Port Pirie: Economic Evaluation of Harbour Improvements

Report

This Report examines in detail the proposal to deepen and widen the entrance channel and harbour of Port Pirie. Not only is this the major port for Broken Hill lead and zinc concentrates and refined metals, but it also handles a considerable volume of wheat and barley exports. Of the various benefits identified from the work, only two have been found to be substantial in economic terms. These are the possibility of ustilising to full capacity the somewhat larger bulk carriers for bulk concentrate exports and similarly, the possibility of fully loading wheat export ships so that they would not require topping up at deep water ports.

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BUREAU OF TRANSPORT ECONOMICS

PORT PIRIE: ECONOMIC EVALUATION OF HARBOUR IMPROVEMENTS

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FOREWORD

The growth in size of a large proportion of the vessels engaged in world sea trades has important implications for port investment. This report contains an evaluation of a proposal to increase the capacity of Port Pirie to accommodate larger vessels taking into account the economies from increasing ship sizes.

The report was prepared by the Economic Evaluation Branch of the BTE, under the direction of G.K. R. Reid. The study was carried out by J.D. Kain with assistance from A.J. Shaw.

The BTE gratefully acknowledges the assistance received from governmental and other organisations including the South Australian Department of Marine and Harbors, the South Australian Parliamentary Standing Committee on Public Works, Australian Mining and Smelting Company Limited, Electrolytic Zinc Company of Australasia Limited and the Broken Hill Associated Smelters Proprietary Limited.

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Director

Bureau of Transport Economics,
Canberra,
October 1975

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SUMMARY

It has been proposed that the entrance channel and harbour of Port Pirie should be deepened and widened. Not only is this the major port for Broken Hill lead and zinc concentrates and refined metals but it also handles a considerable volume of wheat and barley exports. However, the shipping channel is long, and the work would cost some $14 million in 1974 terms.

Various benefits from the improvement work have been identified. They have been examined in detail and are discussed in this report, but only two have been found to be substantial in economic terms. These are the possibility of utilising to full capacity the somewhat larger bulk carriers now used for concentrate exports and, similarly, the possibility of fully loading wheat export ships so that they would not require topping up at deep water ports.

The evaluation is essentially commercial because there are no benefits to the community over and above the cost reductions that would be achieved by using larger ships. Consequently, the benefit-cost ratio is the ratio of discounted commercial cost savings to discounted capital costs. It was found that, under any reasonable assumptions, the benefit-cost ratio is less than one, meaning that the return is not adequate to justify the project.

If the capital expenditure were to be recovered by an amortised charge then this charge would be applied to the export shipments with which the benefits are associated. The charge has been calculated at $7.72 per tonne of concentrate and $0.66 per tonne of grain. However, the fact that the estimated benefit-cost ratio is less than one at a discount rate of 7 per cent or 10 per cent implies that the amortised charge would be too high to be economic for the shipowners.

CHAPTER 1 INTRODUCTION

ORIGIN OF THE STUDY

In October 1971, His Excellency The Lieutenant-Governor of South Australia, the Honourable Sir John Mellis Napier, KCMG, referred a proposal for deepening and widening the channel and harbour at Port Pirie to the South Australian Parliamentary Standing Committee on Public Works for inquiry and report.

The Committee undertook an extensive inquiry, and in its report[1] of December 1973, recommended against the proposed port improvements. The major findings of the Committee were:

- The proposed public works are mainly to meet the requirements of the Lead/Zinc Industry for the export of concentrates overseas in large ships.
- The existing port is quite suitable for the ships trading between Port Pirie and Tasmania.
- It is necessary for grain ships to top up at other ports.
- The view is not accepted that if the entrance channel were deepened and widened more vessels would call at Port Pirie.

In addition the Committee noted that

- There are numerous economic complications in the proposals put forward and a large

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(1) South Australian Parliamentary Standing Committee on Public Works, Report on Port Pirie Harbor Deepening, December 1973. A summary of the Committee's findings is contained in Annex A. Annex B contains a summary of other reports relating to improvements to Port Pirie harbour.

> amount of Government expenditure is involved with little prospect of any direct return. Related matters have interstate implications and it is suggested that the Government gives consideration to referring the project to the Commonwealth Bureau of Transport Economics for an appraisal.

Subsequently, the South Australian Minister of Marine requested the Minister for Transport in the Australian Government, the Honourable C.K. Jones, to examine the economics of the proposed port investment. Mr Jones then directed the BTE to undertake this study.

THE PORT PIRIE PROPOSAL

The Port Pirie proposal involves deepening and widening the entrance channel and harbour to allow the port to accommodate fully loaded vessels of up to 25,500 tonnes deadweight(tdw). In addition, the proposed works include the demolition and resiting of navigational beacons and the provision of new beacons and navigational leads.

As at September 1974, the estimated cost of the proposed works was $13.7 million, details of which are set out below:

		$ million
(1)	Dredging the channel to 8.5 metres low water seawards of Number 10 beacon	7.535
(2)	Deepening the channel from 6.4 metres low water to 8.5 metres low water from Port Pirie harbour to Number 10 beacon including widening of the swinging basin, deepening of the berths and the harbour floor	5.507
(3)	The provision of 29 additional navigational beacons; resiting of 17 existing beacons; demolition of 32 existing beacons and the provision of new navigational leads etc in the inner harbour	0.466
(4)	Miscellaneous associated works	0.192
	TOTAL	13.700

The South Australian Parliamentary Standing Committee questioned the justification for expenditure of this magnitude to safeguard the retention of overseas cargo shipments from Port Pirie. The commercial nature of the project was recognised by the Committee, but it was indicated that the levying of a harbour improvement rate under Section 127 of the South Australian Harbors Act would not be sufficient to allow the undertaking to be self financing.

OUTLINE OF THE STUDY

Stages in the BTE analysis of the proposal comprised:

(i) Identification of existing facilities and their limitations

(ii) Assessment of past and future cargo flows through the port and their implications for the proposed investment

(iii) Estimation of the benefits of upgrading the port on the basis of the potential savings which would accrue by shipping certain cargo types in larger, fully loaded vessels

(iv) Evaluation of the investment by comparing estimated benefits with estimated costs.

CHAPTER 2 CHARACTERISTICS AND LIMITATIONS OF THE PORT OF PORT PIRIE

HISTORICAL BACKGROUND

The emergence of Port Pirie as a shipping gateway to the northern areas of South Australia dates to the era of early pastoral settlement in the 1840's. Closer settlement from 1870 made the port an increasingly important outlet for cereal production, and a government township was laid out alongside the Port Pirie River in 1871. The first rail consignment of ore from the newly discovered silver, lead and zinc mines of Broken Hill arrived at Port Pirie in 1887, and a lead smelting plant was erected on the banks of the river the following year.

This development pattern has remained fundamentally unchanged over the past 90 years, and cargo movements through the port continue to be composed largely of lead and zinc products and cereal exports.

However, in recent years there has been considerable upgrading of port facilities, including the dredging of the entrance channel from 5.5 metres low water to 6.4 metres low water between 1958 and 1961. A major wharf reconstruction project was undertaken over the period 1960-67. New materials handling equipment and grain silo facilities were commissioned between 1962 and 1971.

PHYSICAL CHARACTERISTICS OF THE PORT

Existing Dimensions and Berth Facilties

The location of the port is illustrated in Figure C.1. The harbour at Port Pirie is situated on an estuary formed by Port Pirie River close to where it enters Spencer Gulf at Germein Bay (see Figure C.2).

An approach channel, 16 kilometres in length, connects the harbour with the deeper waters of Germein Bay. There are no appreciable freshwater flows in the Port Pirie River; thus siltation of the harbour and channel is minimal.(1)

The present depth of the Port Pirie entrance channel and harbour is 6.4 metres at low water, 8.1 metres at neap tides and 9.2 metres at common spring tides. The main wharf berths are sheetpiled and dredged to a depth of 8.2 metres low water for a distance of 24 metres from the wharf face. The sheetpiling used in the 1960-67 wharf reconstruction project made provision for further dredging of the berths to approximately 9.2 metres.

The port is served by 11 berths in a continuous line along almost 1,830 linear metres of waterfront (see Figure C.3). Three of these are used specifically for concentrate cargoes and another two for refined metal traffic. There are also individual berths for bulk grain, raw materials, oil, acid, general traffic and a tug berth. A small boat harbour with mooring jetties and landing facilities is situated at the inner end of the port, and serves the fishing and tourist industries centred on the nearby gulf waters. The latter facilities are not considered in this report. Additional details

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(1) However, the South Australian Department of Marine and Harbors advise that maintenance dredging of the harbour and channel is required every 5 to 10 years. This is made necessary by the action of ship propellors disturbing sediment on the harbour floor. In addition, because of the width of the channel, the movement of ship propellors close to the sides of the channel causes some subsidence of the channel banks.

of berth characteristics are contained in Table 2.1.

TABLE 2.1 - PORT PIRIE: DETAILS OF SHIPPING BERTHS

Berth umber	Length	Width	Depth at low water	Type of traffic
	(metres)			
1	150	24	7.3	General
2	180	24	8.2	Bulk Grain
3	200	31	7.3	Oils
4	110	24	5.8	Tugs etc.
5	200	24	8.2	Ores etc.
6	180	24	8.2	Ores etc.
7	150	24	8.2	Ores etc.
8	180	24	8.2	Refined Metals
9	180	24	8.2	Refined Metals
10	160	24	8.2	Raw Materials
11	50	24	3.7	Acid

Source: South Australian Department of Marine and Harbors.

Cargo Handling and Storage Facilities Available

Rail concentrate wagons are unloaded on arrival from Broken Hill by rail wagon tippler. Belt conveyors then transport the concentrates either to stockpiles on the ore wharves or to the smelters for refining. Concentrates destined for overseas ports are lifted from the wharf stockpiles into ships by a travelling ship-loading gantry with a capacity of 500 tonnes per hour. Concentrates shipped to Tasmania and refined metal product exports are lifted into ships by wharf cranes, which also unload raw materials shipped into the port for the smelting plant.

The tippler and conveyor plant can unload up to 20 rail wagons per hour, and has sufficient flexibility and capacity to handle large volumes of other bulk mineral exports should new cargoes of this nature be shipped through the port.

Grain exported through Port Pirie is stored in silos located adjacent to the waterfront as well as in 15 silo stations in the hinterland. The capacity of the terminal grain storage facilities is 175,000 cubic metres while the country silos have a total storage capacity of 395,600 cubic metres. New silos are currently being constructed at the port.

LIMITATIONS OF PORT FACILTIES

The main limitations of existing port facilities at Port Pirie considered in this report relate to the restrictions imposed by the existing depth and width of the harbour and channel on the size of ships using the port. These limitations are accentuated in the case of night sailing operations.

The size of vessels using Port Pirie is limited by channel dimensions to a length of 180 metres in daylight and to a draft of approximately 0.9 metres less than the depth of water at the time of the movement. The confined nature of the Port Pirie channel imposes a further restriction at night upon the navigation of vessels outward from the port when the maximum permitted vessel length is reduced to 160 metres. Inward night navigation is not permitted at all because of the difficulty in defining beacon lights due to the glare of the lights of the city smelters. The limit to the draft of fully loaded vessels capable of negotiating the Port Pirie channel cannot be clearly defined as it depends upon such factors as the design characteristics of the

vessel and tidal conditions. A relationship between the draft of bulk carriers and their deadweight tonnage is illustrated in Table 2.2. The data are based on the dimensions of all vessels included in Clarkson's The Bulk Carrier Register 1973, within the relevant size categories.

TABLE 2.2 - BULK CARRIER DRAFT/TONNES DEADWEIGHT RELATIONSHIP

Vessel size category (tonnes deadweight)	Average draft (metres)	Required depth of water (metres)
10,000 - 14,999	7.77	8.67
15,000 - 19,999	9.09	9.99
20,000 - 24,999	9.79	10.69
25,000 - 29,999	10.21	11.11

Source: The Bulk Carrier Register 1973, compiled and published by H. Clarkson & Co. Ltd., London: 1974.

Because of the need to maintain a 0.9 metre clearance between ship keels and the harbour floor, only vessels in the 10,000 tdw to 14,999 tdw category can be expected to sail fully loaded from Port Pirie, tidal assistance being required for the larger vessels in this class.

Problems arising from the port's limited depth may be increased by erratic variations in water depth. A representative of Scottish Ship Management Ltd (SSM) has advised that adverse winds can reduce the expected water depth at Port Pirie by up to 0.6 metre. Conversely,

exceptionally favourable conditions can serve to boost the cargo lift well above average levels.(1)

(1) It was reported in The Advertiser (Adelaide) November 13, 1974, that the 25,100 tdw vessel 'Nichiju Maru' was loaded with 20,000 tonnes of concentrate at Port Pirie during November 1974. The largest cargo shipped from Port Pirie prior to then was 17,000 tonnes.

CHAPTER 3 PAST AND PROJECTED TRAFFIC AT PORT PIRIE

In this Chapter, the characteristics of vessels and commodity flows through the port are described. Consideration is also given to the likely magnitude of future cargo shipments at the port and the type of ships that may use the port in the future, as these factors will influence the potential benefits from undertaking the project.

CARGO TYPES HANDLED

Relative Importance of Cargoes

The relative importance of each type of cargo shipped through Port Pirie is indicated in Table 3.1. Cargoes are grouped into five major categories:

Concentrate exports comprise lead and zinc concentrates, with relatively small tonnages of copper concentrates.

Refined Metal exports are mainly products of the Port Pirie lead smelter and zinc plant. Small quantities of other non-ferrous metals and iron and steel are also handled at the port.

Grain exports consist of wheat and barley produced in the hinterland.

Refined Petroleum imports are composed of various types of petroleum products.

Coal, Coke and Limesand imports are inputs to the mineral refining processes at Port Pirie.

Port Pirie is overwhelmingly a bulk cargo port. The volume of all other cargo is insignificant.

Direction of Cargo Flows

The direction and relative magnitude of major

TABLE 3.1 - PORT PIRIE: ANNUAL AVERAGE VOLUME OF CARGO AND SHARE OF TRADE BY CARGO TYPE, 1969-70 TO 1972-73

Type of cargo	Volume (tonnes)(1)	Proportion of total (per cent)
Exports		
Concentrates:		
Copper	5,288	0.4
Lead	56,731	4.0
Zinc	481,588	34.2
Refined Metal Products:		
Copper matte, cadmium and antimonial alloys	426	(..)
Iron and Steel	1,868	0.1
Zinc	18,446	1.3
Lead	133,679	9.5
Grain:		
Barley	40,169	2.9
Wheat	229,265	16.3
All Other Cargo	4,419	0.3
Total Exports	971,879	69.0
Imports		
Refined Petroleum and Bulk Oils	312,575	22.2
Coal, Coke and Coke Breeze	97,705	7.0
All Other Cargo	25,376	1.8
Total Imports	435,656	31.0
TOTAL ALL CARGO	1,407,535	100.0

(1) The data presented in the Annual Reports is in tons. Metric conversion factor used for all solid cargoes; 1 ton = 1.02 tonnes, for liquid cargoes; 1 ton = 1.14 tonnes.

NOTE: (..) denotes less than 0.1

Source: South Australian Department of Marine and Harbors, Annual Report, various issues.

cargo flows through the port is represented in Figure 3.1. Port Pirie is a net exporting port, the volume of exports being more than double the volume of imports.

All lead and zinc concentrate traffic consigned from Broken Hill to Port Pirie is transported by rail.(1) The zinc concentrates and about half of the lead concentrates are shipped directly through the port while the rest of the lead is retained at Port Pirie for smelting. The Port Pirie lead smelter is adjacent to the wharves from which refined lead products and refined zinc from the slag treatment plant are shipped to interstate and overseas ports.

