

Bureau of Transport Economics

**REGIONAL IMPACT OF THE
PORT OF GLADSTONE**

February 2001

Indemnity Statement

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FOREWORD

This report presents the results of a BTE study of the regional impact of the Port of Gladstone. The work was undertaken with financial support from the Gladstone Port Authority, through a sponsorship arrangement involving the Association of Australian Ports and Marine Authorities (AAPMA).

The study of the Port of Gladstone followed the BTE's initial work on port impact, which was published in BTE Report 101 *Regional Impact of Ports*. That report included a general framework for undertaking port impact studies in Australia.

The BTE received substantial assistance from a range of individuals and organisations during the study of the Port of Gladstone. We would particularly like to thank the staff of the Gladstone Port Authority and members of the Gladstone port community who provided data and other assistance.

The study was undertaken by Kym Starr (project leader) and Jin Liu, under supervision from Joe Motha, Deputy Executive Director.

Tony Slatyer
Executive Director

Bureau of Transport Economics
Canberra
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EXECUTIVE SUMMARY

This report presents the results of a study of the regional impact of the Port of Gladstone. The study formed part of the BTE's research program on policy-relevant issues in regional development and maritime transport. It was undertaken with financial support from the Gladstone Port Authority, through a sponsorship arrangement involving the Association of Australian Ports and Marine Authorities (AAPMA).

THE LOCAL REGION

The Port of Gladstone is located adjacent to the city of Gladstone, in the Fitzroy region of central Queensland. This region, as defined by the Australian Bureau of Statistics, comprises 12 local government areas—Gladstone City, Livingstone Shire, Rockhampton City, Calliope Shire, Fitzroy Shire, Mount Morgan Shire, Banana Shire, Duaringa Shire, Peak Downs Shire, Emerald Shire, Bauhinia Shire and Jericho Shire. The Fitzroy region had an estimated resident population of 181 202 persons at 30 June 1999.

The regional economy served by the Port of Gladstone has expanded rapidly over the last 30 years, in response to major mining and industrial projects. Mines in the southern Bowen Basin shipped almost 30 million tonnes of export coal through the port in 1999-2000. The area adjacent to the port contains industrial processing facilities such as an alumina refinery, an aluminium smelter, a cement works, several chemical plants, a pilot plant for shale oil production and a demonstration plant for magnesium production. Other activities in the local region include agriculture (e.g. grain), other mining operations (e.g. limestone), forestry, commercial fishing, tourism, and a range of service/support activities.

THE PORT OF GLADSTONE

The Port of Gladstone is a key part of the transport chain for the Fitzroy region and adjacent parts of central Queensland.

In tonnage terms, the port is the State's largest multi-cargo port and Australia's fourth largest port. Traffic has increased at a compound average rate of 4 per cent per annum over the last 10 years, with a rise of 8 per cent in the most recent

period from 1998-99 to 1999-2000. Around 46 million tonnes of cargo, with an estimated value of \$4.2 billion, were shipped through the port in 1999-2000.

The Port of Gladstone mainly handles bulk cargoes. In tonnage terms, coal accounted for 64 per cent of the port's traffic in 1999-2000. A further 29 per cent of the total tonnage involved aluminium and inputs used in its production—bauxite, caustic soda, alumina, petroleum coke and liquid pitch. Other major traffics included cargoes for the cement industry, petroleum products, woodchip and grain.

Around 73 per cent of the cargo shipped through the Port of Gladstone in 1999-2000 involved the overseas trades. The remaining 27 per cent was coastal traffic, which mainly comprised the movement of bauxite from Weipa.

PORT INFRASTRUCTURE AND OPERATIONS

The Port of Gladstone comprises a natural deep-water harbour and facilities for the handling of ships and cargo. There are six wharf centres containing 12 berths and associated loading/unloading facilities. Other facilities include a container terminal, a marina, and large areas of industrial land.

The Gladstone Port Authority (GPA) has overall responsibility for the efficient operation of the port. It carries out the typical functions of a strategic port manager and port landlord, and also owns and operates several bulk loading facilities. The GPA's other activities include land reclamation, pilotage, and operation of the marina.

