days from Booby to Cairns, this particularly restricted section being about 500 nm in length. The majority of this passage, from Cape York to the approaches to Cairns, falls under the compulsory pilotage provisions of the *Great Barrier Reef Marine Park Act 1975* which will be mentioned further later in the paper.

Hydrographers Passage
Following extensive surveying of the area by the Hydrographic Service of the Royal Australian Navy, Hydrographers Passage opened for daylight navigation in December 1984 and for unrestricted, 24 hour use on 19 April 1985. The route offered a shorter route to the Coral Sea for vessels from the central and southern GBR ports, bound for Japan and Asian ports, particularly bulk carriers carrying coal out of Abbot Point (Bowen), Hay Point (Mackay) and Gladstone (Chartlet 3).

The passage has a minimum depth of 25 metres on or near the recommended track, which has also been swept with side-scan sonar to a width of 0.5 nm each side. This greater depth offers an alternative route for deep draft vessels which cannot get through PoW Channel and the Torres Strait. The major dangers lie at the seaward end of the passage which is where the pilots embark and disembark by helicopter. Like the IRGBR, Hydrographers passage is covered by the compulsory pilotage regime.

Characteristics of shipping
Traffic Patterns
Shipping passing through Torres Strait and the Inner Route of the GBR can be categorised as follows:

. International "through" shipping using the Torres Strait as a passage between the Coral Sea and the Arafura Sea and not visiting an Australian port;
. Foreign trading vessels bound to and from Australian ports;
. Australian flag vessels trading overseas;
. Australian registered commercial coastal traffic, including fishing vessels; and
. International and Australian non-commercial traffic, eg., recreational craft, tourist vessels and warships.

The figures in Table 2 refer to major shipping passing through the primary shipping channels and are taken from the reports of the Queensland Coast & Torres Strait Pilot Service (QC&TSPS). They do not include most of the small barges, fishing vessel and yachts that operate routinely in and through this region. However Table 1 is provided as an indication of the type of small support vessels operating in the Cairns-Thursday Island coastal areas of the IRGBR. Noteworthy is the amount of cargo oil, normally in the form of diesel fuel or distillate, carried by some of these vessels.

Great North East Channel
No recent estimates are available for the number of ships proceeding through the GNEC unpiloted in contravention of the International Maritime Organisation's (IMO) recommendation on the carriage of pilots, but anecdotal advice from the Queensland Coast and Torres Strait Pilot Service (QC&TSPS) indicates that about 90% of transits are being piloted. For those vessels piloted by the service, Table 2 provides a breakdown of GNEC ship transits (eastbound and westbound):

Types of Cargoes Passing Through the Torres Strait and GBR
Broad figures kept by the QC&TSPS are shown in Tables 3 and 5. These figures do not distinguish the routes taken by the various types of ships. The large number of coal ships travelling between the Queensland coast and Japan via Hydrographers Passage distorts the overall pattern.

- General Cargo

With the increasing development of Australian trade with Asian markets, particularly Singapore, Thailand, Taiwan, South Korea and Japan, container and general cargo shipping traffic through the Torres Strait and the GBR continues to flow at high levels.

This traffic trend is likely to increase as the international economy climbs out of recession.

- Bauxite and Alumina

Some ninety percent of the bauxite shipped from Weipa passes through Torres Strait. Most of this is carried by four purpose-built coal-fired bulk ships that shuttle to and from the QAL refinery in Gladstone. There were 102 Weipa Gladstone shipments in 1992, carrying a total of 6.35 million tonnes. Alumina product from the Gladstone refinery then proceeds to smelters at Boyne Island (Gladstone), Bell Bay, Tasmania and Tiwai Point, New Zealand. The efficient operation of this trade is of considerable importance to the Australian economy. The value of the Gladstone processing product alone is some $1.1 billion annually.

Each year about 25 shipments of Weipa bauxite (1.18 million tonnes) go through Torres Strait and the Panama Canal to Corpus Christi in the United States. The 100,000 -150,000 tonnes of kaolin to be exported from Weipa each year to Japan, is normally shipped via the Arafura Sea.

About 70 ships passing to or from the Nabalco bauxite mine at Gove also use Torres Strait each year. Of these, about six 40,000 tonne tankers deliver liquid caustic soda to Gove from the United States (via Panama) and then pass back through Torres Strait for Queensland ports to back-load molasses. About ten 65,000 bulk carriers ship Gove bauxite through Torres Strait to Venezuela and some 6 bulk carriers load alumina for Canadian and United States ports each year. Gove is also supplied by ten 2,000 tonne barge shipments from the east coast via Torres Strait each year.

- Manganese

Another important cargo regularly passing through Torres Strait is supply from Australia's only manganese mine at Groote Eylandt to Newcastle, Port Kembla, Geelong and Bell Bay. An average of one bulk carrier a month carries supplies for the domestic market (450,000 tonnes per annum). In addition, there are approximately twelve shipments of manganese each year through Torres Strait to the United States, Canada and Mexico.

- Oil

The new Jabiru and Challis oil fields west of Darwin are adding significantly to the tanker traffic between the northwestern coastal fields (Barrow Island, Northwest Shelf, etc) through Torres Strait to the east coast. This oil trade is currently increasing by 10-15 percent per year. The Kutubu Oil Field in PNG is now on stream and provides about 2-3 tankers per month westbound through the Torres Strait.

- Iron Ore

There is a regular movement of iron ore ships from New South Wales through Torres Strait to the northwest iron ore ports in ballast. These ships are too deep to pass through the Torres Strait when laden and go south about. This route has the advantage that the ships always cross the Great Australian Bight with the prevailing weather astern.

Important international trade passing through Torres Strait includes shipments of coal, wheat, sugar and manufactured goods from Australian east coast ports to Southeast Asia, India and via Suez to Europe. Petroleum products and manufactured goods are carried from Southeast Asian ports to eastern Australia.

- Non-Commercial Ship Usage

The seagoing tourist trade in the area is growing despite the recent setbacks of the recession. At present there are three ships operating out of Cairns into the Torres Strait region on at least a weekly basis during the dry season (the southern winter). The high season for yachts passing through the area is also the dry season, when southern yachtsmen seek warmer climates and they are assisted by the southeast-trades in passages up the east coast.

Fishing vessels are active throughout the year in the GBR, however there is a major increase beginning in late February/March when a multitude of vessels move north to the Arafura Sea and the Gulf of Carpentaria for the prawning season. Fishing vessels and recreational craft pose a particular threat to the safety of navigation of large vessels restricted in their capability to manoeuvre by their size, draft and searoom.

- Trade Projections

The annual trade growth projections by the Harbours Corporation of Queensland sees small, but steady and continuing growth in commodities such as coal, sugar and silica over the next five to seven years. This suggests shipping numbers and movements will not decrease significantly in the period although advances in ship design will probably herald larger volumes of cargo being lifted by individual vessels.

- Trends in Usage

The shipping statistics as a whole show a strong percentage increase for Australian trade for every year since 1983 and use of Torres Strait and the Inner Route of the GBR is growing in broad proportion. The QC&TSPS has reported that record numbers of ships have been piloted and tonnages carried in all of the last four years (Table 4). The industry predicts that traffic through Torres Strait and other passages will continue to increase at about ten percent per year for at least the next five years. Furthermore, if survey work in the Great North East Channel finds better routes, then the trade on that route has the potential to rise rapidly.

There has been a trend for some vessels, particularly Australian owned or operated oil tankers, to transit through Torres Strait and **outside** the GBR, through the Coral Sea. This trend is not large at present but represents a conscious effort by the Australian oil transport industry to avoid routing through the IRGBR.

While there will be an overall increase in movement through the Torres Strait/IRGBR system, it does not seem likely that the balance of ship types will change to any great extent before the turn of the century. However, as we will hear, it is possible that during the next few years we will see the introduction of new designs of ships with shallower drafts which may permit larger numbers of certain types of ships to use Torres Strait; in particular, tankers sailing between the Jabiru (and Challis) oil fields and the eastern coast of Australia and coal ships sailing between the Queensland Coast and Suez (or India).

Problems - ship safety management and regulation

While the functions of AMSA were broadly based on the former of Maritime Operations Division of the Department of Transport and Communications, the approach that AMSA has taken differs in a number of important ways. One of the significant differences is the manner in which AMSA uses a consultative approach in determining policy relating to ship safety and the protection of marine environment. Shipowners, unions, port authorities and State and Territory marine safety authorities play an active role in that consultative process.

Shipping is an international business. As can be gleaned from the previous Tables, the majority of Australia's export and import cargoes are carried on foreign flag vessels and as such Australia relies heavily on international law and conventions to regulate both the safety and commercial aspects of our trade. The most significant international marine safety forum is the International Maritime Organization (IMO). IMO conventions, code and guidelines cover most areas of the design, construction and operation of vessels and other floating structures.

The International Labour Organisation (ILO) has developed convention and codes of practice concerning employment in the industry as well as specifying requirements covering the living conditions on vessels and safety at the ship/shore interface. AMSA also has an involvement with the International Telecommunications Union (ITU), the International Association of Lighthouse Authority (IALA) and flag state authorities as part of port state control cooperation.

"Ships of Shame" Report
The Report from the House of Representatives Standing Committee on Transport, Communications and Infrastructure's (The Morris Committee) Inquiry into Ship Safety, "Ships of Shame", issued in December 1992, highlighted the dangers to the Australian marine environment posed by sub-standard foreign vessels with poorly trained crews operating in our waters. IMO is already targeting such vessels, pressing for greater observance of existing international marine standards and introducing new ship safety management systems and improved standards of crew training.

Government is currently considering the conclusions and recommendations of the "Ships of Shame" report. Significantly, this is the second major report on international ship safety in recent times. In the United Kingdom the Select Committee on Science and Technology of the British House of Lords, in early 1992, issued a report entitled "Safety Aspects of Ship Design and Technology". While the reports differ in the way they approach the issue of ship safety it is important to note that both reports highlighted the importance of the commercial environment in the implementation of safety standards.

Flags of Convenience
Flags of Convenience (FOC) have been used for centuries. As long ago as the 17th century British merchants used the Spanish Flag to avoid Spanish monopoly restrictions on trade to the West Indies. In the modern era however, the genesis lies in the establishment in Panama, in 1917/18, of the first open ship register specifically designed to enable American shipowners to avoid taxation in their own country. In 1919 a Canadian rum runner changed to the Panamanian flag to avoid US Prohibition Laws and by the 1920s, US passenger ships were registering themselves in Panama to avoid prohibition as well as tax.

The migration of ships from traditional flag states to FOC and "second registers" is a clear indication that ship owners are prepared to move to flag states which offer tax and investment incentives. The less stringent approach to ship inspections and compliance with IMO convention standards in some FOC states is also a lure for some unscrupulous owners to switch flag states. With the demise of operating and safety standards on the part of these owners also comes problems associated with the crewing of ships. Lack of crew training and experience, the exploitation and abuse of seamen by shipowners and officers, the reduced size of crews and the loss of crews at sea are all issues of great concern to the majority of seafaring nations.

The use of suspect registers in tax havens and suspect classification (marine survey) societies enables the unscrupulous owners:

- to avoid paying taxes;
- to avoid the cost of complying with the wages and conditions pertaining to the shipowners' countries;
- to avoid the cost of complying with the international conventions, guidelines and codes on safety to which the owners' countries are signatories, and
- to run their ships well past the limits of prudence and safety.

Some vessels registered under some FOC's are of high quality. However in a general sense a FOC allows for the separation of the beneficial owner from the operation of the vessel. This separation of ownership, country of registration and management of the vessel has been a contributing factor to the current problems in the industry.

The international systems of classification, ship inspection and safety, crew training standards and conditions of employment for seafarers, built up so slowly and painfully over several centuries, are now failing under the enormous economic pressure from tax and open flag shipping which began with Panama's open register over 75 years ago. Of course, there are good and responsible owners operating under Flags of Convenience but they must compete with the irresponsible owners whose cost advantage, through non-compliance with tax and safety regulation and payment of starvation wages to their crews, is driving the better owners out of business.

Increasing age profiles of bulk cargo vessels is a matter of serious concern. Current freight values do not allow for rational investment decisions to be made in new tonnage. There is conclusive evidence that links increasing age of vessels with the number of defects found in Port State Control Inspections.

Protective measures and ship safety standards

Port State Control

A crucial element in the maintenance of a safe marine environment is the development of port state control systems. In recent years it has been obvious that some flag states, owners, and particular class societies seemed unable, or unwilling, to adequately control vessels sailing under their jurisdiction.

The *port state* (the country in whose port the vessel is moored) has under the right under international conventions to inspect foreign vessels in their ports to ensure their structural integrity and ability to operate safely in national waters. This inspection system, termed *port state control,* has become a major element in ensuring the maintenance of minimum safety standards.

Paris MOU

The 1991 annual report on the port state control checks carried out in a group of fourteen European countries (the Paris MOU, Table 8) shows that 525 ships had to be detained *"due to deficiencies which impaired their seaworthiness"* compared to 448 in the previous year and 280 three years earlier in 1987. The 1991 detention figure represented 5.2 per cent of all ships inspected being detained which was a 20 per cent increase on the previous year.

As usual, the results showed a high proportion of FOC's among the registers with the worst records, the report cites the increasing age of the world fleet, incidents of "occasional extraordinary negligence in the area of ship maintenance" and the inability of many flag states to maintain a proper control over ships on their respective registers as the primary causes of the falling maritime safety standards.

Most deficiencies were found in lifesaving appliances (31 per cent of the total) and fire fighting appliances (16 per cent). Significant numbers of defects were also found in

general safety (11 per cent), navigational equipment (11 per cent) and ship's certificates (6 per cent).

Although the total number of inspections of all ships calling at Paris MOU ports rose in the reporting period, at 23.7 per cent, it fell short of the target of 25 per cent. However, because of the combined grouping benefits of the MOU countries and their ability to exchange information on visiting vessels, some 85 per cent of all ships which operated in Europe were inspected in at least one port during 1991.

AMSA Activity in Port State Control
Australia is currently at the forefront of developing a Memorandum of Understanding on port state control with the major maritime nations in the Pacific and Asia rim. The uniformity of inspections and the interchange of data regarding suspect vessels will be a major tool in the development of a safe marine environment.

It goes without saying that AMSA cannot guarantee that ships will sail safely in our waters or that they will not pollute the marine environment. What can be done is to put in place the right regulatory framework to enable all stakeholders in industry to act in a way that contributes to the safety of the whole transport system which includes the ship, the people who crew it and the commercial interests who run it.

Maintenance of Navigational Safety
Some obvious measures that AMSA can take as a positive contribution towards the maintenance of a safe navigational environment in the GBR include:

- Provision and maintenance of high availability and standards of navigational aids;
- Supporting mandatory pilotage requirements in particularly sensitive marine areas;
- Requiring high standards of crew training in navigational watchkeeping in Australian vessels and encouraging enforcement of similar standards in foreign vessels.
- Navigational Aids

Hydrographic survey operations and enhancement of navigational aids are a continuing process for AMSA, State marine authorities and the RAN Hydrographer. Improved tidal data gathering arrangements were set in place in the Great North East Channel (GNEC) in late 1992 and since Christmas two Navy hydrographic survey vessels have been active in the same area, revalidating the original route survey first completed in 1945.

The four radio tidal gauges in the Prince of Wales (PoW) Channel area are now all available on the one radio frequency and are also accessible by telephone. A Radar Beacon (RACON) has recently been installed on Bramble Cay as an aid to vessels approaching the eastern end of the GNEC from the Coral Sea. Planning is also proceeding in AMSA towards replacing the navigational buoys in the Varzin and PoW Channels and in the vicinity of Alert and Herald Patches with fixed structures over the next 2-3 years.

Because of the geographic and oceanographic nature of the region and the prominence of the shipping routes through the area, the Queensland coast has the largest density of navigation aids of any part of the Australian coastline and occupies a large part of AMSA's maintenance resources. However, high standards of availability are maintained, the national availability average, based on International Association of Lighthouse Authorities (IALA) standards, for the three year period ending 30 June for

the last three years has been:

1990	99.78%	1991	99.81%	1992	99.82%

With the improved technology now available and being employed by AMSA, such as solar powered lights, such standards of reliability and availability should be maintainable in the foreseeable future.

- Pilotage Services

The Queensland Coast and Torres Pilot Service has provided a reliable and effective pilotage service to the Torres Strait and GBR areas for over 100 years. In the past the Service and its operations have been overseen by the Marine Board of Queensland, but recently the Queensland Government has requested the Commonwealth to assume this role. In response to that request AMSA is presently in the process of assuming responsibility for the licensing of Queensland coastal pilots, the new arrangements for which should commence on 1 July 1993 once the necessary Commonwealth legislation and regulations are in place.

- Mandatory and Voluntary Pilotage Regimes

On 1 October 1991, the requirement to carry a licensed pilot in the Inner Route of the GBR and in Hydrographers Passage was made mandatory under compulsory pilotage legislation introduced through an amendment to the *Great Barrier Reef Marine Park Act 1975*. The requirement applies to all vessels of 70 metres or more in length and all loaded oil tankers, chemical tankers or liquefied gas carriers, regardless of length.

Prior to this time Australia relied on a non-mandatory IMO Resolution which, broadly recommended that all ships over 100 metres in length using the Torres Strait, Great North East Channel, Inner Route of the GBR and Hydrographers Passage should carry a pilot. Since implementation of the compulsory pilotage requirement there have been only five incidents of non-compliance, all in the early stages of the introduction, leading to two prosecutions, both successful.

The problem remains however that, for complex legal and diplomatic reasons, mandatory pilotage was not extended to the Torres Strait and Great North East Channel, which remains an IMO **recommended** requirement, albeit the ship lengths and explicit references to ships with specific types of potentially hazardous cargoes have been aligned with the GBRMP Act under a new IMO Resolution A.710(17). About 10 per cent of all vessels passing through Torres Strait and GNEC continue to ignore the IMO recommendation and proceed unpiloted.

IMO RESOLUTION A.710(17)

THE ASSEMBLY

1. **RECOMMENDS** that ships of 70 m in length and over and all loaded oil tankers chemical tankers or liquefied gas carriers, irrespective of size, use the pilotage services licensed under Australian commonwealth, State or Territory law, when navigating the Torres Strait and the Great North East Channel between Booby Island (latitude 10° 36' S, longitude 141° 54' E) and Bramble Cay (latitude 9° 09'S, longitude 143° 53'E);

2. **REVOKES** resolution A..619(15).

AMSA is considering the feasibility of introducing a voluntary ship reporting system for ships transiting the PoW Channel and GNEC in order to at least keep unpiloted vessels advised as to whether they can expect to meet other vessels in the main channels during their passage. As a secondary outcome, we would also be more aware of what type of vessels and of which flag were passing through this area.

- Standards of Watchkeeping

Traditionally, watchkeeping officers qualifying in Australian ships and trained at Australian colleges have been of a high calibre. The certification and examination processes controlled by AMSA also ensure that officers holding foreign certificates are carefully assessed or formally examined before gaining an equivalent Australian certificate. It is AMSA's stated intention to maintain such high standards of professionalism in Australian registered vessels and in the Australian maritime industry generally.

In the international forum of IMO, the base agreement on watchkeeping standards is the *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers* 1978 (STCW Convention). This convention is currently under review and Australia (AMSA) has participated extensively in the main Working Group set up to consider the framework of that review.

In fact, the Australian paper for the latest IMO Sub-Committee meeting on STCW in March 1993 (STW24.18) has become the reference document for the Working Group consideration of the training requirement of the STCW Convention, particularly in regard to providing alternatives to present crew structures, adoption of skills-based education and training and time-based practical experience elements. The new convention is expected to preserve the essential components of the existing STCW, with suitable provisions to:

. make the convention more effective in attaining its safety and pollution prevention objectives; and
. facilitate adoption of alternative training and certification procedures reflecting modern ship operations.

Significant technical developments in bridge design and navigational systems are also likely to impact on the quality of watchkeeping in the future. Some, like the "One Man Bridge Operation" (OMBO), are meeting a degree of non-acceptance but advances such as the Electronic Chart Display and Information System (ECDIS) and Differential Global Positioning System (DGPS) of which we will hear more later in the presentations, are rapidly entering service.

International Developments
Over the last three years or so the international industry has seen the dire consequences of inadequate standards in the global losses of large numbers of ships and their crews, particularly those carrying unforgiving cargoes such as iron ore. International standards and procedures already exist to ensure safe operation of ships although there will always be a risk of accidents at sea, as in any other mode of transport.

IMO has recognised that many contemporary problems are due, not to the lack of rules, but to the lack of will or competence of some administrations to implement or enforce existing rules. Consequently, a newly formed IMO Sub-Committee on Flag State Implementation (FSI), to meet for the first time in April 1993, has been tasked with investigating all relevant issues concerning the compliance of flag states. Compliance with IMO instruments is an issue that was identified by the "Ships of Shame" Report as being at the root of many of the problems of modern shipping and many of the international issues identified by the Senate Committee of Inquiry are to be pursued within FSI.

As a result of recent IMO meetings an AMSA officer now serves as the Chairman of the IMO Sub-Committee on Design and Equipment which provides an ideal opportunity to further advance improvements in ship design and safety. Australia has also participated actively in discussions at IMO regarding enhanced surveys of bulk carriers

and oil tankers and is supporting the actions of the International Association of Classification Societies to restore the confidence of the maritime community in classification surveys.

Summary
Pilotage by locally trained and qualified pilots is seen as a positive step towards the avoidance of accidents and the protection of the GBR. However, even a skilled pilot, given a decrepit, poorly maintained ship with an incompetent crew, cannot be expected to completely counter the threat such a vessel poses to the environment.

It remains therefore a primary requirement to develop further Australia's ability to detect sub-standard ships in our own ports and in our region of interest using the avenues of more effective port state control and regional cooperation. We must also continue to remain active in the IMO forums, pressing for greater observance of the promulgated standards in maritime safety, including ship and navigational safety and crew training.

The *"Ships of Shame"* Report has highlighted the low level of ship safety being maintained by some owners and flag states. Australia is keenly aware of the dangers and the potential impact of an accident in the Great Barrier Reef. Our safety regime is focussed at achieving the highest practical levels of safety within the marine environment.

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5. Queensland Coast and Torres Strait Pilot Service, Routine Reports and Summaries , 1989-92
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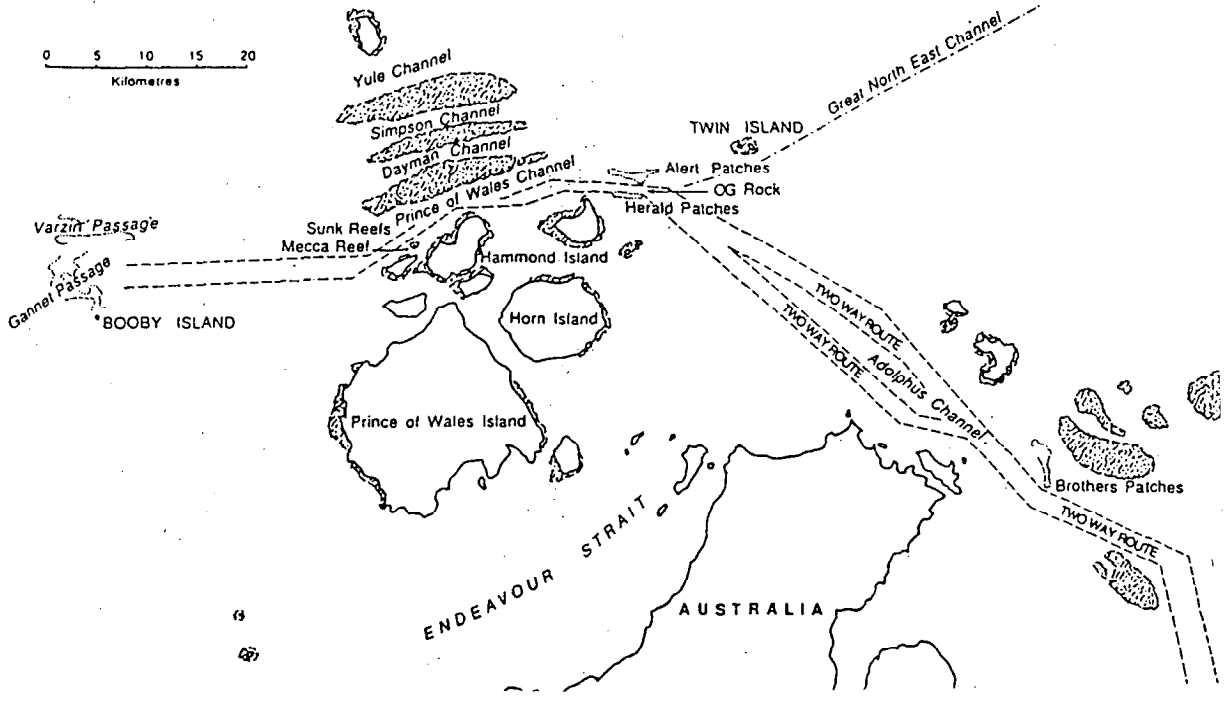
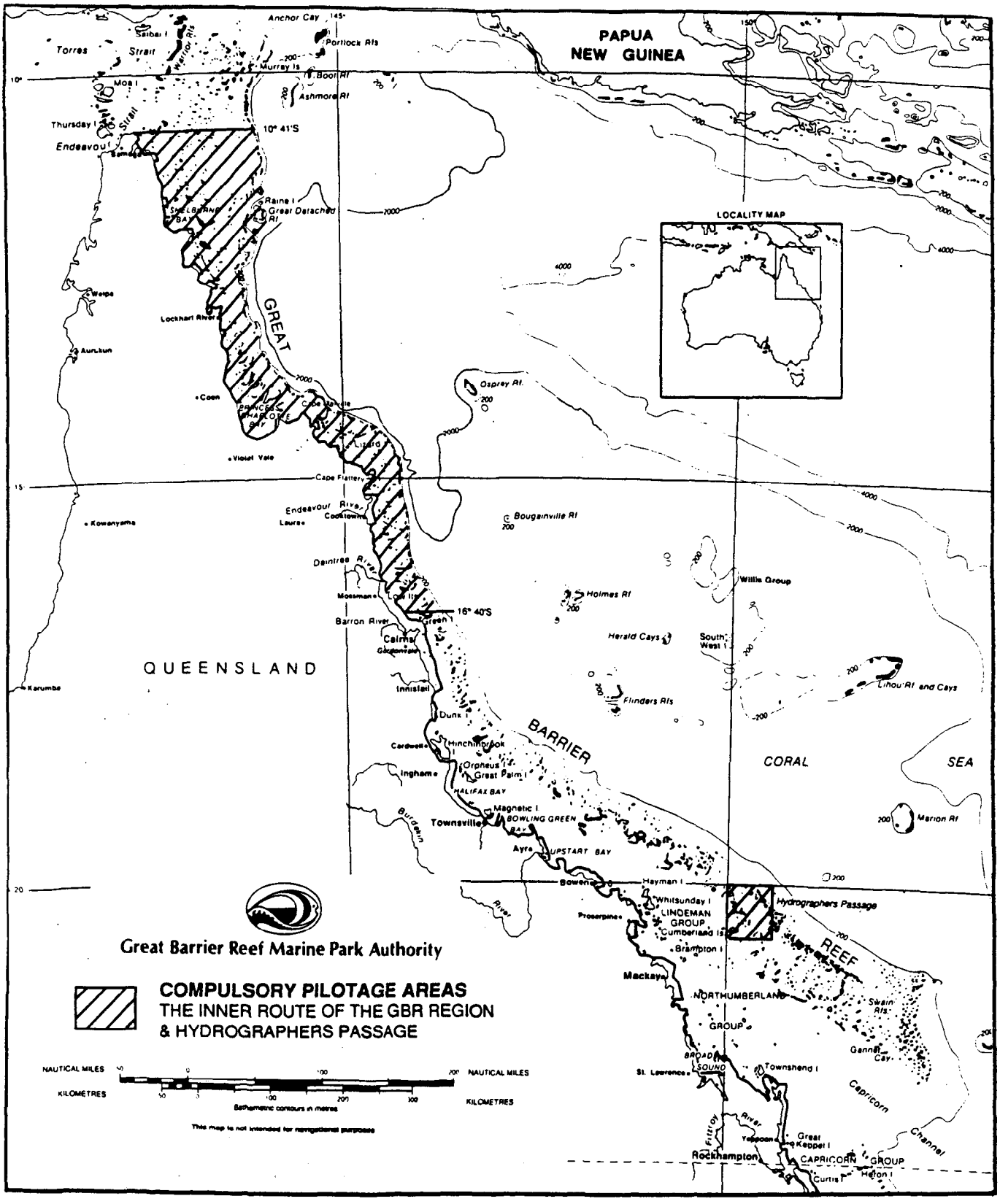
Chartlet 1: The Western Approaches and Prince of Wales Channel



Chartlet 2:


PAPUA
NEW GUINEA
Torres Strait
Anchor Cay
Saibai I
Warrior Rfs
Portlock Rfs
Murray Is
Boot Rf
Ashmore Rf
Mabuiag I
Thursday I
Stull
Endeavour I
10° 41'S
Raine I
Great Detached Rf
SHELBURNE BAY
Weipa
Lockhart River
Aurukun
GREAT
Coen
PRINCE CHARLOTTE BAY
Cape Melville
Lizard I
Violet Vale
Osprey Rf
Cape Flattery
Endeavour River
Cooktown
Laura
Kowanyama
Bougainville Rf
Daintree River
Mossman
Low Isles
Barron River
Green I
16° 40'S
Cairns
Holmes Rf
Herald Cays
South West I
Willis Group
QUEENSLAND
Karumba
Innisfail
Dunk I
Flinders Rfs
Lihou Rf and Cays
BARRIER
REEF
CORAL
SEA
Hinchinbrook I
Cardwell
Orpheus I
Great Palm I
Ingham
HALIFAX BAY
Magnetic I
BOWLING GREEN BAY
Townsville
Burdekin
Ayr
UPSTART BAY
Marion Rf
Bowen
Hayman I
Whitsunday I
LINDEMAN GROUP
Cumberland Is
Proserpine
Brampton I
Hydrographers Passage
Mackay
NORTHUMBERLAND GROUP
Swain Rfs
Gannet Cay
BROAD SOUND
St. Lawrence
Townshend I
Capricorn Channel
Fitzroy River
Yeppoon
Great Keppel I
Rockhampton
CAPRICORN GROUP
Curtis I
Heron I
LOCALITY MAP
Great Barrier Reef Marine Park Authority
COMPULSORY PILOTAGE AREAS
THE INNER ROUTE OF THE GBR REGION
& HYDROGRAPHERS PASSAGE
NAUTICAL MILES
KILOMETRES
Bathymetric contours in metres
This map is not intended for navigational purposes

Chartlet 3:

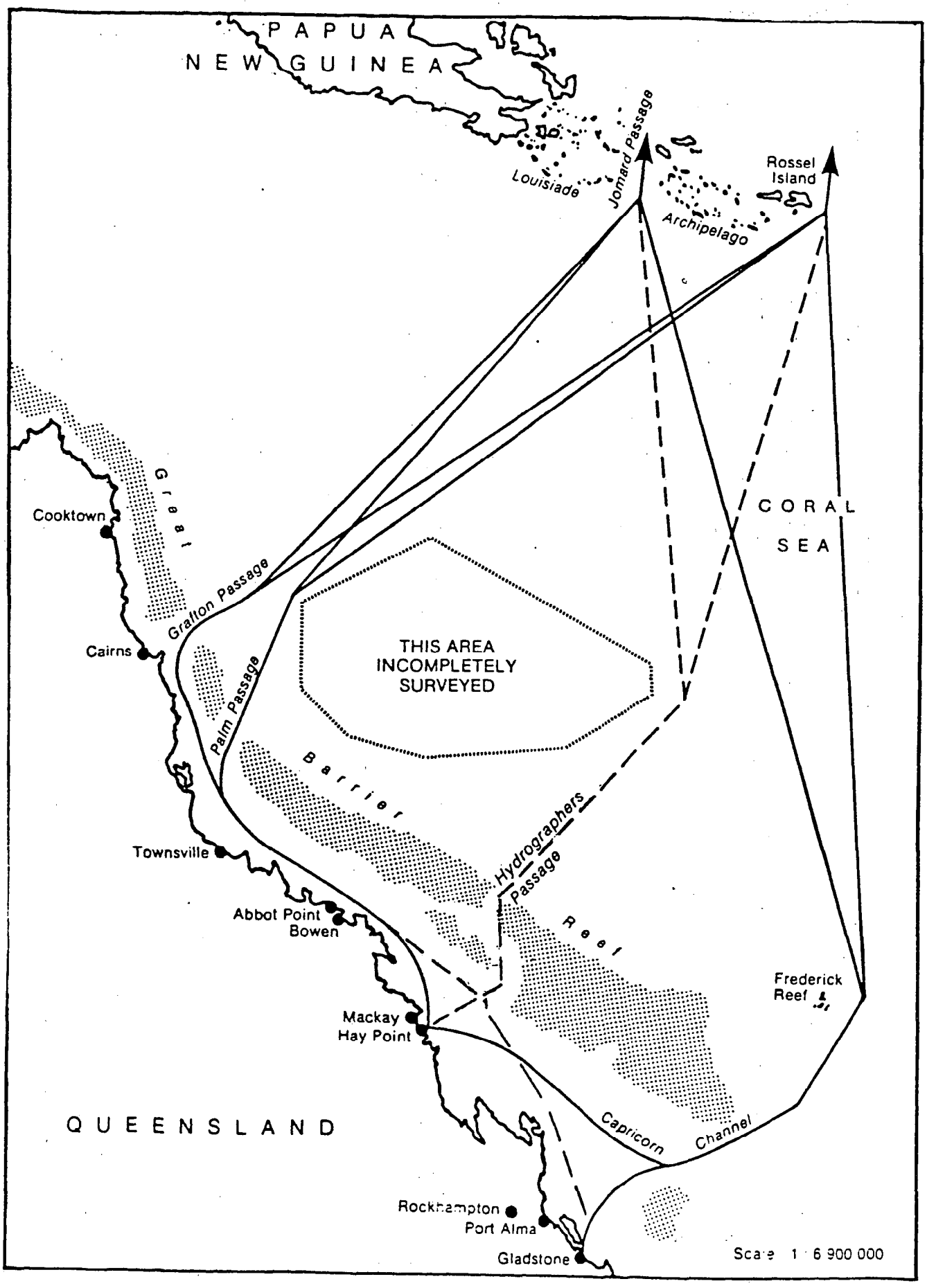

PAPUA
NEW GUINEA
Louisiade
Jomard Passage
Rossel Island
Archipelago
CORAL
SEA
Great
Barrier
Reef
Cooktown
Grafton Passage
Cairns
Palm Passage
THIS AREA
INCOMPLETELY
SURVEYED
Townsville
Hydrographers
Passage
Abbot Point
Bowen
Frederick
Reef
Mackay
Hay Point
QUEENSLAND
Capricorn
Channel
Rockhampton
Port Alma
Gladstone
Scale 1 : 6 900 000

Table 1: Sample - North Queensland Coastal Supply Traffic

VESSEL	LENGTH/ CARGO OIL	OWNER/ OPERATOR	TYPE OF OPERATION
KESTREL BAY	34.9 m 311 m^3	Seaswift Pty Ltd Cairns	FV Mothership
EMU BAY	40.1m 550 m^3	SeaswiftPtyLtd Cairns	FV Mothership
GULF EXPRESS	47.6m 630 m^3	Jardine Shipping Cairns	FV Mothership Supplying Outstations
BARGES Shell 11, Shell 45, Shell 56	39.0 m 600 m^3 45.0 m 830 m^3	Jardine Shipping Cairns	Stationary Fuelling Stations
PACIFIC PIONEER	54.6 m 537 m^3	Endeavour Shipping Cairns	FV Mothership
PACIFIC ENDEAVOUR	50.5 m 668 m^3	Endeavour Shipping Cairns	FV Mothership
MOLUNAT	69.0 m 330 m^3	Seaswift Pty Ltd Cairns	Coastal Trading (Cairns - Lockhart River - Thursday Is - Bamaga)
TRINITY BAY	64.0 m 1125 m^3	Seaswift Pty Ltd Cairns	Coastal Trading (Cairns - Lockhart River - Thursday Is - Bamaga)

Table 2: Ships Piloted (Type) - Great North East Channel(Jun92-Feb93)

Month	General/ Misc.	Bulk Carrier	Oil Tanker	Chemical Tanker	LPG Carrier	TOTAL
JUN 92	6	4	7	-	-	17
JUL	13	4	5	-	-	22
AUG	4	5	10	-	-	19
SEP	8	1	15	-	-	24
OCT	4	10	18	-	-	32
NOV	6	4	14	2	-	26
DEC	6	6	12	1	-	25
JAN 93	1	6	4	-	-	11
FEB	1	6	10	1	1	19
TOTAL	49	46	95	4	1	195

Table 3: Ships Piloted (Hazardous Cargoes) GNEC and IRGBR (Jun92-Feb93)

GREAT NORTH EAST CHANNEL				*INNER ROUTE GBR*		
Month	Oil Tanker	Chemical Tanker	Gas Carrier	Oil Tanker	Chemical Carrier	Gas Carrier
JUN 92	7	-	-	6	3	2
JUL	5	-	-	6	3	7
AUG	10	1	-	7	3	3
SEP	15	-	-	17	-	-
OCT	18	-	-	20	-	-
NOV	14	2	-	3	3	3
DEC	12	1	-	1	3	3
JAN 93	4	-	-	4	3	-
FEB	10	1	1	7	5	3
TOTALS	95	5	1	71	23	21

Note: An Oil Tanker was also taken through Grafton Passage in AUG and SEP92 and JAN93 (3 total)

Table 4: Total Trade Throughput - Queensland Ports

PORT	1986/87	1987/88	1938/89	1989/90	1990/91
ABBOT PT	5,720,379	5,942,594	4,997,689	5,560,692	5,441,892
BRISBANE	13,222,917	14,210,388	15,210,592	15,571,390	16,141,599
BUNDABERG	628,255	605,321	583,723	645,731	561,892
CAIRNS	894,239	1,060,977	1,140,802	1,144,846	1,155,009
CAPE FLATERY	713,133	1,023,315	1,290,385	1,366,607	1,529,621
GLADSTONE	26,875,313	28,141,112	28,962,854	29,570,480	31,854,469
HAY POINT	31,953,252	34,467,873	35,224,715	36,127,253	35,786, 486
LUCINDA	396,856	400,613	444,634	462,251	378,232
MCKAY	1,591,920	1,435,649	1,612,583	1,820,378	1,641,933
MOURILYAN	382,164	458,060	632,247	435,044	462,718
ROCKHAMPTON	314,744	318,875	312,274	309,892	295,748
THURSDAY IS	27,754	34,291	27,290	25,524	15,913
TOWNSVILLE	2,278,443	2,469,041	2,876,283	3,798,176	4,355,462
WEIPA	9,043,057	9,513,492	10,828,474	11,169,523	12,279,501
TOTALS	**94,042,426**	**100,081,601**	**104,144,545**	**108,007,787**	**111,900,475**

Table 5: Vessels Piloted (GNEC, IRGBR & HYDRO)

CARGO TYPE	1989	1990	1991	1992
Coal	696	755	806	969
Bauxite	244	252	272	220
Mineral Ores	61	122	116	126
Tankers	175	204	206	230
Container	193	198	259	347
Sugar	122	101	115	107
General	34	39	60	88
Grain	68	61	67	16
Steel/Metals	46	53	54	41
Reefer	43	30	20	16
Oil Rigs	3	5	5	1
Mineral Sands	22	31	53	71
Passenger	18	21	19	27
Tows	5	2	1	10
Tugs and Trawlers	3	2	1	5
Timber	11	10	7	3
Phosphate	1	2	3	2
Warship	23	5	1	6
Dredge	0	1	2	5
Geophysical	3	1	1	0
TOTAL	**1771**	**1895**	**2068**	**2290**

Table 6: Trade Projections (Selected Ports) - Harbours Corporation of QLD

Port	Cargo Type	1990/91 tonnage	1995/96 tonnage	2000/2001 tonnage
Hay Point	coal	35.8mt	48.0 mt (7.6%*)	53.0mt(2.5%)
Abbot Point	coal	5.4mt	6.2mt (3.30%)	6.2mt (0%)
Lucinda	sugar	378,232t	395,000t (1.1%)	448,000t (3.2%)
Mourilyan	sugar	462,719t	519,000t (2.9%)	588,000t (3.2%)
Cape Flattery	mineral sands	1.5mt	1.8mt (4.2%)	2.0mt (2.7%)

* *figures in brackets represent annual growth projections*

Table 7: Terms of Reference - Morris Committee

TERMS OF REFERENCE

To enquire into and report on the issue of ship safety at the national and international level, with particular reference to:

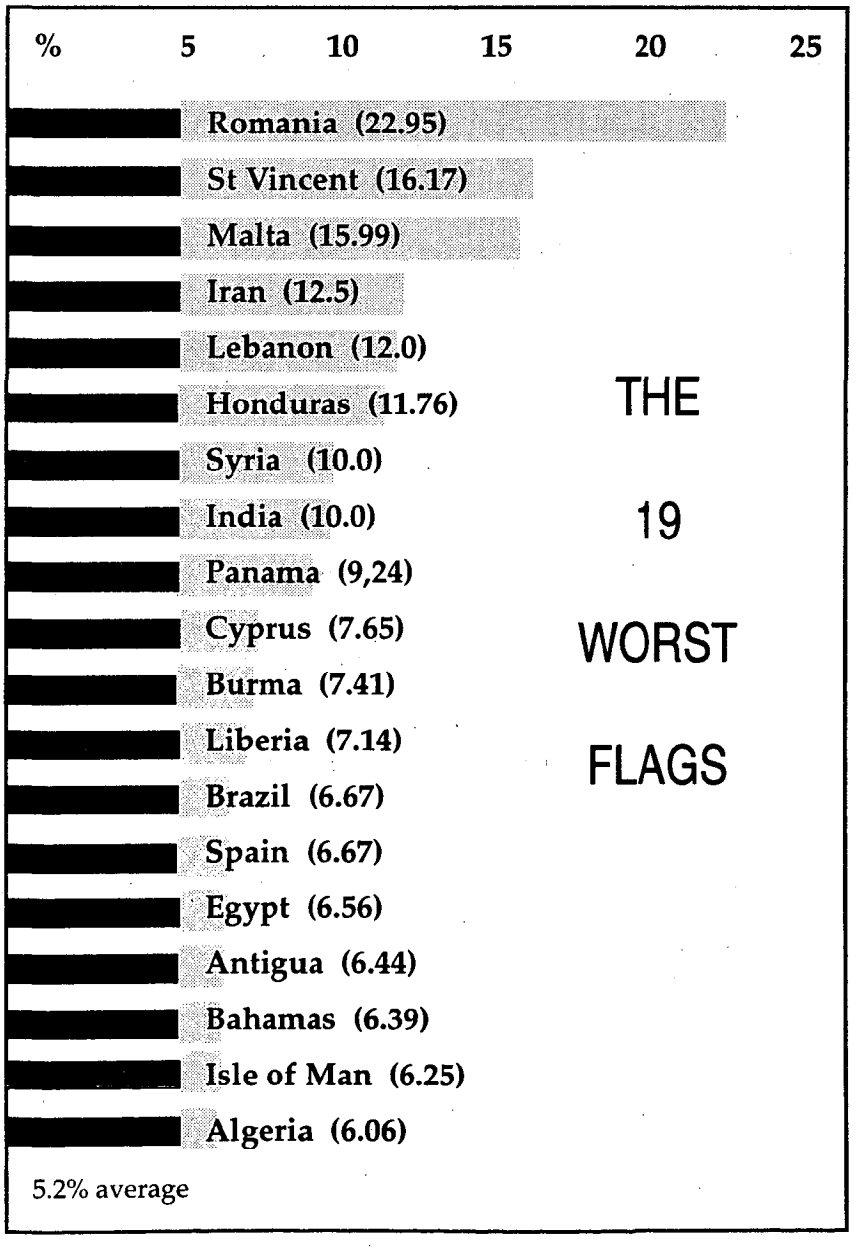
(a) The factors associated with recent vessel losses and incidents, particularly involving bulk carriers and tankers proceeding to and from Australian ports.

(b) The general standard of foreign vessels trading to Australia with particular reference to bulk carriers and tankers.

(c) The adequacy of the parameters established by international law and conventions for action by a port state in the inspection of foreign vessels.

Table 8: Paris MOU Nations - 1991 Report

This shows the 19 flag states whose ships were involved in delays or detentions above the average. Percentage of ships.



QUESTIONS AND ANSWERS *

Patrick Quirk's presentation

Question
What is the of feasibility of establishing a traffic control system in Torres Strait?

Answer
That would require developments within the international legal scene for Australia to have positive control over shipping movements in the Prince of Wales Channel. We could do it tomorrow, but how are we going to enforce it? Have a destroyer a Booby Island checking every ship? If people won't obey a system which is not legal in international terms, it's no good putting it in. I am hopeful the solution is compulsory pilotage.

Question
You mentioned briefly that exemptions from carry pilots exist for some vessels. Is the program working or have there been problems?

Answer
There have been no problems; in fact we have been pleasantly surprised by the co-operation from the vessel operators. They appreciate the significance of the Reef, and they appreciate that their commercial viability depends on their right to continue operating as they do. I have always found them willing to co-operate with AMSA in maintaining marine safety standards. Exemptions are only issued according to very stringent criteria. Those exemptions are primarily designed for local shipping, not large bulkers operating in the Reef area.

Question
You state that compulsory pilotage is the answer for all the Torres Straits and Prince of Wales Channel. When DFAT was looking at introducing a CP scheme in 1991, the understanding was that virtually all ships of concern would go through the inner route of the Reef and would be captured. Also the new port state controls at Kutubu are capturing more ships. How many vessels are missing either of these controls?

Answer
We have a problem that no Commonwealth agency or AMSA collects data in Torres Strait . We mainly rely on pilot statistics, but they can't cover every unpiloted vessel coming through the Great North East or the Prince of Wales Channel. The problem is not confined to tankers. We've noticed lately that large bulk carriers are tracking through the Great North East Channel and down the outside of the Reef to avoid paying Pilotage fees, and some of these large bulk carriers carry three of four thousand tonnes of bunker fuel so a spill there is just as serious as one from an oil tanker.

Question
In the English Channel there's been a traffic separation scheme for many years - admittedly for a much wider waterway - which limits the freedom of manoeuvre of the master of the vessel to a particular place. There are places in the world where it's already happening so why can't one be introduced in this area?

Answer
I've been very careful in my discussions not to raise expectations of a sudden change in international law. Compulsory pilotage is medium term goal. The Traffic

information system is something we can do now on a voluntary basis, which we feel will lower the risk profile of shipping problems in Torres Straits.

Comment from the floor
We know that there has been a voluntary vessel traffic system in the English Channel for a number of years. We know that France and the UK, are both working towards a compulsory commercial traffic scheme. We can watch what happens and see how we can react in Torres Strait. Authorities track about a thousand ships a day through the Dover Straits whereas we have about two thousand a year, so the problem is comparatively insignificant.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

THE JURISDICTION AND OPERATION OF TOURIST AND FISHING VESSELS IN THE GREAT BARRIER REEF

Captain Kerry Dwyer[2]
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Queensland Department of Transport

Summary

An overview is presented of tourism and the marine industry in Queensland with particular reference to the Great Barrier Reef region. A more detailed look at the various elements of marine activity then follows with particular emphasis on tourist operations on and around the Reef.

Recreational boating and supporting facilities are described following which a look is taken at the organisation and extent of the commercial fishing industry in Queensland. State certificates of competency and licensing arrangements are then described.

An explanation of present marine safety administration in Queensland is given, followed by a detailed look at the proposals for a new maritime legislative regime in the State, including new marine pollution provisions. Reference is made to the new arrangements for the licensing of Queensland Coast and Torres Strait pilots by the Commonwealth.

Duty of care principles and the obligations on vessel operators are discussed. A holistic approach to vessel safety is the one most likely to succeed.

Some of the procedures, systems and technological advances that the marine industry will have to absorb are described and the position of the marine industry in Queensland as it operates within the Great Barrier Reef region is described.

Introduction

Queensland is a "Leading State" with features including a strengthening economy with strong growth forecast, an enviable climate and mecca for tourists, bounteous natural resources and recreational opportunities, over 2000 nautical miles of coastline and with the gem of the Great Barrier Reef stretching some 2000 kms.

Tourism

Spending by visitors to Queensland amounts to approximately $2.7 billion of which some $1 billion for the State's economy is generated by The Reef. There are over 2.5 million visitors to the Great Barrier Reef region annually and overseas visitors outnumber interstate and intrastate visitors. We can expect the tourist numbers to continue to increase. Projections for the Cairns area alone indicate an increase in excess of 300% over the next 10 years.

Those countries where there is a good deal of disposable income and where there is a growing desire to travel, particularly the Asia Pacific region, will generate additional traffic.

As an example of tourist operations, out of the Cairns area close on 1 million tourists visit the Reef, most by high speed craft, each year, representing something of the order of $100 million in dollar terms for the local economy.

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[2]Text compiled by the editor from the author's talking notes.

There are a number of major routes to the Reef from ports along the Queensland coast and there are a number of charter operations which go to the outer Reef and Coral Sea Islands.

The Reef experience is such that once having sampled it most visitors aim to return prompting many repeat visits. The wonder that is the Reef makes it the ambition of many overseas visitors to include it in their Australian itinerary - in fact for many it is their very reason for coming to our country in the first place.

Cruise ships
Calls by overseas cruise ships to Queensland ports are on the increase. Last year there were 54 international cruise calls and cruising the Queensland coast has become an integral part of many itineraries. A recent visitor - probably the best known of them all and the most instantly recognisable - the "QE2", with a full complement of passengers, recently made her fourth call to Brisbane, as part of her world cruise. From Brisbane her programme took her up through the Inner Route and through Torres Strait before proceeding on to Darwin. Off Low Isles she transferred over 200 passengers to a Quicksilver wave piercing catamaran from Port Douglas for an trip to Agincourt Reef, before re-embarking them at the end of the day further up the coast off Cooktown.

Those who chose not to go on the Reef trip were able as an alternative to enjoy a leisurely meander along the coast during the day in near perfect conditions (the transfer took place using the QE2's own adjustable access pontoon).

Intrastate vessels
In addition to the international cruise business there are a number of smaller intrastate vessels which offer very attractive programmes. There are approximately 4000 commercial vessels other than Drive-yourself and Hire boats currently in survey in Queensland. Of these, approximately 600 are Class I vessels and in addition a number of other vessels have some limited passenger carrying capability. The larger day passenger catamarans are fast, well appointed vessels carrying over 300 passengers and a crew of 15. They are able to offer a variety of activities out on the Reef and have a solid reputation for customer satisfaction and tourist appeal.

