Evaluation of the Construction and Operation of Navigational Aids in Hydrographers Passage

Occasional Paper

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Evaluation of the Construction and Operation of Navigational Aids in Hydrographers Passage

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ERRATA

BUREAU OF TRANSPORT ECONOMICS
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EVALUATION OF THE CONSTRUCTION AND OPERATION OF NAVIGATIONAL AIDS IN HYDROGRAPHERS PASSAGE

Page 3 Line 9

"30 metres" should read
"25 metres"

Page 40

FIGURE 111.1
Scale : 1cm = 5 Nautical Miles (approx) should read
1cm = 7 Nautical Miles (approx)

FOREWORD

A new channel through the Great Barrier Reef was charted by the Hydrographic Service of the Royal Australian Navy in late 1981 and early 1982. This channel, known as Hydrographers Passage, is located north-east of Mackay and could provide a direct deep sea route for naval and commercial shipping from that part of the Queensland coast to the Coral Sea. Safe transit of the new Passage, however, requires that the Commonwealth Department of Transport and Construction (DTC) install navigational aids in the channel.

In August 1982, the Marine Operations Division of DTC requested the Bureau of Transport Economics (BTE) to undertake an economic evaluation of the provision of navigational aids in Hydrographers Passage. It was agreed that the BTE's evaluation would be made on the basis of cost estimates for navigational aids supplied by DTC.

This study was carried out by the BTE's Economic Assessment Branch. The report was prepared by E.B. Bryan with the assistance of R.W. Campbell and E.M. Casling.

During the study, the BTE held discussions with many companies and organisations concerned with shipping in the region of Hydrographers Passage, as well as with officers of DTC. Their help in providing data and advice during the course of the study is gratefully acknowledged.

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Bureau of Transport Economics
Canberra
December 1982

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SUMMARY

The study shows that the coal export trade from the port of Hay Point will provide most of the shipping which will use Hydrographers Passage.

The costs of opening the Passage for commercial use would be the discounted costs of providing and operating the required navigational aids which is a responsibility of the Commonwealth Government. These would amount to about $8.5 million over the project's life. Use of the Passage could also involve pilotage services. It has been presumed that these services would be provided on a commercial basis and would be self-financing. Therefore they have not been included in this analysis of the economic viability of providing the required navigational aids.

The benefit-cost ratio based on savings in fuel costs alone from use of the Passage would be 2.7. If savings in both ship capital and operating costs are taken into account, the benefit-cost ratio would rise to 10.8. Hence, the project is well justified on economic grounds from a world viewpoint.

However, Australian coal is sold on an fob basis and shipping costs are borne by the foreign importers. Hence, the above savings would accrue initially to foreign companies (primarily the Japanese, Korean and Taiwanese importers of Australian coal). It is not clear to what extent the Australian coal industry could win back some of the benefits of reduced shipping costs. In the short run, the depressed state of the coal market does not place Australia in a strong negotiating position. In the long run, Australia's competitive position in the world coal trade is determined by the landed (cif) price of Australian coal, and hence the reduction in shipping costs through use of the Passage would assist the nation's competitive position.

Present policy is to recover 100 per cent of Commonwealth expenditure on navigational aids by a single-rate levy on all shipping using Australian ports. Navigational aids for Hydrographers Passage would add 3.8 cents per net registered tonne to the current light dues on all shipping using Australian ports. This cost burden would be shared between Australian and foreign interests depending on their relative abilities to pass on such costs.

The BTE has concluded that the proposed investment in navigational aids in the Passage is clearly justified on economic grounds in that total benefits will outweigh total costs on a global basis. The position with respect to costs and benefits accruing to Australians is not clear. It is likely that a substantial share of the benefits would flow to foreign interests, particularly in the short term although this would tend to be offset by cost recovery from overseas ship operators and a long term improvement in the competitive position of Australian coal.

CHAPTER 1—INTRODUCTION

ORIGIN OF THE STUDY

Between September 1981 and March 1982, the Hydrographic Service of the Royal Australian Navy charted a new sea passage through the Great Barrier Reef. The new channel, known as Hydrographers Passage, is located to the north-east of Mackay and is considered by the Commonwealth Department of Transport and Construction (DTC) and The Queensland Coast and Torres Strait Pilot Service to be suitable for use by commercial shipping. Safe transit of the Passage will, however, require the installation of navigational aids. The provision of navigational aids is the responsibility of DTC under the provision of the Commonwealth *Lighthouses Act* 1911-1973.

Accordingly, the Bureau of Transport Economics (BTE) was requested by the Marine Operations Division of DTC to undertake an economic evaluation of the provision of navigational aids in Hydrographers Passage. In particular, the BTE was asked to report on the following issues:

- assessment of the likely shipping traffic through Hydrographers Passage;
- estimation of the benefits on the basis of potential savings likely to accrue from the use of the Passage;
- evaluation of the investment in navigational aids by comparing estimated benefits with estimated costs over the life of the investment; and
- assessment of the distribution of costs and benefits.

STRUCTURE OF THE REPORT

Chapter 2 provides a description of Hydrographers Passage and outlines the characteristics of potential users of the channel. Issues affecting the distribution of benefits and costs associated with the use of the Passage are examined in Chapter 3, and in Chapters 4 and 5 the benefits and costs arising from the development of Hydrographers Passage are estimated. Chapter 6 presents the results of the economic evaluation and Chapter 7 provides a summary of the conclusions.

CHAPTER 2—POTENTIAL TRAFFIC THROUGH HYDROGRAPHERS PASSAGE

The objective of this chapter is to identify the potential users of Hydrographers Passage. To do this the Passage is first of all described and then activity in each of the ports likely to be affected is discussed. After a discussion of present shipping patterns and the shipping distances which could be saved by the use of Hydrographers Passage, an assessment is made of the likely use of the Passage.

HYDROGRAPHERS PASSAGE

Hydrographers Passage is a channel through the Great Barrier Reef north-east of Mackay. Its location is shown in Figure 2.1 and details of the Passage are shown in Figure III.1 in Appendix III. Its seaward entrance is approximately 120 nautical miles off shore and the channel has a minimum depth of 30 metres. The Passage in its final seaward 20 nautical miles is only 1.5 nautical miles wide. This section of the Passage is also subject to tidal flows of between five and six knots. The Passage, however, is deep enough for large bulk carriers without restrictions on vessel size or speed.

EXISTING ROUTES THROUGH THE GREAT BARRIER REEF

There are at present three commercial shipping routes through the Great Barrier Reef. These are Grafton Passage east of Cairns, Palm Passage to the north-east of Townsville and Capricorn Channel around the southern extremity of the Great Barrier Reef east of Rockhampton and Gladstone. These routes are shown in Figure 2.1.

All these routes are marked with navigational aids. A pilot service is available for Grafton Passage and in some circumstances for Capricorn Channel. The proposed use of Hydrographers Passage will provide a direct route from Hay Point and Mackay to the Coral Sea and will shorten the route to a minor extent from Abbot Point to Rossel Island.

PORT ACTIVITIES

During 1980-81, a total of 36.8 million tonnes of cargo were handled at Central Queensland ports. Most cargo moved through the ports of Gladstone and Hay Point. Cargo throughput and number of vessels berthed are outlined in Table 2.1. The type of trade handled in each of the ports listed in Table 2.1 and the shipping patterns associated with it are reviewed briefly below.

Gladstone and Port Alma

Gladstone is Queensland's largest port. Its main exports are alumina to the USA and Japan, and coal to Japan. Incoming cargo is primarily bauxite from Weipa. Shipping has ready access to the Coral Sea through Capricorn Channel. Rockhampton is served by Port Alma. The trade through the port is only small—imports comprising mainly petroleum products while the main exports are bulk tallow, bulk salt and frozen and preserved meats. Shipping from Port Alma is also adequately served by Capricorn Channel.

Townsville

Approximately 1.2 million tonnes of cargo were shipped from Townsville during 1980-81. About half of this was sugar going primarily to Japan. Shipping from Townsville has northerly access to the Coral Sea through either Palm Passage or Grafton Passage.

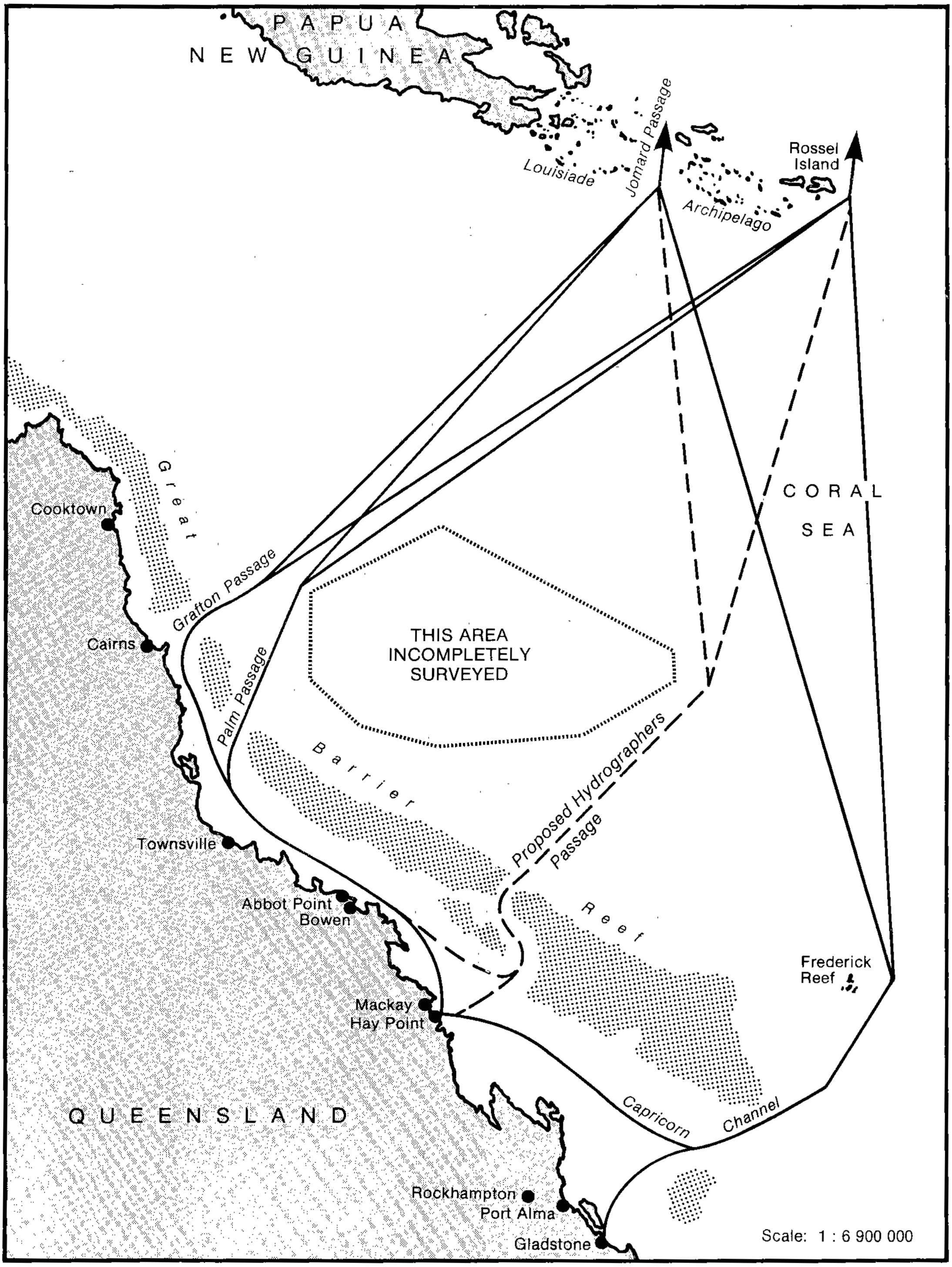

Figure 2.1. Major shipping routes through the Great Barrier Reef

TABLE 2.1—CARGO HANDLED AND NUMBER OF VESSELS IN CENTRAL QUEENSLAND PORTS, 1980-81

Port	*Cargo (million tonnes)*			*Total ship visits*
	Incoming	*Outgoing*	*Total*[a]	
Bowen	—	0.3	0.3	26
Gladstone	6.5	11.2	17.8	500
Hay Point	—	15.1	15.1	207
Mackay	0.3	1.0	1.3	184
Rockhampton (Port Alma)	0.1	0.2	0.2	52
Townsville	0.9	1.2	2.1	385
Total	7.8	29.0	36.8	1 354

a. Totals may not add due to rounding.