Private operators provide a range of services such as ship's agency, stevedoring, towage, bunkering, ship supplies and ship repairs. Government agencies that undertake Gladstone port-related activities include Transport Queensland, the Australian Customs Service, the Australian Maritime Safety Authority, and the Australian Quarantine and Inspection Service.

CONDUCT OF THE STUDY

The study of the Port of Gladstone was undertaken using the general framework for port impact studies developed by the BTE. Port impact is defined as the output, value added, income and employment generated by activities required for the movement of ships and cargoes through the port.

Inclusion of trade facilitation effects would be expected to result in significantly higher estimates of port impact. The BTE did not undertake a detailed analysis of these effects due to several factors including conceptual difficulties and the unavailability of reliable data.

The estimates of port impact prepared by the BTE cover the direct effects of the port and the subsequent flow-on effects to other sectors of the regional economy. A survey of 59 organisations involved in Gladstone port-related

activities provided most of the data for estimating the direct effects. Input-output tables, which quantify the linkages and transactions between different sectors of the regional economy, were used to calculate the flow-on effects to other industry sectors in the Fitzroy region.

ESTIMATES OF PORT IMPACT

The study results are summarised in table 1. They indicate the impact generated by activities required for the operation of the Port of Gladstone in 1999-2000.

Direct effects

Gladstone port-related activities involved output (i.e. gross revenue/expenditure) of \$135 million in 1999–2000. Value added, which represents payments to the primary inputs of production (i.e. labour, capital, land), was \$93 million.

Gladstone port-related activities generated household income of \$44 million and 738 jobs (full-time equivalent) in 1999–2000. Household income associated with these activities averaged \$59 000 per employee, which was well above the average of around \$35 000 per annum for all industries in the Fitzroy region.

Flow-on effects

The flow-on effects to other industry sectors in the Fitzroy region involved output of \$89 million, value added of \$46 million, household income of \$24 million, and 1020 jobs (full-time equivalent).

The flow-on effects particularly involved wholesale and retail trade etc., finance and business services, community services, and other transport activities. These sectors generally accounted for at least 70 per cent of the flow-on effects.

Total impact

The total impact of the Port of Gladstone is the sum of the direct effects and the flow-on effects.

TABLE 1 ECONOMIC IMPACT (DIRECT AND FLOW-ON EFFECTS) OF THE PORT OF GLADSTONE, 1999–2000

<i>Impact measure</i>	<i>Direct effects</i>	<i>Flow-on effects</i>	<i>Total impact</i>
Output (\$m)	135	89	224
Value added (\$m)	93	46	139
Household income (\$m)	44	24	68
Employment (no.) ^a	738	1 020	1 758

a. Number of full-time equivalent jobs.

Source BTE analysis.

Output attributable to the operation of the port totalled \$224 million in 1999–2000. Value added was \$139 million, which was equivalent to around 3.0 per cent of total value added in the Fitzroy region.

Household income generated by the operation of the port totalled \$68 million. Employment involved 1758 jobs (full-time equivalent), representing 2.3 per cent of total employment in the Fitzroy region.

The results of the case study indicate that, on average, each ship call at the Port of Gladstone involved the following impact on the Fitzroy region in 1999–2000:

- \$240 000 of output;
- \$149 000 of value added;
- \$73 000 of household income;
- 1.9 full-time equivalent jobs for one year.

Payments to governments attributable to the operation of the port are estimated at around \$34 million in 1999–2000. This is an approximate figure, which covers direct and flow-on effects. It comprises payments to Commonwealth, State and local governments (excluding duties and taxes on imports handled at the Port of Gladstone).

Detailed impact measures

Table 2 provides information on the total impact of the port by function and by commodity/cargo type. The proportion for a particular component often varies according to the impact measure being used. This variation reflects differences in factors such as profitability, capital intensity, average income, and labour intensity.

Port function

Port authority operations contributed 56 per cent of total impact in terms of value added. This proportion reflects the scope of the GPA's operations, which involve the operation of major bulk cargo terminals as well as strategic port management and landlord activities.

Ship operations generated 14 per cent of total impact in terms of value added. The major activities in this category include towage, ship's agency, ship survey, ship supplies and pilotage.