Port Pirie is also an important outlet for grain destined for overseas ports or Tasmania. Coal and coke are imported from Port Kembla as fuel for refining processes at Port Pirie. The port also receives oil products from interstate and overseas refineries, as fuel for smelting operations and for the general fuel needs of northern South Australia and Broken Hill.

CONSIGNMENT CHARACTERISTICS

Cargo consignment size is an important determinant of the size and type of vessels operating through Port Pirie. A frequency distribution of consignment sizes by cargo type for 1972 is contained in Table 3.2 and its main features are discussed below. Consignment sizes vary with the nature of the cargo concerned.

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(1) Broken Hill concentrates are also railed from Broken Hill to Newcastle for refining at the Cockle Creek zinc smelter. However, the volume of this traffic is relatively small, averaging some 140,000 tonnes per annum, or approximately one sixth of the volume of concentrates freighted to Port Pirie each year.

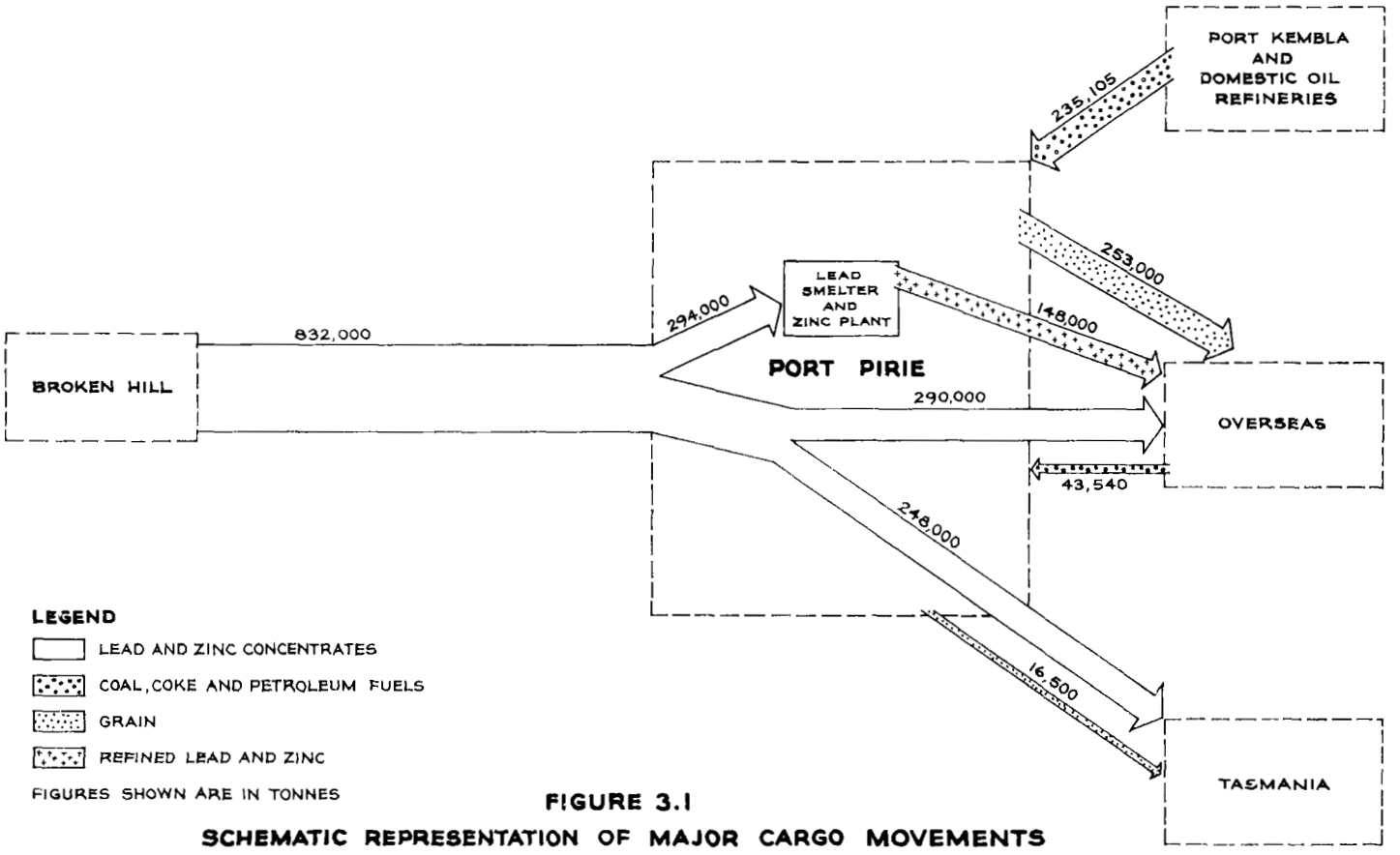

FIGURE 3.1

SCHEMATIC REPRESENTATION OF MAJOR CARGO MOVEMENTS THROUGH THE PORT OF PORT PIRIE 1969-70 TO 1972-73

(TONNAGES SHOWN ARE THE ANNUAL AVERAGE OVER THE FOUR YEAR PERIOD)

SOURCES : SOUTH AUSTRALIAN DEPT. OF MARINE AND HARBORS - ANNUAL REPORT (VARIOUS ISSUES)
SOUTH AUSTRALIAN RAILWAYS COMMISSIONER - ANNUAL REPORT (VARIOUS ISSUES)

TABLE 3.2 - PORT PIRIE: FREQUENCY DISTRIBUTION OF CONSIGNMENT SIZES BY CARGO TYPE, 1972

Consignment size category (tonnes)	Overseas cargoes			Interstate cargoes	
	Concentrates	Grain	Refined metal	Grain	Coal and coke[a]
under 2,000	0	0	33	10	0
2,000 " 4,000	0	0	11	0	0
4,000 " 6,000	2	1	4	0	0
6,000 " 8,000	5	4	2	0	0
8,000 " 10,000	3	8	5	0	0
10,000 " 12,000	1	7	0	0	11
12,000 " 14,000	1	4	0	0	
14,000 " 16,000	4	1	0	0	0
16,000 " 18,000	2	1	0	0	0

(a) BTE estimate

NOTE: Imports of petroleum and interstate concentrate exports are not included in the table. The South Australian Department of Marine and Harbors advises that petroleum product consignments have in recent years ranged in size from 5,250 tonnes to 13,000 tonnes, with the average consignment size being 7,000 tonnes for black oils, and 10,000 tonnes for white oils.
Approximately one third of concentrate shipments to Tasmania in 1972 were between 10,000 and 12,000 tonnes, while the remaining consignments appear to have been less than 10,000 tonnes.

Source: South Australian Parliamentary Standing Committee on Public Works.

Concentrate Exports - Overseas

It is apparent from Table 3.2 that consignments fall into two major size categories. Shipments of less than 10,000 tonnes made up 38 per cent of the export tonnage in 1972, while consignments of between 14,000 and 18,000 tonnes accounted for the rest.

Refined Metal Exports

Although lead products and other refined metals are an important form of traffic through Port Pirie, the statistics in Table 3.2 show that such products have been generally despatched in relatively small consignments.

Coal, Coke and Petroleum Products

Consignments of coal and coke range in size from 9,000 to 11,000 tonnes, while petroleum products are imported in consignments of between 5,000 and 13,000 tonnes.

Grain Exports - Overseas

Shipments of grain to overseas ports are generally within the 6,000 to 14,000 tonne category as can be seen in Table 3.2.

Grain Exports - Tasmania

Consignments of grain to Tasmania are approximately 2,000 tonnes in size.

PAST CARGO GROWTH

An index of the changes in each major category of cargo through Port Pirie over the past decade is shown in Table 3.3. The annual tonnage shipped through the port did not change appreciably over the period 1964-65 to 1968-69. However, in 1969-70 there was a significant increase in traffic mainly attributable to growth in

TABLE 3.3. - PORT PIRIE: INDICES OF MAJOR CARGO TONNAGES
1964-65 TO 1973-74

Year	Concentrates		Refined metals	Coal and coke	Petroleum fuels	Grain		Total cargo
	Overseas	Interstate				Overseas	Interstate	
1964-65	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1965-66	116.0	99.9	99.7	127.4	93.6	58.1	122.1	97.2
1966-67	121.2	104.6	94.0	131.4	104.3	61.9	100.3	100.7
1967-68	128.3	84.6	91.6	199.4	107.9	30.5	298.7	97.6
1968-69	127.0	99.3	80.0	277.0	102.9	44.7	276.5	100.9
1969-70	154.8	101.7	111.5	258.1	118.7	117.7	421.2	126.0
1970-71	122.7	105.7	86.6	221.6	118.6	194.9	125.0	124.3
1971-72	106.5	112.0	92.2	320.0	122.7	145.7	273.5	119.3
1972-73	72.4	111.2	82.0	247.5	141.1	141.2	98.5	110.0
1973-74	108.5	85.3	68.4	268.9	103.6	130.1	150.8	127.9
1964-65 Volume (million tonnes)	0.259	0.231	0.167	0.037	0.250	0.169	0.007	1.173

Source: South Australian Department of Marine and Harbors, Annual Report, various issues.

overseas grain and concentrate traffic. In the four years subsequent to 1969-70, a slight decline in the annual level of traffic from this peak occurred. Nevertheless, traffic remained approximately 25 percent greater than the average annual level achieved between 1964-65 to 1968-69. No sustained growth or decline in shipments of concentrates and refined metals took place over the four years subsequent to 1969-70.

FUTURE CARGO GROWTH

The magnitude of the benefits from upgrading the Port Pirie harbour and channel depend on the future level of cargo handled by the port. Possible growth in existing cargoes and the possibility of new traffics being shipped through the port were therefore considered. It was concluded that significant changes in the volume of most cargoes handled are not likely in the foreseeable future, even though certain cargoes such as petroleum and grain, have increased in recent years.

Broken Hill Mine Output

Since the mining operations at Broken Hill provide Port Pirie with the major portion of its traffic, any prediction of potential traffic flows through the port must take account of the likely level of mining activity at Broken Hill in the future. It is difficult to forecast future output of the mines since it is dependent upon unpredictable factors such as the development of new technology, world metal prices and possible new lead and zinc deposit discoveries. However, published forecasts of the life of the mines suggest a range of from ten to twenty years

for the North Broken Hill and Zinc Corporation Mines.[1]

The eventual closure of the Broken Hill mines would not necessarily mean that the Port of Port Pirie would lose all of its lead and zinc traffic. The Port Pirie lead smelter is one of the largest in the world and it is feasible that it could continue to operate using concentrates imported from overseas sources. In addition, the Port Pirie zinc plant, which was commissioned in 1966-67, could continue in operation for at least 20 years on the basis of its current treatment rate.[2]

Thus, it appears that the present level of lead and zinc traffic through Port Pirie could be maintained for at least another two decades. Further, on the basis of the annual volumes over the past ten years, it is assumed that tonnages of concentrates and refined metals shipped out of the port will remain reasonably constant.

Cereal Exports

The future volume of cereal exports from the northern areas of South Australia was considered by a committee comprising representatives of the South Australian Departments of Agriculture and Marine and Harbors and the South Australian Railways. Their report[3]

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(1) CRA Gazette, April 6, 1973 Vol.8, No.4. The National Times, October 14-19, 1974. These estimates do not take into account the recently discovered silver-lead-zinc orebody at the North Broken Hill mine. However the size and development potential of the deposit is uncertain. See The Recorder (Port Pirie) August 20, 1975.

(2) The zinc plant treats slag derived from the lead blast furnaces and also material recovered from the Port Pirie slag dump. Refined zinc is being produced from these sources at a rate of 40,000 to 44,000 tonnes per annum.

(3) Report to the South Australian Minister of Marine, "Report of the Central Grain Terminal Investigation Committee" (September, 1971)

concluded that while increased area under crop and higher yields per hectare had raised cereal production in the late 1960's, appreciable increases in mean annual cereal production could not be expected over the next 11 years. No information was available to indicate the possible level of grain exports after 1986. It was assumed that the volume of grain exports would remain reasonably constant over the time scale of this study.

Flinders Ranges Mining Operations

New mining activities at Beltana and Mount Gunson in the Flinders Ranges are a potential source of new traffic through the Port of Port Pirie. Willemite ore is being mined in the Beltana district, 285 kilometres north-east of Port Pirie by the Electrolytic Zinc Company of Australasia Limited (EZ). Discussion with a representative of EZ revealed that the company anticipates shipping 40,000 tonnes of willemite per annum to interstate and overseas ports over the next 15 years. The company plans to export 30,000 tonnes of ore to Belgium in 1975, followed by a further 20,000 to 30,000 tonnes in 1976 as well as 10,000 tonnes per annum to Risdon, Tasmania. EZ advises that annual shipments would be spread over a number of consignments rather than all being loaded onto a single vessel. The characteristics of this traffic would not warrant the use of very large bulk carriers. Therefore shipment of this cargo would not benefit from the harbour development works considered in this report.

The output of the copper mining activities at Mount Gunson is anticipated to amount to some 25,000 tonnes of ore per annum. It is expected that this would be shipped in a similar manner to the willemite traffic and thus does not warrant special consideration.

"Iron Triangle" Growth Region

The Port Pirie-Port Augusta-Whyalla area which is known as the "Iron Triangle" has been recognised as a potential growth region to which measures aimed at decentralisation might be successfully directed. Important industries in the region include a steelworks and shipbuilding plant, the lead and zinc smelter works and railway workshops. Locational advantages include proximity to the Moomba-Adelaide natural gas pipeline, the transcontinental railway, and a workforce of over 22,000 people (as at 1971, Australian Bureau of Statistics). These could provide a nucleus for industrial development which could have ramifications for port facilities in these three cities.

Port Pirie is reported to have been considered as a possible site for a uranium enrichment plant.(1) However, it is unlikely that shipping facilities would be necessary to serve such a project because only very small tonnages of materials would be involved.

Summary

Recent mining developments in the Flinders Ranges do not have any significant bearing on the Port Pirie harbour improvements. While the possibility of new industrial development in the Port Pirie region is recognised, there are no indications of any industries requiring deep water port facilities being established at Port Pirie. In addition, the volume of existing cargoes is not likely to change significantly in the foreseeable future. It is concluded that a case for upgrading port facilities at Port Pirie, within the time

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(1) The Australian Financial Review (May 13, 1974)

scale of this study, cannot be based on potential developments.

VESSEL TYPES OPERATING

In evaluating the benefits from upgrading Port Pirie harbour facilities, the degree to which particular shipping operations are adversely affected by the port's depth limitations must be considered. An analysis of the size characteristics of vessels operating through Port Pirie and a brief discussion of vessels engaged in particular trades follows.

Concentrate Shipments - Overseas

Of the vessels engaged in this trade, a distinction can be made between vessels managed by Scottish Ship Management Ltd (SSM) and other vessels. SSM vessels are generally larger and therefore more susceptible to cargo shortloadings due to the limited depth of the Port Pirie harbour and channel.

SSM vessels engaged in the concentrate trade are drawn from two classes of bulk carrier with the following dimensions:

(i) Size: 22,390 tonnes summer deadweight
Length: 161 metres
Beam: 22.9 metres
Summer Draft: 9.76 metres

(ii) Size: 24,070 tonnes summer deadweight
Length: 163 metres
Beam: 22.9 metres
Summer Draft: 10.42 metres.

Non-SSM vessels that use the port have generally been bulk carriers of less than 15,000 tdw. The number of calls at Port Pirie by SSM and non-SSM vessels engaged in the overseas movement of concentrates for the years

1971 and 1972 are detailed in Table 3.4.

Concentrate Shipments - Tasmania

Consignments of concentrates to Tasmania have been handled by the Union Steam Ship Company of New Zealand Ltd's bulk/general cargo carrier "Risdon" and by Australian National Line (ANL) vessels, the latter mainly being "Lake" class bulk carriers. These ships are smaller than those generally employed in the overseas concentrate trades. This is evident from the data contained in Table 3.5. "Lake" class vessels range in size from 10,800 tdw to 11,700 tdw, compared with "Risdon" which is 5,380 tdw in size.