Source: Queensland Department of Harbours and Marine (1981).

Bowen

Cargo volumes from Bowen are small. In 1980-81, approximately 300 000 tonnes were exported using 26 vessels. Outgoing cargo was mainly coal and meat. The coal trade through Bowen will cease when the new coal port at Abbot Point (just north of Bowen) commences operation in 1984. Bowen receives no significant import tonnage.

Mackay

During 1980-81, the port of Mackay handled 1.3 million tonnes of cargo and 172 vessels. The major exports from Mackay are sugar and sugar-related products. These are shipped in relatively small vessels of 20 000-30 000 deadweight tonnes (DWT). Vessels of this size find the protected waters inside the reef an advantage. They have a sufficiently shallow draft to pass through Torres Strait, between the tip of Cape York Peninsula and Papua New Guinea, to markets in Europe and Asia. Sugar ships en route to the United States East Coast and Canada require direct access to the Coral Sea. This is not a significant trade, however, and is not expected to increase. In 1980-81 (for example), there were about 20 shipments of sugar to these destinations. Due to the practice of topping up loads in the larger sugar ports of Lucinda and Townsville, only about six or seven of these vessels left directly from Mackay.

This shipping pattern in the sugar trade from Mackay is not expected to change. Ship sizes are restricted by the relatively small size of sugar refineries, which on average would only require 250 000 tonnes of raw sugar per year and purchase this in shipment lots of 15 000-16 000 tonnes.

Imports to Mackay are small and in 1980-81 totalled 324 000 tonnes. Almost two-thirds of this was bulk fertilizer from the USA.

Work commenced at Mackay in 1980-81 on the construction of a grain export terminal. This terminal is designed to cater for an anticipated throughput of 250 000 tonnes in 1990 and 350 000 tonnes by the year 2000 (Queensland Planning Committee 1981, p51). It is envisaged that Panamax-type bulk carriers of up to 50 000 DWT will ship this grain. This implies only five to seven grain shipments per year from Mackay.

Hay Point

The port of Hay Point was originally developed for the export of coal from the Central Queensland Coal Associates' fields. The existing coal loading and wharf facilities are owned and operated by the Associates for the export of their own output. Central Queensland Coal Associates are 76 per cent owned by Utah Development Company, which also manages the Associates' mines and the port of Hay Point.

During 1980-81, Hay Point handled 207 vessels exporting 15 million tonnes of coal. About 65 per cent of this coal was exported to markets in the North Pacific region (Japan, Korea and Taiwan), and the remainder to Europe.

The coal is shipped in large bulk carriers—65 per cent of it in ships greater than 100 000 DWT. Ships of this size en route to Europe travel south following the coast inside the Great Barrier Reef and pass through Bass Strait, while those going to the North Pacific region usually choose the shortest route to the Coral Sea. Vessels travelling into Hay Point do so in ballast unless they have part-loaded at NSW coal ports or at Gladstone. Part-loading occurs in southern ports due to depth restrictions in these ports and also due to importers' requirements that shiploads of these sizes contain a mixture of coal types. Coal ships on the European trade backload across the Atlantic and then to Japan, and make the Japan-Australia leg in ballast.

Hay Point is now being expanded by the construction of a second bulk coal terminal. The second terminal, known as the Dalrymple Bay Terminal, will be owned and operated on a common user basis by the Harbours Corporation of Queensland. It will have a Stage 1 capacity of 15 million tonnes per annum and a similar Stage 2 capacity, giving a total potential capacity of 30 million tonnes. Stage 1, which has export commitments for its full capacity, is expected to commence operations in mid-1983. Ships of up to 170 000 DWT will be able to berth at the wharf. Four new mining projects in various stages of development are committed to export through the new facilities. Nearly 80 per cent of the export commitments from Dalrymple Bay are destined for North Pacific markets.

Abbot Point

In June 1981, the Queensland Government approved arrangements for the development of port facilities at Abbot Point for the export of coal, initially from the Collinsville and Newlands mines. The port will be administered by the Harbours Corporation of Queensland, but will be operated by Abbot Point Bulk Coal Pty Ltd, a wholly-owned subsidiary of MIM Holdings Ltd. It will cater for vessels of up to the 160 000-180 000 DWT class and is expected to be operative in early 1984. Exports to the North Pacific region will account for about 75 per cent of the initial throughput of 5 million tonnes per annum.

Overview

This survey of port activities indicated that of the six ports in the region of Hydrographers Passage, Gladstone and Rockhampton to the south and Townsville to the north already have good access to open waters, while Bowen and Mackay handled relatively small throughputs in small vessels which obtain advantages in staying inside the reef for part of their journey. While some shipping from Bowen and Mackay would undoubtedly use Hydrographers Passage, the volume is considered to be small enough to ignore for this analysis. It is the coal trade from Hay Point and Abbot Point which would provide the great bulk of the traffic which could benefit from Hydrographers Passage.

SHIPPING ROUTES

Ships in the European and North Pacific coal trades have been identified as potential users of Hydrographers Passage. Those in the European trade arrive at Hay Point or Abbot Point in ballast from Japan and are likely to use Hydrographers Passage on their inward leg. Having loaded coal, they proceed southwards through Bass Strait and therefore are unlikely to use the Passage on their outward leg.

Shipping between the Queensland coal ports and the North Pacific region is able to choose between two main routes. It can either round the eastern end of the Louiseade Archipelago off Papua New Guinea near Rossel Island or it can come through Jomard Passage towards the western end of the archipelago (see Figure 2.1). The most commonly used route is via Rossel Island, although a significant proportion of the current shipping does use Jomard Passage, as shown in Table 2.2.

TABLE 2.2—PROPORTION OF SHIPS TRAVELLING VIA ROSSEL ISLAND OR VIA JOMARD PASSAGE

(per cent)

Route	*Inwards shipping*	*Outwards shipping*
Rossel Island	75.0	59.5
Jomard Passage	25.0	40.5

Source: Survey of Reports to the Australian Coastal Surveillance Centre under the Australian Ship Reporting (AUSREP) Procedures.

Jomard Passage and Rossel Island may be reached currently via each of the three passages through the Great Barrier Reef described previously. These are Capricorn Channel (opposite Gladstone and around the southern end of the reef), Palm Passage off Townsville and Grafton Passage off Cairns. Thus, shipping between the North Pacific region and Hay Point can currently use one of six different routes when making a direct trip.

Table 2.3 shows the proportion of shipping to and from Hay Point currently using these various routes. This information was obtained by inspecting route and position reports provided by shipping to the Australian Coastal Surveillance Centre. These reports covered the three most recent single-leg voyages for 96 vessels arriving at Hay Point and 45 vessels departing from Hay Point. In many cases these three voyages were undertaken over a period in excess of one year. The table shows that ships travelling via Rossel Island most frequently use Capricorn Channel, while those using Jomard Passage use either Palm Passage or Grafton Passage.

TABLE 2.3—PROPORTION OF VESSELS USING VARIOUS SHIPPING ROUTES SERVICING HAY POINT AND THE NORTH PACIFIC

(per cent)

Route	*Present distribution of trips*	
	Outward leg	*Inward leg*
Rossel Island		
via Capricorn Channel	59.4	38.1
via Palm Passage	*nil*	2.4
via Grafton Passage	*nil*	2.4
Jomard Passage		
via Capricorn Channel	*nil*	2.4
via Palm Passage	24.4	4.8
via Grafton Passage	16.2	7.1
Other origins[a]	na	42.9
Total[b]	100.0	100.0

na Not applicable.

a. Ships coming from southern coal ports in Australia to complete their loading at Hay Point.
b. Totals may not add due to rounding.

Source: Survey of Reports to the Australian Coastal Surveillance Centre under the Australian Ship Reporting (AUSREP) Procedures.

The survey showed that 43 per cent of the vessels arriving at Hay Point had come from southern ports. Their route typically was via Rossel Island to Port Kembla, Newcastle or Gladstone and then to Hay Point. The ships partially load at one or more of the southern ports and complete (or top up) their loads at Hay Point.

SHIPPING DISTANCES

The shipping distances from Hay Point and Abbot Point to both Rossel Island and Jomard Passage by the various channels through the Great Barrier Reef are compared in Table 2.4. It can be seen that Hydrographers Passage is the shortest route from Hay Point to both Rossel Island and Jomard Passage. From Abbot Point, however, both Grafton Passage and Palm Passage provide a shorter route to Jomard Passage than does Hydrographers Passage. Hydrographers Passage provides a slight distance saving from Abbot Point to Rossel Island. These savings in distance are shown in Table 2.5.

TABLE 2.4—COMPARATIVE LENGTH OF SHIPPING ROUTES

(nautical miles)

Origin and route	*Distance to*	
	Rossel Island	*Jomard Passage*
Hay Point		
via Capricorn Channel	909	964
via Grafton Passage	949	834
via Palm Passage	905	760
via Hydrographers Passage	683	672
Abbot Point		
via Capricorn Channel	1018	1073
via Grafton Passage	817	702
via Palm Passage	773	660
via Hydrographers Passage	760	749

Source: The Queensland Coast and Torres Strait Pilot Service.