Land transport and storage (excluding activities at the GPA's bulk cargo terminals) accounted for 14 per cent of total impact.

Ship loading and unloading undertaken by operators other than the GPA generated 11 per cent of total impact.

The other port functions were *cargo services* (3 per cent) and activities of *government agencies* (2 per cent).

The BTE also prepared modified impact estimates on a pure functional basis, with activities at the GPA's bulk cargo terminals being transferred from port authority operations to the relevant functional areas. The modified estimates indicated proportions of:

- 19 per cent for port authority operations (i.e. excluding the GPA's bulk cargo terminals);
- 36 per cent for land transport and storage (i.e. incorporating receipt and storage activities at the GPA's bulk cargo terminals); and
- 26 per cent for ship loading/unloading (i.e. incorporating loading activities at the GPA's bulk cargo terminals).

Commodity/cargo type

Coal generated 66 per cent of total impact in terms of value added. It comprised 64 per cent of traffic moved through the Port of Gladstone in 1999-2000.

Other dry bulk cargoes accounted for 21 per cent of total impact, and around 31 per cent of port traffic, in 1999-2000. The major cargoes in this category included bauxite, alumina, cement clinker, woodchip and grain.

Liquid bulk cargoes such as caustic soda and petroleum generated 7 per cent of total impact. They accounted for 4 per cent of the total tonnage moved through the port.

TABLE 2 DETAILED MEASURES OF THE TOTAL IMPACT OF THE PORT OF GLADSTONE, 1999–2000

<i>Component</i>	<i>Output (\$m)</i>	<i>Value added (\$m)</i>	<i>Household income (\$m)</i>	<i>Employment (no.)^a</i>
Function				
Port authority operations	127	79	35	893
Ship operations	30	19	11	296
Ship loading/unloading	26	16	9	220
Cargo services	7	4	3	70
Land transport and storage	30	19	8	228
Government agencies	4	3	2	51
<i>Total</i>	<i>224</i>	<i>139</i>	<i>68</i>	<i>1 758</i>
Commodity/cargo type				
Coal	148	92	44	1122
Other dry bulk cargoes	47	29	15	407
Liquid bulk cargoes	16	9	4	117
Containers, other general cargo	13	9	5	113
<i>Total</i>	<i>224</i>	<i>139</i>	<i>68</i>	<i>1 758</i>

a. Number of full-time equivalent jobs.

Note Components may not sum to totals due to rounding.

Source BTE analysis.

Containers and other general cargo contributed 6 per cent of the total impact, although they accounted for only 1 per cent of port traffic. The input requirements per tonne for these cargoes are relatively high, as their physical attributes result in more resource-intensive handling techniques.

INTERPRETING THE RESULTS

The results of the study indicate the general magnitude of the effects generated by Gladstone port-related activities in 1999-2000. They do not include trade facilitation effects, the economic benefits of exports and imports handled at the port, or the effects of industrial activities in the port area that are not involved in the transport of cargo.

It should also be noted that the estimates of regional impact focus on output, value added, income and employment. They do not measure net economic benefits, technical efficiency, competitiveness, or the contribution of port infrastructure to regional development.

The results of the study indicate the effects of the port on the Fitzroy region. These effects will generally differ from the net effects on the broader (e.g. State or national) economy.

CHAPTER 1 INTRODUCTION

This report presents the results of a study of the regional impact of the Port of Gladstone. The study formed part of the BTE's research program on policy-relevant issues in regional development and maritime transport. It was undertaken with financial support from the Gladstone Port Authority, through a sponsorship arrangement involving the Association of Australian Ports and Marine Authorities (AAPMA).

PORT OF GLADSTONE

The Port of Gladstone is located on the coast of Queensland, just south of the Tropic of Capricorn. The major functions of the port are to:

- Facilitate the export of resources from the central Queensland region.
- Handle the import of raw materials for, and the export of finished products from, major industrial facilities located in the region.

The area adjacent to the port contains industrial facilities such as an alumina refinery, an aluminium smelter, a power station, a cement works and several chemical plants. Other major activities in the local region include coal mining, extraction of other minerals, and agriculture.