Examples of intrastate cruising vessels range from the smaller type with accommodation for approximately 30 to the largest one which can accommodate 136 passengers and has a crew of 30.

Coastal barges
These are a significant sector of the industry in their own right and the various classes of vessel are represented amongst the fifty or so, both passenger and non passenger, coming into this category. Typical of the modern barge is one which is designed to carry 30 cars, 200 tonnes of freight and 50 passengers. A larger passenger and vehicular barge operating as a Smooth Waters ferry would have space for 50 vehicles and a certificate for up to 400 passengers.

Charter boats
There is a very well developed charter boat industry in Queensland and bare-boat chartering, particularly out of the Whitsundays area, is very popular.

Private pleasure craft
In addition, there are over 111,000 private pleasure vessel registrations in Queensland giving the opportunity to many to take advantage of the extensive opportunities for recreational boating and angling in State waters. There are 14 Crown boat harbours and several other recognised boat havens, 350 public boat ramps, 80 public landings and 71 marinas in the State.

Queensland has a vibrant and comprehensive marine industry. Builders and designers of a whole range of craft have a high reputation for innovation and quality products in both domestic and overseas markets; the marine engineering, chandlery suppliers and support sectors offer a first rate service; there are numerous and diverse commercial operations serving the State; there is a thriving fishing industry; and recreational boating is well catered for.

Commercial fishing

Management of commercial fishing in the State comes under the *Fishing Industry Organization and Marketing Act 1982* administered by the Department of Primary Industries.

The Queensland Fish Management Authority (QFMA) is constituted under this Act and has responsibility inter alia for fishery conservation and resource management, the promotion of the fishing and aquaculture industry, the fostering of recreational fishing, and the issue of Master Fisherman's and Assistant Fisherman's licences and fishing vessel licenses. In addition, the Transport Department surveys commercial fishing vessels 10 metres in length and over and currently is responsible for approximately 1100 such craft.

There are over 2000 primary fishing vessel licences and over 6000 licensed commercial fishermen in Queensland. There is a catch value of the order of $400 million. The industry supports over 14,000 jobs, directly and indirectly excluding processing, wholesaling and retailing.

Seafarers certificates of competency and training

State certificates of competency are issued by the Marine Board. The Board is also the licensing authority for pilotage and pilotage exemption and for the granting of recreational speed boat driver's licences.

There are some 18,000 Queensland commercial certificates and licences, of all grades, presently in force, as well as a large number of Speed Driver's Licences: over 200,000.

Maritime training is co-ordinated by the State Maritime Education Co-ordinating Executive (MECE) under the auspices of the State department DEVITIR, combining six colleges of TAFE offering certificate courses as well as a number of short vocational and technical courses and courses aimed at the recreational sailor. There is close co-operation between my Division and MECE in syllabus development. There are some private providers of maritime instruction in the State as well.

Marine safety administration

Responsibility for the administration of maritime safety is presently overseen by the Marine Board of Queensland, constituted under the Queensland Marine Act, subject to the Minister for Transport. Following a government review of the Marine Board and maritime safety administration, some 18 months ago, a process was commenced aimed at replacing the present Marine Act with a more appropriate maritime legislative regime in the State to accord with policy objectives.

The focus is set to change from the present dependence on detailed prescriptive regulation and licensing requirements, to more responsive arrangements with the emphasis more on self-regulation. It will be the duty of operators themselves to ensure safe operation of the vessel, its passengers and crew and the environment. The objective is safety management and a safety culture, with those responsible for the operation meeting their obligations in a more responsive climate. The objective is to encourage efficiency and growth in the industry and meet the State's needs while promoting safety.

Adequate safeguards and an incentive to achieve compliance, with appropriate sanctions for those who fail, will underpin the system. The present drafting stage of the Bill continues to involve extensive consultation with interested parties. There will be important consultative provisions within the Bill and it is intended that appropriate representative bodies will be set up under the Act to advise the Minister on safety policy and investigate major marine incidents.

Much greater attention will be paid to vessel operating standards. A system of monitoring and auditing will be put in place and designers and builders will be expected to move towards having verifiable quality systems. Under the new Bill the regulation of Queensland Coast and Torres Strait Pilotage will no longer be a State function and will be transferred to AMSA.

Objectives of the legislation - policy statement
"The objective of the legislation is to establish a regulatory regime which will provide a safe environment for the operation of the marine industry in Queensland waters, including both the coastal and inland waters. The regime so established will require to be consistent with both international and national obligations.

The objective is to be achieved by a regulatory scheme which:-

- lays down appropriate standards relevant to the circumstances to which they are to apply;
- provides incentives to vessel builders, owners and operators to meet those standards and sanctions for those who fail to do so;
- enables effective detection of failure to meet standards;
- provides on-going consultations with those effected;
- establishes a mechanism for the continued monitoring of the operation of the legislation through the consultative mechanisms;
- provides for a system of appeals from administrative decisions to ensure openness and fairness in administration; and
- is economical in both the costs of administration and the costs of compliance.

Responsibility for administering the new Act will rest with the Director-General of Transport under the Minister and will convey a range of powers and functions to implement the provisions of the Act and deal effectively with breaches of safety."

Pollution prevention

More or less coincidental with the introduction of a new Marine Safety Bill will be a new Marine Pollution Bill for Queensland waters applying to all vessels and giving effect to MARPOL 73/78 annexes I (Oil), II (Noxious Liquid Substances), III (Harmful Substances carried in Packaged Form) and V (Garbage). MARPOL 73/78 Annex IV (Sewage) will have to wait - it is not yet in force internationally.

Once in force the new Marine Pollution Act will ensure that there is appropriate State jurisdiction in matters of marine pollution, to the degree to which control is in force internationally. Of necessity, up to now, such comprehensive control has had to rely on Commonwealth legislation. Tourist vessels and other commercial operations, the fishing industry, the recreational user - all have a vital role to play in pollution prevention.

Good operational practices, good housekeeping, by exercising vigilance and prudent seamanship are all vital ingredients for adequate prevention. Such vessels can also be a contingent resource, even though limited maybe, in an emergent situation. A proper understanding, when encountering other traffic, of the constraints under which other vessels, both large and small, and possibly restricted in their ability to manoeuvre, are operating is essential.

General

A much greater emphasis in the future on operators discharging their duty of care will involve the operator having to have in place, as a minimum, a verifiable basic safety management system, geared to the particular operation. Properly trained and motivated crew and the provision of a well-designed, built and maintained vessel. In addition it will be necessary to have the right back-up and contingency arrangements in place for when things might not quite go to plan. Above all a paramount commitment to safety will have to be provided if that duty of care is to be properly discharged.

On the world scene, the debate on substandard vessels and operations on the one hand, and Quality, the 'Green Tanker', the "Ship of the Future" and Double Hulls etc. on the other goes on. The 'Safety Case', Risk Management, Safety Management Systems, contingent liability, contingent valuation methodology (CVM) and Escort Tugs, and the better enforcement of existing requirements, are all issues which are being given a much wider and often frequent airing, especially following any particularly public casualty. Sound-bites and emotive phrases seem to be media stock in trade. Selectivity can also creep in, resulting in considerably less air time for some casualties; consider the relatively limited prominence, minimal reporting and even lesser public debate afforded to the recent, tragic, *"Neptune"* sinking in the Caribbean, a major loss of life from a coastal ferry in a less developed country when set against some of the exhaustively reported "high profile" incidents - though in themselves extremely serious, round about the same time.

Further and to the future

The introduction of competency based training, better crew motivation and much improved operational standards are all necessary in order to better address the human element involved in vessel safety. Dealing calmly, sensibly and authoritatively with the sometimes shrill and often un-informed chorus of "something must be done" is never easy, a balanced response always difficult to achieve.

The hope is always that wise counsels will be allowed to prevail, with a better and more lasting solution the outcome. I suggest that the advocates of a holistic approach to safe operations will, at last, have their day. Safety will be better served as a result.

Meanwhile the pace of developments in vessel design, technology and equipment, both nationally and internationally is quickening. There is a new and exciting array of equipment, systems and safety management tools, much of it novel. As an industry we have available to us, right now, or look like having in the not too distant future:

- sophisticated simulators
  - Hand-held GPS
  - Differential GPS
  - ECDIS - electronic chart display information system
  - Integrated Bridges

- a wide range of propulsion systems and a selection of different rudder types and manoeuvring aids, in addition to:
  - EDI - electronic data interchange
  - GMDSS - global maritime distress and safety system
  - EPIRBS - emergency position indicating radio beacon
  - SARTS - search and rescue transponders
  - Dynamic underkeel clearance programmes
  - VER - voyage event recorders - 'Black Boxes'
  - Laser beam berthing aids
  - VTS - vessel traffic services

and a system marketed as 'Pilotwatch', a portable radar display ("radar in a briefcase") using a technique known as "data compression image transfer" to enable radar pictures from shore stations to be transmitted over VHF channels to portable receivers.

We are also asked to consider:

- bridge resource management (BRM) which is based on aircraft flight deck management systems increasingly used in aviation. This involves training programmes for ships officers and marine pilots and aimed to address the 'management error factor' involved in ship incidents by equipping those involved to better manage the human and technical resources in an operational maritime environment;

- failure mode and effect analysis (FMEA) which analyses the consequences of failure of each individual component on the safety of the system or operation by considering the behaviour and interaction of the components;

- vessel calling and identification system (VCIS) which will assist identification and request a target vessel to communicate, giving the ability, through advances in the application of GPS, for a ship or shore operator to automatically interrogate a vessel or series of vessels in a known position and the selected vessel's name, course, speed and draft to be transmitted automatically and be vectored and shown on a graphical display at the calling station. The selected vessel could be requested to communicate and this request would be displayed, combined with a visual and audible alarm, on board the selected vessel;

- Radar Target Enhancers, for low radar signatures as in the case of buoys and small craft which presently rely on passive reflectors;

- radar controlled autopilot (ARCAP);

- close approach radar and thermal imaging system (CARAT) enabling the visual outline of an approaching vessel rather than just the radar target to be seen to assist collision avoidance; and

- Marine Night Vision systems.

In the surveying field and marine environmental monitoring there is:

- LADS - laser airborne depth sounding equipment; and
- MERMAID - Marine environmental remote controlled measuring and integrated detection system for marine pollution monitoring

In the innovative and high speed craft arena there are:

- SWATHs - small waterplane area twin hull
- SESs - surface effect ship
- SSCs - semi submerged catamaran
- ASCs - advanced slender catamarans
- WPCs - wave piercing catamarans which have achieved world wide acclaim for their Australian builders
- the SEMP - superconducting electromagnetic propulsion vessel with the Japanese "Yamato I" possibly pointing the way ahead to the further development of this technology.

All these emerging technologies will require an even greater emphasis on the management of the human interface, on proper operational procedures and safety management systems.

Conclusion

In this brief overview of Queensland's marine activity and jurisdictional arrangements coming within the purview of my Division, some general comment on the maritime scene overall, and just a 'soupcon' of some of the technological, organisational and operational advances coming our way as an industry. I hope that I have been able to paint a contextual picture of the marine activities as they presently exist, or are likely to exist in the future, on or around the Great Barrier Reef.

At the same time I trust that I have conveyed to you the aims and objectives of the measures being taken in the State to further foster a responsible and efficient industry: that is up to the challenge, is conscious of its unique capabilities and opportunities, and is mindful of its obligations to operate in a manner which can deliver a safe operation within this absolutely unique and ecologically sensitive treasure that is the Reef.

QUESTIONS AND ANSWERS *

Kerry Dwyer's presentation

Question
Given the vast numbers of craft that you have identified in the GBRMP along the Queensland coast, how frequently do small craft cause navigational hazards to the larger craft navigating within the restricted pilotage area?

Answer
We do get a lot of reports but the pilots could give a better estimate.

Question
There are a lot of tour operators in the northern area of the GBR that have a considerable amount of speed now, 20-25 knots. There has been talk that this could double very shortly, is that likely to happen and where?

Answer
Yes, well we have been advised of a new vessel which is planned to have a capacity of 600 passengers and a 45 knot service speed. That only means that they are going to go further afield and probably further north because this area is largely untapped as a tourist resource. Certainly it would be a lot more flexible for operating out of places like Townsville which is forty miles from the Reef. I think there will be more of this rather than less and it will be the Queensland Department of Transport's task to deal with the safety implications.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

REVIEW OF OIL SPILL CONTINGENCY PLANNING IN AUSTRALIA AND OVERSEAS

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Australian Maritime Safety Authority

Introduction

The Australian Maritime Safety Authority (AMSA) is responsible for the prevention and control of ship-sourced marine pollution by virtue of subsection 6(1) of the *Australian Maritime Safety Authority Act 1990.* AMSA's corporate objectives include the protection of Australia's maritime environment by coordinating a national pollution prevention and response capability, specifically the National Plan to Combat Pollution of the Sea by Oil. (National Plan).

This paper provides information on the National Plan, with particular emphasis on the outcome of a major review which has recently been completed and is due to report to Commonwealth and State Ministers responsible for transport matters in June 1993.

The National Plan

In common with many oil spill contingency plans, the establishment of Australia's National Plan was prompted by an incident having the potential to seriously affect part of the national marine environment. In Australia's case the catalyst was the grounding of the *Oceanic Grandeur* in 1970, which occurred in Torres Strait, an area too close for comfort to the highly sensitive region of the Great Barrier Reef. At that time the impact of major oil pollution incidents and the devastation they could cause was only beginning to be understood. Later events have shown the enormous environmental impact of a major oil spill. The most recent involving the *Exxon Valdez* is still very clear in the thoughts of government administrations and the oil industry.

The National Plan was originally developed and implemented to respond to the need to provide a viable response to the threat of ship-sourced marine oil pollution after the *Oceanic Grandeur* incident. It has been in operation since 1973 and represents a co-operative effort by Commonwealth and State Governments, with the assistance of the oil industry, to help provide a solution to the threat posed to the coastal environment by oil spills from ships.

Since its inception, the National Plan has been administered by the Commonwealth Department having responsibility for maritime operational matters. Until the end of 1990 this function was performed by the Federal Department of Transport and Communications. From 1 January 1991 upon the establishment of the Australian Maritime Safety Authority (AMSA), the administration of the National Plan was transferred via legislation and has become the responsibility of AMSA. This has resulted in a fundamental change in the legal responsibility for managing the National Plan, specifically its funding and capital expenditure, which are now the responsibility of AMSA.

Until recently, the aim of the National Plan has been to provide for the cost effective control and abatement of ship sourced oil spills of up to 1000 tonnes. The figure of 1000 tonnes was based on research undertaken in 1991 by the then Bureau of Transport Economics (BTCE Report 70) which concluded that 1000 tonnes was the upper limit of the most likely threat and that this was most likely to be posed by a ships' bunker oil spill. Prior to the *Kirki* spill of some 17,700 tonnes of light crude oil off the Western Australian coast in July 1991, the largest spill was from the grounding of the *Sanko Harvest*, also off the WA coast, in early 1991 in which some 705 tonnes of ship's bunkers was lost.

Australian experience with respect to oil spill size associated with marine transportation for the 10 year period ending October 1992 shows that 98% of spills were of less than seven tonnes, 1.75% of spills involved between 7 and 700 tonnes of oil and 0.25% involved spills of greater than 700 tonnes.

Accordingly, the National Plan was initially developed to combat oil spills up to the 1,000 tonne size and the equipment acquisition and training programs, particularly in the early years, concentrated on the ability to deal with small to moderate spills. Funding came from the shipping industry by way of the Commonwealth oil pollution levy, which is applied to commercial shipping calling at Australian ports.

In the time since the inception of the National Plan our level of equipment and expertise has grown; equipment, training and response tools have become more sophisticated and we are now capable of mounting a credible response to spills of a significantly larger size that 1,000 tonnes, particularly when resources of the Australian Marine Oil Spills Centre (AMOSC) in Geelong are taken into account.

REEFPLAN

As part of the National Plan, a marine pollution contingency plan known as REEFPLAN has been developed to provide a set of response arrangements to ship sourced pollution incidents that may occur within the Great Barrier Reef area.

Within existing arrangements, prime responsibility for action rests with AMSA based on consultation with the Great Barrier Reef Marine Park Authority, as the reef manager and scientific adviser. Support with logistics is provided by State authorities. A stockpile of equipment for this region is located in Townsville.

GBRMPA provides assistance with exercises and training courses conducted by both Federal and State arms of the National Plan. This assistance has been applied to training events irrespective of location and is valued because of the wide range of practical environmental expertise held by officers of GBRMPA.

The Review of the National Plan

In early 1991 AMSA identified the need for a fundamental review and overhaul of the spill response arrangements enshrined in the National Plan. After consultation with and agreement from his State/Territory colleagues via the Australian Transport Advisory Council, the then Minister for Shipping and Aviation Support, Bob Collins, announced the wide ranging review to ensure that the oil spill response arrangements are adequate to meet both contemporary circumstances and community expectations.

The Review Working Party met seven times between November 1991 and February 1993 and comprised: AMSA (Chief Executive - Chairman) Senior officials from each State and the Northern Territory Department of Transport and Communications, the Department of Primary Industries and Energy, the Commonwealth Environment Protection Agency, the Australian Institute of Petroleum, the Australian National Maritime Association, the Australian Petroleum Exploration Association.

The Report of the Review Working Party will be considered by Ministers at the next meeting of the Australian Transport Advisory Council (ATAC) to be held in June 1993. The decisions of the Review Working Party mentioned in this paper should be considered as provisional only until Ministerial endorsement takes place. The Report to Ministers contains 30 recommendations covering a broad spectrum of National Plan policy, administration and operations.

Objectives of the National Plan

The Working Party agreed that the purpose of the National Plan is to maintain a national integrated Government/industry organisational framework capable of effective response to oil pollution incidents in the marine environment and to manage associated funding, equipment and training programs to support National Plan activities.

The objectives of the National Plan are to provide a national system for responding promptly and effectively to marine oil pollution incidents by designating competent national and local authorities and establishing:

- a national contingency plan for preparedness and response which includes the organisational relationship of the various organisations involved, whether public or private,

- an adequate level of pre-positioned oil spill response equipment, commensurate with the risk involved, and programs for its use;

- a comprehensive national training program designed to familiarise personnel at all levels with the requirements of planning for and responding to the needs arising from an oil spill. This program includes the conduct of frequent exercises;

- detailed national, state, local and industry plans and communications arrangements for mobilising resources and responding to an oil pollution incident;

- an awareness by Governments, media and the community generally of the limitations inherent in a response to a major spill with particular emphasis on the need to accept that other than in exceptional circumstances, current technology does not exist to prevent weather driven oil coming ashore on a coastline. *Scope of the National Plan*

It was agreed at the early meetings of the Review Working Party that the National Plan should plan for and combat marine oil pollution from any source.

This is a significant departure from the intention of the current arrangements in that the existing plan was originally conceived to deal exclusively with ship-sourced oil pollution. In practice though, the existing National Plan has evolved into an organisational framework capable of responding to marine oil spills originating from any source. The potential sources of marine oil pollution now identified for National Plan response include ships, offshore oil industry (both wells and pipelines) and land sources (including both oil industry and other industry and domestic sources). In most of these cases it would be expected that the polluter will be able to be identified and full cost recovery achieved.

National Plan arrangements

The Working Party agreed that identification of the parties to the National Plan with the responsibilities of each clearly defined as well as the establishment of formalised agreements and linkages between parties is essential if the new National Plan is to operate effectively.

The major entities involved in the proposed new arrangements are listed below. In all cases there will need to be a formal agreement or memorandum of understanding in order that the Plan can be guaranteed to work in all circumstances.

- the Australian Maritime Safety Authority (AMSA) having prime responsibility as the managing agency for National Plan matters, and general responsibility for maritime operational issues;

- the Department of Transport and Communications having responsibility for policy issues in shipping matters generally;

- the Department of Primary Industries and Energy having portfolio responsibility for petroleum issues including off-shore oil exploration and drilling operations.

- the Department of the Arts, Sport, the Environment and Territories and more specifically the Commonwealth Environment Protection Agency, having portfolio responsibility for environmental issues;

- the Great Barrier Reef Marine Park Authority (GBRMPA) for particular interest and responsibility in the Marine Park;

- the State and Territory Governments (the States) via nominated Departments or Authorities responsible for National Plan, ports, environmental, counter disaster and oil/offshore industry issues within each State/Territory,

- the shipping industry represented by the Australian National Maritime Association (ANMA), the oil industry represented by the Australian Institute of Petroleum (AIP), and

- the offshore oil exploration industry represented by the Australian Petroleum Exploration Association (APEA).

In addition to the direct interests listed in the preceding paragraph, various other interest groups and authorities have some role or responsibility. These include the Federal Department of Finance, Emergency Management Australia (formerly Natural Disasters Organisation) and other port and shipping bodies such as the Association of Australian Port and Marine Authorities (AAPMA), the Australian Chamber of Shipping (ACS), etc.

Division of responsibilities

If the arrangements are to be truly seen as a "national plan", and in the interests of uniformity and organisational efficiency the arrangements need to provide a clearer distinction about which authority should be the lead agency responsible for providing the response. The Working Party agreed that division can best be confirmed as follows:

- at oil exploration rigs, platforms and pipelines - the relevant oil company with assistance from the National Plan State Committee or AMSA depending on area of jurisdiction

- at oil terminals - the relevant oil company under MOSAP arrangements unless the necessary response is beyond the capability of its resources in which responsibility is transferred to the respective State/Northern Territory authority via the National Plan State Committee, with assistance from AMSA as required. It should be noted that ultimate responsibility for waters and foreshore areas rests with the State/NT and that oil companies are required to enter into predesignated response arrangements with the lead agency.

- in ports (other than oil terminals) and within the three mile coastal waters - the responsible State Northern Territory authority via the National Plan State Committee, with assistance from AMSA as required

- beyond the three mile coastal waters - the Commonwealth via AMSA except in those incidents close to shore when oil is likely to impact the shoreline. In these circumstances, the State/Northern Territory, via the National Plan State Committee, will be the lead authority for protecting the coastline while AMSA assumes responsibility for ship operational matters eg salvage

- in the REEFPLAN area of the Great Barrier Reef - Queensland Government via the National Plan State Committee, with assistance of AMSA as required.

In the case of any spill from a shore installation, prime responsibility for response will rest with the appropriate State Government authority and the industry operator concerned. Spills from other sources will also be the prime responsibility of the relevant State/Northern Territory authority.

Responsibility for overall co-ordination of a major spill response

After considerable discussion on overall oil spill response management, the Review Working Party decided that for a spill considered by the State Committee to be a major incident a high level Oil Spill Commander should be appointed with overall responsibility for managing the response. This will include co-ordination of all available combat resources both in Australia and, where necessary, from overseas.

It is envisaged that State/Northern Territory and Commonwealth Governments will each nominate the Oil Spill Commander to take overall command of a major oil spill in their area of jurisdiction. It is likely that this person may also be responsible for the National Plan State Committee. The Working Party recognised that in most States and the NT a State Disaster Plan, in some form or other, exists and that the State official in overall charge in a disaster, whether oil spill, earthquake, floods, major fires, etc. may be a Commissioner of Police or the State Emergency Controller.

Training

In general, it is agreed that three levels be recognised for training purposes, namely:

- senior government and industry management personnel responsible for high level decision making and will include the Federal and State appointed high level spill Commanders;

- middle management personnel responsible for managing the operational response, that is on scene co-ordinators, their deputies and scientific support co-ordinators. In a major incident this would also include supervisors appointed as site managers,

- operator level personnel, that is those undertaking on site clean up operations.

This three level approach to training is in accord with that accepted by IMO as being appropriate to meet the needs of a national response organisation.

Contingency Plans

At present Australia's National Contingency Plan is somewhat disjointed, consisting of the National Plan Operations & Procedures Manual which contains the Administrative Arrangements, and a separate volume titled "National Contingency Plan Guidelines".

From the State/Northern Territory perspective, each has a National Plan State Supplement to the National Plan Operations and Procedures Manual. From the oil industry perspective there is the Marine Oil Spills Action Plan (MOSAP). For the Great Barrier Reef there is REEFPLAN which also requires updating and to be brought into line with recently revised division of responsibility arrangements agreed between AMSA and Queensland Department of Transport.

Each of the above documents are at various stages of currency. In order to more fully integrate industry plans with the National Plan, it has previously been proposed that MOSAP be incorporated in State Supplements which should also incorporate individual Statewide contingency plans.

To ensure both consistency and adherence to State/Northern Territory requirements as well as national contingency plan guidelines, the Review Working Party agreed that all local contingency plans should be vetted and approved by the relevant State/NT Department and all State/NT Contingency Plans should be endorsed by the Commonwealth (AMSA, and DPIE for oil rigs, platforms and pipelines). DPIE and AMSA (and if necessary, APEA) will discuss present arrangements regarding approval for offshore oil spill contingency plans.

Coastal resources atlases

Funding will continue for the development by the States/NT of coastal resource atlases to assist in protecting the environment from the effects of marine oil spills. It is considered essential to identify very early in a spill response what marine ecosystems are at risk and what areas should have priority for protection, hence the development of coastal resource atlases. The atlases will also identify possible logistical problems by describing access to spill impact areas and will provide clear information on areas suitable for spill management options, boom deployment, dispersant use, etc. Some States are developing computer based atlases, which can then have tidal stream predictions and wind forecasts programmed in.

Equipment

The Working Party specified that the assessment of equipment requirement should be based on a tiered response, as follows:

- tier 1, oil spill of less than 10 tonnes
- tier 2, oil spill of 10 to 1,000 tonnes
- tier 3, oil spill greater than 1,000 tonnes.

The assessment strategy for consideration of equipment needs was developed by the Review Working Party taking into account the following assumptions:

. the National Plan is the prime response Plan with industry supporting its activities as required,
. that the Australian Marine Oil Spill Centre in Geelong will provide major response support.

The strategy used in arriving at the recommendations included in the report was as follows:

. assessment of the relative risk of a spill resulting from oil production, transportation, refining and general shipping on a State by State basis.
. identification of environmentally sensitive areas in consultation with State pollution committees.
. establishing response strategies in consultation with National Plan State/NT Committees.
. determining equipment requirements to mount an initial response.
. determining suitability and serviceability of available equipment by consultation with State pollution committees and identifying any shortfall.
. consulting with industry on these assessments through the auspices of ALP.

In establishing equipment and material needs, it was assumed that a co-ordinated response, which would draw on Government as well as industry resources, would be achieved.

Initial response

Under present National Plan arrangements, AMSA provides oil spill response equipment to States/NT in the Tier One and Tier Two categories. The oil industry provides equipment of Tier I level in oil terminal ports, which may be accessed under National Plan/Marine Oil Spill Action Plan (MOSAP) arrangements. In areas where it is justified, AMSA supplies equipment required to mount an initial response capability for a Tier Three spill. This latter requirement is to provide an initial response until equipment can be brought in from other

National Plan or industry sources including AMOSC, which is recognised as Australia's principal stand alone resource centre for a Tier Three spill anywhere in Australia.
Initial response is that which is designed to:

- be mounted rapidly with the human and physical resources available locally; provide a degree of protection for areas of maximum sensitivity,
- lessen the overall impact of the spill pending arrival of second phase combat equipment.

Options available for initial response are:

- Surveillance.
- Do nothing but monitor.
- Use dispersants.
  Use Booms.
- Recover using skimmers.
- Recover onboard using off-loading equipment.
- Tow the vessel further out to sea or to a safe haven.

Historically, major spills occurring in the coastal zone world-wide have resulted in oil impacting the foreshore. The technology does not currently exist to prevent oil spilt in these circumstances from reaching the coastline. However, strategically placed equipment can minimise the effects of a spill by protecting sensitive resources such as mangrove stands, salt marshes, or bird breeding and nesting sites.

In the view of the Review Working Party, financial and infrastructure arrangements do not permit equipment to be located in every minor port around the coast. However it was agreed the National Plan should have the ability to transfer equipment quickly should an incident occur in a minor port.

Spill size

Recognising the size and types of oil tankers visiting Australian ports it was agreed that 10,000 tonnes was a realistic figure for which to plan/evaluate equipment requirements for Australia. It was also noted that Canada has also selected the same figure. Should a spill occur the size of which was beyond Australia's capability to combat with the equipment held in country, it would be necessary to obtain equipment from overseas such as Singapore and Southampton centres.

Vessels operating in Australian waters also often carry in excess of 1000 tonnes of bunkers on board and much of this oil could be lost to the sea in a severe grounding.

Risk assessment

In assessing the risk of an oil spill in Australian waters, the Review Working Party referred to the Bureau of Transport and Communications Economics (BTCE) report MAJOR MARINE OIL SPILLS RISK AND RESPONSE and supplemented this with information from AMSA and DPIE, International Tanker Owner's Pollution Federation (ITOPF), port authorities around Australia and State pollution committees.

There are a lack of data upon which to make assessments of risk of oil spills within Australia. This view is supported by the authors of BTCE Report 70. Primarily overseas data was used in the risk assessment methodology. At best the information available can be used as a guide to determining the likelihood of an oil spill within Australian waters.

Australian experience in the last 20 years is that larger spills have occurred at sites remote from major shipping ports.

Whilst the information in the BTCE Report gives an overview of the likelihood of a spill Australia wide arising from the transport of oil by tankers, when establishing credible spill scenarios it was considered necessary to place in perspective the likelihood of a spill occurring on a State by State basis. Given that the Australian offshore industries record was better than that calculated in the BTCE 70 report, coupled with the low contribution by the exploration and production industry, it was decided to use the number of ship port visits as a basis for providing perspective on the likelihood of a spill occurring in any one location.

As a means of further rationalising the assessment, each State or Territory was divided into a number of areas. Arising from this approach the most likely locations for oil spills to occur are those with higher traffic densities.

Based on traffic densities the five most likely areas for a spill to occur are:

Queensland:	Cape York/Hervey Bay
NSW:	Port Stephens/Lake Illawarra
Victoria:	Cape Liptrap/Cape Otway
WA:	Western Pilbara
WA:	Southern Ports

Criteria for assessment

Three major points were used to determine the relative risk of a Tier 2/3 spill:

- Environmental sensitivity of the area
- Traffic density
- Hazards to navigation

Based on the three major risk factors outlined above, if in the opinion of the Equipment Review Working Group a zone was considered to pose a risk in any two of these points, then that zone was accepted as requiring appropriate equipment to mount an initial Tier 2/3 response. Zones which were assessed as posing a risk in only one or none of these points are not considered to pose a risk of a Tier 2/3 spill and the supply of oil spill equipment to these areas should only be considered for Tier I port type spills.

Contingency planning overseas

Since the early 1970's many of the world maritime countries have developed national plans to combat pollution of the sea by oil. This policy has been encouraged by the International Maritime Organization (IMO) and the United Nations Environmental Program (UNEP).

The International Convention on oil Pollution, Preparedness, Response and Cooperation 1990 (OPRC 90), which has been ratified by Australia but which is not yet in force internationally, represents current international efforts, through the IMO, to improve capabilities to prepare for and respond to oil spills. The Convention makes provision, among other things, for the establishment of national and regional systems for preparedness and response through National Plans and international agreements.

The Review Working Party compared Australia's Plan with those of several other developed maritime countries.

Canada

Canada has a National Marine Emergency Plan. The purpose of the Plan is to set out the concepts under which the Canadian Coast Guard (CCG) responds to a marine emergency, either as a lead or a resource agency. The Plan also covers:

- the procedures for the rapid activation of a command structure within the Plan.
- establishing the authority and framework under which regional, district and local CCG staff and industry develop their own Plans.
- the establishment of reporting systems.

. establishment of the procedures whereby the Canadian Coast Guard acts as the financial agent for the Federal Government
. the Canadian Coast Guard's responsibilities as a resource agency.

Up until now the Canadian Plan has been similar to our Australian Plan, in that the Coast Guard as a governmental authority has taken responsibility for responding to oil spills. Although at its inception a levy was in place to raise funds this ceased some years ago when some $80m had been raised and with interest was sufficient to maintain both the annual costs of the Canadian Plan and contributions to the International Oil Pollution Compensation Fund. The question of another levy is currently being addressed.

In light of the *Exxon Valdez* spill the CCG has been holding a series of working groups to discuss a Government proposal to amend the Canadian Shipping Act (CSA) with the intention of improving oil spill prevention, response and control. As a part of the proposed amendments to the CRA, vessel and facility owners in Canada would be required to submit response plans, similar to the USA system, that identify a commercial response authority which would be responsible for responding to a spill. If a spill occurs, vessel owners would be required to implement their own plans and clean up the spill using commercial cleanup contractors.

Under these new proposals, the CCG would play a different role in spill response than it currently plays. It would still be the lead agency for vessel spills and maintain final authority over decisions on clean up and response, however it saw itself as also having the following roles:

. monitoring, where the CCG is kept informed about the progress of clean up and may have a representative on-scene if necessary.
. advising, where the CCG lends its expertise.
. directing, where the responsible commercial party takes charge of the clean up but receives some direction from CCG officials on-scene.
. assuming full responsibility for the clean up, where either no responsible party exists and the CCG takes over, or if for some reason the CCG feels that the clean up by the commercial party is inadequate.

The CCG proposals on its new roles are at this stage only intended for discussion purposes and nothing has been formalised as yet. However, the policy of industry having "Response Authority Response Plans" for privately funded spill responders will be enacted, with only the CCG involvement still open to debate.

New Zealand

The authority responsible for oil pollution control on a national basis is the Maritime Transport Division (MTD) of the Ministry of Transport. This division has developed a new marine response strategy for New Zealand which includes replacing the MTD with a Maritime Safety Authority to be up and running by July 1993. The strategy also calls upon vessel owners and operators to prepare site-specific contingency plans (Tier One), regional councils to prepare regional contingency plans (Tier Two) and the MTD to prepare national and international plans (Tier Three and Four).

New Zealand operates a "user-pays" charge on shipping, with an oil pollution levy in effect. This levy is similar to the one which is in operation in Australia. The levy will remain in operation under the new strategy.The new national strategy names the MTD as the lead agency with statutory responsibility for "prevention, control, and minimisation of the impact of oil pollution" in New Zealand waters. The strategy requires the MTD to:

. collect and administer funds for oil pollution measures.
. ensure adherence to responsibilities under international agreements.

- develop standards and guidelines for contingency plans, equipment maintenance and operation, and training.
- provide equipment.
- coordinate and conduct training on oil pollution control and response.
- research new technologies.

Under the New Zealand strategy an Oil Pollution Advisory Committee (OPAC) will be set up to advise the MTD on oil pollution matters. The OPAC will comprise two representatives from regional councils and representation from the following areas: Ministry of Environment, port companies, exploration and production companies, shipping companies, Ministry of Transport and the oil industry.

In terms of equipment, the strategy states that New Zealand will aim for a national target spill response capacity of 7,500 tonnes to maintain a holding position until the arrival of overseas assistance. The national capacity would include equipment owned by both the government and private sector.

The strategy being introduced by New Zealand is similar to that which is already in existence in Australia.

United Kingdom

The Marine Pollution Control Unit (MPCU) of the Department of Transport is responsible for oil spills at sea within UK waters. This unit operates as a single command organisation dealing with oil spills at sea and following it through inshore waters onto the beaches until its ultimate disposal.

The MPCU is responsible for:

- sea going and onshore spill control equipment. training of personnel.
- management and clean up of a spill. contingency planning.
- Research and Development.

A formal working group has been established between government and the oil industry in order to identify areas of common interest and to maximise cooperation and mutual support. The oil industry has appointed oil industry coordinators throughout the country to provide useful local government/oil industry points of contact.

Under the UK Plan, local authorities retain their non-statutory beach cleaning responsibilities with assistance from the MPCU. No levy system exists in UK and the Government meets the full cost of operations at sea and onshore in major spills, thus removing the financial burden from local resources, however local authorities have financial responsibility for small spills in their areas.

The United Kingdom Plan is based on a national response capability so that oil spill cleanups come under a unified command and are maintained within financial limits set by the scope of events. In general, the UK seeks to achieve maximum response through the pooling of resources be it central government, local government or industry.

United States

The USA system has always relied on the principal of individual industries, and, in the case of a marine spill, the shipowner assuming control and responding to an oil spill using cleanup cooperatives.. If the response actions were deemed inadequate by the USCG, the government agency involved in policing spill cleanup response, then the USCG could assume control and bill the spiller for action taken. However in the *Exxon Valdez* incident it was not clear what constituted inadequate action, consequently the USCG declined to take over responsibility.

The *Exxon Valdez* oil spill triggered major federal and state legislation and a reexamination of spill prevention and preparedness. The result was the Oil Pollution Act of 1990 (OPA-90). Many coastal states have also passed legislation and developed spill prevention and preparedness regulations, some of which are more stringent than the federal legislation.

The effects of OPA 90 are complex and will take some time to resolve, some commentators say another *Exxon Valdez* is needed to resolve the issues still being debated. However, the principle of the industry assuming control and responding to a spill has not changed. Existing oil spill cooperatives have been strengthened. The Marine Spill Response Corporation (MSRC), scheduled to be in place in 1993, was founded by the oil industry with the purpose of developing equipment stockpiles and response capabilities to greatly augment those of the cooperatives. The Act requires detailed contingency planning at the national and regional levels.

The Act also attempts to streamline decision making during spill events by requiring that the Coast Guard "direct" response during major spills. The requirement for the shipowner to have in place, prior to the ships arrival in the USA, a contingency plan and a contract for a commercial cleanup cooperative to be on standby is also a requirement of the Act. Most of these requirements will take some time to put in place and it is evident that compliance with provisions of the Act is requiring heavy costs in dollars and effort. An area of significant conflict is the requirement for ship owners to have, what is in effect, unlimited liability insurance to cover almost any eventuality in an oil spill.

Conclusions

These examples give a clear indication of the paths followed by other countries in planning to combat marine pollution. In each case the plan or strategy is based on the specific requirements erates in that country. For this reason, generally no two plans are the same.

The USA system of making the shipowner responsible for oil spill response activity through a commercial cleanup contractor, which is also to be adopted by Canada, is not deemed appropriate in Australia or New Zealand. Commercial response authorities could not function in Australia as the amount of work in oil spill cleanup is so small that it would not be financially viable. Furthermore, the shipping and oil industries are both relatively small and would find the high cost of maintaining commercial response authorities prohibitive. Whereas in Canada and the United States both these of each country and the type of governmental system which operates are significantly larger and have traditionally taken a more active role in the management and response to oil spills.

The Australian policy of Commonwealth and State Governments working together, with greater assistance and involvement of the oil and shipping industry, spreads the financial and operational load over a wider sector of government and industry. The Government's policy of the "potential polluter pays" places the burden of cost directly on that section of the industry which may be responsible for a spill incident. If commercial response authorities were to operate they would have to be responsible for their own financing arrangements.

The system as used in the United Kingdom could not be implemented in this country. The federal system, involving the Commonwealth and State Governments does not lend itself to a one tier organisation encompassing all facets of marine pollution management and cleanup both on the water and foreshore. The UK funding system through the taxpayer would not be acceptable in Australia - where the user pays principle is paramount.

The Review Working Party agreed that the current Australian system of Governments (Commonwealth and State/NT) being responsible for oil spill response with cooperation of the oil industry be retained. However, the concept of making shipowners responsible through commercial cleanup contractors should be reviewed from time to time.

QUESTIONS AND ANSWERS*

Mike Julian's presentation

Question
What provisions are being made now for updating the resource atlases? At the moment in Queensland, there are a lot of projects underway, which are giving us much better information on mangrove areas and seagrass areas throughout the GBR region. How will this new information be added to the atlases?

Answer
That's what I refer to as our phase two approach to resource atlases. Queensland and NSW are probably the two states that are far ahead of the other states. We're trying to bring those other states up to the same level of expertise to that of Queensland and NSW and when we've achieved that, we then want to try to introduce a national scheme. At the moment, it's being done rather ad hoc. Queensland has gone one way with one particular model and NSW another. It should be significant economies of scale if we can bring all the coastal resources atlases into the same computer model. We will probably organise in the course of the next 12 to 18 months a national tender for a contract to supply a system which will cover the requirements of all states. What we've tended to do up till now is just provide the criteria of what should be in a coastal resource atlas, and leave it to states to introduce their own schemes.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

THE GREAT BARRIER REEF ENVIRONMENT: A PILOT'S FUNCTION

Captain Peter Small
Navigation Spokesman.
Queensland Coast & Torres Strait Pilot Service.

Pilotage must be considered a preventative safety operation and this paper is intended to give an overview of the manner in which we go about our task. When I joined the Pilot Service in 1980 the main emphasis for the pilot could be said to centre on the vessel; a quick safe passage was required. Today, as the result of the area being placed on the World Heritage list, the formation of the Marine Park and, in 1991, the introduction of compulsory pilotage, the main emphasis has changed to protection of the environment.

Pilotage, unlike navigation, is a judgemental activity. Pilots when piloting absorb information from a number of sources and are required to make decisions in real time. In areas of confined waters, such as the Inner Route of the Barrier Reef, the Pilot has to be totally aware of his location at all times and the various influences that will effect the progress of the vessel under his control. He has to posses an abundance of local knowledge.

A vessel proceeding from Asian Ports to East Coast Australia or New Zealand Ports has the choice of two routes.

a) Torres Strait and across the Coral Sea (Chart 1).
b) The Inner Route of the Great Barrier Reef (Chart 2).

If proceeding to North Queensland Ports the Inner Route is the more logical.

The comparisons between the two routes are:

	INNER ROUTE.	CORAL SEA ROUTE.
1.	Calm sea conditions.	Possible rough Sea conditions.
2.	Good navigation aids.	Few navigation aids.
3.	Anchorage depth water.	To deep to anchor.
4.	In pilotage waters or pilot service available.	Vessel can transit Torres Strait without a pilot.
5.	Possible Australian Government control on vessel's movements.	No control over route taken.

Pilotage in the Reef is basically divided into four main sections:-
1. The Great North East Channel.
2. Inner Route from Torres Strait south.
3. The coastal Inner Route south of Cairns.
4. Hydrographers Passage.

I will concentrate on the Torres Strait to Cairns section which covers the main compulsory pilotage area

There are many factors that a Pilot will consider when he boards a vessel to commence a pilotage.

1. The vessel's draught.
2. The speed of the vessel.
3. The operational state of the radars.
4. The operational condition of the compasses and associated equipment.
5. The quantity and condition of the navigational charts.
6. The competency of the bridge watch keepers.
7. Prevailing and forecast weather conditions
8. Possible traffic in the area.

How do these factors influence a Pilot?

A vessel's draught will dictate the basic route to be followed and, if it is to transit the area of the Torres Strait between Booby Island and Twin Isles, will set the transit times (Chart 3).

The Booby Island to Twin Island section is where we encounter the shallowest water, the strongest currents, the narrowest section of the reef and also the most complicated tidal system.

As an example today (14th April) the tides are at their maximum and are uniform in ebb and flood (Chart 4). However, a week ago there were minimum tides and contrary tides at either end of the Strait (Chart 5).

The current rate varies between to 2.3 knots today from 6.8 knots last week.

In instances where a deep draught vessel is to transit, Pilots consult the Torres Strait Tide Tables (chart 6), published by AMSA, which give hourly predictions of the tides at Booby Island, Goods Island, Turtle Head and Ince Point. These four tide stations also have VHF radio tide gauges which can be monitored by a transiting vessel and when out of VHF range can be monitored by telephone.

The area Booby to Twin is common to the Inner Route south and the Great North East Channel (Chart 3a) and at present is not a compulsory pilotage area, so we occasionally have the added problem of unpiloted vessels transiting.

The Great North East Channel is, of course, not in the Great Barrier Reef Marine Park but it is a region considered by the Torres Strait Islanders to be environmentally sensitive.

The GNEC is a relatively short passage (average 9 hours) however it is an area where hydrographic surveys are relatively old and strong tidal influences (Chart 7) are to be met along the route. It, thus, requires extra concentration by a Pilot, particularly in the Vigilant Channel and between Bet Reef and Rennel Island.

In the future when the hydrographic surveys have been completed, these two areas could be replaced by an alternative more direct route, with wider channels and deeper water.

The Inner Route south from Torres Strait to Cairns is marked by the Two Way Route (Chart 8). This indicates the best route for vessels of moderate draught. It is not, however, mandatory. Pilots deviate from the Two Way Route in a number of sections to keep the vessel in the deepest water. These deviations are Wyborn Reef east of Cairncross Is to Hannibal Island and Fife/Hay Island to Eden Reef (chart 9).

After the Howick Islands there are three alternate routes, the deepest draught vessels proceed, via Lizard Island, medium draught via Mid Decapolis Channel and light draught via Pethebridge Islets. Loaded panamax size vessels, proceeding south ex Cape Flattery, have an alternate deep water route to the east of Hope Islands.

South of Hope Islands/Gubbins Reef draught is not such a problem as there is greater sea room and deeper water, the main concerns are isolated reefs, shoals and submerged rocks. For vessels proceeding to or from Mackay/Hay Point the vessels draught can determine if the Whitsunday Passage can be used.

In all instances the Pilot considers the chart datum, the state of tide and draught and squat of the vessel to determine if it is safe to transit a particular area.

The speed of the vessel is an important factor for calculating squat and a formulae, worked out by Dr. Barrass of Liverpool, is used to compute it.
For open water conditions the formulae is:

Squat = (Speed*Speed*Block Coeff)/100

An alteration in speed can vary the vessel's squat (Charts 4 and 5). The speed of the vessel will also dictate the times and length of rest periods the Pilot will get.

Pilots would consider the most important item of navigation equipment to be the compass, be it Gyro or Magnetic.

Providing the compass error is known and steady then a successful transit of the Inner Route can be achieved. In general terms the reliability and performance of gyro compasses are good, we do nevertheless meet ones that have large and variable errors. Fortunately there are an abundance of transits which can be used to constantly check the compass error.

Radars on a majority of vessels perform well, but it never fails to amaze me how badly set up the displays can be and the strange ways ships' crews attempt to eliminate the errors.

Among the questions Pilots ask on boarding are; What is the compass error?, What errors are there on the radar?, usually to be told everything is in good working order. A prudent Pilot will ascertain what errors there are and obtain calibrations.

The navigational charts on the vessel can vary from new, corrected and up to date to old, obsolete and uncorrected, also a full set of the largest scale to a bare minimum small scale set. The standard of chart corrections carried out by the designated navigation watchkeeper is also an education!

For the information of the watchkeepers a pilot will put the courses he intends to follow on the ship's charts, it does some times occur that traffic conditions or weather might require deviations from the intended courses.

Pilots carry with them a composite set of charts but its scope is determined by the fact that these are part of his travelling luggage. There are other forms of navigation information that a Pilot will carry the type and extent of which is individual in choice.

As the standard of equipment varies so does the standard of watchkeepers. The reliance on the output from electronic navigation equipment and the manner it is used raises serious questions on the standards of training some crews receive. It appears that the IMO STCW has become a maximum standard instead of the intended minimum. The competency of the watchkeepers has to be assessed so that the Pilot can feel he can leave the bridge for a rest in the more open water areas.
When leaving the bridge the following information would be passed on to the watchkeeper:

- Ships course, error being allowed and allowances for set and leeway.
- Tidal set that should be experienced.
- Known shipping that could be met.
- Movements of any vessels in sight.

- Position on the chart on leaving the bridge and the position the Pilot requires to be called.
- Finally and most importantly that the Pilot should be called at any time the watchkeeper is in doubt or visibility becomes reduced.

For weather information Telecom fax weather charts (Chart 10) and satellite pictures of NE Australia and coastal forecasts can now be obtained prior to joining, this is very useful during the cyclone season. OTC Seaphone service is being extended along the Inner Route which will give direct access to up to date forecasts.

Pilots produce a daily movement sheet on Thursday Island of known shipping movements and each departing Pilot carries a copy with him. This allows for an exchange shipping movement information between passing vessels. From this information when and where you will meet other shipping can be estimated this allows for likely course variations to be pre-planned.

What safety considerations are there in a reef transit apart from those already mentioned?

a) *Reduced visibility in the wet season.*
Standard navigation procedures are followed for a reduced visibility situation. This can have problems where the Master, for commercial reasons, will not reduce speed or, in the extreme situation, anchor the vessel. There needs to be a clear ruling for Pilots to rely on in such a situation.

b) *The movements of cyclones when active.*
Before boarding Pilots inform themselves with up to date information of cyclones that may be threatening and the vessels route will be discussed with the Master. A problem arises on vessels, for reasons unknown, the latest met reports and facsimile maps are not obtained, therefore most Pilots carry a portable radio for such circumstances and a plotting chartlet.

c) *Fishing vessels working at night in the more restricted sea room sections.*
Up until a few years ago Pilots had great difficulty with the trawlers operating in the Inner Route. As a result of training available to fishermen and articles written in their journals explaining the problems of Pilots on differing types of vessels the co-operation received from the trawlers has become good. Calls on the VHF radio can result in a situation being talked out and a safe passing arranged. If there is a basic rule for trawlers, which is in fact covered in the ColRegs, it is *please maintain course and speed when a ship approaches* that way we can work out a safe passing.

Areas of extra care to a Pilot are Booby Island to Alert Patches, Aldolphus Channel, Lloyd Bay, Cape Direction to Eden Reef, Howick Islands. Extra care is necessary due to tidal, current and limited sea room conditions. I have dealt with the first area where all three factors are involved. In the Adolphus Channel the tidal streams are strong, there are the dangers of Quetta and Mid Rocks and shoal spit south of the Brothers. This is an area however where there are an abundance of navigation marks which give clearing transits.

Crossing Lloyd Bay the tide sets across the track and is particularly strong in the vicinity of Cape Weymouth and again at Cape Direction, care has to taken to avoid Tannadice Rock and Lansdown Reef.

From Cape Direction south to Eden Reef is an area of restricted sea room and sections of shallower water. South from Hay/Fife Islands Pilots deviate from the Two-Way Route to pass east of Hannah and Burkitt Isles to obtain deeper water, this route does, however, have the added obstacle of passing Dayman Rk, Ballerina Sh, Simpson Rk, Iris Rf and Beaby Patches.

the added obstacle of passing Dayman Rk, Ballerina Sh, Simpson Rk, Iris Rf and Beaby Patches.

During the fishing season there is the problem of trawlers that operate between Cape Direction and Eden Reef.

The Howick North Channel provides a deep water route it is, however, a narrow twisting channel but is provided with good navigation aids. The Inner Route provides a safe calm water route between Torres Strait and East Coast Australia. Now that the North Section has been declared a Compulsory Pilotage region there is every reason that it can be made safer. There are areas where improvements in knowledge can be made. I would like to see better tidal information between Cairns and Torres Strait, the RAN Hydrographic Office is, I understand, gathering the data but it then requires to be processed and published, the question is who benefits, who pays. The charting is very good and when the LADS system is fully operational wider and deeper channels might be located.

As with any profession as Pilots we never stop gaining knowledge of the equipment being fitted to ships, of the area in which we operate, but what does concern me personally is the apparent lowering of standards of crews which places an extra responsibility on Pilots. There are many new and sophisticated navigation systems and equipment being introduced. From my experience it can not be assumed that ships will have this fitted, even on new tonnage, that I have piloted, I have found only very basic aids to navigation. In many instances where good equipment is fitted the crews are often ignorant in its correct operation and use.