TABLE 3.4 - PORT PIRIE: CALLS BY OVERSEAS CONCENTRATE VESSELS BY SIZE CATEGORY, 1971 AND 1972

Vessel size category (tonnes deadweight)	Scottish Ship Management Ltd vessels	Non-Scottish Ship Management Ltd vessels
less than 5,000	0	0
5,000 and under 10,000	0	1
10,000 " " 15,000	0	18
15,000 " " 20,000	1	4
20,000 " " 25,000	20	2
TOTAL	21	25

Source: South Australian Parliamentary Standing Committee on Public Works.

Refined Metal Shipments

General cargo vessels are usually employed in the shipment of metal products from Port Pirie. The data contained in Table 3.5 show that the majority of these ships were less than 15,000 tdw in 1972.

TABLE 3.5 - PORT PIRIE: FREQUENCY OF VESSEL CALLS BY VESSEL SIZE CATEGORY AND CARGO TYPE,(a) 1972

Vessel size category (tonnes deadweight)	Overseas			Interstate(c)	
	Concentrates(b)	Grain	Refined metals	Concentrates	Grain
less than 5,000	0	0	3	0	10
5,000 and under 10,000	1	1	18	30	0
10,000 " " 15,000	7	9	28	8	0
15,000 " " 20,000	1	12	1	0	0
20,000 " " 25,000	9	4	1	0	0
25,000 " " 30,000	0	0	3	0	0
TOTAL	18	26	54	38	10

(a) Excludes petroleum cargo

(b) Due to market conditions, shipment of concentrates from Port Pirie during 1972 were abnormally low.

(c) BTE estimates; apply to 1971-72

Source: Evidence presented to South Australian Parliamentary Standing Committee on Public Works and BTE estimates.

Coal, Coke and Limesand Shipments

ANL "Lake" class vessels are employed in these trades.

Grain Shipments - Overseas

It is shown in Table 3.5 that over half the vessels which loaded grain at Port Pirie for overseas ports in 1972 were between 15,000 tdw and 25,000 tdw in size, with the remainder being less than 15,000 tdw.

Grain Shipments - Tasmania

The 2,054 tdw ANL bulk/general cargo vessel "North Esk" is the sole ship currently engaged in this trade.

Petroleum Shipments

Petroleum imports from both domestic and overseas sources are typically carried in tankers of up to 22,000 tdw in size.

DECLINE IN FREQUENCY OF VESSEL CALLS

The annual number of vessel calls at Port Pirie between 1964-65 and 1972-73 is contained in Table 3.6. The data reveal that over the ten year period 1964-65 to 1973-74, the number of vessels calling at Port Pirie declined by approximately 50 per cent.

This trend is largely explained by the cessation of two minor coastal trades based at Port Pirie. In 1967-68, the shipment of sulphuric acid in ketches to Port Lincoln ended but this resulted in a drop in annual traffic of little more than 10,000 tonnes, although the number of vessels calling at Port Pirie fell considerably as this cargo was shipped in very small consignments. In the late 1960's limesand shipments from Wardang Island in

Spencer Gulf ceased. This traffic was handled in barges and its cessation resulted in a drop of about 80 vessel calls per annum. Hence the major cause of the fall in the number of vessels calling at the port has been reductions in the numbers of small vessels and not a tendency to introduce larger ones into the concentrate and grain trades.

TABLE 3.6 - PORT PIRIE: NUMBER OF VESSEL CALLS, AND AVERAGE TONNES OF CARGO PER VESSEL, 1964-65 TO 1972-73

Year	Vessel calls	Average tonnes of cargo per vessel
1964-65	440	2,665
1965-66	413	2,758
1966-67	435	2,717
1967-68	342	3,358
1968-69	308	3,842
1969-70	367	4,022
1970-71	235	6,197
1971-72	218	6,421
1972-73	221	5,874

NOTE: Data presented in Annual Reports are in tons. Metric conversion factor used for all solid cargoes; 1 ton = 1.02 tonnes, for liquid cargoes; 1 ton = 1.14 tonnes.

Source: South Australian Department of Marine and Harbors, Annual Report, various issues.

NEW VESSELS FOR PORT PIRIE TRADES

New EZ Trade Vessel

EZ operate the 12,800 tdw vessel "Zincmaster" on the Port Pirie-Tasmania concentrates trade. It has

been designed with the harbour and channel limitations of Port Pirie in mind, and has the following dimensions:

Overall length	151.5 metres
Moulded beam	21.2 "
Full load scantling draft	8.7 "

Although the new vessel requires tidal assistance in order to sail from Port Pirie with a full load of concentrates, it seems unlikely that the depth limitations of the harbour and channel will significantly reduce its load capacity.(1)

ANL Vessels

ANL has recently called tenders for the construction of either three or four 15,000 tdw bulk carriers. The new ships are expected to replace the "Lake" class vessels, which are approaching the end of their economic life. The existing depth of Port Pirie harbour and channel should not adversely affect the efficient use of these vessels.

SSM Vessels

The SSM Group presently has on order four new vessels of approximately 26,000 tdw each, with an overall length of 176 metres, beam of 25.5 metres and a summer draft of 10.0 metres. The existing SSM fleet consists of 26 vessels, all within the 19,000 to 24,000 tdw category, with the exception of one vessel which is 28,050 tdw.

SSM has advised that the new vessels, which are expected to enter service in the second half of 1975, will not be employed in the Port Pirie trade if there is

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(1) Further details on the characteristics and operation of the vessel are provided in Annex D.

no improvement in the depth of water at Port Pirie. However, SSM states that the position would be different if "reasonably profitable" completion cargoes were obtainable.

CHAPTER 4 EFFECTS OF EXISTING HARBOUR AND CHANNEL DIMENSIONS ON PORT PIRIE TRAFFIC

The magnitude of benefits from improving the capacity of Port Pirie harbour to accommodate large bulk carriers will depend in part on the economics of operating such vessels. In this Chapter, consideration is given to the economics of bulk carriage and to the effects of the existing harbour depth on efficient operation of "large" bulk carriers. The major trades adversely affected by this constraint are identified.

THE ECONOMICS OF BULK CARRIAGE

One of the most notable features of the growth in world bulk shipping over the past two decades has been the increase in the relative importance of large bulk carriers. This development has been particularly apparent in the Australian bulk trades.(1)

Large ships achieve economies per unit of payload capacity since firstly, an increase in the gross tonnage of a ship leads to a more than proportional increase in payload capacity. Hence, capital costs per tonne of cargo decrease. Secondly, operating costs per tonne of cargo capacity increase less than proportionately as ship size increases.

On the other hand, savings derived from employing larger vessels are offset to some extent by other resource costs associated with their use. Significant resource cost constraints on ship size exist which must be taken into account in any evaluation of the benefits of large ships. These are of two main types:

(i) Inventory costs: For a given rate of

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(1) This development is apparent from statistics contained in Commonwealth Department of Shipping and Transport, "Large Ships" August 1971.

throughput, it is apparent that as vessel and consignment size increases and the frequency of despatch declines, cargo movements become increasingly lumpy. To accommodate shipments, the size of stockpiles at the despatching point must also be enlarged. In doing so, inventory costs are incurred which offset to some degree the resource savings of employing larger vessels. The higher the value of the cargo being transported, the higher the inventory costs and hence the smaller will be the optimal inventory and shipment sizes. For example, it is estimated that the value of a 12,000 tonne consignment of lead and zinc is approximately equal to that of a 190,000 tonne consignment of iron ore.

(ii) Port costs: The economic operation of large bulk carriers depends on the provision of appropriate port and terminal facilities. The longer large bulk carriers stand idle in ports compared with smaller vessels, the higher the capital costs per tonne kilometre performed. Hence there is a need for cargo handling equipment to be matched to vessel capacity.

In addition, efficient operation of large bulk carriers in port will depend upon factors related to the physical dimensions of the port. These factors include:

- ease of access to and from the hinterland
- the area of wharfage space available for the loading and discharge of large bulk consignments
- the depth of water in the port and its approaches

Of these considerations, harbour depth is at present the main constraint upon the efficient use of vessels of approximately 15,000 tdw and greater at Port Pirie. Although resource savings might accrue through the use of larger vessels, these will be offset to some extent by the resource costs incurred in providing the necessary port facilities for these vessels.

EFFECTS OF DEPTH LIMITATIONS

The major effect of the Port Pirie harbour's relatively shallow depth has been to restrict the volume of cargo that can be lifted by vessels over about 15,000 tdw to less than their full cargo capacity. Associated with this problem are delays which occur when some vessels stand idle in port while awaiting suitable tidal conditions before sailing. The cargoes which are adversely affected by the port's existing depth are considered below. None of the vessel types discussed in the following paragraphs have a length in excess of the maximum permitted for outward night navigation from Port Pirie.

Overseas Concentrate Exports

SSM Vessels: Table 4.1 indicates the magnitude of shortloadings of SSM vessels leaving Port Pirie in 1973-74.

In appears that SSM vessels were loaded with the maximum possible volume of cargo subject to the

prevailing water depth conditions. This is suggested by the data in Table 4.1, which indicate a tendency for the load factor of vessels to increase as the depth of water in the port increases.

Since SSM vessels commenced operations from Port Pirie in 1968, the shipping company has sought to compensate for shortloadings by taking on completion cargoes at deeper ports in South Australia and Western Australia. However, SSM advises that this procedure has met with limited success for various reasons:(1)

(i) Difficulties arise in making forward arrangements for loading completion cargoes on account of the problem of estimating in advance the quantity of cargo any ship will load at Port Pirie due to difficulties in predicting water depth.

(ii) Completion cargoes may be loaded and discharged at different ports from the cargo originating from Port Pirie. Therefore, it is necessary to find top up consignments which will earn sufficient freight revenue on small quantities of 4,500 to 6,000 tonnes, to cover the costs of up to two additional port calls, plus the costs of any deviation to the loading and discharge ports.

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(1) Of the 15 SSM vessel movements from Port Pirie between 15 September 1972 and 25 July 1974, only in three cases were completion cargoes taken on.

TABLE 4.1 - PORT PIRIE: CHARACTERISTICS OF SCOTTISH SHIP MANAGEMENT LTD. VESSELS AND CONSIGNMENTS TO OVERSEAS PORTS, 1973-74.

Departure date	Vessel	Tonnes deadweight	Concentrate loaded (tonnes)	Load factor (per cent)	Draft of vessel (metres)	Depth of water at departure time (metres)
7/8/73	Cape Wrath	22,420	15,466	69	9.8	7.8
22/8/73	Baron Inchape	24,582	14,841	60	10.4	7.8
27/8/73	Cape Clear	20,067	14,438	72	9.8	7.9
27/10/73	Baron Cawdor	22,389	17,451	78	9.8	8.3
26/11/73	Cape York	22,460	17,139	76	9.8	8.4
26/2/74	Temple Inn	24,184	16,607	69	10.4	8.3
11/3/74	Cape Wrath	22,420	16,750	75	9.8	8.4
10/4/74	Baron Cawdor	22,389	15,523	69	9.8	7.8
28/4/74	Cape York	22,460	16,868	75	9.8	8.2
20/5/74	Baron Inchape	24,582	15,850	64	10.4	8.3

Source: Scottish Ship Management Ltd.

(iii) SSM vessels travel to Europe by the western route. A significant proportion of potential completion cargoes comes from the eastern states. Prior loading is required at Port Pirie due to restricted depth and deviation has been unattractive considering the small quantities of cargo involved.

Thus it is apparent that SSM traffic is being adversely affected by the existing depth limitations of the port, although the lengths of SSM vessels presently in use do not exceed the maximum length permitted for vessels leaving the port at night.

Non-SSM Vessels: Despite the relatively shallow draft and smaller size of non-SSM concentrate vessels, load factors for these ships have been generally lower than those of SSM vessels. In 1971 and 1972 only 40 per cent of all non-SSM vessels left Port Pirie with at least 60 per cent of their cargo capacity loaded with concentrates, while in the case of SSM vessels, 81 per cent of such ship movements were characterised by load factors in excess of 60 per cent (see Table 4.2).

It would be expected that non-SSM vessels would have higher load factors than SSM ships if the objective of non-SSM operators was to take on the maximum sized load subject to the depth constraint. The fact that this is not so suggests that non-SSM concentrate shipment sizes are not determined primarily by the depth of water in the port at the time of sailing as appears to be the case with SSM consignments. An examination of the draft of non-SSM concentrate carriers suggests that the majority of them could sail fully loaded from Port Pirie

TABLE 4.2 - PORT PIRIE: CHARACTERISTICS OF NON-SCOTTISH SHIP MANAGEMENT LTD. CONCENTRATE VESSELS AND CONSIGNMENTS OF CONCENTRATES TO OVERSEAS PORTS, 1971 AND 1972

Departure date	Vessel	Length (metres)	Draft (metres)	Tonnes dead-weight	Conc-entrate loaded (tonnes)	Load factor (per cent)
15/2/71	Spencer Maru	135.06	7.93	12,399	6,210	50
1/3/71	Lombardy	140.09	8.57	11,235	10,219	91
5/4/71	Spencer Maru	135.06	7.93	12,399	6,793	55
26/4/71	Tito Campanella	175.30	10.30	20,449	5,102	25
25/5/71	Spencer Maru	135.06	7.93	12,399	6,698	54
19/6/71	Belcargo	165.70	9.27	17,850	15,616	87
11/7/71	Spencer Maru	135.06	7.93	12,399	8,319	67
29/7/71	Cumulus	160.43	8.32	10,424	6,120	59
16/8/71	Paula Howaldt	139.54	9.18	15,239	5,225	34
31/8/71	Spencer Maru	135.06	7.93	12,399	6,449	52
7/10/71	Agios Antonios	152.38	9.21	16,993	4,126	24
19/10/71	Spencer Maru	135.06	7.93	12,399	6,288	51
25/10/71	Aliakmon Pilot	145.09	8.41	10,950	8,214	75
7/12/71	Spencer Maru	135.06	7.93	12,399	6,152	50
20/12/71	Hakusui Maru	136.10	8.51	11,415	9,871	86
11/1/72	Collin	143.10	9.02	15,300	9,233	60
1/2/72	Tarpon Sea	143.26	8.78	11,830	7,597	64
7/2/72	Spencer Maru	135.06	7.93	12,399	6,238	50
23/3/72	Spencer Maru	135.06	7.93	12,399	8,531	69
6/5/72	Spencer Maru	135.06	7.93	12,399	6,742	54
12/5/72	Cap Vincent	116.83	7.53	7,584	7,003	92
7/8/72	Spencer Maru	135.06	7.93	12,399	8,325	67
4/10/72	Kyokushin Maru	164.88	9.33	21,600	5,610	26
6/10/72	Spencer Maru	135.06	7.93	12,399	5,050	41
25/11/72	Spencer Maru	135.06	7.93	12,399	6,540	53

Source: South Australian Parliamentary Standing Committee on Public Works.

on the high water spring tide level of 9.2 metres.(1)

Therefore, it is concluded that the operation of non-SSM concentrate vessels at Port Pirie is not adversely affected by the port's existing depth.

Interstate Concentrate Exports

"Risdon": This vessel has a draft of 6.5 metres and so the depth of water in the Port Pirie harbour and channel does not prevent it from loading to capacity if required.

"Lake" class vessels: An examination of Table 4.3 shows that load factors for "Lake" class vessels engaged in this traffic between 1967 and 1973 range from an annual average of 92.5 per cent in 1973 to 96.9 per cent in 1969. It is concluded that the present dimensions of the Port Pirie harbour and channel do not present serious impediments to efficient operation of these vessels.