In tonnage terms, the Port of Gladstone is Queensland's largest multi-cargo port and Australia's fourth largest port (GPA 2000a, p. 1; pers. com. Jan. 2001). It handled around 46 million tonnes of cargo in 1999-2000. The major commodities included coal and cargoes for the aluminium industry.

ABS international cargo statistics indicate that overseas cargo with a total value of \$3.3 billion (preliminary figure) was shipped through the Port of Gladstone in 1999-2000. The cargo comprised exports of \$3.0 billion and imports of \$0.3 billion. Exports handled at the port were equivalent to around 3 per cent of Australia's total merchandise exports (i.e. sea and air movements).

On the basis of tonnage data and typical unit values, the BTE estimates that the value of coastal cargoes handled at the Port of Gladstone was around \$0.9 billion in 1999-2000. This cargo mainly involved bauxite, alumina and petroleum products.

The value of all (i.e. overseas and coastal) cargo shipped through the Port of Gladstone in 1999-2000 therefore totalled around \$4.2 billion.

STUDY APPROACH

The study of the impact of the Port of Gladstone was undertaken using the general framework for port impact studies developed by the BTE.

For the purposes of the study, port impact is defined as the output, value added, income and employment generated by Gladstone port-related activities in 1999-2000. This definition incorporates all activities required for the movement of ships and their cargoes through the port. It does not include the economic benefits of exports and imports handled at the port, or the impact of industrial activities in the port area that are not involved in transport of cargo.

The Port of Gladstone is a key component of the transport chain for major processing, mining, agricultural and other activities in central Queensland. The inclusion of trade facilitation effects in the analysis would therefore be expected to result in significantly higher estimates of port impact. However, estimating these effects involves major conceptual and practical difficulties, and any estimates would have a relatively high margin of error. In addition, the resulting impact estimates would not be consistent with the primary purpose of a port impact study, which is to indicate the effects on the community immediately affected by physical activities at the port. The BTE's study of the Port of Gladstone therefore focuses on the impact of activities required for the movement of ships and their cargoes through the port.

The estimates of port impact prepared by the BTE cover the direct effects of the Port of Gladstone and the subsequent flow-on effects to other sectors of the regional economy. The study involves two major components:

- a survey of organisations involved in Gladstone port-related activities, to obtain information on the direct effects and on links to other sectors of the regional economy;
- use of input-output tables to estimate port-specific multipliers, and then to calculate the flow-on effects (and total impact) of Gladstone port-related activities.

The estimates of port impact cover output (gross revenue/expenditure), value added (payments to primary inputs of production), household income (mainly wages and salaries) and employment. The analysis also identifies port impact in terms of major port functions (e.g. port authority operations, ship loading and unloading) and commodities/cargo types.

OUTLINE OF THE REPORT

Chapter 2 describes the Port of Gladstone and its hinterland. It includes information on cargo movements and shipping activity at the port.

Chapter 3 provides an overview of the infrastructure and operations at the port. It describes the infrastructure and facilities, institutional arrangements, payments flows for port-related activities, and planning and coordination.

Chapter 4 covers the conduct of the BTE study in terms of the key parameters, estimation of the direct effects, calculation of the flow-on effects, and estimation of payments to government.

The estimates of the impact of the Port of Gladstone are presented in chapter 5. They include the overall impact, the major components of port impact, and the flow-on effects to other industry sectors.

Appendixes contain a survey questionnaire, an overview of input-output analysis, input-output sector definitions used in the study, and the disaggregated multipliers. A glossary provides definitions of technical terms used in this report.

CHAPTER 2 THE PORT AND ITS HINTERLAND

Cargo shipped through the Port of Gladstone mainly involves minerals from central Queensland and traffic related to industrial processing facilities located near the port. This chapter provides an overview of the local region, the major industrial activities in the port area, and the associated cargo movements through the port.

LOCAL REGION

The Port of Gladstone is located adjacent to the city of Gladstone, on the central coast of Queensland. Figure 2.1 provides an overview of Gladstone and the surrounding region.