On a final note a vessel carrying a Pilot has a representative of this nation on board who can keep the vessel advised on Australian regulations and requirements and if required could observe any problems that might be evident.

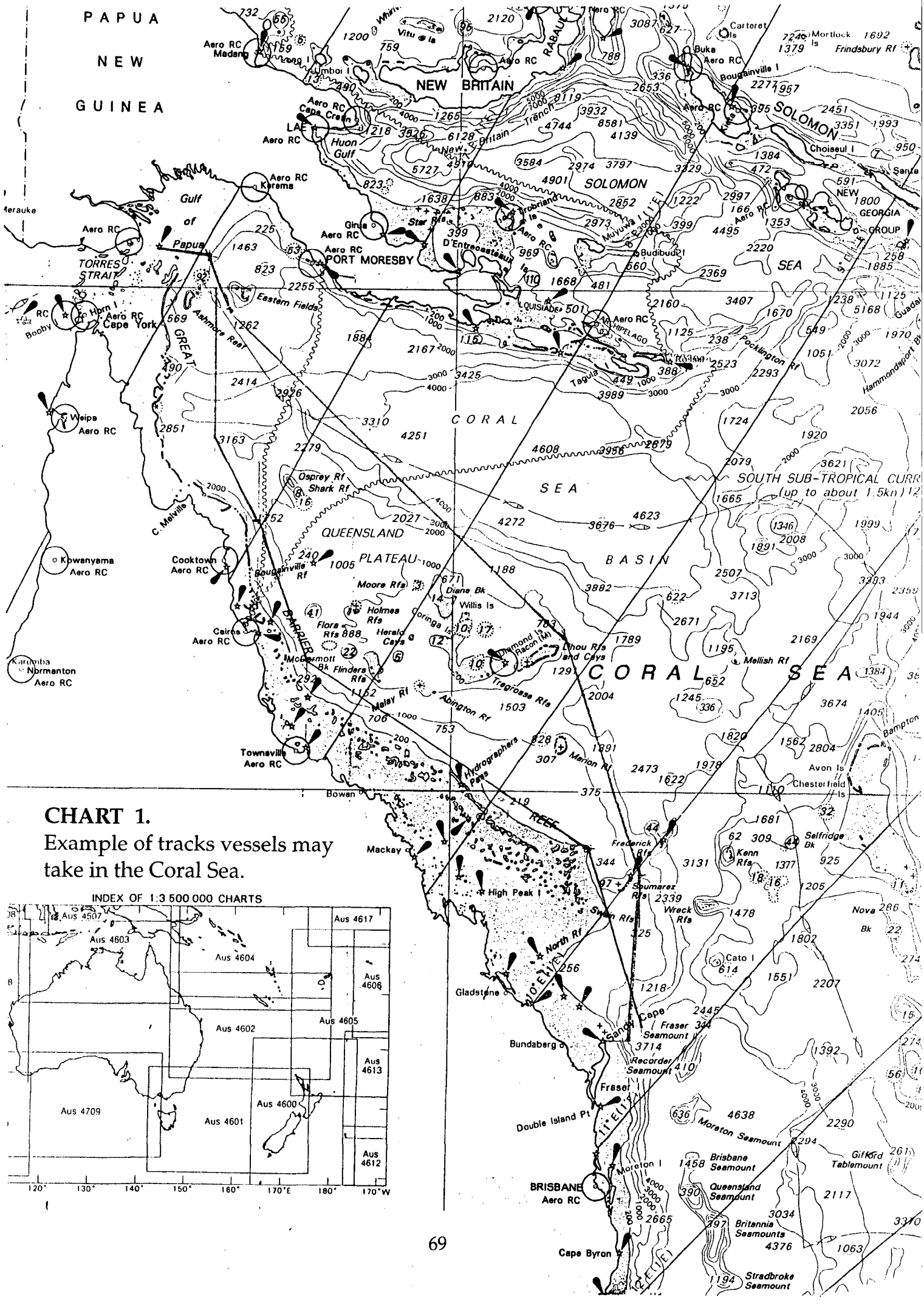


CHART 1.
Example of tracks vessels may take in the Coral Sea.

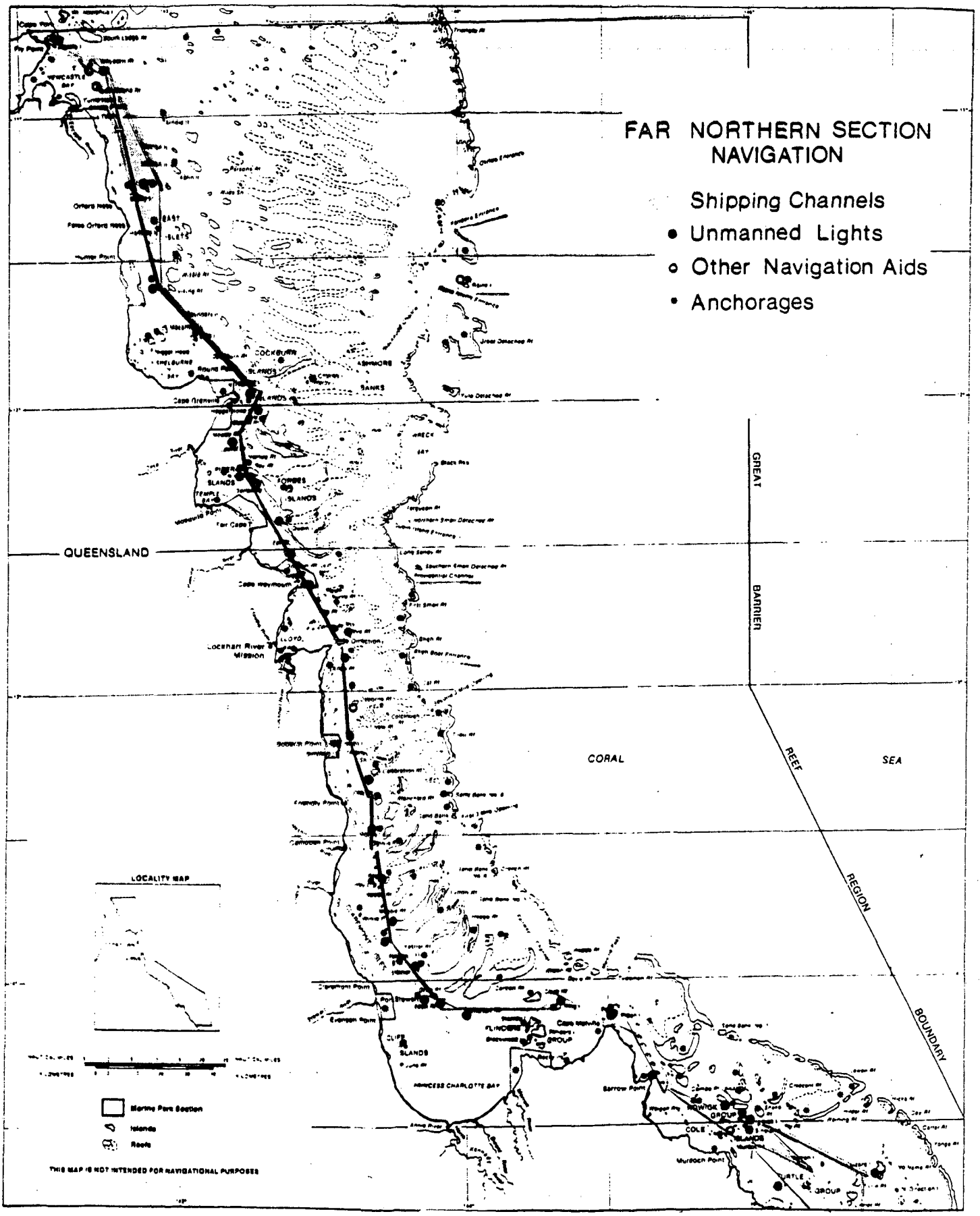


CHART 2.
Inner Route to Lizard Island.

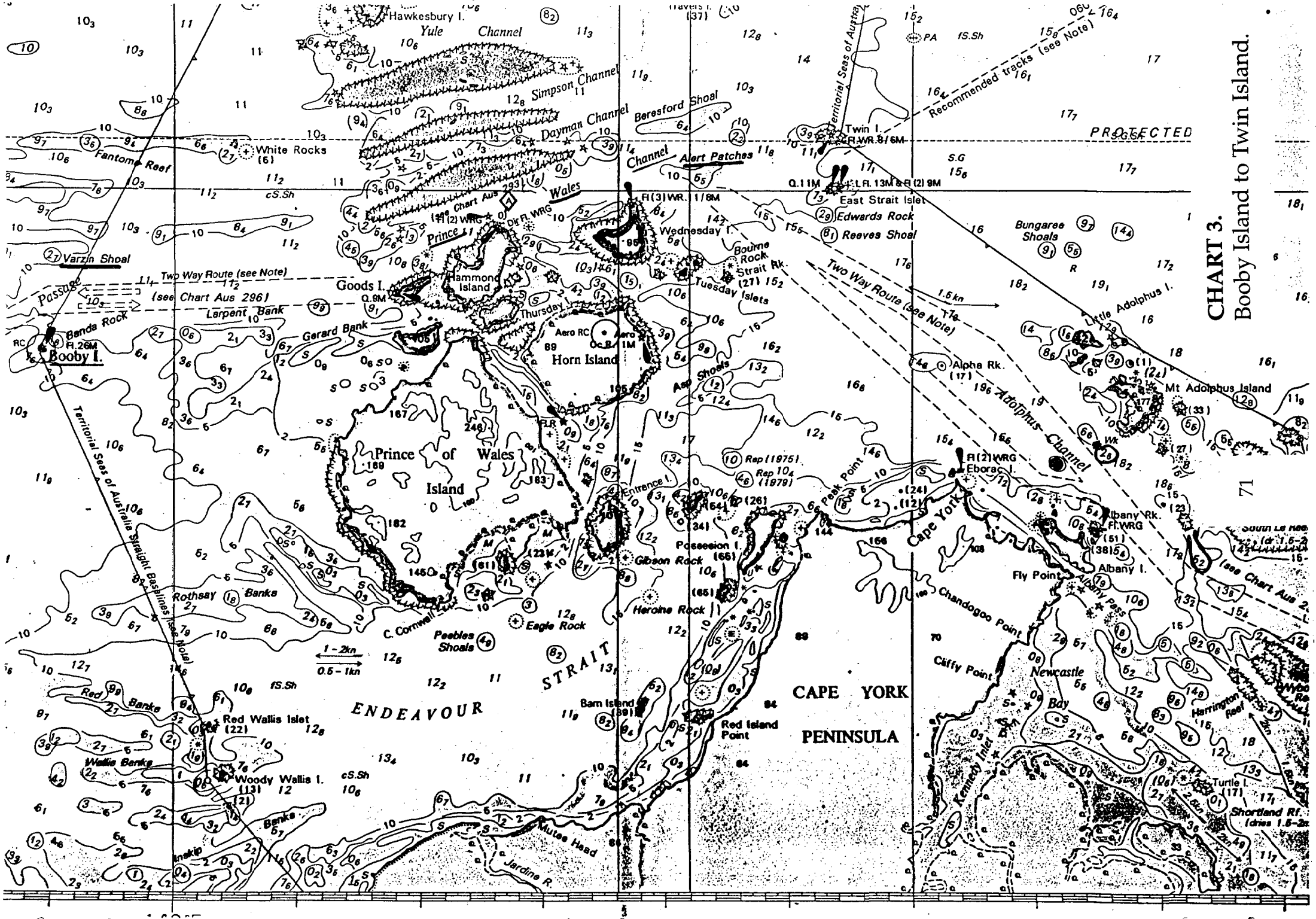


CHART 3.
Booby Island to Twin Island.
71
Hawkesbury I.
Yule Channel
Simpson Channel
Dayman Channel
Beresford Shoal
Fantome Reef
White Rocks (6)
Varzin Shoal
Two Way Route (see Note)
Passage
(see Chart Aus 296)
Larpent Bank
Banda Rock
Fl.26M
Booby I.
Territorial Seas of Australia
Straight Baselines (see Note)
Gerard Bank
Goods I.
Q.9M
Hammond Island
Prince
Wales
Channel
Alert Patches
(see Chart Aus 293)
Fl(2)WRG
Dir Fl.WRG
Fl(3)WR. 1/8M
Wednesday I.
Thursday I.
Aero RC
Aero Oc.R. 1M
Horn Island
Tuesday Islets
Bourne Rock
Strait Rk.
(27) 15.2
Prince of Wales Island
Entrance I.
Rep (1975)
Rep 10.4 (1979)
Possession I.
Gibson Rock (65)
Heroine Rock
Eagle Rock
C. Cornwell
Peebles Shoals
Rothsay Banks
Red Banks
Wallis Banks
Red Wallis Islet
Woody Wallis I.
Inskip Banks
Mutee Head
Jardine R.
1 - 2kn
0.5 - 1kn
STRAIT
ENDEAVOUR
Barn Island
Red Island Point
CAPE YORK PENINSULA
Territorial Seas of Australia
Recommended tracks (see Note)
PROTECTED
Twin I.
Fl.WR.8/6M
Q.11M
L.Fl.13M & Fl(2)9M
East Strait Islet
Edwards Rock
Reeves Shoal
Bungaree Shoals
Two Way Route (see Note)
1.6kn
Alpha Rk.
(17)
Adolphus Channel
Little Adolphus I.
Mt Adolphus Island
Fl(2)WRG
Eborac I.
Peak Point
Cape York
Albany Rk.
Fl.WRG
Albany I.
Fly Point
Albany Pass
Chandogoo Point
Cliffy Point
Newcastle Bay
Harrington Reef
Kennedy Inlet
Turtle I.
Shortland Rf.
(see Chart Aus 2

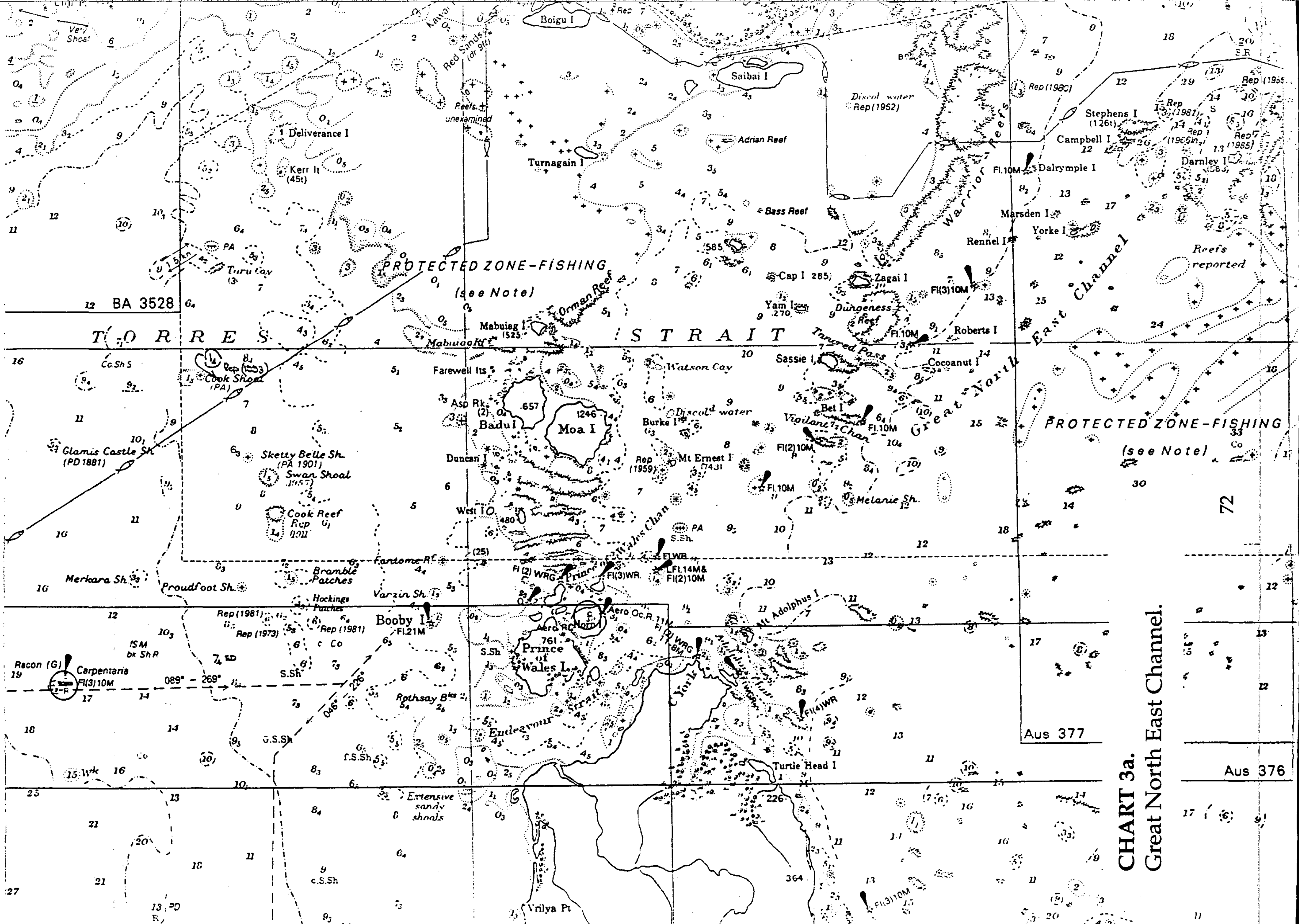
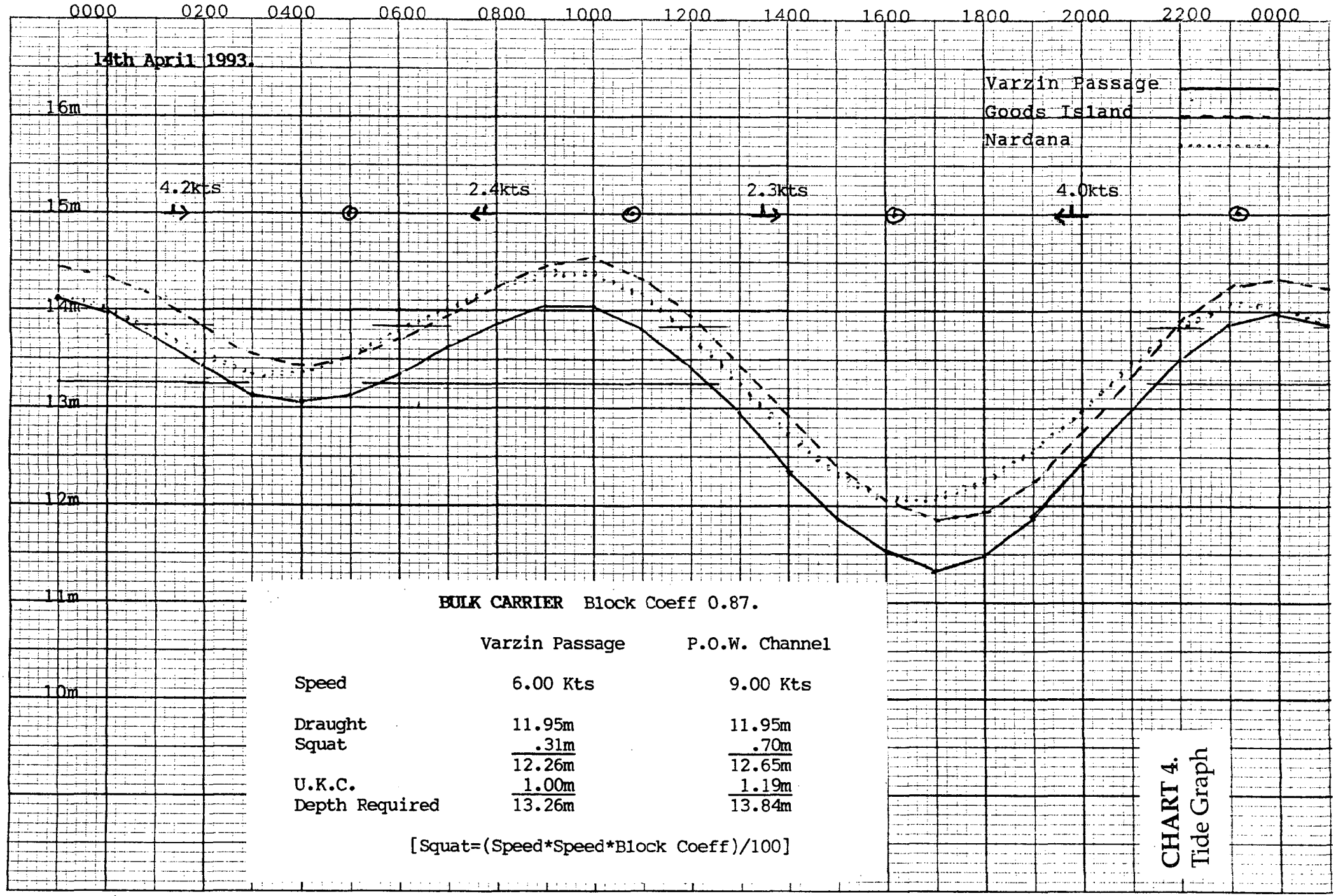


CHART 3a.
Great North East Channel.

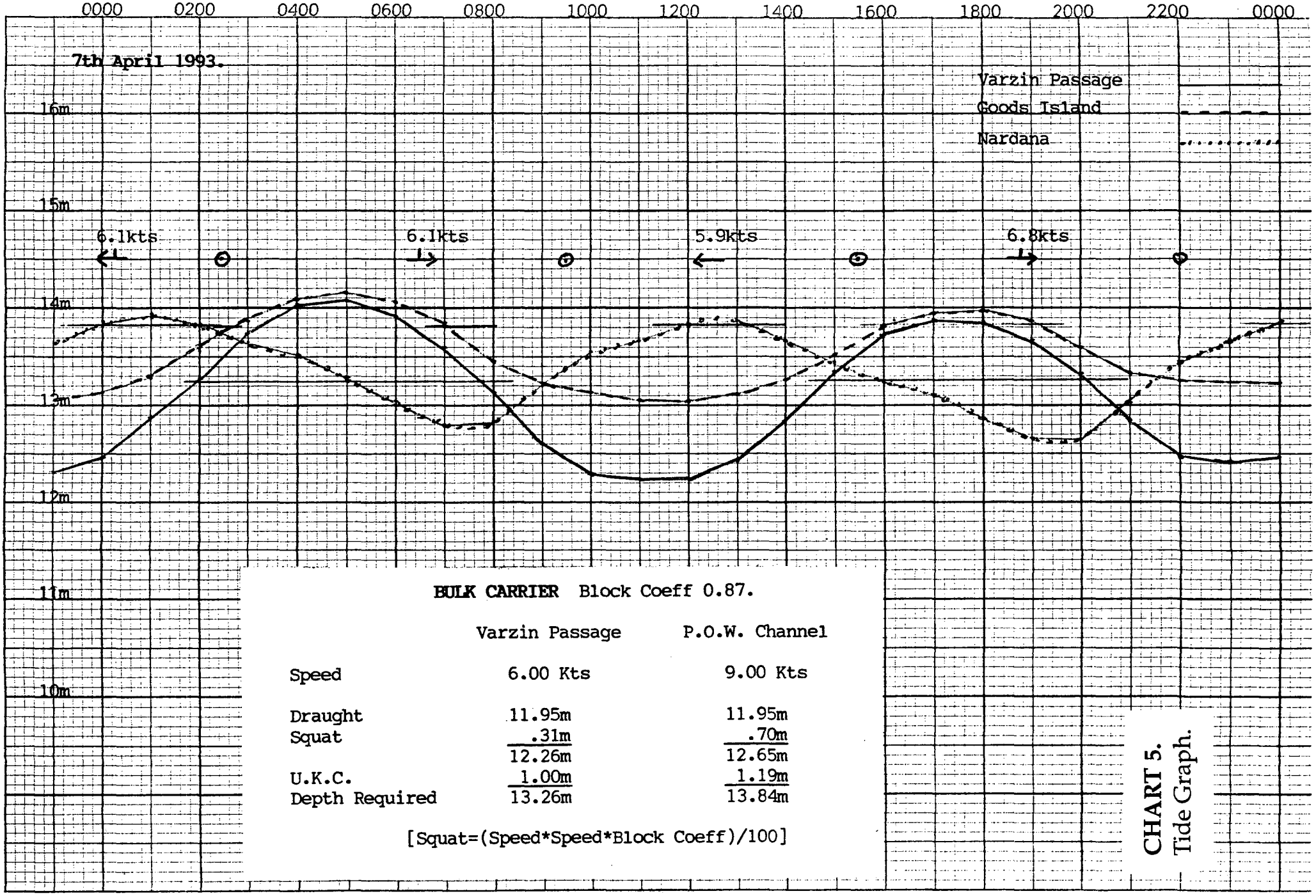


BULK CARRIER Block Coeff 0.87.

	Varzin Passage	P.O.W. Channel
Speed	6.00 Kts	9.00 Kts
Draught	11.95m	11.95m
Squat	.31m	.70m
	12.26m	12.65m
U.K.C.	1.00m	1.19m
Depth Required	13.26m	13.84m

[Squat=(Speed*Speed*Block Coeff)/100]

CHART 4.
Tide Graph



BULK CARRIER Block Coeff 0.87.

	Varzin Passage	P.O.W. Channel
Speed	6.00 Kts	9.00 Kts
Draught	11.95m	11.95m
Squat	.31m	.70m
	12.26m	12.65m
U.K.C.	1.00m	1.19m
Depth Required	13.26m	13.84m

[Squat=(Speed*Speed*Block Coeff)/100]

CHART 5.
Tide Graph.

EASTERN STANDARD TIME — APRIL 1993

	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
THURSDAY 8 APRIL 1993																								
BOOBY ISLAND	1.99	2.17	2.55	3.04	3.47	3.68	3.62	3.36	2.92	2.34	1.79	1.49	1.36	1.35	1.61	2.13	2.72	3.19	3.44	3.47	3.32	2.95	2.48	2.17
GOODS ISLAND	1.93	2.00	2.17	2.45	2.78	2.95	2.95	2.80	2.44	2.00	1.71	1.55	1.44	1.38	1.43	1.66	2.08	2.46	2.70	2.83	2.75	2.49	2.25	2.14
TURTLE HEAD	1.88	1.97	2.04	2.14	2.28	2.22	1.99	1.71	1.46	1.41	1.53	1.52	1.48	1.46	1.44	1.46	1.63	1.77	1.71	1.57	1.47	1.55	1.82	1.99
INCE POINT	2.59	2.80	2.73	2.38	2.02	1.82	1.63	1.32	1.14	1.29	1.66	1.94	2.18	2.32	2.22	1.85	1.46	1.30	1.28	1.16	1.08	1.29	1.75	2.15
TWIN ISLAND	3.03	3.14	2.85	2.26	1.73	1.47	1.22	0.88	0.84	1.26	1.85	2.24	2.49	2.60	2.37	1.78	1.19	0.92	0.83	0.67	0.68	1.14	1.88	2.47
FREDERICK PT	3.25	3.22	2.78	2.11	1.50	1.12	0.89	0.79	1.09	1.67	2.22	2.60	2.72	2.70	2.33	1.67	1.03	0.63	0.50	0.51	0.83	1.50	2.24	2.77
FRIDAY 9 APRIL 1993																								
BOOBY ISLAND	2.11	2.18	2.41	2.83	3.31	3.66	3.78	3.62	3.24	2.69	2.06	1.62	1.21	1.05	1.08	1.41	2.02	2.68	3.19	3.48	3.54	3.39	3.03	2.69
GOODS ISLAND	2.07	2.08	2.16	2.35	2.69	3.00	3.10	3.02	2.76	2.30	1.82	1.49	1.27	1.12	1.03	1.11	1.48	2.04	2.50	2.80	2.95	2.80	2.64	2.40
TURTLE HEAD	1.98	2.00	2.05	2.14	2.30	2.44	2.35	2.12	1.83	1.57	1.44	1.37	1.24	1.16	1.08	1.06	1.20	1.52	1.76	1.82	1.77	1.76	1.88	2.04
INCE POINT	2.44	2.67	2.77	2.64	2.34	2.10	2.00	1.79	1.49	1.32	1.38	1.56	1.72	1.87	1.89	1.73	1.44	1.26	1.32	1.42	1.40	1.44	1.66	1.98
TWIN ISLAND	2.83	3.06	3.06	2.70	2.17	1.79	1.63	1.38	1.10	1.10	1.42	1.76	1.98	2.12	2.14	1.86	1.37	0.99	0.94	0.96	0.93	1.09	1.56	2.14
FREDERICK PT	3.07	3.22	3.09	2.63	2.04	1.57	1.31	1.14	1.09	1.35	1.76	2.10	2.25	2.30	2.22	1.86	1.33	0.88	0.71	0.75	0.90	1.27	1.85	2.41
SATURDAY 10 APRIL 1993																								
BOOBY ISLAND	2.32	2.27	2.39	2.67	3.09	3.52	3.80	3.80	3.54	3.05	2.44	1.82	1.31	0.99	0.83	0.92	1.34	2.00	2.69	3.21	3.51	3.58	3.41	3.06
GOODS ISLAND	2.22	2.16	2.19	2.29	2.54	2.93	3.18	3.21	3.05	2.68	2.15	1.65	1.27	1.01	0.84	0.75	0.92	1.44	2.08	2.58	2.93	3.07	2.98	2.73
TURTLE HEAD	2.06	2.03	2.03	2.09	2.23	2.46	2.59	2.51	2.28	1.96	1.65	1.38	1.15	0.97	0.84	0.73	0.77	1.07	1.54	1.88	2.04	2.05	2.06	2.10
INCE POINT	2.24	2.45	2.59	2.64	2.54	2.36	2.27	2.21	2.00	1.70	1.46	1.36	1.36	1.43	1.47	1.42	1.30	1.19	1.27	1.51	1.68	1.74	1.80	1.92
TWIN ISLAND	2.54	2.78	2.92	2.86	2.54	2.16	1.95	1.85	1.61	1.37	1.31	1.43	1.55	1.62	1.67	1.64	1.43	1.14	1.02	1.15	1.26	1.33	1.50	1.85
FREDERICK PT	2.78	2.97	3.04	2.87	2.49	2.05	1.75	1.59	1.45	1.39	1.51	1.71	1.83	1.84	1.83	1.75	1.49	1.16	0.95	1.00	1.15	1.34	1.64	2.05
SUNDAY 11 APRIL 1993																								
BOOBY ISLAND	2.65	2.41	2.40	2.57	2.89	3.29	3.66	3.84	3.76	3.40	2.85	2.23	1.64	1.15	0.83	0.72	0.89	1.38	2.06	2.74	3.25	3.54	3.59	3.39
GOODS ISLAND	2.44	2.23	2.20	2.25	2.40	2.73	3.10	3.30	3.28	3.03	2.57	2.01	1.50	1.08	0.79	0.61	0.68	0.89	1.52	2.19	2.71	3.04	3.14	3.01
TURTLE HEAD	2.10	2.03	2.00	2.00	2.15	2.34	2.60	2.74	2.68	2.43	2.05	1.63	1.24	0.92	0.71	0.64	0.87	1.05	1.10	1.67	2.10	2.31	2.32	2.17
INCE POINT	2.06	2.10	2.32	2.42	2.49	2.48	2.45	2.47	2.42	2.20	1.85	1.49	1.24	1.11	1.08	1.05	1.04	1.06	1.17	1.45	1.80	2.02	2.08	2.05
TWIN ISLAND	2.21	2.44	2.59	2.67	2.64	2.44	2.24	2.17	2.08	1.85	1.58	1.30	1.31	1.25	1.22	1.23	1.25	1.19	1.14	1.25	1.48	1.63	1.71	1.79
FREDERICK PT	2.42	2.64	2.75	2.79	2.67	2.43	2.16	2.00	1.89	1.72	1.58	1.53	1.52	1.47	1.41	1.42	1.41	1.32	1.21	1.24	1.40	1.56	1.69	1.85
MONDAY 12 APRIL 1993																								
BOOBY ISLAND	3.03	2.66	2.47	2.51	2.72	3.05	3.41	3.70	3.81	3.66	3.24	2.67	2.07	1.51	1.05	0.75	0.71	0.97	1.51	2.18	2.82	3.31	3.56	3.55
GOODS ISLAND	2.72	2.40	2.20	2.20	2.30	2.51	2.87	3.21	3.36	3.28	2.95	2.44	1.88	1.35	0.91	0.62	0.47	0.56	1.00	1.67	2.33	2.84	3.12	3.15
TURTLE HEAD	2.18	2.05	1.94	1.92	1.98	2.17	2.44	2.72	2.86	2.80	2.50	2.04	1.53	1.07	0.72	0.49	0.35	0.39	0.70	1.26	1.88	2.34	2.53	2.49
INCE POINT	2.02	2.00	2.03	2.11	2.25	2.40	2.50	2.59	2.65	2.59	2.31	1.88	1.42	1.06	0.84	0.74	0.74	0.84	1.03	1.33	1.74	2.10	2.30	2.28
TWIN ISLAND	1.95	2.11	2.23	2.34	2.45	2.49	2.44	2.38	2.37	2.26	2.00	1.65	1.34	1.11	0.93	0.87	0.94	1.07	1.20	1.35	1.59	1.83	1.94	1.93
FREDERICK PT	2.07	2.27	2.40	2.50	2.57	2.57	2.47	2.35	2.25	2.10	1.87	1.63	1.42	1.25	1.11	1.09	1.17	1.28	1.37	1.46	1.62	1.78	1.84	1.84
TUESDAY 13 APRIL 1993																								
BOOBY ISLAND	3.32	2.97	2.65	2.51	2.58	2.81	3.13	3.44	3.66	3.71	3.50	3.07	2.51	1.95	1.42	1.00	0.76	0.80	1.14	1.70	2.33	2.92	3.36	3.55
GOODS ISLAND	2.96	2.64	2.31	2.15	2.20	2.36	2.61	2.95	3.23	3.35	3.20	2.83	2.30	1.74	1.22	0.79	0.53	0.48	0.70	1.21	1.86	2.48	2.92	3.13
TURTLE HEAD	2.33	2.12	1.93	1.83	1.87	2.02	2.25	2.53	2.79	2.91	2.81	2.44	1.92	1.38	0.91	0.56	0.37	0.34	0.49	0.90	1.49	2.10	2.51	2.63
INCE POINT	2.14	1.97	1.85	1.83	1.95	2.17	2.39	2.57	2.71	2.76	2.63	2.27	1.77	1.26	0.86	0.59	0.53	0.64	0.88	1.20	1.60	2.02	2.32	2.42
TWIN ISLAND	1.88	1.89	1.92	1.99	2.14	2.33	2.47	2.52	2.54	2.50	2.32	1.99	1.57	1.18	0.87	0.67	0.68	0.87	1.14	1.41	1.67	1.93	2.08	2.08
FREDERICK PT	1.86	1.94	2.04	2.17	2.33	2.48	2.58	2.59	2.53	2.41	2.17	1.86	1.52	1.21	0.96	0.87	0.95	1.15	1.38	1.60	1.80	1.96	1.99	1.92
WEDNESDAY 14 APRIL 1993																								
BOOBY ISLAND	3.48	3.22	2.90	2.64	2.54	2.62	2.85	3.14	3.39	3.55	3.55	3.32	2.90	2.38	1.85	1.38	1.01	0.85	0.98	1.37	1.91	2.48	3.01	3.38
GOODS ISLAND	3.08	2.85	2.52	2.23	2.13	2.23	2.42	2.68	2.96	3.18	3.24	3.04	2.65	2.14	1.62	1.12	0.73	0.56	0.64	0.95	1.45	2.05	2.60	2.95
TURTLE HEAD	2.50	2.25	1.99	1.79	1.76	1.91	2.11	2.34	2.58	2.79	2.85	2.68	2.26	1.73	1.22	0.78	0.47	0.40	0.50	0.74	1.17	1.73	2.25	2.56
INCE POINT	2.31	2.07	1.83	1.67	1.70	1.93	2.21	2.46	2.66	2.78	2.74	2.50	2.08	1.57	1.08	0.66	0.45	0.53	0.77	1.11	1.49	1.90	2.23	2.39
TWIN ISLAND	1.95	1.80	1.71	1.69	1.83	2.10	2.36	2.55	2.64	2.65	2.51	2.22	1.82	1.38	0.98	0.65	0.55	0.71	1.04	1.40	1.74	2.01	2.16	2.16
FREDERICK PT	1.81	1.73	1.72	1.83	2.04	2.30	2.53	2.68	2.72	2.64	2.41	2.07	1.69	1.31	0.96	0.77	0.81	1.03	1.33	1.65	1.92	2.11	2.14	2.01
	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300

CHART6.

A.M.S.A. Torres Strait Tide Tables.

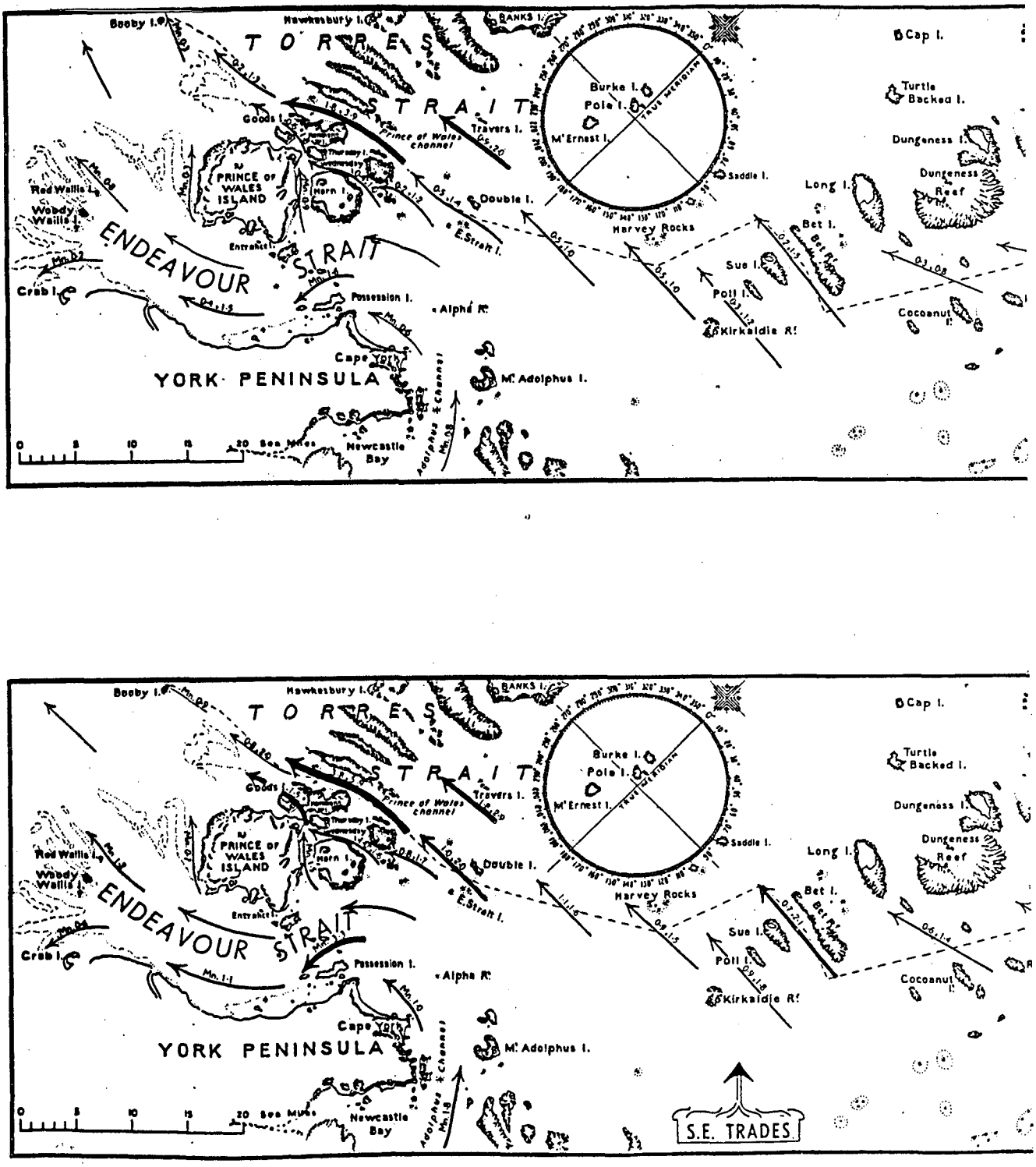


CHART 7.
Tidal Flow in Torres Striat. (Example)

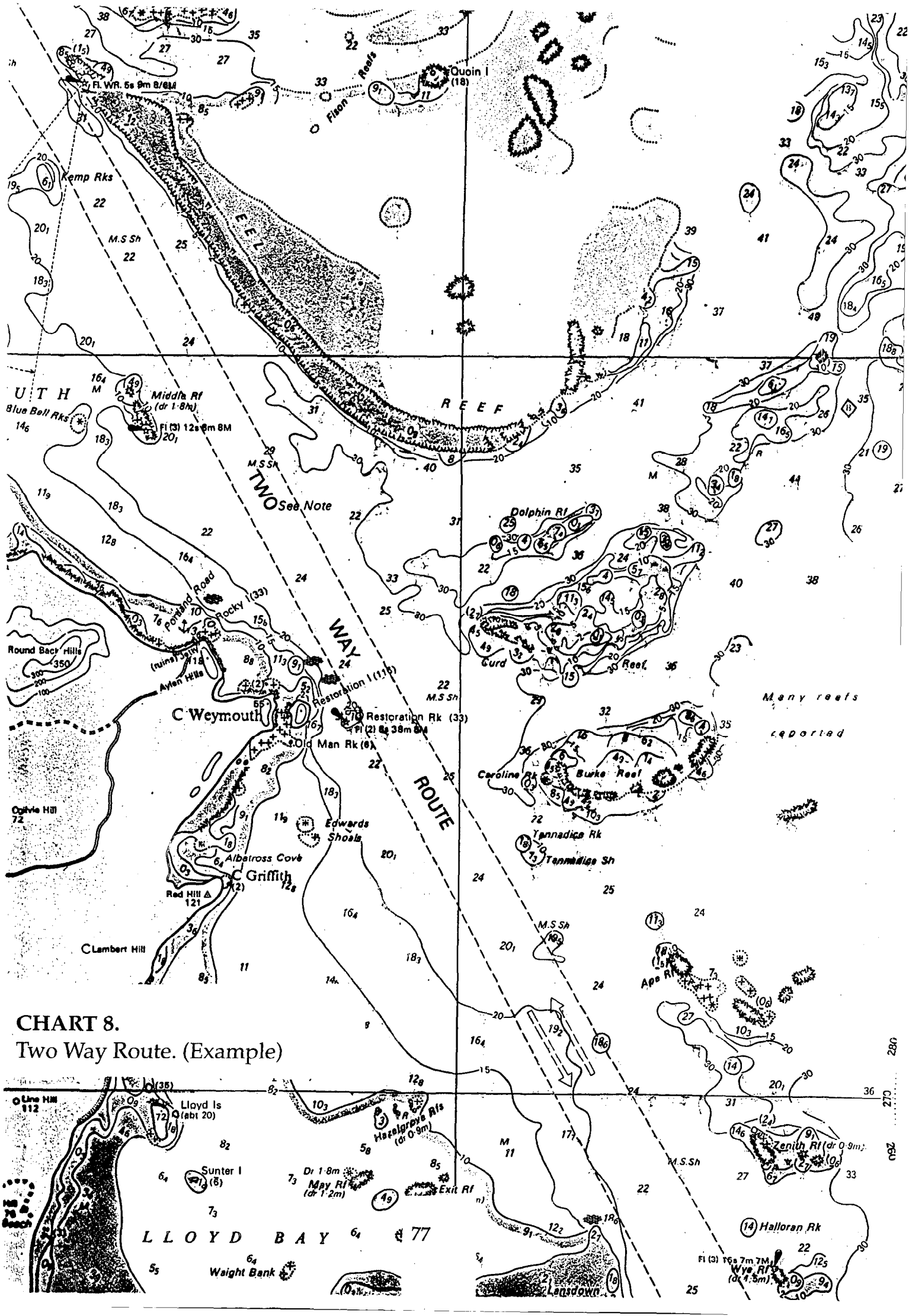


CHART 8.
Two Way Route. (Example)

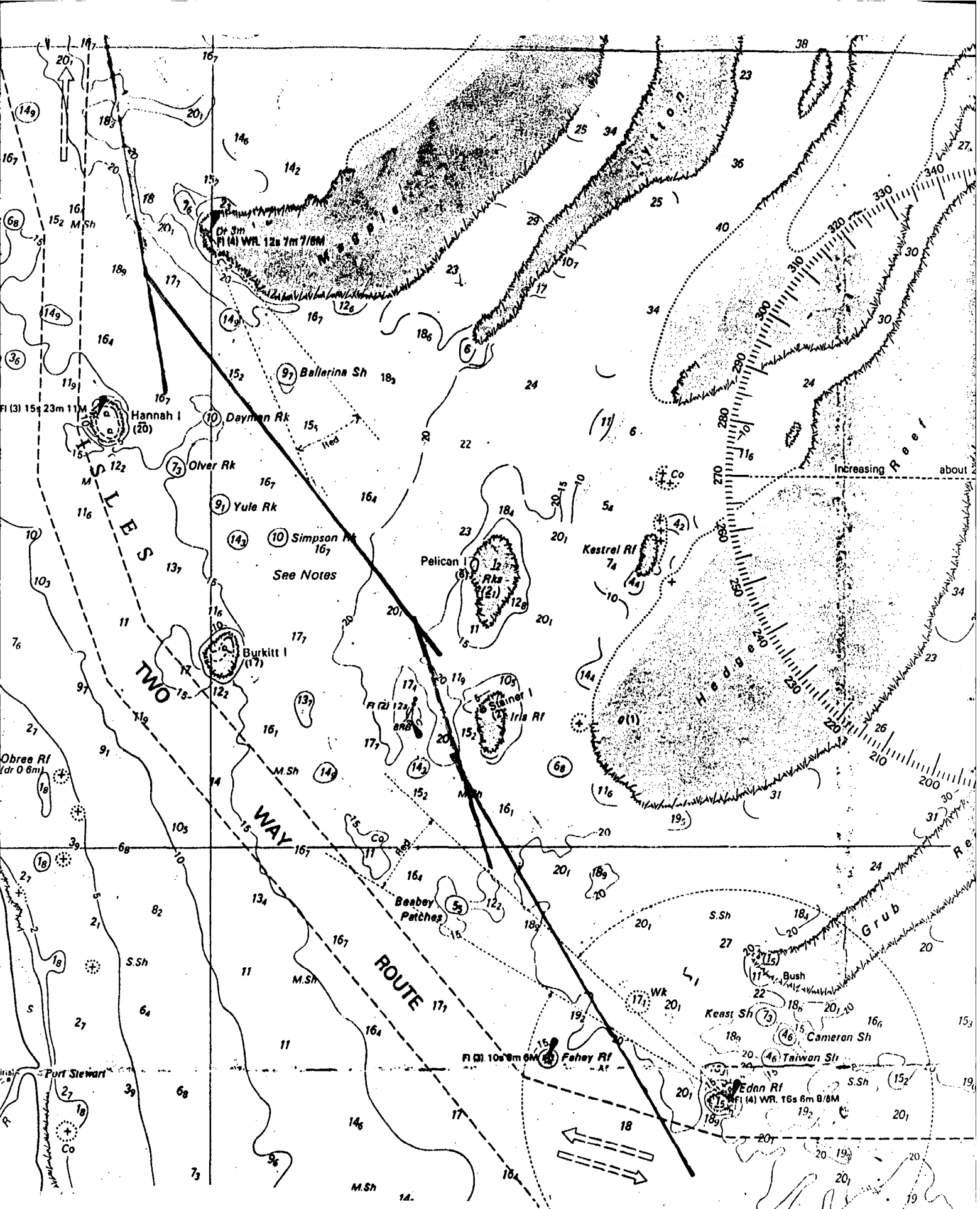


CHART 9.

Deviation from Two Way Route. (Example)

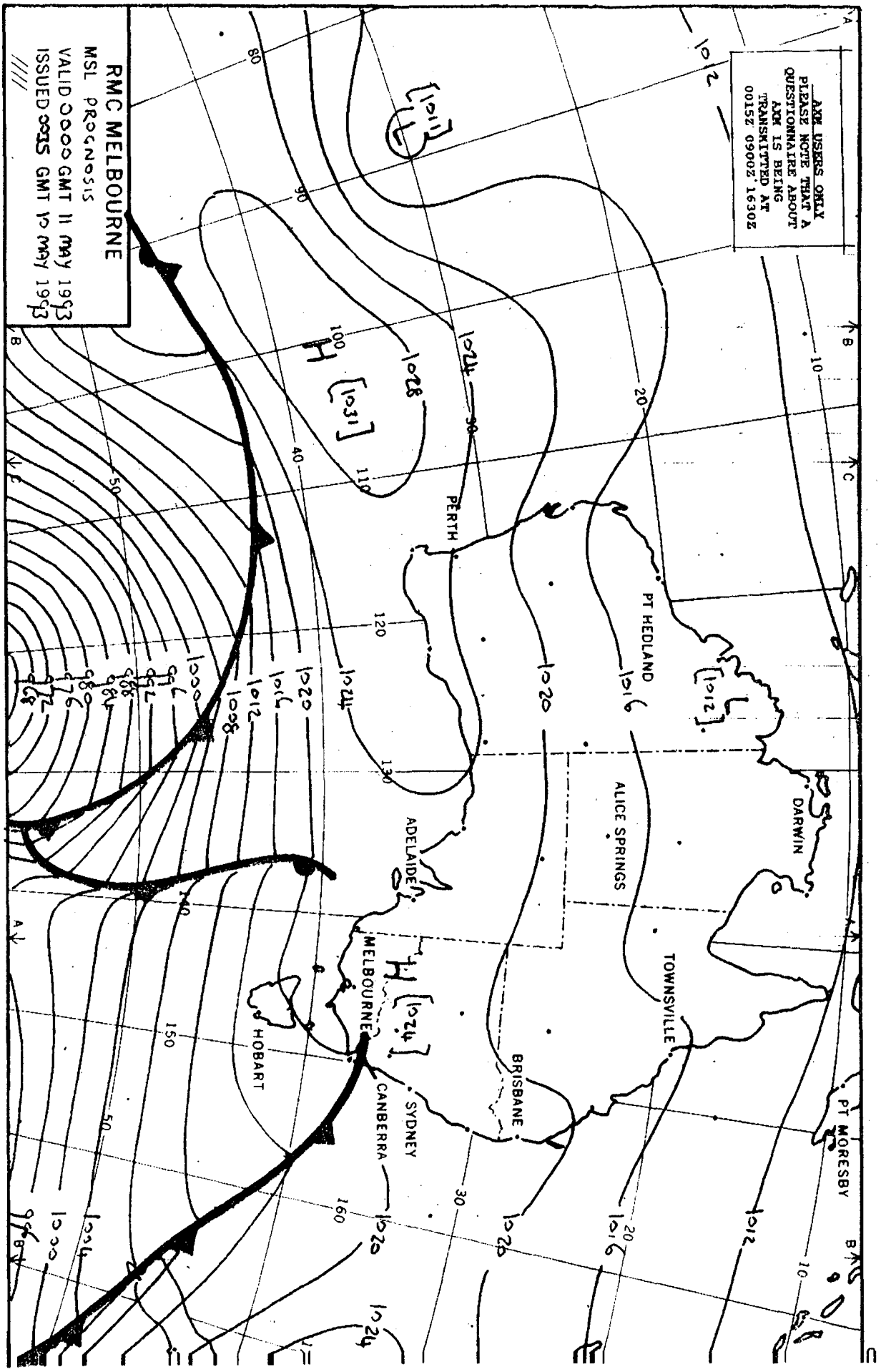


CHART 10. Telecom Fax weather map.

