Demand for Sea Passenger Transport between Tasmania and the Australian Mainland

Report

This Report was prepared in response to a Ministerial reference to the Bureau relating to an investigation of the demand for sea passenger transport between Tasmania and the mainland.

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BUREAU OF TRANSPORT ECONOMICS

Demand for Sea Passenger Transport between Tasmania and the Australian Mainland

Australian Government Publishing Service
Canberra 1980

ISBN 0 642 05044 9

Printed by C. J. THOMPSON, Commonwealth Government Printer, Canberra

FOREWORD

This Report was prepared in response to a Ministerial reference to the Bureau relating to an investigation of the demand for sea passenger transport between Tasmania and the mainland.

The Bureau was initially requested to report on this matter by 30 September, 1980. However, on 18 March the Bureau was directed to bring forward the reporting date to 31 May, 1980.

The central part of this Report is an examination of various service options for meeting the demand for sea passenger transport. In order to do this the Bureau developed an econometric model of demand for sea passenger transport which was then used to forecast likely demand under the various options. Each option was costed and the net present value of the various options was estimated.

Because of the change in reporting deadline, some of the Bureau's research initiatives on this topic have not been completed. The consulting firm, Implementation and Management Group, were commissioned to design a questionnaire and set up an analysis plan for a detailed survey of potential demand for sea passenger travel. This survey was conducted by the Bureau. The findings of this survey have not been used in this Report, however it is intended to publish these at a later date. It is also anticipated that a computer manual to facilitate use of the demand model developed for this Report will be produced as soon as possible.

The Bureau held discussions with numerous persons associated with passenger services between Tasmania and the mainland and wishes to express its appreciation for their assistance under a tight time frame. Mr Douglas White, Captain Graham Smethurst and Mr John Grace, of ANL, provided key information on some of the cost estimates used in the Report. Various port authorities

provided advice on port facilities which was used in identifying options. The Ship Design Group of the Commonwealth Department of Industry and Commerce provided valuable information relating to the capital costs and other technical data of various ships. The Commonwealth Department of Transport provided assistance with documents on which the discussion of the historical background to the service is based. Mr Ed Patterson, Department of Tourism in Tasmania provided useful additional background information. Nicholas Clark and Associates carried out the ticket survey which is described in Appendix 4 and also provided assistance with the analysis of the survey of potential demand.

(Colin A. Gannon)
Director

Bureau of Transport Economics
Canberra
August 1980

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CHAPTER 1 - SCOPE AND PURPOSE OF THE REPORT

For the purposes of this Report, the Bureau has been required to consider the type of shipping arrangements between Tasmania and the mainland which could be construed as a 'passenger service'.

If the Commonwealth concern for a passenger service between Tasmania and the mainland is related to the principle that, as far as possible, Tasmanians should not be disadvantaged by their island location, then it could be considered necessary for a sea passenger service to provide for the transport of private vehicles in order that Tasmanians may use their private vehicles when on the mainland and mainlanders have access to their private vehicles when visiting Tasmania. This objective can be attained by operating a service from a single point on the mainland to a single point in Tasmania.

The Bureau has confined consideration of alternative sea passenger services to those which have the potential to carry a significant number of passengers and their vehicles and operates between either Melbourne or Westernport on the mainland and northern Tasmania.

Chapter 2 provides the background to the development of sea transport services across Bass Strait. The way in which sea passenger services of various standards have been provided since the first European settlement is outlined. The chapter also contains an historical account of the level and form of Commonwealth financial assistance for the service.

In Chapter 3 there is a description of the physical attributes of the existing Tasmania-mainland transport passenger services. The effects of the current fare structure on modal split and the characteristics of the current demand pattern are also discussed.

Various options for meeting the demand for sea passenger services are considered in Chapter 4. Previous studies undertaken by other organisations are outlined. Alternative vessel sizes and speeds are considered as well as two types of service - an overnight passenger service similar to that currently provided by the 'Empress of Australia', and a daylight passenger service similar to that recommended by Commissioner Nimmo. The chapter concludes with cost estimates for a variety of alternative services.

In Chapter 5 an econometric model of the demand for sea travel across Bass Strait is described. The model is then used to make demand forecasts for the alternative services identified in the previous chapter. These forecasts of numbers of travellers form the basis for estimating gross passenger revenue for the alternative ship configurations which are considered in the study.

In Chapter 6 the various options considered in the study are evaluated. The results indicate that the most financially viable option is a daylight passenger/overnight freight service operating between Westernport and Burnie involving two vessels each with a capacity of 200 persons and capacity to transport 75 vehicles. The results also suggest that, provided the passenger service is supplemented by the carriage of freight, no further subsidy of the service would be required.

Chapter 7 contains the detailed conclusions of the study.

CHAPTER 2 - SEA PASSENGER SERVICES BETWEEN TASMANIA AND THE MAINLAND: AN OVERVIEW

This chapter gives a brief overview of the historical development of trans Bass Strait passenger services. In the development of these services, the Second World War marks a natural dividing point. In the pre-war period, passenger transport across Bass Strait was dominated by private shipping firms, while sea transport services in the post-war period have been dominated by the Australian Shipping Commission which is a Commonwealth Government instrumentality. The post-war period has been one of considerable technological change in coastal passenger shipping and marks the decline in sea transport as the principal mode used for the movement of passengers between Tasmania and the mainland.

EUROPEAN SETTLEMENT TO WORLD WAR II

Since 1804, the year of the first European settlement on the island of Tasmania, passenger travel between Tasmania and the mainland has been serviced by sea transport. While a number of trade routes across Bass Strait have subsequently been established, the shortest sea link between Tasmania and the mainland approximates two hundred kilometres.

Until 1853, when Tasmanian convict transportation was terminated, most passengers were convicts or garrison troops, with a small number of free settlers. In the 1830s, with the settling of Port Phillip and South Australia, the number of inter-colonial sailing vessels increased considerably. However, throughout this sailing-ship period, passengers remained subsidiary to the shipping of cargo. Regular passages were advertised, but the vagaries of weather and the practice of masters to wait until sufficient cargo accumulated meant they were not adhered to.

The first recorded steamship service to Tasmania was in 1837. In 1852 services were established on a regular basis. It was

not until the late 1860s that steam vessels started to make more voyages than sailing ships between Tasmania and the mainland. Composite cargo and passenger vessels were the norm until the late nineteenth century when vessels became more passenger oriented. From the late nineteenth century to World War I, Tasmania was serviced by a fleet of fast and relatively economical passenger ships, some plying between the mainland and Tasmania via New Zealand, and some sailing directly across Bass Strait.

During the period between the first and second world wars, a first generation passenger ferry, the 'Taroona' was introduced. This ship was basically constructed for cabin passengers but it did include limited provision for motor vehicles as well as freight. However, passenger services in this period generally declined. The service via New Zealand for instance was terminated in the late 1920s. Nevertheless, as Table 2.1 indicates, some 80 per cent of travellers between Melbourne and Tasmania were using sea transport before the second world war.

POST WORLD WAR II DEVELOPMENTS

In 1934 the first Tasmania-mainland air service was introduced. Technical improvements, during and after World War II, together with the dislocative effects on Bass Strait shipping, accelerated a shift to air travel. As can be seen from Table 2.1, in 1939 approximately 82 per cent of travellers from Melbourne to Tasmania went by sea. In 1948 the figure was 23 per cent. Currently, approximately 10 per cent of travellers prefer travel by sea.

In addition to the pronounced switch in mode preference, a change occurred in the ownership of the shipping services. The last privately owned passenger ferry, the 'Taroona', ended its Bass Strait service in 1959. In the same year the Australian Shipping Commission, trading as the Australian National Line (ANL),

TABLE 2.1 - ESTIMATED SEA/AIR PASSENGER TRAVEL BETWEEN MELBOURNE AND TASMANIA FOR SELECTED YEARS: 1938 TO 1979[a]

('000)

Year	Sea	Air	Total	%Sea
1938	53	12	65	82
1939	55	13	68	81
----	--	--	--	--
1948	47	153	200	23
1949	44	187	231	19
1950	46	194	240	19
1951	39	201	240	16
1952	42	228	270	15
1953	37	217	254	15
1954	36	224	260	14
----	--	---	---	--
1974	133	891	1 024	13
----	---	---	-----	--
1979	112	1 030	1 142	10

(a) Calender years.

Source: Commonwealth Department of Transport unpublished statistics.

entered the service. Increasing costs and declining patronage had made the 'Taroona' unprofitable, even though it had been subsidised by the Commonwealth from 1935. Consequently, private shipowners were reluctant to continue the service. Commonwealth Government recognition of the need for a Tasmania-mainland sea link led to ANL ordering a new, second generation car ferry, the 'Princess of Tasmania', in 1956. This ferry had an average speed of approximately 17 knots. It was a roll-on roll-off vessel, capable of carrying 100 vehicles which was considerably more than the first generation car ferry, along with 334 passengers and freight.

The 'Princess of Tasmania' officially entered the Bass Strait trade in October, 1959. It travelled three times weekly out of Melbourne to Devonport. Up to June 1960 over 65 000 passengers travelled on the ship between Melbourne and Devonport. In the first full year of operation, 1960-61, over 83 000 passengers utilised the service (Table 2.2).

In 1969 the 'Australian Trader' and the 'Empress of Australia' joined the Tasmania-mainland trade. The former operated 3 times a week out of Melbourne while the latter sailed 3 times a fortnight between Sydney and Tasmania. In 1972 the 'Princess of Tasmania' was withdrawn from the Melbourne-Devonport (Tasmania) run and was replaced by the 'Empress of Australia'. The 'Australian Trader' was transferred to the Sydney-Tasmania service and continued in service on this route until 1976.

The information in Table 2.2 shows some of the effects of the changes of ships on routes. The table gives details of the total passengers moved, the number of passengers moved on each route and the vessels used, for each year, 1959-60 to 1978-79. When the sea passenger service operated between Sydney and Tasmania, 1964-65 to 1975-76, annual patronage was around 20 000 passengers with a peak of around 27 000 passengers occurring in 1968-69. Since 1969-70 when the 'Australian Trader' was introduced into the Bass Strait trade, sea passenger travel between Melbourne

TABLE 2.2 - SEA PASSENGER ARRIVALS AND DEPARTURES, TASMANIA: 1959-60 TO 1978-79

Year	Melbourne - Devonport Route		Sydney - Hobart, Bell Bay and Burnie Route		Total Passengers
	Vessels Used	Passengers	Passengers	Vehicles Used	
1959-60	Prin. of Tasmania	65 429	-	-	65 429
1960-61	"	83 498	-	-	83 498
1961-62	"	86 968	-	-	86 968
1962-63	"	88 626	-	-	88 626
1963-64	"	89 212	-	-	89 212
1964-65	"	89 599	10 815	Emp. of Australia	100 414
1965-66	"	88 119	22 174	"	110 293
1966-67	"	87 427	24 642	"	112 069
1967-68	"	87 893	26 733	"	114 626
1968-69	"	86 974	26 878	"	113 852
1969-70	Prin. of Tasmania and Aust. Trader	110 509	21 589	"	132 098
1970-71	"	102 900	22 923	"	125 823
1971-72	"	106 517	21 749	"	128 266
1972-73	Emp. of Australia	108 330	16 700	Australian Trader	125 030
1973-74	"	110 727	18 102	"	128 829
1974-75	"	114 790	18 802	"	133 592
1975-76	"	112 142	19 057	"	131 199
1976-77	"	111 622	484 (a)	"	112 106
1977-78	"	111 500	-	-	111 500
1978-79	"	112 320	-	-	112 320

(a) Trading figures for one month only as the 'Australian Trader' ended its service in July 1976.

Source: Australian Shipping Commission statistics.

and northern Tasmania has been relatively constant, ranging from 102 000 to 112 000 passengers. Over the period 1959-60 to 1974-75 total patronage of sea passenger services exhibited an upward trend reaching a peak of 133 500 passengers in 1974-75. Patronage subsequently declined to around 112 000 passengers in 1978-79.

COMMONWEALTH ASSISTANCE

A direct Commonwealth subsidy for the Bass Strait service was first granted in 1935 to Tasmanian Steamers Pty Ltd for the operation of the 'Taroona'. This subsidy of $52 000 per annum was estimated on the basis of allowing the company to meet taxation and depreciation at 5 per cent per annum and to pay dividends of 6 per cent per annum. From time to time various ad hoc arrangements were also entered into. For instance, when the 'Nairana', which was in operation on the route, was requisitioned in World War II the company was paid its net expenditure plus 9 per cent of the capital cost of the vessel.

Throughout the 1950s, Tasmanian Steamers Pty Ltd received a direct subsidy. The level of subsidy received is shown in Table 2.3.

In addition the Commonwealth provided a grant of $350 000 for refitting the 'Taroona' in order that it could continue in operation on the route.

With the introduction of the 'Princess of Tasmania' in 1959 no subsidy was paid. Subsidy payments were recommenced for the year 1973-74 when $1 million per annum subsidy was granted for the operation of the 'Empress of Australia'.

TABLE 2.3 - 'TAROONA' SUBSIDY

Year (ended 30 April)	Amount ($)
1951	42 000
1952	115 341
1953	134 286
1954	155 321
1955	164 346
1956	165 085
1957	182 430
1958	190 962
1959	179 573

Source: Commonwealth Department of Transport.

Two major Commonwealth investigations have been undertaken into the operations of the Bass Strait route. In March 1955 an inter-departmental committee considered the question of whether any Commonwealth assistance was warranted. They recommended that temporary assistance should be continued largely because the 'Taroona' carried mail and that to transfer the mail service to air transport would involve additional expense. In the longer term the committee recommended that a more suitable vessel be acquired.

This led to the ordering of the 'Princess of Tasmania', which did not receive a subsidy throughout its 13 years of operation on the route.

The second major inquiry was commenced in April 1974 when Mr J.F. Nimmo was requested by the Commonwealth to report on, amongst other matters, the existence and extent of any differences between the level of charges for the transport of

persons between Tasmania and the mainland of Australia, and between locations on the mainland. The terms of reference also covered an investigation of measures that might be taken to eliminate any such differences.

The Commission accepted that Commonwealth policy at the time was to encourage tourists to visit Tasmania, and to assist Tasmanians visiting the mainland by approving sea passenger fares that failed to meet the cost of the service.

The Commission suggested that the most efficient service would be a daylight service provided by two vessels operating between Westernport and Burnie. It also suggested that until such time as a more efficient sea passenger service was introduced, the Commonwealth Government should provide a subsidy of $2 million per annum on the condition that the 'Empress of Australia' made three trips per week, and that ANL increased fares and charges so that when account is taken of the subsidy, the operation is economically viable.

The Commonwealth has, for its part, acted on these Nimmo recommendations. Since 1976-77 a subsidy of $2 million per annum has been provided for the operation of the 'Empress of Australia'. In the interim, ANL has investigated possible alternatives which could lead to a reduction in the subsidy, such as a semi-submersible catamaran and a jetfoil. ANL has concluded that neither of these options is economically or operationally viable.

CHAPTER 3 - PASSENGER TRANSPORT BETWEEN TASMANIA AND THE MAINLAND

This chapter presents a description of the physical attributes of the existing passenger transport services between Tasmania and the mainland and the effects of the current fare structure on the modal split between air and sea. Consideration is also given to the characteristics of the current demand pattern.

The principal sources of information are the 1978 ABS Visitor Survey, air passenger statistics provided by the Commonwealth Department of Transport (DOT), Trans-Australia Airlines (TAA) and Ansett Airlines of Australia (AAA) and a survey of tickets issued to passengers travelling on the 'Empress of Australia' service which is described in Appendix 4.

SEA PASSENGER TRANSPORT

One regular sea transport passenger service is provided between Tasmania and the mainland. This service is operated by ANL with the 'Empress of Australia'. This vessel travels between Melbourne and Devonport (see Figure 3.1).

The 'Empress of Australia' is a roll-on, roll-off passenger vehicular ferry, of 2735 deadweight tonnes(1). The ship is 135.6 metres long, with a vehicle deck of 117 metres. The ship can accommodate 444 passengers and has the capacity for 145 passenger vehicles(2). Passenger accommodation consists of 124 cabins and 190 reclining lounge chairs.

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(1) Australian Shipping Commission, The Australian National Line Annual Report, 1979, p.32.

(2) Unaccompanied vehicles can also be carried by Union Bulkships between Melbourne and Hobart of Sydney and Hobart.

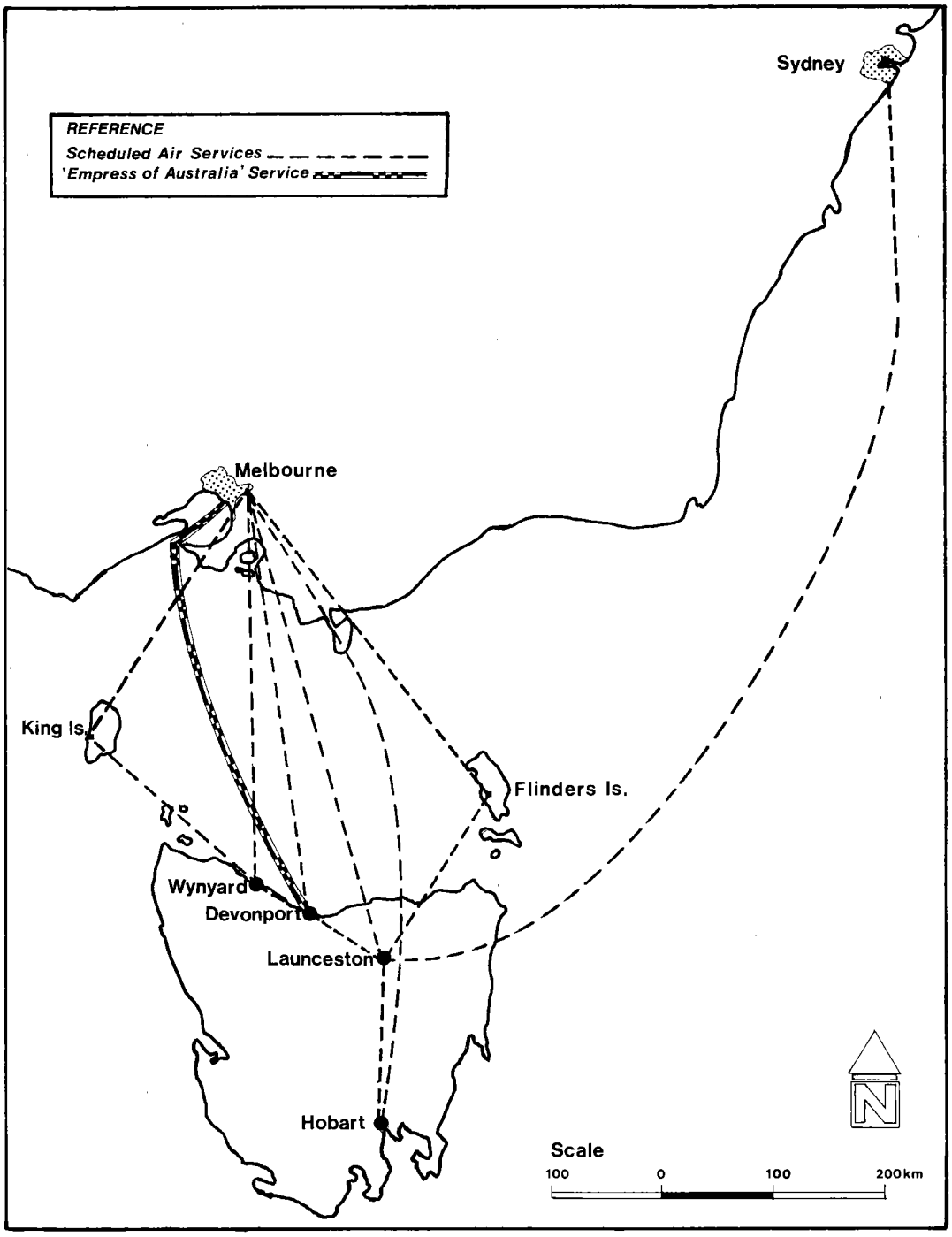

FIGURE 3.1 – TASMANIA – MAINLAND PASSENGER TRANSPORT SERVICES (a)

(a) Launceston – Gold Coast air services not shown

The 'Empress of Australia' makes three return journeys a week between Devonport and Melbourne. Each sailing involves a night crossing of Bass Strait, with a scheduled sailing time of 14 hours. Normally in excess of 300 voyages, that is at least 150 return crossings of Bass Strait, are undertaken each year, thus offering capacity for over 133 ooo passenger movements per annum. In 1978-79, 112 000(1) passengers travelled across Bass Strait on the 'Empress of Australia'. The annual average utilisation of passenger accommodation over the 5 years to 1978-79 exceeded 80 per cent.

AIR PASSENGER TRANSPORT

There are a number of scheduled passenger services between Melbourne and Tasmania. These are operated principally by TAA and AAA. The air major routes are between Melbourne and Hobart, Launceston, Devonport and Wynyard and are illustrated in Figure 3.1.

The airlines offer a high frequency of air service using a variety of aircraft, ranging in size from the F-27 to the B727-200. Typical flying time for direct flights between Hobart and Melbourne is 65 minutes.

Estimates based on data provided by the DOT reveal that a total of 1 254 000 seats were provided by TAA and AAA during 1978-79. Details of the estimated seat capacity are provided in Table 3.1.