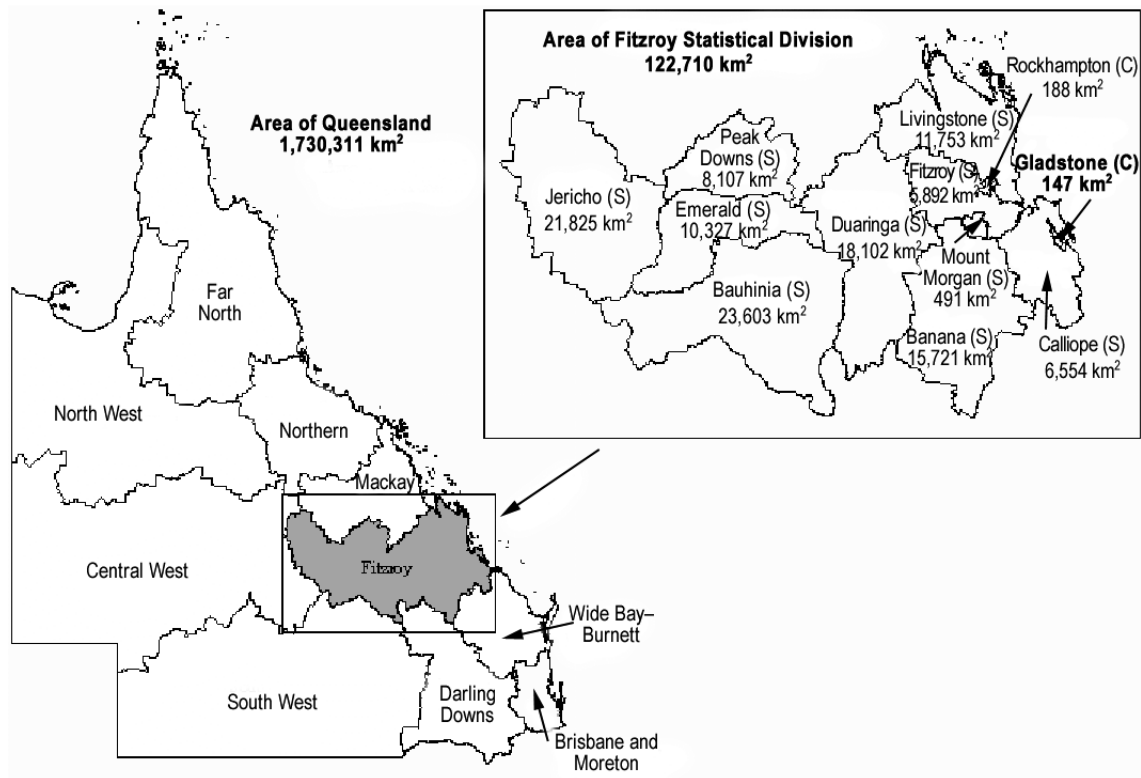
Permanent European settlement in the Gladstone area commenced around 1854, with a minor gold rush bringing many people to the district in 1861 (Australian Geographic 1996, p. 1502). The early development of the region was mainly based on pastoral and agricultural activities. A meatworks was built in 1896, and a butter factory was opened in 1905. Coal mining was undertaken on a limited scale from the 1920s.

There was a substantial expansion of the regional economy after 1960 with the commencement of large-scale coal mining for export markets, and the construction of major industrial processing facilities (e.g. an alumina refinery). These developments facilitated a period of rapid growth. The population of Gladstone increased from 7200 persons in 1961 to 22 100 persons in 1981 and 27 500 persons in 1999 (Australian Geographic 1996, p. 1501; ABS 2000, p. 34). The Port of Gladstone played a key role in facilitating industry development and the expansion of the local economy.¹

The Australian Bureau of Statistics (ABS) incorporates Gladstone in the Fitzroy Statistical Division. This region comprises 12 local government areas—Gladstone City, Livingstone Shire, Rockhampton City, Calliope Shire, Fitzroy Shire, Mount Morgan Shire, Banana Shire, Duaringa Shire,

¹ The only other trading port in the Fitzroy region is Port Alma, which handled 165 542 tonnes of cargo (mainly salt, tallow, scrap metal, ammonium nitrate and meat) in 1998-99.