QUESTIONS AND ANSWERS*

Peter Small's presentation

Question
Is the "outer route" track as shown by the green line on your overhead suggested as being unsafe.

Answer
No, definitely not. It is a recommended outer route for vessels proceeding outside the Reef and is derived on the basis of information from the Hydrographer and others including ANMA. It's not suggested as being unsafe. The green track can be recommended to the master, but he does not have to use it.

Comment from the floor. In March we had a cyclone in the Coral Sea and two tankers coming up from the south and heading for the Great North East Channel both spent two and a half days sitting in the one spot in the middle of the cyclone. If they had come up the inside route they would have been half way to Singapore in two and half days. But they did get caught out there and if they did break down, you'd have a situation they could be on the outer reef.

Question
Someone raised the question earlier about the affect of pleasure craft?

Answer
The only area you really see them is the area between Cairns and Cooktown. I had an incident I'll describe in an area between Cubbin's Reef and Low Isles, where we have a rest. I was on a vessel with a third officer I wasn't happy about, so I kept a close eye by making regular visits to the bridge. I went there on one occasion, and I quickly looked over, and there was one of the large local tourist vessels, starboard bow, coming straight, coming across, and I could see that there was an potential collision situation. I checked it very quickly and said to the third mate, "What are you doing?" And he just looks at me, "Ah, what am I supposed to do?" Anyway, I altered course, and then the tourist vessel altered course, so I went back to the original course. I didn't know who he was then, but when he got close enough, I called him up, and I said, "Well, excuse me, this is the situation, I'm required to keep clear of you under the regulations, but you've now gone and altered course; what are you playing at?" He said, "Oh, we've just come out to have a look," and I said, "That's very nice, but it puts me in a difficult situation to know what to do and if I'd left the third mate to look after things... it probably would have been okay and the tourist vessel would have turned away.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

TRANSPORT OF OIL AND OTHER HAZARDOUS SUBSTANCES IN THE GREAT BARRIER REEF: HYDROGRAPHIC ASPECTS

Commodore JW Leech RAN
Australian Hydrographic Service

Introduction

This paper draws to the attention of the meeting of experts the importance of the national nautical charting programme in prevention of pollution of the sea.

The national nautical chart series describes dangers to navigation, and assists mariners to avoid shipwreck, which is one cause of catastrophic pollution.

The 1989 Canadian Public Review on Tanker Safety and Marine Spills Response Capability (arguably one of the more authoritative government documents on prevention of pollution at sea) identified spill prevention as the highest priority for protecting the coastal and marine environment. One of its recommendations was that *"In order to reduce the risks of accidents the Canadian Hydrographic Service should accelerate its programme for updating Hydrographic charts, and expedite development of electronic charting technology"*. This initiative is relevant in the Australian situation.

The Need for Nautical Charts

Many people involved in oil spill response and prevention are engineers, ecologists, and policy makers. They may not have any understanding of navigation. It seems sensible, therefore, to start this address with a brief comment on the need for nautical charts, with apologies to the navigators present.

Most drivers appreciate the need for a Street Directory when visiting an unfamiliar part of their own city, or another city. They would appreciate that a ship's captain needs a chart to find his way through unfamiliar waters. However, if the driver loses his way using the Street Directory, he can avoid hazards to his car by using his own eyes. Unfortunately the ship's captain, as he looks out from his bridge, can see only the surface of the sea. He cannot see the rocks, and reefs and sand banks which lie below the surface and which are very dangerous to his ship. The nautical chart provides him with the information he needs to avoid these unseen dangers, and he cannot navigate safely without it.

Because of this, carriage of charts by vessels in Australian waters is mandated by the Navigation Act 1912. In International Law, ships are required by the SOLAS Convention 1974 to carry up-to-date charts, and contracting Governments are obliged to provide warnings of dangers to navigation. This obligation is extended in the UNCLOS Convention 1982 to include measures to protect the environment.

The Need to Upgrade the Hydrographic Surveys of the Australian Coast

From 1800 until 1920 the British Admiralty was responsible for the surveying and charting of the Australian coast. In 1920 The Royal Australian Navy took over responsibility for hydrographic surveying. Since 1945 the Navy has continuously operated two or three surveying ships and has made good progress with the survey of the Australian coast.

Figure 1 shows the areas surveyed by the RAN since 1945. This date is important, because it marks the introduction of Echo Sounder technology. Prior to 1945, depth measurement was by leadline. Although the old surveyors produced excellent results, there was always

the risk in their surveys that they may not have found some obstruction which is a hazard to navigation because of gaps between data points. However, since the introduction of the Echo Sounder and the SONAR it is possible, using modern surveying techniques, to say after a survey that all dangers to navigation have been discovered. In short, surveys conducted prior to 1945 are not regarded as satisfactory for the purposes of guaranteeing safe navigation.

Figure 1 shows that 30% of the Australian continental shelf has been adequately surveyed and that a further 20% is regarded as temporarily adequate; 50% of the shelf has not been surveyed by modern means. Figure 1a is an enlargement of the Great Barrier Reef area.

Many of the unsurveyed areas carry significant volumes of shipping. These include parts of the Great Barrier Reef inner route, the Bass Strait, the coast between Melbourne and Adelaide, the Great North East Channel and much of the northern approaches to Australia. Figure 2 shows the sea lanes that are not yet adequately surveyed. It amounts to 100,000 sq nm, 20 years work for a single ship. An enlargement of the GBR area is shown in Figure 2a. The Great North East Channel remains an area of particular concern, and our progress of re-survey has been slower than we would have wished. The Hydrographic Office does not maintain casualty figures associated with groundings on uncharted hazards, but some statistics were provided for a programme evaluation in 1990. These statistics are shown in Figure 3 and they indicate that approximately two major vessels each year have been going aground on uncharted hazards. You will note that the first vessel on the list is *Oceanic Grandeur*. This casualty provided Australia's worst oil spill ever, and led to the development of the National Plan for Prevention of Pollution of the Sea by Oil. We had another example of a ship hitting an uncharted object in November 1992 when the liner QEII found a rock off Nantucket Island. A well used sea way, but not surveyed since the 1930s. The repair bill was $30M, indicating the scale of damage. Such an accident could happen at any time in Australia, particularly in the Whitsunday Islands.

The Hydrographic survey work is currently fully funded by the Department of Defence. The assets employed include one ocean going survey ship with three survey boats, one coastal survey ship with one survey boat, four inshore survey catamarans, a mobile survey team for quick response and the Laser Airborne Depth Sounder which has just entered service.

Hydrographic surveying to the required standard is a very time consuming activity, limited by available technology. It differs considerably from the process of topographic mapping which is greatly assisted by aerial photography and remote sensing. To illustrate this point, consider the relative effort required to make a map of an area the size of Canberra, approximately ten kilometres by thirty kilometres. To gather the data for a *land* area by aerial photography would take approximately one hour. To gather the data for a similar *sea* area using conventional means would require approximately 150 hours.

It is most unlikely that the Department of Defence would be able to increase the rate of effort devoted to Hydrographic surveying beyond present levels.

The Need to Upgrade the National Chart Series

Australia has been publishing nautical charts since 1941. There are currently 400 charts in the Australian series of which approximately 200 are metric charts published to modern international specification. The remainder are published in imperial units using a variety of superseded vertical and horizontal datums. 40 of the latter were published before 1950 and a further 40 before 1960. Whilst many of these charts are sufficient for traditional navigation using range and bearing techniques they are quite unsuitable for satellite based navigation. This is because the accuracy of the chart is inferior to the potential accuracy of the satellite navigation device.

In addition, the 400 charts currently in publication do not provide an adequate coverage of the area of Australia and Papua New Guinea for which the Government is responsible. The Hydrographic Service has identified the need for a series of 700 charts to adequately cover this area.

Chart series statistics are illustrated in Figures 4, 5, 6, 7, 8. In summary, Australia has 200 good charts, with a further 500 required. Figure 8a shows the figures for the Great Barrier Reef area.
The present chart compilation resources of the Hydrographic Office allow an incremental improvement in this situation of approximately 12 charts per annum. This rate of effort needs to be doubled if reasonable progress is to be made with the problem. A production rate of 25 charts per annum would see the task completed in approximately 20 years. The Department of Defence has recognised the need to improve the rate of chart production, and intends to provide additional manpower resources over the next four years, at the rate of about 10 positions per annum.

Navigation Error as a Cause of Shipwreck

Figure 9 is taken from an analysis of Lloyds casualty figures and recently published by Det Norske Veritas, shows that 33% of pollution incidents in the period 1979 to 1989 resulted from ship strandings. It is generally thought that some 80% of ship groundings are caused by navigation error. Such errors include incorrect plotting of fixes, setting of incorrect courses and failure to alter course when required. As a result of these errors, mariners can become disoriented so that they fail to appreciate the hidden dangers which surround them. This type of error led to the grounding of *Exxon Valdez* and the *Torrey Canyon*, both of which resulted in major oil spills.

Another common navigational error is the failure to appreciate that navigation dangers exist. In this case the mariner may deliberately set a course through unsafe waters. Such an error caused the loss of the *Sanko Harvest*, which fortunately was not carrying a bulk cargo of oil, but environmentally significant quantities of bunker fuel were released to the sea.

Human errors continue to be a frequent cause of ship groundings in the Great Barrier Reef, despite the introduction of compulsory pilotage. The Hydrographic Service does not keep statistics of groundings due to navigation error, but they are thought to be more frequent than groundings on uncharted hazards. Captain Filor may have some comment on this later today. The recent incidents involving *Tnt Express* and *Tnt Carpentaria* are examples. Both these ships had pilots embarked. It is not true to say that all casualties are Flag of Convenience ships. The Bureau of Communications and Transport Economics Study of 1991 noted that shipping accident rates are highest in the inner route of the Great Barrier Reef.

The Potential of the Electronic Chart in Reducing Errors of Navigation

The incidence of errors of navigation referred to above could possibly be reduced by use of a new device called the Electronic Chart. This device consists of a display which presents chart information, on which is superimposed the continuous real time position of the ship. No manual plotting or fixing is required, and the mariner can see at a glance the position and direction of his ship in relation to charted hazards. Most electronic chart instruments can provide audible warnings for cross track error, shallow waters, impending dangers and errors of navigation. As noted in the introduction to this address, the potential of ECDIS technology to reduce accidents resulting from navigation error has received much attention in North America. Some North American statistics claim that 70% of groundings resulting from navigation error may be avoided by the use of ECDIS. In Australia, the GBRMPA has recognised the potential of ECDIS in protecting the Reef environment, and has supported its development in Australia.

International Initiatives in ECDIS

In the United States the Congress has become aware of the environmental dangers posed by the shipping of hazardous cargoes, and has passed a Bill that mandates a number of actions that should reduce the probability of damage to the environment. If it becomes evident that an integrated navigation system such as ECDIS is a primary tool for accident prevention, then the use of such a system is highly likely to become mandatory for ships in United States waters. The US Coast Guard as Maritime Safety Authority and the Coast and Geodetic Survey as Charting Authority are currently spending substantial sums of money on ECDIS research and development in response to Government initiatives.

In June 1992 the Canadian Government announced a commitment of one hundred million dollars for a new marine environment emergency response strategy. This strategy specifically calls for *"The development of a new electronic navigation chart capability that can alert ships to possible groundings or collisions".*

Many other member states of the IHO and IMO including Australia are working hard on ECDIS research and development. The main purpose of these development programmes is to assist in defining the specifications and standards for data base structure, content, display, and updating. They also will define standards for integration of chart display and navaid information, radar, audio warnings and the like. Such standards will enable the IMO to adopt ECDIS as a chart equivalent under the SOLAS regulations.

The experts consider that a true electronic chart will involve a completely new approach to the presentation of navigational information. It will allow the mariner to manipulate the information, (which he cannot now do), will incorporate an ability to display textual information, will have a facility for chart correction, and will contain other new features which are only now being proposed. It is this comprehensive new device that is the subject of the IMO standards and specifications for ECDIS, which is to be written into the SOLAS convention by the end of the decade.

Australian Developments

Australia has played a useful part in these developments, because the Hydrographic Office has long experience in digital chart production. The Hydrographic Office has also spent substantial sums and has been involved in an ECDIS development programme for the last two years, and currently has a working test bed afloat in Sydney Harbour. We plan to construct a second trial data base for Port Philip Bay in conjunction with AMSA trials of a DGPS broadcast. We believe that it will be possible, following further development in the next 12 months, to embark on production of an Australian ECDIS data base. By that time workable standards for ECDIS will have been agreed and most major maritime countries will be producing data sets. IMO ratification of the standards will take many years to achieve, but a reliable ECDIS will be available and in use soon.

At this point I would like to emphasise the importance of an 'authorised' national data base. Without an 'authorised' data set it will be impossible to guarantee the fidelity or completeness of the navigational information that ECDIS contains. Quality of the data set is one of the key ingredients in the success of any ECDIS product. It is a clear case of rubbish in, rubbish out. However few people appreciate the complex and time consuming aspects of creating data of the required standard of excellence. Maintenance of that standard of excellence demands that there be only one authorised data set.

The problem for Australia, as always, is funding. We estimate that data creation of an IMO compliant coverage of the continental shelf will cost at least $50M, and will take about ten years to achieve. I intend to bid through the Department of Defence for this funding, but it is unlikely to be available before FY 95/96.

A static display of our test bed is available in the foyer, and our contractor will demonstrate it during breaks if you would like to have a closer look.

Voluntary ECDIS

The IMO standard ECDIS is very complex to produce, and this will delay its general availability for a number of years. In the meantime ECDIS facilities are already available on the market. They are generally based on raster scanned images of paper charts, and are not so versatile as the IMO proposed standard. Whilst they have some imperfections they nevertheless offer the essential benefits of ECDIS, that is constant display of precise real time position and heading superimposed on the chart image. There is currently one manufacturer offering a reasonable raster based coverage of the Australian coast.

Whilst voluntary ECDIS has some attractions, particularly in pricing and availability, we have some reservations about it. Even an authorised data set for Australia based on the published charts has limitations in use, because of the old and imperfect nature of the Australian chart series. Chart correction facilities are also somewhat crude. We are very concerned about the marketing of sub standard products, particularly from overseas, which may have many imperfections in precision and content.

A number of countries through their Maritime Safety Authorities, are considering domestic regulations to specify a minimum standard of "voluntary" ECDIS for this economic and readily available product. Such regulation is important if the integrity of the chart product is to be maintained. A suggested means of regulation is provision of a government produced raster data set, probably based on the national chart series. This is something that AMSA and the Hydrographic Office need to discuss.

ECDIS for Traffic Management

We tend to think of ECDIS as a navigation aid, but it can be used 'in reverse' as part of a traffic monitoring system. For example, it could be used for monitoring the activities of all major vessels (equipped with INMARSAT) in the Great Barrier Reef Inner Route or any other sensitive area.

ECDIS as a Data Base for Resource Management

Another very useful aspect of the IMO compliant ECDIS is that it provides a valuable tool for resource managers and researchers in all sorts of categories; for example coastal zone management, fisheries management and research, oil spill response etc. The data structure and the enquiry and display facilities are well suited to management and research applications. We have recently experienced a significantly increased demand for digital data for research purposes.

Conclusion

Because the Hydrographic Service is located in the Department of Defence it is not readily associated with protection of the marine environment. Nor are its activities particularly visible. Nevertheless I believe that it has a central role to play in maritime safety and environmental protection programs. This role is highlighted in overseas initiatives.

A lot of people think that general availability of ECDIS is a long way off. This is not true. It is available now as a 'voluntary' system based on paper charts. The more complex IMO compliant ECDIS will be available at sea within a couple of years, and an Australian data set can commence production at that time subject to availability of funds.

I particularly commend this technology to the working groups on Navaids and Policy. It has a lot of potential for the reduction in vessel strandings and subsequent pollution of the sea. This potential has been recognised already by many governments in maritime nations.

I also commend to you the basic national charting programme. The utility of ECDIS is, like any other information system, dependant upon the availability of good data. The continuation of the hydrographic survey of the continental shelf at a reasonable rate of

effort must remain a national priority, as must the improvement of the national chart series.

I therefore conclude by repeating the recommendation of the Canadian Public Review on Tanker Safety; *"In order to reduce the risk of accidents the Hydrographic Service should accelerate its programme for updating hydrographic charts, and expedite development of electronic chart technology"*. This is very relevant in Australia today. Recognition and endorsement of the Australian Hydrographic Program would be one useful outcome of this workshop.

I note also that the Canadian Government has committed $100M to a marine environment protection programme. It would be useful if this workshop could also recognise and highlight the considerable resource implications of effective protection of the marine environment.

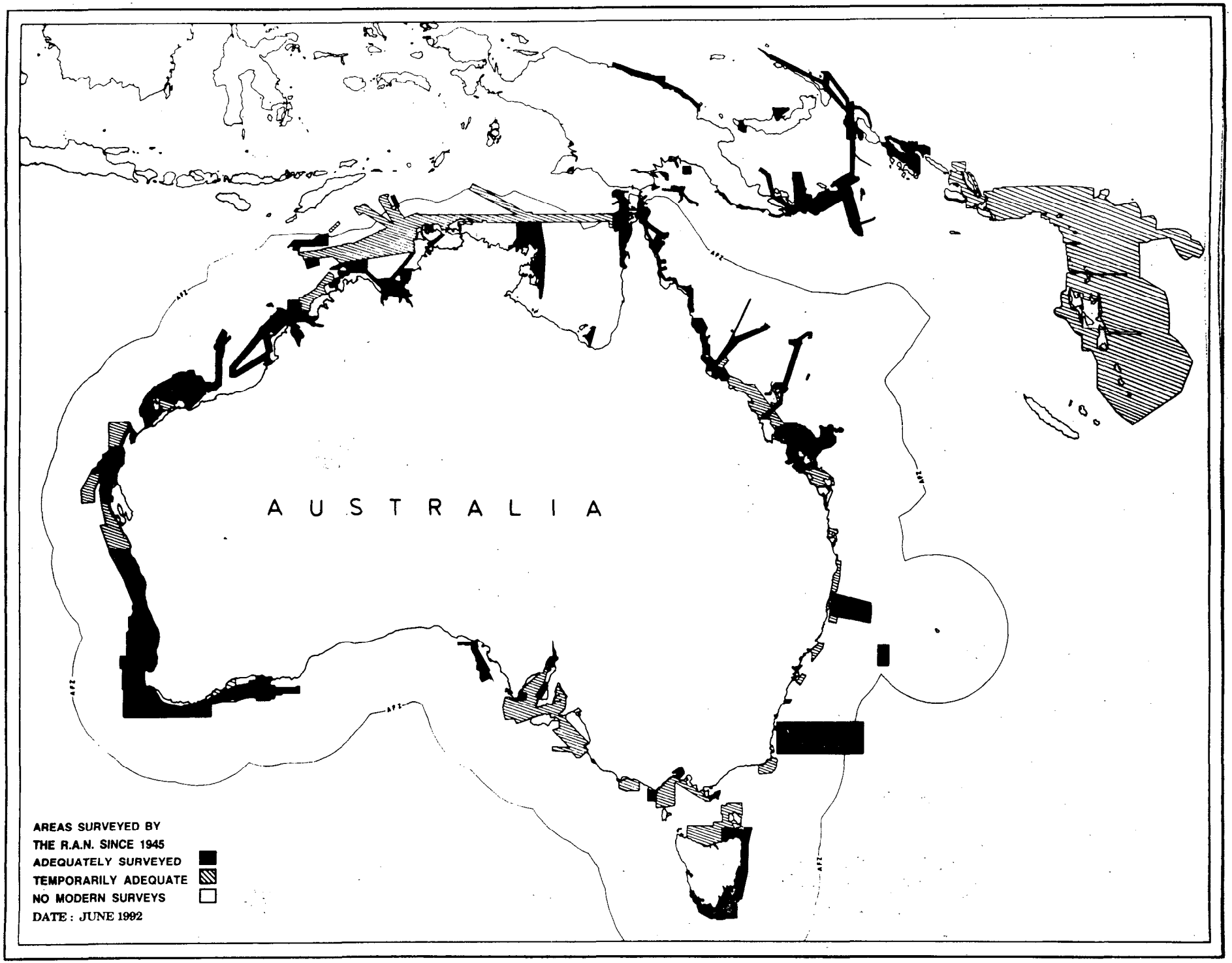

AUSTRALIA
AREAS SURVEYED BY
THE R.A.N. SINCE 1945
ADEQUATELY SURVEYED
TEMPORARILY ADEQUATE
NO MODERN SURVEYS
DATE : JUNE 1992

FIGURE 1

FIGURE 1a

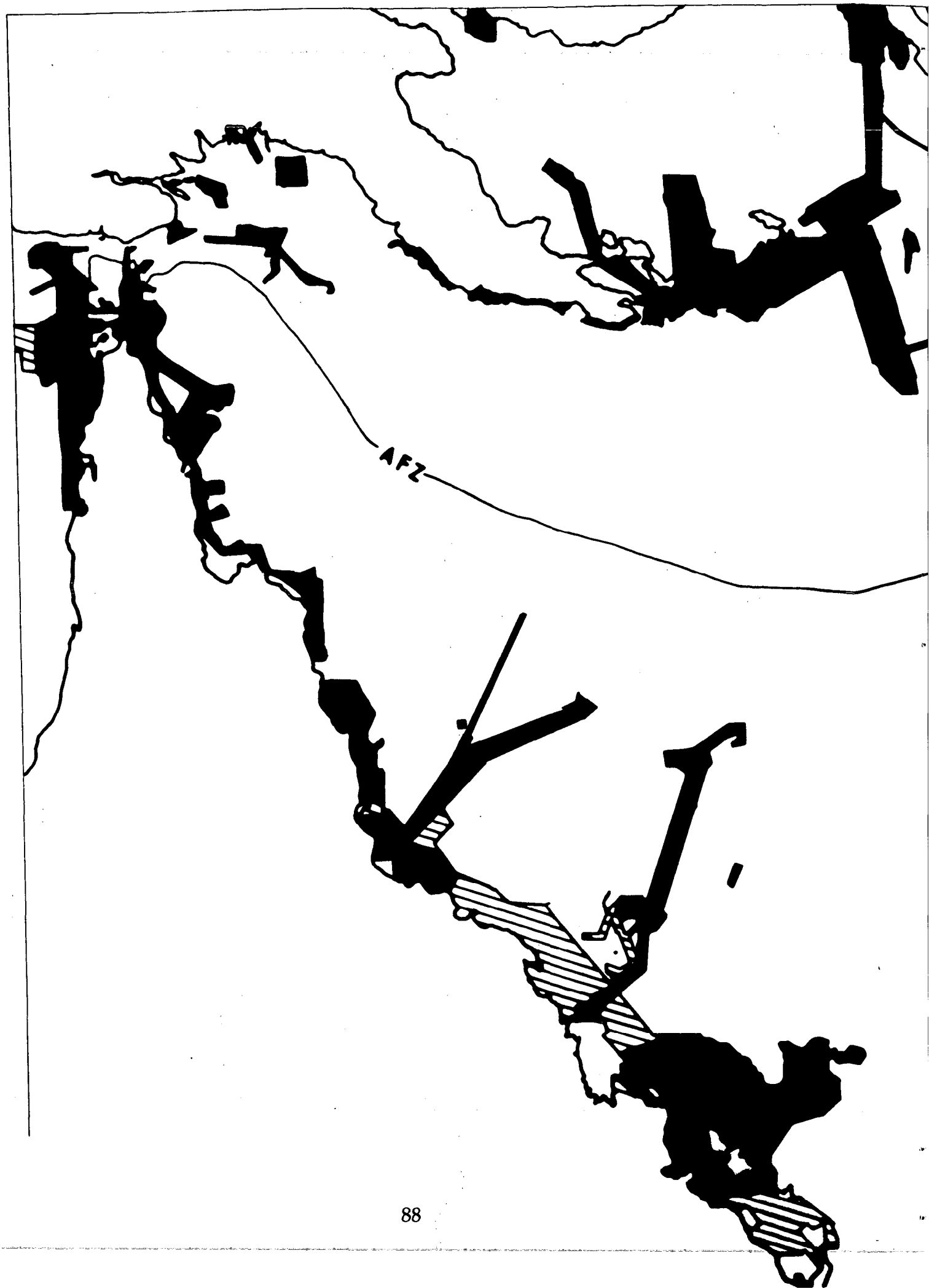


FIGURE 2

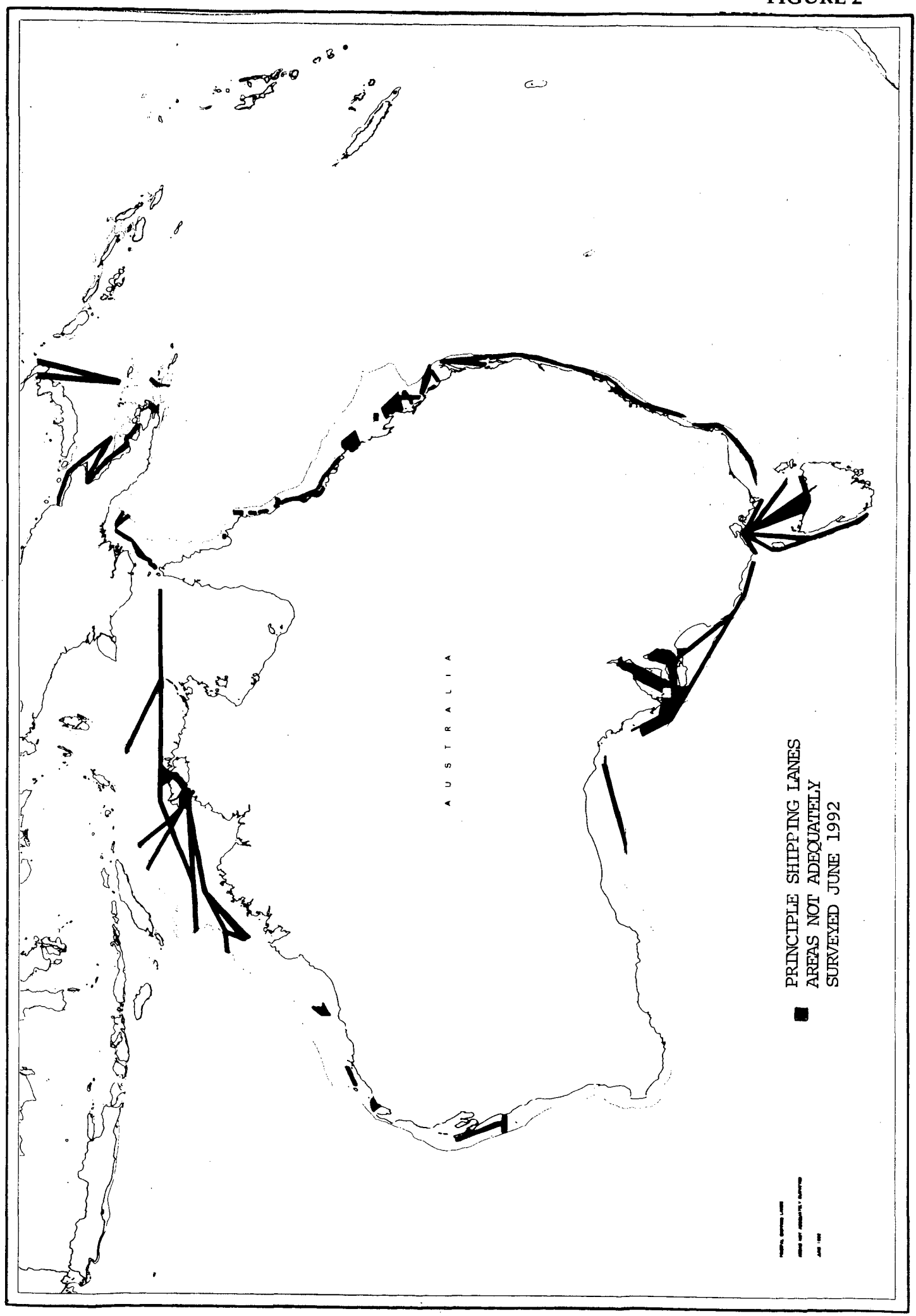

AUSTRALIA
PRINCIPLE SHIPPING LANES
AREAS NOT ADEQUATELY
SURVEYED JUNE 1992

FIGURE 2a

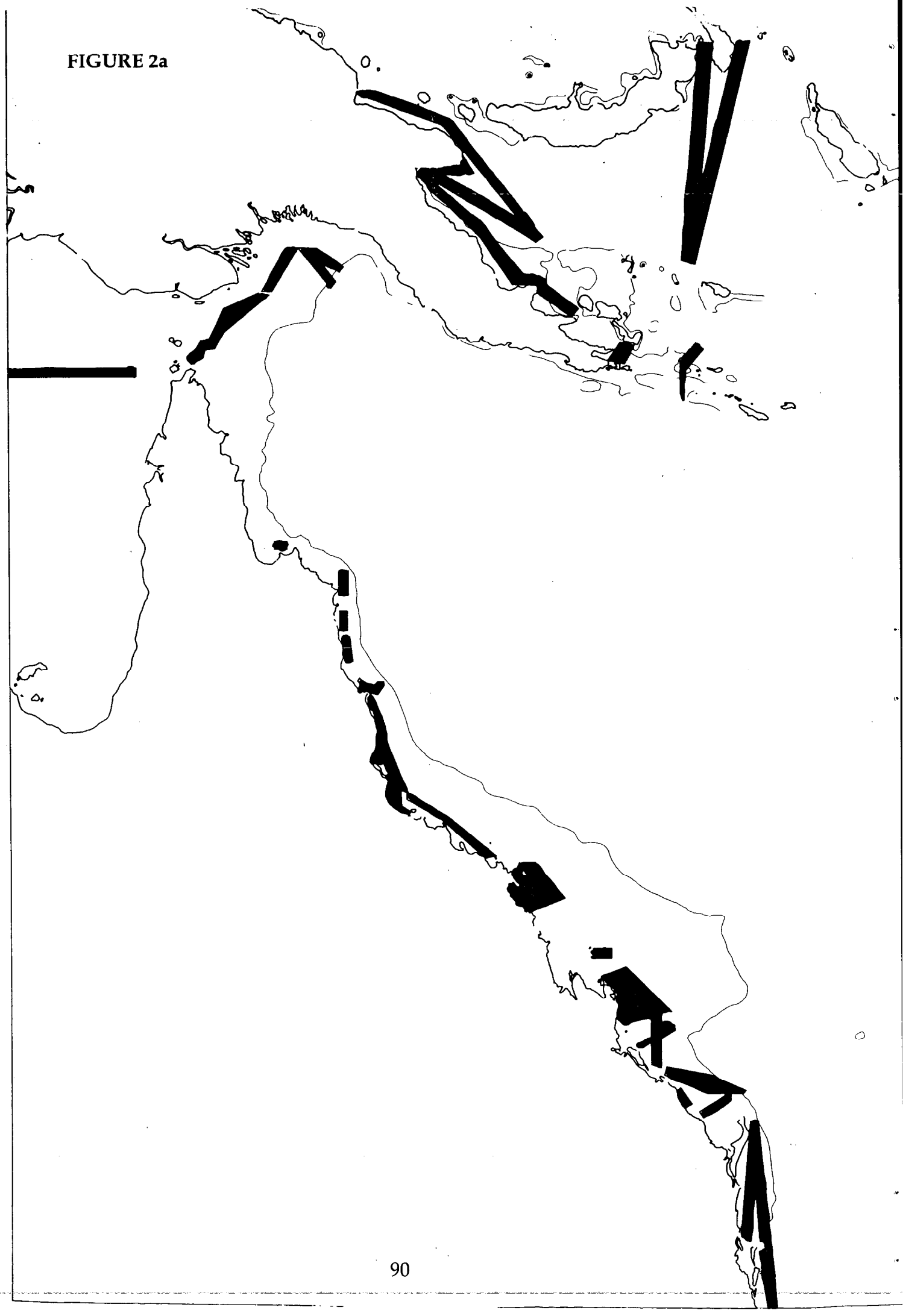


FIGURE 3

LIST OF RECENT GROUNDINGS ON UNCHARTED HAZARDS IN AUSTRALIAN WATERS

1971 Oil Tanker 'OCEANIC GRANDEUR' hit an **uncharted** rock in the Torres Strait. (Resulting pollution destroyed 20 pearl farms).

1978 General Cargo Vessel 'TRANSGOLD' 11 000 tons, grounded in **poorly surveyed** area near Rosade Spit PNG.

1980 Cruise Liner 'LINDBAD EXPLORER', 28 000 tons, hit an **uncharted** rock in the Antarctic.

1981 WA State Ship 'KIMBERLEY', 12 000 tons, grounded off Derby **outside charted area.** (Ship broke her back on falling tide).

General Cargo Vessel 'HAIGONI EXPRESS' grounded in **poorly surveyed** waters near Hood Point PNG.

1982 Oil Tanker 'AMPOL SAREL', 78 000 tons, touched ground in Prince of Wales Channel probably due to **shifting sandbanks** (this highlights the need for re-surveys in areas known to be unstable).

Patrol Boat HMAS BARBETTE grounded in the approaches to Derby, probably due to **shifting sandbanks**.

Landing Ship HMAS TOBRUK grounded in Port Clinton in an area which had been **surveyed only by 'sketch'** methods.

Timber Ship 'PEONY' grounded in **poorly surveyed** waters in Open Bay PNG.

1983 Landing Ship USS VANCOUVER grounded on an **uncharted shoal** off the Lancelin range, in an area marked 'incompletely surveyed'. Screws were damaged, and ship's capability was impaired.

Bulk Carrier 'MV BRAVENESS', 18 000 tons, hit a reported but **unsurveyed shoal** off Cape Otway. Several double bottoms were punctured.

Timber Ship 'MARINE STAR' grounded in **poorly charted** waters off West New Britain.

Tanker 'MANHATTAN DUKE' 82 000 tons, grounded on **ill defined** Basilisk Reef PNG.

1984 Bulk Carrier 'IRON CURTIS', 70 000 tons, drawing 12.2 metres on passage in the Great Barrier Reef recommended route near Lizard Island, crossed a 12.2 metre **uncharted rock.** Fortunately it was high tide.

Antarctic Support Ship 'ICEBIRD' 6 000 tons, entering Mawson in general depths of 400 metres, struck an **uncharted rock.** Ships draught 5 metres.

Car Carrier 'BRIGHT ACE' on passage from Japan to Australia grounded on an **uncharted shoal** in the vicinity of the Star Reefs, PNG.

FIGURE 4

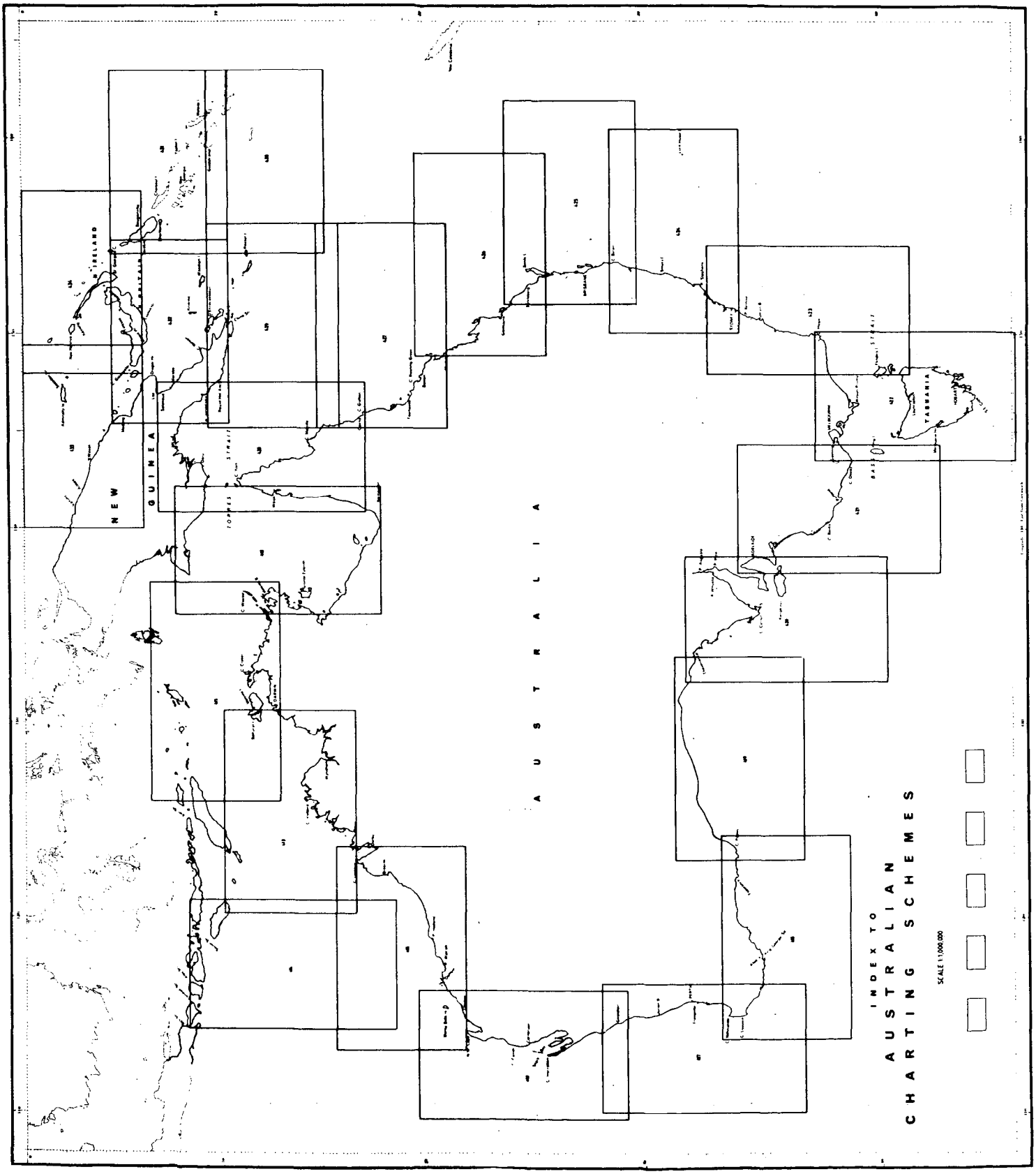

NEW GUINEA
AUSTRALIA
TASMANIA
INDEX TO AUSTRALIAN CHARTING SCHEMES
SCALE 1:1,000,000

FIGURE 5

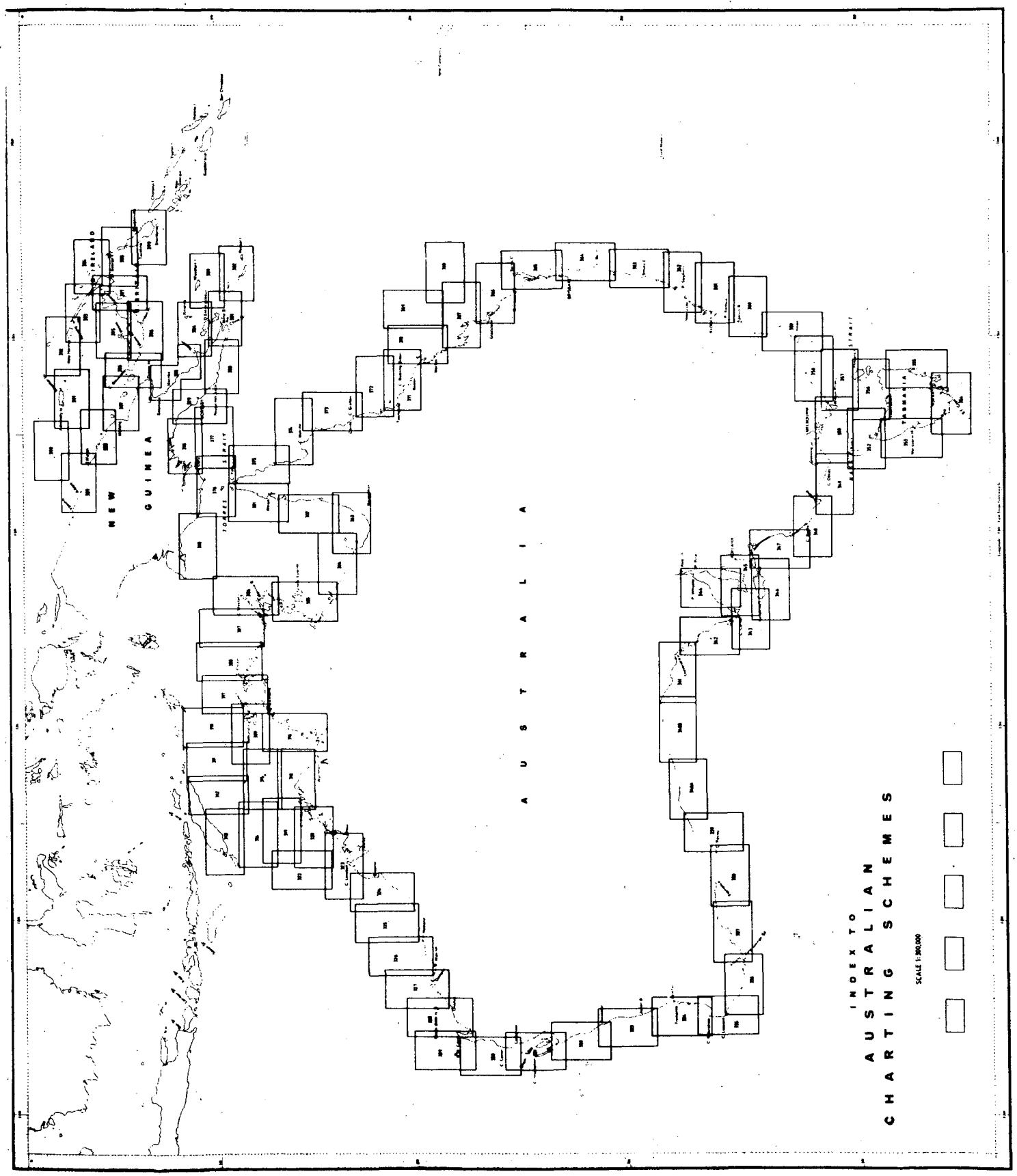

NEW GUINEA
AUSTRALIA
INDEX TO
AUSTRALIAN
CHARTING SCHEMES
SCALE 1:3000,000

FIGURE 6

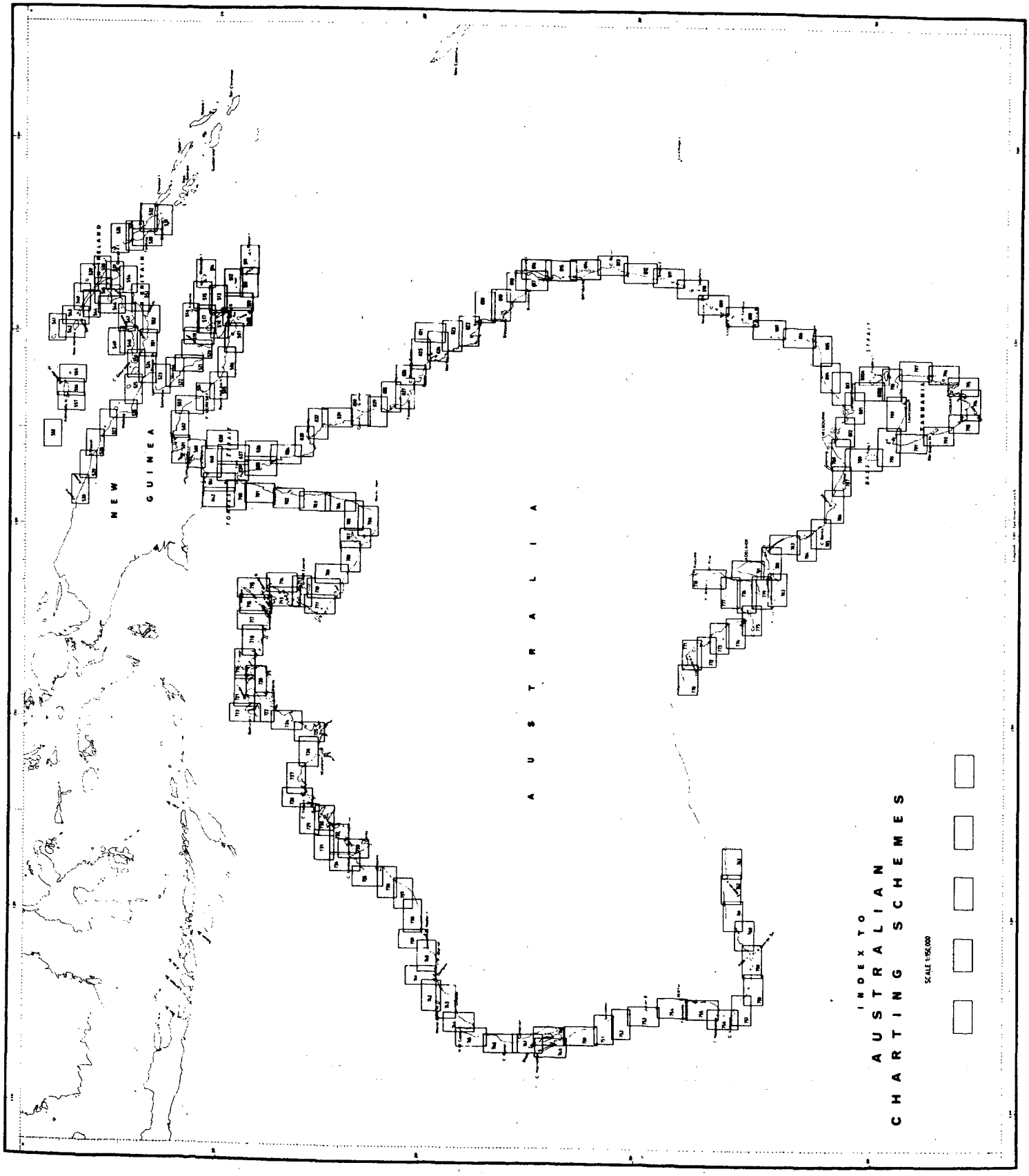

NEW GUINEA
AUSTRALIA
INDEX TO
AUSTRALIAN
CHARTING SCHEMES
SCALE 1:5M,000

FIGURE 7

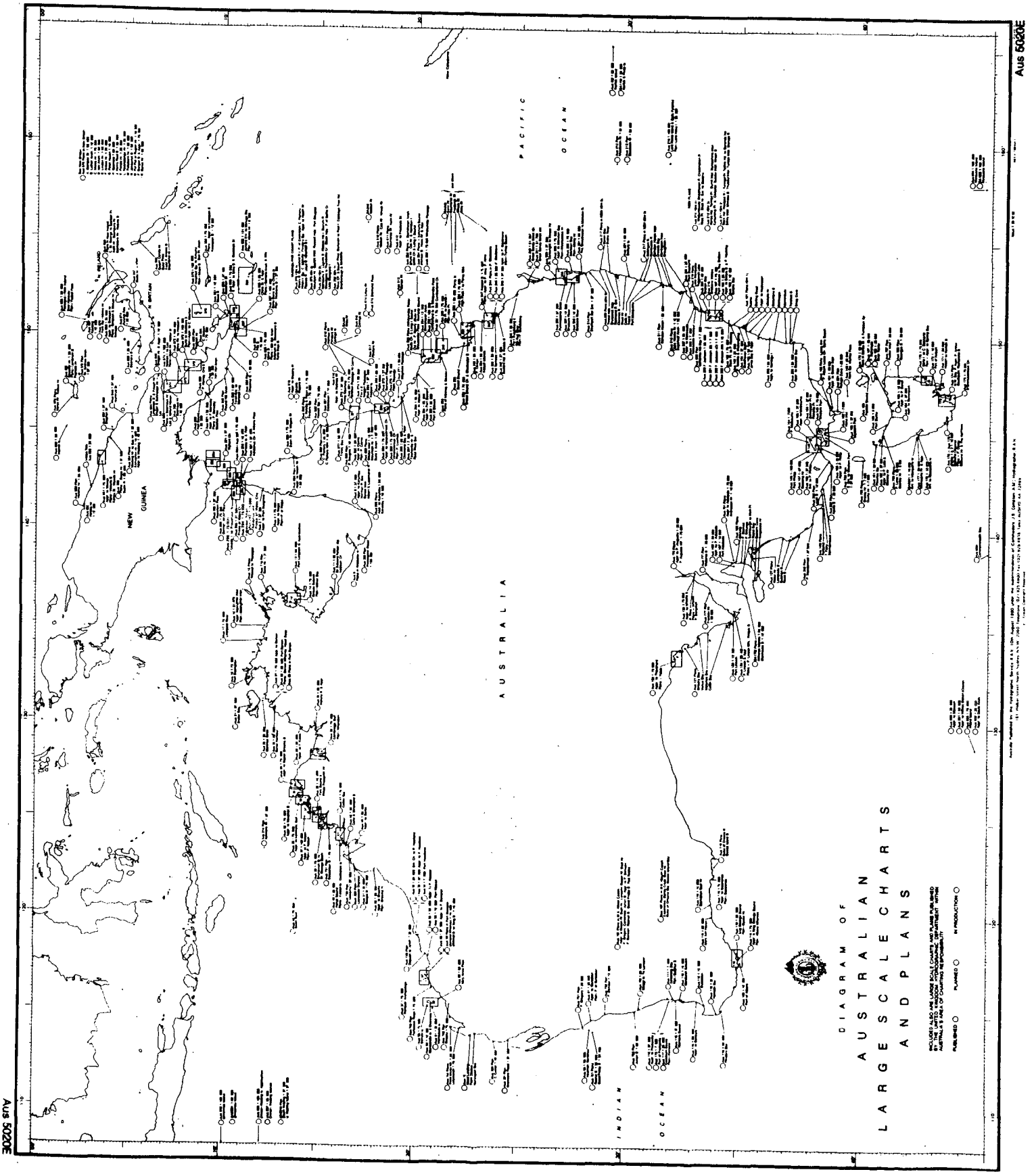


DIAGRAM OF
AUSTRALIAN
LARGE SCALE CHARTS
AND PLANS
PUBLISHED
PLANNED
IN PRODUCTION
AUSTRALIA
NEW GUINEA
PACIFIC
OCEAN
INDIAN
OCEAN
Aus 5020E
Aus 5020E

FIGURE 8 CHART SCHEME STATISTICS 30 JUNE 91

Scale	Published		Planned	Shortfall*
	All	Metric		
1:500 00	30	(14)	74	*60*
1:300 000	78	(30)	100	*70*
1:150 000	88	(60)	200	*140*
Large Scale	156	(102)	262	*160*
Sub Total	**352**	**(208)**	**636**	***430***

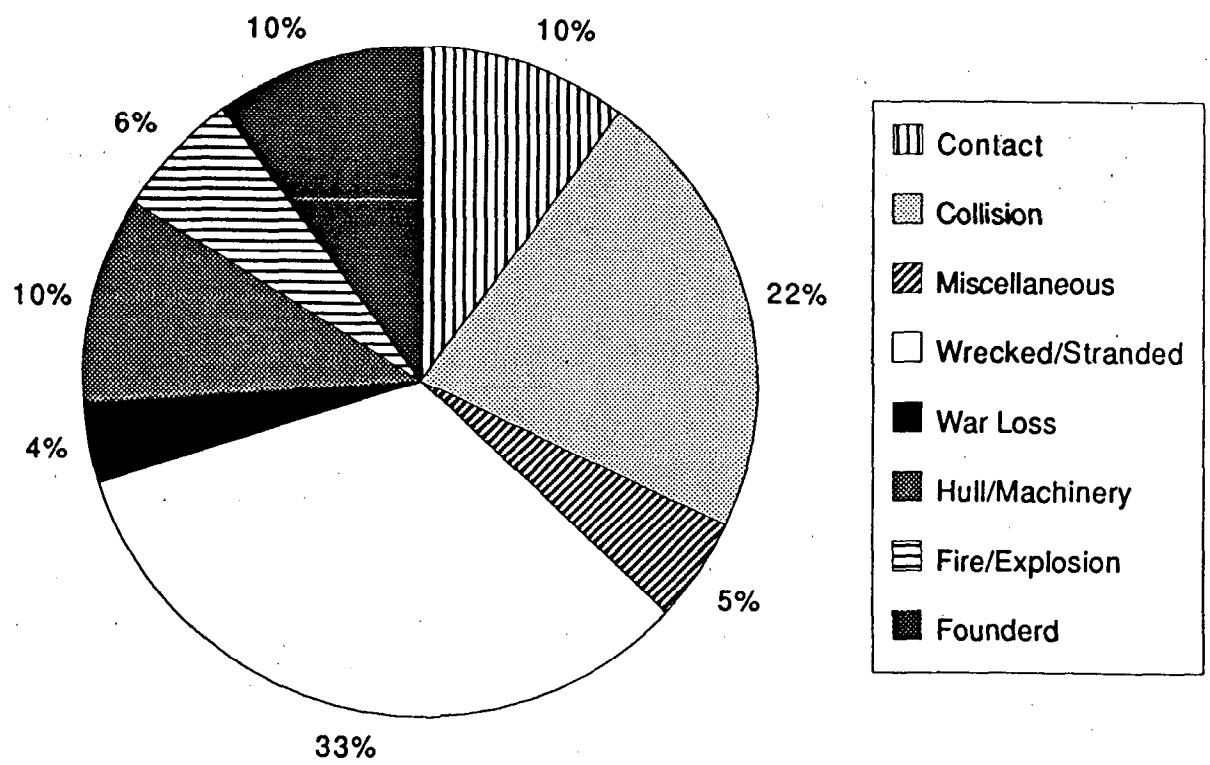
*Shortfall = Planned number - number of metric charts already published

FIGURE 8 (a) CHART SCHEME STATISTICS GREAT BARRIER REEF

	Planned	Published		Shortfall
		All	Metric	
1 : 100 000	3	3	(0)	*3*
1 : 300 000	12	9	(3)	*9*
1 : 150 00	28	24	(19)	*9*
Sub Total	**43**	**36**	**(22)**	***21***

CASUALTY CATEGORY v. POLLUTION INCIDENTS

952 CASUALTIES



WORLD FLEET > 100 GRT 1978 - 89

QUESTIONS AND ANSWERS*

Cmr Leech's presentation

Question
On your overhead, you identified a number of areas that have been incompletely charted or surveyed and other areas that need to be updated. Do you have a system of identifying the priority areas in your program?