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(1) See Table 2.2.

TABLE 3.1 - ESTIMATED SEAT CAPACITY, TAA AND AAA: 1978-79
('000)

Route	TAA	AAA	TOTAL
Melbourne-Hobart	352.6	336.6	689.2
Melbourne-Launceston[a]	163.6	183.3	346.9
Melbourne-Wynyard	106.8	111.0	217.8
Total	623.0	630.9	1 253.9

(a) Includes patronage between Melbourne and Devonport.

Source: Derived from DOT, Air Transport Statistics, Domestic Air Transport 1977.

In 1978-79, 1 011 000 passengers travelled between Tasmania and the mainland by air. This amounted to an overall utilisation rate of 81 per cent[1], a level very similar to that achieved by the 'Empress of Australia' service.

A COMPARISON OF AIR AND SEA FARES

The main types of passenger fares for sea and air services are outlined in Tables 3.2 and 3.3 respectively. The median one-way charge for an accompanied vehicle on the sea voyage is $145.30, and there is no extra charge for the return journey of the vehicle provided this occurs within twelve months of the original crossing.

(1) This figure is the total number of passenger journeys over the total number of seats available.

TABLE 3.2 - MELBOURNE-DEVONPORT SEA FARES: 1979-80

Type of Accommodation	Return Adult Fares	
	Standard[a]	Off-Season[b]
	$	$
Sleeping lounge-chair	69.20	60.40
4 berth cabin	82.60	71.80
2 berth cabin	102.60	89.20
2 berth cabin deluxe[c]	152.60	132.80
Single berth cabin (without facilities)	110.20	96.00
Single berth cabin (with facilities)[d]	140.00	122.00
Suite	166.00	144.60

(a) Applies 15 December to 31 May.

(b) Applies 1 June to 14 December.

(c) Superior appointed cabins with private shower and toilet.

(d) With private shower and toilet.

Source: ANL, Empress of Australia Schedule of Fares and Sailings, December 1979.

TABLE 3.3 - TASMANIA-MAINLAND AIR FARES: 1979-80

Route	Return Adult Fares					
	Economy	First Class	Super Apex[a]	Apex[b]	Budget[c]	Standby (single fare)
Melbourne-Hobart	118.40	148.00	71.00	88.80	100.60	41.00
Melbourne-Launceston	99.00	123.80	59.40	74.30	84.20	35.00
Melbourne-Devonport	79.80	99.80	-	-	-	-
Melbourne-Wynyard[d]	79.80	99.80	-	-	-	-

(a) Super Apex fares are available on return tickets only, booked and paid for at least 45 days prior to departure. No concession rates are available for children or students.
(b) Apex fares are available on return ticket only, booked and paid for at least 40 days prior to departure. No concession rates are available.
(c) Budget fares are available at certain specified times on off-peak flights and apply to return travel only. No concession rates are available.
(d) Service operated only by AAA.

Note: The mix of, and conditions applicable to, 'promotional' fares have changed over time.

Source: TAA and AAA fare schedules, December 1979.

Air transport offers the cheapest return fare between Tasmania and the mainland. The cheapest air fare, the Super Apex return air ticket between Melbourne and Launceston was $59.40 whereas the cheapest 'Empress of Australia' fare on offer was $60.40. Such a comparison is however fairly simplistic because both fares applied only for off-peak travel and the definition of off-peak varied between modes.

The standard return 'Empress' fare for travel over the peak December-January period was $69.20 for a lounge chair and $82.60 for a four-berth cabin, compared to $79.80 for a return economy air fare between Melbourne and Devonport.

In summary the 'Empress' has a cost advantage for peak period travel.

Both fare structures include provision for a range of concessional fares. The concessional fares offered by the 'Empress' service may be imputed from Table 3.4. This table also reveals the penetration of these concessions into the standard fare structure: over 25 per cent of tickets are issued with a concession of some sort. Consequently, sea travellers, on average, pay about 90 per cent of the scheduled fare.

Concessional fares are also offered by air. Details of concessional penetration of the air fare schedules are contained in Table 3.5. In excess of 35 per cent of air travellers receive some form of fare concession. Consequently, air passengers, on average, pay about 95 per cent of the scheduled fare. Significantly, pensioners who receive a 55 per cent discount on the 'Empress' receive no concessions on air fares.

TABLE 3.4 - TRAFFIC MIX ACCORDING TO FARE CATEGORY ON THE 'EMPRESS OF AUSTRALIA': 1979

Fare Types	Percentage of Full Adult Fare	Percentage of Revenue Passengers
Standard Fare	100	74.4
Student (aged 15-19 years)	67.66	1.6
Student (aged 19 and over)	90	1.4
Group travel	90	1.1
School tours (off-season only)	80	-
Child concession	50	1.1
Searoad economy holiday	85	4.4
Commonwealth pensioner	45	15.1
Tour operator concession	95	0.9
Agents staff concession	50	-
Waterside Workers Federation	85	-
Total		100.0

Source: BTE Empress of Australia Ticket Survey, 1979: for details see Appendix 4.

TABLE 3.5 - AIR TRAFFIX MIX ACCORDING TO FARE CATEGORY, ALL ROUTES, 1977

Type of Fare Concession	Percentage of Normal Fare	Percentage of all Revenue Passengers
Economy:		
Full Economy - Adults	100	50.6
Full Economy - Children	50	8.7
Staff	25	1.5
Students	65	4.7
Off Peak/Winter/Apex	80	5.3
Group	90	9.5
Holiday Packages	85	5.2
'See Australia'	70	0.1
First:		
Full First Class - Adults	100	9.2
Full First Class - Children	50	0.4
Staff	20	0.8
Students	65	0.2
Standard:		
Full Standard - Adults	100	3.7
Full Standard - Children	50	0.1
Total		100.0

Source: C.A. Gannon, 'Pricing of Domestic Airline Services - Selected Aspects of Fares on Australia's Competitive Routes', Domestic Air Transport Policy Review, Table 3.3, p.124, Appendix A10.1, Vol II, AGPS, 1979.

CHARACTERISTICS OF THE CURRENT DEMAND PATTERN

In this section a number of the characteristics of passenger demand for sea and air travel between Tasmania and the mainland are examined.

Total Patronage

A total of 1 123 000 people travelled between Tasmania and the mainland during 1978-79 (see Table 3.6). Approximately 112 000 (or 10 per cent) of these used the 'Empress of Australia' service. The remainder travelled by air between the mainland and Hobart, Launceston, Devonport and Wynyard.

Modal split

Table 3.6 outlines the modal split between sea and air for travel between Tasmania and the mainland during 1978-79. Air is the dominant mode with 90 per cent of interstate passenger travel.

TABLE 3.6 - SEA AND AIR PASSENGER TRAVEL BETWEEN TASMANIA AND THE MAINLAND: 1978-79

Mode	Passenger Travel to Tasmania		Passenger Travel from Tasmania		Total
	'000	%	'000	%	'000
Sea	57	10	55	10	112
Air	502	90	509	90	1 011
Total	559	100	564	100	1 123

Source: ANL and DOT.

Distribution of Travellers by Mode and Purpose of Travel

The relative attributes of sea and air travel depends in part on the value which travellers attach to travel time. This is a function of trip purpose.

The distribution of passenger travel by mode and trip purpose is described in Table 3.7.

TABLE 3.7 - ESTIMATED DISTRIBUTION OF PASSENGER TRAVEL BETWEEN TASMANIA AND THE MAINLAND, BY MODE AND PURPOSE OF TRAVEL: 1978-79

(per cent)

Mode	Purpose of Travel		
	Holiday	Other (including business)	Total
Sea	9.5	0.5	10.0
Air	56.5	33.5	90.0
Total	66.0	34.0	100.0

Source: Bureau of Transport Economics estimates derived from data contained in Visitor Survey, 1978. Department of Tourism and Australian Bureau of Statistics Tasmania.

Holiday travel formed a major part of the demand for travel to Tasmania. About two-thirds of all visitors travelled to Tasmania for purposes related to holidays. Over 95 per cent of sea traffic may be identified as holiday travellers against 63 per cent of air traffic.

The preference of non-holiday travellers for air reflects the time advantage of air which becomes much more important for trips of shorter duration and as the opportunity 'cost' of time increases.

Origin and Destination of Travellers

More than half of the visitors to Tasmania reside in Victoria. Conversely, Victoria is the most popular destination for Tasmanian residents. Tables 3.8 and 3.9 outline the origins of visitors to Tasmania and the destinations of adult Tasmanian residents, by choice of mode.

Sea travel is relatively more popular with visitors from NSW than from any other State. Twenty per cent of visitors from NSW travelled by sea whereas less than 10 per cent of all other interstate visitors chose this mode (see Table 3.8).

Tasmanians travelling to the mainland have a marked preference for air travel; over 92 per cent of Tasmanians travelling to the mainland travel by air (see Table 3.9).

As would be expected preference for air is a function of distance; people travelling from the more distant origins are more likely to travel by air. The data available generally supports the contention that visitors from more distant origins are less likely to travel by car (and therefore less likely to choose the 'Empress of Australia' service).

Length of Stay

Adult visitors to Tasmania in 1978 spent an average of 10.4 nights on the island. Sea travellers spent relatively more time in Tasmania than did air travellers, staying for an average of 18.5 nights. The average length of stay of visitors using the air mode was 9.2 nights(1).

(1) Visitor Survey, 1978. Department of Tourism and Australian Bureau of Statistics Tasmania.

TABLE 3.8 - ORIGIN OF VISITORS TO TASMANIA BY MODE OF TRAVEL: 1978

('000)

Mode of Travel	State or Origin					Overseas	Total
	NSW	Vic	Qld	SA	Other[a]		
Sea	12	13	3	4	3	-	35
Air	48	135	19	19	19	13	253
Total	60	148	22	23	22	13	288

(a) Given the small volume of traffic from both the territories and Western Australia these figures have been combined.

Source: Visitor Survey, 1978. Department of Tourism and Australian Bureau of Statistics Tasmania.

TABLE 3.9 - DESTINATION OF ADULT RESIDENTS OF TASMANIA: BY MODE OF TRAVEL: 1978

('000)

Mode	Furtherest Destination						Total[a]
	NSW	Vic	Qld	SA	WA	Overseas	
Sea	3	9	2	1	1	1	18
Air	32	99	27	12	16	20	203
Total[a]	35	108	29	13	17	21	221

(a) Totals do not add due to rounding.

Source: Bureau of Transport Economics.

Estimates of the composite cost of two typical Tasmanian holidays[1] reveal that the relative attraction of a sea-based holiday vis-a-vis an air-based holiday tends to increase as length of stay increases. For example, the cost of an air-based holiday for four people incorporating a hire car and hotel/motel accommodation was $728 for one week rising to $1724 for four weeks. In comparison a sea-based holiday for four people taking their own car and using hotel/motel accommodation was $631 for one week rising to $1081 for four weeks.

Seasonality

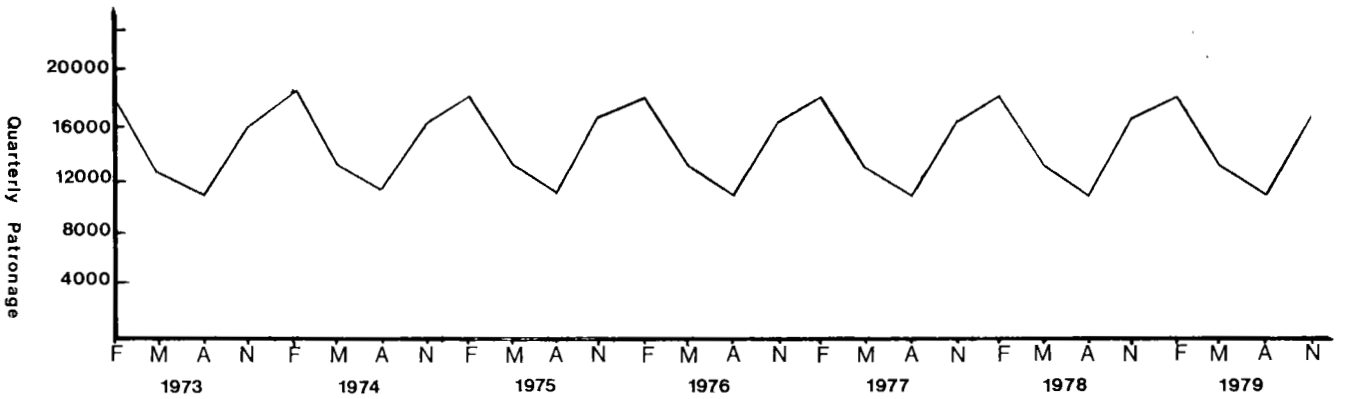
The extent of variation in demand by season can be gauged from Figures 3.2 and 3.3. It is evident from Figure 3.2 that the demand for sea travel displays persistent seasonality, with the peak periods being the first and fourth quarters, covering the months of January-March and October-December.

The demand for air travel is also seasonal in nature, with peak periods being the first, and to a lesser extent the fourth, quarters.

The extent of seasonality is greater in the case of sea travel than it is for air travel.

An analysis of the monthly variation in the demand for sea transport reveals that there may be a considerable number of individuals who would like to travel on the 'Empress of Australia' at a certain time of the year but are unable to do so because of insufficient ship capacity. Passenger load factors are very high for the period December-March (see Figure 3.4).

(1) These figures were compiled from published tariffs etc contained in Tasmanian Travelways, Department of Tourism and Immigration, Tasmania, October-November 1979



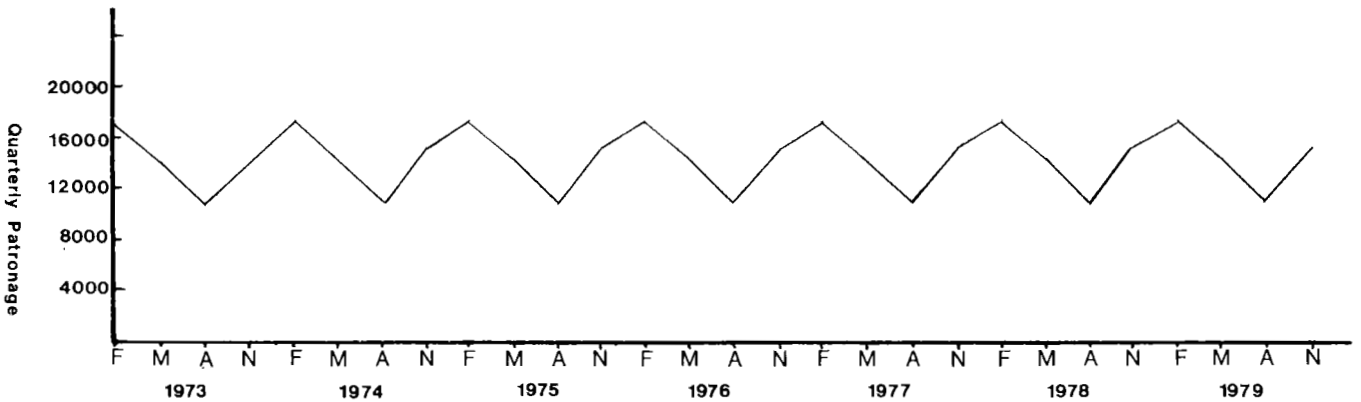
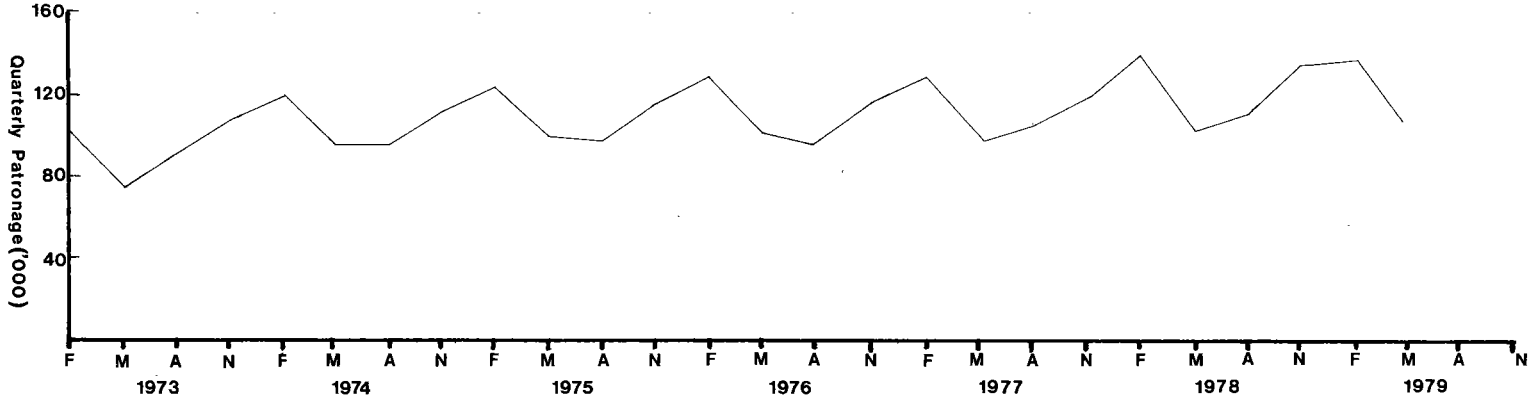


FIGURE 3.2 – VARIATION IN TRAVEL DEMAND, EMPRESS OF AUSTRALIA



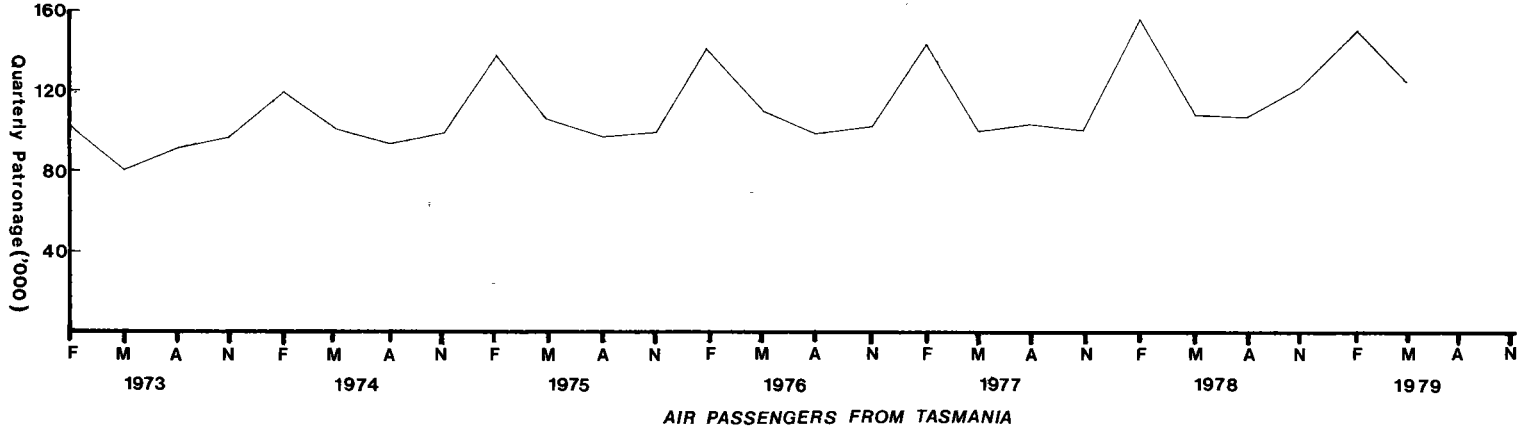


FIGURE 3.3 – VARIATION IN TRAVEL DEMAND, AIR SERVICES

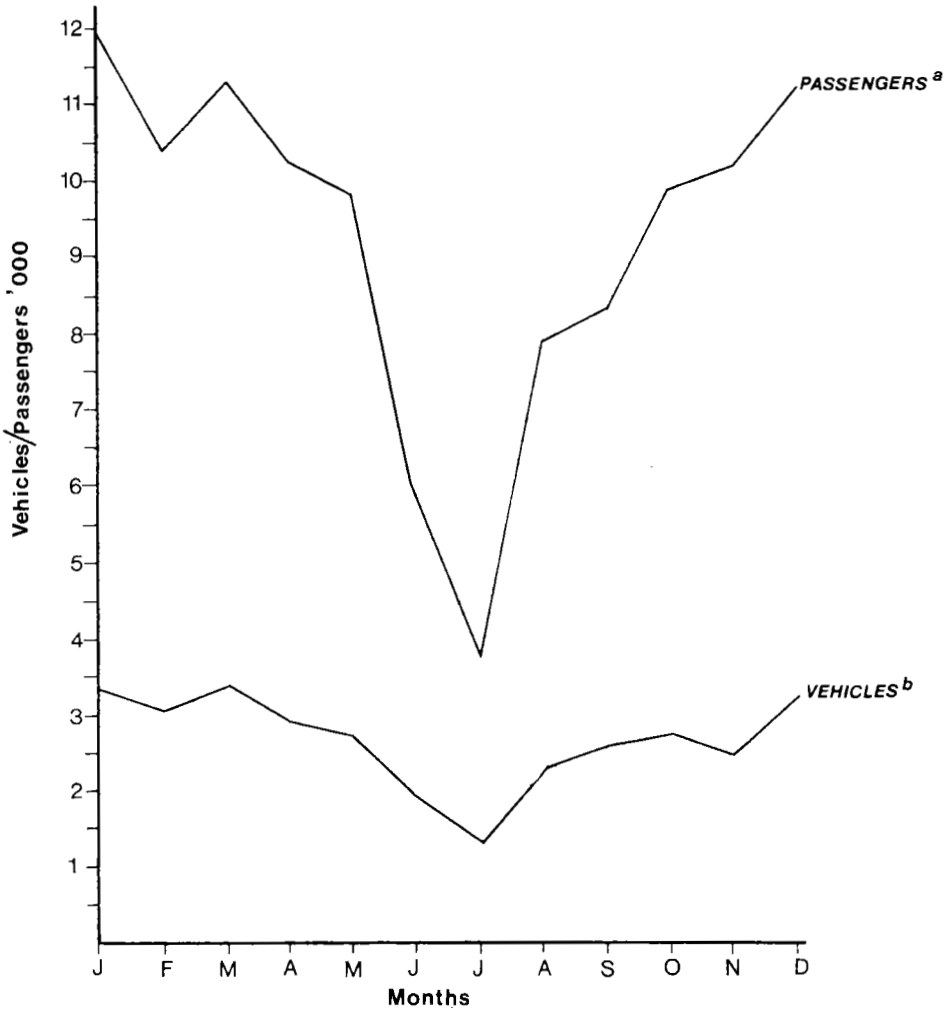


FIGURE 3.4 – MONTHLY VARIATION IN SEA DEMAND, EMPRESS OF AUSTRALIA 1979,

(a) Both directions

(b) Accompanied vehicles

THE CONTRIBUTION OF SEA PASSENGERS TO THE TASMANIAN ECONOMY

In 1979 the estimated 320 000 people from the mainland who visited Tasmania spent an average of $340[1] during their visit. This resulted in the direct expenditure of $109 million. Based on national input-output relationships this expenditure would have resulted in the employment of approximately 4 700 persons in Tasmania. Allowing for leakages from the Tasmanian economy through the importation of goods and services from the mainland, this tourist expenditure made an addition of $87 million to the Tasmanian Gross Domestic Product.