TABLE 2.5—DISTANCE SAVED BY THE USE OF HYDROGRAPHERS PASSAGE

(nautical miles)

Origin and Route	*Distance to*	
	Rossel Island	*Jomard Passage*
Hay Point		
via Hydrographers Passage		
instead of Capricorn Channel	226	292
instead of Grafton Passage	266	162
instead of Palm Passage	222	88
Abbot Point		
via Hydrographers Passage		
instead of Capricorn Channel	258	324
instead of Grafton Passage	57	(47)[a]
instead of Palm Passage	13	(89)[a]

a. ( ) denotes an increase in distance.

Source: BTE, from Table 2.4.

LIKELY USE OF HYDROGRAPHERS PASSAGE

The shortest route currently available to shipping from Hay Point and Abbot Point is via Palm Passage to Jomard Passage. This route is 149 nautical miles shorter than the most commonly used route via Capricorn Channel and Rossel Island. Despite this, Palm Passage to Jomard Passage only accounts for 4.8 per cent of the inward traffic to Hay Point and 24.4 per cent of the outward traffic. Clearly factors other than distance (such as safety, ease of transit, availability of pilotage and cost of pilotage) enter into the choice of route. In this case, for example, satellite navigation is required to transit Jomard Passage, while Palm Passage is considered a difficult passage as it opens into the Coral Sea near an extensive area of uncharted reef around which shipping must divert. Judgment of the importance of these factors will vary among ships' masters.

For the purpose of estimating the proportion of traffic likely to use Hydrographers Passage, two criteria have been established:

- the proportion of shipping using the Rossel Island and Jomard Passage routes will remain the same as shown in Table 2.3; and
- ships will take the most cost-effective route between these locations and Hay Point and Abbot Point. Thus if a saving in distance is made by incurring pilotage costs, then the cheapest alternative will be chosen.

Tables 2.6 and 2.7 show estimates of the use of Hydrographers Passage, exclusive of the effect of pilotage costs. It is anticipated that all of the outward traffic from Hay Point to the North Pacific would use Hydrographers Passage, while only 57 per cent of the inward traffic is likely to use it. This is because of the large proportion of inward traffic which first calls at more southern ports to take on part of their load. With a trend to larger coal ships (see Chapter 4) and the requirement for mixes of coal types in these large shipments, this practice of topping up is unlikely to decline.

The inclusion of pilotage costs does not alter the estimated use of the Passage to and from Hay Point, shown in Tables 2.6 and 2.7. The calculations described in Chapter 4, however, show that from Abbot Point the distance saved by the use of Hydrographers Passage is not sufficient to offset anticipated pilotage charges of about \$5000 per transit of the Passage, assuming that ships take on a pilot. Thus, based on this assumption, Hydrographers Passage is not the most cost-efficient route from Abbot Point to either Rossel Island or Jomard Passage. In this analysis it has been assumed that traffic for Abbot Point does not use Hydrographers Passage.

TABLE 2.6—ANALYSIS OF SHIPPING ROUTES TO HAY POINT AND ABBOT POINT; INWARD LEG (EXCLUDING ASSESSMENT OF PILOTAGE COSTS)

Route	*Total distance* (*n miles*)	*Present distribution of trips* (*per cent*)	*Distance saved using Hydrographers Passage* (*n miles*)	*Likely use of Hydrographers Passage*
To Hay Point				
from Rossel Island				
via Capricorn Channel	909	38.1	226	*yes*
via Palm Passage	905	2.4	222	*yes*
via Grafton Passage	949	2.4	266	*yes*
via Hydrographers Passage	683	—	—	42.9%
from Jomard Passage				
via Capricorn Channel	964	2.4	292	*yes*
via Palm Passage	760	4.8	88	*yes*
via Grafton Passage	834	7.1	162	*yes*
via Hydrographers Passage	672	—	—	14.3%
from other destinations[a]	—	*42.9*	*na*	*no*
Total	na	100.0	na	57.2%
To Abbot Point				
from Rossel Island				
via Capricorn Channel	1018		258	na
via Palm Passage	773		13	*yes*
via Grafton Passage	817		57	na
via Hydrographers Passage	760		—	42.9%[b]
from Jomard Passage				
via Capricorn Channel	1073		324	na
via Palm Passage	660		(89)[c]	*no*
via Grafton Passage	702		(47)[c]	*no*
via Hydrographers Passage	749		—	*no*
from other destinations[a]	—		*na*	*no*
Total	na		na	42.9%

a. Other destinations includes southern ports and waters and Torres Strait.
b. Based on the assumption that the proportion of traffic using the routes via Rossel Island or Jomard Passage will be the same as from Hay Point, and that the voyage to Abbot Point will be made by the shortest route.
c. ( ) indicates an increase in distance.

na Not applicable.

Sources: Estimates provided by The Queensland Coast and Torres Strait Pilot Service.
Survey of Reports to the Australian Coastal Surveillance Centre under the Australian Ship Reporting (AUSREP) Procedures.

TABLE 2.7—ANALYSIS OF SHIPPING ROUTES TO HAY POINT AND ABBOT POINT ; OUTWARD LEG (EXCLUDING ASSESSMENT OF PILOTAGE COSTS)

Route	*Total distance* (*n miles*)	*Present distribution of trips* (*per cent*)	*Distance saved using Hydrographers Passage* (*n miles*)	*Likely use of Hydrographers Passage*
From Hay Point				
to Rossel Island				
via Capricorn Channel	909	59.4	226	*yes*
via Palm Passage	905	*nil*	222	na
via Grafton Passage	949	*nil*	266	na
via Hydrographers Passage	683	—	—	59.4%
to Jomard Passage				
via Capricorn Channel	964	*nil*	292	na
via Palm Passage	760	24.4	88	*yes*
via Grafton Passage	834	16.2	162	*yes*
via Hydrographers Passage	672	—	—	40.6%
to other destinations[a]	—	*na*	*na*	*na*
Total	na	100.0	na	100.0%
From Abbot Point				
to Rossel Island				
via Capricorn Channel	1018		258	na
via Palm Passage	773		13	*yes*
via Grafton Passage	817		57	na
via Hydrographers Passage	760		—	40.7%[b]
to Jomard Passage				
via Capricorn Channel	1073		324	na
via Palm Passage	660		(89)[c]	*no*
via Grafton Passage	702		(47)[c]	*no*
via Hydrographers Passage	749		—	*nil*
to other destinations[a]	—		na	*no*
Total	na		na	40.7%

a. Other destinations includes southern ports and waters and Torres Strait.
b. Based on the assumption that the proportion of traffic using the routes via Rossel Island or Jomard Passage will be the same as from Hay Point, and that the voyage to Abbot Point will be made by the shortest route.
c. ( ) indicates an increase in distance.

na Not applicable.

Sources: Estimates provided by The Queensland Coast and Torres Strait Pilot Service.
Survey of Reports to the Australian Coastal Surveillance Centre under the Australian Ship Reporting (AUSREP) Procedures.

CHAPTER 3—IMPORTANT ISSUES IN THE EVALUATION OF BENEFITS AND COSTS

This chapter is concerned with identifying the appropriate benefits and costs to be taken into account in the evaluation of the provision of navigational aids in Hydrographers Passage. The benefits will be associated with the savings in shipping costs of exporting coal from Hay Point. The benefits to Australia will then depend on the degree to which these savings in shipping costs result in an increase in Australian incomes.

On the cost side, the provision of navigational aids is an essential expenditure in making the Passage safe for commercial shipping. It is also anticipated that a commercial pilot service will be provided.

This chapter discusses background information relevant to these two issues and examines them in general terms. In addition environmental and defence issues associated with the use of the Passage are discussed.

EVALUATION OF BENEFITS

The discovery of a shorter shipping route from one of Australia's major coal ports to its major markets must improve the competitive position of the export industry. A concern of this study, however, is to establish whether any substantive benefits are likely to accrue to Australian residents as a result of this proposed investment by the Commonwealth Government.

Over 65 per cent of the coal exported from Hay Point is sold to North Pacific countries on an fob basis, where the customer provides the sea transport. Most of the remainder of the coal is sold to Europe on a cif basis, where the seller provides the shipping.

Where the coal importers bear the cost of shipping, the immediate savings associated with reduced shipping time will accrue to them or to shipping companies. Vessels used on the North Pacific trade are mainly Japanese-owned or operated. They operate under 'cargo guarantees' extended by the steel companies; these guarantees usually last for the useful life of the ship. The details of contracts between coal exporters and importers are not known to the BTE. However, it is understood that it is not usual for changes in shipping costs to be specifically allowed for in an fob contract. Thus, recovery of part of the savings which coal importers make by the use of Hydrographers Passage will be dependent on market forces and on the ability of exporters to negotiate some of this windfall gain.

The cost of transporting coal to Europe is met by the seller. However, as Hydrographers Passage is not used in the journey to Europe, there will be no gains to the seller from development of the channel. It is only on the return ballast voyage from Japan to Australia, after having carried other commodities on other trades from Europe to America and America to Japan, that these ships might obtain a saving by using Hydrographers Passage.

There are two ways in which Australian coal exporters could benefit from reduced shipping costs accruing to importers. These are by directly negotiating an increase in the fob price of coal, or through increased sales of coal which result from the lower landed cost. Benefits to Australian exporters gained by either of these means will be dependent on market conditions.

Australian coal is exported under long-term 'framework' contracts, which set a base price and allow for a negotiation process to review prices and other factors in the light of market conditions. The savings from reduced shipping costs could be brought into this negotiating process by Australian exporters.

SHORT-TERM NEGOTIATING POSITION

The short-term negotiating position of Australian exporters is an important consideration in evaluating the benefits from Hydrographers Passage as DTC expects that the Passage could be in operation by 1985.

The current depressed state of the coal market is expected to continue for some time. This will make it harder for Australian exporters to negotiate benefits from a reduction of shipping costs under the present market conditions. For example, the Australian Financial Review (Loudon and Dyer 15 November 1982, p1 and p39) carried the following account of Utah Development Company's current negotiations with the Japanese:

> 'Utah officials said last week they were confident of improvement around the middle of 1984 but did not expect any real pick-up in demand for coking coal until the end of the decade.
>
> While some improvement could be expected around the middle of 1983, Utah will be under tremendous pressure to trim its long-term contracts with the Japanese steel mills which fall due that year.
>
> Utah has three contracts covering Goonyella, Peak Downs and Saraji coal falling due in 1984, totalling about 9.7 million tonnes.
>
> These contracts are the basis of Utah's mining success and the Japanese have already warned the company that there could be reductions.
>
> The Japanese have looked to trim between 20 and 40 per cent of the contracts and place the tonnage under a buyer's option. In return the mills would agree to Utah's request for a price increase.
>
> Utah officials have held several discussions with the Japanese on these lines but as the coal and steel industries have worsened, the talks have become less and less important. Utah has preferred to try to keep as much tonnage as possible for the time being.'

These comments apply to the coking coal market. Although the major long-run growth in coal exports from Hay Point is expected to be in steaming coal, present volumes are well under one per cent of total coal exports and are only likely to be about 10 per cent of total coal exports by the time Hydrographers Passage could be in operation in 1985 (World Coal Study 1980).