Answer
Yes. We publish a five-year survey program which is called the Hydroscheme, and it contains a mixture of defence and civil priorities, and we have co-ordinated that by making inquiries of the Defence department, and also making inquiries in the past of the DoTC. In the future we will direct inquiries to AMSA which will co-ordinate responses from the civil community. We haven't had any clashes of priorities because the defence priorities are in the north and you can see we've done a great deal of work in the Barrier Reef area; it has to be one of the priority areas.

Question:
I was wondering how many ships that transit the Australian coast have an electronic charting capability?

Answer
I don't believe there are any ships using it at the moment. I mentioned one manufacturer of voluntary ECDIS, and his principal market is the fishing industry in Western Australia. I was told though, by somebody here, that one of his systems is to be fitted in a oil tanker this year, and I do know that it's also being fitted in the fast catamarans so I think as it becomes known, he may find a good market. He certainly has the coverage of the coast to be able to provide a simple ECDIS product.

Question
Would that be something that we could work towards the IMO working into the SOLAS system, ultimately?

Answer
No, because the product that I'm talking about, which is based on these paper charts, is not an IMO compliant product; it is a voluntary product. The IMO may recognise voluntary products, but it's more likely that domestic governments will provide a regulation which requires people to use those standard products.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

FUTURE MARINE NAVIGATION SYSTEMS

David Langford
Navigational Services
Australian Maritime Safety Authority

Summary

New technology is beginning to provide electronic navigation systems offering high accuracies of position fixing over wide areas, together with a range of associated sophisticated information services. Most shipping is however still reliant on traditional aids to navigation.

Visual aids, radar aids and radio navigation systems are three of the main types of navigation systems and services used for marine navigation. Visual aids have traditionally been the predominant type of aid provided in Australia for coastal navigation. Radar aids, specifically racons, are a relatively new type of aid, and have become increasingly popular. Although radio navigation systems are widely used in many developed countries, they have only ever been provided on a very minor scale in Australia.

AMSA provides an extensive network of visual aids in the Great Barrier Reef and Torres Strait regions, supplemented by a few racons. No radio navigation systems have ever been provided for the Great Barrier Reef region.

The Global Positioning System (GPS) operated by the US Department of Defense will provide, to all civil users throughout the world, a horizontal position fixing accuracy of 100 metres. GPS will be widely used for marine navigation, and will most likely be the major worldwide radio navigation system for many years. Although 100 metre accuracy is acceptable for many navigational situations, it does not meet the requirements for some of the more demanding requirements, such as navigation through much of the Great Barrier Reef. A Differential GPS service can enable the accuracy of position fixing to be improved to better than 10 metres.

The paper describes the main features of a DGPS service for marine navigation, and the implications for users. The status of DGPS services provided by maritime authorities in other countries is mentioned. The AMSA strategy for the provision of DGPS services, which includes the first trial DGPS service planned for installation in Victoria, is discussed. Indicative details of a possible DGPS network for the Great Barrier Reef, Torres Strait and Great North East Channel are outlined.

The role which DGPS could play in shipboard integrated navigation systems, and in vessel reporting systems, is briefly mentioned.

Introduction

New technology is providing the opportunity for dramatically changing the process of navigation on the sea, on land, and in the air. Satellite navigation systems are enabling the achievement of high accuracies of position fixing throughout the world, in all weather conditions and at all times. The new technology will not only provide the mariner with accurate position fixes. Other information available from satellite navigation systems includes, for example, speed, heading, distance to waypoints, and cross track errors with respect to a preplanned route. Because all this information is available in electronic form, it can be employed in association with electronic charts, and integrated shipboard navigation systems. The information can also be automatically relayed to shore installations, say to the shipowner's office, to a vessel traffic monitoring centre, or to a search and rescue centre.

Most shipping is still heavily reliant on traditional aids to navigation, with navigation by visual means being predominant. The aim of this paper is to look at the features and

benefits of satellite navigation, and especially at a new system known as Differential GPS. It is not the intention of this paper to argue the case for the establishment of any new system. The intention is merely to describe new technologies which are already available, and which appear to offer considerable benefits to vessel operators and other parties concerned with navigational safety. The possible application of these new technologies in the Great Barrier Reef and surrounding areas would need to be examined in more detail before any firm proposals could be drawn up.

Marine Navigation Systems and Services

The International Association of Lighthouse Authorities' publication "Navguide" lists seven different types of systems and services available to the user for position fixing and navigation. These are astronomical position fixing, charts (and other nautical documents), pilotage, vessel traffic services, visual aids to navigation, radar aids to navigation and radio navigation systems.

Astronomical position fixing has little relevance to navigating the Inner Route of the Great Barrier Reef. Charting and pilotage are the subject of other papers at this Workshop. Towards the end of this paper, brief mention will be made of vessel traffic services. All the position fixing services provided by AMSA in the Great Barrier Reef region are either visual aids or radar aids. The numbers of existing aids in the Great Barrier Reef and surrounding areas are listed in **Attachment 1**. Visual aids predominate. This is because navigation in the region has principally been by visual means, with reliance on pilotage services.

The visual aids are conventional lights, now almost all solar powered. Most of the structures housing these aids also serve a useful function as daymarks for navigation during daylight. For many years the Commonwealth has provided a very extensive network of visual aids in this region, particularly in the northern section of the Great Barrier Reef and the Torres Strait. AMSA, and its predecessor Commonwealth organisations, has consulted closely with the shipping industry and the Queensland Coast and Torres Strait Pilot Service in planning the various changes made to the network of aids. One major change currently being planned is the replacement of all floating aids in this region, most by fixed structures.

AMSA operates a small number of radar aids. All these are racons, or radar transponder beacons. Five were installed in the Great Barrier Reef, and another four in surrounding areas, all over the period 1985 to 1992. The purpose of the racon is to provide positive identification, on a ship's radar display, of a known point, typically a lighthouse tower. Thus the range and bearing to this point from the ship can be determined.

AMSA operates four radio reporting tide gauges in the Torres Strait, which broadcast real time tide height over VHF radio. The data is also accessible over the public telephone system.

Unlike many developed countries in the Northern Hemisphere, Australia has only ventured into marine radio navigation systems in a very small way. The Commonwealth operated up to ten radio direction finding beacons, and the last of these will be discontinued later this year. Only one was in Queensland, at Booby Island. The era of the usefulness of this aid has passed. The Commonwealth established two Decca Navigator Chains in Western Australia just over twenty years ago. One was closed in 1986 and the other last year. AMSA continues to operate the Australian Omega station, under an agreement between the Australian and U.S. Governments. The station is one of a network of eight stations in the world comprising the Omega Navigation System. Omega has an accuracy of 2 to 4 miles, and no longer serves any useful purpose for marine navigation in the Australian area.

Global Positioning System

The radio navigation system which is on the verge of revolutionising navigation is the NAVSTAR Global Positioning System, usually referred to simply as GPS. Although developed by the United States Department of Defense, the US Government has declared that the Standard Positioning Service of GPS will be available to all civil users around the world with an accuracy of 100 metres at the 95% probability level. GPS is due to be declared as achieving its "Interim Operational Capability" in August this year, and its "Full Operational Capability" next year.

The space segment of GPS consists of 24 orbiting satellites. A user's GPS receiver determines its position by making range measurements to satellites which are in view. For a three dimensional fix, measurements must be made to four or more satellites. For a two dimensional fix, measurements must be made to three or more satellites.

In providing the Standard Positioning Service of GPS, the US Department of Defence has deliberately degraded the achievable accuracy, by a process known as Selective Availability. If Selective Availability were not imposed, then the two dimensional position fixing accuracy would be about 30 metres instead of the specified 100 metres.

DGPS Basics

Although GPS provides sufficient accuracy for most navigational situations, it does not meet the requirements for some of the more demanding applications, such as navigation in channels, ports and confined waterways. Differential GPS services have been developed to provide considerable improvement in position fixing using GPS. For the type of DGPS service discussed in this paper, the achievable accuracy is better than 10 metres.

A Differential GPS (DGPS) service is based on the principle that if a GPS receiver is located at an accurately known ("reference station") location, it can continuously measure the errors in ranges to all the satellites in view, and relay these errors to users within a distance of up to some hundreds of miles away. The user's receiving equipment will apply these errors to improve the accuracy of position fixing. DGPS cancels out the effects of Selective Availability, as well as correcting for some other factors which contribute to the errors of GPS measurements.

The principle of DGPS is illustrated in **Attachment 2**. If the ship is equipped with only a GPS receiver, then the ship's position is determined by range measurements to the three satellites in view, that is R1, R2 and R3. The GPS receiver at the DGPS reference station makes range measurements to the satellites, and its computer calculates the corrections applicable to these range measurements, that is R1, R2 and R3. These corrections are then broadcast over a radio transmitter. If the ship is equipped with the appropriate equipment to receive these broadcast corrections, it will apply the corrections to its range measurements, and thereby improve its accuracy of position fixing to better than 10 metres.

In addition to improving the accuracy of position determination and other data, DGPS performs an important function in monitoring the integrity of GPS itself. The US Department of Defence operates a sophisticated network of monitoring and control stations as part of GPS. When a satellite is detected as "unhealthy", the satellite is commanded to transmit a message to that effect, so that user GPS receivers are made aware. Although GPS is expected to achieve very high standards of performance, it is possible for a satellite to transmit an unhealthy signal before users can be warned not to use the signal. A recent International Association of Lighthouse Authorities' discussion paper states that "the disposition of the Ground Segment of the system is such that a satellite can malfunction, broadcasting erroneous data for up to 2 hours before any warning can be issued or the satellite can be commanded to broadcast its faulty state". A

recent U.S. Coast Guard paper states that "a satellite can be transmitting an unhealthy signal for 2 to 6 hours before it can be detected and corrected by the Master Control Station or before users can be warned not to use the signal". With DGPS messages, a direction can be given not to use a particular satellite (which may or may not be marked as unhealthy), or an unhealthy satellite may still be used in certain circumstances.

DGPS Benefits

The benefits to mariners of public broadcast DGPS services are:

- improves accuracy of position fixing using GPS
- improves accuracy of other GPS derived information
- provides information to other shipborne systems
- provides real time integrity monitoring of GPS
- requires only modest amount of additional shipborne equipment
- shipborne equipment useable in many countries
- reception of data is "free".

DGPS in other countries

Several countries are already operating DGPS services for marine navigation purposes, and more services are planned. The services known to AMSA are listed in **Attachment 3.** In all cases except the U.K., the broadcast data is free at the point of use. The data broadcast from the U.K. stations is encrypted, and access requires users to pay.

All countries providing these services are following the same standards for the broadcast data, as recommended by the International Association of Lighthouse Authorities. The IALA standard is based on the RTCM (Radio Technical Commission for Maritime Services, U.S.A.) Special Committee No. 104 "Recommended Standards for Differential Navstar GPS Service (Version 2.0.)". All countries are using Medium Frequency radio transmitters to broadcast the data, operating in the band allocated for maritime radionavigation.

If a ship is already fitted with a GPS receiver having the capability to process differential corrections to the RTCM recommended standards, then the additional shipborne equipment required is a single unit consisting of a Medium Frequency radio receiver, demodulator, and a processor which converts the data into the prescribed form suitable for transfer to the GPS receiver. Several companies are producing these units.

AMSA strategy for DGPS

AMSA has a strategy for the provision of DGPS services in Australia for marine navigation. The key elements of this strategy are:

- establish one or two pilot installations
- examine the establishment of further installations
- consult with maritime organisations in developing plans
- keep abreast of developments in Australia and overseas
- contribute to the development of standards
- follow international standards for data transmission
- evaluate the services provided
- promote the use of the services established
- provide advisory service to users and receiver suppliers.

The first pilot installation will be in Victoria, with the broadcasting station located at Cape Schanck, the site of an existing radio beacon. Tenders for the supply of equipment were called in December 1992, and it is expected that a contract will be placed in the very near future. The current program is for broadcasts to commence on a trial basis in December 1993.

If the first one or two installations perform satisfactorily, and if it is considered that there would be substantial benefits to navigational safety from installing additional stations, then a program could be drawn up for a network of stations. The Great Barrier Reef, Torres Strait and Great North East Channel are areas which could potentially benefit from the provision of DGPS services.

An indicative DGPS network for these areas is depicted in **Attachment 4.** This possible network comprises six broadcasting stations, each transmitting data on a different frequency in the Medium Frequency marine radionavigation band. It is stressed that the number and locations of these stations is at this stage indicative only. Further examination would be required before a firm proposal could be drawn up, and cost estimates prepared. Present indications are that the cost of establishing a six station network may be around $2 million. One major determinant of cost would be the extent to which AMSA might be able to install its equipment at existing facilities operated by other organisations.

Integrated Navigation Systems

Highly sophisticated integrated navigation systems are available to the mariner. The electronic chart will be a key element of future integrated navigation systems. For the full potential of electronic charts to be realised, there must be accurate real time position information available in electronic form. DGPS is a highly suitable means of meeting this need.

An integrated navigation system is illustrated in **Attachment 5.** This is the system used in the Norwegian Seatrans Project, which assessed the use of ECDIS, as described in the February 1991 report by the Norwegian Marine Technology Research Institute. The prime role of DGPS was to feed accurate position data to the electronic chart display. The Inmarsat service was used to provide chart updates from the Hydrographic Service to the ship, and also to relay position information (as determined by GPS/DGPS) on request to the shipowner or maritime authorities.

Vessel Reporting Systems

In the aftermath of the Exxon Valdez grounding in Alaska in 1989, various measures were taken with the view to minimising the possibility of future such disasters. One measure is the introduction of a vessel traffic system in Prince William Sound. All tankers will be required to carry equipment which will continuously and automatically report their position, and other data. The prescribed vessel position reporting sensor will be DGPS, using DGPS signals provided by U.S. Coast Guard DGPS broadcasting stations.

The provision of some form of vessel reporting system in the Torres Strait and Great Barrier Reef, and how such a system could contribute to safety, appears to be worth examining. A vessel reporting system could take various possible forms. At one extreme is the type being introduced in Alaska, that is a compulsory system with automatic highly accurate position sensing, and with rigid controls. At the other extreme is a voluntary system with manual reporting of approximate positions at prescribed times. It would be most desirable however for any planned system to have the capability of not only feeding ship position information to a "central station", but also of enabling each participating ship to receive position reports from all other participating ships. The technology is already here to meet any type of system within these two extremes. The prime determinant should be the resultant contribution which the system would make to navigational safety, and to minimising the probability of environmental damage due to collisions or groundings.

Conclusions

Satellite navigation, and specifically GPS, will be used extensively for marine navigation throughout the world. The accuracy of GPS is adequate for many situations, but not for

navigation in confined waterways. DGPS services provide considerably enhanced accuracies, and carry out integrity monitoring of GPS, at modest cost to shipowners. AMSA is planning one or two pilot DGPS services, and may consider the establishment of further services.

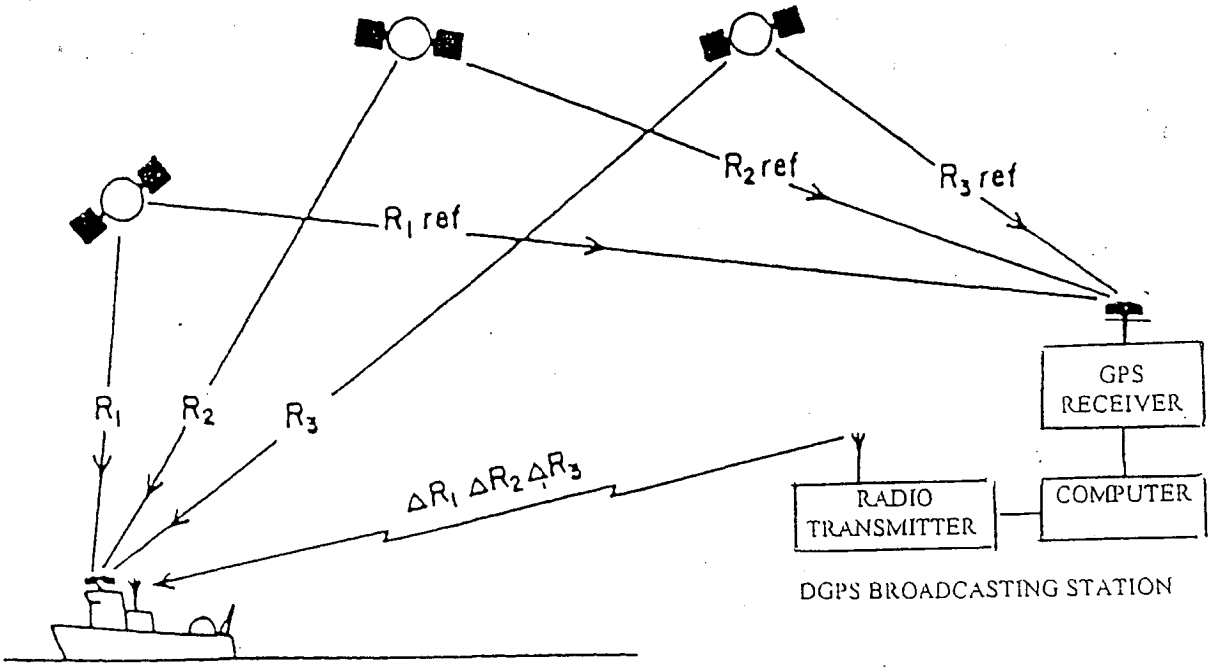
The establishment of a network of DGPS broadcasting stations to cover the Great Barrier Reef, Torres Strait and Great North East Channel would appear to be worth examining, in view of the contribution that such a network could conceivably make to improving navigational safety. It would also seem desirable for an examination to be carried out into the provision of some form of vessel reporting system for this region.

ATTACHMENT 1

AMSA AIDS TO NAVIGATION IN THE GREAT BARRIER REEF MARINE PARK AND ADJOINING AREAS

Type	Great Barrier Reef Marine Park	Torres Strait	Great North East Channel	Coral Sea
Light (on structure)	77	11	6	4
Light (floating aid)	2	6	0	0
Unlit Aid	7	1	0	0
Racon	5	0	1	3
Tide Gauge	0	4	0	0
Total	91	22	7	7

ATTACHMENT 2



DGPS - SCHEMATIC

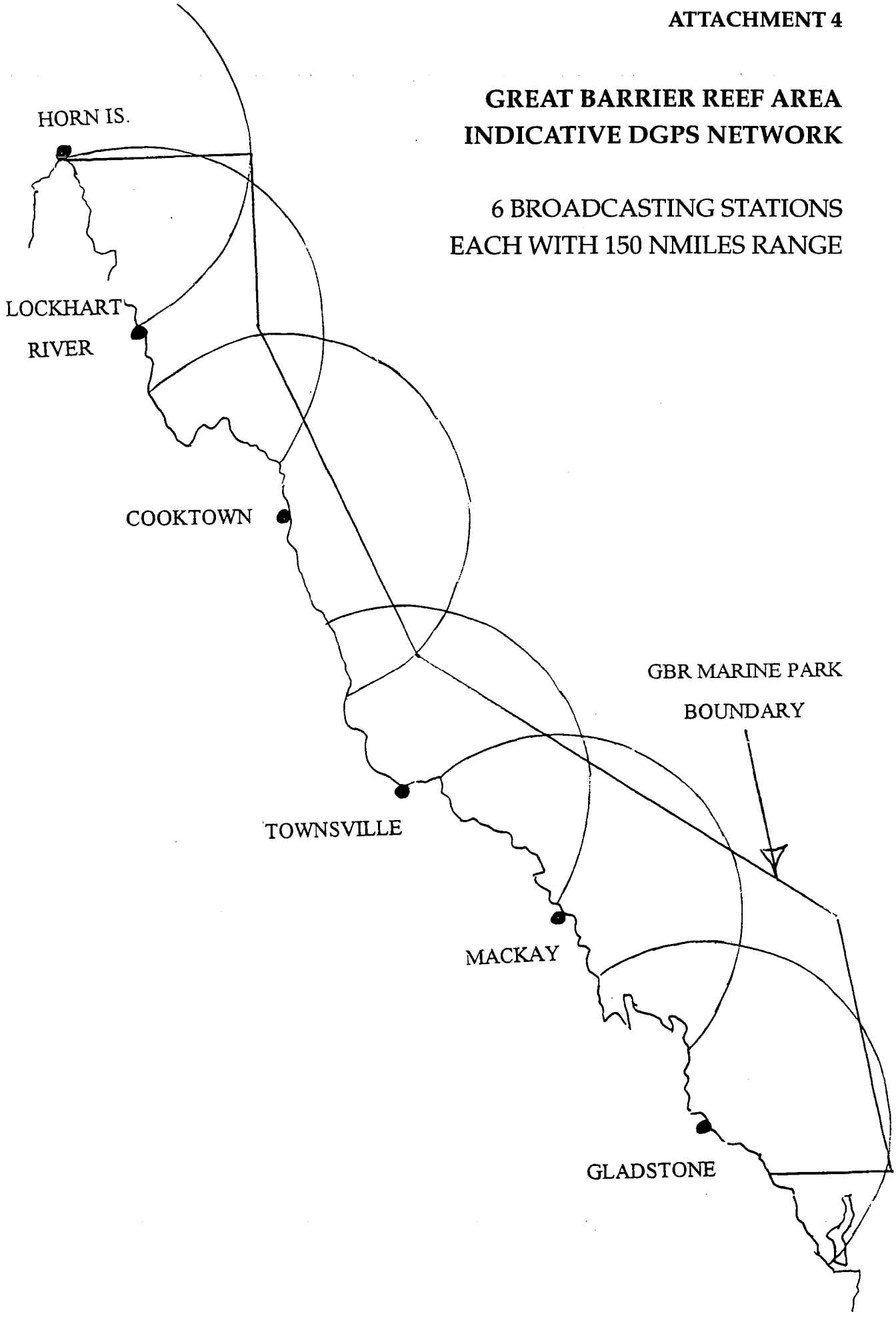
ATTACHMENT 3

MARITIME DGPS SERVICES PROVIDED IN OTHER COUNTRIES

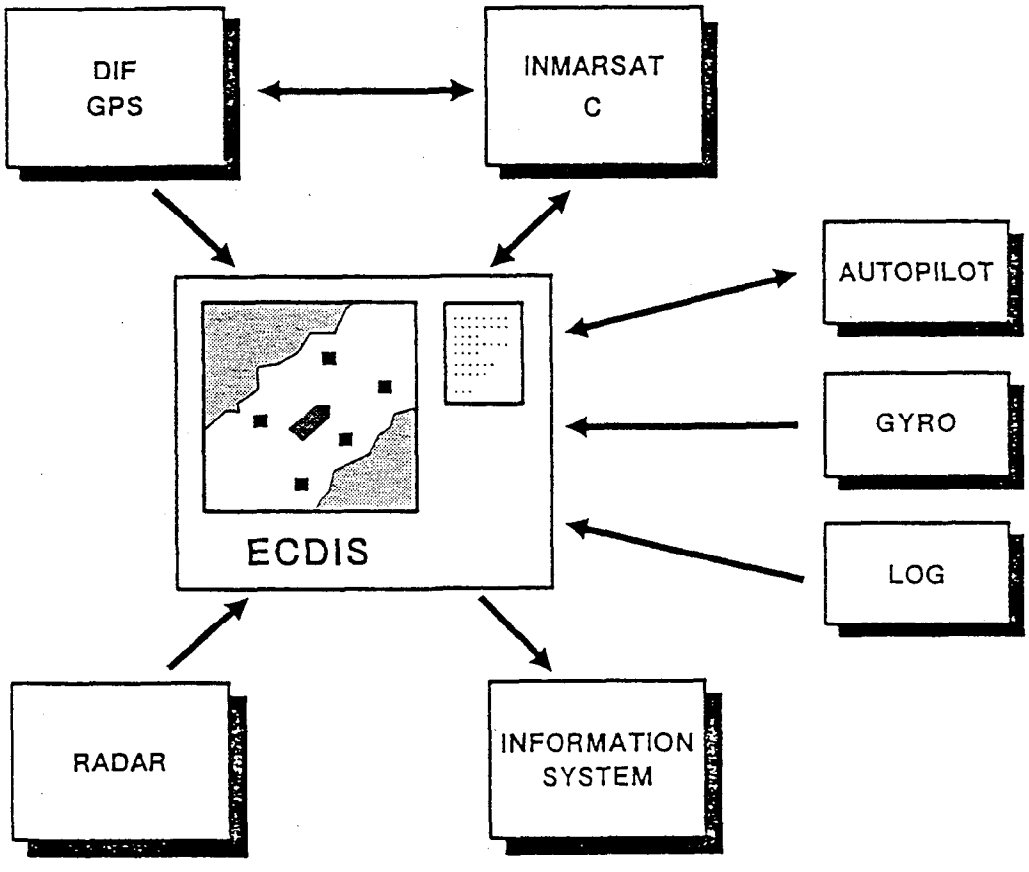
	Stations Operating as at Feb. 1993	Total Number of Stations Planned
USA	9	52 (by 1996)
NORWAY	4	12 (by 1995)
SWEDEN	3	6
FINLAND	3	5
DENMARK	1	4
GERMANY	0	2
NETHERLANDS	1	2
UK and IRELAND	7	11

GREAT BARRIER REEF AREA
INDICATIVE DGPS NETWORK

6 BROADCASTING STATIONS
EACH WITH 150 NMILES RANGE



ATTACHMENT 5



INTEGRATED NAVIGATION SYSTEM
SYSTEM CONFIGURATION USED FOR SEATRANS PROJECT

QUESTIONS AND ANSWERS*

David Langford's presentation

Question
The two million dollar figure you mentioned was for the construction of six stations in the GBR region?

Answer
Yes, it's an indicative cost for six stations. The unit cost would, including the MF transmitting aerial, be probably be about $200,000 with an allowance of $100,000 for building. The main factor would be the building cost.

Question
You said that at the moment, the accuracy with a differential GPS system is roughly ten metres and this is not adequate. On land we are getting down to accuracies of centimetres. Is there any technological reason why, through accommodation of the integrated systems we're talking about and using the inertial systems, we can't get that kind of accuracy.

Answer
I think the accuracy that's achievable from the differential GPS service that I've been talking about is 6 or 7 metres which I think is adequate for almost every navigational situation. I do not think the centimetre accuracy is really needed for marine navigation. It is achievable but requires a lot of expensive equipment. For surveys, they use two or three sets of equipment that they move around to do a precise survey in a certain area. For an accuracy of 6-7 metres, and assuming that a ship already has a GPS receiver, the additional cost of the ship owner providing a unit which will access and process the differential information is at the moment about $2,000. I'm sure that this will come down, because there's already a lot of competition.

Comment from the floor.
The centimetre precision is really derived from a static observation, where you can have an enormous number of observations, so you can reduce your root-mean-square error. Of course in a dynamic situation, you've only got one observation and you're not there anymore, so the machine will only therefore reduce your root-mean-square error to something to the order of 10 metres. There's a lot of interest in the use of ECDIS and DGPS in north America where they suffer very badly from fog and ice, and particularly the St Lawrence Seaway and these things are being used on a daily basis in ferries in the St Lawrence Seaway to put ships along-side wharves. There it's not a problem. Centimetre accuracy is certainly achievable, but it requires a lot more sophisticated equipment.

Question
On your slide you seem to be using MF for passing information of DGPS to ships. What consideration has been given to using either VHF or INMARSAT?

Answer
Well, at the moment, we've decided to follow the standard which has been laid down by the International Association of Lighthouse Authorities (IALA). They've looked a range of options to transmit the differential corrections to the ship. There are advantages and disadvantages with the various systems. I suppose the main advantage of the INMARSAT service is that it can cover a very wide geographical area, but it comes at a considerably higher cost to the ship owner. I think the aviation community may well in future years have a system that does use INMARSAT and there's a certain amount of development in that area at the moment. The main thing about the MF transmission is

that it is being implemented now. It is a system that has been agreed upon by a lot of countries, it's very easy and very economical to install on the ship. The INMARSAT approach, would be considerably more expensive to implement. I think at the end of the day, it may not be producing any great advantages. The main problem with VHF is it has a much smaller area of coverage. In order to cover the GBR area, you'd probably need 6 stations of medium frequency; if you went to VHF, it might be 2 or 3 times that number of stations. With VHF, you really get the signal by line of sight, from the transmitter to the ship. With MF it is essentially ground wave propagation and there is no line of sight requirement.

* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

TANKER OWNER'S AND OPERATOR'S PERSPECTIVE

Robin Grajios
Australian National Maritime Association

Developing environmental awareness by society and, in particular, the recognition of the vulnerability and fragility of the GBR, has created the need to critically assess the safety of the reef from pollution. Communities living adjacent to and on the reef, whether tourism organisations, state, national or international environmental groups and most recently, legislative concerns evolving from the World Heritage Listing, are all intent on ensuring the protection and preservation of one of the world's greatest natural wonders.

The length of the reef, stretching from the Torres Strait in the north, down to the Tropic of Capricorn, an overall distance of approximately 1100 nautical miles, provides a level of protection from the elements for coastal and island communities, as well as ensuring a safe all-year round passage for ships of all types trading along the eastern seaboard.

The developing environmental awareness mentioned earlier is now looking for any obvious sources that may pose a threat to the reef area to the point where reaction to potential or perceived sources of threat has at time become quite emotive, as well as aggressive, with calls for the exclusion of any of these identified sources from the reef area.

Threats are seen as emanating from such widely varying sources as:

1. Runoff in rivers of agricultural fertilisers, etc
2. Discharge of sewage from shore based location, irrespective of the degree of treatment
3. Tourists walking on or swimming in the reef area
4. Tourist vessels - both commercial and private
5. Waste generated on and by tourist islands
6. Commercial shipping.

It is the last of these, the perceived threat from commercial shipping, on which we now make comment.

The current fleet of modern Australian flag vessels provides the reef area with a transport mode that is safe and environmentally clean. Australian tankers provide an essential service to Queensland reef ports and have supplied them with tens of millions of tonnes of refined petroleum product over the last twenty years without incident.

This is not to say we in any way take pollution lightly. Quite the opposite. The protection of our environment is an essential priority in the Australian shipping industry, which is involved in a number of areas of pollution prevention and control. These are:

- safety and pollution prevention practices on Australian vessels and moves to adopt an International Safety Management Code being developed by the International Maritime Organisation,
- the recent adoption by Australian shipping of a charter of practice,
- drug and alcohol controls on board vessels,
- contingency plans on board vessels , and
- the National Plan to Combat Oil Pollution

Safety and Environment Protection Management

In response to increasing concern over ship casualties, marine pollution and the very significant role of the human factor in such incidents, the International Maritime

Organisation is developing an International Safety Management Code which is intended to become an industry standard throughout the world.

The Code will encompass management systems requiring:

- a safety and environment protection policy;
- instructions and procedures to ensure safe operation of ships and protection of the environment in compliance with relevant international and flag State Legislation;
- defined levels of authority and lines of communication between, and amongst, shore and shipboard personnel;
- procedures for reporting accidents and non-conformities with the provisions of this Code;
- procedures to prepare for and respond to emergency situations; and
- procedures for internal audits and management reviews.

Most, if not all of these requirements are common features of management on Australian ships.

In our submission to the Morris Inquiry into Ship Safety, we informed the Inquiry that Australian shipowners and operators were developing a code of safety. It is intended that such a code will conform with the code being developed within IMO and thus establish international recognition of safety and environment protection standards onboard Australian ships.

An Australian shipping Charter of Practice was adopted by the industry in December 1992.

Drug and Alcohol Controls

Australian shipping now has comprehensive guidelines governing drug abuse and alcohol consumption ranging from "dry' ships to ships on which there are strict rules regarding blood alcohol levels, bar hours and liquor stores.

These guidelines are complemented by stiffer penalties under the Navigation Act for behaviour under the influences of alcohol or other drugs leading to damage to property, injury to other persons, or the performance of his or her duties is impaired.

In this context, the risk of pollution from carelessness arising from seafarers under the influence of alcohol has been largely eliminated.

Contingency Plans

Australian ships have on board contingency plans for action following an oil spill, no matter how small. In addition, Australian vessels are subject to regulations for the prevention of pollution in accord with the IMO Convention for the Prevention of Pollution from Ships (MARPOL 1973/78).

IMO has developed amendments to MARPOL to lay down guidelines for emergency plans in the event of a spill. The primary purpose is to set in motion the necessary actions to stop or minimise a discharge and mitigate its effects. Australian shipowners fully support these developments as they support steps and plans already in place on Australian vessels.

Involvement in the National Plan to Combat Oil Pollution

The Australian maritime industry through ANMA and the oil industry through the Australian Institute of Petroleum (AIP) have taken an active and constructive role in the Review of the National Plan undertaken by the Commonwealth and the States.

The oil industry in Australia has established the Australian Marine Oil Spill Centre which holds stockpiles of equipment and materials to contain and clean up marine oil spills. The Centre also has the ability to enter into agreements to access stockpiles in Singapore and other overseas centres in the event of very large spills. The aim of the National Plan is to set in place procedures for containing and removing spills utilising such resources as have been made available.

The above involvement in safety and pollution quality management, at both national and international levels, reflects a commitment by the Australian oil industry and Australian shipowners in minimising and eliminating whenever possible the risks to our environment from all shipping movements, whether Australian or foreign ships.

QUESTIONS AND ANSWERS*

Robin Grajios's presentation

Question
There's a lot of talk in the US now about putting equipment on ships to combat pollution; do you have any comment?

Answer
Yes, I think it's a complete waste of money and a complete waste of resources. As it's been said in this room so many times this morning, once an accident has occurred, the ship's crew can do more constructive things than trying to launch bits and pieces of gadgetry to try and control the situation.

Question
When you look at our operational experience with the one major spill in the Torres Strait in 1970 with the *Oceanic Grandeur*, we had flat calm conditions for 10 days, and certainly if you had equipment on board, the spill could have been avoided. Rather we had to wait 3 days to get out one little pump out of TI. It was a very slow response, because there wasn't equipment available in the area at the time, but it would be faster now. However, in good situations, if you had equipment on the boat, one could imagine it could be employed, although not in horrific conditions as in the Shetlands. Accidents may take place in conditions which aren't always so bad.

Answer
I'll note what you say, but I would suggest every piece of equipment that you put on a ship has got to be maintained otherwise it's going to be useless.

Question
Peter Small showed us a slide this morning that had that red track, that essentially took this oil tanker all along a lee shore for a couple of thousand miles, and it seems to me that the same problem occurred in the Shetland Islands recently where the chap had obviously picked the incorrect route and there have been other examples. Have you got any comment on what one can do to combat that sort of thing?

Answer
I think the answer is that traditionally flag states, administrations and ship owners have adopted a position that the ship master is responsible for the safe navigation of the vessel, and having said that, they have given him a free hand in terms of the way in which he has gone about taking the ship from point A to point B, taking into consideration his training and experience. If you are going to get into the business of routeing ships, from a charterer or a ship owner's perspective then I believe you have to be very explicit in terms of the route that you state that the master is to follow and that it mustn't be ambiguous.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

LATEST DEVELOPMENTS IN THE SUBDIVISION AND CONSTRUCTION STANDARDS OF VESSELS WITH SPECIAL REGARD TO THE PREVENTION OF POLLUTION AFTER DAMAGE

Rob Gehling
Manager, Ship Structures
Australian Maritime Safety Authority

Summary
The structural integrity and subdivision of ships, particularly oil tankers, are major factors in the prevention of pollution. This paper outlines improvements made to international requirements in this area over recent years and puts these into context in relation to other areas of the maritime industry.

Introduction

The protection of the environment is a concern to all sections of society. A large tanker casualty inevitably attracts media and environmental attention, particularly as result of the immediate impact of the released oil on the local environment and industries.

However, this was not always so as the original development of subdivision standards was in response to a need to improve the survivability of vessels after *collision* damage. Later, as public awareness of the effects of oil pollution increased, standards were established to reduce the potential for pollution, both from an operational and a damage control aspect.

This paper focuses on the improvement of standards to reduce pollution from oil tankers, but the aspects outlined in this paper generally also apply to tankers carrying chemicals in bulk.

Structure

The structure of a vessel is what separates the cargo from the environment. Vessels under the Australian flag and most foreign flag vessels are built and maintained in accordance with the structural requirements of the major international classification societies. At present there is no evidence to suggest that the standards are deficient. Rather, where structural problems have arisen, it has generally been as a result of excessive wastage through poor maintenance and inadequate enforcement of standards. AMSA's port state control activities are directed towards ensuring international adherence to these standards.

There is a perception that modern structural computation methods and the extensive use of higher strength steels has reduced the scantlings of modern vessels to a point where there is now not sufficient allowance for corrosion and wastage in the structure. The maintenance schedules and survey procedures must now be increased to ensure these vessels maintain their strength. The International Maritime Organisation (IMO) is currently developing enhanced requirements in these areas, particularly in relation to tankers and bulk carriers. The economic imperative to reduce the scantlings and hence the lightship weight of the vessel may not be as essential in the tankers of the future as these vessels will in general be restricted in the volume of cargo they can carry rather than the weight of that cargo.

Sub-Division Of Tankers

When the structure is penetrated, such as in a grounding or collision, the amount of pollution that results depends very much on the designed subdivision characteristics of the vessel.

Prior to the International Load Line Convention (ILLC 66)

Prior to the ILLC 66, there were no subdivision requirements for tankers (Figure 1). The Safety Of Life At Sea Convention (SOLAS) made no provisions until the 1981 amendments to the SOLAS 74 convention called for collision bulkheads and watertight bulkheads surrounding the engine room. However, oil tankers built after W.W.II and into the 60's had good survivability characteristics through the low permeability of their cargo spaces, the number of tanks into which the cargo area was subdivided, (up to 27 cargo tanks) cofferdams and pump rooms so characteristic of these types of vessels.

The ILLC 66

ILLC 66 produced the first subdivision standard for cargo vessels carrying liquids in bulk (Figure 2). This standard required a tanker down to its load water line to have a minimum positive, residual stability after the flooding of any one **empty** compartment. In return for meeting this standard the vessel was able to sail with a reduced (type A) freeboard. The incentive for the introduction of this regulation was the increased carrying capacity and hence profitability rather than a desire to minimise pollution of the sea. If the ILLC 66 provided any contribution to pollution prevention it was that oil loss would be contained, as the vessel would survive and be salvageable.

The ILLC 66 also applied a similar standard to other ships, enabling them to operate with reduced freeboards if they met the standard. Ships taking advantage of this provision have generally been designed for carriage of iron ore and other high density bulk cargoes.

MARPOL Convention 1973 (MARPOL 73)

By the early 70's environmental concerns over the amount of oil being released into the sea by tankers both through normal operations and incidents like the *"Torrey Canyon"* disaster forced the IMO in 1973 to adopt the MARPOL Convention, with measures calling for;

- the provision of oil discharge monitoring equipment,
- the provision of segregated ballast tanks (SBT's) for new tankers above 70,000 dwt to operate on ballast voyages without the need to carry ballast in cargo tanks,
- limitations on the length and volume of individual cargo tanks,
- the monitoring of oil discharge and maintenance of the oil record book,
- substantially increased subdivision requirements (over those of the 1966 ILLC) to minimise oil pollution due to side and bottom damage resulting from collision or grounding.

These new provisions created vast changes in the design of tankers (Figure 3).

The provisions specified the extent of damage and the hypothetical outflow of oil resulting from this damage. Importantly, whereas the ILLC 66 requirements assumed that damage would occur to the side of the tanker through collision and would not damage any main subdivision bulkhead, the MARPOL requirements involved assuming damage could occur at any point on the ship's side or bottom. The size of wing tanks were now limited both longitudinally and transversely.

From a commercial view point, one of the main implications of these changes was the requirement for water ballast to be carried in dedicated tanks, which necessitated a larger ship to carry a similar quantity of oil. Through this measure, the quantity of oil that could be carried on a tanker was no longer limited by weight, but by volume.

MARPOL Protocol 1978 (MARPOL 73/78)
A number of factors, including oil pollution incidents occurring subsequent to the MARPOL Convention in 1973 forced the maritime community to review and seek to improve upon those standards. In 1978, through IMO a protocol to MARPOL 73 was introduced (MARPOL 73/78) which provided the following improvements in the design and construction of new tankers (Figure 4):

- the provision of SBT's reduced from 70,000 dwt to 20,000 and 30,000 dwt for new crude and products tankers respectively,
- cargo oil washing of all cargo tanks (COW) rather than the use of water,
- existing tankers to be converted to SBT and COW or to convert existing cargo tanks to dedicated ballast tanks as an interim measure
- provision of the inert gas systems to all cargo tank atmospheres,
- protective location of the SBT's outboard so as to protect the cargo tanks.

The intention of these amendments was to;

- minimise the quantity of oil discharged through routine tanker operations by using the COW system,
- to reduce the risk of fire and explosion by inerting the atmosphere especially during discharge and cleaning operations, and
- to protectively locate segregated ballast spaces along the sides and bottom of the cargo tank area so as to reduce the likelihood of cargo tanks being penetrated from a collision or grounding.

The provision of segregated ballast tanks removed the need to carry water ballast in cargo tanks and hence the need to routinely undertake the potentially hazardous task of cargo tank cleaning and to carry and dispose of slops. The location of the segregated ballast tanks on the outboard side also provided some protection from the spill of oil in the event of a collision. These tanks are required to cover 30 to 45% of the bottom and side shell area in way of the cargo tank length.

Initially, the new designs located the dedicated ballast tanks on the outboard sides, but by the mid 80's tanker builders began to recognise the benefit of double bottoms in prevention of pollution after groundings and began to design tankers, especially products tankers with full length double bottoms dedicated to the carriage of ballast.

It should be noted that, in developing the MARPOL 73/78 requirements, IMO did not adopt the United States' proposal for tankers to be double hulled.

As a result of the *"Exxon Valdez"* stranding in Alaska in 1989, the United States revised its 1978 proposal that the most effective way of protecting all cargo spaces was with double hull spaces (not used for cargo) and acted unilaterally by implementing the Oil Pollution Act (OPA 90) to require all new tankers (phased in for existing tankers) using US ports to be of double hull construction. It should be noted that OPA 90 also includes requirements on oil spill contingency planning and unlimited financial responsibility for clean-up from a spill.

MARPOL 73/78 and Regulation 13F and 13G
The United States sought IMO endorsement of its double hull requirements by proposing further amendments to MARPOL 73/78. This submission was made to the Marine Environment Protection Committee (MEPC). The United States supported its proposals with an extensive research study conducted by the National Academy of Sciences to investigate methods to prevent the outflow of oil from cargo tanks following damage to a tanker.

In considering the United States proposal and the alternative mid-height deck design put forward by Japan (Figure 5), IMO conducted an exhaustive comparative evaluation of the oil outflow characteristics of the two configurations in the event of a low energy grounding or collision. The study showed the two designs to perform equally well under these conditions. Endorsement of the United States' double hull concept, in the March 1992 MARPOL amendments also accorded equivalent acceptability status to the mid-height deck design and determined that the double hull design should be used as a benchmark against which future design proposals will be evaluated by IMO. Guidelines for acceptance of other designs are currently being developed within IMO, but no strong contenders have yet emerged for acceptance alongside the double hull and mid-height deck designs.

These amendments will commence entry into force on 6 July 1993. This is the earliest of the various dates applying to different aspects of the package; it is used to apply the full double hull or equivalent requirements to any oil tanker for which the building or major conversion contract is placed on or after that date.

The package adopted by IMO also contains a set of requirements for existing oil tankers, including:

- requirements limiting the service life of such ships to 25 years unless specified modifications are completed which can permit extension to 30 years -- this can only be extended further if the ship complies with full double hull or equivalent requirements;

- enhanced survey requirements to ensure that the vessel is maintained in a safe condition throughout its service life; and

- carriage of documentation to enable the vessel's survey history to be monitored by surveyors of port states.

The United States' national requirements on double hulls generally parallel those agreed by IMO . However, the United States has not accepted that the mid-height deck or other tanker designs can be equivalent to double hulls. Should this situation continue, any new tanker which is not of double hull type would be excluded from United States ports.

At present, a tanker owner contemplating new tonnage will invariably order a tanker meeting the latest amendments to MARPOL and ILLC, and be of double hull construction, as to do otherwise would preclude the vessel from trading into US ports. The US action has, therefore prevented the arguable superiority of the mid-height deck design being recognised through building orders.

Characteristics of the double hull and mid-height deck designs
MARPOL 73/78 calls for survival from bottom raking damage of 40 to 60% of the length from the fore end depending on ship size.
The double hull configuration is designed to contain oil in cases of low energy grounding or collision. For the double hull configuration, the segregated ballast tanks (SBT) may be arranged as;

- U type with no longitudinal bulkhead separation,
- J type with centre line longitudinal bulkhead,
- L and I section ballast tanks,
- J type with upper wing tanks, or
- separate double bottoms arrangements.

Each of these arrangements affect the residual stability of the vessel after damage.

In the case of the double hull design, where the inner hull is breached, there will be a total outflow of oil from the damaged compartments. The width of the SBT space of the double hull design is much less than the transverse extent of collision damage of B/5 required by ILLC 66.

The configuration of the mid-height deck design provides a suitable alternative (Figure 6). This configuration has wider wing tanks than the double hull design and has no empty double bottoms. In groundings, the oil in lower cargo tanks is retained on board through hydrostatic pressure removing the small ullage space above the cargo.

Both designs are reported to be of similar capital cost, being about 20% more expensive to build than their predecessor MARPOL 73/78 tankers, although the mid-height deck design may be slightly cheaper to build than the double hull design.

In a double hull tanker the cargo block is subdivided transversely and often longitudinally. In the mid-height deck tanker, the cargo oil block is also subdivided vertically by the mid-height deck.

One of the ramifications of double hull and mid-height deck designs is their susceptibility to intact and damage stability problems unless special care is taken in the early design stages. Other ramifications include the arrangement of the SBT's to allow adequate inspection, maintenance and ventilation of these spaces.

Despite these changes and improvements, none of these designs will guarantee containment of oil in a high energy collision, or grounding. Such a guarantee would not appear achievable as long as oil is carried by sea, as illustrated by the break-up of the *"Braer"* by heavy seas following its grounding.

The double hull requirement has also increased the volume of hull dedicated to ballast tanks and thus extended the volume (as against weight) limitations on cargo capacity which commenced with MARPOL.