Visitors to Tasmania using the 'Empress of Australia' service contributed an estimated $10 million dollars and resulted in the employment of about 550 persons. The balance of $77 million and 4 150 persons was contributed by tourists arriving by air[2].

These figures should not be taken as implying that the closure of the 'Empress of Australia' service would result in a loss to the Tasmanian economy. As noted above air transport is the most preferred mode and many of those visitors who currently travel by sea could be expected to elect to go by air if a sea-based service was not available. Indeed, given the preference for holidays based around a private motor vehicle, it is likely that those visitors presently taking their own vehicle aboard the 'Empress of Australia' would elect to travel to Tasmania by air and hire a car in Tasmania. This would result in an increase in visitor expenditure in Tasmania and may well more than outweigh the partial loss of visitors that may follow any closure of the 'Empress of Australia' service.

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(1) Based on data contained in Visitor Survey 1978, Department of Tourism and Australian Bureau of Statistics Tasmania, 1979 prices.

(2) A more accurate calculation of the effect of tourist expenditure on the Australian economy will be possible when the latest Tasmanian Input-Output table is released.

SUMMARY

A total of more than one million passengers travelled between Tasmania and the mainland during 1979. Air transport accounted for 90 per cent of this total.

Holiday-makers represented 66 per cent of the travellers to and from Tasmania and most chose to travel by air.

The 'Empress of Australia' accounted for 10 per cent of total Tasmania-mainland travel during 1979. The 'Empress of Australia' catered predominantly for holiday-makers and in this regard competed with air transport. A lower proportion (8 per cent) of Tasmanian residents travelling interstate chose to travel by sea.

In 1979 most visitors to Tasmania were Victorian; similarly Victoria was the most popular destination for Tasmanians travelling interstate.

On average, sea travellers spent 18.5 nights in Tasmania, twice the length of stay of air mode visitors. This is consistent with the cost information mentioned above which suggested that visitors would tend to switch from air to sea in response to a change in the price relativities between air- and sea-based holidays. This is due to the cost of hiring a car which unlike the cost of transporting a private vehicle increases with length of stay.

Seasonal trends in the demand for passenger services were evident during 1979, particularly for the sea mode. Demand peaked in the first quarter. During this period, insufficient ship capacity may have prevented some passengers from travelling on the 'Empress of Australia'.

CHAPTER 4 - OPTIONS FOR MEETING DEMAND

The purpose of this chapter is to outline a range of possible alternative sea passenger services plying selected routes across Bass Strait and to develop estimates of the costs of these alternatives. The first section sets out the various routes under consideration. This is followed by an outline of previous studies which have attempted to examine the financial viability of some future services. Finally, cost estimates for a variety of operating strategies are presented.

ALTERNATIVE ROUTE CONFIGURATIONS

The accompanying map of southern Victoria and northern Tasmania (See Figure 4.1), illustrates that the following alternative routes considered in this report are:

- Melbourne-Devonport
- Melbourne-Burnie
- Westernport Bay-Devonport
- Westernport Bay-Burnie.

The draught and berth limitations of the wharves at these ports are indicated in Table 4.1 while Table 4.2 details the lengths of the four routes considered.

PREVIOUS STUDIES

The 'Empress of Australia' was commissioned in January 1965 and is considered to be approaching the end of her period of efficient operation[1]. At present the Commonwealth Government is providing an annual subsidy of $2 million dollars to the

(1) Report of the Commission of Inquiry into Transport to and from Tasmania (AGPS, Canberra 1976), p.71, commonly referred to as the Nimmo Commission.

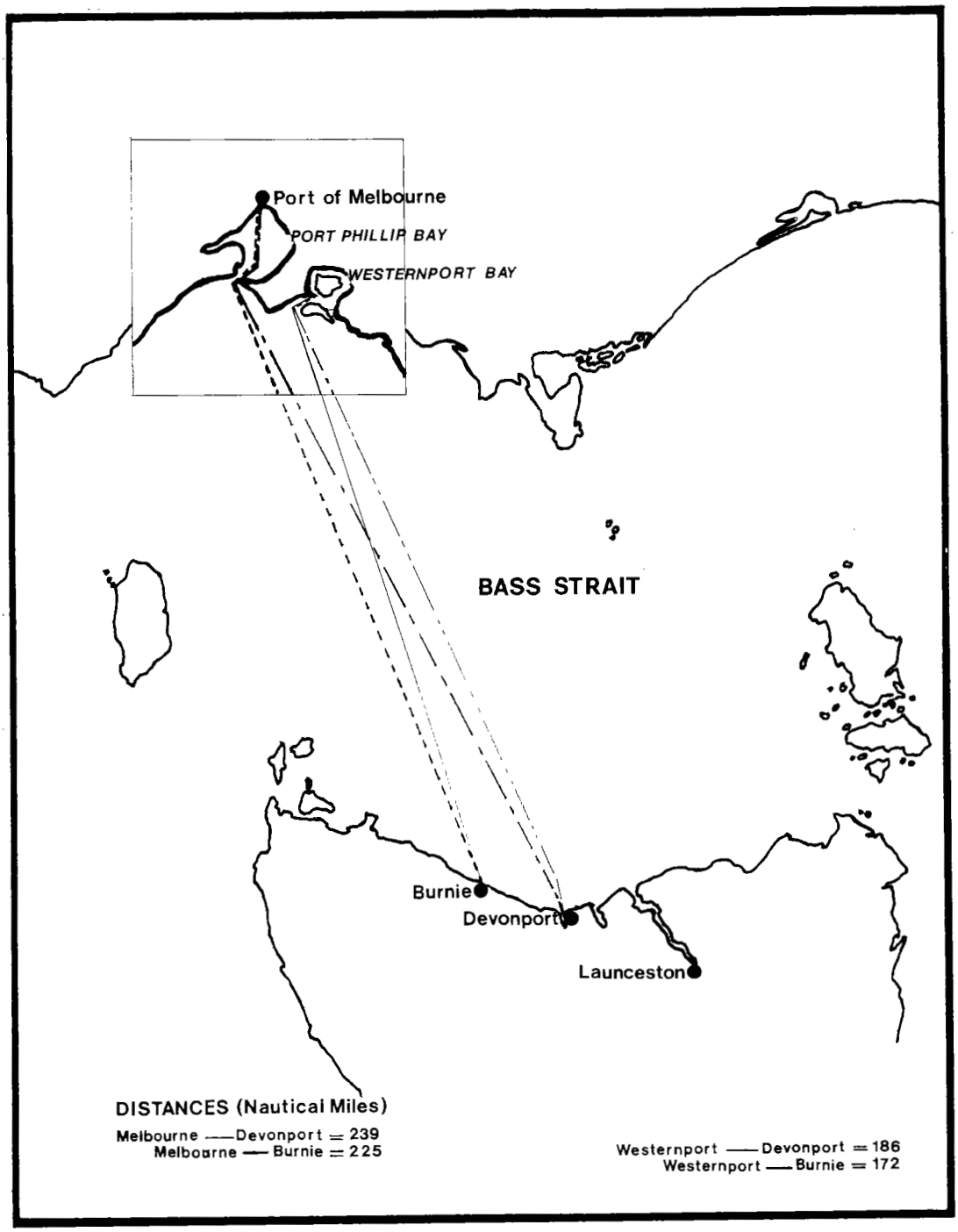

FIGURE 4.1 – ALTERNATIVE SEA TRANSPORT ROUTES ACROSS BASS STRAIT

TABLE 4.1 - WHARF CAPACITY AT SELECTED PORTS FOR PASSENGER VESSELS

Wharf	Depth alongside wharf (metres)	Maximum berth (metres)
Melbourne (Webb Dock No. 1)	7.0	137
Westernport Bay[a] (Stoney Point Jetty)	6.0	-
Burnie (Ferry Terminal)	9.4	198
Devonport (East Wharf No. 1 Berth)	7.0	152

(a) At present no suitable passenger terminal exists in Westernport Bay. If a terminal were to be sited at Stoney Point in Westernport Bay some dredging near the wharf may be necessary to give a 6 metre clearance.

Source: Port authorities and Australian Chamber of Shipping, Directory of the Ports of Australia Seventh Edition - 1979 (January 1979).

TABLE 4.2 - DISTANCE BETWEEN SELECTED PORTS

Route	Distance (nautical miles)					
	Pilot to Pilot	Pilotage				Total
		Burnie	Devonport	Westernport Bay	Port Phillip Bay	
Melbourne-Devonport	189		2		48 (a)	239
Melbourne-Burnie	175	2			48 (a)	225
Westernport Bay-Devonport	169		2	15		186
Westernport Bay-Burnie	155	2		15		172

(a) Distance calculated using deep water channel (South Channel) in Port Phillip Bay.

Source: Australian Chamber of Shipping, Directory of the Ports of Australia Seventh Edition - 1979 (January 1979).

Australian Shipping Commission to operate the service. As was mentioned above, the influence of these two factors has resulted in a number of studies being undertaken to examine the financial viability of future services.

The two main studies undertaken to date relating to the future of Bass Strait sea passenger services examine the feasibility of a jetfoil service and a fast daylight passenger service.

Bass Strait Jetfoil Service

A preliminary study to evaluate the possibility of operating a jetfoil service between Melbourne and Tasmania has been jointly undertaken by P. & O. Ferries Limited and the Tasmanian Government. Ideally, the service would have most potential if it could link city centres such as Melbourne and Launceston. However, the jetfoil vessel considered required 6.4 metres of water for full speed operations. This depth of water is only available in the Tamar River as far as Windemere at low water and for this reason, it was proposed that the service operate out of Devonport. Two jetfoils each seating 230 passengers were considered for the service. No passenger vehicles were to be carried on the service.

The findings of the study were that there were no prospects of a profitable operation. It was assumed in the study that the only guaranteed traffic available was the estimated 40 000 passengers per annum now travelling by the 'Empress of Australia'. Furthermore, jetfoil rates were set at 75 per cent of economy air fares. The capital cost of the two craft (including the spares inventory and other start-up costs) was estimated at $A23 million in 1979.

It was emphasised in the study that the route length of approximately 230 nautical miles, the five to six hour passage time and the weather unreliability were significant operational disincentives. It can be appreciated that running a service

through Bass Strait would be a testing challenge for a jetfoil and its operators. As far as the Bureau is aware, no such distance has been covered in regular passenger jetfoil operations.

Thus it was concluded that the proposed Bass Strait Jetfoil Service was neither operationally practical nor commercially viable.

Fast Daylight Passenger Service

A fast daylight sea passenger service was recommended by Commissioner Nimmo in his 1976 report. The service would be provided by two vessels operating between Westernport Bay and Burnie (the shortest sea crossing). Each vessel would be designed to complete a return crossing in twenty-four hours. By simultaneously operating a vessel in each direction, the majority of passengers and their cars would be carried on daylight crossings.

On the return trip at night each vessel would move predominantly freight in the form of trailers or pantechnicons(1). However, demand fluctuations for passengers and freight could be catered for by moving additional freight by day or additional passengers and their cars by night.

The Commission's advisers, Canadian-Pacific Consulting Services Limited, estimated that '... at 1974 costs ... and with the fares and freight rates then being charged for the Bass Strait crossing, the vessels could have been operated on an economic basis'(2).

(1) This study assumed that all the cargo presented would have to be on wheels and would remain on those wheels to be towed off the vessel on completion of the sea journey.
(2) Nimmo Commission, op.cit., p.71.

The proposed vessels would carry approximately 250 passengers and 60 cars each completing six round trips per week. It was postulated that the daylight passenger crossing would enable a reduction in the overall number of crew needed, compared with the number at present employed on the 'Empress of Australia'(1). Furthermore, Canadian-Pacific Consulting Services advised the Commission that freight revenue could increase well above the levels earned by the 'Empress of Australia'(2).

Thus the recommendation by Commissioner Nimmo for a fast daylight passenger service is based, to a large extent, on:

- a reduction in operating costs (through a reduction in crew costs); and
- increase in freight revenue.

ALTERNATIVE OPERATING STRATEGIES

There is a much wider range of options for the provision of a Bass Strait passenger service than those previously mentioned. Possibilities include operation over the other routes mentioned above (see Figure 4.1). Vessels of different sizes and configurations, and hence different passenger capacities, could also be considered, each size configuration of vessel being capable of providing various qualities of service.

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(1) This assumption may not be realistic. The Bureau has been advised that in accordance with maritime union manning requirements the total number of personnel required to operate two vessels simultaneously would not be significantly different from that currently employed on the 'Empress of Australia'.

(2) The potential increase in freight revenue was not quantified in the Nimmo Commission.

Since this Report has been prepared under a tight time frame, and emphasis in the Bureau's terms of reference is placed upon demand considerations, the Bureau has only considered two distinct types of service using conventional vessels(1). However, the methodology developed to undertake this study has general application irrespective of the type of service. The two service types are:

- the provision of a service similar to that currently offered by the 'Empress of Australia' - an overnight combined passenger and freight crossing, completing three round trips each week hereafter denoted Type A service; and

- the daylight passenger/overnight freight service similar to that proposed by Commissioner Nimmo, with two vessels each completing six return trips per week hereafter denoted Type B service.

In addition to the two distinct types of service, the Bureau in consultation with the Ship Design Group of the Commonwealth Department of Industry and Commerce(2), considered various vessel service speeds. On the basis of the maximum voyage times allowed, Table 4.3 presents the practicality of these services over the four routes discussed earlier.

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(1) The Bureau has enquired into the application of new technology to passenger ferries, such as the semi-submersible catamaran ferry. Currently the development of this technology is not sufficiently advanced for passenger vehicles to be transported. Consequently, this option was not evaluated by the Bureau.

(2) Details of the information supplied to the Bureau by the Ship Design Group of the Commonwealth Department of Industry and Commerce are shown in Appendix 3.

TABLE 4.3 - PRACTICALITY OF PROPOSED PASSENGER SERVICES

	Passenger Service			
	Overnight (A)		Daylight (B)	
Vessel Service Speed (knots)	17	22	17	23
Maximum Voyage Duration (Hours)	14.5	9.0	10.5	8.0
Route	Feasibility			
Melbourne-Devonport	P	NP	F	NP
Melbourne-Burnie	P	NP	F	NP
Westernport Bay-Devonport	P	P	P	F
Westernport Bay-Burnie	P	P	P	P

P denotes practical
F denotes possible, but not considered practical
NP denotes not practical

Source: Ship Design Group, Commonwealth Department of Industry and Commerce.

Of the sixteen alternatives set out in Table 4.3, it can be seen that there are nine options considered practical. For each of these practical options three alternative ship passenger and passenger car capacities were examined. The selected vessel carrying capacities are detailed in Table 4.4.

TABLE 4.4 - VESSEL CARRYING CAPACITIES - SELECTED OPTIONS

Capacity Options	Passenger Service					
	Overnight (A)			Daylight (B)		
No. of Passengers	700	550	400	350	275	200
No. of Cars	200	175	150	100	85	75

Source: Bureau of Transport Economics.

In total, therefore, the Bureau developed 27 options (9 service alternatives x 3 capacity alternatives). For each option, technical data and construction costs were provided by the Ship Design Group of the Commonwealth Department of Industry and Commerce. Using this information and data supplied by ANL and various port authorities, total annual operating costs were estimated, based upon the following cost components:

- voyage
- management (hire)
- terminals
- cargo gear
- administration
- depreciation.

The costs of the various options for meeting demand have been estimated and are presented in Table 4.5(1). The vessel denoted by the code A400/17a, that is, an overnight service operating 6 one-way trips per week between Melbourne and Devonport with the capacity to carry 400 passengers and 150 vehicles, approximates the service currently being provided by the 'Empress of Australia'.

It should be noted, however, that in some cases the Bureau could do no more than postulate the likely variations in certain cost components resulting from changes in vessel size and speed. Therefore the estimates set out in Table 4.5 should be regarded as indicative only. Explanation of the assumptions underlying the derivation of costs is provided in Appendix 3, together with background data provided by the Ship Design Group of the Commonwealth Department of Industry and Commerce.

(1) Estimation procedures are outlined in Appendix 3.

TABLE 4.5 - ESTIMATED ANNUAL OPERATING COSTS FOR EACH PASSENGER SERVICE OPTION
($ million - 1980 prices)

Option	Vessel/Route Code[a]	Cost Item						Total
		Voyage	Management (Hire)	Terminals	Cargo Gear	Administration	Depreciation	
1	A700/17a	2.218	7.626	1.330	0.080	1.093	1.750	14.097
2	A550/17a	2.048	6.814	1.330	0.080	1.093	1.600	12.965
3	A400/17a	1.879	6.065	1.330	0.080	1.093	1.500	11.947
4	A700/17b	2.121	7.626	1.330	0.080	1.093	1.750	14.000
5	A550/17b	1.959	6.814	1.330	0.080	1.093	1.600	12.876
6	A400/17b	1.798	6.065	1.330	0.080	1.093	1.500	11.866
7	A700/17c	1.851	7.626	1.330	0.080	1.093	1.750	13.730
8	A550/17c	1.708	6.814	1.330	0.080	1.093	1.600	12.625
9	A400/17c	1.566	6.065	1.330	0.080	1.093	1.500	11.634
10	A700/17d	1.754	7.626	1.330	0.080	1.093	1.750	13.633
11	A500/17d	1.619	6.814	1.330	0.080	1.093	1.600	12.536
12	A400/17d	1.484	6.065	1.330	0.080	1.093	1.500	11.552
13	A700/22c	2.309	7.939	1.330	0.080	1.093	2.000	14.751
14	A550/22c	2.116	7.128	1.330	0.080	1.093	1.850	13.597
15	A400/22c	1.922	6.316	1.330	0.080	1.093	1.700	12.441
16	A700/22d	2.182	7.939	1.330	0.080	1.093	2.000	14.624
17	A550/22d	1.999	7.128	1.330	0.080	1.093	1.850	13.480
18	A400/22d	1.817	6.316	1.330	0.080	1.093	1.700	12.336
19	B350/17c	4.146	8.049	1.330	0.080	1.093	2.100	16.798
20	B275/17c	3.675	7.643	1.330	0.080	1.093	1.900	15.721
21	B200/17c	3.203	6.572	1.330	0.080	1.093	1.800	14.078
22	B350/17d	3.893	8.049	1.330	0.080	1.093	2.100	16.545
23	B275/17d	3.447	7.643	1.330	0.080	1.093	1.900	15.493
24	B200/17d	3.005	6.572	1.330	0.080	1.093	1.800	13.880
25	B350/23d	6.848	8.676	1.330	0.080	1.093	2.600	20.627
26	B275/23d	6.203	8.395	1.330	0.080	1.093	2.500	19.601
27	B200/23d	5.593	7.325	1.330	0.080	1.093	2.400	17.821

Note: For details of estimation procedures see Appendix 3.

(a) Vessel Code: First letter: A or B - A denotes overnight service, B denotes daylight service
Three digit number: passenger capacity - note daylight service involves two vessels of the specified capacity whereas overnight service involves one vessel
Two digit number: denotes vessel speed in knots
Lower case letter: route code - a = Melbourne-Devonport
b = Melbourne-Burnie
c = Westernport Bay-Devonport
d = Westernport Bay-Burnie

Source: Bureau of Transport Economics.

SUMMARY

In this chapter various options for meeting the demand for sea passenger services have been established. Previous studies undertaken by other organisations have also been outlined. Alternative vessel sizes and speeds have been considered as well as two types of service - an overnight passenger service similar to that currently provided by the 'Empress of Australia', and, in accordance with the terms of reference, a daylight passenger service similar to that recommended by Commissioner Nimmo. The chapter concludes with cost estimates for a variety of operating strategies.