TABLE 4.3 - AVERAGE ANNUAL LOAD FACTORS OF "LAKE" CLASS VESSELS ENGAGED IN PORT PIRIE-TASMANIA CONCENTRATE TRADE 1967 TO 1973

Calendar year	Average annual load factor (per cent)
1967	94.8
1968	94.0
1969	96.9
1970	94.5
1971	93.9
1972	95.1
1973	92.5

Source: Data provided by Electrolytic Zinc Company of Australasia Limited.

(1) An analysis of Port Pirie tidal characteristics is contained in Annex E.

Refined Metal Exports

The consignment and vessel characteristics of refined metal exports from Port Pirie for the half calendar year ending 30 June 1972 are shown in Table 4.4. An examination of the draft of these vessels suggests that most of the ships could have readily sailed from the port fully loaded, given limited tidal assistance. The statistics suggest that operators of vessels carrying refined metals from Port Pirie do not aim to take on a full load at Port Pirie, as such consignments are usually quite small relative to the cargo capacity of even the shallow drafted vessels.

Refined metals have been railed from Port Pirie in substantial quantities for shipment from Port Adelaide. However, this leakage appears to have been influenced by the size of individual consignments rather than by the depth limitations of Port Pirie. For example, during 1971-72, 144,000 tonnes of refined lead and zinc were shipped from Port Pirie by sea, while 85,000 tonnes were despatched by rail. Of the latter figure, 20,000 tonnes were shipped overseas from Port Adelaide and 800 tonnes were exported from the Port of Melbourne, the remainder being retained in Australia. The consignment sizes and destinations of refined metal exports originating from Port Pirie but shipped through Port Adelaide during 1971-72 are presented in Table 4.5.

It is apparent that the diversity of destinations would make it difficult to amalgamate individual consignments into larger parcels. Further, it is noted that the majority of Port Adelaide consignments during 1971-72 were less than 300 tonnes, whereas the average size of shipments from Port Pirie was 2,690 tonnes. If harbour depth was the main factor determining whether or

TABLE 4.4 - PORT PIRIE: REFINED METAL EXPORTS, VESSEL AND CONSIGNMENT CHARACTERISTICS, 1 JANUARY 1972 TO 30 JUNE 1972

Departure date	Vessel	Overall length (metres)	Draft (metres)	Tonnes dead-weight	Refined metal loaded (tonnes)
17/1/72	Koraki	105.21	6.83	5,343	1,439
20/1/72	Fossanger	175.87	10.43	25,373	8,246
23/1/72	Vishva Vikas	145.36	9.09	11,606	633
30/1/72	Aleksander Zawadzki	152.60	8.75	11,896	3,011
31/1/72	Vishva Kalyan	152.60	9.07	12,355	1,887
10/2/72	Ngapara	111.89	7.16	6,140	1,237
10/2/72	Larchbank	148.67	8.80	12,342	3,887
18/2/72	Adolf Warski	153.90	8.34	10,230	1,525
19/2/72	Kowhai	105.21	6.82	5,293	783
20/2/72	Straat Cook	133.81	7.59	7,574	614
28/2/72	Vishva Vibhuti	152.60	8.86	9,486	1,784
3/3/72	Weirbank	148.67	8.80	12,342	3,060
29/3/72	Lindenbank	148.67	8.80	12,342	3,071
30/3/72	Caroline	159.89	9.35	15,392	9,111
6/4/72	Karetu	99.29	5.82	3,723	1,822
8/4/72	Vishva Bindu	145.36	8.78	11,791	4,571
12/4/72	Rosebank	147.32	8.91	12,563	3,582
9/5/72	Laganbank	138.68	7.94	9,155	1,530
12/5/72	Koranui	105.26	6.82	5,240	1,475
16/5/72	Waikare	105.18	6.84	5,148	1,021
23/5/72	Vishva Vikas	145.36	9.09	11,606	1,506
8/6/72	Katea	105.21	6.83	5,343	1,466
10/6/72	Vishva Kaylan	152.60	9.07	12,355	1,265
12/6/72	Straat Jahore	138.63	7.39	7,592	502
21/6/72	Vishva Vibhuti	152.60	8.86	9,486	1,037
22/6/72	Rowanbank	148.46	8.81	12,424	4,090
26/6/72	Cirrus	160.40	8.20	10,404	8,128

Source: South Australian Parliamentary Standing Committee on Public Works.

TABLE 4.5 - SHIPMENTS OF PORT PIRIE REFINED LEAD AND ZINC PRODUCTS THROUGH PORT ADELAIDE, 1971-72

Destination	Number of consignments		Average consignment size (tonnes)	
	Lead	Zinc	Lead	Zinc
Thailand	13	3	247	46
Philippines	13	6	353	118
Indonesia	7	4	24	103
Korea	1	-	20	-
U.S.A.	6	-	524	-
Malaysia	3	-	175	-
India	5	1	101	17
Sri Lanka	4	-	100	-
Taiwan	8	9	259	113
Pakistan	1	-	100	-
New Zealand	2	4	403	4
Hong Kong	1	-	25	-
Singapore	2	-	40	-
Iran	1	-	33	-
Russia	-	1	-	46
Japan	-	1	-	22
South Africa	-	3	-	300
Belgium	-	1	-	57

Source: South Australian Department of Marine and Harbors

not individual consignments are loaded at Port Pirie, then it would be expected that the largest consignments would be diverted from Port Pirie. This has not been the case.

It is concluded that the present depth of the harbour and channel does not have a significant adverse effect on the efficiency of the refined metal trade.

Coal and Coke Imports

Because of the low density of coke, it is difficult to load coal and coke ships operating between Port Kembla and Port Pirie to their deadweight tonnage capacity. Coal and coke consignments typically consist of 60 per cent coal and 40 per cent coke. Shortloading can occasionally be necessary when a consignment is relatively heavy due to having a high proportion of coal and its arrival coincides with low tides at Port Pirie. Thus, the water depth limitations of Port Pirie harbour may affect the cargo composition of vessels in the coal and coke trade.

Overseas Grain Exports

Significant shortloadings of vessels departing Port Pirie with grain for overseas ports are apparent in the data contained in Table 4.6. While SSM concentrate vessels face difficulty in obtaining suitable completion cargoes, the proximity of deep sea grain ports to Port Pirie means that part loaded grain carriers from Port Pirie can readily obtain top up consignments. The main top up ports are Port Lincoln and Wallaroo, which are located on Spencer Gulf.

Diversion of grain carriers for topping up does involve resource costs which would be avoided if these vessels could fully load at Port Pirie. These are:

TABLE 4.6 - PORT PIRIE GRAIN EXPORTS: CHARACTERISTICS OF VESSELS AND CONSIGNMENTS, 1972

Date	Vessel	Length (metres)	Draft (metres)	Tonnes deadweight	Grain loaded (tonnes)	Load factor (per cent)	Remarks
12/1/72	Atreo	147.62	8.84	12,735	9,389	74	Top up Wallaroo
16/1/72	Hollands Duin	155.06	9.09	14,175	11,220	79	Top up Port Adelaide
24/1/72	Belocean	165.67	9.30	18,156	8,210	45	Top up Port Lincoln
7/2/72	Stove Caledonia	161.65	9.36	18,584	8,977	48	Top up Wallaroo
11/2/72	Melbrook	159.51	9.18	15,086	6,684	44	Top up Port Lincoln
25/2/72	Sissy	136.06	8.51	11,415	6,185	54	Full cargo
29/2/72	Athens	142.29	9.02	15,238	8,773	58	Top up Port Lincoln
2/3/72	Voorne	160.12	9.91	20,196	13,770	68	Top up Port Adelaide
8/3/72	Apollon	164.39	9.85	22,685	7,171	32	Top up Port Lincoln
25/3/72	Glenpark	142.68	9.13	12,558	11,223	89	Top up Port Lincoln
4/4/72	Okhotsk	154.82	9.39	14,426	8,517	59	Top up Port Adelaide
23/5/72	Goeree	160.12	9.51	19,135	13,464	70	Top up Port Adelaide
5/6/72	Georgios Paravalos	142.32	9.02	15,236	11,220	74	Top up Wallaroo
22/6/72	Amstelveen	163.11	9.36	18,447	14,485	79	Top up Port Lincoln
11/8/72	Minlly	153.57	9.21	15,388	9,092	59	Top up Wallaroo
18/8/72	Golden Fleece	145.48	9.36	17,092	11,577	68	Top up Port Lincoln
22/8/72	Schouwen	160.15	9.51	19,135	13,978	73	Top up Port Lincoln
7/9/72	Atlantic Splendour	160.95	9.73	20,344	12,063	59	Top up Port Lincoln
10/9/72	Kashima Maru	167.04	9.48	22,548	16,609	74	Full cargo
19/9/72	Orenburg	154.81	9.31	14,429	8,803	61	Top up Port Lincoln
12/10/72	Athens	142.29	9.02	15,238	11,601	76	Top up Port Lincoln
26/10/72	Ostrogozhsk	154.82	9.39	14,680	7,078	48	Top up Port Lincoln
2/11/72	Omsk	154.82	9.39	14,475	10,040	69	Top up Port Lincoln
13/11/72	Orenburg	154.81	9.39	14,429	8,784	61	Top up Port Lincoln
4/12/72	Nikolai Mirinov	123.93	6.83	5,991	5,471	91	Full cargo
19/12/72	Hampton Lion	142.38	-	16,335	11,680	72	Top up Port Lincoln

Source: South Australian Parliamentary Standing Committee on Public Works.

(i) The additional ship capital charges and operating costs resulting from the extra time involved in getting the vessel into and out of the diversion port.

(ii) The increased terminal costs incurred as a result of an additional port call. These are reflected in additional tug charges, mooring and unmooring costs, pilotage and tonnage charges.

Discussions with a representative of the Australian Wheat Board revealed that shortloadings of overseas grain vessels from Port Pirie could not be explained in terms of small order sizes or exhaustion of supplies of particular grades of wheat and barley at Port Pirie. Thus, it is assumed that all additional costs associated with grain vessel diversions arise from the depth limitation of the harbour and channel at Port Pirie.

Interstate Grain Exports

The draft of "North Esk" is only 4.9 metres. Therefore, the existing depth of the port does not reduce the load capacity of this vessel when it operates out of Port Pirie.

Petroleum Imports

The South Australian Department of Marine and Harbors advises that oil companies have not reported tanker load problems arising from the depth limitation at Port Pirie. Tankers operating through the port are up to 22,000 tdw in size, with the average consignment size being 10,000 tonnes for white products and 7,000 tonnes for black products. These vessels usually enter part loaded having typically discharged petroleum products at Port Lincoln and Whyalla before proceeding to

Port Pirie.

Summary

In conclusion, the main traffic adversely affected by Port Pirie's harbour and channel depth are the overseas grain trades and the concentrate trades employing SSM vessels. Problems of shortloadings are more readily overcome for grain vessels than they are for SSM concentrate vessels.

CHAPTER 5 EVALUATION OF THE PROPOSED IMPROVEMENTS TO THE HARBOUR AND CHANNEL

The basis of the evaluation was a comparison of the cost of the proposed port development works with the possible benefits resulting from the project.

It is recognised that benefits could accrue to overseas interests as a result of upgrading the port. These could take the form of a lowering in the operating costs of foreign shipping companies or a reduction in the price of lead and zinc products to overseas consumers. From the Australian viewpoint, such benefits should be deducted from the estimate of total benefits accruing from the project. However, it is assumed initially that all benefits from the project accrue to the Australian community.

CAPITAL COST

The cost of the proposed deepening, widening and other improvements to the Port Pirie harbour and entrance channel was estimated to be $13.7 million as at 1 September 1974. The South Australian Department of Marine and Harbors is unable to give a firm indication of the time period necessary to undertake the improvements.

In deriving a measure of the discounted capital cost of the project, it was assumed that expenditure would be evenly divided over either 2, 3, 4 or 5 year periods. Two discount rates were used, and a range of discounted costs established. These are set out in Table 5.1.

TABLE 5.1 - DISCOUNTED COST OF PROPOSED PORT PIRIE HARBOUR AND CHANNEL IMPROVEMENTS

($ million)

Number of years to complete the project	Discount rate	
	7 per cent	10 per cent
2	12.5	12.0
3	12.1	11.4
4	11.5	10.8
5	11.1	10.2

BENEFITS

On the assumption that only SSM vessels carrying concentrates and vessels carrying grain destined for overseas ports are adversely affected by Port Pirie's depth limitations, two broad categories of benefits attributable to the proposed improvements were considered. Savings would accrue to the SSM concentrate traffic as vessels in the approximate size range 15,000 tdw to 26,000 tdw would be able to sail from the port fully loaded. Secondly, additional savings would be obtained by vessels in the overseas grain trades as there would no longer be a need for grain vessels to "top up" at other ports.

EVALUATION PROCEDURE

This section outlines the approach used to evaluate the benefits from the project to the SSM concentrate and the overseas grain trades, and quantifies the magnitude of these benefits. In estimating benefits it was assumed that 26,000 tdw is the upper size limit of vessels likely to operate through Port Pirie in the foreseeable future. This is the size of the new, larger bulk carriers which SSM plans to put into service in the second half of 1975.

SSM Concentrate Trade

Estimates were made of typical annual ship operating and capital costs of transporting SSM concentrate traffic in hypothetical vessels of various sizes. It was assumed that the annual volume of SSM concentrate traffic is 160,000 tonnes, and that this cargo is shipped to Europe via the Cape of Good Hope. Two series of cost estimates were prepared, firstly on the basis of the likely shortloading that would occur given the existing port depth, and secondly assuming that vessels up to 26,000 tdw are fully loaded. These estimates are presented in Table 5.2. They indicate that the greater the vessel size used, the greater will be the saving from upgrading the port.

TABLE 5.2 - ESTIMATED ANNUAL COST OF SHIPPING SCOTTISH SHIP MANAGEMENT LTD. CONCENTRATE TRAFFIC BY VESSEL SIZE AND LOAD

($ million)

Vessel size (tonnes deadweight)	Vessel load	
	Part loaded[a]	Fully loaded
12,000	-	2.957
18,000	2.877	2.395
20,000	2.839	2.269
22,000	2.978	2.173
24,000	3.116	2.089
26,000	3.246	2.009

(a) It was assumed that 12,000 tdw vessels can sail from Port Pirie fully loaded, while the maximum load for 18,000 tdw vessels is 15,000 tonnes. All other part loaded vessels were assumed to load 16,000 tonnes.

The existing SSM fleet operating out of Port Pirie mainly consists of vessels ranging in size from

22,000 to 24,000 tdw. Assuming that all vessels currently in use are 26,000 tdw estimates show that annual cost savings of $1.237 million could be obtained by the substitution of fully loaded 26,000 tdw vessels for part loaded vessels of the same size. However, this overestimates the benefits to the SSM concentrate traffic to the extent that some of these savings could be achieved without deepening the harbour. The basis of the proposition is apparent in Figure 5.1 which is derived from Table 5.2.

In Figure 5.1 AcF represents the annual capital and operating costs of shipping SSM concentrate traffic in fully loaded bulk carriers of various sizes. AcP represents the annual capital and operating costs of shipping SSM concentrate traffic in vessels of various sizes where the size of loads is constrained by the existing harbour and channel depth at Port Pirie. The vessel size at which the two curves begin to diverge represents the size beyond which it is not possible for vessels to sail fully loaded from Port Pirie. The relationship between AcF and AcP indicates that as vessel size increases beyond X, the cost of using part loaded vessels will continue to decline up to 20,000 tdw. Therefore, up to 20,000 tdw, savings from increasing vessel size more than offset the declining load factors. However, beyond 20,000 tdw, the annual cost associated with using part loaded vessels increases as vessel size increases.