FIGURE 2.1 GLADSTONE AND THE SURROUNDING REGION



Source Office of Economic and Statistical Research (2000, p. 3).

Peak Downs Shire, Emerald Shire, Bauhinia Shire and Jericho Shire (ABS 2000, p. 32).

The Fitzroy region (as defined by the ABS) had a resident population of 181 202 persons (preliminary estimate) at 30 June 1999. This was equivalent to 5.2 per cent of Queensland's total population. The major population centres are Rockhampton, Gladstone, Blackwater, Emerald and Biloela.

Mining

Coal from 14 mines in the southern Bowen Basin is exported through the Port of Gladstone. It comprises hard coking coal, soft coking coal, and thermal coal. Haulage distances to the port range from 190 kilometres for the Moura mines to 370 kilometres for mines in the Gregory region (GPA 2000a, p. 15).

Several other mining activities provide materials for local processing or for shipment through the Port of Gladstone. The minerals include limestone and

silica sands (for the production of cement), calcite (white marble) and magnesite (used in the production of magnesia and magnesium). Oil shale deposits located north of Gladstone may provide another potential source of traffic for the port.

Industrial processing

Several major industrial processing facilities are located near the Port of Gladstone (GPA 2000a, pp. 1-2). The port provides essential transport-related services for these facilities.

An alumina refinery operated by Queensland Alumina Limited (QAL) began operations in 1967, and is now the largest facility of its type in the world. Output is around 3.5 million tonnes per annum. QAL is currently assessing an expansion of the refinery to lift capacity to 5.1 million tonnes per annum. In addition, Comalco Limited (one of the four shareholders in QAL) is conducting a feasibility study for a new alumina refinery at Gladstone, with initial output of 1.4 million tonnes per annum.

Part of the output of the QAL refinery is used to produce aluminium at the nearby smelter operated by Boyne Smelters Limited, a joint venture company managed by Comalco Limited. Annual output of the smelter, which was opened in 1982, is around 490 000 tonnes per annum. The Gladstone power station (the largest generating facility in Queensland) is operated by a consortium of companies headed by Comalco Limited.

Queensland Cement Limited produces cement clinker and cement at a facility that was established in 1979 and subsequently expanded. Output is 1.6 million tonnes per annum, with product being supplied to markets in northern Australia and overseas.

There are two chemical plants located near the port. Orica Australia Pty Limited produces solid sodium cyanide, liquid cyanide, caustic soda, chlorine, nitric acid and ammonium nitrate. Ticor Chemical Company Pty Ltd produces solid sodium cyanide and caustic soda.

A consortium comprising Southern Pacific Petroleum/Central Pacific Minerals and Suncor Energy has been operating a pilot plant to assess the production of shale oil. Australian Magnesium Corporation operates a demonstration plant for the production of magnesium, and is currently evaluating the construction of a commercial plant at Stanwell (near Rockhampton).

Other activities

Significant quantities of grain (mainly wheat, with some sorghum and sunflower seeds) are produced in the areas around Emerald and Biloela. Other activities in the region include cattle grazing, growing of tropical fruit,

production of timber (based on softwood plantations and native hardwoods), salt production, commercial fishing and tourism.

There are also significant support activities, such as consulting engineers and engineering workshops, at Gladstone and other major centres. Central Queensland University has a campus at Gladstone.

CARGO AND TRADE PATTERNS

Table 2.1 presents information on shipments of cargo through the Port of Gladstone over the 10 years to 1999-2000. Total throughput increased at a compound average rate of around 4 per cent per annum over this period. Traffic in 1999-2000 was 8 per cent higher than traffic in the previous year.

Coal and cargoes related to the aluminium industry (bauxite, caustic soda, petroleum coke, liquid pitch, alumina, aluminium) accounted for 93 per cent of total traffic in 1999-2000.

Major commodities

Table 2.2 provides information on the major commodities shipped through the Port of Gladstone over the five years to 1999-2000. The port mainly handles bulk cargoes, with small shipments of containerised and breakbulk cargoes.

Coal accounted for 64 per cent of port traffic in 1999-2000. Shipments have increased at a compound rate of almost 6 per cent per annum over the period since 1990-91.