CHAPTER 5 - PASSENGER DEMAND FOR SEA TRAVEL

In this chapter an econometric model of the demand for sea travel across the Bass Strait is developed. This model is then used to make forecasts of the number of persons and gross operating revenue for various ship configurations which were identified in the previous chapter.

AN ECONOMETRIC MODEL OF DEMAND FOR SEA TRAVEL ACROSS THE BASS STRAIT

It is not intended to cover the formal demand model specification or the estimation technique in this chapter. These topics are dealt with in Appendix 2 of this Report which contains a detailed outline of the theoretical model of passenger demand and the method adopted to empirically estimate the model.

In broad terms the basic economic problem involved is to estimate the demand for a service - in this case sea travel by passengers across the Bass Strait - when supply is periodically constrained by vessel capacity.

The approach adopted has been to estimate a total corridor model which incorporates a system to allocate travel to separate modes.

The model consists of four equations. The first equation deals with total potential demand for travel in the corridor. Explanatory variables used in this equation include income level and the prices of air and sea travel relative to the general level of prices.

The second and third equations relate to the way in which the total potential demand estimated from the first equation is allocated between air and sea modes. Explanatory variables used in these two equations include income levels, the relative price of air and sea travel and the likelihood of experiencing

rough weather when making the sea crossing. An adjustment is also incorporated for the period up to July 1976 when both the 'Empress of Australia' and the 'Australian Trader' were in operation.

The fourth equation relates to the way in which potential demand for sea travel is translated into actual demand. In periods when the potential demand is well below vessel capacity, potential and actual demand are equal. However, in periods where potential demand approaches or exceeds vessel capacity, then some of the potential demand is not realised. The theory underlying the fourth equation is that when passenger to capacity ratio exceeds 90 per cent some potential passengers are discouraged from making the trip either because of the likely congestion which might reduce the attractiveness of the trip or, alternatively, because it is not possible to make a booking at the desired time. Furthermore, it is postulated that at the same fare structure passengers are indifferent to travelling between Westernport and Tasmania or Melbourne and Tasmania(1).

PROJECTIONS OF ALTERNATIVE SHIPPING SERVICES

Once the model had been estimated and it had been demonstrated that it performed adequately over the sample period, the model was set up in a computer simulation framework in order that projections of the likely demand for various vessel configurations could be made.

Forecasts were made over a period of twenty years commencing in June 1980. The model uses as input a basic scenario of the economy over the period 1980 to 2000. The scenario used is shown in Table 5.1.

(1) Preliminary results from the BTE Empress of Australia survey suggests that this is a reasonable assumption. The results of this survey which permit a more detailed assessment of the characteristics of demand, including fare/service trade-offs, are currently being prepared for publication as a BTE Occasional Paper.

TABLE 5.1 - ECONOMIC SCENARIO 1980-2000 USED FOR EVALUATION OF ALTERNATIVE SHIPPING SERVICES

Variable	Rate of Increase Assumed %
Consumer Price Index	6.0
Sea Passage Fare	6.0
Air Passage Fare	6.0
Population of Australia	1.31
Gross Domestic Product at Constant Prices per Head	1.81

Notes: These variables are formally defined in Table A2.1, Appendix 2.

Source: Bureau of Transport Economics.

The Consumer Price Index was assumed to rise at 6.0 per cent per annum over the period. The prices of sea travel and air travel were assumed to rise in line with increases in the general level of prices. Population projections were based on an annual rate of increase of 1.31 per cent. This is based upon an assumed rate of migration of 50 000 persons per annum. Gross Domestic Product per head at constant prices was assumed to rise at 1.81 per cent per annum which is probably in line with the observed rate of increase between 1971 and 1979.

Having established a suitable scenario on which to operate the model, six alternative ship configurations that are identified in the previous chapter were evaluated. These configurations were:

- an overnight service involving 6 one-way trips per week consisting of one vessel with provision for 700 passengers, 420 in berths and 280 in lounge chairs, and space for 200 vehicles (option A700);

- an overnight service involving 6 one-way trips per week consisting of one vessel with provision for 550 passengers, 330 in berths and 220 in lounge chairs, and space for 175 vehicles (option A550);

- an overnight service involving 6 one-way trips per week consisting of one vessel with provision for 400 passengers, 240 in berths and 160 in lounge chairs, and space for 150 vehicles (option A400);

- a daylight service involving 12 one-way trips per week consisting of two vessels each with provision for 350 passengers, all accommodated in lounge chairs, and space for 100 vehicles (option B350);

- a daylight service involving 12 one-way trips per week consisting of two vessels each with provision for 275 passengers, all accommodated in lounge chairs, and space for 85 vehicles (option B275); and

- a daylight service involving 12 one-way trips per week consisting of two vessels each with provision for 200 passengers, all accommodated in lounge chairs and space for 75 vehicles (option B200).

A summary of the results of evaluating the ship configuration options over the forecast period is shown in Table 5.2.

Options A700 and B350 cater for the largest demand. These two services involve identical vessel capacity. The A700, is a single 700 passenger ship with an overnight service and 6 trips per week, and the B350 is a two 350 passenger ship arrangement with a daylight service and 12 trips per week. This type of service could be expected to cater for 135 000 persons in 1980-81

TABLE 5.2 - ESTIMATED PASSENGER AND RELATED REVENUE FORECASTS FOR THE SIX SELECTED SHIP CONFIGURATIONS

Options	1980-81	1981-82	1982-83	1983-84	1984-85	1989-90	1999-2000
A 700							
Passengers (Numbers)	135 006	135 758	136 665	137 958	138 800	145 153	165 076
Gross Revenue[a] $000 (1979-80 prices)	7 593	7 636	7 686	7 759	7 807	8 164	9 285
A 550							
Passengers (Numbers)	126 028	126 648	127 405	128 793	129 240	134 855	153 623
Gross Revenue[a] $000 (1979-80 prices)	7 088	7 124	7 165	7 244	7 269	7 585	8 641
A 400							
Passengers (Numbers)	113 126	113 540	114 009	114 565	114 886	116 643	120 006
Gross Revenue[a] $000 (1979-80 prices)	6 363	6 387	6 412	6 444	6 462	6 561	6 750
B 350							
Passengers (Numbers)	135 006	135 758	136 645	137 958	138 800	145 153	165 076
Gross Revenue[a] $000 (1979-80 prices)	6 896	6 934	6 980	7 046	7 089	7 415	8 432
B 275							
Passengers (Numbers)	126 028	126 648	127 405	128 793	129 229	134 855	153 623
Gross Revenue[a] $000 (1979-80 prices)	6 437	6 469	6 507	6 578	6 600	6 889	7 847
B 200							
Passengers (Numbers)	113 126	113 540	114 009	114 565	114 886	116 643	120 006
Gross Revenue[a] $000 (1979-80 prices)	5 778	5 799	5 824	5 851	5 869	5 958	6 130

(a) Includes Fares, Vehicle Freight, Bar and Cafeteria Takings, less Commission/Agency Fees.

Source: Bureau of Transport Economics.

rising to 165 000 in 1999-2000. This compares with an estimated 113 000 in 1980-81 and 120 000 in 1999-2000 which would be catered for by a vessel with the capacity similar to the 'Empress of Australia'.

The major reasons for the differences in numbers carried between systems which offer larger capacity (such as A700 and B350) and those which offer lower capacity (such as A400 and B200) is the inability of the latter to meet potential demand in the peak March quarter. The maximum numbers achieved in a March quarter with the low capacity arrangements is between 31 and 32 thousand persons while the high capacity arrangements enable a maximum of between 51 and 54 thousand persons to be carried in a peak quarter. It should be noted however that the ability to transport a large volume of persons in the peak period is associated with low utilisation rates in the off peak period. Options A700 and B350 have utilisation rates in the September off-peak periods of approximately 50 per cent while options A400 and B200 maintain utilisation rates of approximately 90 per cent in the September quarter.

While the identical capacities of options A700 and B350 result in the same estimate for number of passengers carried, gross revenue from the two options differs considerably. The gross revenue gained from the overnight service is higher because a proportion of passengers using this service are willing to pay higher fares in order to obtain a sleeping berth whereas this does not occur on the daylight service.

CHAPTER 6 - FINANCIAL ANALYSIS OF OPTIONS

In this chapter the options previously outlined in Chapter 4 are evaluated using discounted flows of expected future net revenues obtained from alternative investments. These discounted net revenue flows (DNRF) ignore any taxation effects(1).

Annual operating costs of 27 options were estimated in Chapter 4 (see Table 4.5)(2). In Chapter 5 a demand model was developed with which it is possible to estimate both passenger and passenger vehicle revenues over the life of the proposed vessels. The expected gross passenger revenue figures are presented in Tables 6.1 and 6.2.

The difference in revenues between Table 6.1 and Table 6.2 for similar options is due to the fact that in Table 6.2 allowance has been made for the carriage of freight by the vessels involved. This has the effect in some instances of reducing available capacity for passengers' vehicles with a consequent reduction in both patronage and passenger revenue.

The DNRF of each option may be given by the following equation:

$$DNRF = \sum_{n=1}^{N} \frac{I_n}{(1+k)^n} - C + \frac{S_n}{(1+k)^N} \qquad (6.1)$$

(1) At 30 June 1979 the Australian Shipping Commission had an accumulated income loss of approximately $25.5 million (Australian Shipping Commission, The Australian National Line Annual Report, 1979, p.24). The benefit of this loss is available to ANL and is contingent upon future profits, and the continuance of existing provisions of the Income Tax Assessment Act. Given the existence of these accumulated losses which may be offset against any possible profits generated from a new service to replace the 'Empress of Australia', this approach may well be the most suitable.

(2) Operating costs are assumed to move in line with the general level of prices.

TABLE 6.1 - ESTIMATED PASSENGER RELATED REVENUE - IF NO FREIGHT IS CARRIED
($ million, 1979/80 prices)

Year	Option					
	A700	A550	A400	B350	B275	B200
1980-81	7.593	7.088	6.363	6.896	6.437	5.778
1981-82	7.636	7.124	6.387	6.934	6.469	5.799
1982-83	7.686	7.165	6.412	6.980	6.507	5.824
1983-84	7.759	7.244	6.444	7.046	6.578	5.851
1984-85	7.807	7.269	6.462	7.089	6.600	5.869
1985-86	7.872	7.325	6.486	7.149	6.652	5.890
1986-87	7.941	7.386	6.509	7.212	6.708	5.912
1987-88	8.035	7.478	6.554	7.298	6.792	5.955
1988-89	8.111	7.545	6.558	7.366	6.852	5.956
1989-90	8.164	7.585	6.561	7.415	6.889	5.958
1990-91	8.243	7.657	6.595	7.487	6.954	5.988
1991-92	8.360	7.768	6.637	7.592	7.054	6.026
1992-93	8.428	7.828	6.633	7.654	7.109	6.024
1993-94	8.526	7.919	6.650	7.744	7.193	6.039
1994-95	8.664	8.050	6.669	7.868	7.311	6.056
1995-96	8.777	8.156	6.655	7.970	7.407	6.071
1996-97	8.859	8.236	6.694	8.046	7.481	6.080
1997-98	8.980	8.353	6.707	8.156	7.587	6.090
1998-99	9.111	8.481	6.718	8.274	7.701	6.100
1999-2000	9.285	8.641	6.750	8.432	7.847	6.130

Source: Bureau of Transport Economics.

TABLE 6.2 - ESTIMATED PASSENGER RELATED REVENUE - IF FREIGHT IS CARRIED
($ million, 1979-80 prices)

Year	Option					
	A700	A550	A400	B350	B275	B200
1980-81	5.998	5.631	5.082	6.896	6.437	5.778
1981-82	6.017	5.639	5.088	6.934	6.469	5.799
1982-83	6.039	5.650	5.094	6.980	6.507	5.824
1983-84	6.068	5.670	5.103	7.046	6.578	5.851
1984-85	6.086	5.675	5.107	7.089	6.600	5.869
1985-86	6.102	5.690	5.113	7.149	6.652	5.890
1986-87	6.119	5.705	5.118	7.212	6.708	5.912
1987-88	6.143	5.728	5.129	7.298	6.792	5.953
1988-89	6.160	5.744	5.130	7.366	6.852	5.956
1989-90	6.174	5.754	5.131	7.415	6.889	5.958
1990-91	6.194	5.772	5.140	7.487	6.954	5.988
1991-92	6.223	5.800	5.150	7.592	7.054	6.026
1992-93	6.241	5.816	5.149	7.654	7.109	6.024
1993-94	6.265	5.838	5.154	7.744	7.193	6.039
1994-95	6.299	5.870	5.157	7.868	7.311	6.056
1995-96	6.327	5.895	5.162	7.970	7.407	6.071
1996-97	6.347	5.916	5.165	8.046	7.481	6.080
1997-98	6.377	5.945	5.168	8.156	7.587	6.090
1998-99	6.410	5.977	5.171	8.274	7.021	6.100
1999-2000	6.453	6.017	5.178	8.432	7.847	6.130

Source: Bureau of Transport Economics.

where $I_n = P_n + F_n - O_n$

and N is the life of the vessel(s)
I_n is the net cash inflow in the nth period
k is the discount rate
C is the initial capital cost
S_N is the salvage value
P_n is the revenue from passengers and passenger vehicles the nth period
F_n is the net revenue from freight in the nth period
O_n is the operating costs in the nth period.

A project life of 20 years is assumed(1). The salvage value is assumed to be zero for the purpose of this analysis. The formula then reduces to:

$$DNRF = \sum_{n=1}^{20} \frac{I_n}{(1+k)^n} - C \qquad (6.2)$$

As a first step the options are evaluated as if no freight revenue was earned. In other words, the only source of revenue is that derived from passengers and passenger vehicles.

The results of this DNRF calculation are shown in Table 6.3.

All DNRF figures in the table are negative indicating that from a commercial viewpoint <u>all</u> the options should be rejected. That is, if ANL was required to operate the Bass Strait service on a strictly commercial basis then replacement of the 'Empress of Australia' with a purely passenger/car ferry (transporting no freight) should not be undertaken, on the basis of the options examined.

(1) Operating costs are assumed to move in line with the general level of prices.

TABLE 6.3 - DISCOUNTED NET REVENUE FLOWS FOR OPTIONS - WITHOUT FREIGHT
(REVENUES FROM PASSENGERS AND PASSENGER VEHICLES ONLY)
($ million, 1979/80 prices)

Option	Discount Rate (%)							
	3	4	5	6	7	8	9	10
1	-122.6	-115.4	-109.0	-103.4	-98.5	-94.0	-90.1	-86.6
2	-111.3	-104.7	-99.0	-93.9	-89.4	-85.4	-81.8	-78.6
3	-110.2	-103.4	-97.4	-92.1	-87.4	-83.2	-79.6	-76.3
4	-121.2	-114.1	-107.8	-102.3	-97.4	-93.1	-89.2	-85.7
5	-109.9	-103.5	-97.9	-92.9	-88.5	-84.5	-81.0	-77.9
6	-109.0	-102.3	-96.4	-91.1	-86.5	-82.5	-78.8	-75.6
7	-117.2	-110.4	-104.5	-99.2	-94.6	-90.4	-86.7	-83.4
8	-106.2	-100.1	-94.7	-90.0	-85.8	-82.1	-78.7	-75.8
9	-105.6	-99.1	-93.5	-88.5	-84.1	-80.2	-76.7	-73.6
10	-115.7	-109.1	-103.3	-98.1	-93.5	-89.5	-85.9	-82.6
11	-104.9	-98.9	-93.6	-89.0	-84.9	-81.2	-77.9	-75.0
12	-104.4	-98.0	-92.4	-87.5	-83.2	-79.4	-76.0	-72.9
13	-137.3	-129.3	-122.2	-115.9	-110.4	-105.5	-101.1	-97.1
14	-125.7	-118.3	-111.9	-106.2	-101.1	-96.6	-92.6	-89.0
15	-121.6	-114.1	-107.5	-101.7	-96.6	-92.1	-88.1	-84.5
16	-135.5	-127.6	-120.6	-114.5	-109.0	-104.2	-99.9	-96.1
17	-123.9	-116.7	-110.4	-104.8	-99.9	-95.5	-91.5	-88.0
18	-110.0	-112.7	-106.2	-100.5	-95.5	-91.1	-87.1	-83.6
19	-181.0	-169.3	-159.0	-150.0	-142.0	-134.8	-128.5	-122.8
20	-168.7	-157.7	-148.0	-139.5	-132.0	-125.3	-119.3	-114.0
21	-156.9	-146.5	-137.4	-129.4	-122.3	-116.1	-110.5	-105.5
22	-177.3	-165.9	-155.9	-147.1	-139.3	-132.4	-126.2	-120.7
23	-165.3	-154.6	-145.2	-136.9	-129.5	-123.0	-117.2	-112.0
24	-153.9	-143.8	-134.9	-127.1	-120.2	-114.1	-108.7	-103.8
25	-248.0	-231.4	-216.8	-203.9	-192.5	-182.4	-173.5	-165.4
26	-238.4	-222.4	-208.4	-196.0	-185.1	-175.4	-166.7	-159.0
27	-224.6	-209.4	-196.1	-184.3	-174.0	-164.8	-156.6	-149.4

Source: Bureau of Transport Economics.

Estimates of net freight revenues have been added to the net income streams of the various options considered above. Details of the method used to estimate these freight revenues are provided in Appendix 5. It should be noted that freight revenue estimates are net of cargo handling costs. These estimates are presented in Table 6.4(1).

Once freight revenue estimates are added into the net income streams, the results are significantly altered. As demonstrated in Table 6.5, many options have positive DNRF results across a wide spectrum of discount rates.

Options 19 to 24 all appear to be viable. Table 6.6 summarises these 6 options. Option 24 is, on the criterion used, the preferred option. Conclusions which can be drawn from this analysis include:

- the daylight passenger/overnight freight service (Type B) is preferred on financial grounds to the combined overnight passenger/freight service (Type A);

- the two ships which are required to operate the service provide higher financial returns at the slower of the two steaming speed options considered (that is 17 knots rather than 23 knots);

- the ships provide marginally higher financial returns if operated on the Burnie-Westernport Bay route. The second most preferred route is the Devonport-Westernport Bay route;

- on both these routes the two ships which provide highest financial returns are those with a passenger capacity of 200.

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(1) The calculation of net freight revenues assume that the Tasmanian Freight Equalisation Scheme (TFES) subsidies wil continue.

TABLE 6.4 - ESTIMATED ANNUAL NET FREIGHT REVENUE

($ million, 1979-80 prices)

Option	Net Freight Revenue
1	8.568
2	8.179
3	7.790
4	8.568
5	8.179
6	7.790
7	8.568
8	8.179
9	7.790
10	8.568
11	8.179
12	7.790
13	8.828
14	8.568
15	8.179
16	8.828
17	8.568
18	8.179
19	14.281
20	13.502
21	12.983
22	14.281
23	13.502
24	12.983
25	15.839
26	15.060
27	14.281

TABLE 6.5 - DISCOUNTED NET REVENUES FOR OPTIONS (INCLUDING REVENUES FROM PASSENGERS, PASSENGER VEHICLES AND FREIGHT)

($ million, 1979-80 prices)

Option[a]	Discount Rate (%)							
	3	4	5	6	7	8	9	10
1	-25.3	-26.2	-27.1	-27.8	-28.4	-28.9	-29.4	-29.8
2	-17.4	-18.7	-19.9	-20.9	-21.8	-22.6	-23.3	-24.0
3	-15.5	-16.8	-17.9	-18.9	-19.8	-20.5	-21.2	-21.8
4	-23.9	-24.9	-25.9	-26.7	-27.4	-28.0	-28.5	-29.0
5	-16.1	-17.5	-18.8	-19.9	-20.9	-21.8	-22.5	-23.2
6	-14.3	-15.7	-16.9	-18.0	-18.9	-19.7	-20.5	-21.1
7	-19.9	-21.3	-22.5	-23.6	-24.5	-25.3	-26.1	-26.7
8	-12.3	-14.1	-15.7	-17.0	-18.2	-19.3	-20.2	-21.1
9	-10.9	-12.5	-14.0	-15.3	-16.4	-17.5	-18.3	-19.1
10	-18.4	-19.9	-21.3	-22.4	-23.5	-24.4	-25.2	-25.9
11	-11.0	-12.9	-14.6	-16.0	-17.3	-18.4	-19.4	-20.3
12	-9.7	-11.4	-13.0	-14.4	-15.6	-16.6	-17.6	-18.4
13	-36.2	-36.6	-37.0	-37.3	-37.6	-37.8	-38.0	-38.2
14	-26.0	-27.0	-27.9	-28.7	-29.4	-30.0	-30.6	-31.0
15	-21.1	-22.2	-23.2	-24.1	-24.9	-25.6	-26.2	-26.7
16	-34.3	-34.9	-35.4	-35.8	-36.2	-36.6	-36.8	-37.1
17	-24.3	-25.5	-26.5	-27.4	-28.2	-28.9	-29.5	-30.0
18	-19.5	-20.8	-21.9	-22.9	-23.8	-24.5	-25.2	-25.8
19	31.5	24.8	18.9	13.8	9.3	5.4	1.9	-1.3
20	32.2	25.8	20.3	15.4	11.1	7.3	4.0	1.0
21	36.3	29.9	24.4	19.5	15.2	11.4	8.0	5.0
22	35.2	28.3	22.1	16.7	12.0	7.8	4.2	0.9
23	35.6	28.9	23.1	18.0	13.5	9.5	6.0	2.9
24	39.2	32.6	26.9	21.8	17.3	13.4	9.8	6.7
25	-12.3	-16.1	-19.4	-22.2	-24.7	-26.9	-28.9	-30.6
26	-14.4	-17.7	-20.7	-23.3	-25.5	-27.5	-29.2	-30.8
27	-12.1	-15.3	-18.1	-20.5	-22.7	-24.6	-26.3	-27.8

(a) For option specification see Table 4.5.