It should also be noted that the introduction of double hull tankers has given rise to concerns of an increased risk of explosion due to accumulation of petroleum vapours, particularly in double bottom ballast spaces.

Tank Size Limitations And Hypothetical Oil Outflow
The fitting of a longitudinal bulkhead serves to reduce tank size and hypothetical oil outflow. It also helps to reduce free surface effects and hence increase the residual damage stability of the vessel.

Under these regulations, the size of the mid-height deck tanker cargo tanks can be larger (if the upper and lower tank volumes are combined) and hence with a mid-height deck tanker there is the opportunity to have fewer bulkheads and tanks. The mid-height deck tanker designs show better hypothetical oil outflow characteristics from side damage which can be explained by the larger double side width.

IMO has recognised that the present formula for determining oil outflow may not be satisfactorily representing the different arrangements now being put forward and is attempting to improve the method to give more realistic results.

Other Alternatives
Other alternatives include the *"Rescue Pipe"* variant of the mid-height deck design where oil can be siphoned from damaged tanks into undamaged, intact tanks, and the *"Coulombi Egg"* design.

Other alternatives have been included in the measures applicable to existing tankers such as to restrict loading of oil into tanks to a level where the hydrostatic pressure is balanced. That is;

h1 * SGsw = h2 * SGoil

Summary
It can be seen from the foregoing that international requirements introduced over the past 20 years have substantially reduced the potential for pollution resulting from grounding or collision of an oil tanker.

Subdivision In Dry Cargo Ships

IMO recently enacted provisions in SOLAS for the damage stability of Dry Cargo Ships not covered by the damage stability requirements of other IMO instruments such as the ILLC 66 subdivision requirements for assignment of reduced freeboard. These provisions are probabilistic in nature and apply to vessels 100m and over in length. Their aim is to improve the survivability of vessels after damage rather than as a measure to prevent the potential for pollution. However, they have the indirect effect of improving the salvage ability of damaged vessels and thus reducing the potential for pollution. Prior to these provisions, there were effectively no subdivision requirements applicable to these vessels apart from the requirements for a collision bulkhead forward and a transverse, watertight bulkhead to protect the engine room compartment. Vessels covered by the new provisions include bulk carriers, container ships and ro/ro vessels.

This probabilistic concept is based on statistical data derived from approximately 250 incidents. It is not specific on damage location, but rather uses probabilistic density functions to determine the overall survivability of the vessel. Vessels with wing compartments extending well inboard and having numerous transverse, watertight bulkheads have little trouble meeting the standard. As such, bulk carriers, especially the large ones, easily meet the standard. The vessels which do have trouble meeting this standard are the smaller ro/ro vessels around 100 to 140m in length with their long vehicle decks, well below the freeboard deck, extending to the collision bulkhead.

Interestingly, the standard provides no benefits for vessels fitted with double bottoms as the vertical extent of damage is considered to extend through the bottom to the freeboard deck. There is no guarantee that a vessel meeting this standard will survive damage to one compartment.

Introduction of this standard to ships built since February 1992 has substantially increased the survivability of these vessels after damage, and IMO is currently looking at extending it application to dry cargo vessels under 100m in length.

Future - Possible Improvements
Possible improvements in the subdivision of ships has to be viewed in the context of what is feasible in the international arena. Do we need another *Exxon Valdez?* The whole international agenda is driven by vested interests. These vested interests include countries with large merchant fleets who would not wish to see legislation which made

existing ships obsolete before the economic end of their working life. It also includes countries with large ship building capacities who would benefit from the introduction of legislation requiring the building of new vessels. Australia, as a minor shipping nation would need to convince countries with large shipping and ship building interests that stronger regulations are required. This would include strong justification that stricter requirements are really necessary, in view of the recent improvements already outlined above.

Bearing in mind that the improvements outlined above relate to "hardware" whereas it has been demonstrated that about 80% of accidents are due to human error, these countries would need to be convinced that further new construction requirements did not merely compensate for an inability to adequately respond to the need to reduce the effect of human factors.

We also have to recognise the impact of strengthened regulation which could make new vessels less economic than existing vessels. Hence ship owners will retain their existing vessels and therefore defeating the purpose of the new regulation. Retrospective legislation could be enacted or Australian ports could restrict entry to the new vessels only. Such things raise the question of "Grandfather clauses" and retrospective legislation.

Normally new construction rules only apply to new ships as it is impracticable to alter the basic design of existing vessels, But this may result in the new ships having a distinct economic disadvantage. One example of where this problem has been addressed is the introduction of requirements for existing tankers (MARPOL 73/78, Reg 13G) at the same time as those for new tankers (MARPOL 73/78 Reg. 13F). These provisions will reduce the carrying capacity, but not the overall number of vessels. They would not immediately make existing vessels unemployable and hence would not lead to a shortage of vessels. On the down side, such vessels with cargo tanks only partially full would need to withstand the increased sloshing loads of the slack tanks and thus be subject of more stringent structural requirements.

On the structural side, part of the new requirements for tankers and bulk carrier's are improved and strengthened survey requirements for these ships and that involves making information available to port state authorities which originally was only available to the owner and class society. This would ensure that standards are maintained and more importantly, documented.

Conclusion

This paper has summarised recent developments in the structure and subdivision of ships as applied to the prevention of pollution.

On the structural side, existing standards are adequate so long as sufficient attention is paid to the enforcement of those standards.

With regard to subdivision, significant improvements have been made in recent years. Standards for subdivision of the larger dry ships were introduced in 1992 where previously none existed. Tanker subdivision requirements have been substantially upgraded in a series of amendments to MARPOL, to the stage where the latest tanker new buildings are truly environmentally friendly.

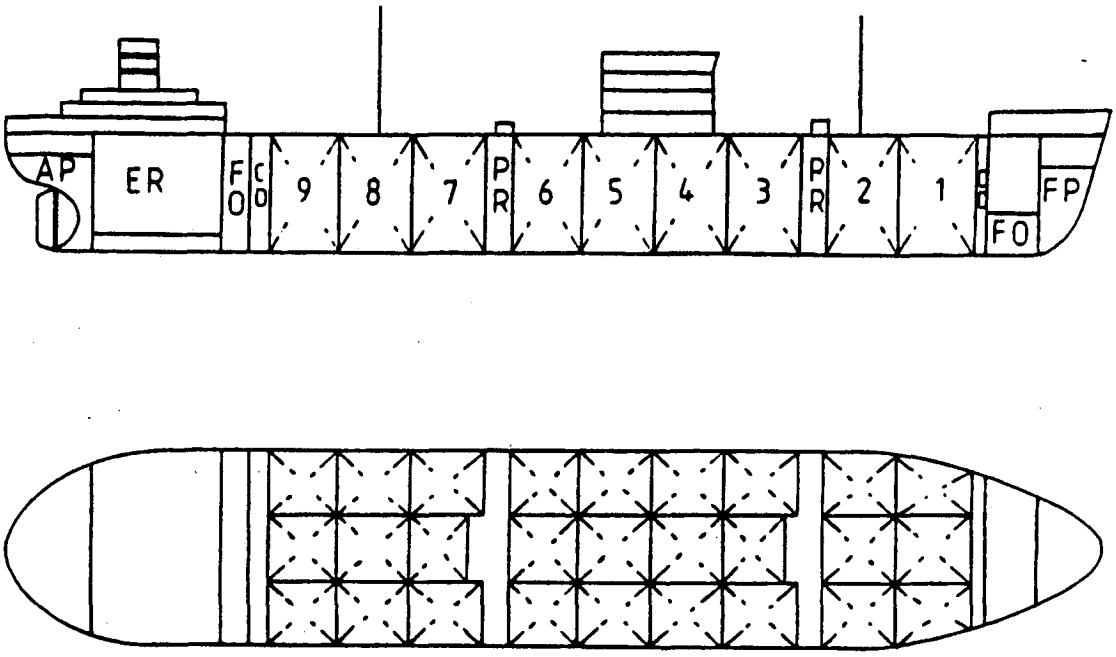
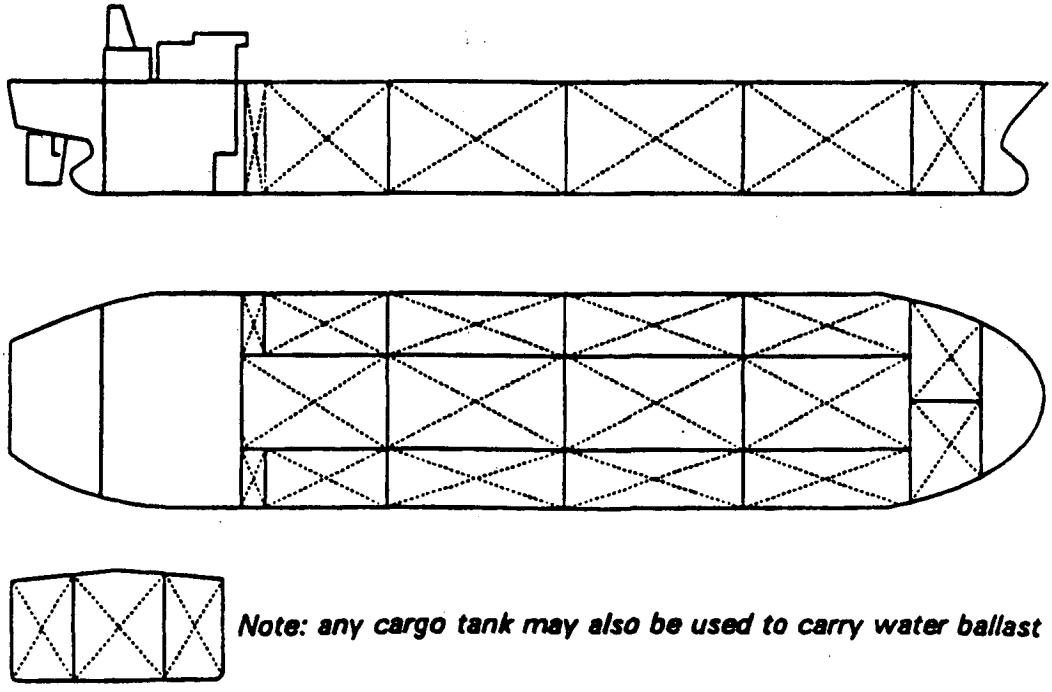


FIGURE 1. TYPICAL SUBDIVISION OF A POST WAR TANKER



Note: any cargo tank may also be used to carry water ballast

FIGURE 2: PRE-MARPOL TANKER

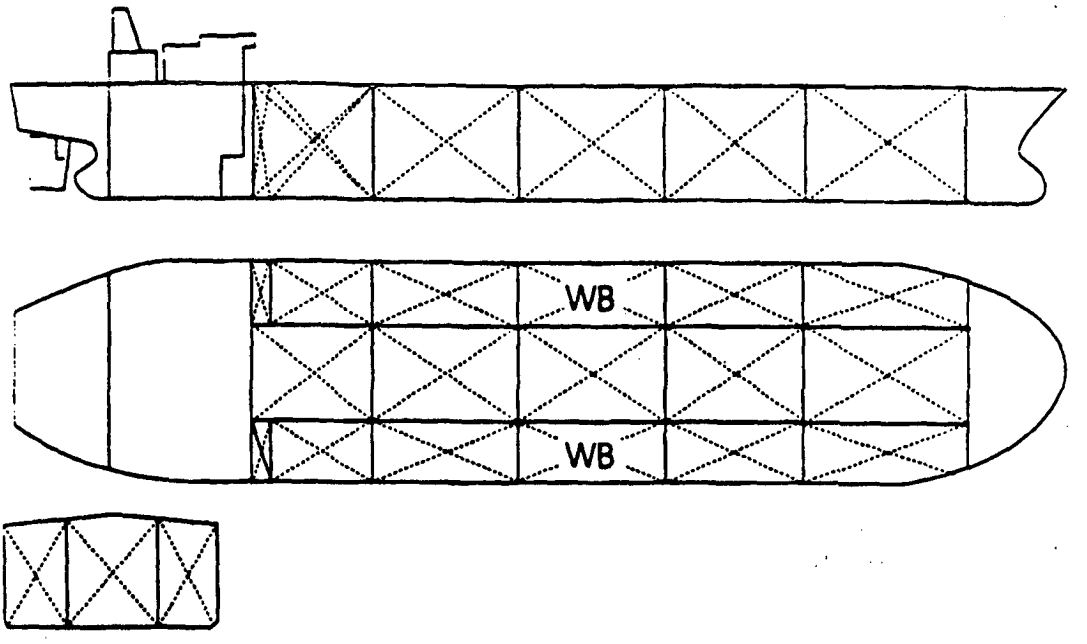


FIGURE 3. MARPOL '73 TANKER
Note: segregated ballast tanks marked WB

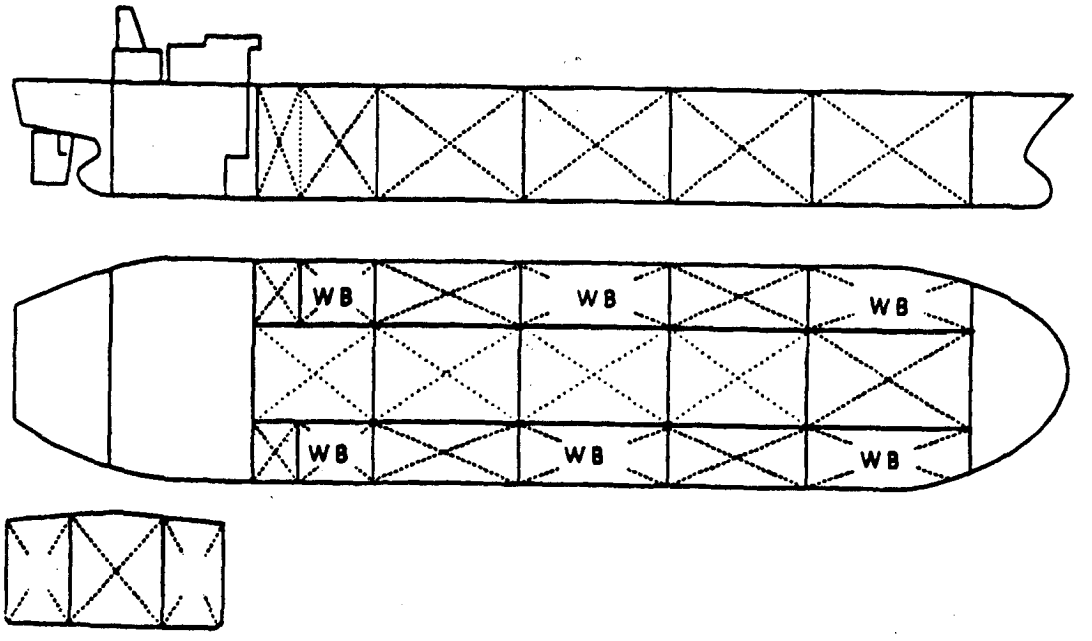


FIGURE 4. MARPOL 73/78 TANKER
Note: segregated ballast tanks marked WB.

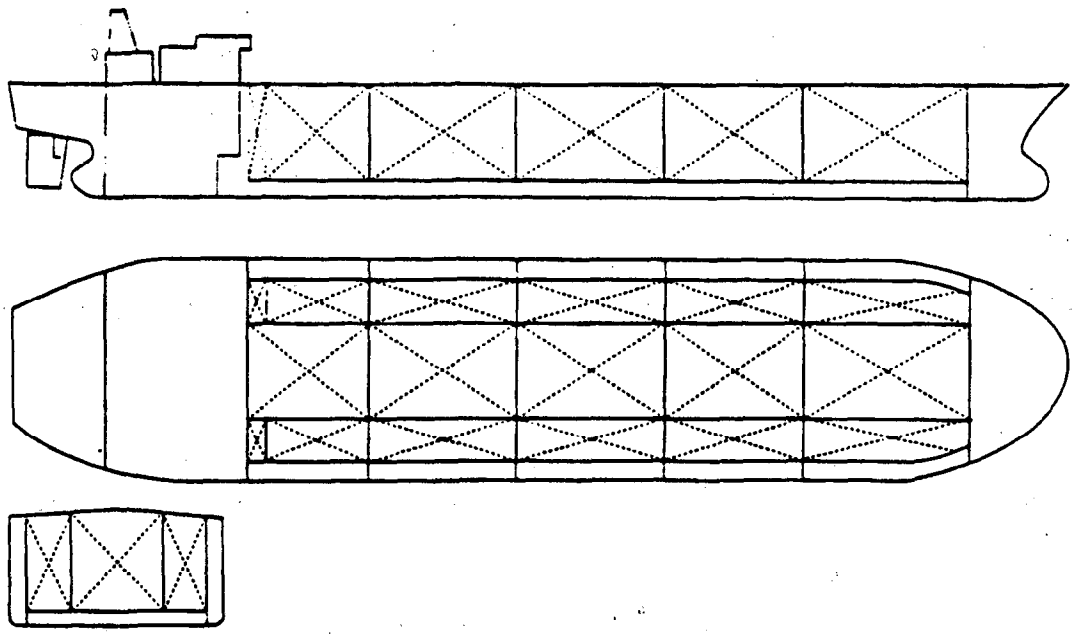


FIGURE 5: DOUBLE HULL TANKER

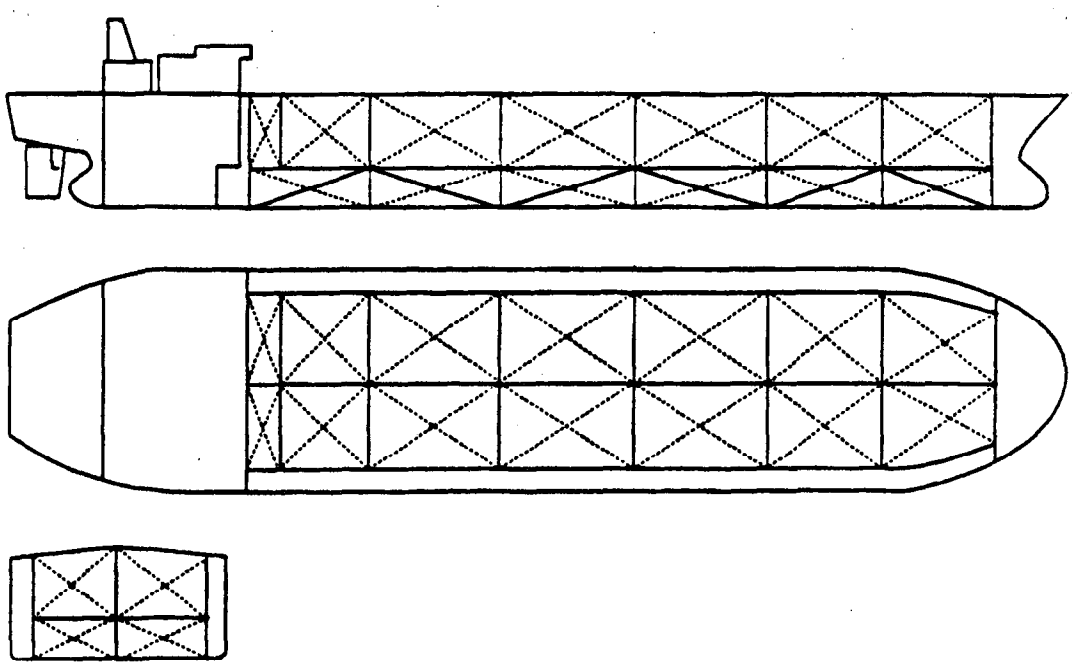


FIGURE 6. MID-HEIGHT DECK TANKER

QUESTIONS AND ANSWERS*

Robin Gehling's presentation

Question
I think that it is important to stress that the whole objective of designing a double hull or mid-deck tanker is to reduce oil outflow in the event of a grounding or collision, and the design has been made specifically to cover low impact grounding and low impact collisions, and in the case of the *Exxon Valdez*, probably a double hull would not have made any difference. So it's not the "be all and end all" of preventing oil pollution at sea, but certainly a mechanism which is designed to reduce or minimise.

Answer
Yes, that's a point in my paper that I didn't get around to making. I would also add that as well as the *Exxon Valdez*, if you've seen the TV footage of the *Braer* grounding onto the rocks in the Shetlands, a double hull would have made absolutely no difference.

Question
When you're talking about low impact, how do you define it? It was clear that the *Braer* was high impact collision, but the *Exxon Valdez* grounding was a reasonably calm day, so was that high or low impact?

Answer
Generally speaking, it's not defined. If there is likely to be penetration into the vessel by more than about two metres then it is a high impact incident, because double hulls won't make any difference.

Question
You said there's a danger in a double hull tanker of explosive mixtures in the ballast tanks. Are they taking any steps to make "inert" those ballast tanks?

Answer
It's still being talked about to my knowledge. It's still being considered as a safety issue by the Maritime Safety Committee.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

MARINE SURVEY AND THE SAFE CARRIAGE OF HAZARDOUS SUBSTANCES

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Summary
This paper outlines the surveys carried out by or on behalf of AMSA of the hull, machinery, safety and pollution prevention equipment carried on Australian cargo ships engaged in overseas or interstate voyages. AMSA's actions to safeguard ships from cargo hazards are summarised. The importance of safe manning and crew competence are highlighted.

Introduction
Many of the cargoes carried by sea today are hazardous not only to the crew of the ships carrying them but also to the marine environment. These include not only substances carried in packages but also solid and liquid substances carried in bulk. As the world becomes increasingly industrialised and more complex the range and quantity of hazardous substances transported by sea will continue to rise. It is essential if the shipping industry is to improve its safety and pollution prevention record that such cargoes are carried without incident.

Conditions for Safe Carriage
Safe carriage of cargoes requires: the condition of the hull, machinery and equipment to be properly maintained; correct stowage of the cargo taking its properties into account, the number and qualifications of the crew to be satisfactory and for the ship not to be overloaded.

Hull, Machinery and Equipment
Compliance with the International Convention on Load Lines 1966 ensures, amongst other things, the watertight integrity of ship, adequate hull strength when loaded and sufficient stability for the intended service. Compliance with the Convention is mandatory for Australian ships engaged in overseas or interstate voyages.

A Load Line Certificate is issued to a ship after the satisfactory completion of the initial survey before the ship enters service. The certificate is valid for a period of 5 years and is subject to satisfactory annual surveys to ensure the ship remains unchanged and in a satisfactory condition. Load line surveys and issue of certificates are normally carried out by class societies authorised by AMSA for that purpose. Examples of the items included in a load line survey are given in Appendix 1.

The International Convention for the Safety of Life at Sea 1974 (SOLAS), includes, amongst other things, standards for machinery, electrical installations, fire prevention, detection and extinction systems, and cargo stowage requirements. Compliance with the SOLAS requirements is mandatory for Australian ships engaged in interstate and overseas voyages.

The Cargo Ship Safety Construction Certificate is prima facie evidence that a ship complies with the SOLAS requirements. The certificate is issued after the first survey is satisfactorily completed before a ship enters service. The certificate has a period of validity of 5 years and is valid subject to satisfactory annual surveys which ensure that the SOLAS standards have been maintained. Surveys are conducted by classification societies

authorised by AMSA for that purpose. Examples of the items included in the survey for the certificate are given in Appendix 2.

SOLAS '74 requires chemical tankers to meet the requirements of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code). The IBC Code applies to chemical tankers built after July 1986.

The purpose of the Code is to provide international standards for the safe carriage by sea of dangerous and noxious liquid chemicals in bulk by prescribing the design, construction and equipment standards for ships engaged in such carriage. They therefore minimise the risk to a ship, its crew and the environment. The Code does not apply to petroleum or similar flammable products.

The Code contains standards for such things as ship survival capability, location of crew accommodation and machinery spaces, cargo containment, cargo transfer systems, cargo temperature control, control of the environment within cargo tanks, electrical installations, fire protection and extinction, instrumentation and personnel protection. Special requirements for specific cargoes are also included. The Code is mandatory in Australia.

A certificate called the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk is issued under the IBC Code to a ship following satisfactory completion of the initial survey before the ship first enters service. The surveys are carried out by class societies authorised by AMSA for that purpose. The certificate is valid for 5 years after which it is renewed. Annual surveys are conducted during the period of validity of the certificate. Examples of the items included in the surveys are given in Appendix 3.

Pollution Prevention

The International Convention for the Prevention of Pollution from Ships, modified by the 1978 Protocol (MARPOL 73/78) contains operational and equipment requirements aimed at minimising pollution of the marine environment. Annex I contains operational and equipment standards to reduce pollution of the seas by oil. It applies to oil tankers of 150 tons gross tonnage and above and every other ship of 400 tons gross tonnage and above. These ships are surveyed for an International Oil Pollution Prevention Certificate before they first enter service. This certificate is valid for 5 years and is subject to satisfactory annual surveys during to maintain its validity.

AMSA has authorised six classification societies to conduct the surveys and issue certificates to Australian oil tankers. Pollution prevention equipment and arrangements on all other types of ships are surveyed by AMSA surveyors. Examples of the items surveyed for the certificate are given in Appendix 4.

Annex II of MARPOL 73/78 contains regulations to control pollution by noxious liquid substances carried in bulk, and it applies to all ships carrying these cargoes.

The International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk is issued after a ship has been satisfactorily surveyed and is valid for 5 years. Annual surveys are carried out to ensure that the equipment and arrangements on a ship remain in all respects satisfactory for the intended service of the ship. Noxious liquid substances are normally carried by dedicated chemical tankers, which are surveyed by class societies on behalf of AMSA. Examples of items included in the survey are given in Appendix 5.

Cargoes

The properties of some cargoes have the potential to cause a ship to founder and cause pollution. The dangers of mineral bulk cargoes include chemical hazards such as the

emission of toxic or explosive gases, depletion of oxygen in the atmosphere of a hold, spontaneous combustion and severe corrosive effects. AMSA surveyors can inspect ships intending to load mineral bulk cargoes at any time but some cargoes are regularly policed. These include coal and ferrosilicon.

The prime purpose of coal inspections is to ensure that adequate means are in place to prevent the ignition of methane gas which may be evolved during a voyage. Electrical wiring, electric motors, the suitability of hold ventilation arrangements and gas detection equipment used to monitor the presence of methane in the space above the coal cargo are examples of items inspected.

Ferrosilicon evolves hydrogen gas when in contact with water or moisture. This product contains impurities which produce the toxic gases phosphine and arsine. Inspections of ships intending to load ferrosilicon include bilge wells, precautions to prevent the ingress of gas into machinery spaces, pipes passing through holds in which ferrosilicon is to be loaded, electrical circuits within holds, mechanical ventilation systems to ensure they are explosion proof or arranged so that motors are not in the direct path of hold atmosphere exhausts.

Grain cargoes when carried in their natural state in ships have a tendency to move and represent a potential hazard to ships, crew and the environment. Consequently the carriage of grain by sea is subject to international requirements. These requirements are mandatory in Australia and are applicable to all ships loading grain at Australian ports for discharge in Australia or overseas. Ships intending to load grain in Australia are inspected by AMSA surveyors to verify that the ship is permitted to load grain by the flag State, and has approved grain stability data on board together with an approved plan. The stability under the proposed loading is checked to ensure it meets the international stability criteria, and that the bilge wells are clean, efficient and protected against the ingress of grain. The trimming of the grain surface in completed holds is also checked.

Spaces used for the carriage of dangerous goods must meet special requirements under SOLAS '74. These govern water supply, ignition sources, fire detection systems, ventilation, bilge pumping arrangements, insulation of machinery space bulkheads, personnel protection, firefighting equipment and water spray systems. The requirements for particular ships are determined by ship type and the type of dangerous goods to be carried. The arrangements provided on a ship are surveyed by AMSA as part of the Cargo Ship Safety Equipment Certificate before it enters service and annually thereafter to ensure that the arrangements are in a satisfactory condition. A document of compliance is issued to a ship by AMSA following satisfactory completion of the initial survey.

The principles in SOLAS '74 concerning the carriage of packaged dangerous goods are embodied and elaborated in the International Maritime Dangerous Goods (IMDG) Code. The Code is mandatory for ships loading dangerous goods in Australia. Surveyors normally inspect ships loading explosives or radioactive materials. Other classes of dangerous goods are inspected randomly. Around 30 per cent of ships carrying inward dangerous goods or dangerous goods in transit are inspected. These inspections ensure that dangerous goods are correctly labelled, stowed and incompatible goods effectively segregated to prevent pollution through a fire and explosion at sea or in port. Compliance with the Document of Compliance is also verified.

Manning and Crew Qualifications

It is a requirement of the International Convention on Standards of Training, Certification and Watchkeeping of Seafarers (STCW) for the crews of ships to be properly trained and qualified. These elements of manning are important as the safety of a ship, its crew, cargo and the protection of the marine environment depend to a large extent on the competence of crew.

It is the responsibility of each flag State to determine the manning of ships under its jurisdiction. SOLAS '74 requires flag States to issue safe manning certificates to their ships.

Where the number and category of seafarers on a ship comply with such a document it is accepted as evidence that a ship is safely manned. If a ship does not carry such a document and doubt arises as to whether it is safely manned, the matter is resolved in consultation with the appropriate authority of the flag State concerned. The manning and crew qualifications are checked by AMSA surveyors.

Tanker Surveillance

The operation of tankers in Australian waters is monitored by AMSA under a Tanker Safety Surveillance Programme, developed after discussions with the then Tanker Technical Committee of the Australian Chamber of Shipping. The oil companies, in their capacity as owners or charterers of tankers visiting Australian ports, co-operate closely with AMSA and other government bodies. The program applies to tankers carrying crude oil or petroleum products, including high flash point products such as lubricating oil, but not to tankers carrying vegetable oils. Surveillance of chemical tankers and gas carriers is included in the program.

The principal objective is to reduce the risk of pollution and fire particularly during the loading and unloading operation. Australian and foreign flag tankers are treated alike. The inspection of the tanker operations is based on the International Safety Guide for Oil Tankers and Terminals.

During an inspection the qualifications and experience of the ship's officers are investigated and recorded. The following inspection program has been implemented by AMSA:-

- Tankers engaged in Australian coastal trade are inspected about every 3 months.
- Crude carriers engaged in overseas trade are inspected at the first port of loading or discharge on each occasion the vessel visits Australia.
- Refined Products Tankers engaged in overseas trade visiting ports where a surveyor is stationed are inspected at the first port of loading or discharge on each occasion the vessel visits Australia.
- Refined Products Tankers engaged in overseas trade visiting only outports where there is no surveyor stationed are inspected about every 3 months.

Future Developments

Flag State Compliance

It has been internationally recognised that not all States effectively implement international standards for safety or pollution prevention. A new sub-committee on Flag State Implementation has been established at IMO. Its purpose will be to facilitate implementation of international maritime safety and pollution prevention standards by flag States.

Crew Competence

The IMO Sub-committee on Standards of Training and Watchkeeping is to review the STCW Convention with the broad aims of making the Convention more effective and to incorporate modern training and certification systems. The review will not be completed until mid-1995 at the earliest.

Evaluation of Solid Bulk Cargoes

Work is currently underway at IMO which may lead to MARPOL 73/78 being extended to include solid bulk cargoes.

APPENDIX 1

INTERNATIONAL LOAD LINE CERTIFICATE
Items examined for this certificate include: stability information; superstructures; doors; cargo and other hatchways; machinery space openings; air pipes; openings in the ships side; scuppers; discharges; freeing ports; crew accommodation strength; bulwarks and access to working

APPENDIX 2

CARGO SHIP SAFETY CONSTRUCTION CERTIFICATE
Items surveyed for this certificate include: bulkheads; watertightness of doors and decks; bilge pumping arrangements; main and auxiliary machinery; steering gear arrangements; boilers; engine-room ventilation; engine-room/bridge communication systems, main and auxiliary electrical power sources and unattended machinery space arrangements.

APPENDIX 3

INTERNATIONAL CERTIFICATE OF FITNESS FOR THE
CARRIAGE OF DANGEROUS CHEMICALS IN BULK
Items surveyed for this certificate include: location of cargo tanks; cargo containment, construction materials, cargo temperature controls, cargo tank vent systems, environmental control; electrical installations; fire protection and extinction; instrumentation; personnel equipment; stability, location of crew accommodation and machinery spaces; bilge and ballast systems and cargo transfer systems.

APPENDIX 4

INTERNATIONAL OIL POLLUTION PREVENTION CERTIFICATE
Item surveyed for issue of this certificate include: oily water separating equipment; oil filter equipment and arrangements for alarm and automatically stopping discharge; oil content meter; segregation of oil fuel and ballast water systems, sludge tanks and Oil Record Book.
Additional items for oil tankers include: segregated ballast tank arrangements; crude oil washing arrangements; cargo transfer system; shipboard oil pollution emergency plan; and oil discharge monitoring control systems.

APPENDIX 5

INTERNATIONAL POLLUTION PREVENTION CERTIFICATE FOR THE CARRIAGE OF NOXIOUS LIQUID SUBSTANCES
Items surveyed for this certificate include: pumping systems; stripping system; tank washing system; Procedures and Arrangements Manual; underwater discharge arrangements; ventilation arrangements for the removal of cargo residue; Cargo Record Book; and devices to record the discharge time of cargo residue/water mixtures.

QUESTIONS AND ANSWERS*

Ted Clements's presentation

Question
There are obviously very detailed regulations which are required and I suppose that supports a comment expressed this morning about being over-regulated. I also note that a lot of these regulations are determined through international systems and negotiations which means you could get the lowest common denominator. Therefore, are these standards adequate to do the job expected of them and meet environmental objectives and as well as meet the standards for the GBR Marine Park?

Answer
The international opinion of the IMO is that the hardware is there and is adequate to do the job. What is happening is the standards of training and standards of seafarers are declining. For reasons that have been mentioned earlier in the day like traditional maritime countries losing their ships to non-traditional maritime countries, the role of ownership and flag of convenience vessels, all these tend to bring the standard of seafarer lower than what it has been, for example, when I was at sea.

This has also been recognised by IMO because the STCW convention is to be reviewed to bring it into line with the modern day methods and training schemes, Now the secretary general of IMO attaches such importance to this matter that he's told the committee charged with this that the review has to be completed in 2 years. So we wouldn't expect anything to come out of that review until around about the middle of 1995.

Question
Hazardous materials may stowed in containers which in turn may be stowed on deck. Is the loss of containers from a ship a problem? Does AMSA inspect container lashings on ships before they sail ?

Answer
We have the power to do that but we would not normally do it as a matter of routine, because as you can appreciate, there are an awful lot of containers and ships carrying containers leaving Australia. But this is a very interesting point, because it brings up another point about dangerous goods that are not packed in containers, but are stowed on deck. As I said this afternoon, the IMDG code lays down principles which govern the safe carriage of those materials. Those materials can get washed over the side and they could cause pollution. Again, IMO has picked up that point, and it has picked up a point from American experience involving a vessel where several containers of arsenic trioxide were washed over the side. That report went to IMO and they are now looking at the stowage segregation requirements of the IMDG code to see what can be done, including ways to store these substances below deck. They are also looking at the lack of IMO standards for securing of containers. The class societies have their standards for container lashings , but there are no IMO standards on container lashings at the moment. Now the American experience may very well lead to the development of a minimum international standard for lashing of containers.

Comment from the floor
I think we'd like to see industry being able to self-regulate how they lash their cargoes and containers.

Question
Waste reception facilities in ports are very important in getting rid of pollutants. ANMA did a survey which is in the hands of AMSA on waste reception facilities. It found there is a very wide range of adequacy, ranging from reasonably adequate to quite inadequate.

I'm not singling out the GBR ports in this regard; it applies to all ports in Australia. But some of the Reef ports aren't really very adequate. Some of the more irresponsible ship operators from overseas will just flush pollutants overside and into the sea if facilities are inadequate.

Answer
I'm not sure what the current status is but several months ago when AMSA received that report from ANMA it was passed to the Department of Transport and Communication so that it could be considered by the Marine and Ports Group under the ATAC umbrella. My understanding is that at the Marine and Ports Group, it was agreed by AAPMA that they would take that issue on board and as it's been the association responsible for ports and authorities around Australia, they would look at the question of waste reception facilities in the ports and respond to the ANMA report.

Question
You made mention of the STCW convention for the training of crews and this morning it was mentioned that achieving a high standard of training is one of AMSA's goals. Are you going to now review your policy of issuing Australian certificates of competency for foreign certificates?

Answer
We recognise the STCW convention. People from overseas who come here with certificates issued under the STCW convention will have their certificate recognised if they pass a prestructured oral test, do a short course and have a command of English. To do otherwise would put us in a lot of trouble with the equal opportunity and anti-discrimination bodies in Australia. It's a problem for employers and for the unions, but we are bound by some pretty strict Commonwealth laws. We're looking into it and we realise the sensitivity of the issue but there's no overnight solution. Our oral tests and short courses and English tests will hopefully achieve a certain level of competency which will not endanger the integrity of the Australian fleet.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

PROTECTING THE MARINE ENVIRONMENT OF THE GREAT BARRIER REEF: WHAT IS THE ROLE OF INTERNATIONAL LAW?

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Legal Office
Department of Foreign Affairs and Trade

Introduction

The purpose of this paper is to survey international legal mechanisms for protection and preservation of the marine environment, particularly as they relate to areas of great environmental significance such as the Great Barrier Reef. Proceeding from the 1982 United Nations Convention on the Law of the Sea, relevant global and regional conventions are examined. The interface between domestic and international law is explored. Particular emphasis is given to the role of the International Maritime Organisation (IMO) in introducing protective measures which go beyond those normally applying in coastal zones. The recently emerged concept of particularly sensitive areas (PSAs) represents an important aspect of this role. Options for increasing current levels of protection are also examined.

Australia's Interests In The Law Of The Sea

Australia is a major coastal state with significant maritime interests. Australia's coastline is among the longest in the world. It has the world's second largest continental margin. Australia's waters possess abundant natural resources, both living and non-living. The majority of Australia's population lives in the vicinity of the coast. Australia's coastal zone contains the world's largest repository of marine biological diversity: the Great Barrier Reef.

At the same time, Australia, as an island, is highly dependent on maritime trade for a significant proportion of its overall trade. Increasing globalisation and integration of the Australian economy into the world economy (as evidenced by a steady increase in the value of exports and imports as a percentage of gross domestic product) will tend to increase this dependency on shipping. In addition, a large proportion of domestic trade within Australia is carried out by sea. Transport of crude oil and refined oil-based products make up a considerable proportion of seaborne transport. The quantities of these goods transported by sea are likely to expand with the decline in the proportion of Australian domestic oil production compared with imports.[3]

Despite the fact that Australia's maritime fleet is not large by international standards, its policies and practices with regard to marine pollution reflect its dependence on sea transport. These policies represent an attempt to create a balance between the interests of shippers and the need to protect and preserve the marine environment.

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[*] Note: The views expressed are those of the author and do not necessarily reflect those of the Department of Foreign Affairs and Trade.

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3 see Burmester, H., *Australia and the Law of the Sea - The Protection and Preservation of the Marine Environment*, in Ryan, K.D., International Law in Australia (2nd Ed.), p. 440.

The Need for Global Measures for Protection and Preservation of the Marine Environment

The nature of the marine environment is such that effective prevention, reduction and control of marine pollution can only be achieved through international cooperation and coordination. In recent times there has been recognition of the interdependence of ecosystems on our planet and the consequent need for global action to combat and control adverse effects upon the environment. Local activities can have significant effects on distant ecosystems. Thus many people are aware of the depletion of the ozone layer over Antarctica, and more recently over populated areas of the northern hemisphere, which has been primarily caused by distant chloroflourocarbon emissions. In response to this, the *1985 Vienna Convention for the Protection of the Ozone Layer* and its *1987 Montreal Protocol on Substances that Deplete the Ozone Layer* introduced global obligations upon States Parties to reduce, control and phase-out production and use of such substances.

What is perhaps less well-known is that the international community has been cooperating in efforts to prevent, reduce and control vessel-sourced pollution of the marine environment for a much longer period than this. As early as 1954 the Intergovernmental Maritime Consultative Organisation (IMCO), the forerunner of the International Maritime Organisation (IMO) adopted the *International Convention for the Prevention of Pollution of the Sea by Oil* (OILPOL), paving the way for a series of international marine pollution control instruments which will be discussed below.

Australia is committed to the uniform application and development of international law and recognises the desirability of international cooperation, rather than unilateral action, in the protection and preservation of the marine environment. For example, excessive controls on vessel sourced pollution beyond those applying internationally could impose costs upon Australian shipowners and operators which would negatively affect Australia's trade competitiveness. However in areas of particular environmental significance, such as the Great Barrier Reef, the dynamic equilibrium which exists between freedom of navigation and protection and preservation of the marine environment may be weighted more towards the latter. This will be adverted to below.

Australia's commitment to multilateralism in protection and preservation of the marine environment has been shown through the fact that Australia was a founding member of IMCO, and has been a member of the Council of IMCO and then the IMO for all but two of the last thirty-four years. However Australia, while actively participating in the negotiation of international marine pollution instruments, has been relatively slow in the ratification of or accession to such instruments.[4] This has had much to do with the Australia's federal constitutional system and the need for extensive federal/State coordination and cooperation to enable implementation of these instruments.

Development Of The New Law Of The Sea

As noted by Harris[5], the law of the sea was the first large area of international law to be the subject of a broad attempt at codification. This occurred in two major phases: during the first and second United Nations Conferences on the Law of the Sea in 1958 and 1960 respectively, and during the third United Nations Conference on the Law of the Sea (UNCLOS III) from 1973 until 1982. Australia played an active role during the first two conferences, and particularly during UNCLOS III. The conference of 1958 resulted in four conventions: The Geneva Conventions on the Territorial Sea and the Contiguous Zone,

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4 Burmester, *ibid.*

5 Harris, D.J., Cases and Materials on International Law (3rd ed.), Sweet & Maxwell, London 1983, p. 284.

the High Seas, the Continental Shelf and Fishing and Conservation of the Living Resources of the High Seas[6]. Australia ratified all four conventions in 1963.

A broad range of developments led to various aspects of the 1958 conventions' becoming superseded within ten years of their adoption. The need for a new, comprehensive and widely accepted legal order for the oceans arose from the serious pressures affecting the oceans in the late 1960s. Inequities and inadequacies were perceived in the traditional law of the sea. Fishing grounds were faced with depletion, and the rules governing their exploitation unfairly favoured distant water fishing nations. Archipelagic States believed their security and integrity were jeopardised by the doctrine that the waters surrounding their islands were high seas. Pollution controls were inadequate to deal with disasters involving supertankers and flag States were failing to take appropriate enforcement actions. There was uncertainty about the extent of coastal states' rights over the continental shelf. Many States were making excessive territorial sea claims (up to 200 nautical miles) that threatened the high seas rights of other States. There were also fears of unilateral exploitation of the mineral resources of seabed beyond national jurisdiction. Major maritime powers saw a threat to their rights through a move to extend the territorial sea to 12 nautical miles, making most international straits into territorial waters.

These developments led to the convening of UNCLOS III, which produced the *1982 United Nations Convention on the Law of the Sea* (LOSC). Australia signed the LOSC on 10 December 1982. It was the product of 9 years of intensive negotiations in which Australia played an important role. It was the longest and most complex negotiation for a single convention ever undertaken. The LOSC was signed by 159 States, including Australia, but has not yet entered into force. This would require 60 ratifications. As of March 1993 55 States had ratified/acceded to the LOSC. Australia has not ratified the LOSC, but has applied and implemented many aspects of the legal regime which it embodies.

Since 1982 the LOSC has served to guide state practice in the whole range of law of the sea matters. 133 States now have a 12 nautical mile territorial sea, 33 States have a 24 nautical mile contiguous zone and 82 States claim an exclusive economic zone (EEZ)[7]

Maritime Zones Under International Law

Coastal regions represent, in a general sense, areas of decreasing coastal state jurisdiction, from internal waters through territorial sea and contiguous zone to the exclusive economic zone, as well as the underlying continental shelf.

Under the LOSC each coastal state is entitled a 12 nautical miles (nm) territorial sea, a contiguous zone, an exclusive economic zone ('EEZ') and a continental shelf. Within these zones the coastal state exercises specified rights and responsibilities.

Australia has adopted an incremental approach towards implementing these zones. The 200 nm Australian fishing zone (AFZ), which relies on EEZ jurisdiction, has been in place since 1979. More recently Australia extended its territorial sea from 3 to 12 nm. Also Australia has claimed a continental shelf since 1953. The decision by the Australian Government in September 1991 to adopt the balance of the maritime zones as defined in the LOSC has confirmed Australia's intention to fully exercise the maritime zone rights to which it is entitled under international law.

The following section describes Australian practice with regard to these zones.

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6 All four conventions are found in Australian Treaty Series 1963 No. 12.

7 Report of the United Nations Secretary General on the Law of the Sea, UN Doc. A/46/724, 5 Dec 1991, p.7.

I. Internal Waters and Ports

The Preamble and s. 10 of the Commonwealth *Seas and Submerged Lands Act 1973* confirm Australian sovereignty over internal waters. In addition, Australia signed the 1958 Geneva Convention on the Territorial Sea and the Contiguous Zone on 29 April 1958 and ratified on 14 May 1963. Art. 1 of that Convention confirms coastal state sovereignty over, *inter alia*, internal waters. This rule is repeated in Article 2 of the LOSC.

It is generally accepted as a principal of international law that coastal states may regulate access to their ports in a manner which they see fit as an exercise of sovereignty in their internal waters, as long as such regulation is not discriminatory[8].

II. The Territorial Sea and the Contiguous Zone

Under s. 6 of the *Seas and Submerged Lands Act 1973* Australia exercises sovereignty over the territorial sea and the seabed and the subsoil under it. Australia was one of the last coastal states to extend its territorial sea to twelve nautical miles in accordance with customary international law as reflected in Art. 3 LOSC. This reflects Australia's generally cautious approach to implementation of its rights as a coastal state. The proclamation of Australia's twelve nautical mile territorial sea pursuant to s. 7 of the *Seas and Submerged Lands Act 1973* took place on 9 November 1990.

Australia's territorial sea remains at three nautical miles around islands in the Torres Strait north of the seabed jurisdiction line with Papua New Guinea, as provided for in Art. 3 of the 1978 *Treaty between Australia and the Independent State of Papua New Guinea concerning Sovereignty and Maritime Boundaries in the area between the two Countries, including the area known as Torres Strait, and Related Matters (the Torres Strait Treaty).*[9]

A contiguous zone is a declared zone of sea contiguous to and beyond the territorial sea in which a coastal state has limited powers of enforcement of customs, fiscal, sanitary and immigration laws. Under the LOSC countries are entitled to claim a 24 nautical mile contiguous zone.

Since extension of the territorial sea to 12 nautical miles in November 1990 Australia has not had a separate contiguous zone. However the Australian Government has decided to extend the contiguous zone to 24 nautical miles, and legislation consistent with the Law of the Sea Convention is being prepared. Adoption of a contiguous zone of this breadth should assist in the enforcement of certain laws in the area between 12 and 24 nautical miles from the coast.

III. Exclusive economic zone

Australia is entitled to an EEZ the outer limit of which is 200 nm from the territorial sea baselines. Within that area Australia is entitled to explore, exploit, conserve and manage the living and non-living natural resources. It also has jurisdiction over offshore installations, marine scientific research and the protection and preservation of the marine environment.

Well over 80 countries have now established an EEZ. A smaller number of States, including Australia, have established an exclusive fisheries zone, which is but one element of an EEZ regime. Although Australia has not yet declared an exclusive economic zone, Australia has asserted its rights and accepted its duties with regard to

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8 see the Geneva Convention and Statute on the International Régime of Maritime Ports 1923. Australia acceded to this Convention on 29 June 1925. United Kingdom Treaty Series 1925 No. 2 (Cmd. 2304).

9 ATS 1985 No. 4. The Torres Strait Treaty was signed on 18 December 1978 and entered into force on 15 February 1985.

living and non-living resources, the establishment and use of artificial islands, installations and structures, marine scientific research and the protection and preservation of the marine environment.

Formal establishment of an EEZ will underpin the EEZ rights which are already being exercised by Australia The Australian Government decided in September 1991 to establish an exclusive economic zone in accordance with Part V of the LOSC. Legislation is being prepared.

IV. Continental shelf

The importance of the continental shelf centres around its extensive potential resources of oil and gas and other minerals and its status as a source of biological diversity. The coastal state has exclusive sovereign rights to explore and exploit these resources under both the 1958 Geneva Convention on the Continental Shelf and the LOSC. Australian legislation is currently linked to the 1958 Geneva Convention on the Continental Shelf which sets the outer limit at a depth of 200 metres, or beyond that limit to a depth capable of exploitation of the natural resources. While this definition has subsequently been confined to the natural prolongation of the land territory it remains imprecise and unsuitable given developments in technology.

Under the more precise LOSC definition, the outer edge of the legal shelf is a minimum of 200 nautical miles from the territorial sea base-line. Beyond that point the shelf also covers the continental margin (if any) to a point 350 nautical miles from the baseline or 100 nautical miles from the 2500 metre isobath, whichever is the greater. Adoption of the 1982 Convention definition of the shelf will enable Australia to claim, consistently with international law, a larger total area of continental shelf than under the 1958 Convention. However Australia would be obliged, within ten years after entry into force of the LOSC for it, to permanently delineate the outer edge of its continental shelf

Australia has taken steps to delineate the outer limits of its continental shelf, as provided for in paragraph 7 of Article 76 of the LOSC. Australia has conducted and continues to conduct extensive surveys relating to the geomorphology of the Australian continental shelf and continental margin. However prior to entry into force of the LOSC Australia does not intend to carry out a formal delineation exercise in terms of paragraph 7 of Article 76 of the Convention.

Protection and Preservation of the Marine Environment under International Law

The last few decades have seen the development of a series of legal mechanisms and structures for the protection and preservation of the marine environment. A significant step in this development was Principle 7 of the 1972 Stockholm Declaration on the Human Environment, which enjoined States to take all possible steps to prevent pollution of the seas by substances that are liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea. This principle was to prove influential in the development of a whole range of legal mechanisms, from the global to the local level.

Global Conventions

There exist a number of global conventions dealing with various aspects of the protection and preservation of the marine environment. Some of these are described below. The most significant single global instrument dealing with the marine environment is the 1982 United Nations Law of the Sea Convention.

The Law of the Sea Convention

Principle 7 of the Stockholm Declaration played a significant role in the negotiations concerning the marine environment at the Third United Nations Conference on the Law of

the Sea, which commenced in 1973 and culminated in the opening for signature of the LOSC in 1982. Thus Articles 192 and 194 of the LOSC describe the general obligations of States to protect and preserve the marine environment in similar terms to those found in the Stockholm Declaration.[10]

Although not yet in force[11] the LOSC has served as a catalyst for a whole series of international agreements of both a global and regional character for the protection and preservation of the marine environment. It has also led to many States utilising domestic legislation to implement environmental jurisdiction in their coastal areas along the lines envisaged in the LOSC.