The responsiveness of Australian coal exports to a reduction in prices (through lower shipping costs) may also be dampened by importers' moves to diversify their sources of supply. Japan, in particular, has adopted a policy of diversifying suppliers, and has looked to North America, South Africa and the People's Republic of China. Australia's share of the Japanese market for coking coal has ranged between 40 and 45 per cent over the last few years, while the share of the steaming coal market has declined from earlier levels of nearly 100 per cent to 63 per cent in 1981. Because of the Japanese diversification policy, these shares are not expected to increase.

The combined impact of these factors—that is the operation of long-term contracts, the current depressed state of the coal market, and importer policies of supply diversification—would appear to pose a fairly poor prospect in the short run for the Australian coal exporter to negotiate significant gains from a reduction in shipping costs.

LONG-TERM COMPETITIVENESS

The discussion above has been couched in terms of the market conditions likely to be prevailing at the time when Hydrographers Passage could come into operation. In the longer term, the benefits of the Passage would be reflected in whatever improvement it could make to the competitiveness of Australian coal from Hay Point to major markets in the North Pacific.

The cost of sea transport is a significant proportion of the landed cost of coal and, including port charges, represents approximately 19 per cent of the landed cost of Queensland coal in Japan.

The main factors affecting shipping costs of coal are distance from the market and the size of the ship employed to transport coal. Distance from the market is a critical factor in determining Australian export competitiveness in the international coal trade. The length of the voyage for Australian export coal to Japan vis-a-vis West Canada, USA and South Africa is shown in Table 3.1. Relative distance from markets provides Australia with an advantage for exports to Japan and other countries in the Asian region and a disadvantage for exports to Europe. The distance saved on the route to Japan by the use of Hydrographers Passage is about 5-6 per cent of the total trip distance. The three closest coal export ports to Japan are Tsingtao in China, Hay Point in Australia and Vancouver in Canada. The distance saving made by Hydrographers Passage will not alter this ranking.

TABLE 3.1—LENGTH OF MARITIME COAL TRADE ROUTES TO JAPAN[a]

Country	*Port*	*Distance (nautical miles)*
Canada	Vancouver	4 265
USA	Hampton Roads	9 565
USA	West Coast	4 750
South Africa	Richards Bay	7 895
Australia	Hay Point	4 065
Australia	Abbot Point	3 956[b]
Poland	Gdansk	11 910[c]
USSR	Odessa	9 105[c]
China	Tsingtao	1 100

a. Yokohama, Japan.
b. Calculated using information from industry discussions.
c. Via Suez Canal.

Source: Drewry (1980, p35).

EVALUATION OF COSTS

The costs of using Hydrographers Passage for commercial shipping are assumed in this study to be the capital costs for establishing navigational aids and the operating costs of servicing those aids.

It is anticipated that a pilot service will be provided to users of the Passage by The Queensland Coast and Torres Strait Pilot Service. However, it is assumed that it would not be mandatory to take a pilot on board when negotiating Hydrographers Passage and none of the infrastructure costs for the establishment of pilot services will be met by the Commonwealth Government.

It is presumed that pilot services will be provided on a commercial basis, and will be a self-financing enterprise, not involving any national costs and benefits which should be included in this economic evaluation. The costs of this service are deducted in assessing the net benefits from use of the Passage.

ENVIRONMENTAL EFFECTS

Hydrographers Passage could have environmental implications because of its location in the Great Barrier Reef. At present, Hydrographers Passage is not in an area declared as a marine park. However only 14 per cent of the Great Barrier Reef has marine park status and additional areas are currently under review.

The environmental implications of constructing navigational aids in Hydrographers Passage are being assessed by the Commonwealth Department of Home Affairs and the Environment and the Great Barrier Reef Marine Park Authority and no account is taken of them in this study.

DEFENCE BENEFITS

The Royal Australian Navy hydrographic surveyors have been responsible for the charting of Hydrographers Passage. The Ministers for Defence and for Transport and Construction have stated that the requirement for the Navy to be able to deploy its ships rapidly from the coastal route near Mackay into the Coral Sea was a factor in the decision to undertake this work (Sinclair and Hunt, 1982). No attempt has been made in this study to quantify the defence benefits associated with faster access to the Coral Sea from Mackay. These benefits, however, need to be borne in mind when evaluating the final results of the study.

CHAPTER 4—ESTIMATION OF BENEFITS

In previous chapters it has been shown that the direct benefits arising from the development of Hydrographers Passage will accrue to ship operators. Benefits are associated primarily with savings in shipping costs, which in turn derive from decreases in route distances. In this chapter, benefits are estimated and discounted over a 40-year period (which is the assumed effective life of Commonwealth Government navigational aids).

ESTIMATING PROCEDURE

Benefits to ship operators derived from reductions in shipping costs may arise in two ways; first, as cost savings associated with reduced journey times, and second, if the time saving on each journey is sufficient, as reductions in the fleet size necessary to transport a given volume of cargo. The procedure used for estimating savings is set out in Appendix I.

A range of factors affects the magnitude of the cost savings. These include vessel size, average load size, voyage time, daily shipping cost, likely pilot charges (and the effect they have on choice of route) and forecasts of future coal exports. Each of the factors affecting savings is discussed in the following section.

KEY FACTORS AFFECTING BENEFITS

Vessel size

A major factor affecting the cost of transporting coal is the size of the ship employed. Significant economies of scale can be obtained from the use of large bulk carriers on all but the shortest routes.

The deep-sea routes are typically served by two types of bulk carrier: those dimensioned to pass through the Panama Canal (the Panamax class of about 65 000 DWT) and others of about 120 000 DWT which are regarded as optimal for long-haul coal trades. New coal carriers entering the trade, however, are larger than this. New Japanese carriers are up to 200 000 DWT, and it is envisaged that bulk carriers of around 160 000 DWT will become increasingly common during the latter part of this decade and beyond (Drewry 1981).

Ship size is restricted by the capacity of ports of loading and discharge to accommodate large ships. Both the present Hay Point facility and the facility which is being constructed at Dalrymple Bay can accommodate vessels up to about 170 000 DWT[1].

Major ports of discharge for coking coal used by the Japanese steel industry can accommodate ships well in excess of 150 000 DWT. Japanese discharge ports for steaming coal, however, are frequently restricted to 80 000 DWT or less. Discharge ports for Australian coal in some of the developing markets in South Asia (for example, India) cannot accommodate the large coal carriers.

1. This is only an indicative figure. The size of vessels is dependent on various factors which include the length of the berth, the outreach of the shiploaders, the depth of water at the berth, and the navigational channels in the port, as well as the configuration of these channels.

At present, 67 per cent of the Hay Point throughput is transported in large carriers of greater than 100 000 DWT and 24 per cent is carried in vessels of 60 000 to 100 000 DWT (see Table 4.1).

In order to estimate the cost savings associated with reduction in distance between the North Pacific, European and Queensland coal ports, the costs associated with 65 000, 120 000 and 175 000 DWT bulk carriers have been used as the basis for the calculation. Based on the data included in Table 4.1, it has been assumed that 33 per cent of the coal will be transported in ships of 65 000 DWT, 44 per cent in ships of 120 000 DWT, and 23 per cent in ships of 175 000 DWT.

TABLE 4.1—DISTRIBUTION OF COAL SHIPMENTS BY SHIP DEADWEIGHT, HAY POINT, JULY-DECEMBER 1979[a]

Ship DWT	*Proportion of total shipping (per cent)*	*Cargo carried (per cent)*	*Load factor[b] (per cent)*	*Average shipment size[c] ('000 tonnes)*
less than 30 000	11	3	75	17
30 001- 40 000	na	na	na	na
40 001- 50 000	na	na	na	na
50 001- 60 000	8	6	76	44
60 001- 80 000	19	18	89	60
80 001-100 000	5	6	82	72
100 001-150 000	41	44	60	67
150 000+	16	23	56	92
Total	100	100	na	na
Weighted average	na	na	65	63

a. Due to data deficiencies, the table refers to only 80 per cent to 90 per cent of total shipments.
b. Load factor is the ratio of total tonnage of shipments carried to the total DWT of the bulk carriers carrying that tonnage.
c. Loaded at Hay Point.

na Not applicable.

Source: DTC (1982, p60).

Average shipment size

The average shipment size of vessels loading at Hay Point is also shown in Table 4.1. Shipment size represents the amount of coal actually loaded at Hay Point and not the average load of the ship. The average shipment size for vessels of over 100 000 DWT at Hay Point is low. This reflects the practice of the larger ships to part-load at NSW coal ports or at Gladstone and top up their load at Hay Point.

As pointed out in Chapter 2 this takes place in part because depth restrictions at southern ports prevent the full loading of the larger vessels but primarily because a mix of varieties of coal is required by end users. Thus any planned deepening of southern ports (for example, the new Port Clinton loader at Gladstone) will not necessarily affect this loading pattern.

For the purpose of estimating cost savings, average load sizes have been assumed for each of the three classes of vessel. Two cases have been investigated and are described in Table 4.2. Case I assumes that the present topping up procedure continues and Case II, by adopting optimal load sizes, enables the sensitivity of the results in relation to the topping up assumption to be tested. This sensitivity analysis is described in Appendix II.

TABLE 4.2—AVERAGE SHIPMENT SIZE

(tonnes)

	Average shipment size for		
	65 000 DWT	120 000 DWT	175 000 DWT
Case I —current load sizes	60 000	67 000	92 000
Case II—optimal load sizes	60 000	114 000	166 250

Source: BTE.

Voyage time

The average time taken for a round trip, Japan-Hay Point-Japan, and Europe-Hay Point-Europe is detailed in Table 4.3 below. The trip times assume an average steaming speed of 13 knots and port turnaround times in Japan for 65 000, 120 000 and 175 000 DWT vessels of 5.6, 10.5 and 14.4 days respectively; in Europe of 4.0, 7.5 and 10.2 days respectively.

TABLE 4.3—ROUND TRIP VOYAGE TIMES, HAY POINT AND ABBOT POINT TO JAPAN AND EUROPE

(days)

Route		Vessel size (DWT)		
		65 000	120 000	175 000
Hay Point:	Japan	31.66	37.56	40.46
	Europe	91.73	95.23	97.93
Abbot Point:	Japan	29.55	34.45	38.35

Source: Drewry (1981, p96).

Shipping costs

Sea transport costs comprise the capital charges associated with ship purchase, the vessel's operating costs and the expenses incurred on the voyage. These underlying costs however are not necessarily reflected in freight rates. Spot freight rates are largely determined by short-term demand and supply situations in the shipping market and show large fluctuations. Time charter rates on the other hand which are charged when ships are hired out by their owners for varying periods of time, imply longer-term commitments and tend to reflect the underlying sea transport cost structure more closely.

Most of the coal trade is dependent on long-term freighting contracts. Much of the trade carried from Australian loading ports to Japan is carried by ships owned by Japanese shipping lines, or on long-term charter to them, operating under 'cargo guarantees' made by Japanese companies. This type of contract generally involves a long-term arrangement for the useful life of the ship, with regular round voyages being undertaken between more or less fixed points of origin and destination.