Source: Bureau of Transport Economics.

TABLE 6.6 - SUMMARY OF PREFERRED OPTIONS

Options	Description of options					Discounted net revenues ($million 1979-80)		
	Type of service	Route	No. of vessels	Size of vessels (No. of passengers)	Vessel speed (knots)	r = 3%	r = 7%	r = 10%
19	daylight	Westernport Bay-Devonport	2	350	17	31.5	9.3	-1.3
20	daylight	Westernport Bay-Devonport	2	275	17	32.2	11.1	1.0
21	daylight	Westernport Bay-Devonport	2	200	17	36.3	15.2	5.0
22	daylight	Westernport Bay-Burnie	2	350	17	35.2	12.0	0.9
23	daylight	Westernport Bay-Burnie	2	275	17	35.6	13.5	2.9
24 (a)	daylight	Westernport Bay-Burnie	2	200	17	39.2	17.3	6.7

(a) Most preferred option.

Source: Table 6.5.

The discounted net revenue flow from the preferred option (Option 24) would be $17.3 million at the discount rate of 7 per cent per annum. This is the net revenue that would accrue to ANL over the 20 year evaluation period.

At this stage a number of points should be stressed. First, if estimates of net freight revenues are to be realised, some of the freight would have to be transferred from other ANL cargo services. Thus implementation of the above proposals may have an adverse effect on revenues generated by other ANL coastal vessels. A restructuring of the ANL fleet servicing northern Tasmania may be required. Given that some of these vessels are approaching the end of their economic life(1), it would seem desirable for ANL to give consideration to refraining from replacement of some of these vessels. It is desirable that the replacement decision of the 'Empress of Australia' is not viewed in isolation from other coastal vessel replacement decisions. In addition any decision on the type of ship would have implications for land based investment in facilities for loading and unloading freight expeditiously.

Second, it needs to be stressed that initial capital costs and net income streams are all estimates which could be refined with further research. Accordingly, further work should be carried out to evaluate possible options which have not been considered in this Report. It is unlikely however that the several viable options identified would require an operating subsidy, even with further refinement of these estimates.

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(1) These include the 'Brisbane Trader' and the 'Sydney Trader' both of which operate into Tasmania.

The financial analysis of options has been undertaken by discounting the expected future net revenues obtained from alternative investments. As the projects are mutually exclusive, the option with the highest discounted net revenue flow is regarded as financially superior for each interest rate. However, it would be naive to suggest that investment decisions should always be made simply on the basis of the discounted net revenue flow criterion. In practice there is no single method which management can use to answer all questions raised concerning the use of the company's resources. Numerous qualitative factors may also play an important role in project selection.

While recognising the significance of this qualification, the most financially advantageous option considered in this Report would be a daylight passenger/overnight freight service, operating over the Westernport Burnie-Bay route, using two vessels with service steaming speeds of 17 knots. Each vessel should have the capacity to carry 200 passengers. While it is recommended that a more detailed financial analysis of this variant is warranted, the adoption of the operating strategy identified by the BTE could well mean that no further subsidy is required.

CHAPTER 7 - CONCLUSIONS

The Bureau was directed to investigate and report on the demand for a sea passenger service between Tasmania and the mainland.

The Bureau's response has been to develop an econometric demand model for sea passenger services across the Bass Strait. This enabled projections of revenue streams for alternative services to be made. The Bureau compared the estimated revenue streams from alternative services with the estimated costs of these services. The conclusion is that there does not appear to be any 'passenger-only' shipping service which could operate without a substantial (i.e. of at least $4 million annually) operating subsidy. However if the shipping service transported both passengers and freight then there would appear to be some options which would not require an operating subsidy. Of the options considered in this Report, the one which performs best on financial grounds is a daylight passenger/overnight freight service, operating over the Westernport Bay-Burnie route, using two vessels with service steaming speeds of 17 knots. Each vessel should have a passenger capacity of 200.

The Bureau was also directed to investigate and report on:

- travel preferences for existing air and sea services

  Currently 90 per cent of travellers between the mainland and Tasmania use the air mode. The principal reason for travellers using the sea mode is that enables them to use their car on arrival.

- the effect that current fare structure and marketing have on the split between air and sea passengers

  Current prices for air and sea are 'competitive'. A normal return 'Empress' fare costs $69.20 for a lounge chair or $82.60 for a four berth cabin, compared to $79.80 for a

return economy air fare between Melbourne and Devonport. There is relatively little scope for increases in sea passenger rates without resulting in fares which would not be competitive with air. Visitors travelling to Tasmania and intending to stay an extended period - for instance more than two weeks - would be prepared to pay a premium in order to transport their vehicle to and from the mainland. It may be possible to make a substantial increase in rates charged for the transport of vehicles and offer a reduced rate, (or rebate) for persons who make the return trip within two weeks. This would enable ANL to increase revenue without affecting the decisions of short term visitors who are most susceptible to a switch to air if sea fares were to increase. There would also appear to be further scope for peak load pricing. The extent to which such a strategy could be implemented requires further detailed investigation by ANL.

- trends in the proportion of passengers travelling by sea, the characteristics of these passengers and the contribution that their spending makes to the Tasmanian economy

There has been a long term decline in the proportion of travellers using the sea mode. In 1938, 82 per cent of travellers used the sea mode, in 1948 this figure had fallen to 23 per cent and it is currently about 10 per cent. In 1979 an estimated 320 000 persons visited Tasmania. This resulted in direct expenditure in Tasmania of approximately $109 million and a net addition of $87 million to the Tasmanian Gross Domestic Product. Visitors to Tasmania using the sea service contributed a net addition to the Tasmanian economy of $10 million.

- the effect that variations in the type of sea passenger service provided would have on the number and composition of passengers travelling to and from Tasmania

The Bureau examined the demand implications of six different types of shipping services. Currently approximately 34 000 persons travel in the 'Empress of Australia' (capacity 444 persons) over the peak March quarter. Most of these are mainland visitors to Tasmania. Services which catered for a large number of persons such as a one vessel 700 persons overnight service or a two vessels 350 persons daylight service would achieve patronage figures in the March quarter of between 51 and 54 000 persons. In the absence of further peak load pricing such vessels would be considerably underutilised in the off-peak periods. The facility to transport motor vehicles is a particularly important component of the service. For instance the 'Empress of Australia' which caters for approximately 112 000 persons per annum could be expected to attract only about 50 000 persons per annum if this facility was not available.

- likely demand for a fast daylight sea passenger service between Westernport Bay and Burnie as recommended by Commissioner Nimmo in his 1976 Report on transport to and from Tasmania

The most preferred option on financial grounds is a daylight sea passenger service between Westernport Bay and Burnie. This finding is similar to the recommendation made by Commissioner Nimmo.

However, the Bureau's investigation indicates that relatively smaller vessels are likely to provide superior financial results than those proposed by Commissioner Nimmo. Also the options examined in this report suggest that a relatively lower steaming speed by the proposed vessels would be more economical than that recommended by the Nimmo Commission. A major reason for this would appear to be the substantial increase in the real price of bunker fuels which has occurred since the time when the financial analysis was done for the Nimmo Commission. It should be noted that

the service options identified as financially superior by the Bureau would require additional investment in land based infrastructure to ensure fast turnaround.

The Bureau was also requested to take into account any other matters relevant to an assessment of the justification for maintaining a sea passenger service across Bass Strait.

If subsidisation of the service is to continue, it would seem desirable for consideration to be given to the provision by ANL of sufficient details regarding operating costs for a detailed assessment of the need for such a subsidy to be carried out.

APPENDIX 1 - TERMS OF REFERENCE

MINISTER FOR TRANSPORT
28 NOV 1979

DIRECTOR
BUREAU OF TRANSPORT ECONOMICS

TERMS OF REFERENCE FOR A STUDY BY BTE INTO THE DEMAND FOR SEA PASSENGER TRANSPORT BETWEEN TASMANIA AND THE MAINLAND

At present the Australian National Line's 'Empress of Australia' provides the only sea passenger service across Bass Strait. This vessel was built in 1965 and could be expected to reach the end of its normal life by the mid-1980's. The 'Empress of Australia' is currently operating with a $2m annual subsidy from the Commonwealth Government.

In view of the foregoing I direct the Bureau of Transport Economics to investigate and report on the demand for a sea passenger service between Tasmania and the mainland.

In particular, the Bureau should investigate and report on:

(a) travel preferences for existing air and sea services;

(b) effect that current fare structure and marketing have on the split between air and sea passengers;

(c) trends in the proportion of passengers travelling by sea, the characteristics of these passengers, and the contribution that their spending makes to the Tasmanian economy;

(d) effect that variations in the type of sea passenger service provided would have on the number and composition of passengers travelling to and from Tasmania;

(e) likely demand for a fast daylight sea passenger service between Westernport and Burnie as recommended by Commissioner Nimmo in his 1976 report on Transport to and from Tasmania.

The Bureau should also take into account any other matters relevant to an assessment of the justification for maintaining a sea passenger service across Bass Strait.

The Bureau should complete its report by 30 September 1980.

(P.J. NIXON)

MINISTER FOR TRANSPORT
18 MAR 1980

DIRECTOR
BUREAU OF TRANSPORT ECONOMICS

STUDY INTO DEMAND FOR SEA PASSENGER SERVICE BETWEEN TASMANIA AND MAINLAND

The terms of reference for the above study required the Bureau to complete its report by 30 September 1980.

Cabinet requires the report to be available in time to allow its consideration in the context of budget decisions for 1980/81. With this in mind, I now direct the Bureau of Transport Economics to complete its report on the demand for a sea passenger service between Tasmania and the Mainland by 31 May 1980.

(RALPH J. HUNT)

APPENDIX 2 - AN ECONOMETRIC MODEL OF DEMAND FOR SEA PASSENGER TRAVEL ACROSS THE BASS STRAIT

This appendix outlines in detail the econometric model of demand for passenger travel by sea across the Bass Strait which forms the basis of a number of the conclusions drawn in this Report.

The discussion is divided into two sections. The first section contains a description of the theoretical model while the second section covers the empirical estimation of the model.

THE THEORETICAL MODEL

The basic economic problem is one of estimating demand for a service - in this case passenger travel by sea across the Bass Strait - when supply in certain periods is constrained - in this case by vessel capacity.

The approach adopted is to attempt to model the total corridor and the modal split. The first equation attempts to measure 'unconstrained' demand for passenger travel by all modes between Tasmania and the mainland. Two allocation equations are used to split the total unconstrained demand figure into its sea and air components. A final equation converts unconstrained demand for sea travel into constrained demand.

The four equation model is

$$T_t^* = \alpha_1 Y_t + \alpha_2 CPI_t/PA_t + \alpha_3 CPI_t/PS_t + \alpha_4 DEC_t + \alpha_5 SEP_t + \alpha_6 MARCH_t + \alpha_7 \quad (A2.1)$$

$$DA_t^* = \beta_1 T_t^* + \beta_2 Y_t/POP_t + \beta_3 (PA_t/PS_t) (S_t) + \beta_4 TRAD_t + \beta_5 JUN_t + \beta_6 MARCH_t + \beta_7 \quad (A2.2)$$

$$DS_t^* = (1-\beta_1)T_t^* - \beta_2\, Y_t/POP_t - \beta_3(PA_t/PS_t)\,(S_t) - \beta_4\, TRAD_t$$

$$- \beta_5\, JUN_t - \beta_6\, MARCH_t - \beta_7 \qquad \text{(A2.3)}$$

$$DS^{**}_t = \theta_1\, DS_t^* + \theta_2\, \{k\, K_t + (K_t - k\, K_t)\,(1-e^{-\phi(DS_t^* - k\, K_t)})\} \qquad \text{(A2.4)}$$

where T_t^* is unconstrained demand for all modes in period t, DA_t^* and DS_t^* are unconstrained demand for air and sea travel respectively; DS^{**}_t is constrained demand for sea travel(1); Y_t is a measure of total community income; CPI_t is the consumer price index in period t; PA_t and PS_t are the prices for air and sea travel respectively; S_t is the relative service level of a sea trip to an air trip; $TRAD_t$ is a zero-one dummy which is one when both the 'Trader' and the 'Empress' were in operation on the route; POP_t is the population level in period t; K_t is vessel capacity; k is a positive coefficient which is less than one; θ_1 is a zero-one dummy which takes the value one if $(DS_t^*/K_t \leq k)$ and zero otherwise; θ_2 is a zero-one dummy which is zero when $\theta_1 = 1$ and equals unity when $\theta_1 = 0$ and $MARCH_t$, JUN_t, SEP_t and DEC_t are seasonal dummies for March, June, September and December quarters respectively.

All prices are expressed in relative terms. This means for instance that if the general level of prices and prices for sea and air travel doubled, there would be no price effect on demand for travel because the relativities remain constant. Similarly if air and sea travel prices changed by the same amount there would be no change in the modal split.

The term $(PAP/S_t)(S_t)$ has been included in order to adjust the sea travel price for variations in the services provided relative to air. For instance the perceived price of sea travel

---

(1) Since it is assumed that there are no supply constraints on air travel, $DA_t^* = DA_t^{**}$ for all periods.

in June and September relative to the price of air is higher than in December or June because there is a much greater probability of a rough crossing.

It can be seen that equation A2.4 ensures that the constrained sea travel figure, DS_t^{**}, cannot be greater than total vessel capacity, K_t. The theory underlying equation A2.4 is that beyond a given passenger to capacity ratio, k, vessel capacity exerts an influence on demand. In situations when the vessel utilisation rate is high, some potential passengers could be expected to be discouraged from making the trip either because it was not possible to make a booking at the desired time, or, alternatively, because the likely congestion costs might discourage them from undertaking the trip.

EMPIRICAL ESTIMATION

Data sources for the estimation of the model are contained in Table A2.1. Table A2.2 shows ship passenger movements on a quarterly basis compared to total available capacity. It is apparent from this table that capacity impacts on demand in the March quarter. In terms of the theoretical model outlined above, for all quarters other than March, constrained and unconstrained demand are identical and observable ($DS_t^{**} = DS_t^{*}$). In the March quarter it is only possible to observe constrained demand (DS_t^{**}).

In addition to the problem associated with March quarters, there is the problem that the theoretical model does not easily lend itself to estimation because it cannot be linearised. This problem is due to the functional form of equation A2.4.

TABLE A2.1 - DATA SOURCES USED IN THE ESTIMATION OF THE MODEL[a]

Variable	Description	Source
Y_t	Gross Domestic Product at average 1974-75 prices	ABS: Australian National Accounts - National Income and Expenditure: Reference No 5204.0
CPI_t	Consumer Price Index for the six Australian State Capital cities	ABS: Consumer Price Index; Reference No 6401.0
PA_t	The cheapest adult air fare offered between Melbourne and Launceston by one of the major domestic operators	Various fare schedules
PS_t	The price for an adult in a lounge chair on the 'Empress of Australia'	ANL
DA_t^*	Number of passenger movements between Tasmania and the mainland by normal scheduled services (Commuter movements included)	DOT
DS_t^{**}	Number of passenger movements to and from the mainland by scheduled sea passenger services	ANL
POP_t	Estimates of the total population of Australia	ABS: Population and Vital Statistics; Reference No 3212.0
K_t	The total number of passengers able to be carried by scheduled sea services. Capacity figures are adjusted for seating capacity of vessel, frequency of service, annual maintenance, downtime, industrial disputes and accidents	Based on ANL figures
S_t	A measure of the services provided by a ship crossing relative to an air crossing. Probability of experiencing gale force winds in a given quarter was normalised over the year (i.e. figures for each quarter adjusted in order that they sum to unity over the year). The reciprocal of this figure was used as a proxy for changes in the relativity between sea and air services over time. Time savings between the modes have not been considered since they could be expected to remain constant over the sample period	Climatic data on Cape Northumberlain: Australian Pilot: South Coast of Australia from Cape Leeuwin to Green Point: 6th edition 1973, Navy Hydrography, p.27.

(a) All data were quarterly series over the period from the September quarter, 1972 to the December quarter, 1979 with the exception of the S_t series for which a single value was calculated for each of the four quarters.

TABLE A2.2 - PASSENGER UTILISATION AND VESSEL CAPACITY: BASS STRAIT SEA PASSENGER SERVICES
(persons)

Year	Quarter	Utilisation	Capacity	Utilisation/ Capacity
1972	3	24 881	34 536	.7204
	4	31 954	41 706	.7762
1973	1	38 034	40 818	.9318
	2	30 074	41 262	.7289
	3	24 521	35 868	.6836
	4	35 322	41 706	.8469
1974	1	37 445	40 818	.9174
	2	31 541	41 262	.7644
	3	25 991	35 868	.7246
	4	36 271	41 706	.8697
1975	1	38 599	40 818	.9456
	2	32 709	41 262	.7927
	3	26 704	34 980	.7634
	4	34 837	41 706	.8353
1976	1	39 078	41 262	.9471
	2	30 585	41 262	.7412
	3	20 994	30 598	.6861
	4	29 726	35 076	.8475
1977	1	33 465	34 188	.9789
	2	27 878	34 632	.8050
	3	22 869	29 748	.7688
	4	31 134	34 632	.8990
1978	1	31 573	32 412	.9741
	2	25 924	34 632	.7486
	3	21 307	28 416	.7498
	4	31 475	35 076	.8973
1979	1	33 557	34 188	.9815
	2	25 981	34 632	.7502
	3	20 657	29 748	.6944
	4	31 058	35 076	.8854

Source: ANL.

TABLE A2.3 - INITIAL ESTIMATION OF MODEL: SEPT 1972 - DEC 1979 - MARCH QUARTERS EXCLUDED

$$T_t^* = \alpha_1 Y_t + \alpha_2 CPI_t/PA_t + \alpha_3 CPI_t/PS_t + \alpha_4 DEC_t + \alpha_5 SEP_t + \alpha_6 MARCH_t + \alpha_7$$

$$T_t^* = \underset{(10.0)}{422.1}\, Y_t + \underset{(3.8)}{102.4}\, CPI_t/PA_t + \underset{(1.8)}{36.70}\, CPI_t/PS_t + \underset{(4.7)}{21.38}\, DEC_t - \underset{(-2.4)}{10.91}\, SEP_t - \underset{(-5.8)}{275.2} \qquad (R^2 = .9248)\ (D.W. = 1.87)$$

$$DA_t^* = \beta_1 T_t^* + \beta_2 Y_t/POP_t + \beta_3 (PA_t/PS_t)(S_t) + \beta_4 TRAD_t + \beta_5 JUN_t + \beta_6 MARCH_t + \beta_7$$

$$DA_t^* = \underset{(46.3)}{.9058}\, T_t + \underset{(2.3)}{57.86}\, Y_t/POP_t - \underset{(-6.9)}{1.434}\, (PA_t/PS_t)(S_t) - \underset{(-3.5)}{3.307}\, TRAD_t - \underset{(-4.4)}{2.510}\, JUN_t - \underset{(-2.4)}{52.14} \qquad (R^2 = .9984)\ (D.W. = 1.24)$$

$$DS_t^* = (1-\beta_1)\, T_t^* - \beta_2 Y_t/POP_t - \beta_3 (PA_t/PS_t)(S_t) - \beta_4 TRAD_t - \beta_5 JUN_t - \beta_6 MARCH_t - \beta_7$$

$$DS_t^* = \underset{(4.8)}{.0942}\, T_t^* - \underset{(-2.3)}{57.86}\, Y_t/POP_t + \underset{(6.9)}{1.434}\, (PA_t/PS_t)(S_t) + \underset{(3.5)}{3.307}\, TRAD_t + \underset{(4.4)}{2.510}\, JUN_t + \underset{(2.4)}{52.14} \qquad (R^2 = .9311)\ (D.W. = 1.24)$$

Notes: t values in parentheses.

If k, which is the ratio of passenger numbers to the vessel capacity figure at which vessel capacity begins to have an influence on demand, is set at 0.9, estimation of the system for June, September and December quarters is a relatively straightforward matter. This is because for these quarters $DS_t^* / K_t < k$, hence $\theta_2 = 0$ and therefore $DS_t^{**} = DS_t^*$. Under these circumstances equation A2.4 becomes redundant.

Table A2.3 gives details of the estimates for equations A2.1 to A2.3 when the March quarter observations are not used. All coefficients are of the expected sign and, with the exception of the relative price of shipping term (CPI_t/PS_t) in the total corridor equation, all are significant at the 95 per cent level.

In terms of the theoretical model the system estimated in Table A2.3 gives values for all the coefficients with the exception of the values for the March dummies in equations A2.1, A2.2 and A2.3, that is α_6 and β_6 and the coefficient ϕ which appears in equation A2.4.