The LOSC represents the first attempt by the intentional community to create a comprehensive global legal framework for the protection and preservation of the marine environment. To this end it encompasses all aspects of the marine environment and all sources of marine pollution.[12] The word "framework" is important in this regard: the LOSC does not go into great detail in setting specific standards for various forms of marine pollution. Nor does it specify individual geographical areas in which special forms of protection from pollution may be required (as is the case with regard to special areas under the 1973 International Convention for the Prevention of Pollution from Ships and its 1978 Protocol, generally known as MARPOL 73/78).

The LOSC does however identify certain categories of areas, rather than specific areas, which may require higher standards of environmental protection. Thus Art. 194(5) places an obligation upon States to take measures necessary to protect and preserve rare or fragile ecosystems. Part IX of the LOSC identifies enclosed or semi-enclosed areas as places where States shall endeavour to coordinate management and environmental protection[13], and Art. 234 recognises ice-covered sea areas as places where special protective measures may be taken by the relevant coastal state (see below). In addition, Art. 211(6)(a) provides for States to submit to the "appropriate international organisation" (this is universally understood to be a reference to the IMO) for its approval proposals for special mandatory measures in areas within their exclusive economic zones which require extra protection from vessel-sourced pollution for recognised technical reasons in relation to its oceanographical and ecological conditions, as well as its utilisation or the protection of its resources and the particular character of its traffic.

The LOSC thus creates an overall structure for the protection and preservation of the marine environment and a general obligation for States to implement and elaborate upon this structure through both global conventions addressing particular forms of pollution and regional agreements tailored to the requirements of discrete sea areas.

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10 Art. 192: "States have the obligation to protect and preserve the marine environment."

Art. 194(1):"States shall take, individually or jointly as appropriate, all measures consistent with this Convention that are necessary to prevent, reduce and control pollution of the marine environment from any source, using for this purpose the best practicable means at their disposal and in accordance with their capabilities, and they shall endeavour to harmonize their policies in this connection."

11 The Law of the Sea Convention will come into force 12 months after the 60th instrument of ratification is deposited with the Secretary-General of the United Nations. As of March 1993 55 States had ratified the Convention.

12 For an overview of the current state of the marine environment see: Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), *The State of the Marine Environment*, United Nations Environment Programme (UNEP), 1990.

13 Art. 123 Law of the Sea Convention.

Other global conventions

Global conventions have been negotiated for the regulation of pollution from shipping[14] and dumping[15] as well as civil liability and compensation for pollution from vessels[16] and seabed activities[17] and intervention on the high seas in cases of emergency[18]. In addition, global agreements on seaworthiness standards have an effect in reducing the likelihood of pollution incidents.[19] The two major areas where there are as yet no global conventions which relate to and elaborate on the environmental protection requirements of the LOSC are marine pollution from land-based sources[20] and marine pollution from or through the atmosphere[21]. The following describes global conventions of particular importance for Australia with regard marine pollution prevention, reduction and control:

i) MARPOL 73/78

MARPOL 73/78 contains provisions for protecting the marine environment through minimising operational and accidental discharge from ships of oil, noxious liquid substances, harmful substances in packaged form, sewage and garbage. The details of these provisions are contained in five annexes. MARPOL 73/78 also provides for port States to inspect ships and enforce these provisions.

- Discharge standards

MARPOL 73/78 sets standards for operational discharges with the aim of preventing or minimising such discharges. Thus under Annex I of MARPOL a vessel of more than 400 tonnes gross tonnage whose State of registry is a State Party to MARPOL is prohibited from discharging oil or oily wastes into the sea unless the vessel is more than 12 nautical miles from the land and the oil content of the effluent is less than 100 parts per million.[22] For oil tankers the vessel must be at least 50 nautical miles from the nearest land and the total oil content of discharges must not exceed 1/15 000th of the total cargo for existing

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14 MARPOL 73/78. In addition, a convention on oil pollution preparedness and response resulting from maritime incidents is being negotiated within the International Maritime Organization (IMO)

15 The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (hereinafter referred to as the London Dumping Convention).

16 The 1969 International Convention on Civil Liability for Oil Pollution Damage and its 1976 Protocol, as well as the 1971 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage.

17 The 1977 International Convention on Civil Liability for Oil Pollution Damage resulting from the Exploration for and Exploitation of Submarine Mineral Resources.

18 The 1969 International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties and its 1973 Protocol.

19 e.g. the International Convention for the Safety of Life at Sea, 1974 and its Protocols of 1978 and 1988.

20 Arts. 207 and 213 of the Law of the Sea Convention. This gap has been addressed frequently in the past, most recently in the context of the London Dumping Convention, but an international consensus on the need for and the substance of a global convention regulating land-based pollution has not arisen.

21 Arts. 212 and 220 of the Law of the Sea Convention.

22 Regulation 9(1)(b) of Annex I of MARPOL 73/78.

tankers or 1/30 000th of the total cargo for new tankers.[23] Analogous prohibitions exist for the other categories of substances covered by Annexes II, III, IV and V of MARPOL.

- Special areas under MARPOL 73/78

MARPOL 73/78 has established in its Annexes I, II and V the concept of "special areas" in which special mandatory methods for the prevention of sea pollution may be employed over and above those applying to sea areas in general. The definition of "special area" under the three Annexes of MARPOL 73/78 mentioned above is uniform and quite broad: these are areas in which oceanographic and ecological characteristics as well as vessel traffic characteristics require special mandatory measures prevent marine pollution. This definition predates the definition of areas requiring special protection contained in Art. 211(6)(a) of the LOSC (see above). It is also less detailed in its substantive and its procedural provisions than Art 211(6)(a).

Annex I of MARPOL 73/78 deals with oil pollution. Under this Annex the following areas have been designated as special areas: the Mediterranean Sea, the Baltic Sea, the Black Sea, the Red Sea, the Persian Gulf/Gulf of Oman, the Gulf of Aden and Antarctic waters below 60°S. Under Annex II, dealing with noxious liquid substances in bulk, the Baltic Sea and the Black Sea have been designated special areas. Annex V deals with garbage, and thus far the Mediterranean Sea, the Baltic Sea, the Black Sea, the Red Sea, and the Persian Gulf/Gulf of Oman have been declared special areas in this context.[24]

The standards for prevention, reduction and control of vessel-sourced pollution are more stringent in special areas than in other sea areas. Under Annex I, all discharges of oil or oily mixtures from oil tankers and ships of 400 tons gross tonnage and above are prohibited in special areas, and such discharges from ships of less than 400 tons gross tonnage are strictly limited.[25] Under Annex II, concentrations of substances which may be discharged in special areas are lower than for other sea areas.[26] Under Annex V, discharges of certain categories of garbage are prohibited in special areas, whereas other categories of garbage must be discharged further from the nearest land than is the case in other sea areas.

- MARPOL Provisions for the Great Barrier Reef

The outer edge of the Great Barrier Reef has been defined as "nearest land" for the purposes of Annexes I, II, IV and V of MARPOL 73/78[27]. This definition has the practical effect of prohibiting most forms of vessel-sourced discharges within the Great Barrier Reef area, thereby affording this area a degree of protection analogous to that available under the special areas provisions of MARPOL 73/78.

ii) The 1974 International Convention for the Safety of Life at Sea (SOLAS)

Through SOLAS the International Maritime Organisation has been given the task of identifying Areas to be Avoided in which there exist navigational hazards or where it is exceptionally important to avoid casualties. The IMO may identify classes of ships which

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23 Regulation 9(1)(a) of Annex I of MARPOL 73/78.

24 Other areas currently being considered for designation as special areas under MARPOL 73/78 are the Gulf of Mexico and the Caribbean Sea.

25 Regulation 10(2) of Annex I of MARPOL 73/78.

26 Regulations 5(8) and 5(9) of Annex II of MARPOL 73/78.

27 Regulation 1(9) of Annex I; Regulation 1(4) of Annex II; Regulation 1(5) of Annex IV; Regulation 1(2) of Annex V.

should not transit such areas on the basis of its General Provisions on Ships" Routeing. There currently exist 16 such Areas to be Avoided.[28]

iii) The 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage

This convention has the aim of establishing an inventory of properties of outstanding universal value which deserve particular protection. Marine areas which fulfil the criteria laid out in Art. 1 (dealing with cultural property) and/or Art. 2 (dealing with natural property) of the convention may be included in the list.[29] Criteria for inclusion of natural heritage properties in the World Heritage List under Art. 2 are as follows:

- outstanding examples representing the major stages of the earth's history; or
- outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment; or
- areas containing unique, rare or superlative natural phenomena or features or areas of exceptional natural beauty; or
- habitats where populations of rare or endangered species of plants and animals still survive.

in addition, all such areas should display *integrity*, i.e., they should be of a sufficient size to represent all aspects of the system represented.

UNESCO has developed operational guidelines for the implementation of the World Heritage Convention[30] which share some characteristics with the guidelines for the identification of particularly sensitive areas developed within the IMO.

iv) 1969 International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties and its 1973 Protocol

Accidental discharges of oil or other pollutants from vessels can cause major negative effects on the marine environment. It is obvious that the coastal state should have some rights to intervene to protect its interests in the event of such accidents. In the wake of the *Torrey Canyon* disaster in 1967 the *1969 International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties* (the Intervention Convention) was negotiated and adopted. This Convention attempted to clarify the rights of the coastal state. In 1973 the *Protocol relating to Intervention on the High Seas in Cases of Pollution by Substances other than Oil* was adopted. This Protocol applies to substances liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea, including substances contained in a list annexed to the Protocol.

Australia signed the Intervention Convention in 1970, and adopted the 1973 Protocol in 1981. The implementing legislation is discussed at E.II below.

v) 1969 International Convention on Civil Liability for Oil Pollution Damage and its 1976 and 1984 Protocols

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28 These include areas located within the following regions: the Rochebonne Shelf (France); Cape Terpeniya (USSR); Nantucket Shoals (USA); Northwest Hawaiian Islands (USA); Great Barrier Reef (Australia); Bermuda Islands; Smalls Lighthouse/Grassholme Island (UK).

29 See the description of the Great Barrier Reef below.

30 UNESCO document WHC/2/Revised, December 1988.

Article 235 of the LOSC provides that:

1. States are responsible for the fulfilment of their international obligations concerning the protection and preservation of the marine environment. They shall be liable in accordance with international law.

2. States shall ensure that recourse is available in accordance with their legal systems for prompt and adequate compensation or other relief in respect of damage caused by pollution of the marine environment by natural or juridical persons under their jurisdiction.

3. With the objective of assuring prompt and adequate compensation in respect of all damage caused by pollution of the marine environment, States shall cooperate in the implementation of existing international law and the further development of international law relating to responsibility and liability for assessment of and compensation for damage and the settlement of related disputes, as well as, where appropriate, development of criteria and procedures for payment of adequate compensation, such as compul sory insurance or compensation funds.

Australia has generally taken a strong position in favour of State responsibility and strict liability in cases where vessels under the jurisdiction and control of a State have caused damage to other States or to areas beyond national jurisdiction, supporting the establishment of compulsory international funds to ensure adequate compensation for pollution damage.

Article 235(3) LOSC may be seen as reflecting in part the development of the *1969 International Convention on Civil Liability for Oil Pollution Damage* and its 1976 and 1984 Protocols (the CLC Convention). Under the CLC Convention strict liability is imposed on a shipowner for damages resulting from oil pollution in the territory and the territorial sea of a State. However in 1969 there was no international consensus in favour of extending a system of liability beyond the limits of the territorial sea. The 1976 and 1984 international conferences under the auspices of the IMO amended the CLC to ensure that the amount of compensation available kept pace with the size of payouts necessary.

The Commonwealth passed legislation in 1981 implementing the CLC Convention for Australia. Australia has not yet ratified the *International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1971* (the Fund Convention), which was intended to supplement the CLC Convention.

The major argument which led to Australia's not ratifying the Fund Convention when the issue was last raised in 1984 was based on the concern that Australia, as a low-risk country, would in effect be subsidising high-risk countries through its contributions to the Fund. However subsequent developments with regard to the existing private industry arrangements under the voluntary TOVALOP[31] and CRISTAL[32] schemes mean that previous financial arguments against ratification are no longer as relevant as they may previously have been. Members of the TOVALOP and CRISTAL schemes may now be reimbursed for contributions to the IOPC Fund, thereby making the net cost of Australian participation in the Fund negligible. In addition, the Exxon Valdez disaster has again shown the need for considerable financial resources to be quickly available in the event of a major oil spill.

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31 The Tanker Owners' Voluntary Agreement concerning Liability for Oil Pollution, concluded 7 January 1969, reprinted in International Legal Materials 497 (1969).

32 The Contract regarding an Interim Supplement to Tanker Liability for Oil Pollution, concluded 14 January 1971, reprinted in International Legal Materials 137 (1971).

Heightened awareness of the need to protect and conserve the marine environment, particularly with respect to the Great Barrier Reef, has lent weight to the case for ratification of the Fund Convention. The support of the Australian Transport Advisory Council and the Australian oil industry for ratification of the Fund Convention is another significant factor in favour of ratification.

At the same time, there are difficulties with the Fund Convention which the IMO is attempting to address. Of particular concern is the fact that the United States, the world's biggest importer of oil, has rejected both the CLC and Fund Conventions through passing its 1990 *Oil Pollution Act.* This Act provides for strict and (theoretically) unlimited liability for pollution damage, including damage to the resources and amenities of the marine environment which do not have a direct economic value.

The U.S. approach would appear to be incompatible with the current CLC convention approach, which defines "pollution damage" in its Article 1 as

> "... loss or damage caused outside the ship carrying oil by contamination resulting from the escape or discharge of oil from the ship, wherever such escape or discharge may occur, and includes the costs of preventive measures and further loss or damage caused by preventive measures"

The IOPC Fund Convention adopts the same definition by referring in its Article 1(2) to the CLC definition of pollution damage.
The definition is unclear as to precisely what kinds of loss or damage are to be covered and therefore are capable of redress under the CLC or IOPC Fund conventions. The watershed *Trail Smelter* arbitration determined in 1949 that pollution damages can only be claimed for "tangible injury translatable into provable monetary damages".[33] On this basis, damage to the environment which is not directly quantifiable in monetary terms would not be subject to compensation. It is difficult to ascertain the extent to which this principle has been followed under the CLC, as the results of settlements under the CLC are not generally published, being usually determined out of court by the P&I clubs (the shipowners' insurers). For this reason the bulk of public documentation relating to the question of the definition of pollution damage has arisen out of the practice of the IOPC Fund.

The issue of the applicability of an abstract formula for the calculation of damages (i.e., allowing for possible damage to the environment per se, independent of directly quantifiable economic damage) was considered by the Fund in the case of the Soviet oil tanker *Antonio Gramsci* in 1980. In a resolution of the IOPC Fund Assembly from that year it stated that assessment of compensation for oil pollution damage was not to be carried out on the basis of abstract theories but rather on the basis of quantifiable economic loss.[34]

In addition, the fact that both the CLC Convention and the IOPC Fund Convention provide limits on payouts makes them incompatible with the U.S. legislation's unlimited liability provisions. Further negotiations are being carried out to attempt to reconcile the U.S. position with that of other states in order to achieve a widely accepted international system of compensation for oil pollution damage.

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33 Decision of the U.S./Canadian arbitral tribunal of 11 March 1941 in the *Trail Smelter* case, RIAA III, p. 1965.

34 See Redgewell, C., *Compensation for oil pollution damage,* in Marine Policy, Volume 12 Number 2, March 1992, pp. 91-92.

vi) 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention)[35]

Dumping of wastes at sea was one of the first areas of marine pollution to be the subject of a global international convention, preceded only by those conventions dealing with oil pollution. The London Convention entered into force in 1975, having been signed by Australia in 1973. For reference to Australian legislation implementing the London Convention see E.IV below.

Dumping is defined under Article 1(5)(a) of the LOSC as any deliberate disposal of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea, as well as any deliberate disposal of vessels, aircraft, platforms or other man-made structures at sea. However in general dumping does not include the disposal of wastes or other matter incidental to, or derived from the normal operations of vessels, aircraft, platforms or other structures at sea. Besides regulating most forms of dumping, the London Convention bans the dumping of high-level radioactive waste, although the dumping of low-level radioactive waste is permissible.[36]

At the time of negotiation of the London Convention there was no agreement among States as to the extent of coastal state jurisdiction over dumping activities in its exclusive economic zone or on its continental shelf. Negotiations at UNCLOS III however confirmed that coastal states did have jurisdiction over such dumping activities. Thus Article 216(1) LOSC provides that:

1. Laws and regulations adopted in accordance with this Convention and applicable international rules and standards established through competent international organisations or diplomatic conference for the prevention, reduction and control of pollution of the marine environment by dumping shall be enforced:

   (a) by the coastal state with regard to dumping within its territorial sea or its exclusive economic zone or onto its continental shelf;

   (b) by the flag State with regard to vessels flying its flag or vessels or aircraft of its registry;

   (c) by any State with regard to acts of loading of wastes or other matter occurring within its territory or at its off-shore terminals.

At the 13th consultative meeting of the London Convention, held in 1990, a consensus resolution was passed agreeing to the global cessation of sea dumping of industrial waste by 31 December 1995. Australia supported the achievement of consensus on this issue. Although not binding at international law, the resolution imposes a strong moral and political obligation upon all States Parties to the London Convention to cease sea dumping of industrial waste by 31 December 1995 at the latest.

At the 15th consultative meeting of the London Convention, held in 1992, it was agreed to commence consideration of amendments to the London Convention. One of the major

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35 **Until late 1992 the London Convention was known as the London Dumping Convention. In view of the general trend of negotiations away from the regulation of dumping at sea to its cessation wherever possible, it was felt appropriate by the States Parties to the Convention to amend its name to remove the reference to "dumping" from its common title.**

36 There is currently a moratorium on the sea dumping of low-level radioactive waste, pending the outcome of investigations being carried out by the Intergovernmental Panel of Experts on Radioactive Waste Disposal at Sea (IGPRAD).

aims will be to transform the current non-binding resolution on the dumping of industrial wastes into a black-letter international legal obligation.

vii) The 1989 Basel Convention on the Control of Transboundary Movements and Disposal of Hazardous Wastes

The management, transport and disposal of hazardous wastes has become a matter of increasing concern in recent years. Increasing regulation of hazardous wastes in industrialised countries has made the management of these wastes more and more difficult and expensive. This has led to a movement of hazardous wastes, both with and without the consent of relevant authorities, from industrialised countries to developing countries with less stringent environmental regulation of such wastes. The growth in this flow of potentially lethal substances from developed to developing countries was one of the major reasons for the adoption of the *1989 Basel Convention on the Control of Transboundary Movements and Disposal of Hazardous Wastes* (Basel Convention).[37]

The Basel Convention, by requiring importing countries to provide adequate facilities for the adequate storage of hazardous wastes, has reduced significantly the likelihood of the export of such wastes to developing countries.

Although the Basel Convention regulates all means of transporting hazardous wastes from one country to another, sea transport is of particular concern, as it may involve the added risk of contamination and infiltration of the marine environment.

Australia ratified the Basel Convention in 1992. Australia was the twentieth country to do so, thereby bringing the Convention into force. For a discussion of Australian implementing legislation see E.V below.

Regional Conventions

There currently exist some thirty-nine regional conventions, protocols and agreements for the protection and preservation of the marine environment.[38] It would be beyond the scope of this paper to elaborate on each of these instruments. It is rather intended to provide an overview of the two major groups of regional agreements:[39] those dealing with the North Atlantic and the North Sea, and those created in the context of the United Nations Environment Programme (UNEP) Regional Seas Programme. The 1974 Convention on the Protection of the Marine Environment of the Baltic Sea Area or Helsinki Convention is important in this regard. This convention provided an impetus towards the development of the UNEP Regional Seas Programme.

The North Atlantic and the North Sea

It was in the North Atlantic and the North Sea that the first large-scale multilateral initiatives aimed at regional cooperation for the protection and preservation of the marine environment were commenced. These conventions concerned specific forms of marine pollution, rather than attempting to embrace all such forms in one agreement.

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37 Reproduced in 28 International Legal Materials, Number 3, May 1989, pp. 657-686.

38 United Nations Office for Ocean Affairs and the Law of the Sea, *The Law of the Sea: Protection and Preservation of the Marine Environment: Repertory of International Agreements Relating to Sections 5 and 6 of Part XII of the United Nations Convention on the Law of the Sea*, United Nations, New York, 1990, pp. 72-75; United Nations Office for Ocean Affairs and the Law of the Sea, *Law of the Sea Bulletin* (No. 15 May 1990), United Nations, New York, 1990, pp. 41-53.

39 See A. E. Boyle, *Regional Pollution Agreements and the Law of the Sea Convention*, in W. E. Butler (ed.), The Law of the Sea and International Shipping: Anglo-Soviet Post-UNCLOS Perspectives, Oceana Publications, New York/London/Rome, 1985, pp. 315-354, at 318.

A milestone in the development of multilateral regional agreements for the protection of the marine environment was the 1969 Agreement for Co-operation in Dealing with Pollution of the North Sea by Oil (the Bonn Agreement). The area of coverage was the North Sea and the English Channel, and it was functionally limited to oil pollution issues. This Agreement was superseded on 1 September 1989 by the entry into force of the 1983 Agreement for Co-operation in Dealing with Pollution of the North Sea by Oil and Other Harmful Substances, thereby broadening the functional range of the Agreement considerably.[40] In 1972 the Convention for the Prevention of Marine Pollution by Dumping by Ships and Aircraft (the Oslo Convention) was negotiated. It covers the North Sea, the eastern North Atlantic, and an area bounded by Greenland, the Azores and Franz Josef Land.[41] In the same year the Convention for the Prevention of Marine Pollution from Land-Based Sources (the Paris Convention) came into existence, covering the same area as that of the Oslo Convention. A further element in this group of regional agreements was the 1979 Convention on Long-Range Transboundary Air Pollution. Most European states are parties to this convention, as are the USA and Canada.

Thus all major forms of marine pollution have been addressed in the North Sea and North Atlantic region through an incremental process involving the development of individual conventions for various kinds of marine pollution.

The Helsinki Convention
The first regional agreement which attempted to comprehensively address the problem of marine pollution, rather than relying on individual agreements for various forms of pollution, was the 1974 Convention on the Protection of the Marine Environment of the Baltic Sea Area (the Helsinki Convention). This convention influenced the form of the later UNEP regional seas conventions. It also provided a basis for negotiations at the Third UN Conference on the Law of the Sea.[42]

The UNEP Regional Seas Programme
The UNEP Regional Seas Programme confirmed a trend set by the Helsinki Convention through fostering regional agreements aimed at regulating all forms of marine pollution along the lines envisaged in Part XII of the LOSC.

This Programme commenced in 1974 and now includes conventions covering the Mediterranean,[43] the Persian Gulf and the Gulf of Oman,[44] the Caribbean,[45] the African

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40 The Agreement does not define in detail the kinds of substances covered. It rather applies

> "whenever the presence or prospective presence of oil or other harmful substances polluting or threatening to pollute the sea ... presents a grave and imminent danger to the coast or related interests of one or more Contracting Parties."

41 ibid., p. 319.

42 ibid., p. 320.

43 Convention for the Protection of the Mediterranean against Pollution 1976 (Barcelona Convention).

44 Kuwait Regional Convention for Co-operation on the Protection of the Marine Environment from Pollution (Kuwait Convention).

45 Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region 1983 (Cartagena Convention).

West Coast,[46] the South-East Pacific,[47] the Red Sea and Gulf of Aden,[48] the East African region[49] and the South Pacific.[50]

All conventions created under the UNEP Regional Seas Programme follow a similar format. The conventions themselves contain general obligations with regard to protection and preservation of the marine environment,[51] whilst detailed provisions relating to these obligations are elaborated in separate protocols. Such protocols can provide for the establishment of protected areas.[52]

The UNEP Regional Seas Programme has played a significant role in transforming many of the environmental provisions of the LOSC, including those referring to environmentally sensitive areas, into norms of conventional international law which are binding upon the parties to these conventions.[53]

Implementation of international marine environment protection norms in Australia: The significance of the Offshore Constitutional Settlement

Origins

The development during UNCLOS III of new international rules relating to the offshore jurisdiction of coastal states raised significant issues in a number of federal states, such as Australia, the United States and Canada, as to the appropriate division of responsibilities in the offshore area.

A 1971 report of the Senate Select Committee on Offshore Petroleum Resources determined that it was in Australia's interest to resolve the relative extent of State and Commonwealth authority in the seabed of the territorial sea and on the continental shelf.

The Seas and Submerged Lands Act 1973

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46 Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region 1981 (Abidjan Convention)

47 Convention for the Protection of the Marine Environment and Coastal Areas of the South-East Pacific 1981 (Lima Convention).

48 Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment 1982 (Jeddah Convention).

49 Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region 1985 (Nairobi Convention).

50 Convention for the Protection and Development of the Natural Resources and Environment of the South Pacific Region 1986 (Noumea Convention) which has recently come into force.

51 These general obligations are drawn directly from the Law of the Sea Convention.

52 See e.g. the 1985 Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region. Analogous protocols have been created in the context of the Barcelona and Cartagena conventions. In addition, Art. 14 of the Noumea Convention provides for the establishment of protected areas.

53 An example of this process is Art. 8 of the Noumea Convention, which reconfirms the duty under Art. 208 of the Law of the Sea Convention for States to adopt laws and regulations to prevent, reduce and control pollution of the marine environment relating to seabed activities. There currently exist no global international conventions pursuant to this duty.

The next phase commenced with the passage of the *Seas and Submerged Lands Act 1973.* In 1975 the High Court upheld[54] the Commonwealth's assertion of sovereign rights on the part of the Crown in right of the Commonwealth, as against the States, over:

- the continental shelf:
- the territorial sea;
- internal waters outside State limits as at 1901; and
- the seabed beneath the territorial sea and internal waters outside State limits as at 1901.

This decision had the effect of confirming that, for most purposes, Commonwealth sovereignty extends up to the low-water mark. However, the decision in *New South Wales v. Commonwealth* did not mean that States have no power to regulate offshore activities. The subsequent ruling of the High Court in *Pearce v. Florenca* [55]upheld the application of State fisheries laws in the territorial sea.

Emergence of the Offshore Constitutional Settlement
Subsequent discussions were held between the Commonwealth and the States with a view to producing a solution acceptable for the Commonwealth and all States. This solution, known as the Offshore Constitutional Settlement (OCS), was reached in 1979, although the complete implementation of the Settlement has not yet been achieved.

Under the OCS the Commonwealth Parliament passed legislation, based on section 51 (xxxviii) of the Constitution, to give each State the same powers with respect to the adjacent territorial sea (including the seabed) as it would have if the waters were within the limits of the State.

The proclamation of the *Coastal Waters (State Title) Act 1980,* the *Coastal Waters (State Powers) Act 1980,* the *Coastal Waters (Northern Territory Title) Act 1980* and the *Coastal Waters (Northern Territory Powers) Act 1980* occurred in early 1983. Through this proclamation the Commonwealth vested title in and legislative power over the three nautical mile territorial sea in the States and the Northern Territory. Whilst this legislation does not preclude the Commonwealth from legislating with respect to the 3 nautical mile territorial sea, it does mean that many provisions of Commonwealth legislation implementing the international agreements referred to above may be replaced or supplemented by State legislation.

These Acts include savings provisions to safeguard existing State extra-territorial powers in the offshore area and to ensure that laws of the Commonwealth applying in the territorial sea prevail over any inconsistent State law as provided for under section 109 of the Constitution.

Ship-Sourced Marine Pollution Under The OCS
The initial division of responsibilities between the Commonwealth and the States in the field of ship-sourced marine pollution came about in 1960 when the *1954 International Convention for the Prevention of Pollution of the Sea by Oil* (OILPOL) entered into force for Australia. Effect was given to OILPOL by the enactment of Commonwealth legislation which applied to Australian ships outside the territorial sea, and similar legislation passed by the States which applied to all ships within the territorial sea.

It was also agreed that the Commonwealth would prepare legislation implementing the provisions of the International Conventions relating to Intervention on the High Seas in

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54 *New South Wales v. Commonwealth* (1976) 135 CLR 337

55 (1976) 135 CLR 507

cases of Oil Pollution Casualties, 1969, and Civil Liability for Oil Pollution Damage, 1969 (see above, B.I.b.ii and iii). In implementing the latter Convention, a saving clause was inserted allowing States to legislate to implement certain aspects of the Convention if they wish to do so.

Commonwealth And State Legislation Implementing Global Conventions

Protection of the Sea (Prevention of Pollution from Ships) Act 1983
Commonwealth legislation implementing the 1973 International Convention for the Prevention of Pollution from Ships and its 1978 Protocol (MARPOL 73/78) was passed in 1983, and came into force for Australia in October 1987. The legislation initially gave effect to the mandatory Annexes I and II of MARPOL 73/78, dealing with oil and noxious liquid substances carried in bulk respectively. Annex V (dealing with discharges of garbage) entered into force for Australia in November 1990.

The *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* contains, consistent with the OCS (see E.IV above), a saving provision in s. 5(2) whereby the States may legislate to implement MARPOL 73/78. Thus far several States have taken this opportunity:

- Victoria: *Pollution of Waters by Oil and Noxious Substances Act 1987* (Part of Annex I, Annex V of MARPOL);
- NSW: *Marine Pollution Act 1987* (Annexes I and II of MARPOL);
- South Australia: *Pollution of Waters by Oil and Noxious Substances Act 1987* (Annexes I and II of MARPOL); and
- Tasmania: *Pollution of Waters by Oil and Noxious Substances Act 1987* (Annexes I and II of MARPOL).

Western Australia has passed an Act implementing Annexes I and II of MARPOL, but it is yet to be proclaimed. A corresponding Queensland Act is being drafted.

Protection of the Sea (Powers of Intervention) Act 1981
The *Protection of the Sea (Powers of Intervention) Act 1981* relies on the 1969 International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties and its 1973 Protocol with regard to exercise of coastal state jurisdiction on the High Seas. At the same time the Act provides for a power of intervention in internal waters and in the territorial sea based on customary international law, as long as the degree of intervention is proportional to the incident.

Section 5 of the Act provides that the Act is not in derogation of any State or Territory law. Some States exercise intervention powers as provided for under section 5 of the Act, chiefly in relation to smaller spills in internal waters and within three nautical miles of the territorial sea baselines. Such provisions are found in the following State acts:

- NSW: *Marine Pollution Act 1987;*
- Victoria: *Marine Act 1988;*
- Queensland: *Pollution of Waters by Oil Act 1973;* and
- South Australia: *Pollution of Waters by Oil and Noxious Substances Act 1987.*

Protection of the Sea (Civil Liability) Act 1981
Passage of this Act enabled Australia to ratify the 1969 International Convention on Civility for Oil Pollution Damage and its 1976 Protocol (CLC) in 1983. The Act commenced in 1984. In June 1988 amendments to the Act implementing the 1984 Protocol to the CLC were proclaimed, but the Protocol has not yet entered into force internationally.

The Act provides for mandatory insurance for all oil tankers entering Australian ports, building upon the voluntary TOVALOP and CRISTAL schemes (see B.I.b.iii above). In addition, the Act provides for recovery by the Commonwealth of costs it may incur in oil spill clean up operations or for prophylactic measures to prevent a spill.

Section 7(1) of the Act provides for roll-back of the provisions of the Act to the extent that State or Northern Territory laws apply the provisions of the CLC in relation to a particular ship. Thus far no States have expressly enacted such legislation, although section 51 of the NSW *Marine Pollution Act 1987* appears to apply terms similar to the provisions of the CLC in relation to the recovery of civil damages.

Environment Protection (Sea Dumping) Act 1981
The Act implements the *1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention)*. Section 9 of the Act is a roll-back clause pursuant to the Offshore Constitutional Settlement enabling State or Territory legislation to give effect to the London Convention within the coastal waters of the State or Territory.

Thus far only Tasmania has enacted roll-back legislation, i.e. the *Environment Protection (Sea Dumping) Act 1987*. This is to be expected, as the only permitted dumping operation coming under the purview of the London Convention is in Tasmania. It is an operation dumping jarosite. [56]

Hazardous Waste (Regulation of Exports and Imports) Act 1989
This Act implements the 1989 Basel Convention on the Control of Transboundary Movements and Disposal of Hazardous Wastes.

Section 17 (1)(b)(ii) of the Act appears to place a stricter burden upon an applicant for a permit to export hazardous waste than required under the Basel Convention. Section 17 (1)(b)(ii) appears to require the consent of a coastal state for transit through the territorial sea of a vessel carrying hazardous waste which is the subject of a permit. It is not expressly stated in the Basel Convention, and is strongly disputed by many states, that such consent should be required.

A Marine Area Of Great Environmental Significance: The Great Barrier Reef

The Great Barrier Reef off the North-East coast of Australia has long been recognised as one of the most environmentally significant areas in the world. It is the largest coral reef system in existence, stretching for almost two thousand kilometres. It is recognised as being the greatest known marine repository of biodiversity.

Recognition of the unique value of the Great Barrier Reef has led to a whole range of measures being taken under both international and domestic law to increase the level of protection afforded the Great Barrier Reef.

International Measures
In 1981 the Great Barrier Reef was inscribed on the UNESCO World Heritage List established pursuant to the Convention concerning the Protection of the World Cultural and Natural Heritage. It is arguably the most significant marine area to have been inscribed on the List.

Discharges of most marine pollutants within the Great Barrier Reef have been prohibited through specific provisions in Annexes I, II, IV and V of MARPOL 73/78 (see above).

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56 Jarosite is a waste material from the smelting of zinc. It contains significant quantities of zinc, cadmium, lead, iron, mercury, arsenic and copper.

An area to be avoided by all ships in excess of 500 tonnes gross tonnage has been established in the Mackay/Capricorn section of the Great Barrier Reef under the 1974 International Convention for the Safety of Life at Sea (SOLAS).

In November 1987 the Assembly of the IMO passed Resolution A.619(15), which recommended that all loaded oil tankers and chemical carriers and all vessels over 100 meters in length, regardless of cargo, should carry a pilot when navigating in the northern part of the Great Barrier Reef.

Domestic Legislation
The cornerstone of domestic legal measures aimed at ensuring the environmental integrity of the Great Barrier Reef is the *Great Barrier Reef Marine Park Act 1975*, which established the 344 000 km^2 Great Barrier Reef Marine Park as well as an organisation (the Great Barrier Reef Marine Park Authority) responsible for creating and implementing management plans for the Great Barrier Reef. The Marine Park Authority has been granted extensive powers to manage and protect the Great Barrier Reef environment.

Unlike terrestrial national parks, the Great Barrier Reef Marine Park is characterised by multiple-use. Thus areas are zoned in accordance with their environmental sensitivity and the degree of permissible human activity regulated accordingly. The zoning plans are reviewed at regular intervals.

There are three primary categories of zones in the zoning plans which have thus far been created. These are:

- Preservation zones and Scientific Research zones, which are analogous to IUCN Category 1 (Scientific Reserve/Strict Nature Reserve). The only permissible human activity in these zones is scientific research, for which express approval from the Great Barrier Reef Marine Park Authority is required. Only a relatively small part of the Great Barrier Reef Marine Park has been designated as Preservation zone or Scientific Research Zone;
- Three kinds of Marine National Park zones, which are analogous to IUCN Category II (National Park). Permissible human activities in these zones are of a scientific, educational and recreational nature;
- Two kinds of General Use Zones, which are analogous to IUCN Categories IV (Managed Nature Reserve) and VI (Resource Reserve). Management in these zones is directed towards maintaining sustainable use of the living resources of the Great Barrier Reef. Most forms of commercial and recreational fishing are permissible.

The Act applies to the area of the Park itself, which includes internal waters (but not those which were within the limits of Queensland on 1 January 1901), territorial sea and Australian Fishing Zone, as well as the seabed and the subsoil below it, subject to Australia's international obligations.[57]

Under s. 38 of the Act there shall be no operations for the recovery of minerals in the Marine Park, although such operations may be carried out for research purposes (s. 38(3)).

Multilateralism Versus Unilateralism: Two Case Studies

As noted above, international cooperation is an essential component of coastal state regulations for the protection and preservation of the marine environment. Without the support, or at least the acquiescence, of the international community, coastal state legislation is at best opposable only against those vessels registered in the coastal state.

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57 s. 3(1), s.65(2)) of the *Great Barrier Marine Park Act 1975.*

The following two case studies illustrate the advantages inherent in the multilateral approach. In the first study, Canada attempted unilateral assertion of jurisdiction over its Arctic waters in the early 1970s. Despite the obvious merit of many of the Canadian proposals, the attempt met with widespread rejection until the Canadians adopted the multilateral approach through the vehicle of UNCLOS III, several years later.

In the second study, Australia introduced a scheme for compulsory pilotage in the inner route of the Great Barrier Reef in 1991. By employing the multilateral vehicle of the IMO, Australia was able to assert this new form of jurisdiction within one year of commencing its IMO strategy, and has experienced no dissent from other States.

The second case study also highlights the important fact that much regulation of international shipping is carried out under the auspices of the IMO without the negotiation of international agreements which are directly binding upon the IMO member states. Under Article 15(j) of the IMO Convention, resolutions of the IMO can be no more than recommendatory in nature. Nonetheless, these resolutions can have a significant effect upon the development of international law as it relates to shipping and shipowners. Shipowners can find themselves bound by domestic legislation enacted pursuant to international understandings built upon resolutions which are not binding upon the states enacting the legislation or acquiescing in the application of such legislation.

The Canadian Arctic Waters Pollution Prevention Act 1970
The need for a multilateral approach to marine environmental protection was underlined by the events of the early 1970's relating to the Arctic waters of Canada. Although Canada attempted to impose through unilateral means a regime of coastal state control beyond that currently existing, it was not until emergence of an agreed text in the LOSC that this regime was given any kind of underpinning in international law such as to make it opposable against non-Canadian vessels.

In 1969 the US tanker *Manhattan* became the first large commercial vessel to successfully navigate the icy North-West Passage off the northern Canadian and Alaskan coast. This was to have significant repercussions for the development of international law as it relates to protection and preservation of the marine environment and its relation to security.

The voyage of the *Manhattan* focussed attention on the possibility of significant oil and gas tanker traffic through the North-West Passage. The passage by the *Manhattan* was doubtless a significant navigational feat, but it was not without its dangers in the longer term. Canada was alarmed at this prospect and the possible environmental consequences of an oil or noxious chemical spill in these waters. In such areas it takes a very long time for crude oil to be broken down due to the low density of the micro-organisms which ingest the oil. This was demonstrated by the recent *Exxon Valdez* disaster. Canada therefore passed comprehensive legislation to control shipping in the North-West Passage. This generated great international controversy and a range of protests, particularly from the United States.

The Canadian *Arctic Waters Pollution Prevention Act* 1970,[58] provided for the creation of "shipping safety control zones" with a breadth of 100 nautical miles off the Canadian Arctic coastline. In addition, Section 12(1) of the Act provided for regulations to be made prohibiting any ship of a specified class or classes from navigating within any shipping safety control zone specified therein unless certain criteria were fulfilled, such as taking on a pilot, etc. The Act also provides for Governor in Council may make regulations applicable to ships of any class or classes absolute liability on the part of shipowners and cargo owners for deposit of waste. Certain standards of construction, navigational aids, manning and icebreaker assistance are also included. Foreign public ships may be

58 Text reprinted in ILM 9 (1970).

exempted if they meet substantially equivalent standards. Under certain circumstances pollution prevention officers may board a ship and even seize the ship and its cargo. Such powers have not been exercised thus far. However the new Canadian Act was without precedent in its unilateral assertion of jurisdiction for the purposes of securing greater environmental security.

One of the arguments used by Canada, at least informally, in defending its purported unilateral extension of coastal state jurisdiction was that of a definition of security expanded to encompass not just the traditional concept of military security but also a new concept of environmental security. However none of these arguments were accepted in the broader international community. The United States, in particular, maintained consistent criticism of the Canadian legislation

a) Innocent passage in the territorial sea.

The US and others were particularly concerned about the implications for the right of innocent passage through the territorial sea which such legislation could have, seeing the establishment of broad coastal zones with extensive jurisdiction as inimical to the rights and interests of maritime states in general and the US in particular.

What are these rights and interests of maritime states? Article 17 of the 1958 Geneva Convention on the Territorial Sea and the Contiguous Zone requires that

> "Foreign ships exercising the right of innocent passage shall comply with the laws and regulations enacted by the coastal state in conformity with these articles and *other rules of international law* and, in particular, with such laws and regulations relating to transport and navigation."

The 1982 Convention is significant as an indicator of what these other rules of international law may be. Despite the fact that it has not yet come into force, many of its provisions, including those relating to innocent passage, are seen by a significant proportion of the international community as being declaratory of international law. In addition, the 159 States which are signatories to the 1982 Convention are obliged under Article 18 of the Vienna Convention on the Law of Treaties and/or the rule of customary international law which it embodies to refrain from acts which would defeat the object and purpose of the 1982 Convention.

Under Article 21(1)(a), (b) and (h) of the 1982 Convention the coastal state may adopt laws and regulations on innocent passage with respect to, inter alia, the safety of navigation and the regulation of maritime traffic, the conservation of the living resources of the sea, and the *preservation of the environment* of the coastal state. These rights are however limited through Article 24:

> "1. The coastal State shall not hamper the innocent passage of foreign ships through the territorial sea except in accordance with this Convention. In particular, in the application of this Convention or of any laws or regulations adopted in conformity with this Convention, the coastal State shall not:
>
> (a) impose requirements on foreign ships which have the practical effect of denying *or impairing* the right of innocent passage; ..." (emphasis added)

Many countries, including Australia and the US, regard unilateral coastal state requirements of notification, authorisation or other potential imposts upon innocent passage such as those contained in the Canadian Act to be such an impairment.

This view was reflected in a joint US/USSR statement of 23 September 1989, known as the Jackson Hole Declaration:

> "[the US and Soviet] Governments are guided by the provisions of the 1982 United Nations Convention on the Law of the Sea ... all ships, including warships, regardless of cargo, armament or means of propulsion, enjoy the right of innocent passage through the territorial sea in accordance with international law, for which neither *prior notification nor authorisation* is required." (emphasis added)

The Australian Government has consistently agreed with this interpretation of right of innocent passage. In the view of Australia and most other maritime states, this right cannot be restricted through unilateral application of domestic legislation such as the Canadian Act, unless and until it is accompanied by broad international agreement.

In view of the fact that the majority of the international community was opposed to the unilateral Canadian legislation, it is clear that the legislation was unsuccessful in enhancing protection of Canadian Arctic waters insofar as it attempted to cover foreign vessels. This is not meant as a criticism of the substantive provisions of the Canadian legislation. There is ample objective scientific evidence to support the application of particularly stringent environmental standards to maritime traffic in areas such as Canadian Arctic waters. However unilateral action to apply such standards, however justifiable, cannot succeed by itself, as such action relies not upon the rule of law but upon the relative power of a coastal state to enforce its will on others.

b) UNCLOS III

It was not until several years enactment of the Canadian legislation that its provisions eventually gained an international legal status through the inclusion in part XII of the LOSC of Article 234, which gives coastal states broad jurisdiction for the prevention, reduction and control of marine pollution in ice-covered areas within the exclusive economic zone (EEZ), without the need for such measures to be internationally approved or to be in accordance with accepted international standards. Even today, the legislation can only be seen as in conformity with international law to the extent that Art. 234 of the LOSC may be declaratory of customary international law.

Thus the Canadian experience shows the importance of the multilateral approach in achieving internationally enforceable standards for protection and preservation of the marine environment. Unilateralism, apart from being ineffective against those states which do not accept the unilateral actions, has a negative effect on the general formation of international law.

Compulsory Pilotage In The Great Barrier Reef

The Great Barrier Reef is the world's largest system of corals and associated life forms. It is the greatest known marine repository of biodiversity, and is a unique area requiring the highest possible level of environmental protection.

The inner route through the Reef is also a significant sea route, with approximately 2000 transits per year by large vessels or those carrying hazardous cargoes. The route offers relatively calm waters, but it is intricate and shallow. The ecological and economic cost to the Great Barrier Reef region of a shipping mishap could be incalculable. The carriage of a properly qualified, skilled mariner with local knowledge considerably reduces the risk of shipping accidents in the region.

Having surveyed all options for reducing the risk of maritime accidents in the Reef region, Australia has implemented a scheme of compulsory pilotage for ships which constitute a potential threat to the environment of the Great Barrier Reef.

The implementation of this scheme was preceded by an international campaign consisting of three phases. During the first phase, international representations were made to seek compliance with the existing system of voluntary pilotage for the region. Despite this,

about 10% of ships continued to transit without pilots. In the second phase, Australia participated in the development within the IMO of the new concept of particularly sensitive areas. During this phase it was agreed that the Great Barrier Reef was the world's leading candidate for identification as such an area. The third phase involved a global lobbying campaign to achieve formal identification of the Great Barrier Reef as a particularly sensitive area and international endorsement of the compulsory pilotage scheme through the IMO.

a) The problem

Recent tanker disasters such as the *Exxon Valdez* off Alaska and the *Bahaia Paraiso* in Antarctica have highlighted the dangers which can arise from vessel-sourced pollution. The Great Barrier Reef region has not been spared in the past. The grounding of the *Oceanic Grandeur* in 1970 resulted in considerable oil pollution in the region, causing serious damage to the marine environment as well as to the local oyster industry.

b) Voluntary pilotage

One aspect of the protection of the environment of the Great Barrier Reef region was a system of voluntary pilotage for all ships of 100 metres in length and over and all loaded oil tankers, chemical carriers or liquefied gas carriers, irrespective of size, navigating in the Torres Strait, the inner route of the Great Barrier Reef, the Great North-East Channel and Hydrographer's Passage. In 1987 Australia sought and gained endorsement from the IMO for this scheme in the Great Barrier Reef and Torres Strait region. It was embodied in IMO Resolution A.619(15) of 19 November 1987.

In seeking to promote compliance with the IMO Resolution, Australia monitored ships defined by the resolution transiting the inner route of the Great Barrier Reef without a pilot. Many vessels however ignored, or by virtue of length were not covered by, the IMO resolution. Approximately 10 per cent of the vessels covered by the resolution continued to transit the defined area without a pilot. This amounts to approximately 200 unpiloted transits per year.

In February 1990 Australia intensively lobbied the governments of those countries whose ships were not availing themselves of the voluntary system, urging them to ensure that ships operating under their flag complied with IMO Resolution A.619(15). Despite these efforts there had not been a noticeable increase in compliance. As a consequence the risk of an accident remained unacceptably high.

c) Compulsory pilotage

In the light of these circumstances, Australia proceeded to implement a scheme of compulsory pilotage for merchant ships navigating the inner route of the Great Barrier Reef between the northern boundary of the Great Barrier Reef Marine Park and a point just north of Cairns, as well as in Hydrographers Passage, which is off Mackay. The length requirement was reduced to 70 metres to further reduce risks from larger ships. The scheme does not encompass the Torres Strait and the Great North-East Channel, as these are straits used for international navigation and thus subject to the right of transit passage, which places greater obligations on coastal states to allow unimpeded passage than is the case in the territorial sea. As a matter of practice, the great majority of ships using the Torres Strait and the Great North-East Channel are covered by the scheme, as ships transiting the inner route of the GBR normally pick up or set down pilots at the western extreme of Torres Strait.

d) International endorsement of Australia's initiative

The Marine Environment Protection Committee (MEPC) of the IMO had in recent years formulated guidelines containing criteria for the identification of particularly sensitive

areas and appropriate measures for such areas. Australia was involved in the development of the guidelines.

As part of this process, a seminar on Sensitive Sea Areas was held under the auspices of the IMO in September 1990 in Sweden, attended by experts from approximately fifty countries. The seminar endorsed the guidelines for particularly sensitive areas. It also called on the IMO to identify the Great Barrier Reef as a particularly sensitive area and to recognise compulsory pilotage as an appropriate measure in such areas under certain circumstances.

At the same time, Australia embarked on a major diplomatic effort to gain support for IMO identification of the Great Barrier Reef as a particularly sensitive area[59] and endorsement of Australia's pilotage scheme[60] in the Reef region. This was achieved in November 1990 at a meeting of the MEPC in London. The Great Barrier Reef thus became the first area in the world to be identified as a particularly sensitive area.

The culmination of these efforts was the introduction of an amendment to the *Great Barrier Reef Marine Park Act 1975* implementing the compulsory pilotage scheme. The new scheme entered into effect in October 1991.

Trends

This section outlines some recent developments and emerging trends of significance for regulation of the marine environment as it relates to the Great Barrier Reef.

Vessel Design Standards

Following the announcement in 1990 of unilateral moves by the United States to phase in requirements for oil tankers visiting U.S. ports to have double hulls in order to reduce the risk of oil spills, the IMO took up the issue, reaching a an international compromise whereby double-hulled vessels will be introduced gradually over the course of the next thirty years. New regulations pursuant to MARPOL 73/78 have been negotiated.

For new oil tankers, the regulations will take effect from 6 July 1993. New tankers of 5 000 dead weight tonnes (dwt) and above will be required to have double bottoms, except in the case of "mid-deck" tankers, which will be required to have double sides. Other standards of design and construction providing the same level of protection against oil spills may also be employed.

For existing tankers, the regulations will take effect from 6 July 1995 and will apply to crude carriers of 20 000 dwt and above and product carriers of 30 000 dwt and above. Existing tankers will have to meet the full requirements not later than 30 years after their delivery date.

Corresponding amendments to the Commonwealth *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* have been made and will commence when the MARPOL amendments enter into force internationally.

Evolving Legal Regimes For Shipping Regulation In Environmentally Sensitive Areas

The developments outlined above show that there has been considerable progress in the last few decades in developing global, regional and domestic legal mechanisms to protect and preserve the marine environment in relation to environmentally significant marine areas. There nonetheless exist difficulties quite apart from the fact that the status of the LOSC continues to be less than clear.

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59 IMO MEPC resolution 44(30)

60 IMO MEPC resolution 45(30)

Coastal regions represent, from a legal perspective, areas of decreasing coastal state jurisdiction, from internal waters through territorial sea and contiguous zone to the exclusive economic zone. Particularly sensitive ecosystems tend not to respect these various levels of jurisdiction, and may straddle one or more of them. This can often create a quite complex labyrinth of various levels of coastal state jurisdiction, particularly where the form of the coastline is complicated by indented features or offshore islands. It is thus possible to have areas of exclusive economic zone surrounded by territorial sea or areas of high seas surrounded by exclusive economic zone. Such complex interfaces between various sea zones can lead to difficulties in establishing coherent and effective management regimes for environmentally sensitive marine areas, as the degree of coastal state jurisdiction and the kinds of enforcement measures which coastal states may employ vary between such areas. Thus under the enforcement regime of the LOSC, a foreign ship illegally discharging oily waste into the territorial sea in an environmentally sensitive area may be detained by the coastal state,[61] whereas a foreign ship committing the same act in an equally sensitive and adjacent pocket of exclusive economic zone within the territorial sea may only be requested by the coastal state to provide information, unless the discharge is so serious as to cause major damage or threat of major damage to the coastline or related interests of the coastal state.[62] Whilst it is clear that the general limitation on coastal state enforcement powers in the exclusive economic zone is justified on the basis of the principle of freedom of navigation, this principle would appear to be of less moment in environmentally sensitive pockets of exclusive economic zone within the territorial sea. The recognition of the newly-developed concept of particularly sensitive areas within the IMO and the identification of such areas may be significant in the process of developing a basis for the uniform application of jurisdictional and enforcement principles in environmentally significant marine areas which form a single ecological unit.

a) The Role of the IMO

It was in 1978 that the International Conference on Tanker Safety and Pollution Prevention passed Resolution 9, which called upon the IMO to create an inventory of sea areas requiring special protection from maritime activities due to their sensitivity with regard to renewable natural resources or scientific significance. The Marine Environment Protection Committee (MEPC) of the IMO subsequently commenced work in order to define such areas and to elaborate criteria for their identification.