In the existing situation it is apparent that the use of 20,000 tdw vessels will minimise annual costs, at the level represented by AcP20 in Figure 5.1. Compared to this situation, upgrading the port would allow the use of fully loaded vessels for all vessel sizes up to 26,000 tdw.

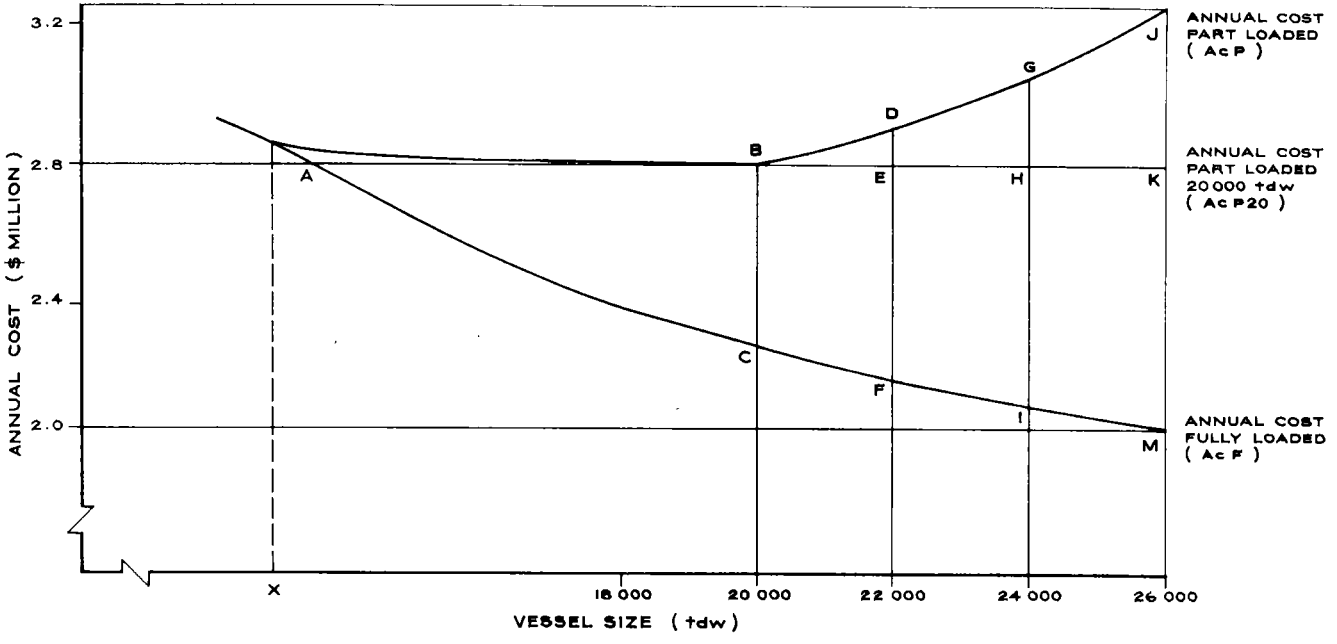

FIGURE 5.1

ESTIMATED ANNUAL SHIP COSTS BY VESSEL SIZE AND LOAD *

* FIGURES PLOTTED FROM TABLE 5.2

In the figure, for any vessel size between X and 26,000 tdw, the savings to be made by switching from part loaded vessels to fully loaded vessels are represented by the vertical distance between AcP and AcF. For example, for vessels of 22,000 tdw, the savings are represented by DF. Similarly for vessels of 24,000 tdw and 26,000 tdw, the savings are represented by GI and JM respectively. However, for any given vessel size, the vertical distance between AcP and AcF is an overestimate of the annual cost savings from the project to the extent that some of these savings could be achieved without upgrading the port.

Thus, in the figure, savings of JK could be achieved if part loaded 20,000 tdw vessels were substituted for part loaded 26,000 tdw carriers. Similarly, savings of GK and DE could be achieved if it is assumed that vessels currently in use are 24,000 and 22,000 tdw respectively. Therefore, to measure the benefits of improving the port, given ship size, it is necessary to measure the difference between the annual cost of using part loaded 20,000 tdw ships as against the annual cost of using fully loaded vessels of various sizes. This is represented by the vertical distance between the AcP20 and AcF curves.

Substituting the cost estimates contained in Table 5.2, the annual cost saving from using fully loaded 26,000 tdw vessels instead of partly loaded 20,000 tdw vessels is

$$\$(2.839 - 2.009) \text{ million}$$
$$= \$0.830 \text{ million.}$$

In practice, SSM vessels used in the Port Pirie trade may continue to be largely comprised of vessels of between 22,000 and 24,000 tdw if the port were

deepened. If this were the case, benefits to SSM traffic would be smaller. Using the data contained in Table 5.2 and on the assumption that after the port is deepened, 65 per cent of SSM vessel calls would be by 22,000 tdw vessels and the remainder by 24,000 tdw vessels,(1) annual cost savings are estimated at $0.695 million.

Overseas Grain Traffic

The benefits to the grain trade from the project are of two main types:

(i) Savings in ship costs from avoidance of top up operations. It is noted that in 1972, 23 out of the 26 overseas grain vessels which loaded grain at Port Pirie took on top up cargoes.

(ii) Savings in port costs from avoidance of top up operations. The estimated savings to the shipowner in terms of reduced port charges were used as an approximation to the actual resource savings.

Ship and port cost savings to the grain trade from improving Port Pirie harbour were estimated to be $109,000 per annum as indicated in Table 5.3. It was assumed that, in the absence of the project, grain vessels would top up at the new Port Lincoln grain berth, and that all vessels carrying grain from Port Pirie to overseas ports are 26,000 tdw and load 16,000 tonnes of grain at Port Pirie.

In practice, Port Adelaide and Wallaroo also provide completion cargoes for part loaded grain carriers from Port Pirie. For example, in 1972 these ports

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(1) This assumption is based on actual vessel call characteristics during 1971, 1972 and 1973.

TABLE 5.3 - ESTIMATED COST OF TOP UP OPERATIONS BY PART LOADED GRAIN VESSELS FROM PORT PIRIE

Cost Category	Annual $	Discounted (20 years @ 10 per cent) $million
SHIP COSTS		
Capital charges	27,773	0.237
Crew costs	12,581	0.107
Other crew costs	5,037	0.043
Machinery costs	1,219	0.010
Survey and docking costs	11,776	0.100
Insurance costs	3,358	0.029
Administration	1,449	0.012
Total	63,193	0.538
PORT COSTS		
Tug charges	20,930	0.179
Mooring & Unmooring costs	6,977	0.059
Pilotage	5,060	0.043
Tonnage Charges	12,558	0.107
Total	45,525	0.388
GRAND TOTAL	108,718	0.926

provided top up cargoes to 8 grain vessels from Port Pirie, while Port Lincoln provided 15 top up consignments. The assumption that part loaded grain vessels from Port Pirie top up only at Port Lincoln tends to underestimate top up costs to the extent that the Port Lincoln facilities load grain considerably faster than is the case with the other top up ports. However, this consideration is offset by the assumption that grain vessels currently in use are 26,000 tdw in size. Most grain vessels currently operating through Port Pirie are less than 20,000 tdw, so the scale and cost of top up operations would tend to be less than estimated.(1)

COMBINED COST SAVINGS

The combined annual cost savings to the SSM concentrate and overseas grain trades are within the range of $0.804 million to $0.939 million, depending on the assumptions about the size of SSM vessels which would operate through the port if the harbour facilties were improved.

EVALUATION RESULTS

The discounted benefits and costs of the Port Pirie proposal, for discount rates of 7 per cent and 10 per cent over a range of discount and construction periods are presented in Table 5.4 and Table 5.5. The data presented in Table 5.4 provide a range of benefit-cost ratios on the basis of the most optimistic assumptions concerning the construction period and the size of vessels that might use the port subsequent to the improvements being undertaken. Similarly, Table 5.5 contains a range of benefit-cost ratios based on the most pessimistic assumptions concerning the construction period and vessel

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(1) Further discussion on the cost of top up operations is contained in Annex F.

TABLE 5.4 - BENEFITS AND COSTS OF PORT PIRIE PROPOSAL FOR TWO YEAR CONSTRUCTION PERIOD AND 26,000 TDW SCOTTISH SHIP MANAGEMENT LTD. VESSELS

	Period over which benefits are discounted (years)			
	20	30	40	50
	7 per cent discount rate			
Benefits ($ million)	8.3	10.0	10.8	11.3
Costs ($ million)	12.5	12.5	12.5	12.5
Benefit-cost ratio	0.66	0.80	0.86	0.90
	10 per cent discount rate			
Benefits ($ million)	6.4	7.2	7.6	7.7
Costs ($ million)	12.0	12.0	12.0	12.0
Benefit-cost ratio	0.53	0.60	0.63	0.64

TABLE 5.5 - BENEFITS AND COSTS OF PORT PIRIE PROPOSAL FOR FIVE YEAR CONSTRUCTION PERIOD AND 22,000 AND 24,000 TDW SCOTTISH SHIP MANAGEMENT LTD. VESSELS

	Period over which benefits are discounted (years)			
	20	30	40	50
	7 per cent discount rate			
Benefits ($ million)	5.2	6.7	7.4	7.8
Costs ($ million)	11.1	11.1	11.1	11.1
Benefit-cost ratio	0.47	0.60	0.67	0.70
	10 per cent discount rate			
Benefits ($ million)	3.8	4.5	4.8	4.9
Costs ($ million)	10.2	10.2	10.2	10.2
Benefit-cost ratio	0.37	0.44	0.47	0.48

size. The sensitivity of the benefit-cost ratio to changes in the construction period and vessel size variables is indicated in further detail in Annex G. The evaluation results show benefit-cost ratios ranging from 0.37 to 0.90.

INTERPRETATION OF RESULTS

Benefits not considered

It was recognised that the estimation procedure did not take full account of all benefits from undertaking the project. No account was taken of the idle ship time in port while vessels await suitable tidal conditions. Deepening the harbour would mean that fully loaded vessels would be less dependent on high tides to produce the necessary water depth to allow them to sail from the port. However, improving the harbour and channel would not necessarily alleviate such delays, if the port improvement promotes the replacement of existing vessel types with vessels of deeper draft.

In addition, the evaluation results do not include possible benefits that might accrue from easier night access to the port due to improvements to the width of the channel and lighting facilities.

Finally, although a study period ranging from 20 to 50 years was selected, the port improvements, if undertaken, would still be in existence at the end of 50 years and should continue to produce benefits. However, the difference between assuming 50 years and say 100 years, is not great in present value terms.(1)

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(1) For example, benefits of the project over 100 years at 7 per cent assuming a two year construction period and annual savings of $0.939 million amount to $11.7 million over 100 years, compared with $11.3 million over 50 years.

Benefits Accruing Outside Australia

The estimate of benefits tends to be biased upwards because it was assumed that all benefits would accrue to the Australian economy. In reality at least some of the benefits of the project are likely to accrue to overseas interests. These could add to the benefits Australia receives only if their value could be recovered by appropriate charges. If concentrate cargo shipped with SSM were charged for the cost of the improvements, an annual charge of $1.4 million, or $8.76 per tonne would need to be levied. This is based on the assumption that construction costs are amortised over 40 years at 10 per cent, and that the average annual volume of SSM cargo between 1969-70 and 1972-73 is maintained in the future. If the cost of the port improvement were shared between the SSM concentrate and overseas grain trades in proportion to the estimated benefits received by each trade, the charges would be $7.72 per tonne of concentrate and $0.66 per tonne of grain.

ALTERNATIVE TO PORT PIRIE PROPOSAL

An alternative to improving Port Pirie harbour would be to redirect SSM concentrate traffic to another port which already has a depth at least equal to that proposed for Port Pirie. Diversion of overseas grain traffic to another port was not considered. Data contained in the Central Grain Terminal Investigation Committee's Report[1] indicated that the cost of diverting grain, even to ports in relatively close proximity to Port Pirie (e.g. Wallaroo or Port Adelaide) would greatly exceed the cost of continuing with top up operations.[2]

The benefits to SSM traffic from diversion were

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(1) op. cit. p.20

(2) The estimated cost of top up operations is $0.43 per tonne while the Committee's 1971 estimate of the additional land transport cost of diverting Port Pirie grain to Wallaroo is approximately $2.00 per tonne.

assumed to be of the same magnitude as would apply if the Port Pirie harbour improvments were undertaken.

The following alternative ports were considered:

Newcastle
Portland
Port Adelaide
Port Giles
Port Lincoln
Redcliffs
Whyalla
Wallaroo

In each case the cost of redirecting SSM concentrate traffic would exceed the benefits from diversion, and so it was concluded that the diversion strategy would not be a viable alternative to the Port Pirie proposal. Further details on the diversion strategies are contained in Annex H.

CHAPTER 6 CONCLUSIONS

Examination of shipping at Port Pirie revealed that the port's depth limitation was adversely affecting the operations of vessels of approximately 15,000 tdw and greater. In particular, vessels engaged in certain overseas trades have been characterised by significant shortloading of cargo on departure from Port Pirie. Such vessels have also experienced delays while waiting for favourable tidal conditions before sailing. In addition, the existing dimensions of the channel and the nature of existing lighting facilities have prohibited inward, and restricted outward navigation at night.

The review of the characteristics of the loads and sizes of vessels used in the shipment of grain and concentrate to Tasmania suggested that the existing port is adequate for ships currently handling these cargoes. Similarly the nature of consignments of refined metals and petroleum fuels suggested that these trades were not being adversely affected by the existing dimensions of the harbour and channel. However, certain overseas concentrate cargoes and, to a lesser degree, overseas grain exports would benefit from the port improvements to the extent that vessels in these trades have short-loaded due to the existing port depth.

Economic evaluation of the proposal produced benefit-cost ratios ranging from 0.37 to 0.90 depending upon the assumptions made concerning the length of time taken in construction, discount rates and the size of vessels employed in the SSM concentrate trade subsequent to deepening the port. Because most of the benefits would be associated with SSM concentrate cargoes, a harbour improvement charge of the order of $8.00 per tonne would need to be levied on this traffic for the

project to be self financing.

On the basis of this analysis the port improvements cannot be economically justified. This conclusion supports the view held by the South Australian Parliamentary Standing Committee on Public Works which recommended that the project should not be undertaken.

ANNEX A

FINDINGS OF THE PARLIAMENTARY COMMITTEE

Reprinted from the Report of the Parliamentary Standing Committee on Public Works on Port Pirie Harbor Deepening, Parliamentary Paper 125, Government Printer, South Australia 1974.

The findings of the Committee are as follows:-

(1) Geographically Port Pirie is badly situated for development into a deep sea port. Even the present proposal of deepening the entrance channel to 18ft. (8.5 metres) L.W. requires an approach channel 10 miles (16 kilometres) in length.

(2) The present proposal is mainly to meet the requirements of the Lead/Zinc Industry for the export of concentrates overseas in large ships.

(3) The present proposal barely meets the needs of the overseas ships predicted as visiting the port and further deepening would need to be accepted as a strong possibility in the very near future.

(4) Any further deepening would require dredging and widening of the approach channel over its entire length of 10 miles (16 kilometres) as well as a major reconstruction programme for existing wharves at considerable additional cost to that already proposed.

(5) Larger vessels using the port would not necessarily increase the trade for business houses in Port Pirie because a lesser number of ships would be required to shift the available cargo and proportionally these ships have lesser crew members than existing vessels.

(6) Many suggestions were made by witnesses at Port Pirie dealing with further improvements to the harbor. For example, to meet the needs of the fishing and tourist industries and to provide additional recreational facilities for residents in Port Pirie. Some of the suggestions had desirable features but were outside the terms of reference.

(7) The view is not accepted that if the entrance channel were deepened and widened more vessels would call at Port Pirie because no indications were given of any substantial increases in cargo that would pass through the port and the Committee is inclined to the view that if the channel were deepened to 28ft. (8.5 metres) as proposed there could be up to 25 per cent less ships visiting Port Pirie than at the present time.