The procedure adopted to obtain the missing coefficients α_6, β_6 and ϕ was to first evaluate the Table A2.3 system for each of the March quarters. Denoting the values obtained for the t th March observation from the three equations in Table A2.3 as $AMARCH_t$ $BMARCH_t$ and $CMARCH_t$ respectively, equations A2.1 to A2.4 in the theoretical model can be represented for March observations as

$$T_t^* = AMARCH_t + \alpha_6 \qquad \text{(A2.5)}$$

$$DA_t^* = BMARCH_t + \beta_1\alpha_6 + \beta_6 \qquad \text{(A2.6)}$$

$$DS_t^* = CMARCH_t + (1-\beta_1)\alpha_6 - \beta_6 \qquad \text{(A2.7)}$$

$$DS_t^{**} = .9K_t + .1K_t(1-e^{-\phi(DS_t^*-.9K_t)}) \qquad \text{(A2.8)}$$

Substituting equation A2.7 into equation A2.8 and expressing in terms of logs gives

$$DMARCH_t = \log(10) + \log\{(K_t - DS_t^{**})/K_t\}$$

$$= -\phi\{CMARCH_t + (1-\beta_1)\alpha_6 - \beta_6 - .9K_t\} \qquad (A2.9)$$

If $EMARCH_t$ is defined as

$$EMARCH_t = CMARCH_t - .9K_t \qquad (A2.10)$$

then, substituting into A2.9 gives

$$DMARCH_t = -\phi\, EMARCH_t - \phi\{(1-\beta_1)\alpha_6 - \beta_6\} \qquad (A2.11)$$

Since it is possible to obtain values for $DMARCH_t$ and $EMARCH_t$, equation A2.11 can be estimated. The results obtained were

$$DMARCH_t = \underset{(-4.2)}{-.2444}\ EMARCH_t - \underset{(-5.4)}{4.000} \qquad R^2 = .7351,\ D.W. = 2.9 \qquad (A2.12)$$

Equation A2.12 implies that $\phi = .244$

and, since

$$\beta_1 = .9058 \text{ (from Table A2.3)}$$

$$(-4.000 - .2444) = \alpha_6(.09418) - \beta_6 \qquad (A2.13)$$

From equation A2.6 it is possible to obtain an estimate of $(\beta_1\alpha_6 + \beta_6)$. For each March observation values can be obtained for DA_t^* and $BMARCH_t$. Denoting DA_t^* and $BMARCH_t$ as the respective averages for all March observations,

$$DA_t^* - BMARCH_t = \beta_1\alpha_6 + \beta_6 \qquad (A2.14)$$

that is

$$53.862 = .9058\alpha_6 + \beta_6 \qquad \text{(A2.15)}$$

Solving equations A2.13 and A2.14 for α_6 and β_6 gives $\alpha_6 = 70.23$ and $\beta_6 = -9.753$.

The estimated system which is in accordance with the specified theoretical system is shown in Table A2.4. Figure A2.1 shows the performance of the model over the sample period. It would appear to perform adequately over the period. The results derived from it are discussed in Chapters 5 and 6 of this Report. Table A2.5 contains a listing of the simulation program, typical input data and the program and a copy of the print-out obtained from the model.

Users of an econometric demand model such as that described above should note that any model is to some degree an abstraction from reality. There are factors which may influence both the absolute and relative levels of patronage of the two modes, such as changes in fuel prices which may influence the type of holiday taken, and changes in air fares to holiday destinations other than Tasmania which have not been taken into account in this model. In constructing this model it was considered that, compared to such considerations as vessel capacity, these factors have a relatively small influence on demand for sea passenger travel to Tasmania and, in any event, the data available from the sample period is not sufficiently robust for any degree of confidence to be attached to such refinements. The assumptions underlying this model are:

- service type (e.g. type of vessel) is assumed to have no effect on the level of demand;
- service frequency is varied for daylight services but is assumed to have no effect on the level of demand;
- similarly origin-destination variation is assumed to have no effect on the level of demand; and
- relative prices are incorporated in the model and are assumed to be fixed, i.e. moving in line with the CPI.

TABLE A2.4 - THE COMPLETE MODEL

$$T_t^* = 422.1\, Y_t + 102.4\, CPI_t/PA_t + 36.70\, CPI_t/PS_t + 21.38\, DEC_t - 10.91\, SEP_t + 70.23\, MARCH_t - 275.2$$

$$DA_t^* = .9058\, T_t^* + 57.86\, Y_t/POP_t - 1.434\, (PA_t/PS_t)(S_t) - 3.307\, TRAD_t - 2.510\, JUN_t - 9.753\, MARCH_t - 52.14$$

$$DS_t^* = .0942\, T_t^* - 57.86\, Y_t/POP_t + 1.434\, (PA_t/PS_t)(S_t) + 3.307\, TRAD_t + 2.510\, JUN_t + 9.753\, MARCH_t + 52.14$$

$$DS_t^{**} = \theta_1\, DS_t^* + \theta_2\, \{\, .9K_t + .1K_t(1-e^{-.244(DA_t^* - .9K_t)})\}$$

TABLE A2.5 - LISTING OF SIMULATION PACKAGE, DATA AND OUTPUT

PROGRAM

```
JOB,P5000.
BANNER,EMPRESS.
FUSE.
MNF,L=OUTPUT,T.
MAP,PART.
LDSET(PRESET=NGINF)
LGO.

      PROGRAM DICK(INPUT,OUTPUT,TAPE 60=INPUT,TAPE 61=OUTPUT)
      COMMON NQ,NDAY,NSTART,NFIN,KDAY(200,7),XKAP(200),NSLEEP,NSIT,
     + XTOT(200),XA(200),XS(200),XAS(200),X(12,200),Y(5,200),XCAR(200),
     + VKCAR(200),VCAR(200),SLEEP(200),SIT(200),VSLEEP(200),VSIT(200),
     + VKSLEEP(200),VKSIT(200),REV(200),REVK(200),NCAR
C
C     THIS IS A DEMAND SIMULATION ON MODEL FOR SEA TRAVEL
C     ACROSS THE BASS STRAIT
C     THE ECONOMETRIC MODEL IS DESCRIBED IN THE
C     BTE MAY 1980 REPORT ON THIS TOPIC
C
      CALL INGRID
      CALL MELISSA
      CALL JULIE
      STOP
      END
```

```
      SUBROUTINE INGRID
      COMMON NQ,NDAY,NSTART,NFIN,KDAY(200,7),XKAP(200),NSLEEP,NSIT,
     + XTOT(200),XA(200),XS(200),XAS(200),X(12,200),Y(5,200),XCAR(200),
     + VKCAR(200),VCAR(200),SLEEP(200),SIT(200),VSLEEP(200),VSIT(200),
     + VKSLEEP(200),VKSIT(200),REV(200),REVK(200),NCAR
      DIMENSION NDEP(4,7),NDOWN(4),KSUM(4),N(2,200),NDUM(4),
     + BASE(5),XV(4)
C     THIS SUBROUTINE IS WHERE WE READ IN THE INPUT FOR
C     THE SIMULATION
C         FIRST OF ALL READ IN SERVICE DETAILS
C         READ IN SEATING CAPACITY AND WHETHER
C         A DAYLIGHT SERVICE-NDAY=1 IF DAYLIGHT ZERO OTHERWISE
C         ALSO NUMBER OF SLEEPING BERTHS AND SIT UPS AND CAR CAPACITY
      READ(60,102)NQ,NDAY,NSLEEP,NSIT,NCAR
  102 FORMAT(5I5)
      KCH=NSLEEP+NSIT
      IF(NQ-KCH)800,801,800
800   WRITE(61,802)
802   FORMAT(1HO,*YOUR SLEEPERSPLUS SITUPS DOES NOT ADD TO TOTAL*)
      GO TO 999
801   CONTINUE
C     READ IN FOUR LINES WHICH FOR EACH QUARTER
C     GIVES THE NUMBER OF MONDAY,TUES,WED...SUNDAY DEPATURES
C     AND NUMBER OF DAYS THE SERVICE WILL BE DOWN FOR IN THE
C     QUARTER
      DO 103 J=1,4
C     MARCH,JUNE,SEPT,DECEMBER IN THAT ORDER
      READ(60,104)(NDEP(J,K),K=1,7),NDOWN(J)
  104 FORMAT(8I5)
  103 CONTINUE
C     READ IN DETAILS OF WHICH QUARTER YOU
C     WANT PROJECTION TO START AND FINISH
C     MARCH 1980 IS WRITTEN 1 1980
C
      READ(60,105)NSQ,NSY,NFQ,NFY
  105 FORMAT(4I5)
C     WE TRANSLATE THESE PERIODS
C     INTO TIME WHERE 1970 QUARTER=1
      NSTART=(4*(NSY-1970))+NSQ
      NFIN=(4*(NFY-1970))+NFQ
      NAB=NSQ
C     CALCULATE CAPACITY
C
      CALL HELEN
      DO 106 I=NSTART,NFIN
      XKAP(I)=0.0
      DO 107 K=1,7
      XKAP(I)=XKAP(I)+(KDAY(I,K)*NDEP(NAB,K))
  107 CONTINUE
      IF(NDOWN(NAB))108,108,109
  109 NOK=NDOWN(NAB)
      ME=1
      DO 110 M=1,NOK
      XKAP(I)=XKAP(I)-NDEP(NAB,ME)
      IF(ME-7)111,112,112
  112 ME=1
      GO TO 110
  111 ME=ME+1
  110 CONTINUE
C
```

TABLE A2.5 (CONT) - LISTING OF SIMULATION PACKAGE, DATA AND OUTPUT

```
C
C    ADJUST FOR STRIKES AND FIRE IN THE SAMPLE PERIOD
C
C
  108 CONTINUE
      IF(I-35)307,309,307
  309 XKAP(I)=XKAP(I)-2.0
  307 IF(I-33)311,312,311
  312 XKAP(I)=XKAP(I)-5.0
  311 CONTINUE
      XKAP(I)=XKAP(I)*NQ/1000.0
      NCAR=XKAP(I)*NCAR
      IF (NAB-4)113,114,114
  114 NAB=1
      GO TO 106
  113 NAB=NAB+1
  106 CONTINUE
C     READ IN THE EXOGENOUS VARIABLES
C     5 VARIABLES
C        POPULATION
C        CPI
C        INCOME PER HEAD CONSTANT PRICES
C        PRICE OF AIR
C        PRICE OF SHIPPING
C     THERE SHOULD BE VALUES OF THESE FOR ALL QUARTERS
C     UP TO AND INCLUDING THE QUARTER NOMINATED
C     AS THE ONE FOR THE SIMULATION TO FINISH
      DO 120 I=11,NFIN
      READ(60,121)(N(K,I),K=1,2),(Y(M,I),M=1,5)
  121 FORMAT(2I5,2F10.0,3F10.5)
  120 CONTINUE
      DO 122 I=11,NFIN
      X(4,I)=0.0
      X(11,I)=0.0
      X(5,I)=0.0
      X(12,I)=0.0
  122 CONTINUE
      NDUM(1)=11
      NDUM(2)=4
      NDUM(3)=5
      NDUM(4)=12
      K=1
      DO 123 I=11,NFIN
      KDUM=NDUM(K)
      X(KDUM,I)=1.0
      IF(K-4)125,126,126
  126 K=1
      GO TO 123
  125 K=K+1
  123 CONTINUE
C     THIS SECTION SETS UP THE SEASONAL DUMMIES
C     SET UP THE TRADER DUMMY
      DO 127 I=11,26
      X(9,I)=1.0
  127 CONTINUE
      DO 128 I=27,NFIN
      X(9,I)=0.0
  128 CONTINUE
C     REBASE OUR 5 ECONOMIC VARIABLES TO DECEMBER 1979
      DO 129 I=1,5
```

```
      BASE(I)=Y(I,40)
129   CONTINUE
      DO 130 I=11,NFIN
      DO 131 J=1,5
      Y(J,I)=Y(J,I)/BASE(J)
131   CONTINUE
130   CONTINUE
      DO 132 I=11,NFIN
      X(2,I)=Y(2,I)/Y(4,I)
      X(1,I)=Y(1,I)*Y(3,I)
      X(3,I)=Y(2,I)/Y(5,I)
      X(10,I)=XKAP(I)
      X(6,I)=Y(3,I)
      X(7,I)=Y(4,I)/Y(5,I)
132   CONTINUE
      XV(1)=2.35
      XV(2)=5.5
      XV(3)=9.4
      XV(4)=3.4
C     THIS IS WHERE WE DO THE GALE VARIABLE
      K=1
      DO 135 I=11,NFIN
      X(8,I)=XV(K)
      IF(K-4)137,138,138
138   K=1
      GO TO 139
137   K=K+1
139   CONTINUE
  135 CONTINUE
      DO 908 K=1,4
      KSUM(K)=0
      DO 909 KA=1,7
      KSUM(K)=KSUM(K)+NDEP(K,KA)
909   CONTINUE
908   CONTINUE
C
C     WRITE OUT THE BASIC DETAILS ABOUT THE SERVICE
C     WE ARE EVALUATING
C
      WRITE(61,901)
901   FORMAT(1H1,6X,*BUREAU OF TRANSPORT ECONOMICS - EVALUATION OF BASS
     + STRAIT SHIPPING SERVICE*//)
      IF(NDAY)902,902,903
902   WRITE(61,904)NSLEEP,NQ
904   FORMAT(6X,*OVERNIGHT SERVICE BERTHS-*,I5,3X,*TOTAL CAPACITY*,I5)
      GO TO 906
903   WRITE(61,907)NQ
907   FORMAT(6X,*DAYLIGHT SERVICE WITH TOTAL CAPACITY*,I5,//)
906   WRITE(61,988)(KSUM(M),M=1,4)
988   FORMAT(6X,*TRIPS PER WEEK - MARCH*,I5,3X,*JUN*,I5,3X,* SEPT*,I5,3X
     + ,*DEC*,I5 )
  999 RETURN
      END
```

TABLE A2.5 (CONT) - LISTING OF SIMULATION PACKAGE, DATA AND OUTPUT

```
      SUBROUTINE HELEN
      COMMON NQ,NDAY,NSTART,NFIN,KDAY(200,7),XKAP(200),NSLEEP,NSIT,
     + XTOT(200),XA(200),XS(200),XAS(200),X(12,200),Y(5,200),XCAR(200),
     + VKCAR(200),VCAR(200),SLEEP(200),SIT(200),VSLEEP(200),VSIT(200),
     + VKSLEEP(200),VKSIT(200),REV(200),REVK(200),NCAR
      DIMENSION Q(4,40),ND(7)
C     THIS SUBROUTINE CALCULATES THE NUMBER
C     OF EACH TYPE OF DAY IN A QUARTER IT IS
C     USED TO CALCULATE CAPACITY AND IS CALLED
C     FROM INGRID
      DO 2 I=1,40
      Q(1,I)=90.0
      Q(2,I)=91.0
      Q(3,I)=92.0
      Q(4,I)=92.0
2     CONTINUE
C     ADJUST FOR LEAP YEARS
      DO 3 I=3,39,4
      Q(1,I)=91.0
3     CONTINUE
      DO 5 I=1,7
      ND(I)=0
5     CONTINUE
      XN=0.0
      NI=4
      DO 33 I=1,40
      DO 4 J=1,4
   13 ND(NI)=ND(NI)+1
      NI=NI+1
      IF(NI-8)6,7,7
7     NI=1
6     XN=XN+1.0
      IF(Q(J,I)-XN)12,12,13
12    NUMB=((I-1)*4)+J
      DO 25 K=1,7
      KDAY(NUMB,K)=ND(K)
25    CONTINUE
      IF(NUMB-NFIN)18,99,99
18    DO 19 KA=1,7
      ND(KA)=0
19    CONTINUE
      XN=0.0
4     CONTINUE
33    CONTINUE
99    CONTINUE
      RETURN
      END
```

TABLE A2.5 (CONT) - LISTING OF SIMULATION PACKAGE, DATA AND OUTPUT

```
      SUBROUTINE MELISSA
      COMMON NQ,NDAY,NSTART,NFIN,KDAY(200,7),XKAP(200),NSLEEP,NSIT,
     + XTOT(200),XA(200),XS(200),XAS(200),X(12,200),Y(5,200),XCAR(200),
     + VKCAR(200),VCAR(200),SLEEP(200),SIT(200),VSLEEP(200),VSIT(200),
     + VKSLEEP(200),VKSIT(200),REV(200),REVK(200),ZCAR
C     THIS SUBROUTINE EVALUATES THE MODEL IT CALCULATES TOTAL
C     TRAFFIC AND EXPECTED REVENUE
C
      DO 100 I=NSTART,NFIN
      XTOT(I)=(422.1*X(1,I))+(102.40*X(2,I))+(36.70*X(3,I))
     + +(21.38*X(4,I))+(70.230*X(5,I))-(10.91*X(11,I))-275.2
      XA(I)=(.9058*XTOT(I))+(57.86*X(6,I))-(1.434*X(7,I)*X(8,I))
     + -(3.307*X(9,I))-(9.753*X(5,I))-52.14-(2.510*X(12,I))
      XS(I)=(.0942*XTOT(I))-(57.86*X(6,I))+(1.434*X(7,I)*X(8,I))
     + +(3.307*X(9,I))+(9.753*X(5,I))+52.14+(2.510*X(12,I))
      A=.9*X(10,I)
      IF(XS(I)-A)501,501,502
502   B=(-.2444)*(XS(I)-A)
      XAS(I)=(.9*X(10,I))+((.1*X(10,I))*(1.0-EXP(B)))
      GO TO 503
501   XAS(I)=XS(I)
503   CONTINUE
C     WE HAVE THE TOTAL TRAFFIC NOW WE WANT TOTAL REVENUE
C
C
100   CONTINUE
      Z=NSLEEP
      ZZ=NSIT
      R=(Y(5,37)+Y(5,38)+Y(5,39)+Y(5,40))/4.0
      ZAP=ZCAR
C     CALCULATE CAR REVENUE
      DO 105 I=NSTART,NFIN
      XCAR(I)=.29*(XAS(I))
      IF(XCAR(I)-ZAP)800,800,801
  801 XAS(I)=XAS(I)-(2.0*(XCAR(I)-ZAP))
      XCAR(I)=ZAP
  800 CONTINUE
      VKCAR(I)=.13*XCAR(I)*145.03
      VKCAR(I)=((XCAR(I)*.87)*145.03/2.0)+VKCAR(I)
      VCAR(I)=VKCAR(I)*Y(5,I)/R
105   CONTINUE
      IF(NDAY)101,102,101
101   DO 103 I=NSTART,NFIN
      SLEEP(I)=0.0
      SIT(I)=XAS(I)
      VSLEEP(I)=0.0
      VSIT(I)=SIT(I)*26.39*Y(5,I)/R
      VKSLEEP(I)=0.0
      VKSIT(I)=SIT(I)*26.39
103   CONTINUE
      GO TO 909
102   DO 104 I=NSTART,NFIN
      SLEEP(I)=.56*XAS(I)
      SIT(I)=XAS(I)-SLEEP(I)
      IF(SLEEP(I)-Z)107,107,108
108   SLEEP(I)=Z
      SIT(I)=XAS(I)-Z
107   IF(SIT(I)-ZZ)109,109,110
110   SIT(I)=ZZ
```

TABLE A2.5 (CONT) - LISTING OF SIMULATION PACKAGE, DATA AND OUTPUT

```
      SLEEP(I)=XAS(I)-SIT(I)
109   CONTINUE
      VKSLEEP(I)=SLEEP(I)*35.95
      VSLEEP(I)=VKSLEEP(I)*Y(5,I)/R
      VKSIT(I)=SIT(I)*26.39
      VSIT(I)=VKSIT(I)*Y(5,I)/R
104   CONTINUE
909   CONTINUE
      DO 120 I=NSTART,NFIN
      REV(I)=VCAR(I)+VSLEEP(I)+VSIT(I)
      REVK(I)=VKCAR(I)+VKSLEEP(I)+VKSIT(I)
      REVK(I)=.965*REVK(I)
      REV(I)=.965*REV(I)
      BAR=2.68*(XAS(I))*Y(5,I)/R
      BARK=2.68*XAS(I)
      REVK(I)=REVK(I)+BARK
      REV(I)=REV(I)+BAR
120   CONTINUE
      RETURN
      END
```

TABLE A2.5 (CONT) - LISTING OF SIMULATION PACKAGE, DATA AND OUTPUT

```
      SUBROUTINE JULIE
      COMMON NQ,NDAY,NSTART,NFIN,KDAY(200,7),XKAP(200),NSLEEP,NSIT,
     + XTOT(200),XA(200),XS(200),XAS(200),X(12,200),Y(5,200),XCAR(200),
     + VKCAR(200),VCAR(200),SLEEP(200),SIT(200),VSLEEP(200),VSIT(200),
     + VKSLEEP(200),VKSIT(200),REV(200),REVK(200),NCAR
C     THIS SUBROUTINE PRINTS OUT ALL THE OUTPUT EXCEPT
C     THE SPECIFICATIONS OF THE SERVICE TO BE
C     SIMULATION WHICH WAS PRINTED OUT
C     IN INGRID
C
      WRITE(61,200)
200   FORMAT(9X,*MOVEMENTS ('000)*,25X,*REVENUE NET OF COMMISSION/AGENCY
     +  FEES*)
      WRITE(61,201)
      NYEAR=1970
      NQU=1
      NK=1
      DO 203 I=1,200
      IF(NSTART-NK)204,208,204
204   IF(NQU-4)209,210,210
210   NQU=1
      NYEAR=NYEAR+1
      GO TO 212
209   NQU=NQU+1
212   CONTINUE
      NK=NK+1
203   CONTINUE
208   CONTINUE
      KYEAR=NYEAR
      KQ=NQU
      DO 225 I=NSTART,NFIN
      TPT=XA(I)+XAS(I)
      WRITE(61,215)XAS(I),XA(I),TPT,XCAR(I),REVK(I),REV(I),KQ,KYEAR
201   FORMAT(3X,*SHIP*,8X,*AIR*,8X,*TOTAL*,6X,*VEHICLES*,7X,*1979 PRICES
     +     CURRENT PRICES*)
215   FORMAT(1X,3(F7.3,5X),F7.3,10X,F7.0,10X,F7.0,12X,I1,*-*,I4)
      IF(KQ-4)216,217,217
217   KQ=1
      KYEAR=KYEAR+1
      GO TO 218
216   KQ=KQ+1
218   CONTINUE
  225 CONTINUE
      RETURN
      END
```