Because of the length of the life of the proposed navigational aids in Hydrographers Passage (40 years) and the nature of the Australian-North Pacific trade, the most appropriate charge for sea transport is the real cost of operating ships on the route rather than current freight rates.

H.P. Drewry provides estimates of the daily costs of coal carriers in 1980, and these are shown in Table 4.4. Conversion of these costs to Australian dollars and 1981 prices provides the estimates detailed in Table 4.5.

TABLE 4.4—DAILY COST OF COAL CARRIERS, 1980

($US)

Costs	*Vessel size (DWT)*		
	65 000	*120 000*	*175 000*
Capital	9 826	13 560	17 196
Operating	5 314	5 820	8 143
Voyage	13 608	15 097	17 247
Total	28 748	34 477	42 586

Source: Drewry (1981, pp89-99).

TABLE 4.5—DAILY COST OF COAL CARRIERS, 1981

($A)

Costs[a]	*Vessel size (DWT)*		
	65 000	*120 000*	*175 000*
Capital[b]	9 057	12 498	15 850
Operating[c]	4 991	5 365	7 647
Voyage[d]	11 833	13 128	14 997
Total	25 881	30 991	38 494

a. Converted from $US at a rate of 1.15.
b. Assumes a 6 per cent increase in capital costs.
c. Assumes an 8 per cent increase in operating costs.
d. Assumes no increase in bunkering costs.

Source: BTE, from Table 4.4; Drewry (1982).

Upper and lower bounds of the cost savings will be set by using both total daily costs and voyage cost. The use of total daily costs implies that all the time saved by the ship can be used to transport additional cargo. This is unlikely due to the comparatively small time savings involved on each voyage and the long-term nature of the coal shipping arrangements. The use of voyage cost savings only implies that no additional use will be made of the time saved and thus the only savings will be in actual steaming costs (that is, fuel costs).

Pilotage costs

Benefits flowing to shipping using Hydrographers Passage may be offset to some degree if a ship's master chooses to engage a pilot for the navigation of the channel. The Queensland Coast and Torres Strait Pilot Service have suggested a pilotage charge in the order of $5 000 for the transit of Hydrographers Passage.

Shipping using Grafton Passage usually engages a pilot. Charges applicable to this route for each vessel size have been calculated from information provided by The Queensland Coast and Torres Strait Pilot Service and are set out in Table 4.6.

A small proportion of vessels using Capricorn Channel also engage pilots. However, this proportion is unknown and pilotage costs are assumed to be negligible as the channel provides a route with few navigational difficulties. A pilot service is not currently available for Palm Passage.

TABLE 4.6—ESTIMATED PILOT CHARGES FOR GRAFTON PASSAGE

Vessel size (DWT)	*Pilot Charge ($)*	
	Arriving (in ballast)	*Departing (loaded)*
65 000	2 254	2 941
120 000	2 594	3 281
175 000	2 594	3 281

Source: The Queensland Coast and Torres Strait Pilot Service.

The length and narrowness of Hydrographers Passage suggest that it will generate a greater need for pilotage than the existing channels. For this reason it is assumed that all ships will take on a pilot, and the estimated pilotage charge of $5 000 per transit is deducted from the assessed benefits of using the Passage. This reflects the maximum possible use of pilotage services and hence introduces an element of conservatism into the estimates of the benefit-cost ratios.

Effect of pilotage costs on use of the Passage

In Chapter 2 criteria were established as the basis for estimating the proportion of traffic likely to use Hydrographers Passage. One of these criteria was that ships would take the most cost-effective route between Rossel Island or Jomard Passage and the ports of Hay Point or Abbot Point.

For shipping between Rossel Island or Jomard Passage and Hay Point, the cost savings brought about by the use of Hydrographers Passage clearly outweigh the anticipated pilotage charge of $5 000. This is not the case, however, for Abbot Point. For shipping from Abbot Point using Jomard Passage, both Palm and Grafton Passages provide a shorter route than does Hydrographers Passage. It is only for shipping from Abbot Point using Rossel Island that Hydrographers Passage provides a shorter route. The distance saving compared with the next shortest route, Palm Passage, is only 13 nautical miles, or a saving in time of one hour. Based on total ship costs this implies a cost saving of $1 080 for a 65 000 DWT vessel, $1 290 for a 120 000 DWT vessel and $1 600 for a 175 000 DWT vessel. These savings are not sufficient to offset a pilotage cost of $5 000 through Hydrographers Passage.

It has therefore been assumed in this evaluation that traffic from Abbot Point will not use Hydrographers Passage. This is considered to be a conservative assumption as the cost difference is small and some ships' masters are likely to prefer to take a pilot through Hydrographers Passage than navigate alone through Palm Passage.

Forecasts of coal exports

In order to estimate the stream of cost savings associated with coal ships using Hydrographers Passage, it is necessary to forecast the volume of coal exports from Hay Point to the North Pacific; that is to Japan, Korea, Taiwan and Hong Kong plus the small but growing trade to other Asian countries.

The present level of exports from Hay Point and forecasts of exports to 1984 based on current export contracts for Hay Point and the new coal export facilities are shown in Table 4.7. About 73 per cent of these exports are destined for markets in the North Pacific region, as shown in Table 4.8.

Two recent sets of long term forecasts of Australian coal exports are available (Commonwealth Department of Trade and Resources 1981 and World Coal Study (WOCOL) 1980). The Commonwealth Department of Trade and Resources has recently revised its forecasts and now recommends use of the lower bound of its range of values. As can be seen from Table 4.9, the two sets of forecasts are very similar.

TABLE 4.7—CURRENT LEVELS OF EXPORTS AND EXPORT CONTRACT VOLUMES

(million tonnes)

Port	*Actual*		*Forecast*		
	1979-80	*1980-81*	*1982*	*1983*	*1984*
Hay Point	14.8	15.1	13.5[a]	na	na
Dalrymple Bay	—	—	—	—	14.5[b]
Abbot Point	—	—	—	—	4.0[c]

a. Estimate. A 10 per cent reduction in coal output was announced by Utah Development Co in August 1982.
b. Export contracts announced by the shareholders of Dalrymple Bay Coal Terminal Pty Ltd.
c. MIM export contracts.

na Not available.

Source: Various company sources.

TABLE 4.8—PER CENT OF COAL EXPORTS COMMITTED TO NORTH PACIFIC MARKETS

Port of origin	*Per cent*
Hay Point	65
Dalrymple Bay	79
Abbot Point	76
Weighted Average of above	73

Source: Various company sources.

TABLE 4.9—FORECASTS OF AUSTRALIAN COAL EXPORTS

(million tonnes)

Source of forecast	*1985*	*1990*	*2000*
WOCOL	80	110	170
Dept Trade and Resources[a]	78-95	100-130	na

a. Department of Trade and Resources, after revision of these forecasts in October 1982, recommends use of the lower bound.

na Not available.

Source: Commonwealth Department of Trade and Resources (1981) and WOCOL (1980).

TABLE 4.10—PROJECTED AUSTRALIAN COAL EXPORTS BY SELECTED PORTS

(million tonnes)

Port	*1985*	*1990*	*2000*
Bowen			
Hay Point/Dalrymple Bay	30	37	47
Abbot Point			
Gladstone	10	17	28
Total	40	54	75
Per cent of total Australian coal exports	50	49	44

Source: WOCOL (1980).

WOCOL provides export forecasts by port of origin and the Commonwealth Department of Trade and Resources provides export forecasts by country of destination. Both forecasts have been used as guides in making the required estimates.

WOCOL forecasts of exports from the three main coal ports on the Queensland coast are shown in Table 4.10. These forecasts do not distinguish between the three locations of concern to this study—Bowen, Hay Point/Dalrymple Bay, and the 'new' port, Abbot Point. For the purposes of this study it is assumed that the very small tonnages currently being loaded at Bowen will be exported through Abbot Point when operations are commenced in 1984. It is necessary however to differentiate the forecast exports between those from the Hay Point/Dalrymple Bay complex and those from Abbot Point. The different export capacities of the facilities have been taken as a guide in making this distinction.

It is planned that Abbot Point will have an annual capacity of 4.5 million tonnes by 1984. This is to be increased to 6.5 million tonnes by 1985. Further upgradings of Abbot Point by stages to 10 and 24 million tonnes capacity have been planned, but construction of the capacity is dependent on market conditions.

Hay Point currently has a throughput of 18 million tonnes per year, and provision has been made to expand it to 23 million tonnes should market conditions warrant this extension. Dalrymple Bay is planned to commence operations in mid-1983 with a throughput of 15 million tonnes per year. This capacity can be doubled if greater throughput is required.

Table 4.11 shows the Commonwealth Department of Trade and Resources forecasts of exports to North Pacific and other Asian countries. These regions are expected to account for over 70 per cent of Australian coal exports in the period 1985-1990. This market share accords with the proportions of the coal exports from Hay Point and Abbot Point destined for the North Pacific markets shown in Table 4.8.

The forecasts to the year 2000 of coal export tonnages from Hay Point used in this study are shown in Figure 4.1. The average annual growth rate between 1985 (the likely date for opening the Passage) and the year 2000 is 2.8 per cent. In order to calculate benefit streams arising over the 40-year life of the navigational aids, it has been necessary to estimate coal exports over 40 years. It has been assumed that export tonnages after the year 2000 will grow at a rate of 2.3 per cent per annum.

Due to the present uncertainty facing the world coal market an alternative forecast to that shown in Figure 4.1 has been made, by assuming that future exports are reduced by 20 per cent. The effect of this on shipping cost savings resulting from use of Hydrographers Passage is reported in Appendix II.

TOTAL DISCOUNTED BENEFITS

Savings have been estimated on two bases. These are total ship cost savings (capital, operating and voyage costs), and voyage (or bunker) cost savings alone. These two bases provide estimates of the upper and lower bounds of possible savings. Savings based on total ship cost savings assume that any time saved on a voyage can be used to carry additional cargo. In the present climate of excess supply of shipping, this is an unlikely assumption unless the time savings are large enough over a period to reduce the size of the fleet required to service a trade. Savings based on voyage, or bunker cost savings, are estimates of the amount of fuel cost savings accruing from a decrease in sailing time.

Net savings in shipping costs have been discounted over a 40-year period and are outlined in Table 4.12. It is estimated that the benefit in terms of total ship cost savings gained through use of Hydrographers Passage will total $92 million (at a discount rate of 10 per cent). At the same discount rate, the savings on voyage costs alone would be almost $23 million.