(8) Whilst suggestions were made that industries were lost to Port Pirie because of inadequate depth in the approach channel the Committee checked individual examples and did not ascertain one such case.

(9) If concentrates were exported overseas via Newcastle it would represent a considerable loss in freight to the South Australian Railways but this port need not be the only alternative to Port Pirie because it is a long and expensive rail haul from Broken Hill to the east coast of Australia.

(10) Possible alternative sites for a deep sea port to ship concentrates overseas in large vessls could be Port Adelaide, Ardrossan, Portland, Red Cliffs and Whyalla but considerable investigation would be required.

(11) In the event of large overseas ships developing as predicted and suitable alternative smaller ships not being available the only cargo at risk from Port Pirie relates to the overseas export of lead and zinc concentrates. The existing port is quite suitable for the ships trading between Port Pirie and Tasmania.

(12) Savings in the vicinity of $6 a ton for freight charges on lead/zinc concentrates shipped to the United Kingdom and Europe in large vessels was mentioned. Even though the Government is faced with a cost of approximately $11000000 to meet the overseas shipping requirements of the Lead/Zinc Industry, that industry could not see its way clear to offer any harbor improvement contribution as an offsetting factor.

(13) With an expenditure of this magnitude the Marine and Harbors Department would be faced with an annual bill of $600000 for interest alone, whereas the present earnings relating to the overseas export of concentrates is approximately $194000 and no indication was given that the department could anticipate any increase in these earnings.

(14) It is necessary for grain ships to top up at other ports but this industry was also opposed to any harbor improvement levy.

(15) There are numerous economic complications in the proposal put forward and a large amount of Government expenditure is involved with little prospect of any direct return. Related matters have interstate implications and it is suggested that the Government gives consideration to referring the project to the Commonwealth Bureau of Transport Economics for an appraisal.

RECOMMENDATION

The Committee recommends against the proposed public work of deepening the Port Pirie harbor and draws attention to its findings in paragraph 11 above.

J.J. JENNINGS, Chairman

Public Works Standing Committee Room,
Parliament House, Adelaide.
21st December, 1973.

ANNEX B

RESUMÉ OF OTHER STUDIES RELATED TO THE DEVELOPMENT OF PORT FACILITIES AT PORT PIRIE

Report of the Parliamentary Standing Committee on Public Works on Port Pirie Isolated Oil Berth (1967)

In 1965, the proposed construction of an isolated oil berth at Port Pirie was referred to the Committee for inquiry and report.

The proposal for a new berth arose from concern by the South Australian Department of Marine and Harbors of the hazards associated with the existing tanker berthing and discharging arrangements. The Department noted that with the discharge of oil at a berth located almost in the centre of the city, there is always the risk of an accident resulting in fire and explosion and wide destruction of life and property.

The planned oil berth was reviewed by the Committee, which decided in favour of a new berth at Fibre Creek, well removed from the existing wharves and swinging basin. In addition, an oil pipeline, 3.2 kilometres in length, would connect the berth with oil company storage tanks. The pipeline would be used for white oil products only, as black oil could continue to be discharged at the central wharves without risk. The estimated cost of the proposed works was $1.9 million in 1967 prices. No concern was expressed in the report regarding problems facing tankers arising from the depth of the harbour and channel.

To date, no action has been taken on the construction of the planned berth.

Report of the Central Grain Terminal Investigation Committee

The Committee was appointed in August 1970

> "to investigate and recommend the best location for a bulk grain loading berth for large grain vessels to serve the central grain producing area of the State, taking into account all the economic factors associated with the proposal."

The study was based on the provision of a bulk loading berth capable of handling grain vessels of either 66,000 tdw or 46,000 tdw.

Port Pirie was considered as one potential site, but was rejected on the basis of the heavy cost of new dredging work, loading facilities, reclamation and road and rail extensions that would be required.

The Committee also undertook investigations into the possibility of diverting grain presently shipped through Port Pirie to either Wallaroo or Ardrossan, which would be upgraded to accommodate vessels of either 66,000 tdw or 46,000 tdw. Cost estimates were prepared and it was concluded

> "that any savings which might result from moving grain out of its zone (e.g. from Port Pirie to Wallaroo or Ardrossan) so that it might enjoy the lower freight rate applying to large bulk carriers would be more than offset by higher land transport costs."

ANNEX C

FIGURE C.1 SOUTH-EASTERN AUSTRALIA

(Showing towns, cities, rail and sea routes referred to in this report)

FIGURE C.2 PORT PIRIE HARBOUR AND CHANNEL - EXISTING FACILITIES

Source: South Australian Department of Marine and Harbors

FIGURE C.3 PORT PIRIE HARBOUR - EXISTING FACILITIES

Source: South Australian Department of Marine and Harbors

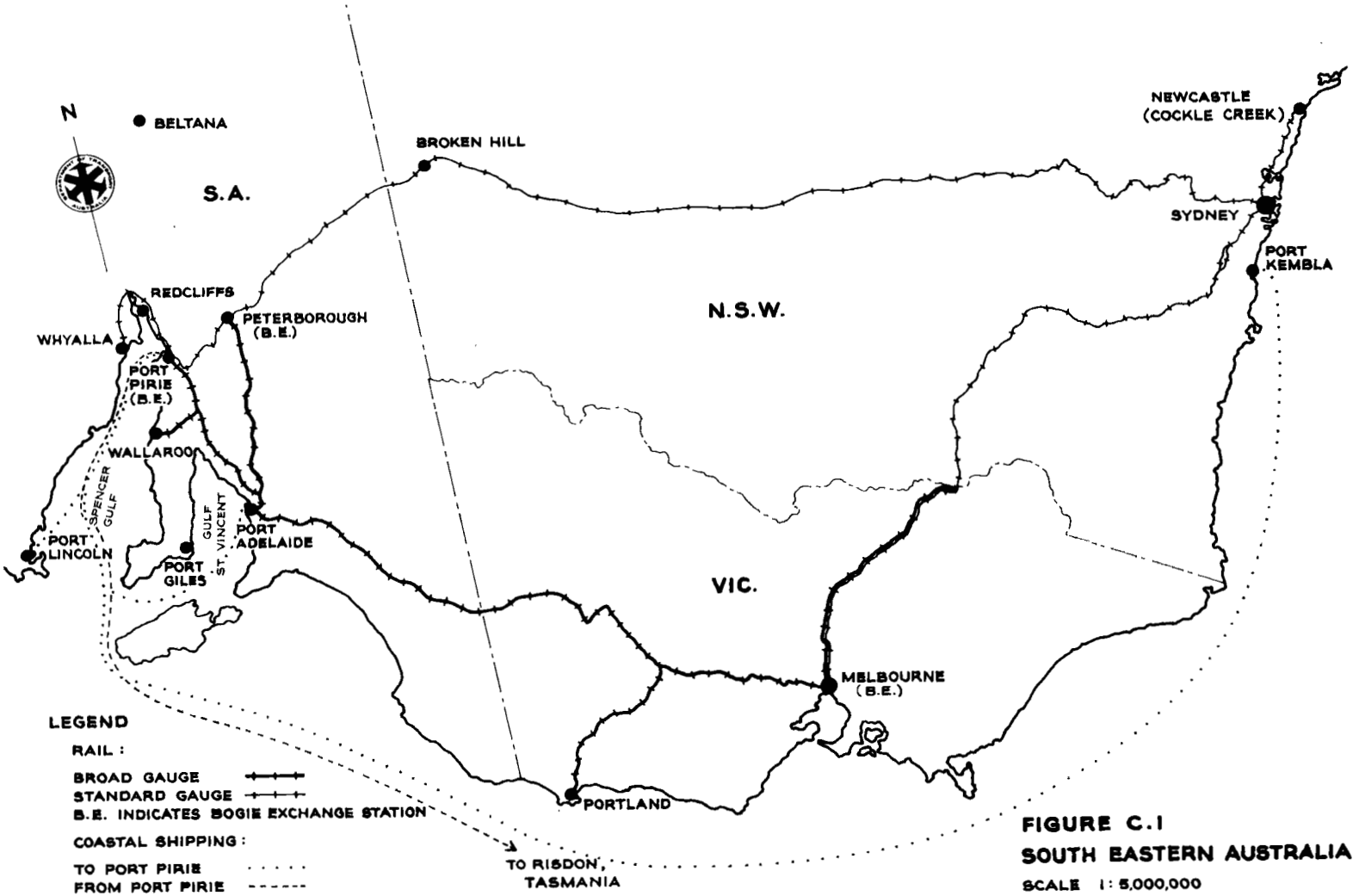
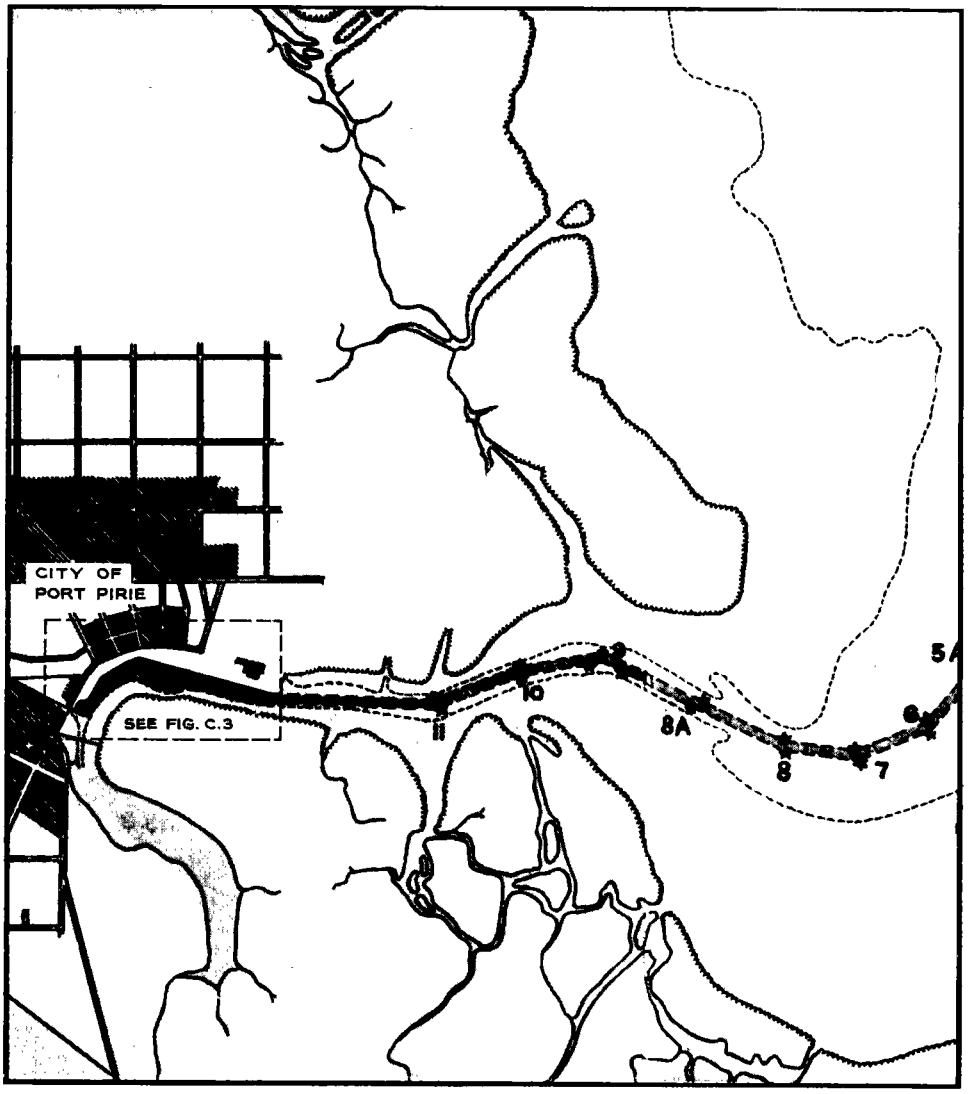
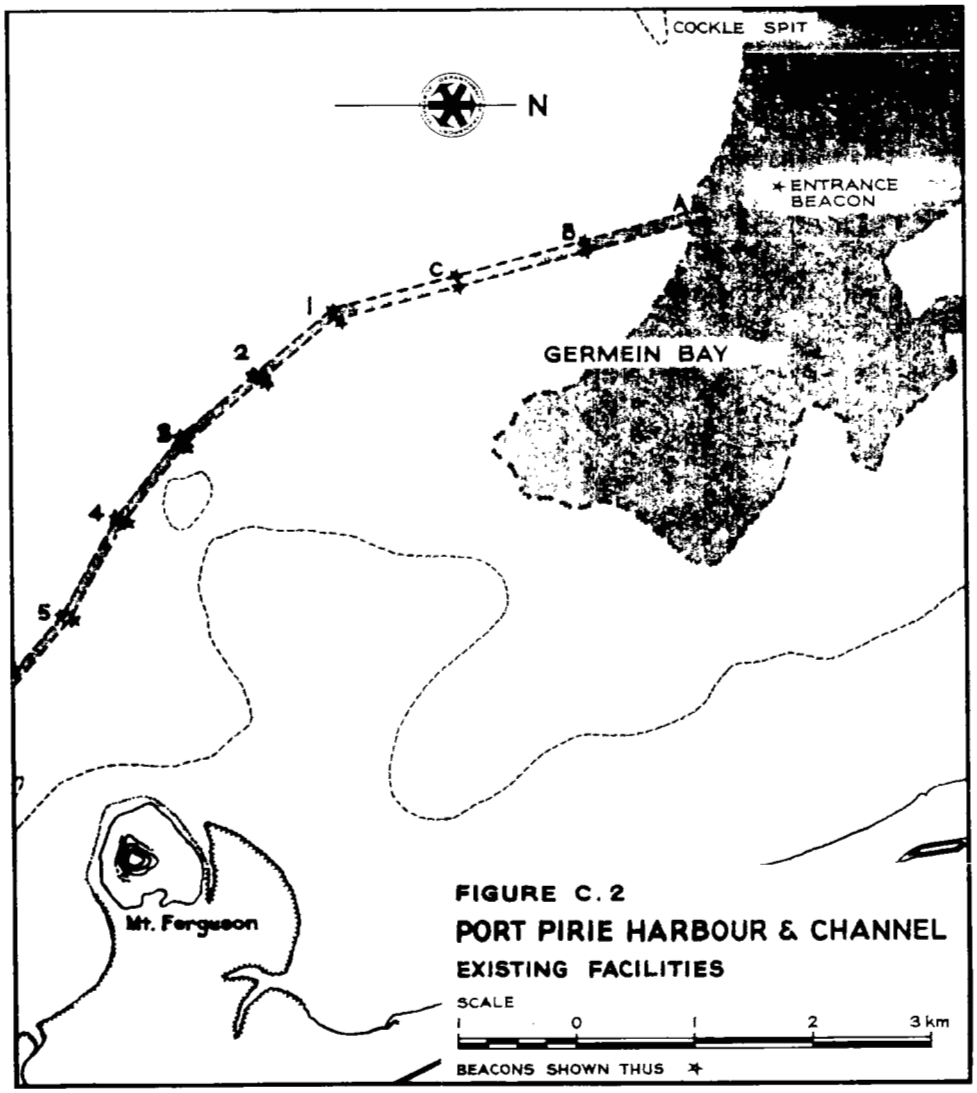
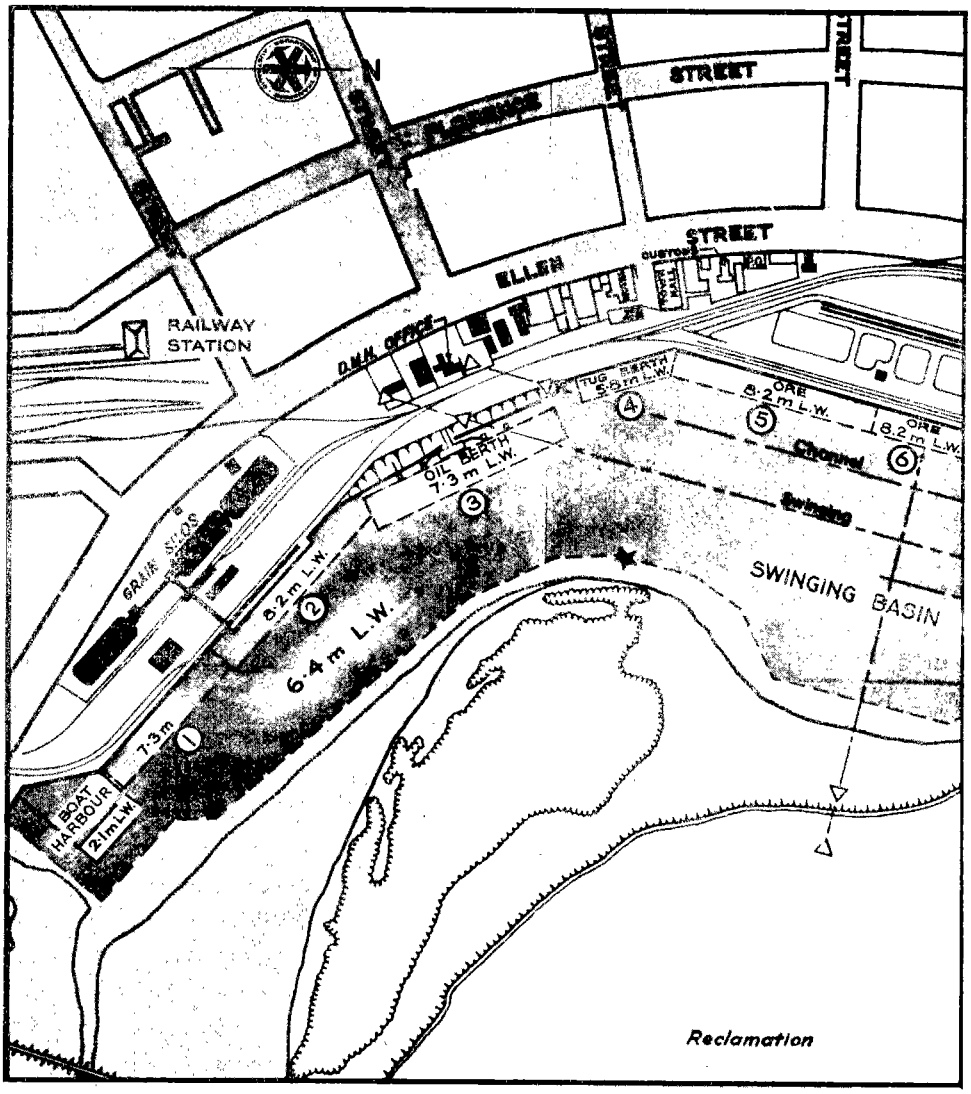