TABLE A2.5 (CONT) - LISTING OF SIMULATION PACKAGE, DATA AND OUTPUT

DATA

```
 444        254  190  145
   1    1     1    1    1          1
   1    1     1    1    1          1
   1    1     1    1    1          1   14
   1    1     1    1    1          1
   1 1980     4 2000
1972    3     1322.     1262.     .87790     .65657     .40493
1972    4     1328.     1277.     .89285     .65657     .45775
1973    1     1333.     1304.     .91606     .65657     .45775
1973    2     1337.     1347.     .91124     .65657     .45775
1973    3     1342.     1396.     .92987     .65657     .45775
1973    4     1349.     1446.     .93603     .61616     .45775
1974    1     1354.     1481.     .93368     .61616     .50352
1974    2     1359.     1541.     .92266     .61616     .50352
1974    3     1364.     1620.     .92498     .61616     .50352
1974    4     1370.     1681.     .92743     .61616     .50352
1975    1     1374.     1741.     .93004     .74916     .58099
1975    2     1377.     1802.     .94486     .74916     .58099
1975    3     1380.     1816.     .93786     .74916     .75704
1975    4     1384.     1917.     .92579     .74747     .75704
1976    1     1388.     1974.     .95562     .74747     .75704
1976    2     1391.     2024.     .95877     .94949     .75704
1976    3     1394.     2069.     .96633     .94949     .86972
1976    4     1398.     2193.     .96810    1.01010     .87676
1977    1     1403.     2243.     .95951    1.01010     .87676
1977    2     1407.     2296.     .96445    1.01010     .87676
1977    3     1411.     2341.     .96164    1.07576     .87676
1977    4     1416.     2396.     .95065    1.07576     .87676
1978    1     1420.     2427.     .96258    1.11616    1.02817
1978    2     1424.     2477.     .96293     .98485    1.02817
1978    3     1430.     2525.     .98238     .89226     .89789
1978    4     1434.     2583.     .99012    1.11448     .89789
1979    1     1439.     2630.     .98997    1.11448    1.08099
1979    2     1444.     2678.     .97919    1.11448    1.08099
1979    3     1448.     2727.     .99292    1.25084     .94366
1979    4     1453.     2777.    1.00000    1.00000    1.00000
1980    1     1457.     2818.    1.00450    1.01467    1.01467
1980    2     1461.     2859.    1.00902    1.02956    1.02956
1980    3     1466.     2901.    1.01356    1.04467    1.04467
1980    4     1471.     2944.    1.01812    1.06000    1.06000
1981    1     1475.     2987.    1.02271    1.07555    1.07555
1981    2     1480.     3031.    1.02731    1.09133    1.09133
1981    3     1485.     3075.    1.03193    1.10734    1.10734
1981    4     1489.     3120.    1.03658    1.12359    1.12359
1982    1     1494.     3166.    1.04124    1.14008    1.14008
1982    2     1499.     3212.    1.04593    1.15680    1.15680
1982    3     1504.     3260.    1.05063    1.17378    1.17378
1982    4     1509.     3307.    1.05536    1.19100    1.19100
1983    1     1514.     3356.    1.06011    1.20847    1.20847
1983    2     1519.     3405.    1.06488    1.22621    1.22621
1983    3     1524.     3455.    1.06968    1.24420    1.24420
1983    4     1529.     3506.    1.07449    1.26245    1.26245
1984    1     1534.     3557.    1.07933    1.28098    1.28098
1984    2     1540.     3610.    1.08418    1.29977    1.29977
1984    3     1545.     3663.    1.08906    1.31884    1.31884
1984    4     1550.     3716.    1.09396    1.33819    1.33819
1985    1     1555.     3771.    1.09889    1.35783    1.35783
1985    2     1561.     3826.    1.10383    1.37775    1.37775
1985    3     1566.     3882.    1.10880    1.39797    1.39797
1985    4     1571.     3939.    1.11379    1.41848    1.41848
```

TABLE A2.5 (CONT) - LISTING OF SIMULATION PACKAGE, DATA AND OUTPUT

1986	1	1576.	3997.	1.11880	1.43929	1.43929
1986	2	1582.	4056.	1.12384	1.46041	1.46041
1986	3	1587.	4115.	1.12890	1.48184	1.48184
1986	4	1592.	4176.	1.13398	1.50358	1.50358
1987	1	1597.	4237.	1.13908	1.52564	1.52564
1987	2	1603.	4299.	1.14421	1.54803	1.54803
1987	3	1608.	4362.	1.14936	1.57074	1.57074
1987	4	1613.	4426.	1.15453	1.59379	1.59379
1988	1	1618.	4491.	1.15973	1.61717	1.61717
1988	2	1624.	4557.	1.16495	1.64090	1.64090
1988	3	1629.	4624.	1.17019	1.66498	1.66498
1988	4	1634.	4692.	1.17546	1.68941	1.68941
1989	1	1639.	4761.	1.18075	1.71420	1.71420
1989	2	1645.	4830.	1.18606	1.73935	1.73935
1989	3	1650.	4901.	1.19140	1.76487	1.76487
1989	4	1655.	4973.	1.19676	1.79076	1.79076
1990	1	1660.	5046.	1.20215	1.81704	1.81704
1990	2	1666.	5120.	1.20756	1.84370	1.84370
1990	3	1671.	5195.	1.21299	1.87075	1.87075
1990	4	1676.	5272.	1.21845	1.89820	1.89820
1991	1	1681.	5349.	1.22393	1.92605	1.92605
1991	2	1687.	5428.	1.22944	1.95431	1.95431
1991	3	1692.	5507.	1.23497	1.98299	1.98299
1991	4	1698.	5588.	1.24053	2.01208	2.01208
1992	1	1704.	5670.	1.24612	2.04161	2.04161
1992	2	1709.	5753.	1.25172	2.07156	2.07156
1992	3	1715.	5838.	1.25736	2.10196	2.10196
1992	4	1720.	5924.	1.26302	2.13280	2.13280
1993	1	1726.	6010.	1.26870	2.16409	2.16409
1993	2	1732.	6099.	1.27441	2.19584	2.19584
1993	3	1737.	6188.	1.28015	2.22806	2.22806
1993	4	1743.	6279.	1.28591	2.26075	2.26075
1994	1	1749.	6371.	1.29169	2.29393	2.29393
1994	2	1754.	6465.	1.29751	2.32758	2.32758
1994	3	1760.	6559.	1.30335	2.36174	2.36174
1994	4	1766.	6656.	1.30921	2.39639	2.39639
1995	1	1772.	6753.	1.31510	2.43155	2.43155
1995	2	1777.	6852.	1.32102	2.46723	2.46723
1995	3	1783.	6953.	1.32697	2.50343	2.50343
1995	4	1789.	7055.	1.33294	2.54016	2.54016
1996	1	1795.	7158.	1.33894	2.57743	2.57743
1996	2	1801.	7264.	1.34497	2.61525	2.61525
1996	3	1807.	7370.	1.35102	2.65362	2.65362
1996	4	1812.	7478.	1.35710	2.69256	2.69256
1997	1	1818.	7588.	1.36321	2.73206	2.73206
1997	2	1824.	7699.	1.36934	2.77215	2.77215
1997	3	1830.	7812.	1.37550	2.81283	2.81283
1997	4	1836.	7927.	1.38169	2.85410	2.85410
1998	1	1842.	8043.	1.38791	2.89597	2.89597
1998	2	1848.	8161.	1.39416	2.93847	2.93847
1998	3	1854.	8281.	1.40043	2.98158	2.98158
1998	4	1860.	8402.	1.40674	3.02533	3.02533
1999	1	1866.	8526.	1.41307	3.06972	3.06972
1999	2	1873.	8651.	1.41943	3.11476	3.11476
1999	3	1879.	8778.	1.42582	3.16046	3.16046
1999	4	1885.	8907.	1.43223	3.20683	3.20683
2000	1	1891.	9037.	1.43868	3.25389	3.25389
2000	2	1897.	9170.	1.44515	3.30163	3.30163
2000	3	1903.	9304.	1.45166	3.35007	3.35007
2000	4	1910.	9441.	1.45819	3.39923	3.39923

OUTPUT

BUREAU OF TRANSPORT ECONOMICS - EVALUATION OF BASS STRAIT SHIPPING SERVICE

OVERNIGHT SERVICE BERTHS- 254 TOTAL CAPACITY 444
TRIPS PER WEEK - MARCH 6 JUN 6 SEPT 6 DEC 6

MOVEMENTS ('000) SHIP	AIR	TOTAL	VEHICLES	REVENUE NET OF COMMISSION/AGENCY FEES 1979 PRICES	CURRENT PRICES	
34.609	308.208	342.818	10.037	1947.	1924.	1-1980
28.664	263.484	292.148	8.313	1612.	1617.	2-1980
23.678	260.961	284.639	6.867	1332.	1355.	3-1980
31.297	289.073	320.370	9.076	1760.	1818.	4-1980
34.169	321.084	355.253	9.909	1922.	2014.	1-1981
28.873	276.729	305.603	8.373	1624.	1727.	2-1981
23.889	274.268	298.157	6.928	1344.	1450.	3-1981
31.480	302.171	333.652	9.129	1771.	1938.	4-1981
34.170	334.546	368.715	9.909	1922.	2135.	1-1982
29.090	290.255	319.345	8.436	1636.	1844.	2-1982
24.115	287.929	312.044	6.993	1356.	1551.	3-1982
31.716	316.163	347.879	9.198	1784.	2070.	4-1982
34.171	348.638	382.809	9.910	1922.	2263.	1-1983
29.355	304.440	333.795	8.513	1651.	1972.	2-1983
24.380	302.179	326.559	7.070	1371.	1662.	3-1983
31.841	330.543	362.383	9.234	1791.	2203.	4-1983
34.614	363.074	397.689	10.038	1947.	2430.	1-1984
29.666	319.288	348.954	8.603	1669.	2113.	2-1984
24.695	317.115	341.811	7.162	1389.	1785.	3-1984
32.187	345.536	377.724	9.334	1810.	2360.	4-1984
34.173	378.194	412.367	9.910	1922.	2543.	1-1985
29.990	334.468	364.458	8.697	1687.	2264.	2-1985
25.022	332.385	357.407	7.257	1407.	1917.	3-1985
32.425	360.928	393.352	9.403	1824.	2520.	4-1985
34.175	393.668	427.842	9.911	1922.	2695.	1-1986
30.334	350.069	380.404	8.797	1706.	2428.	2-1986
25.370	348.071	373.441	7.357	1427.	2060.	3-1986
32.655	376.729	409.383	9.470	1837.	2690.	4-1986
34.176	409.552	443.728	9.911	1922.	2857.	1-1987
30.694	366.040	396.734	8.901	1726.	2604.	2-1987
25.736	364.154	389.890	7.463	1447.	2215.	3-1987
32.873	392.891	425.764	9.533	1849.	2871.	4-1987
34.619	425.827	460.447	10.040	1947.	3068.	1-1988
31.073	382.429	413.502	9.011	1748.	2794.	2-1988
26.120	380.647	406.768	7.575	1469.	2383.	3-1988
32.855	409.493	442.349	9.528	1848.	3042.	4-1988
34.621	442.532	477.153	10.040	1947.	3252.	1-1989
31.427	399.214	430.641	9.114	1768.	2995.	2-1989
26.483	397.539	424.022	7.680	1490.	2561.	3-1989
33.280	426.485	459.765	9.651	1872.	3266.	4-1989
34.179	459.627	493.806	9.912	1922.	3403.	1-1990
31.753	416.443	448.197	9.208	1786.	3208.	2-1990
26.901	414.864	441.766	7.801	1513.	2758.	3-1990
33.467	443.934	477.401	9.705	1882.	3481.	4-1990
34.180	477.171	511.350	9.912	1922.	3607.	1-1991
32.061	434.114	466.175	9.298	1803.	3433.	2-1991
27.208	432.632	459.840	7.890	1530.	2956.	3-1991
33.654	462.124	495.778	9.760	1893.	3711.	4-1991
34.624	495.813	530.437	10.041	1947.	3874.	1-1992
32.365	452.526	484.891	9.386	1820.	3674.	2-1992
27.533	451.519	479.052	7.985	1549.	3171.	3-1992
33.827	480.801	514.628	9.810	1903.	3953.	4-1992
34.182	514.585	548.767	9.913	1923.	4053.	1-1993

32.665	471.773	504.438	9.473	1837.	3930.	2-1993
27.810	470.529	498.339	8.065	1564.	3395.	3-1993
33.995	500.260	534.255	9.858	1912.	4211.	4-1993
34.183	534.183	568.365	9.913	1923.	4297.	1-1994
32.919	491.150	524.070	9.547	1852.	4199.	2-1994
28.078	490.358	518.436	8.143	1579.	3634.	3-1994
33.803	520.224	554.027	9.803	1901.	4439.	4-1994
34.627	554.266	588.893	10.042	1948.	4614.	1-1995
33.163	511.340	544.503	9.617	1865.	4483.	2-1995
28.034	510.704	538.737	8.130	1577.	3846.	3-1995
34.281	540.685	574.967	9.942	1928.	4772.	4-1995
34.628	574.863	609.490	10.042	1948.	4891.	1-1996
33.393	532.435	565.828	9.684	1878.	4785.	2-1996
28.545	531.909	560.453	8.278	1605.	4151.	3-1996
34.401	561.665	596.067	9.976	1935.	5076.	4-1996
34.185	595.990	630.175	9.914	1923.	5118.	1-1997
33.584	553.668	587.252	9.739	1889.	5102.	2-1997
28.732	553.287	582.019	8.332	1616.	4429.	3-1997
34.513	583.544	618.057	10.009	1941.	5398.	4-1997
34.185	617.997	652.182	9.914	1923.	5425.	1-1998
33.760	575.823	609.583	9.790	1899.	5436.	2-1998
28.905	575.583	604.488	8.382	1626.	4722.	3-1998
34.609	605.971	640.581	10.037	1947.	5737.	4-1998
34.186	640.578	674.764	9.914	1923.	5750.	1-1999
33.920	598.917	632.836	9.837	1908.	5789.	2-1999
29.060	598.821	627.881	8.427	1634.	5033.	3-1999
34.696	629.357	664.053	10.062	1951.	6097.	4-1999
34.630	664.092	698.721	10.043	1948.	6175.	1-2000
34.049	622.207	656.256	9.874	1915.	6160.	2-2000
28.804	622.252	651.056	8.353	1620.	5288.	3-2000
34.770	653.323	688.092	10.083	1956.	6476.	4-2000

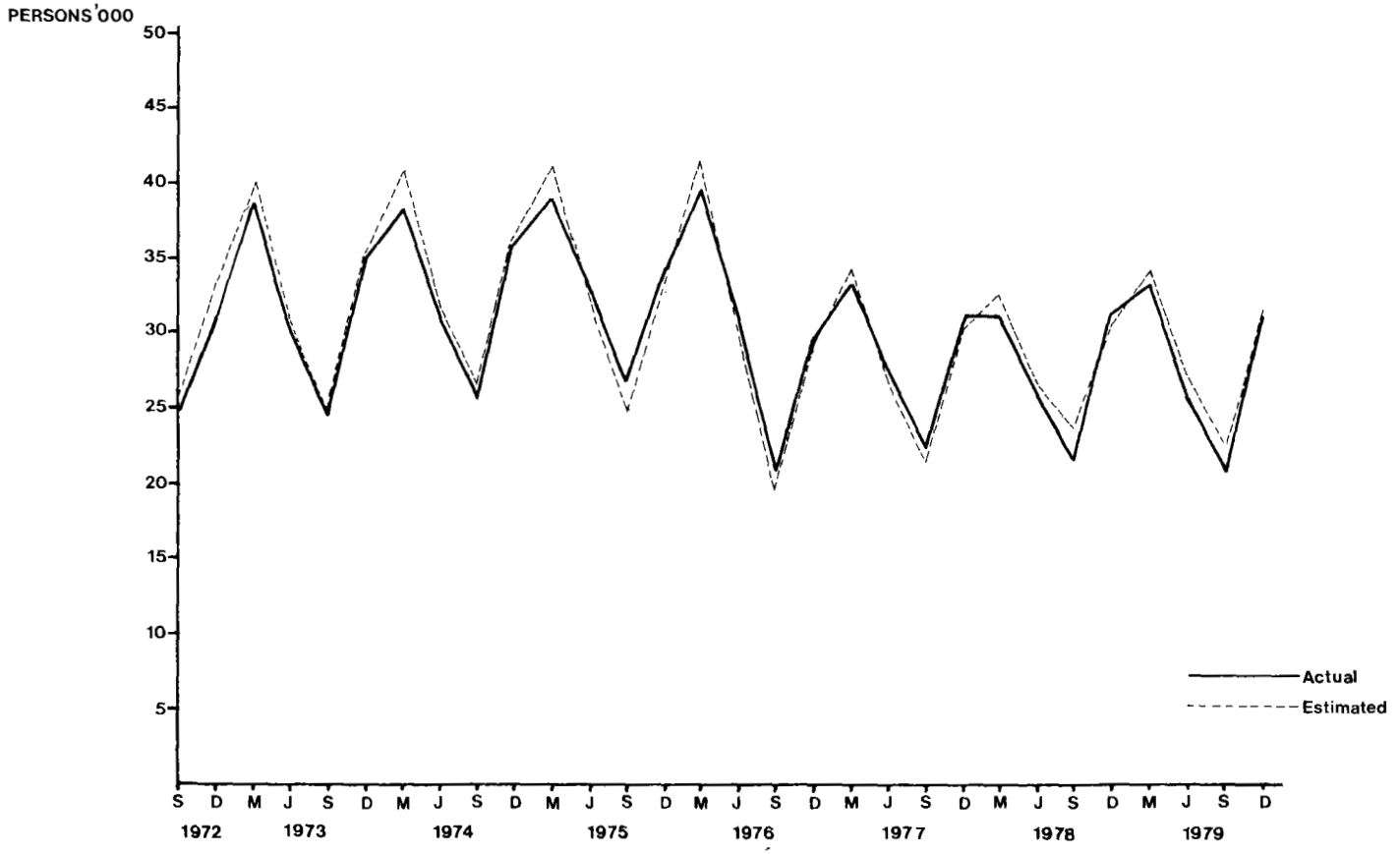

FIGURE A2.1 – MODEL PERFORMANCE SEA PASSENGERS ACTUAL AND ESTIMATED, 1972–1979

APPENDIX 3 - TECHNICAL DATA AND COST ESTIMATION PROCEDURES

TECHNICAL DATA AND SHIP CONSTRUCTION COSTS

The following is a summary of information provided to the Bureau by the Ship Design Group (SDG) of the Commonwealth Department of Industry and Commerce. The Bureau requested advice on technical data and ship construction costs for various alternative sizes and speeds of vessels.

Data supplied to SDG by the Bureau

The following information was supplied to the SDG by the Bureau:

- alternatives for a combined overnight passenger/freight service (Type A - see Table A3.1)
  - alternatives for numbers of passengers and cars (3 sizes), speeds of vessels (2 variants), machinery type (2 alternatives) and number of internal decks (2 alternatives)
- alternatives for a daylight passenger/overnight freight service, operated by two vessels (Type B - see Table A3.2)
  - alternatives as for Type A service, but restricted to only one internal deck
- table of travel times and distances for alternative services (see Table A3.3)
- table of pilotage distances for the alternative services (see Chapter 4, Table 4.2).

TABLE A3.1 - OVERNIGHT PASSENGER/FREIGHT SERVICE

Vessel Capacity		Propulsion Alternatives		Speed (knots)[a]
Passengers	Vehicles			
700	200	Diesel	Steam turbine (coal fired)	equivalent to total
550	175	"	"	voyage times of
400	150	"	"	14 1/2 hours, 9 hours
Accommodation configuration:		60% cabins	40% lounge chairs	
Draft limitations:		6.4 metres		
Length limitations:		137 metres		
Vehicle/freight deck height:		1 x 4 metres		
- alternative:		Twin Decks	1 x 2 metres (cars only)	
			1 x 4 metres (freight)	

(a) Voyage times are alternatives for each method of propulsion.

Source: Ship Design Group, Commonwealth Department of Industry and Commerce.