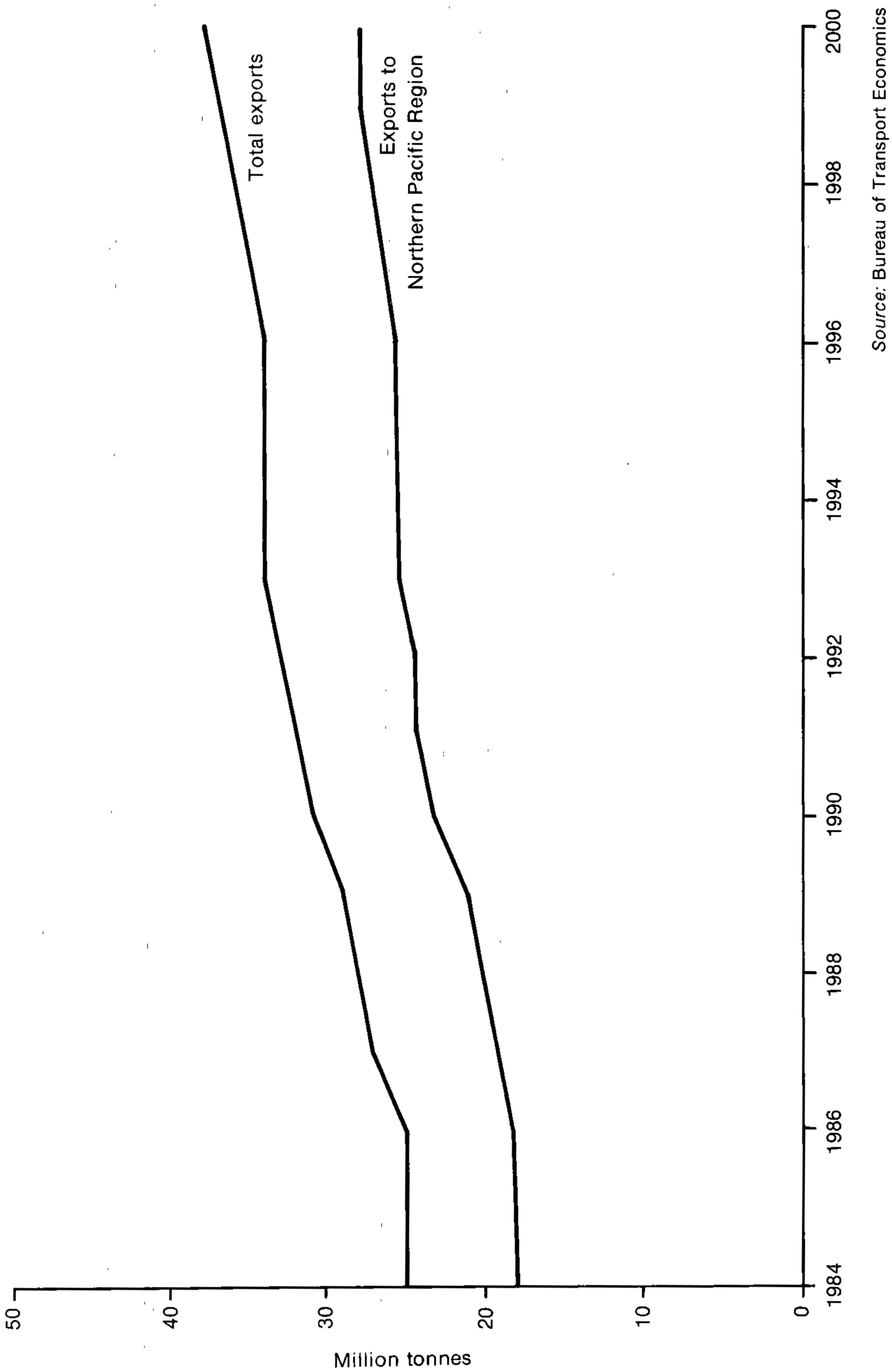

Figure 4.1. Forecasts of exports from Hay Point

TABLE 4.11—FORECAST EXPORTS OF COAL TO NORTH PACIFIC AND OTHER ASIAN COUNTRIES

(million tonnes)

Region	*1985*	*1990*
North Pacific		
Japan	44	50
Republic of Korea	6	11
Taiwan	3	6
Hong Kong	1	3
Total North Pacific	54	70
Other Asia	3	5
Total	57	75
Per cent of total Australian coal exports	73	75

Source: Commonwealth Department of Trade and Resources (1981).

TABLE 4.12—BENEFITS FROM USE OF HYDROGRAPHERS PASSAGE

($ million)

Estimated saving	*Discount rate (per cent)*		
	7	*10*	*13*
Total ship costs	132.16	91.66	68.23
Voyage costs	32.63	22.63	16.89

Source: BTE.

CHAPTER 5—ESTIMATION OF COSTS

The costs involved in the development of Hydrographers Passage are those incurred by the Commonwealth Government in providing navigational aids.

PROPOSED NAVIGATIONAL AIDS

The safe transit of Hydrographers Passage requires the construction of a number of navigational aids. These include four lighthouses and a daymark/radar reflector. The proposed structures mark the extremities of the reef entrances and provide bearings for turning points and course guidance through reefs and shoals in the area. Each of the structures is described in detail in Appendix III.

Navigational aid options

Two options are under study for maintaining and re-supplying the navigational aids. These are to service the aids by ship or by helicopter. Because of the distance of the aids from the mainland and the prevailing exposed sea conditions, one of DTC's 'Cape' class lighthouse service vessels (2100 GRT) would be required if servicing is to be done by ship. Servicing by vessels would have a higher operating cost than that involved in servicing the navigational aids by helicopter. Helicopter servicing would be done through chartering helicopters but would require additional capital costs to be incurred in constructing a helipad adjacent to each lighthouse tower. It was not possible to estimate other potential costs associated with these two options which might arise from differences in the availability of vessels or helicopters, or from a difference in closure time of a navigational aid due to delays in providing emergency maintenance. The cost estimates for each alternative are set out in Table 5.1.

TABLE 5.1—ESTIMATED INITIAL CAPITAL EXPENDITURE AND ANNUAL OPERATING EXPENDITURE ON NAVIGATIONAL AIDS BY COMMONWEALTH GOVERNMENT

($'000)

Costs	*Without helipads*	*With helipads*
Capital Costs		
towers	4 500	7 000[a]
navigational aid equipment	1 000	1 000
Total capital	5 500	8 000
Annual operating and maintenance costs	by vessel	by helicopter
three routine visits	223.5	127.5
two unscheduled fault maintenance visits	12.5	6.5
Total operating/maintenance	236.0	134.0

a. Includes cost of helipads.

Source: DTC, Marine Operations Division.

It is estimated by DTC that the earliest possible timing for completion of the navigational aids is late 1984.

In this evaluation these costs have been discounted over a period of 40 years. This is the expected effective life of the towers after which their residual value is assumed to be zero. Navigational aid equipment is assumed to have a life span of ten years, after which the residual value will be 30 per cent. It has been assumed that navigational aids will be replaced three times during the life of the towers.

TOTAL DISCOUNTED COSTS

The estimated capital, operating and maintenance costs to be incurred by the Commonwealth Government over the 40 year period are discounted to current day values and the results are shown in Table 5.2. At a discount rate of 10 per cent, costs of $9.9 million and $8.5 million would be involved in providing navigational aids for the helipads/no helipads options respectively.

TABLE 5.2—COSTS OF NAVIGATIONAL AIDS IN HYDROGRAPHERS PASSAGE

($ million)

Option	*Discount rate (per cent)*		
	7	*10*	*13*
With helipads	10.59	9.90	9.48
Without helipads	9.55	8.50	7.86

Source: BTE.

CHAPTER 6—APPRAISAL OF RESULTS

This chapter outlines the results of the economic evaluation of development of Hydrographers Passage. The criterion used for evaluation is the benefit-cost ratio, which is the ratio of discounted benefits flowing from the project to discounted costs. A benefit-cost ratio greater than one implies that the project option under consideration is economically viable.

Three rates of discount (7 per cent, 10 per cent and 13 per cent) have been applied in determining the benefit-cost ratios for this project. The Commonwealth Department of the Treasury recommends use of the 10 per cent rate for projects of this type while the 7 and 13 per cent levels have been included to illustrate the sensitivity of the project costs and benefits to the discount rate.

Further sensitivity testing has been undertaken, including investigation of the effect of a 20 per cent reduction in the forecast volume of coal exports and examination of increases in the average load size of vessels.

EVALUATION OF HYDROGRAPHERS PASSAGE

The results set out below are presented from a global point of view—assessing whether or not the total benefits from the project outweigh its costs, irrespective of whether the benefits accrue to Australians or to foreign interests. The benefits have been calculated in terms of both savings in the full cost of operating a vessel (that is, capital, operating and voyage costs) and savings in voyage costs only. In addition, two alternatives concerning the servicing (that is, provision of maintenance services) of the navigational aids have been investigated. These are the alternatives of:

- constructing helipads and servicing the aids by helicopter; or
- servicing the aids by ship, thus removing the need to construct helipads.

The discounted cost analysis shows that the construction and servicing of the towers and navigational aids without helipads is the less costly alternative. Hence, the addition of helipads would only be justified if it could be demonstrated that the use of helicopters provided additional benefits in the form of a more efficient maintenance system which justified the additional cost involved. The BTE did not have information to assess the relative efficiency of the two alternatives. However, the difference in costs associated with whether or not the helipads are constructed does not alter the basic economic viability of the project. This can be seen from Table 6.1.

The benefit-cost ratios at various discount rates are summarised in Table 6.1. As noted in Chapter 4, the ratios are conservative as it has been assumed that all ships using Hydrographers Passage will take on a pilot, and the cost of this pilotage has been netted out of the benefit stream. All the benefit-cost ratios exceed unity, indicating that from a global perspective, the Hydrographers Passage project is economically justifiable.

SENSITIVITY ANALYSIS

Analysis has been undertaken to test the robustness of these results. The effects of a 20 per cent reduction in the forecast volumes of coal and of increases in average load size are set out in Appendix II. In no case do changes in these assumptions make the project non-viable on a global basis.

The results therefore can be considered robust.

TABLE 6.1—BENEFIT-COST RATIOS FOR CONSTRUCTION OF NAVIGATIONAL AIDS IN HYDROGRAPHERS PASSAGE

Benefit	*Discount rate (per cent)*		
	7	*10*	*13*
Total ship cost savings			
without helipads	13.84	10.78	8.68
with helipads	12.48	9.26	7.20
Voyage cost savings only			
without helipads	3.42	2.66	2.15
with helipads	3.08	2.29	1.78

Source: BTE.

SAVINGS PER TONNE OF COAL

The use of Hydrographers Passage on the round trip to the North Pacific region instead of the shipping routes currently used, saves on average about $22 300 per trip if total vessel operating costs are taken into account and about $5500 per trip if only voyage costs are taken into account. This is equivalent to an average saving of 32 cents per tonne and 8 cents per tonne respectively.

The savings on a round trip to Europe are less because Hydrographers Passage is only likely to be used on one leg of the trip. They are $9000 per trip for the full cost case and $2400 per trip for the voyage cost case, or 13 cents per tonne and 3 cents per tonne respectively.