FIGURE C.1
SOUTH EASTERN AUSTRALIA
SCALE 1 : 5,000,000


CITY OF
PORT PIRIE
SEE FIG. C.3
11
10
8A
8
7
5A


COCKLE SPIT
N
ENTRANCE BEACON
A
B
C
1
2
3
4
5
GERMEIN BAY
Mt. Ferguson
FIGURE C.2
PORT PIRIE HARBOUR & CHANNEL
EXISTING FACILITIES
SCALE
1 0 1 2 3 km
BEACONS SHOWN THUS


N
STREET
STREET
STREET
ELLEN
CUSTOMS
RAILWAY STATION
O.M.R. OFFICE
TUG BERTH 5·5m L.W.
ORE 8·2m L.W.
ORE 8·2m L.W.
OIL BERTH 7·3m L.W.
GRAIN SILOS
8·2m L.W.
6·4m L.W.
7·3m
BOAT HARBOUR
2·1m L.W.
Channel
Swinging
SWINGING BASIN
Reclamation
1
2
3
4
5
6

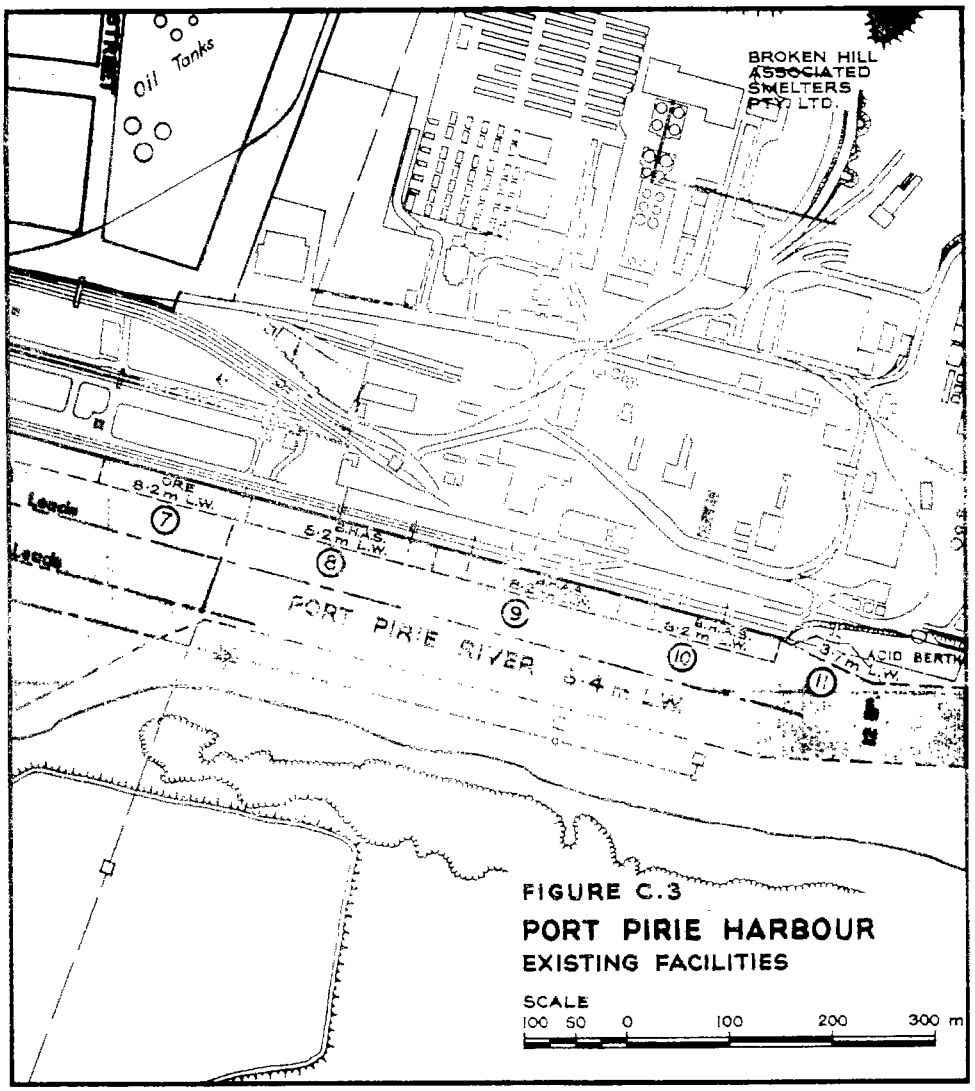


FIGURE C.3

PORT PIRIE HARBOUR

EXISTING FACILITIES

SCALE

100 50 0 100 200 300 m

ANNEX D

NEW MULTI-PURPOSE VESSEL TO OPERATE PORT PIRIE-TASMANIA ZINC TRADE: "ZINCMASTER"

Details and Specifications

"Zincmaster" was recently launched at the Whyalla shipyards specifically to cater for the Electrolytic Zinc Company's raw material and product shipments between Port Pirie, Victoria and Tasmania including Tasmanian intrastate movements.

The specifications of the vessel are as follows:

Designed deadweight tonnage capacity	12,812 tonnes
Overall length	151.54 metres
Moulded beam	21.20 metres
Full load scantling draft (when holds and vehicle decks are fully loaded)	8.65 metres
Draft (when holds only are fully loaded)	7.75 metres

The quantity of zinc concentrates that can be loaded is limited not by the load line, but by the cubic capacity of the holds. It is expected that a full load of concentrates will be of the order of 12,800 tonnes.

In addition to concentrates, the new vessel will be capable of handling in separate compartments bundled zinc slabs on a roll-on roll-off basis and general cargo. A door and ramp will be placed in the starboard bow through which forklift trucks will enter and leave to load and unload zinc and general cargo. The vessel will also be able to carry two tiers of 6 metre long ISO containers. The holds were modular to ISO containers and the hatch covers were strengthened to

accommodate ISO containers on deck two high. Although the vessel has this capability, there is no firm plan to carry containers.

Operation of "Zincmaster" at Port Pirie

On the assumption that only concentrates are shipped out of Port Pirie in "Zincmaster", water depth should not present any restrictions on its loadings. The tidal range at Port Pirie (difference in depth between low water and highest high water) is 2.5 metres. To sail with a full load of concentrates would require a tide of 2.1 metres above low water. EZ advise: "There are comparatively few days in the year where at least one tide does not reach 2.1 metres" although "frequently, however, the lowest high tide of the day is less than 2.1 metres."

If, in addition to concentrates, the vessel was required to load cargo such as lead in the vehicle decks and sail fully laden at the designed draft of 8.69 metres, a tide of 3.00 metres is required. This is outside the maximum tidal range experienced at Port Pirie, and so shortloading will be necessary. However, on the basis of past evidence it appears that this problem is unlikely to arise.

In recent years, total refined lead consignments from Port Pirie to Tasmania have been of the order of 5,000 tonnes per annum. Assuming "Zincmaster" carried out 18 return trips to Tasmania per annum and that lead consignments are spread fairly evenly over each trip (as seems most likely) then individual lead consignments would approximate 280 tonnes. It is improbable that parcels of this size would produce significant overloading problems, given the port's existing depth.

Thus, the present dimensions of the harbour and channel at Port Pirie should not adversely affect efficient operation of this vessel.

Night Navigation of "Zincmaster" at Port Pirie

While "Zincmaster" should be able to negotiate Port Pirie harbour and channel under appropriate tidal conditions, the present restrictions on inward night navigation at the port could prevent the ship operator from being able to take advantage of suitable tides, thus giving rise to delays. However, it does not seem likely that the vessel will be heavily loaded when entering Port Pirie. Thus the need to take advantage of favourable tidal conditions would not be great.

ANNEX E

SALIENT FEATURES OF PORT PIRIE TIDAL DATA

The features of the tidal data contained in this Annex of relevance to the study are:-

- The large tidal range experienced at Port Pirie
- The relatively high incidence of high water levels in the upper part of the tidal range (see Table E.1)
  For example, in 1975, 5 per cent of highest daily water levels were between 7.0 metres and 8.5 metres (i.e., the tides were equal to, or in excess of, 0.6 metres and less than 2.1 metres above low water), while 95 per cent of highest daily water levels were between 8.5 metres and under 10.0 metres (i.e., the tides were equal to, or in excess of, 2.1 metres and less than 3.6 metres above low water).
- There is approximately equal incidence of highest daily water levels between night time and day time hours (see Table E.2).

TABLE E.1 - FREQUENCY DISTRIBUTION OF HIGHEST DAILY WATER LEVELS FOR PORT PIRIE HARBOUR AND CHANNEL, 1975

Month	7.0 and under 7.5	7.5 and under 8.0	8.0 and under 8.5	8.5 and under 9.0	9.0 and under 9.5	9.5 and under 10.0
			(metres)			
January	1	1	-	9	20	-
February	2	-	-	7	19	-
March	-	-	1	8	12	10
April	-	-	-	8	9	13
May	-	-	3	5	14	9
June	-	-	1	9	15	5
July	-	-	-	12	16	3
August	-	-	-	9	22	-
September	-	-	1	8	21	-
October	-	-	3	9	14	5
November	-	-	4	7	13	6
December	-	-	2	10	17	2
TOTAL	3	1	15	101	192	53

Source: Department of Defence, Australian National Tide Tables 1975, Australian Government Publishing Service, Canberra 1974.

TABLE E.2 - PORT PIRIE: FREQUENCY DISTRIBUTION OF HIGH WATER TIMES, 1975

Month	Day[a]	Night	Total
January	17	14	31
February	11	17	28
March	-	31	31
April	-	30	30
May	4	27	31
June	9	21	30
July	15	16	31
August	20	11	31
September	22	8	30
October	29	2	31
November	25	5	30
December	23	8	31
TOTAL	175	190	365
Percentage of Total	47.9	52.1	100

(a) Day refers to period between 6.00 am and 6.00 pm inclusive.

Source: Department of Defence, Australian National Tide Tables 1975, Australian Government Publishing Service, Canberra, 1974.

ANNEX F

COST OF "TOP UP" OPERATIONS BY GRAIN VESSELS EX PORT PIRIE

This Annex discusses the estimate of resource costs arising from the practice of part loaded grain vessels ex Port Pirie topping up with completion cargoes of grain at other South Australian ports.

Assumptions Made in Estimating Ship Costs

(i) All top up operations are carried out at Port Lincoln. In practice, Port Adelaide and Wallaroo sometimes provide completion cargoes also, but Port Lincoln is the main top up port.

(ii) In view of the likely growth in bulk carrier sizes, and for purposes of simplification, the cost estimates assume that all vessels diverted to Port Lincoln are 26,000 tdw in size.

(iii) The annual number of grain vessels ex Port Pirie which top up is 23. (This is the actual 1972 figure.)

(iv) The mean annual volume of grain exports will not change appreciably in the future.

(v) Top up consignments of grain are 10,000 tonnes in size. In practice, completion cargoes range from 5,000 to 10,000 tonnes in size, depending on vessel size and the quantity of grain taken on at Port Pirie.

(vi) All top up consignments are loaded at the new grain loading berths which have the facilities to load grain vessels at the rate of 2,000 tonnes per hour. Thus 10,000 tonnes of grain could be loaded in 5 hours.

(vii) With respect to time delays in port, it was recognised that these could originate from three sources:

(a) time delays while awaiting berth accommodation;

(b) delays resulting from inability to load grain at night;

(c) delays arising from the need to wait for suitable tidal conditions when sailing from the port.

In practice only timedelay (b) is likely to arise. BTE has been advised that (a) is not a significant source of time loss. Given that the new Port Lincoln grain berth is designed to accommodate bulk carriers of up to 70,000 tdw in size, it is assumed that 26,000 tdw vessels would be capable of sailing fully laden from Port Lincoln, irrespective of the prevailing tidal conditions.

It is assumed that all vessels are delayed in port a maximum of 15 hours. Thus, total time in port, including loading time, is 20 hours.

Port Costs

Table F.1 indicates port charges payable at South Australian Government ports, and the basis of payments.

It is apparent from the Table that wharfage rates, light dues and conservancy dues do not depend on the frequency of port calls, and so are excluded from the estimate of top up costs.

Other costs incurred in port which are assigned as costs of topping up are:

tug costs

mooring and unmooring costs.

TABLE F.1 - LISTING OF PORT CHARGES LEVIED AT SOUTH AUSTRALIAN GOVERNMENT PORTS

Port charge	Basis of payment
Pilotage	Levied on vessel's gross tonnage at a rate of $38.00 plus 5.18 cents per ton above 100 tons. Maximum charge for inward and outward movement at Port Lincoln is $220.00.
Tonnage rates	Rate is 3 cents per gross ton for period less than 24 hours, plus 0.75 cents per ton for each additional period of six hours.
Conservancy dues	Rate is 9 cents per gross ton of vessel weight.
Commonwealth light dues	Payable every 3 months at 31 cents per net registered ton.
Wharfage rates	Are applied on a commodity by commodity basis. Rate is 35 cents per ton of grain.