TABLE A3.2 - DAYLIGHT PASSENGER/OVERNIGHT FREIGHT SERVICE

Vessel Capacity		Propulsion Alternatives		Speed (knots)[a]
Passengers	Vehicles			
350	100	Diesel	Steam turbine (coal fired)	equivalent to total
275	85	"	"	voyage times of
200	75	"	"	10 1/2 hours, 8 hours

Accommodation configuration: 100% lounge chairs
Draft limitations: 5.8 metres
Length limitations: 137 metres
Vehicle/freight deck height: 4 metres

(a) Voyage times are alternatives for each method of propulsion.

Source: Ship Design Group, Commonwealth Department of Industry and Commerce.

TABLE A3.3 - TRAVEL TIME AND DISTANCE BETWEEN SELECTED PORTS IN VICTORIA AND TASMANIA

Origin/Destination	Total Distance (nautical miles)	Travel Time by Service (hours)	
		O/night	Daylight
Melbourne-Devonport	239	14.5	-
	(pilotage 50)	9.0	-
Melbourne-Devonport	219	-	10.5
	(pilotage 50)	-	8.0
Melbourne-Burnie	225	14.5	-
	(pilotage 50)	9.0	-
Melbourne-Burnie	205	-	10.5
	(pilotage 50)	-	8.0
Westernport Bay - Devonport	186	14.5	-
	(pilotage 17)	9.0	-
Westernport Bay - Devonport	186	-	10.5
	(pilotage 17)	-	8.0
Westernport Bay - Devonport	172	14.5	-
	(pilotage 17)	9.0	-
Westernport Bay - Devonport	172	-	10.5
	(pilotage 17)	-	8.0

Source: Bureau of Transport Economics.

Procedure

The SDG advised that the following processes were used to obtain the necessary ship data and best estimates of costs within the limitations of time scale available:

. evaluation of various alternatives suggested for investigation by Bureau, and elimination of any alternatives not considered practical or feasible

  - SDG recommended the coal fired steam turbine alternative be eliminated on the basis that it would be impracticable for application to passenger-car ferries

  - the speed requirements for a number of the alternatives would be impractical and therefore the SDG applied a somewhat arbitrary maximum of 23 knots to service speed. This SDG decision was based on an analysis of comparable vessels and has been substantiated by advice to SDG from overseas

  - the SDG sent telex/cable enquiries to selected shipyards (see Table A3.4) having proven expertise in the building of each vessel type, requesting the supply of best possible estimates of construction costs within the restricted time applicable

  - SDG then investigated technical requirements, analysed the information on costs received from the selected shipyards (see Table A3.5) and tabulated a summary of advice to the Bureau relating to the costs and technical particulars of the various alternatives.

Analysis of Investigation

In the final analysis, twelve alternative designs of ferries have been investigated which broadly cover the range sought by the Bureau. A summary of these options is given in Table A3.6.

TABLE A3.4 - TELEX ENQUIRY TO OVERSEAS SHIPYARDS

STANDARD TELEX SENT TO:

CENTROMOR, GDANSK, POLAND
HARLAND AND WOLFF LTD., BELFAST, N. IRELAND
RAUMA-REPOLA OY, RAUMA, FINLAND
WARTSILA AB.OY., HELSINKI, FINLAND
WARTSILA TURKU, TURKU, FINLAND
HOWALDTSWERKE-DEUTSCHE WERFT AKTIENGESELLSCHAFT, HAMBURG
SCHICHAU UNTERWESER A.G., BREMERHAVEN, GERMANY
ITALCANTIERI, TRIESTE, ITALY
GOTAVERKEN ORESUNDSVARET A/B, SWEDEN
AKER GROUP, OSLO, NORWAY
FRANCE-DUNKERQUE, DUNKERQUE, FRANCE
SOCIETE NOUVELLE DES ATELIERS ET CHANTIERS DU HAVRE, LE HAVRE, FRANCE
CAMMELL LAIRD SHIPBUILDERS, BIRKENHEAD, ENGLAND
ASTILLEROS DE SANTANDER S.A., SANTANDAR, SPAIN
MITSUI, JAPAN
AALBORG VAERFT, AALBORG, DENMARK

'WE REQUIRE AT EXTREMELY SHORT NOTICE INDICATIVE BUDGET CONSTRUCTION COSTS FOR VARIOUS ALTERNATIVE SIZES AND SPEEDS OF RO/RO PASSENGER/VEHICULAR FERRIES. REQUIREMENT RELATES TO A PARAMETRIC STUDY OF FUTURE DEMAND FOR RO/RO PASSENGER/VEHICULAR SHIPS ON AUSTRALIAN COASTAL TRADE, FOR WHICH OUR ASSISTANCE HAS BEEN SOUGHT. FOLLOWING IS SUMMARY OF RANGE OF VESSELS UNDER CONSIDERATION

A) OVERNIGHT PASSENGER/FREIGHT SERVICE
CAPACITY (2000-2500 TONNES DWT)

PASSENGERS (60% CABINS/40% SIT UP)	FREIGHT (VEHICLES)	SPEED ALTERNATIVES (KNOTS)
700	200 OR CARGO	17/22
550	175 OR CARGO	17/22
400	150 OR CARGO	17/22

TABLE A3.5, SHEET 1 - SHIPYARD RESPONSES TO ENQUIRY

Source	Centromor, Poland	Akers, Norway	Aalborg Vaerft, Denmark		Astilleros De Santander, Spain	Italcantieri, Trieste, Italy				Schichau Unterweser Ag, Bremerhaven, Germany		Mitsui Eng. & Ship, Japan
Basis	(Ship under Construction)	Ship Type Built	'Povl Anker'	'Dana Anglia'	(Recently Delivered, Another on Order)	Overnight 6979/D	Pass./Freight 6978/A	Daylight 7054	Express 7055	'European Enterprise'	'Spirit of Free Enterprise'	'Mesa-80' Semi-submersible Ship
Length (metres)		106.0 (LOA)	121.2 (LOA)	152.9 (LOA)	99.50 (LOA)	125	110	84	67	107		35.9 (LOA)
Breadth (metres)		17.3	21.5	23.7	17.00	23	20	16	13	19.91		17.1
Depth (metres)			7.0	8.32	10.50	7	7.2	5.3	5	11.66		5.9
Draught (metres)		4.12	5.15	6.1	4.5	5.9	5.6	4.0	3.4	5.8		3.15
Dwt (tonnes)	1 650	800	1 940	4 000	950	3 300	1 950	950	600			
Passengers												
- Berths	588	372	354	809		490	490			54		
- Sit Up		164(a)	1 146	121 440(b)	13 000	510	510	600(c) 600	500(c) 500	78	1 300	446
Car Capacity												
- Car	277	150	170 Vh.dk.	240	120	36	93	120	79		182	
- Trailers			130 Pl.dk.	230		70	23	21	12		168	
Service Speed (knots)	20.7	19	20.5	21	18	20	20	18	18	18.5	22	24
Power (bhp)	16 800		16 900	20 800	8 800	19 200	19 200	7 000	7 000			7200
Machinery	4-Sulzer		4-Diesels	2-Diesels	2-Diesels							
Price ($US m)	23/25	25	DK180 m (32)	DK275 m (49)	16	41.2	33.5	12	10.6	DM45 m (25.0)	DM75 m (41.7)	YEN2 billion (8.5)

(a) In sleepettes

(b) In couchettes

(c) Deck passengers

Source: Ship Design Group, Commonwealth Department of Industry and Commerce.

TABLE A3.5, SHEET 2 - SHIPYARD RESPONSES TO ENQUIRY

Shipyard: Harland and Wolff, Belfast, Northern Ireland

Alternative (Passengers/speed)	A700/22	A700/17	A550/22	A550/17	A400/22	A400/17	B350/23	B350/17	B275/23	B275/17	B200/23	B200/17
Length (metres)												
Breadth (metres)												
Depth (metres)												
Draught (metres)												
Dwt (tonnes)												
Passengers												
- Berthed	420	420	330	330	240	240						
- Sit Up	280	280	220	220	160	160	350	350	275	275	200	200
Car Capacity	200	200	175	175	150	150	100	100	85	85	75	75
Service Speed (knots)	22	17	22	17	22	17	23[a]	17	23	17	23	17
Power (bhp)												
Machinery												
Price (£UK mill)	25.6	20.5	23.0	18.3	20.2	16.3	15.6	11.0	14.8	10.6	14.3	10.1
($US mill)	52.0	41.6	46.7	37.2	41.0	33.0	31.7	22.3	30.0	21.5	29.0	20.5

(a) About + £4 million for 25 v. 23 knot (= £19.6 million total), however 25 knots regarded as impracticable for the size vessel.

Source: Ship Design Group, Commonwealth Department of Industry and Commerce.

TABLE A3.5, SHEET 3 - SHIPYARD RESPONSES TO ENQUIRY

Shipyard: Wartsila Shipyard, Helsinki, Finland

Alternative (Passengers/speed)	A700/17	A550/17	A400/17	A700/22	A550/22	A400/22	B350/17	B275/17	B200/17	B350/23	B275/23	B200/23
Length (metres)		125			130			95			105	
Breadth (metres)		20			20			17			17	
Depth (metres)		5.2			5.2			4.5			4.5	
Draught (metres)												
Passengers	700	500	400	700	550	400	350	275	200	350	275	200
Car Capacity												
Service Speed (knots)		17			22			17			25	
Power (bhp)		13 000			22 000			8 000			22 000	
Machinery												
Price ($US mill)	44.3	43.2	42.4	46.8	45.7	44.9	28.7	28.1	27.6	34.2	33.5	33.0

Source: Ship Design Group, Commonwealth Department of Industry and Commerce.

B) DAYLIGHT EXPRESS SERVICE (RETURN OVERNIGHT FREIGHT SERVICE)
CAPACITY (1000-1200 TONNES DWT)

PASSENGERS (100% SIT UP)	FREIGHT (VEHICLES)	SPEED ALTERNATIVES (KNOTS)
350	100 OR CARGO	17/25
275	85 OR CARGO	17/25
200	75 OR CARGO	17/25

IN LIGHT OF YOUR EXPERIENCE IN BUILDING SUCH VESSELS WOULD BE MOST APPRECIATIVE OF ANY FIGURES YOU MIGHT BE ABLE TO ADVISE. SUCH INFORMATION (COSTS AND CORRESPONDING BASIC TECHNICAL DATA) IS REQUIRED FOR FRIDAY 9 MAY DEADLINE. APPRECIATE SEVERELY LIMITED TIME AVAILABLE MAY RESTRICT ANY ADVICE YOU MIGHT FEEL ABLE TO GIVE TO UPDATE OF COMPARABLE SHIPS BUILT IN RECENT YEARS. ANY INFORMATION ON COSTS YOU CAN PROVIDE WOULD BE MUCH APPRECIATED. PLEASE TELEX RESPONSE TO MEET DEADLINE OF FRIDAY 9 MAY'.

Source: Ship Design Group, Commonwealth Department of Industry and Commerce.

Based on the advice received from the shipyards, in association with consideration of the technical requirements, an interpolation was made by the SDG to obtain estimates of the construction costs for the twelve alternative designs referred to in Table A3.6. These costs are detailed in Table A3.7, which also makes reference to the budget price(1) submitted by Mitsui, Japan, in respect of their recently developed semi-submersible catamaran passenger only ferry.

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(1) A budget is an indicative price for the purpose of a preliminary analysis, that is, it is not a firm quotation from shipbuilders.

TABLE A3.6 - SUMMARY OF OPTIONS INVESTIGATED

Size		Speed	Designation Code
Passengers	Cars	(knots)	
PROPOSALS 'A' - COMBINED OVERNIGHT PASSENGER/FREIGHT SERVICE			
700	200	17	A700/17
700	200	22	A700/22
550	175	17	A550/17
550	175	22	A550/22
400	150	17	A400/17
400	150	22	A400/22
PROPOSALS 'B' - DAYLIGHT PASSENGER/OVERNIGHT FREIGHT SERVICE			
350	100	17	B350/17
350	100	23	B350/23
275	85	17	B275/17
275	85	23	B275/23
200	75	17	B200/17
200	75	23	B200/23

Source: Bureau of Transport Economics.

An approximate assessment of the technical particulars for the various options is given in Table A3.8. This is based on the data obtained from overseas shipyards, analysis of published data and, in particular, consideration of conditions applying to the Australian coastal trade.

Reservations

The SDG wished to make clear that in providing this information the following reservations must be clearly understood:

- because of the very restricted time available, many approximations were made to obtain the relevant information. The SDG suggested that a reasonably thorough investigation would require at least three months;

TABLE A3.7 - ASSESSMENT OF INDICATIVE VARIABLE SHIP CONSTRUCTION COSTS

Alternative	Passengers (Berthed/Sit Up)	Cars	Speed (knots)	Indicative Cost ($Aust. million)
PROPOSALS 'A' - OVERNIGHT PASSENGER/FREIGHT SERVICE				
A700/17	420/280	200	17	35
A700/22	420/280	200	22	40
A550/17	330/220	175	17	32
A550/22	330/220	175	22	37
A400/17	240/160	150	17	30
A400/22	240/160	150	22	34
PROPOSALS 'B' - DAYLIGHT PASSENGER/OVERNIGHT FREIGHT SERVICE	(All Sit Up)			
B350/17	350	100	17	21
B350/23	350	100	23	26
B275/17	275	85	17	19
B275/23	275	85	23	25
B200/17	200	75	17	18
B200/23	200	75	23	24

Notes: Above indicative costs have been deduced by analyses of budget figures sought from overseas shipyards. Due to a variety of factors, such as location of shipyards (reflected in labour rates), state of order books at the shipyards, possible subsidies applying and the vagaries of the international shipbuilding market, quite a wide variation in figures was obtained. These have been rationalised as far as practicable, and some due regard made to the high standards of accommodation and outfitting generally applicable to the Australian coastal trade, which has resulted in the above assessment as to indicative building costs.

It should be clearly understood that they must be regarded as indicative only and could be subject to an error of the order of $\pm$ 30 per cent when tenders may be called.

The above are indicative variable prices as at mid 1980.

It is considered the cost of building any of the above alternatives in an Australian shipyard could be of the order of 30 per cent to 50 per cent higher.

A budget quotation was obtained from Mitsui Shipbuilding and Engineering, Japan, for their Semi-Submersible Catamaran (SSC) vessel ('Mesa 80'), technical details of which are given in Table A3.5. Although the 'Mesa 80' is now in operation - albeit restricted to Japanese coastal use - it must still be regarded as a prototype craft, and subject to evaluation. Also the 'Mesa 80' is used solely for the carriage of passengers, although Mitsui advise that alternative SSC versions of passenger/car ferries are being evolved.

Source: Ship Design Group, Commonwealth Department of Industry and Commerce.

TABLE A3.8 - APPROXIMATE ASSESSMENT OF TECHNICAL PARTICULARS FOR VARIOUS ALTERNATIVES

	A700/17	A550/17	A400/17	A700/22	A550/22	A400/22	B350/17	B275/17	B200/17	B350/23	B275/23	B200/23
Length (metres)	130	125	120	135	130	125	100	95	90	110	105	100
Breadth (metres)	20	20	20	20	20	20	17	17	17	17	17	17
Draught (metres)	5.2	5.2	5.2	5.2	5.2	5.2	4.5	4.5	4.5	4.5	4.5	4.5
Passengers -Berthed	420	330	240	420	330	240						
-Sit up	280	220	160	280	220	160	350	275	200	350	275	200
Crew	126	110	94	126	110	94	60	58	56	60	58	56
Cars	200	175	150	200	175	150	100	85	75	100	85	75
Service Speed	17	17	17	22	22	22	17	17	17	23	23	23
BHP	14 000	13 000	12 000	24 000	22 000	20 000	9 000	8 000	7 000	24 000	22 000	20 000
Machinery	TWIN SCREW DIESEL						TWIN SCREW DIESEL					
Fuel Consumption (tons/day)												
- Main engines	41	38	35	70	64	58	27	24	21	70	64	58
- Auxiliaries	4.5	4	3.5	5	4.5	4	3.25	2.75	2.25	3.5	3	2.5

Source: Ship Design Group, Commonwealth Department of Industry and Commerce.

- no layouts of vessels have been possible within the time scale. Sketch layouts are of prime importance to any such investigation, particularly for ferries where a major element in determination of size is space occupied by passengers, crew and RO/RO[1] traffic. Therefore the sizes of vessels given have largely been assessed from layouts of existing ferries and could be subject to variation, e.g., if changes are made to the numbers of crew, the extent of passenger and crew facilities, or the numbers and use of cargo and platform decks;

- costs have been sought and obtained from shipyards in various countries and prices quoted reflect the financial conditions in these countries. This aspect makes it difficult in interpolating a 'general' cost for the various proposals under consideration.

Conclusion

The SDG considers that the data and information provided constitute a reasonable basis for an indicative comparative assessment of operational costs for various options of ferries to be made. While reservations must be entertained with respect to the degree of accuracy of individual options, nevertheless the SDG believes that the figures provided should enable projections of individual operating costs to be assessed.

COST ESTIMATION PROCEDURES

All costs are estimated at 1979-80 prices.

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(1) RO/RO = Roll on/Roll off.

Voyage Costs

Included in voyage costs are bunkering estimates and miscellaneous port and navigational charges. Port and navigational charges included are ship water, light dues, general port costs and watchman, and are estimated at 0.132 million dollars.

Bunker cost calculations are based on fuel consumption figures provided by the SDG of the Commonwealth Department of Industry and Commerce. All main engines use marine fuel oil while auxiliaries use light diesel oil. Bunker costs were those ruling in April 1980.

Management (hire)

In this category manning costs, maintenance and general vessel operating costs and an estimate for incidentals are included. Incidental estimates which include an allowance for insurance costs are a relatively minor cost component and have been held constant at 0.300 million dollars annually. Ideally a growth factor for these costs should be estimated. However given the relative size of this cost component and the Bureau's time limitations this has not been done. Manning cost estimates are derived from information supplied by ANL on crew costs applicable to the 'Empress of Australia'. Maintenance and general vessel operating costs have also been supplied by ANL for the 'Empress of Australia'. The BTE has assumed that ship maintenance costs vary in proportion to the relative construction costs.

Terminal Costs

Terminal costs are estimated at $1.33 million from data supplied by ANL and are assumed constant regardless of the option considered.

Cargo Gear Costs

This estimate of 0.80 million dollars is derived from data supplied by ANL and is assumed constant regardless of option type.

Administration Costs

The estimate of $1.093 million is derived from data supplied by ANL and is assumed constant regardless of operating type.

Depreciation Costs

Depreciation allowances are obtained by depreciating the capital cost over 20 years on a straight line basis. Salvage values of the vessels are assumed zero.

APPENDIX 4 - TICKET SURVEY OF SEA PASSENGERS

The Bureau commissioned Nicholas Clark and Associates to sample records of tickets for sea passengers in order to obtain information relating to the characteristics of persons travelling and the type of fare which they used.

The sample was drawn from travel coupons surrendered by passengers making voyages on the 'Empress of Australia' in the calendar year 1979.

The total population of tickets was classified by month of sailing and within each month three northbound and three southbound sailings were randomly selected. The tickets selected in the sample were drawn from these sailings so that a fixed proportion of passengers involved in each of the sailings was included in the sample.

An adjustment was made for that month in which the ship was not in operation for 14 days due to maintenance.

A total of 1527 tickets was obtained. Information extracted included name and address of passenger, date of sailing, type and price of ticket purchased, whether the passenger transported a motor vehicle and the place of purchase of the ticket.

The information has been used in Chapter 3 of this Report. In addition, a sub-sample of this sample was included in the survey of potential passengers, the results of which it is anticipated will be published at a later date.

APPENDIX 5 - ESTIMATION OF NET FREIGHT REVENUES

The purpose of this appendix is to set out the assumptions underlying the estimation of net freight revenues for each of the 12 types of ships considered in this study. Table A5.1 sets out the freight capacity in terms of twenty foot container equivalent units (TEU) for each vessel.

TABLE A5.1 - FREIGHT CAPACITY BY VESSEL TYPE

Vessel Type	Containers (TEUs) per Vessel per Voyage
A700/17	66
A550/17	63
A400/17	60
A700/22	68
A550/22	66
A400/22	63
B350/17	55
B275/17	52
B200/17	50
B350/23	61
B275/23	58
B200/23	55

Source: Ship Design Group, Commonwealth Department of Industry and Commerce.

For each vessel, net freight revenue was estimated based on the following assumptions:

- the overnight service (type A options) makes 300 crossings of Bass Strait each year, i.e., 150 each way;

- each vessel in the daylight service (type B options) makes 300 crossings of Bass Strait per year;

- the freight charge for each TEU is $739 southbound and $662 northbound(1);

- cargo handling costs were assumed to be 38 per cent of gross revenue, based on the weighted average cost of handling cargo on the 'Empress of Australia' over the last 5 years.

Based on these assumptions the estimated net revenue per annum for each vessel type is set out in Table A5.2.

TABLE A5.2 - ESTIMATED NET FREIGHT REVENUE BY VESSEL TYPE

Vessel Type	Net Revenue per Annum ($ million, 1979/80 prices)
A700/17	8.57
A550/17	8.18
A400/17	7.79
A700/22	8.83
A550/22	8.57
A400/22	8.18
B350/17	14.28
B275/17	13.50
B200/17	12.98
B350/23	15.84
B275/23	15.06
B200/23	14.28

Source: Bureau of Transport Economics.

(1) Excludes pick up and delivery costs and container hire charges where units are hired from the shipping line.