Total cost savings (that is, the weighted average of savings accruing to vessels in the North Pacific and European coal trades) are $18 300 per trip on a full operating cost basis and $4 500 on a voyage cost basis, or 27 cents per tonne and 7 cents per tonne respectively.

The analysis described in Appendix I has demonstrated that vessel time savings will not be sufficient to reduce the number of vessels required in any one year to transport the coal. This result is based on a comparison of the minimum number of vessels each year dedicated to this trade required to ship the projected export tonnages, with and without the option of the Hydrographers Passage route.

This result, coupled with the current excess supply of world bulk shipping, implies that in a short-run evaluation of the Passage, the more appropriate cost saving option to use is the savings arising from voyage costs only, that is, a total saving of 7 cents per tonne of coal shipped. In the longer run with the growth in the coal trade, the number of dedicated vessels will tend to more closely match the demand (including the impact of shorter voyage time). This will increase the likelihood of realising the full potential cost savings of 27 cents per tonne.

On the current typical landed price of coal in Japan of $A63, the estimated transport cost reductions of 7 to 27 cents per tonne represent falls of only 0.1 to 0.4 per cent, respectively.

DISTRIBUTION OF BENEFITS AND COSTS

Taken on a global basis, the project is economically viable—its benefits outweigh its costs. In terms of benefits to Australians being greater than costs to Australians however, the issue is not so clear.

For the project to be economically viable from an Australian point of view, part of the benefits received by shipping companies or importers must be passed back to Australia. This must be sufficient to cover the cost incurred by Australians in providing the navigational aids. For the benefit-cost ratio to Australians to exceed unity and thus make the project economically viable to Australians, at least 38 per cent of net benefits from reduced voyage costs (or 10 per cent of the potential net benefits from reductions in capital, operating and voyage costs) must be passed back to Australia.

One way of ensuring that the benefits to Australians from Hydrographers Passage outweigh the costs to Australians of establishing the Passage would be to place a levy on use of the Passage, based on cost, to return at least the proportions of net benefits to Australia set out above. This would involve a significant departure from existing policy under which the full cost of navigational aids is recovered by a charge on all shipping, rather than by allocating costs to the direct beneficiaries of the aids.

The 1982-83 levy for light dues imposed on all shipping using Australian waters is 49 cents per net registered tonne. The costs of establishing navigational aids in Hydrographers Passage will increase this levy in the first year of operation of the Passage by 3.8 cents to 52.8 cents per net registered tonne (see Appendix IV).

CHAPTER 7—CONCLUDING REMARKS

The major users of Hydrographers Passage would be those involved in the export coal trade from the port of Hay Point. The benefits from development of the Passage would take the form of reduced shipping times and hence lower shipping costs to export markets.

It has been estimated that the following *benefits* would flow from commercial use of the Passage.

- A reduction in shipping fuel costs equivalent to seven cents per tonne of coal, or $1.7 million per annum on current tonnages. Discounted at 10 per cent per annum over the project's life (assumed to be 40 years), the cumulative benefit from this source would be $22.6 million.
- An additional *potential* reduction in ship capital and operating costs which would only be realised if the coal ships could be utilised for the time saved by use of the Passage; the maximum reduction in shipping costs from this source would be about 20 cents per tonne, or $5.3 million per annum. Over the project's life, the discounted benefit from this source would be $69.1 million.
- The combined fuel savings and potential savings in shipping costs would thus be 27 cents per tonne of coal, $7.0 million per annum, or $91.7 million over the project's life.

The *costs* of opening the Passage for commercial use would be the discounted costs of providing and operating the required navigational aids. These would amount to about $8.5 million over the project's life. Present policy is to recover 100 per cent of Commonwealth expenditure on navigational aids by a single-rate levy on all shipping using Australian ports. Navigational aids for Hydrographers Passage would in their first year of operation add 3.8 cents per net registered tonne to the current light dues on all shipping using Australian ports.

The *benefit-cost ratio* based on savings in fuel costs alone from use of the Passage would be 2.7. If ship cost savings in both capital and operating costs are taken into account, the benefit-cost ratio would rise to 10.8. Hence, the project is well justified on economic grounds from a world viewpoint.

However, most coal likely to be shipped through Hydrographers Passage is sold on an fob basis and shipping costs are borne by the foreign importers. Hence, the above savings would accrue initially to foreign companies (primarily the Japanese, Korean and Taiwanese importers of Australian coal). It is not clear to what extent the Australian coal industry could win back some of the benefits of reduced shipping costs. In the short run, the depressed state of the coal market does not place Australia in a strong negotiating position. In the long run, Australia's competitive position in the world coal trade is determined by the landed price of Australian coal, and hence the reduction in shipping costs through use of the Passage would assist the nation's competitive position.

The final incidence of the cost of navigational aids for Hydrographers Passage is also not clear. As noted above, this cost would be spread over all shipping, and the burden would be shared between Australian and foreign interests depending on their relative abilities to pass on such costs.

It is concluded that the proposed investment in navigational aids in the Passage is clearly justified on economic grounds in that total benefits will outweigh total costs on a global basis. The position with respect to costs and benefits accruing to Australians is not clear. It is likely that a substantial share of the benefits would flow to foreign interests, particularly in the short term although this would tend to be offset by cost recovery from overseas ship operators and a long term improvement in the competitive position of Australian coal.

This analysis did not evaluate environmental factors and possible defence benefits associated with development and use of the Passage. In addition it was noted that use of the Passage could involve pilotage services. It was presumed that these services would be provided on a commercial basis and would be self-financing.

APPENDIX I—PROCEDURE FOR ESTIMATION OF BENEFITS

In this appendix, annual shipping cost savings associated with decreases in route distance are investigated and a procedure enabling quantification of benefits derived from these reductions in shipping costs developed. The procedure also allows examination of the possibility of reductions in the fleet size necessary to transport a given amount of cargo.

ESTIMATION PROCEDURE

The algorithm used to calculate the reductions in costs which result from decreased voyage times is set out below. Costs associated with three classes of vessel[1] have been used to determine savings arising from decreases in route distances.

For each vessel class i, the number of round trips per annum, n_i, required to transport the contracted tonnage of coal, C, is given by,

$$n_i = \frac{p_i C}{a_i} \tag{I.1}$$

where p_i is the proportion of the total trade carried by vessels of class i ($\Sigma p_i = 1$) and a_i is the average shipment size carried by vessels of class i.

If the average number of days per journey for each vessel of class i, prior to the opening of Hydrographers Passage is d_i, and the number of days saved per trip on each route j after the opening of the Passage is h_{ij}, then the total number of days saved per trip each year on each route j, t_{ij}, will be given by,

$$t_{ij} = n_i \, h_{ij}, \tag{I.2}$$

$$\text{where } h_{ij} = \frac{\text{distance saved (nautical miles)}}{\text{average steaming speed (knots)}} \div 24.$$

The average length of voyage (in days) after the opening of the Passage, d_{ij}, is therefore given by,

$$d_{ij} = d_i - h_{ij}.$$

Cost savings per annum for each vessel class i and route j, s_{ij}, are therefore given by,

$$s_{ij} = c_i t_{ij} \tag{I.3}$$

where c_i is the daily shipping cost for vessels of class i[1]. Since n_i is the number of *round* trips required to transport the contracted tonnages of coal, the saving per vessel s_{ij} is obtained from round trips. The savings per annum obtained on inward or outward journeys alone are half this value.

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1. The three vessel classes are 65 000 DWT, 120 000 DWT and 175 000 DWT. They have been discussed in Chapter 4.

The total cost saving per annum, S, is the sum of savings arising from reductions in route distance on both outward and inward journeys. It is given by,

$$S = 1/2 \sum_j (prop_d(j) + prop_a(j)) \sum_i s_{ij}, \qquad (I.4)$$

where $prop_d(j)$ is the proportion of departing vessels and $prop_a(j)$ is the proportion of arriving vessels using route j.

Savings in the cost of pilotage accruing to users of the new Passage can also be calculated. The savings will be equal to the present pilotage charge applicable (discussed in Chapter 4) minus $5000 which is the estimated charge for transit by Hydrographers Passage.

If $pil_d(i,j)$ is the saving in pilot costs for a vessel of class i departing by route j and $pil_a(i,j)$ is the saving for a vessel of class i arriving by route j, then the total saving in the cost of pilotage, P, is given by,

$$P = \sum_j prop_d(j) \sum_i n_i\, pil_d(i,j) + \sum_j prop_a(j) \sum_i n_i\, pil_a(i,j). \qquad (I.5)$$

The number of possible extra trips for each vessel class i and route j per annum, E_{ij}, can be determined. It is given by,

$$E_{ij} = \frac{t_{ij}}{d_{ij}}, \qquad (I.6)$$

where E_{ij} is rounded down to the nearest integer.

The hypothetical vessel saving (over the minimum number required), V_{ij}, can also be calculated. It is given, for vessel class i and route j, as follows,

$$V_{ij} = \frac{t_{ij}}{292}, \qquad (I.7)$$

where V_{ij} is rounded down to the nearest integer. 292 days corresponds to a vessel utilisation factor of 80 per cent.

1. As described in Chapter 4 daily shipping costs are represented in this Report as both capital, operating and voyage costs (to set an upper bound), and voyage costs only (to set a lower bound).

APPENDIX II—SENSITIVITY ANALYSIS

The magnitude of benefits flowing from Hydrographers Passage depends on a number of factors, the most significant of which are forecast volumes of coal exports and average load size of vessels. In this appendix, the effects of the adoption of optimal load sizes and a 20 per cent reduction in future coal exports are investigated.

OPTIMAL LOAD SIZES

Table II.1 lists benefits accruing to users of Hydrographers Passage where load sizes are optimal (see Table 4.2). The increase in load size would result in a reduction in the number of trips each year required to transport the coal, and thus reduce the level of benefits accruing from use of the Passage. This lower level of benefits is shown in Table II.1. These are conservative estimates, as vessels which load fully at Hay Point would tend to use Hydrographers Passage on their inward leg instead of the route up the coast from southern ports. This effect has been omitted to test the sensitivity of the results to assumptions about load size.

Also set out in Table II.1 are the benefit-cost ratios (for the no-helipad option) arising from the assumption of optimal load sizes.

TABLE II.1—DISCOUNTED BENEFITS AND BENEFIT-COST RATIOS ASSUMING OPTIMAL LOAD SIZE

	Discount rate (per cent)		
	7	*10*	*13*
Discounted benefits			
Total ship cost savings ($m)	93.16	64.61	48.23
Voyage cost savings only ($m)	23.00	15.95	11.91
Benefit-cost ratios			
Total ship cost savings	9.75	7.60	6.14
Voyage cost savings only	5.62	4.38	3.54

Source: BTE.

These results indicate that the project is economically viable if optimal load sizes are assumed.

REDUCED COAL EXPORT FORECASTS

The effect of a 20 per cent reduction in forecast coal exports is examined in this section. Benefits and the benefit-cost ratios resulting from these streams of benefits are summarised in Table II.2.