Source: Government Gazette, 5 July 1973, South Australian Government Printer, Adelaide.

ANNEX G

DETAILED EVALUATION RESULTS

This Annex contains tables setting out the results of the evaluation for each combination of assumptions. The tables, and the different assumptions incorporated in each, are as follows:-

TABLE G.1 - BENEFITS AND COSTS OF PORT PIRIE PROPOSAL FOR TWO YEAR CONSTRUCTION PERIOD AND 22,000 and 24,000 TDW SCOTTISH SHIP MANAGEMENT LTD. VESSELS

	Period over which benefits are discounted (years)			
	20	30	40	50
	7 per cent discount rate			
Benefits ($ million)	7.1	8.5	9.3	9.6
Costs ($ million)	12.5	12.5	12.5	12.5
Benefit-cost ratio	0.57	0.68	0.74	0.77
	10 per cent discount rate			
Benefits ($ million)	5.4	6.2	6.5	6.6
Costs ($ million)	12.0	12.0	12.0	12.0
Benefit-cost ratio	0.45	0.52	0.54	0.55

TABLE G.2 - BENEFITS AND COSTS OF PORT PIRIE PROPOSAL FOR THREE YEAR CONSTRUCTION PERIOD AND 22,000 AND 24,000 TDW SCOTTISH SHIP MANAGEMENT LTD. VESSELS

	Period over which benefits are discounted (years)			
	20	30	40	50
	7 per cent discount rate			
Benefits ($ million)	6.4	7.9	8.6	9.0
Costs ($ million)	12.1	12.1	12.1	12.1
Benefit-cost ratio	0.53	0.65	0.71	0.74
	10 per cent discount rate			
Benefits ($ million)	4.8	5.6	5.9	6.0
Costs ($ million)	11.4	11.4	11.4	11.4
Benefit-cost ratio	0.42	0.49	0.52	0.53

TABLE G.3 - BENEFITS AND COSTS OF PORT PIRIE PROPOSAL FOR FOUR YEAR CONSTRUCTION PERIOD AND 22,000 AND 24,000 TDW SCOTTISH SHIP MANAGEMENT LTD. VESSELS

	Period over which benefits are discounted (years)			
	20	30	40	50
	7 per cent discount rate			
Benefits ($ million)	5.8	7.3	8.0	8.4
Costs ($ million)	11.5	11.5	11.5	11.5
Benefit-cost ratio	0.50	0.63	0.70	0.73
	10 per cent discount rate			
Benefits ($ million)	4.3	5.0	5.3	5.4
Costs ($ million)	10.8	10.8	10.8	10.8
Benefit-cost ratio	0.40	0.46	0.49	0.50

TABLE G.4 - BENEFITS AND COSTS OF PORT PIRIE PROPOSAL FOR FIVE YEAR CONSTRUCTION PERIOD AND 22,000 AND 24,000 TDW SCOTTISH SHIP MANAGEMENT LTD. VESSELS

	Period over which benefits are discounted (years)			
	20	30	40	50
	7 per cent discount rate			
Benefits ($ million)	5.2	6.7	7.4	7.8
Costs ($ million)	11.1	11.1	11.1	11.1
Benefit-cost ratio	0.47	0.60	0.67	0.70
	10 per cent discount rate			
Benefits ($ million)	3.8	4.5	4.8	4.9
Costs ($ million)	10.2	10.2	10.2	10.2
Benefit-cost ratio	0.37	0.44	0.47	0.48

TABLE G.5 - BENEFITS AND COSTS OF PORT PIRIE PROPOSAL FOR TWO YEAR CONSTRUCTION PERIOD AND 26,000 TDW SCOTTISH SHIP MANAGEMENT LTD. VESSELS

	Period over which benefits are discounted (years)			
	20	30	40	50
	7 per cent discount rate			
Benefits ($ million)	8.3	10.0	10.8	11.3
Costs ($ million)	12.5	12.5	12.5	12.5
Benefit-cost ratio	0.66	0.80	0.86	0.90
	10 per cent discount rate			
Benefits ($ million)	6.4	7.2	7.6	7.7
Costs ($ million)	12.0	12.0	12.0	12.0
Benefit-cost ratio	0.53	0.60	0.63	0.64

TABLE G.6 - BENEFITS AND COSTS OF PORT PIRIE PROPOSAL FOR THREE YEAR CONSTRUCTION PERIOD AND 26,000 TDW SCOTTISH SHIP MANAGEMENT LTD. VESSELS

	Period over which benefits are discounted (years)			
	20	30	40	50
	7 per cent discount rate			
Benefits ($ million)	7.5	9.2	10.1	10.5
Costs ($ million)	12.1	12.1	12.1	12.1
Benefit-cost ratio	0.62	0.76	0.83	0.87
	10 per cent discount rate			
Benefits ($ million)	5.7	6.5	6.9	7.0
Costs ($ million)	11.4	11.4	11.4	11.4
Benefit-cost ratio	0.50	0.57	0.61	0.61

TABLE G.7 - BENEFITS AND COSTS OF PORT PIRIE PROPOSAL FOR FOUR YEAR CONSTRUCTION PERIOD AND 26,000 TDW SCOTTISH SHIP MANAGEMENT LTD. VESSELS

	Period over which benefits are discounted (years)			
	20	30	40	50
	7 per cent discount rate			
Benefits ($ million)	6.8	8.5	9.3	9.8
Costs ($ million)	11.5	11.5	11.5	11.5
Benefit-cost ratio	0.59	0.74	0.81	0.85
	10 per cent discount rate			
Benefits ($ million)	5.0	5.9	6.2	6.3
Costs ($ million)	10.8	10.8	10.8	10.8
Benefit-cost ratio	0.46	0.55	0.57	0.58

TABLE G.8 - BENEFITS AND COSTS OF PORT PIRIE PROPOSAL FOR FIVE YEAR CONSTRUCTION PERIOD AND 26,000 TDW SCOTTISH SHIP MANAGEMENT LTD. VESSELS

	Period over which benefits are discounted (years)			
	20	30	40	50
	7 per cent discount rate			
Benefits ($ million)	6.1	7.8	8.7	9.1
Costs ($ million)	11.1	11.1	11.1	11.1
Benefit-cost ratio	0.55	0.70	0.78	0.82
	10 per cent discount rate			
Benefits ($ million)	4.4	5.3	5.6	5.8
Costs ($ million)	10.2	10.2	10.2	10.2
Benefit-cost ratio	0.43	0.52	0.55	0.57

ANNEX H

EVALUATION OF DIVERSION STRATEGY

COSTS OF DIVERSION

Diversion of SSM concentrate traffic from Port Pirie to another port would give rise to the following costs:

Additional Rail Line Haul Costs

Given that Port Pirie is the nearest port to the source of the concentrates, any diversion of traffic from Port Pirie would result in additional rail line haul costs. In the case of certain ports considered, the cost of bogie exchange operations made necessary by differences in rail gauge would add further to the rail line haul costs of diversion.

Cost of Concentrate Handling Equipment

Only concentrates destined for direct export can be diverted from Port Pirie to another port. In the event of diverting SSM concentrate cargo, a substantial volume of concentrate would still be transported to Port Pirie for refining in the lead smelter and for export in the Tasmanian and non-SSM overseas trades. Thus handling equipment would still be required at Port Pirie for this traffic. The assessment of the diversion strategy must therefore take account of the cost of new concentrate handling equipment at the diversion port.

Cost of New Rail Infrastructure

In the case of some of the potential diversion ports, rail links do not presently exist between them and Broken Hill. In such circumstances, the construction of new railway lines for the purpose of transporting concentrates must be taken into account.

Other Costs

These will vary from port to port but might include the cost of land acquisition, wharf construction and the installation of shiploading equipment.

EVALUATION OF DIVERSION STRATEGY BY PORT

In this section an analysis is made of the cost of diverting Port Pirie's SSM concentrate traffic to alternative ports. There was not sufficient information to make a detailed study of the various cost items entailed in diversion. However, two major costs associated with diversion were quantified. In the case of all ports considered it was readily apparent that the estimated costs associated with diversion of SSM concentrate cargo from Port Pirie would exceed benefits. Annual benefits from diversion were assumed to be equal in magnitude to the benefits to SSM traffic from improving Port Pirie harbour. It was also assumed that benefits from diversion would be available without the construction period delay which occurs in the case of the Port Pirie strategy.

The estimated costs associated with the additional rail line haul task and new handling equipment at the diversion port are indicated in Table H.1. It was assumed that concentrate handling equipment would be installed at the diversion port similar to that currently in use at Pore Pirie. The Port Pirie plant cost $3.5 million when commissioned in 1970, but information is not available on the present day cost of the plant. Therefore the estimated cost of a similar plant in 1975 was derived by applying a wholesale price index on non-housing building materials to the 1970 figure. The updated cost figure was $5.6 million.

Table H.2 shows the characteristics of the various ports considered in this Annex.

Newcastle

Although the depth of Newcastle harbour is already well in excess of that proposed for Port Pirie harbour, the line haul costs alone of diverting traffic from Port Pirie would be well in excess of the benefits from diversion. This is apparent in Table H.1.

The additional land transport costs could be offset to some extent by loading at an east cost port and so reducing ship trip length and ship costs for some destinations, for example, Japan. However, the major portion of concentrate exports is destined for Europe and vessels in this trade are generally routed via the Cape of Good Hope. Thus, diversion to an east coast port would mainly increase average trip length.

Portland

While the characteristics of the Port of Portland are highly satisfactory from the point of view of depth, Table H.1 shows that additional line haul costs alone associated with diversion of SSM concentrate to this port would exceed estimated benefits.

Port Adelaide

The Osborne bulk handling wharf between Port Adelaide and Outer Harbor was considered to be the most suitable outlet for concentrate exports should diversion to Port Adelaide take place. Cargo presently handled at the wharf includes phosphate rock, coal and sulphur products. With a channel depth of 9.8 metres low water and a depth at the wharf of 9.2 metres low water, the Osborne berth already has a depth in excess of that proposed for Port Pirie.

However, Table H.1 shows that the additional land transport costs and handling equipment costs exceed estimated benefits.

TABLE H.1 - ANNUAL RAIL LINE HAUL AND HANDLING EQUIPMENT COSTS ASSOCIATED WITH DIVERSION STRATEGY

($ million)

Port	Annual rail line haul and handling equipment costs (a)
Newcastle	1.714
Portland	1.541
Port Lincoln	1.157
Port Giles	0.984
Redcliffs	(b)
Wallaroo	0.819
Whyalla	0.858
Port Adelaide	0.917

(a) Handling equipment cost amortised over 20 years at 10 per cent.

(b) Not calculated

Port Giles

Table H.1. indicates that the additional line haul and handling equipment costs associated with diversion to Port Giles exceed the estimated benefits. It is noted that redirection of concentrate cargo to Port Giles would also require the construction of a railway approximately 55 kilometres in length to connect the port to the existing rail network. In addition, shiploading facilities would need to be provided for concentrate cargoes, as this traffic could not share the existing grain conveyor system owing to problems of contamination.

Port Lincoln

Diversion of concentrates to Port Lincoln would involve similar considerations to diversion to Port Giles, and Table H.1 shows that the line haul and handling equipment costs associated with this strategy exceed the estimated benefits.

Redcliffs

Proposals for a petrochemical plant at Redcliffs, on Spencer Gulf to the north of Port Pirie, include the provision of port facilities capable of accommodating vessels of up to 70,000 tdw without dredging. It is envisaged that vessels will be loaded from a trestle jetty consisting of an approach 3.3 kilometres in length and a head 400 metres in length. Petrochemical exports will be piped along the jetty, and in addition provision is made for a narrow single lane roadway along it.

A study by the South Australian Department of Marine and Harbors considered the feasibility of loading vessels with concentrates at Redcliffs. It is noted that the following port development works would need to be undertaken should such a diversion of concentrate shipments take place:

(i) The installation of harbour-side rail siding facilities and a stockpiling area at Redcliffs. In the event that no spur line is built from the Port Pirie-Port Augusta railway to the petrochemical plant, such a line would need to be constructed to serve the concentrate traffic. It would be about 8 kilometres in length.

(ii) A conveyor belt for the loading of concentrates would need to be built either over the top of the roadway, or cantilevered on the side of the jetty. Problems of contamination militate against concentrates sharing the pipelines with petrochemical exports.

(iii) A separate berth for the handling of concentrate traffic would need to be built off the jetty. The risk of concentrates contaminating the petrochemical products would mean that concentrates could not be loaded off the same berth as petrochemicals. In addition it is anticipated that the petrochemical berth would be used to near capacity throughout the year, thus limiting the possibility of petrochemicals and concentrates sharing the same berth.

(iv) It is proposed that strict controls over the production and shipment of petrochemicals will be imposed to guard against any detrimental environmental effects of the petrochemical plant. Considering the highly poisonous nature of lead and zinc concentrate products, stringent measures would be necessary to prevent environmental damage from this source.

While no detailed estimates were made of the cost of providing these facilities, it was concluded that the scale of the necessary harbour works would be such that the required expenditures would be at least equal in magnitude to that proposed for Port Pirie harbour.

Whyalla

Although this port is used for the bulk shipment of iron ore and has satisfactory depth characteristics (see Table H.2), Table H.1 indicates that the estimated additional line haul costs and handling equipment costs exceed estimated benefits.

Wallaroo

Diversion of SSM concentrate cargo to Wallaroo would involve additional rail line haul costs and handling equipment costs in excess of the estimated benefits of diversion.

Shipments out of Wallaroo presently consist of wheat and barley while rock phosphate is the major import commodity. Cargo is discharged and loaded into vessels from a shipping pier with 6 berths located either side of a jetty head. The jetty head is 512 metres in length and is connected to the shore by a 350 metre approach jetty. Wheat and barley is loaded into ships using a conveyor system linked to harbourside grain silos. The conveyor facilities could not be shared with concentrate traffic owing to problems of contamination. Ship's gear is used to unload rock phosphate directly from vessels to rail wagons shunted onto the jetty.

TABLE H.2 - SUMMARY OF PORT CHARACTERISTICS

Port	Approach channel depth at low water	Wharf depth at low water	Tidal data		Distance from Broken Hill (kms)	Rail transport facilities	Remarks
			Lower high water	Higher high water			
	(Metres)						
Port Pirie	6.4	8.2	1.8	2.5	400	Uniform gauge link with Broken Hill	Wharf depth refers to concentrate berths
Newcastle	11.0	11.0	1.3	1.6	1,290	Uniform gauge link with Broken Hill	Wharf depth refers to Kooragang Bulk Berth
Port Adelaide	9.2	9.8	2.0	2.4	580 (via Crystal Brook)	Rail link with Broken Hill but break of gauge at Port Pirie	Wharf depth refers to Osborne Bulk Handling Plant
Portland	14.9	11.0	0.6	0.9	1,140 (via Peterborough)	Rail link with Broken Hill but break of gauge at Peterborough	-
Port Giles	11.6	11.6	n.a.	n.a.	670	No rail link	-
Port Lincoln	9.1	10.4	1.1	1.5	830	No rail link	Wharf referred to is BHP Wharf at Proper Bay
Redcliffs	n.a.	n.a.	n.a.	n.a.	460	No rail link	-
Wallaroo	8.5	9.5	0.9	1.5	540	Rail link with Broken Hill but break of gauge at Port Pirie	Wharf depth refers to deepest berth
Whyalla	10.7	11.0	1.8	2.5	570	Uniform gauge link with Broken Hill	Wharf referred to is ore loading jetty

n.a. denotes data not available.
Source: Australian Chamber of Shipping, Directory of Ports of Australia (Fifth Edition) BTE estimates