The concept of particularly sensitive areas was endorsed by the IMO through the MEPC at its 30th meeting in November 1990. It now has the responsibility of further developing the concept and identifying areas on the basis of nominations received from member states. The first such area to be identified was the Great Barrier Reef.[63] Further identification of areas will take place if the areas nominated conform to the selection criteria contained in the guidelines, which have been formulated by the MEPC working group on particularly sensitive areas. The IMO is also responsible for endorsing appropriate measures by coastal states within the identified areas. It was in this context that the MEPC endorsed the Australian scheme of compulsory pilotage for vessels posing a potential environmental hazard to the Great Barrier Reef.[64]

The IMO will therefore play a significant role in the development of international law as it relates to the protection of marine areas of great environmental significance. The IMO

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61 Art. 220(2) of the Law of the Sea Convention.

62 Art. 220(6) of the Law of the Sea Convention. .

63 The relevant IMO resolution (MEPC resolution 44(30)) is at annex 1

64 The relevant IMO resolution (MEPC resolution 45(30)) is at annex 2.

will, through its member states, be determining the future shape of the dynamic balance which exists between the need for environmental protection and the requirements of freedom of navigation. This role already exists through the IMO's responsibilities under MARPOL 73/78, and is also recognised, inter alia, in Art. 211(6) of the Law of the Sea Convention (see above) with regard to sensitive areas requiring protection from vessel-sourced pollution.

b) Further development of the concept of particularly sensitive areas

The development of the concept of particularly sensitive areas within the IMO will be a further indication of the recognition by the international community of the increasing need to protect and preserve the marine environment, particularly those parts of it which are most sensitive to human activities. To this extent the concept of particularly sensitive areas may have an effect upon the development of customary international law and the interpretation of conventional international law.

States may however arrive at the conclusion that it would be preferable to raise the normative status of this new concept by having it embedded in a formal international agreement, either as a protocol or amendment to an existing convention, or as a separate and new convention.

One option worthy of consideration would be for the concept of particularly sensitive areas to be introduced in the form of amendments to the respective existing UNEP Regional Seas protocols on Protected Areas and as an integral part of new protocols on Protected Areas as they are created. Such amendments or protocols could provide for reciprocal recognition of particularly sensitive areas by states parties to the respective UNEP Regional Seas conventions, thereby creating a global and interlocking conventional legal framework, with the IMO as its linchpin. Such reciprocal recognition could be binding upon states parties to the respective amendments/protocols, without each state having to become a party to every regional convention. The possibility for states to be bound by treaties to which they are not a party is provided for in Art. 35. of the 1969 Vienna Convention on the Law of Treaties.[65]

65 Art. 35 of the vienna Convention on the Law of Treaties:

"An obligation arises for a third State from a provision of a treaty if the parties to the treaty intend the provision to be the means of establishing the obligation and the third State expressly accepts that obligation in writing."

QUESTIONS AND ANSWERS*

Greg French's presentation

Question
Would there be any advantages and would it be possible to regard the Great Barrier Reef as an archipelago in terms of international law?

Answer
It wouldn't conform to the classic criteria of an archipelago, in the sense that you normally look at archipelagos in terms of group of islands. The archipelago is the state, so unless the GBRMPA were to secede it would be difficult to look at it in that point of view. Even if you were to bring it under an archipelagic state regime, the amount of jurisdiction you'd get is not necessarily a huge amount more than that if it was a Territorial sea, because if you look at the constraints on archipelagic states they too must go to the IMO . If you're looking at the designation of archipelagic sea-lane, then the archipelagic sea-lane transit passage regime is quite analogous to the one that exists for coastal states and so I don't think you'd get a great additional amount of jurisdiction if you go down that path.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

MARINE ACCIDENTS: PRESENT TRENDS AND A PERSPECTIVE OF THE HUMAN ELEMENT

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Introduction

This paper briefly reviews shipping casualty trends within the world trading fleet, with an emphasis on tanker casualties, and shipping accidents within the Great Barrier Reef (GBR). It then discusses a view of the human element in industrial accidents, that is gaining currency in high hazard/low risk industries, such as aviation and the nuclear power industry.

Many hazardous cargoes are transported by sea. Despite incidents such as the collision between the *Olau Britannia* and the *Mont Louis*, about twelve miles off the Belgium coast in August 1984, when the *Mont Louis* sank with 450 tonnes of uranium hexaflouride, casualties to oil tankers are the most visible and their cargo, if spilt, the most obvious. Yet it can be argued that oil spills, while having very serious consequences in the short term, are often not the catastrophe that first impressions and reactions would have us believe. Public perception seems to equate oil tankers with risk and this paper will tend to be orientated toward tanker accidents.

Accidents, including marine accidents, are random events, which can not be predicted in time or space. Yet, accidents seem to come in series (or form groupings) within the human consciousness, thereby creating a greater impact.

The tanker *Haven* exploded off Genoa on 11 April 1991, killing two crew members, and on the same day, just 90 miles away, off another North Italian port, Leghorn, the ferry *Moby Prince* collided with the anchored tanker *Agip Abruzzo*, loaded with 80,000 tonnes of naphtha, resulting in 142 deaths and pollution.

The *Aegean Sea* (Corruna, Spain, December 1992), the *Braer* (Shetlands, January 1993), and the *Freja Sea* (Teesport, UK, February 1993) occurred within weeks of one another.

Five incidents, the *Exxon Valdez* (March 1989); the *Khark V* and the *Aragon* off Morocco and the Canary Islands respectively (December 1989); the *American Trader* off Huntington Beach, California (February 1990); and the *Mega Borg* in the Gulf of Mexico (June 1990); occurred over a span of 14 months, yet appear to have formed a "cluster" of pollution incidents.

These groupings give rise to the fear that pollution incidents are common and that the risk to the environment is high. These fears are not entirely baseless, nor are they altogether rational.

In seeking a reason for these and other major casualties, and disasters (*Herald of Free Enterprise*, 193 dead, March 1987 - *Dona Paz*, 4,400 dead, December 1987 - *Moby Prince*, 142 dead, April 1991 - *Neptune*, up to 1800 dead, February 1993) current wisdom is that the acts or omissions of the master or crew of these ships are the dominant cause of the accident.

The World Casualty Rate

There is a general perception that the shipping industry is going through something of a safety crisis. However, I would argue that the weight of evidence does not support this perception.

In the 1991 Lloyd's Register Casualty Returns, the world fleet of trading and fishing vessels of over 100 gross tonnage was put at 80,030. Of that fleet, 258 vessels were declared as total losses during the year, the worst absolute figure since 1986, when the world fleet was 65,266 ships and 265 ships were totally lost (Figure 1).

Although 1991 was judged a "bad year" for shipping casualties, the loss rate was about the same as in 1988, at 0.32 per cent of the total fleet. Although a rise in absolute numbers over the preceding years, the actual number of ships lost was lower than all the years between 1965 (when 277 ships were lost from a fleet of 41,865) and 1987 when 219 ships were lost from a fleet of 75,240 ships. The loss of ships on a percentage of the total registered fleet had exceeded the 1991 figure in all the years between 1939 and 1987. Early indications are that the losses sustained in 1992 will be significantly lower than in 1991.

Vessels that are at greatest risk and make up the bulk of the losses are fishing vessels and cargo ships of under 1,000 gross tonnage. The statistics show that 1991 was no different, with small trading ships and fishing vessels accounting for 48.5 per cent of all losses.

The tanker fleet of 5962 ships represents 7.4 per cent of the world's registered ships. Thirteen tankers were reported as lost in 1991, giving a loss rate of 0.22 per cent of all tankers. The world tanker fleet contains a substantial number of small tankers, with 45 per cent of vessels being less than 1000 tonnes deadweight. Of greatest concern to us are the 1970 tankers over 30,000 tonnes deadweight, which make up 2.5 per cent of the world fleet (33 per cent of the tanker fleet). Eight of these large tankers were declared lost in the year, two through war damage. Six larger tankers or 0.3 per cent of the tanker fleet were therefore lost through "normal" causes.

The loss rate for larger tankers equates with the loss rate of the world's registered ships in general. It is possible to conclude that, on a pro rata basis, tankers are no more likely to be involved in a shipping casualty than any other type of ship. However, any resultant pollution is highly visible and the damage caused by oil, whether transient or not, raises public emotion, and the news media's circulation or rating.

It should be pointed out, that not all accidents result in a vessel being declared a total loss. *Exxon Valdez* was repaired and did not figure in the 1989 statistics. The bulk carrier *Atlas Pride*, lost much of its bow in August 1991 about a month after the *Kirki* incident, but was repaired; the *Kirki* was declared a constructive total loss and appears in the 1991 losses. However, total loss figures are a reasonable index of shipping casualties in general, against which accident trends may be measured.

Shipping Incidents Within the GBR 1983 to 1993

For the purposes of this paper the GBR is taken to include the Torres Strait and the system of Reefs and cays south to Sandy Cape.

While not "busy" on a world scale, some 2132 ships used the inner route in 1992, on passage between South East Asia (and the mineral ports of Weipa and Groote Eyland) and the east coast ports of Australia. This works out at between 5 and 6 ships per day. However, the pro rata rate of shipping accidents within the Great Barrier Reef Area has been relatively higher than other sea areas around the Australian Coast.

Some statistical figures suggest that the rate of collisions within the Great Barrier Reef is higher than that in the Dover Strait by a factor of 25 and that of grounding by a factor of

17.1[66] This is difficult to accept as a meaningful measure, given the significant density in traffic, the fact that the Dover Strait experience in four days the volume of traffic that the GBR may experience in one year. Other factors such as the depth, length and width of the passage together with the number of course alterations should also be taken into account.

The most significant grounding to occur in the area of the Great Barrier Reef was the *Oceanic Grandeur*, on 3 March 1970, when the loaded tanker grounded on an uncharted rock south of Alert Patches. This paper draws on incidents since January 1983(Table 1). None of the accidents within the GBR have resulted in the total loss of a trading ship, though some fishing vessels have been lost.

Since 1983, there have been twenty reported incidents in the GBR area involving trading ships. Of these twenty incidents, the Department has investigated fourteen. The six not investigated were on passage out of the area and the incident was referred to the flag state.

Two of the trading ships were tankers. The most significant of these was the unpiloted, loaded, Liberian tanker, *Mobil Endeavour*, which sustained bottom damage on Alert Patches while on passage from Singapore to the west Pacific in July 1986. It was of double hull construction and, although spaces below the cargo tanks were breached, no pollution resulted. The Liberian Authorities investigated the incident, suspended the master's certificate, recommended strongly that all Liberian flag ships should comply with the IMO resolution on recommended pilotage, and circulated the report and its recommendations at the IMO Maritime Safety Committee.

Of the 2132 ships passing through the inner route in 1992, 12.75 per cent were Australian flag vessels. The most common type of ship using the route are bulk carriers, with tankers making up 6.4 per cent of the traffic.

Leaving aside the qualifications of the pilot, seven of the twenty trading ships involved in reported incidents since 1983 were manned by navigating officers holding Australian certificates of competency. Given the proportion of Australian shipping using the inner route, Australian qualified personnel feature in a disproportionately large number of accidents.

Of the twenty incidents, there have been 13 incidents of grounding and seven incidents of collision with fishing vessels or yachts.

Accidents in the GBR predominantly take place during the hours of darkness, only four incidents have occurred in daylight, of the 16 that have occurred in darkness, 11 occurred between midnight and six o'clock in the morning.

Any marine accident in the GBR will almost certainly be a grounding or collision, which will take place in the hours of darkness. Collisions seem more likely to involve larger ships over 100m in length, perhaps suggesting that the manoeuvrability of the ship's themselves, and limitation on the depth of water, are factors. Otherwise it is difficult to find any common threat which might suggest a pattern that would help in predicting a typical GBR accident.

Of the 20 trading ships involved in accidents, seven carried pilots, but in only two of the incidents was the pilot in charge of the navigation at the time. Both accidents involving the pilots occurred during daylight hours, between 1700 and 1800, on Australian flag ships.

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66 Evanson,J.P. & Potts, A.E. 1990, Risk of ship collision in the Barrier Reef Inner Route shipping lane, Paper presented to Conference on Engineering in Coral Reef Region, GBRMPA and Institute of Engineers Australia, Townsville, November 1990.

In none of the accidents have the navigation aids within the reef area been shown to be deficient.

We are therefore thrown back to human error as the causal factor.

Some Considerations of the Human Factor

With a growing awareness of environmental issues and consumer rights, public tolerance of accidents in any field has decreased. This reduction in tolerance has been as marked in shipping as in any other area of commercial or government service to the public.

Nevertheless, there is a general trend to fewer accidents, although there is an argument that there has been an increase in "maritime disasters", what ever they may be. I prefer to refer to disasters when loss of life is involved, and then a substantial number of lives.

Better regulation, training and equipment all have played a part in improving marine accident figures. However when they do occur, the errors committed and the actions or omissions often seem so glaring that people are outraged that those in charge of ships are not in some way more accountable.

Current wisdom is that human error, attributable to the master and/or crew of a ship, has been responsible for over 80 per cent of all accidents. The Tavistock Institute of Human Behaviour, after analysing data from UK shipping incident reports, came to the conclusion that the human element was found to be present in over 90 per cent of all collisions and groundings and in 75 percent of all incidents involving contacts, fires and/or explosions. The report noted the response to such incidents was towards regulation and enforcement and went on to comment:

"These developments suggest that the sheer volume of safety related measures in the field of legislation and other rules and standards might be defeating the objective, and that an entirely new approach might in consequence be called for".

It does seem to those of us involved in investigating marine casualties, that at some stage there is a level at which accidents will level out, the "normal accident level". The Tavistock Institute seems to be suggesting that we may well be close to that level now. If this is true, and we are to continue to make shipping safer, we may need to look at human factors in a different light and borrow from a different transport mode.

"A report to the Flight Safety Foundation in 1986 claimed that mechanical failure preceded by faulty maintenance was the principal cause of air accidents (Foreman, 1990). In 1987, the chairman of the U.S. Transportation Safety Board (NTSB) told the press that bad weather near airports caused 64 per cent of major crashes in the preceding five years. The Lufthansa World Accident Survey (1989) found that cockpit crew errors were the prime contributor, accounting for 76 per cent of all causal factors.

Whom should we believe? In my view none of them."[67]

Professor James Reason, of the Department of Psychology, University of Manchester, went on to argue that failures in performance are not uncommon but only rarely do they cause accidents, although they are necessary elements.

Shipping is in general a (relatively) high hazard low risk operation.

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67 Reason, Latent Causes in Aircraft Accidents, p.2

"About 1.4 million tons of oil is moved annually by over 3,000 tankers over an average distance of 4,700 nautical miles. Only a very minute amount of oil is spilt, as 99.9995 per cent of all oil cargoes is delivered safely."[68]

The best managed and operated shipping company can not control all factors that make up an accident,
"In other words, "safe" organisations can still have bad accidents, while "unsafe" ones can escape them for long periods".[69]

Accidents are caused by a chance combination of elements coming together at a moment of vulnerability. These may be represented as the result of a number of causal chains simultaneously failing, or coming together to a single link, which is overloaded and breaks. The causal chains can also be seen to consist of both latent and active failures, which may be seen as separate but related elements in a production sequence. It has to be recognised that safety is an element of production, just as the output of goods or cargo tonne/miles. While the outputs can be measured directly in terms of monies earned or lost, safety has a measurable cost but its benefits are not easy to demonstrate directly and hard to quantify in any sort of cost benefit analysis when competing for finite resources.

So how should we be looking at accidents and what lessons should be learnt to improve safety?
"In considering the human contribution to systems disasters, it is important to distinguish two kinds of error: active errors, *whose effects are felt almost immediately, and* latent errors *whose adverse effects may lie dormant within the system for a long time,...."*[70]

Active errors can be seen to be the actions of the ship's crew leading up to and at the time of the incident. Latent errors may have their origins many years before, at the building of a ship or in some high level management decision, or at some lower level line management decision.

"Rather than being the main instigator of an accident, operators tend to be the inheritors of systems defects created by poor design, incorrect installation, faulty maintenance and bad management decisions. Their part is usually that of adding the final garnish to a lethal brew whose ingredients have already been long in cooking."[71]

Conclusion

Despite all that has been written in newspapers and stated at various conferences and in learned papers, the evidence is that the accident trends world wide are improving. By the very nature of accidents in general a zero level will never be reached and it is probable that we are approaching a level at which accident rates will form a plateau, possibly at about 0.2 per cent of the world's fleet.

However, with the possibility of serious and wide spread pollution from oil tankers and ships' bunkers, and the far more serious and long term risks in the transport of certain chemicals and radio active materials, society's tolerance of shipping accidents will continue to be severely tested. There will be demands for ever safer shipping, which in turn may involve special efforts in specific areas of maritime transport, as has been the case with tankers and gas carriers.

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68 Reason, Latent Causes in Aircraft Accidents, p.2
69 Reason, Latent Causes in Aircraft Accidents, p.2
70 Reason, J. Human Error, p.173, Cambridge University Press. 1990.
71 Reason, Human Error, p.173.

It may be possible to protect the GBR by local initiatives aimed at regulating and controlling shipping within the reef. That will not make the overall problem disappear.

It will be necessary for investigators to identify a variety of factors within the human element, as well as any mechanical factors that may be present. Regulators and operators will need to squarely face the issues of latent failures that contain the seeds of an accident, particularly in the field of ship management and human psychology.

In reviewing accidents in the GBR we know that the human element has been a dominant factor. On the evidence of Australian investigations, it is not possible to simplify the issue as one of sub-standard crew or ships, or to single out foreign certificates of competency as significant; Australian crew qualifications have been present in 35 per cent of the incidents since 1983.

Yet while people may have acted incompetently, it is difficult to point to an incompetent person - the most competent person is not competent all the time. Again in a number of cases it is possible to follow a path of latent failures that, combined with the psychological precursors and the actions or omissions of the individual, have come together to result in an accident.

One reaction to this approach is that it is a means of excusing the actions of those involved. This reaction may, in itself, be a means of avoiding the real issues. If society is to face up to the problems of any activity involving humans and significant risk, then we should be concerned with human risk analysis techniques. We do not have to excuse people their actions, but we do need to understand them fully, anticipate them and build defences to guard against them, to protect the oceans and seas of the world in general and the GBR in particular.

Table 1 TRADING SHIP GROUNDING AND COLLISION INCIDENTS GBR INNER ROUTE 1985 - 1992

VESSEL	FLAG	TYPE	DATE	PLACE	LENGTH	CARGO	POLLU -TION	PILOT ON BOARD
TNT Alltrans *	Aus	Grounding	Mar 85	Lady Musgrave Island	189	Bulk Carrier - Alumina	None	No
River Boyne / F.V. Babirusa *	Aus Aus	Collision	Jun 85	off Barrow Island	255 40	Bulk Carrier - Bauxite	None	Yes
Iron Cumberland / F.V. Saltfjord *	Aus Aus	Collision	Jun 85	Princess Charlotte Bay	190 30	Bulk Carrier -Ballast	None	Yes
Maritime Gardenia *	Lib	Grounding	Aug 85	Alert Patches - Prince of Wales Channel	128	Bulk Carrier - Wheat	Minor Oil Poll	No
Mobil Endeavour	Lib	Grounding	Jul 86	East Bouy - Prince of Wales Channel	171	Petroleum Products	None	No
Alam Indah *	Lib	Grounding	Sep 86	Chapman Is Reef	142	General Cargo	None	No
Ruca Challenge *	Cyp	Grounding	Apr 87	Piper Reef	80	Bulk Carrier - Potassium Nitrate	None	No
River Embley *	Aus	Grounding	May 87	Alert Patches - Prince of Wales Channel	255	Bulk Carrier - Bauxite	None	Yes
Leichhardt *	Aus	Grounding	Dec 87	Endeavour Strait	64	Ro/Ro	None	No
Pacific Ace	Pan	Grounding	Aug 88	Waterwitch Reef	154	Bulk Carrier	None	No
Spartan II / F.V. Unknown	Pan Aus	Collision	Jan 89	off Eel Reef	300 53	Supply Vessel	Nil	No
Adele	Dan	Grounding	Jun 89	Heath Reef	89	Livestock Carrier		No
Caraka Jaya Niaga 3	Ida	Grounding	Apr 90	South Warden Reef	98	General Cargo - Ballast	None	No
Pioneer Tween / F.V. Elizabeth *	Lib Aus	Collision	Aug 90	off Unison Reef	145	General Cargo		No
Jin Shan Hai / Kikenni *	CPR Aus	Collision	Jun 91	off Port Douglas	176 15	Bulk Carrier - Alumina	None	Yes
Jovian Loop *	Pan	Grounding	Sep 91	Unison Reef	107	Product Tanker - Tallow	None	Yes
Khudozhik Iganson / Zodiac *	Usr Aus	Collision	Sep 91	off Cairns	169 14	Container	None	No
TNT Carpentaria *	Aus	Grounding	Oct 91	Prince of Wales Channel	225	Bulk Carrier - Bauxite	None	Yes
Fareast / Ronda Lene *	Bah Aus	Collision	Dec 92	Middle Reef	144 17	Bulk Carrier - Coal	None	Yes
Gulf Tide	Aus	Grounding	Jan 91	Endeavour Strait	56	Diesel Oil	Limited	No

* Unit investigation report published.

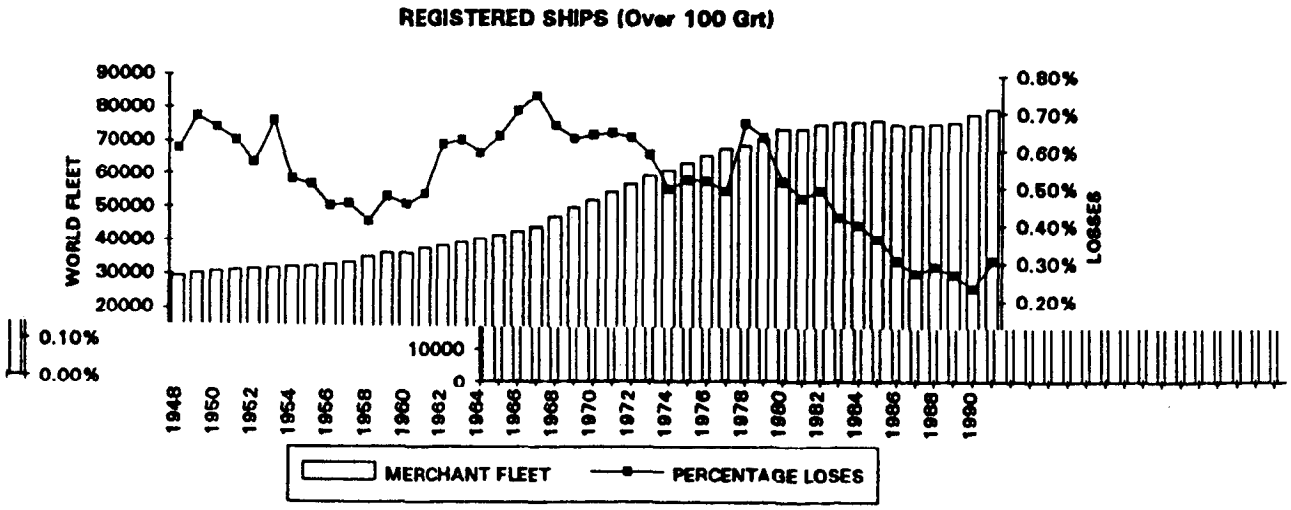
Table 2

SHIPPING USING THE INNER ROUTE OF THE GREAT BARRIER REEF

Month 1992-	Total Number of ships	Australian Flag	Tankers *(oil and Chemical)
January	180	24	12
February	175	23	16
March	162	22	5
April	170	24	8
May	169	23	8
June	157	17	18
July	183	23	12
August	187	24	11
September	178	26	14
October	176	23	16
November	203	24	12
December	192	19	4
TOTAL	2132	272	136
Average	177.7	22.7	11.3
Percentage of total fleet		12.76	6.38

* Gas carriers have been excluded as the cargo is judged as not posing a risk to the environment. It should be noted that a number of chemical tankers carry tallow loaded at a series of Australian ports.

Figure 1



QUESTIONS AND ANSWERS*

Kit Filor's presentation

Question
With respect to the statistics about ship losses and trends; is there any correlation between the obvious stable trend and the use of port state controls, particulary in Europe, to detect unseaworthy ships before they go to sea and get lost?
Second, your optimistic outlook that they are not getting any worse. Can you explain why the oil companies and the major export bulk commodity groups are spending big money vetting ships before they come to Australia, and other ports overseas?

Answer
It is that lowering of tolerance, and I'm not saying it's a wrong thing to do. The point I'm trying to make is, when I was a lad at sea, and you were too, and these things (unseaworthy ships) were still going around. The public tolerance has changed and things like *Exxon Valdez* have raised the liability levels of oil companies and the like to huge heights now, so what they're really doing in my view is underlying what's been there all along, but they are now much more accountable.

Question
How about the correlation between port state control and reduction in ship losses?

Answer
Well I think that may have been a factor in Europe in bringing that down, but also too, are better radars and various other navigational aids.

Comment from the floor
I am just concerned that you are raising expections that at the coal face things are getting better. I would say that at the coal face most people here that work on the ships, say that standards are getting worse over time.

Comment from the floor
The standards of watch keeping officers at sea do vary vastly but we're getting vastly more crews from third world countries and their standards are considerably less. I've noticed in the years I've been in the pilot service, about the last 5 or 6 years, they've definitely gone down. Now how that fits in with the statisics you show there about accidents decreasing, it's a little hard to understand.

Answer
Well I think there's two aspects there if I may. One is perception: "I was a lot better at sea than anyone else." We become immune in time, with great respect to everyone here. I've suffered it myself and you have to offset some of these perceptions against that sort of view. I can only speak as I find, and I go on board these ships when they have accidents and we talk to people. We've been on as many Australian ships as others, and we're finding the same sort of thing, and they are momentary lapses, they are things that they will never do again in a hundred years. It's the human condition.

Question
You put some graphs up, and you said accidents are going down, The graph shows that accidents have gone down since the eighties, but to the same level it was in the seventies. There was a "lump" in the eighties.

Answer
What you have to do, is compare it against the increase in the total fleet, The fleet has doubled since the late sixties and early seventies. Twice as many ships are at risk.

Comment
I commend you for what you're trying to do. You're trying to show figures to address the media-hype that sometimes goes on. But regarding the total fleet, it's a bit of scary figure to put up because there's so many different vessels involved. I think some work needs to be done there. The 1983 figures are interesting for the total number of deaths is very low relative to all the other figures you've got up there, yet that was one of the worst pollution years that we had.

Question
Today, we undoubtedly face a situation where there are more and more people ashore legislating for less and less people at sea. There is an enormous amount of time and effort put into keeping abreast of legislation by sea staff. In port state surveillance the emphasis is still on looking at equipment. I would suggest that a lot can be learnt from observing the practices of the officers and crew while the ship is in port to determine their competence, because the IMO legislation makes provisions within the port states administration of control to intervene if in their opinions the officers and crew of the vessel demonstrate that they do not have a sound working of the vessel. I really feel that, if we are to come out and make statements about the incompetence of people then we need to address that, and we need to start gathering statistics and taking action because otherwise we're just going to keep going around in circles.

Answer from the floor
We're trying to develop objective criteria to judge crew competence. It is a difficult area because there are some Australian ships that are not good. So it's a world-wide problem. It is an area where the IMO is working and we hope to have some guidelines in three or four months time.

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* Note: This text is not a verbatim record of the questions and answers. To assist with comprehension, the Editor has deleted some text and made modifications to highlight key points. Speakers are not identified.

WORKSHOP OUTPUTS

WORKSHOP 1: CONTINGENCY PLANNING

Mr Mike Julian	AMSA	Facilitator
Mr Steve Raaymakers	GBRMPA	Reporter

Is REEFPLAN adequate and how can it be improved?

- REEFPLAN is a good overview document, but to be accurate, it is not a contingency plan; it does not have the level of detailed information required on procedures, contacts, telephone numbers and check lists that will guide someone through a spill.
- Therefore, need to develop real contingency plans for the GBR Region. AMSA should devise a national standard/template (in consultation with States and industry) that can be used by the States and NT throughout Australia.
- Ring binder format best to facilitate updates.
- There should be one for each Queensland Department of Transport region and they should be integrated with the National Plan.
- For the GBR, this should be done as part of the Queensland coastal planning process, which is now beginning.
- Need to improve contingency plans for chemicals etc - incorporate results of National Review when finished.
- Agreed REEFPLAN document be retained for updating as an educational publication rather than a contingency plan.

Dispersants

- Prime method for preventing oil from affecting sensitive sites.
- Improvements can be made.
- Stockpiles now old with 1st generation BP-AB dispersants. These are toxic and cannot be applied from aircraft. Upgrades now underway.
- Need to create a register of suitable spray aircraft and develop a standard contract (this underway AMSA/AMOSC).
- Need to designate use/no-use zones; the GBRMPA has begun but a huge task given the size of the GBR.
- Little knowledge about the effects on ecosystem of dispersants. Current use is limited by a cautious approach. Need research and funds.

New response technologies: bio-remediation

- Was very successful in Alaska and potential in the GBR could be high because of higher temperatures.
- As little is known about use in tropical waters, potential use is limited until more information is available.
- Workshop was held recently to assess the potential and a research program has been designed and funds are being sought from industry and government.
- Scientific Support Co-ordinators are considering.

Research and development for new technologies

- A national R&D program should be established to investigate possibilities including *in-situ* burning.

Coastal resource atlas

- A valuable planning and response tool.
- An important part of any response capability and one now exists for the whole of GBRMP. Need to ensure continued updating and review to ensure integration with a national system.
- Compatible for GIS technology.

Booms

. Lack of expertise identified in some ports in how to deploy so need to improve training in use. GBRMPA to provide advice of these locations.

Oiled wildlife

. Need to develop proper plans: existing plans not adequate.

Occupational Health and Safety

. Existing plans do not include information about the effects of oil and dispersants on people and how they should be handled. Should be included.

Post spill damage assessment

. Important for compensation and recovery of costs.
. Need procedures.

Reception facilities

. Maybe a problem but need to determine current situation.
. State authorities should give consideration to providing adequate facilities where needed.
. Ships need to be informed about facilities if they are to be encouraged to use them.

Military involvement

. Huge resource that could be used. Should be greater involvement in practice and response and should be a member of the State Committee.

WORKSHOP 2: SHIP OPERATIONS

Mr Kit Filor	DOTC	Facilitator
Mr Robin Grajois	ANMA	Reporter

Inner vs outer route

- Ships should not be told which one to use - it is their decision - but they should have information about
  - navigational routes;
  - safe passage planning;
  - reliable hydrographic information;
  - available searoom;
  - density of traffic;
  - tidal streams and sea state;
  - adequacy of navigational aids.
- Marine Notice 4/93 which addresses recommended passages in the GBR is relevant.
- Should build on existing recognised methods to promote safe passage advice eg follow International Chamber of Shipping approach following the *Braer* incident which gave explicit and relevant advice to avoid similar events occurring.

Operation of small vessels;

Small vessels do interfere with large deep craft in channels and many do not understand the draft and manoeuvring limitations of larger craft.

- There is non observance of Collision Regs; and these need to be enforced.
- Conflict of lighting requirements between national and international collision regulations; need to be fixed.
- The distance between steaming lights on large vessels can confuse small craft. Could provide illumination along ship sides and deck area on very large ships.
- See Marine Notice 9/91 Navigation and Working lights on fishing vessel.
- Should consider introduction of a coastal navigation VHF working channel to allow ships restrained in their manoeuvrability to alert small craft.
- GBRMPA's Deckhand video could be useful tool to educate small craft.

Onboard oil spill containment equipment

- Requirements now exist under MARPOL for ships to respond to onboard spills.
- Extension of these requirements would not be practicable, because:
  - crew numbers are small and time is directed to ship operation
  - need multilateral agreement on type and standards of equipment
  - deployment problem with limited crew
  - maintenance problem with limited crew
  - crew training required
  - priorities will have to be determined about what the crew does after an accident
  - design limitation with current technology

Crew performance (human element)

- Impossible to generalise but scope exists to build on existing and projected standards.
- STCW under review and Australia should use this avenue to ensure adequate proficiency of crews on ships.
- The International Safety Management Code is addressing communication onboard between officers, port authorities, pilots and has agreed that knowledge of the English language by senior officers is important and there should be a common language between officers and crews to facilitate effective communication.
- The ICS guide is to be adopted as the standard for safe navigation of all vessels in the GBR region and Australian territorial waters.

- A good idea would be to distribute a video to ships as they enter the Marine Park (perhaps pilots could distribute) to assist in informing and educating crews about the Marine Park and procedures (like the GBRMPA "Deckhand" video which is distributed to commercial fishermen.)
- Should not forget that crew performance also gets ships out of problems.
- Public statements about shipping safety should only follow after proper consideration and consultation between interested government and industry parties.

WORKSHOP 3: NAVIGATION SYSTEMS

Mr David Langford	AMSA	Facilitator
Mr Ken Burrows	Hydrographer	Reporter

Accuracy of charts

- Safe operation of ships requires accurate and up-to-date information, and charts are the prime information source.
- Existing charts already indicate where large commercial vessels (Class 1) should navigate but they need to also identify where smaller vessels can go.
- Therefore, need to identify, classify and rank areas within the Reef suitable for navigation including areas outside the existing routes or channels; the Hydrographer can then develop a survey program that addresses the priority information requirements for these areas.

ECDIS: should it be implemented and if so how and when?

- This is a technology that deserves detailed consideration.
- There is considerable work internationally and standards are being developed and the reality is that at some time in the future all ships will have ECDIS and there will be no paper charts.
- Most effort should be directed towards ECDIS for Category 1 vessels.
- Data are the most important component of an ECDIS system: not the hardware.
- Standards for data acquisition, equipment and transmission are important which Australia should seek to work towards. The GBR could be the focal point for Australian activity in the development of ECDIS.
- Data must be created to a standard acceptable to an international ECDIS.
- Data control necessary to ensure quality and updating in a controlled manner.
- Need to ensure all operators use the same data.
- Do not need to limit hardware so much if data are controlled.
- Introduction of technology will take time and will depend on acceptability to operators; a national plan for the introduction of ECDIS may be justified.

DGPS: should it be implemented and if so how and when?

- Should be implemented to the plan advised by AMSA.
- Need to study the results of the test of the system in Victoria and could consider the establishment of a GBR pilot project for DGPS and ECDIS.
- Need to adjust paper charts to WGS 84 datum.

Vessel reporting systems

- Insufficient traffic in the GBR to justify.
- A compulsory reporting system in the Prince of Wales channel could be justified for safety and environmental reasons. Would apply to ships approaching, in and leaving the channel. However, possible legal problems are recognised.
- A "flight plan" registration system might be justified in some areas, particularly for high speed craft that carry large numbers of passengers.

WORKSHOP 4 : SHIP DESIGN AND SURVEY

Mr Ken Williamson	ANMA	Facilitator
Mr Robin Gehling	AMSA	Reporter

Adequacy of present design requirements

- Structural failures due to corrosion can be minimised if tanks are coated with paint or plastics. Tank coatings in ballast tanks are now a requirement in new ships. Quality can be variable and depends on weather conditions and supervision at time of application.
- Ships **can** be designed to meet the specific needs of the GBR, thereby reducing the risk of accident. Limited effectiveness because: special designs focus on a specific type of trade and shipping passing through the GBR represent many different trades. The trend is towards chartering vessels and these types of vessels are of generic design.
- Australia could ensure that new ships are built to proper design safety standards by having its surveyors inspect the ships during construction.
- AMSA can assist by facilitating overseas inspections by its surveyors at request of owners to assure certified compliance with safety requirement is factual.

Self-regulation and quality assurance

- Not seen as substitute for regular survey.
- Could be applied to Australian flag ships which have a good safety record but needs to be proven effective internationally because most ships transiting GBR are under foreign flags.
- Commitment to safety standards declines with frequent crew changes. Also, increased use of ship management companies and crewing agencies can lead to a decline in standards.
- Audit of standards could be possible if records are kept and are adequate.
- Satisfactory survey/safety standards to be verifiable in future by requirement for survey file to be carried onboard tankers (MARPOL) and bulk carriers (SOLAS).
- Noted that lists of tankers that have undergone satisfactory docking inspections (white lists), and lists of tankers that are unsatisfactory (black lists) are maintained by many chartering companies. US anti-trust laws prevents the consolidation and making public of this information, however, publication of the white lists may be acceptable.

Problems with under-powered ships exist.

- Engine control systems in new ships limit available power which can be used in manoeuvring situations. Applies more to berthing situations rather than changing course when under way. There are no international requirements that describe "adequate power".

Blackouts (loss of steering power)

- Existing rules address to a degree. Response time for resumption of power to steering gear is important. Noted that safety could be enhanced if the engine room was manned in manoeuvring situations.

Navigation systems

- Existing regulations are not adequate to deal with rapid pace of technological developments. Many new developments coming on to the market and are a problem for ship owners who choose what is best and ensure crews are properly trained.

Bridge layouts

- Could be standardised but would require considerable international research and co-operation.

Are survey standards adequate?

. Port State Control is effective in controlling substandard ships coming into Australia including GBR; targeting is useful in catching the likely worst cases.
. PSC may not be enforced by some countries or class societies; but there is progress.
  - supports a Asia-Pacific PSC regime which is now under development
  - noted the improvements expected to be achieved through IMO flag state implementation sub-committee

Possible mandatory early use of double hulls

. Costs and benefits need careful analysis.
. Practicability and effectiveness of double hulls is questionable;
  - may in fact increase likelihood of grounding;
  - likely to increase difficulty of salvage and thus delay containing pollution;
  - ineffective against high energy grounding/collision (eg full speed grounding or collision in the GBR);
  - involves increased risks;
    possible explosive gas pockets
    access/inspection/maintenance
. Policing difficult except maybe through chartering and inspections and will not be able to deal with tankers proceeding through GBR to destinations outside of Australia.
. Could encourage diversion of traffic to routes outside GBR which may be more hazardous to shipping.

Development and operation of very fast, small passenger ferry vessels and risks of accidents

. A real problem exists with traffic management and there is increased demand for use of these craft by tourism industry.
. Satisfactory operation is dependent on enforcement of safety management requirements, particularly the new high-speed craft code which is to be finalised in 1994, by owners and the relevant regulatory authorities (mostly under state jurisdiction).
. Collisions Regulations apply to close quarters situations with these craft.
. Noted that a system could be established for reporting navigational incidents involving high-speed vessels.

Questions

How do double hulls increase chance of grounding?

Answer

They are bigger ships with a deeper draft and therefore less sea room.

Question

Do we need another investigation into effectiveness of double hulls when reviews by the Canadians, Americans and IMO conclude that double-hulls do decrease the chance of losing oil in a spill?

Answer

It is generally agreed that they will decrease pollution from tankers but there is a down-side. AMSA accepts the international adoption of double hull requirements and realises that the uni-lateral action taken by the United States is not likely to be overcome easily, if at all and that, effectively, double hulls are here whether we like it or not. It should be pointed out that the United States approach is being driven by the Congress rather than the technical people and the technical people are having to come along afterwards and mop up and try and justify the stance being put forward by the congress. IMO has been attempting to put together a rational basis on which the double hull requirements are implemented.

WORKSHOP 5: POLICY, LAW AND ADMINISTRATION

Mr Peter Ottesen	GBRMPA	Facilitator
Mr Greg French	DFAT	Reporter

Trends in accidents, shipping and tanker activity

. Level of accidents appears static, but may not reflect actual pollution trends.
. Average size of vessels increasing.
. More shipping using outer route.
. Expect increase in maritime traffic to service growing local communities and transit traffic (Kutubu Terminal, Timor Sea/NW Shelf fields).
. "Quantum leaps" in traffic will occur as new facilities are opened or expanded (eg Hay Point).
. However, need better information to confirm trends, from sources including:
  - records from Port Authorities
  - records of vessels intransit
  - from Pilots and other sources?
. Seems to be a view that the standards of crews (competence) may be less than in past, but this needs confirmation.
. Possible Australian initiative on improving crew standards in IMO. Perhaps can be advanced through the flagging convention to help deal with Flag of Convenience issues.

Banning tankers

. Banning not yet realistic option so support for the proposal not warranted.
. Queensland coastal communities need maritime trade and transport.
. We do not have jurisdiction to do so.
. Lead to competitive disadvantage for Australian vessels.
. May divert tankers to Sydney/Melbourne via WA/SA.

Surveillance and enforcement

. Currently not adequate aerial surveillance in Far Northern Section of the Reef but resource limitations recognise - could examine possibility of more flights.
. Problems with enforcement do exist where surveillance reveals infringements. Introduction of an EEZ will help.

International standards

. We should and must conform to international standards.
. We need to participate in elaboration of these standards to influence the outcome.
. Development and implementation of standards will be assisted by better communication and co-ordination between agencies and industry; perhaps a newsletter from GBRMPA will help.

Liability/incentives

. Recognised that these can influence behaviour.
. Australia should ratify asap International Oil Pollution Compensation Fund Convention Protocol and Civil Liabilities Convention Protocol.
. Significant criminal penalties already exist, but need to ensure that courts impose adequate fines to deter.
. Maximum penalties appear adequate but minimum penalties could be introduced
. Question of liability could exist and should be investigated for:
  - Pilots
  - Hydrographers (accuracy of maps)
  - GBRMPA (for Reg Systems)

Possibility of Torres Strait compulsory pilotage

- Should be pursued but a high degree of compulsory pilotage has now been achieved through port state jurisdiction (the port of Kutubu now requires a pilot for entry and exit) and compulsory pilotage in the GBR. Most vessels now caught but some target vessels could still avoid by using outer route.
- Would need to recognise existence of the Torres Strait Treaty so need co-operation between PNG/Australia. Also need IMO approval and there will be international resistance.
- Very strong Australian community support.

Development of a tighter regulatory scheme

- Traffic separation scheme should be investigated and introduced if and where feasible. However, need pressure to declare Australia EEZ and give better regulation/enforcement ability.
- Maybe we should seek an IMO recommendation for an outer route (an area which has significant hazards). This should recommend where vessels should go; perhaps to avoid going to close to the outer reefs. Data shortage a problem; not as good as for inner route. However, should be able to frame a recommendation that will make passage of vessels safer without creating a liability problem for ourselves.
- Should participate actively in IMO deliberations on mandatory ship reporting systems, which will catch vessels that can avoid the compulsory pilotage requirement.

Reporting and information systems

- Believe that pilots could provide more information (to AMSA) and Queensland Government could provide more information from ports.
- Possibility exists for more frequent and comprehensive reporting under AUSREP in Torres Strait and GBR and from other sources (eg pilots). However, recognised that AUSREP only a voluntary scheme.

ECDIS and DGPS

- Strong view that should accelerate introduction of this new navigational technology and this will need agency cooperation.
- Not only for improved navigation, but also for position monitoring.
- IMO will take time to introduce ECDIS standards but Australia could implement evolving North American and European standards.
- Database creation is expensive.
- GBR inner route data good but gaps in great North East Channel and Whitsunday's.
- Government needs to ensure standardised and authorised ECDIS database (ie. resolve hardware/software issues).

Communication and co-ordination

- Proper coordination and communication between agencies important.
- Already good cooperation and communication between key agencies (eg GBRMPA and AMSA.
- Could be expanded and integrated and include with states and industry.

Information to ships

- Information should be provided to ships, agents and owners about facilities etc.
- Need innovative approach: eg videos and computers and in various languages.
- Perhaps directly to masters from pilots upon entry into inner route.

Port waste reception facilities

- In general, not adequate.
- Need to remove disincentives for use on eastern seaboard - examine cost structures.
- Need more facilities and adequate cost recovery important.

. Information needs to be provided to vessels about waste facilities when they enter the GBR.

Who pays for increased protection?

For ECDIS etc

. All industry and government sectors will have a role depending on the specific measures and who benefits, including:
  - users (Navigation System)
  - governments (Monitoring)
. Need to push the point that the GBR is a *res communis* (ie public good) and that it may not be getting sufficient government attention compared with the terrestrial environment.
. Benefits of ECDIS etc will flow to others, including the tourism industry.

APPENDICES

APPENDIX A

MEETING OF EXPERTS ON THE TRANSPORT OF OIL AND OTHER HAZARDOUS SUBSTANCES IN THE GREAT BARRIER REEF

14 and 15 April 1993

PROGRAM

DAY 1

8.30	Registration, Drawing Room, University House.
8.45	Introductory statements by: Graeme Kelleher, Chairman, GBRMPA Paul McGrath, Chief Executive Officer, AMSA
Session 1	**Chair Peter Ottesen, GBRMPA**
9.00	*Steven Raaymakers GBRMPA* Ship sourced oil pollution in the Great Barrier Reef: causes, frequency and opportunities for prevention
9.30	*Patrick Quirk AMSA* Development in ship safety standards; implications for protection of the Great Barrier Reef
10.00	*Kerry Dwyer Qld DoT* The jurisdiction and operation of small vessels in the Great Barrier Reef
10.30	*Mike Julian AMSA* Review of oil spill contingency planning in Australia and overseas
11.00	Morning tea
Session 2	**Chair Patrick Hunt AMSA**
11.15	*Peter Small QCPS* The Great Barrier Reef environment: a pilot's perspective
11.45	*John Leech Hydrographer* Transport of oil and other hazardous substances in the Great Barrier Reef: hydrographic aspects
12.15	*David Langford AMSA* Future marine navigation systems
12.45	Lunch

Session 3 **Chair Patrick Quirk AMSA**

1.30 *Robin Grajios ANMA*
Tanker owner's and operator's perspective

2.00 *Robin Gehling AMSA*
Latest developments in the subdivision and construction standards of vessels with special regard to the prevention of pollution after damage

2.30 *Ted Clements AMSA*
Marine survey and the safe carriage of hazardous cargoes

3.00 Afternoon tea

Session 4 **Chair Mike Julian AMSA**

3.15 *Greg French DFAT*
Protecting the marine environment of the GBR: what is the role of international law?

3.45 *Kit Filor DoTC*
Marine accidents and a perspective of the human element

4.15 Discussion

5.00 Close

DAY 2

9.00 Instructions on workshops and allocation of participants

9.30 Workshops

Contingency planning
Ship operations
Navigation aids
Ship design and survey
Policy, law and administration

12.00 Lunch

1.00 Presentation of workshop reports and discussion

3.00 Close

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3.00 Close

APPENDIX B

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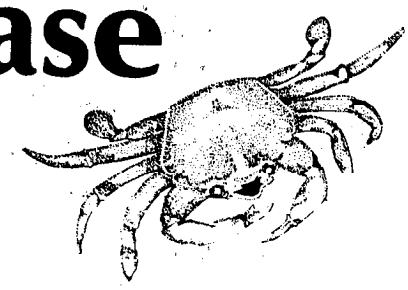
APPENDIX C

Great Barrier Reef Marine Park Authority

Media Release



P.O. Box 1379, TOWNSVILLE. Tel. (077) 81 8811

FOR IMMEDIATE RELEASE

CLOSING STATEMENT FROM THE OIL SPILL CONFERENCE OF EXPERTS, HELD IN CANBERRA, 14 & 15 APRIL 1993

EXCLUSIVE ECONOMIC ZONE URGENTLY NEEDED TO PROTECT REEF

The Australian Government should be urged immediately to finalise legislation to create a 200 nautical mile Exclusive Economic Zone right around the nation, which will have a secondary but vital purpose of extending Australia's ability to protect the Great Barrier Reef.

This was one of two measures unanimously endorsed by some of Australia's leading maritime safety experts attending an Oil Spill Conference of Experts at the Australian National University in Canberra over the past two days.

The Conference agreed that an Exclusive Economic Zone such as those declared and accepted by many other countries around the globe would allow Australia to instigate greater protective measures against major oil or toxic cargo spills near the Great Barrier Reef. It was suggested that such a move was simply a matter of putting suitable legislation in place, and because of overseas precedent, should not involve complicated and protracted international negotiations.

The second measure which gained full Conference support was to accelerate the development and use of an Electronic Mapping and Satellite Navigation System meeting international standards to cover the shipping channels in the Great Barrier Reef Region.

This is seen as the most practical way to greatly reduce the risk of an oil or toxic spill in the increasingly busy shipping lanes within the Reef area.

The Conference, the most comprehensive of its kind ever held in this country, was organised jointly by the Great Barrier Reef Marine Park Authority (GBRMPA) and the Australian Maritime Safety Authority (AMSA). The forty people who attended heard papers and opinions from experts in every field of maritime safety, including mapping agencies, Torres Strait and Great Barrier Reef shipping pilots, the shipping and oil industries and conservation organisations.

A series of workshops revealed that there was complete agreement on the call for more sophisticated mapping and navigational systems. The GBRMPA will now urgently investigate how to speed up the development and deployment of an electronic mapping system and an associated satellite navigational system for the Reef Region.

There has been an increase in both shipping traffic through the Reef, and a general decline internationally in adequately trained crews. About 100 tankers, some carrying 100,000 tonnes of oil, use the GBR shipping lanes each year. In all, 2000 ships pass through the area annually, some of the larger bulk ore and mineral carriers needing 10,000 tonnes of bunker (i.e. engine) oil.

The meeting noted that the country's most valuable marine ecosystem generated income and employment worth more than $1.6 billion dollars every year, a figure growing at 8% annually.

The conference endorsed AMSA's initiative to undertake pilot studies of a new satellite navigation system in Bass Strait and North-West Australia. It further recommended that every effort be made to introduce proven electronic charting and positioning systems on board ships ,as they become available.The meeting recognised that any system introduced in Australia would have to meet international standards established by the International Maritime Organization.

For further information, contact:

Graeme Kelleher, Chairman Great Barrier Reef Marine Park Authority
or Peter Ottesen, Canberra Office Manager.

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APPENDIX D

BIBLIOGRAPHY OF PAPERS WRITTEN BY GBRMPA STAFF, GBRMPA SPONSORED WORKSHOPS AND RESEARCH PROJECTS FUNDED BY THE GBRMPA ON OIL-RELATED MATTERS

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