These results indicate that despite a 20 per cent reduction in coal exports, the development of Hydrographers Passage would be economically viable at all discount rates less than 13 per cent.

TABLE II.2—DISCOUNTED BENEFITS AND BENEFIT-COST RATIOS ASSUMING REDUCED COAL EXPORTS

	Discount rate (per cent)		
	7	*10*	*13*
Discounted benefits			
Total ship cost savings ($m)	105.73	73.33	54.58
Voyage cost savings only ($m)	26.10	18.10	13.51
Benefit-cost ratios			
Total ship cost savings	11.07	8.63	6.94
Voyage cost savings only	2.73	2.13	1.72

Source: BTE.

TABLE II.3—DISCOUNTED BENEFITS AND BENEFIT-COST RATIOS ASSUMING REDUCED COAL EXPORTS AND OPTIMAL LOAD SIZE

	Discount rate (per cent)		
	7	*10*	*13*
Discounted benefits			
Total ship cost savings ($m)	74.53	51.69	38.58
Voyage cost savings only ($m)	18.40	12.76	9.52
Benefit-cost ratios			
Total ship cost savings	7.80	6.08	4.91
Voyage cost savings only	1.93	1.50	1.21

Source: BTE.

REDUCED COAL EXPORTS COMBINED WITH OPTIMAL LOAD SIZE

Where both sensitivity assumptions operate (that is, both reduced coal exports and optimal load size) benefits will accrue in the manner outlined in Table II.3.

Under the scenario of reduced coal export tonnages combined with optimal load size, the project remains economically viable.

APPENDIX III—PROPOSED NAVIGATIONAL AIDS

The proposed navigational aids are shown in Figure III.1.

The following is a description of the navigational aids proposed for each of the reef sites.

WHITE TIP REEF LIGHTS

Rear main light

Structure 20 nautical mile light supported on a 30 metre high tower fitted with a radar transponder beacon (Racon) and a 15-17 nautical mile standby light.

Function Provides a landfall light and radar aid for locating the seaward entrance to the Passage for inbound vessels and, together with the front lead light on White Tip Reef, forms the line of leading marks for accurate course guidance between shoaled patches approximately 8 nautical miles to seaward from the reef entrance.

Front lead light

Structure 15-17 nautical mile light supported on an 18 metre high tower fitted with a standby light of similar range.

Function Together with the rear main light on White Tip Reef forms the line of leading marks for accurate course guidance between shoaled patches approximately 8 nautical miles to seaward from the reef entrance. This light also provides course guidance between Bugatti Reef and Little Bugatti Reef and marks the western extremity of the reef entrance.

BOND REEF DAYMARK/RADAR REFLECTOR

Structure 5 metre high daymark and passive radar reflector mounted on a 7 metre high concrete or stainless steel column.

Function Provides an additional radar bearing to identify the turning point from the line of leading marks (across White Tip Reef) to the reef entrance for inbound vessels, and marks the eastern extremity of the reef entrance.

LITTLE BUGATTI REEF LIGHT

Structure 15-17 nautical mile light supported on a 22 metre high tower fitted with a standby light of similar range.

Function Provides course guidance between White Tip Reef and Bond Reef, and provides course guidance south of Little Bugatti Reef until within range of the Creal Reef light. This light also provides bearings to identify three course turning points in the northern section of the Passage.

CREAL REEF LIGHT

Structure Same as the rear main light on White Tip Reef.

Function Provides course guidance between Little Bugatti Reef and Creal Reef, and from Creal Reef to the inshore end of the Passage between Cole Reefs and Stevens Reefs. This light also marks the turning points between the east-west and north-south legs of the Passage.

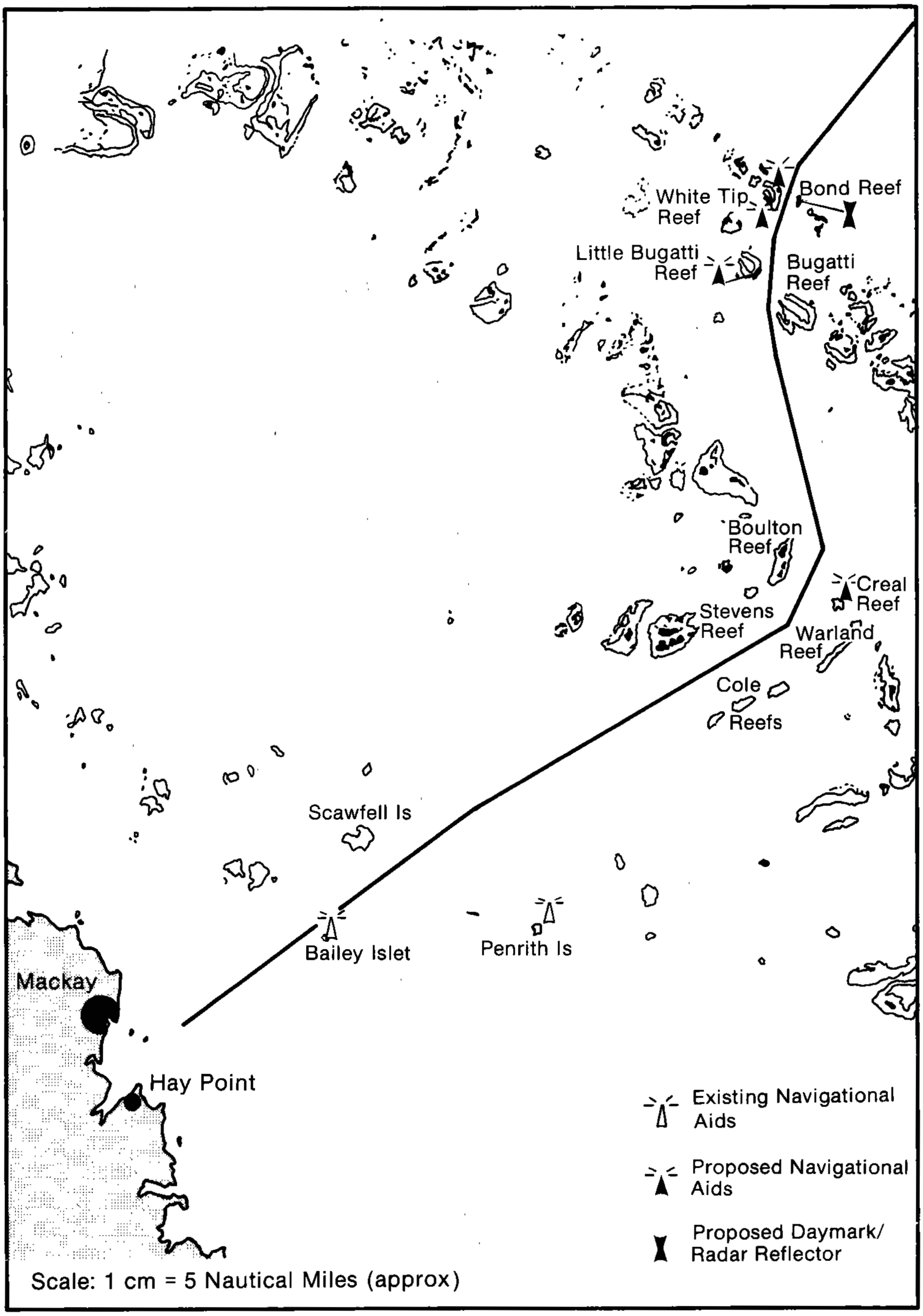

Figure III.1. Hydrographers Passage Navigational Aids

APPENDIX IV—COST RECOVERY—LIGHT DUES

LIGHT DUES

Light dues are levied to recover 100 per cent of the commercial cost of providing, maintaining and operating marine navigational aids. Light dues are levied in accordance with the Commonwealth *Lighthouses Act* 1911-1973. The rate of light dues is prescribed by Regulation 15 of the Lighthouse and Light Dues Regulation. The current rate, which has been operative from 1 October 1982, is 49 cents per net registered tonne.

Light dues are payable in respect of a seagoing ship, which, in the course of its voyage to or from an Australian port, passes a marine navigational aid under the control of the Commonwealth. Light dues are payable on the first day of each quarter to a Collector at the home port of the ship or at such other ports as the owner or agent of the ship has notified to a Collector at the home port before the date on which the dues become payable. Light dues are payable every three months provided the ship makes at least one voyage into Australian waters during that period. Additional voyages incur no additional charges.

RECOVERY OF COSTS—HYDROGRAPHERS PASSAGE

The projected cost of existing navigational aids in 1982-83 is $28 347 700[1]. This is to be recovered from shipping moving through Australian ports which in 1982-83 is estimated to total 56.3 million net registered tonnes. At the prescribed rate of 49 cents per net registered tonne, recovery of costs will be achieved at a rate of 97 per cent.

The construction of lighthouse towers and navigational aids required to make Hydrographers Passage operational will require additional costs of $1 719 600 (in the case where towers are constructed with helipads) or $1 351 100 (without helipads) to be recovered in the first year of operation of the Passage. These amounts assume that interest is payable on the capital cost at a rate of 15 per cent and that the cost of the towers is depreciated over 40 years and navigational aids over 10 years. Furthermore, it assumes that construction commences during 1984 and is completed early in 1985 at which time Hydrographers Passage would be navigable by shipping.

Costs to be recovered from Hydrographers Passage are in addition to the costs of $28 347 700 which must be recovered in respect of existing navigational aids. Total costs to be recovered in the first year of operation of Hydrographers Passage are therefore $30 067 300 (with helipads) or $29 698 800 (without helipads). This assumes no real increase in costs since 1982-83.

Total costs are to be recovered from vessels moving through Australian ports. If it is assumed that tonnage in 1985-86 is 56.3 million (the estimated net registered tonnage in 1982-83) plus or minus five per cent, and that 100 per cent cost recovery is achieved, then light dues will be as outlined in Table IV.1. Assuming a net registered tonnage of 56.3 million, light dues will need to be increased to 53.4 cents per net registered tonne (for the helipads option) or to 52.8 cents per net registered tonne for the option without helipads.

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1. DTC, Marine Operations Division.

TABLE IV.1—LIGHT DUES RESULTING FROM DEVELOPMENT OF HYDROGRAPHERS PASSAGE

(1982 prices)

Total cost to be recovered *($)*	*Net registered tonnage* *(million tonnes)*	*Light dues* *(cents/net registered tonnes)*
With helipads		
	53.5	56.2
30 067 300	56.3	53.4
	59.1	50.9
Without helipads		
	53.5	55.5
29 698 800	56.3	52.8
	59.1	50.3

Source: BTE.

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ABBREVIATIONS

AUSREP	Australian Ship Reporting Procedures
BTE	Bureau of Transport Economics
cif	customs, insurance and freight
DTC	Commonwealth Department of Transport and Construction
DWT	Deadweight Tonnes
fob	free on board
GRP	glass reinforced plastic
GRT	Gross Registered Tonnage
NSW	New South Wales
USA	United States of America
VHF	very high frequency
WOCOL	World Coal Study