Aluminium and inputs used in its production comprised about 29 per cent of port traffic in 1999-2000. Bauxite (20 per cent of traffic) and caustic soda are

TABLE 2.1 CARGO SHIPPED THROUGH THE PORT OF GLADSTONE, 1990–91 TO 1999–2000

('000 tonnes)

<i>Year</i>	<i>Coal</i>	<i>Aluminium industry cargoes^a</i>	<i>Other cargoes</i>	<i>Total</i>
1990–91	18 195	11 926	1 733	31 854
1991–92	19 638	10 921	1 417	31 976
1992–93	19 958	11 500	1 665	33 123
1993–94	19 964	11 043	1 548	32 555
1994–95	23 318	11 952	1 559	36 829
1995–96	22 977	11 892	1 875	36 744
1996–97	24 171	12 015	2 134	38 320
1997–98	25 808	11 583	2 534	39 925
1998–99	27 302	12 497	3 018	42 817
1999–2000	29 459	13 258	3 461	46 178

a. Comprises bauxite, caustic soda (at South Trees Wharves), petroleum coke, liquid pitch, alumina and aluminium.

Source GPA (pers. com. Sep. 2000).

major inputs for the production of alumina, while petroleum coke and liquid pitch are used in the smelting process. Some of the alumina produced at the Gladstone refinery (6 per cent of traffic) is shipped to other smelters.

In tonnage terms, the other major traffics handled at the Port of Gladstone in 1999-2000 included cargoes for the cement industry, petroleum products, woodchip and grain. Small quantities of several minerals, such as magnesite and calcite, are also shipped through the port. General cargo, in containers or in breakbulk form (excluding military vehicles), totalled 120 000 tonnes in 1999-2000.

TABLE 2.2 MAJOR COMMODITIES HANDLED AT THE PORT OF GLADSTONE, 1995–96
TO 1999–2000

	('000 tonnes)				
<i>Commodity</i>	1995–96	1996–97	1997–98	1998–99	1999–2000
Outbound					
Coal	22 977	24 171	25 808	27 302	29 459
Alumina	2 960	2 699	2 492	2 716	2 711
Cement clinker	103	48	256	897	1 078
Aluminium	176	179	311	364	349
Woodchip	260	241	343	267	315
Cement	318	343	292	304	273
Grain	112	282	330	343	256
Bunker coal & oil	199	215	206	207	229
Magnesia	0	0	0	87	91
Fly ash	70	69	84	97	79
Containers	32	42	69	70	72
Calcite	57	57	115	58	70
Magnesite	66	57	107	21	45
Other ^a	21	22	9	31	68
Total outbound	27 349	28 425	30 421	32 764	35 095
Inbound					
Bauxite	7 939	8 489	7 953	8 417	9 133
Caustic soda	790	606	654	867	949
Petroleum products	404	437	452	444	466
Petroleum coke	125	121	221	171	158
Bunker fuel oil	89	130	112	49	141
Liquid pitch	0	23	44	42	70
Liquid ammonia	0	0	0	0	52
General cargo	3	34	21	24	41
Other ^b	45	55	48	40	73
Total inbound	9 395	9 894	9 504	10 053	11 083
Total trade	36 744	38 320	39 925	42 817	46 178

a. In each year, incorporates several of the following—Koppers Poles, scrap metal, limestone, cottonseed, general/breakbulk cargoes, cement gypsum, military vehicles, bunker fuel oil.

b. In each year, incorporates several of the following—cement gypsum, LP gas, containers, military vehicles.

Source GPA (pers. com. Sep. 2000).

Cargo destinations and origins

Table 2.3 provides data on the destinations of outbound shipments and the origins of inbound shipments handled at the Port of Gladstone in 1999–2000.

Around 73 per cent of total traffic involved the overseas trades. Cargoes shipped through the port in 1999–2000 were exported to 37 countries and imported from 19 countries (GPA 2000c, p. 26). The major destinations/origins

included Japan (39 per cent of total traffic), Korea (7 per cent), India (5 per cent) and Taiwan (4 per cent). Trade with these countries mainly involved coal.

The remaining 27 per cent of traffic handled at the Port of Gladstone in 1999-2000 comprised coastal (i.e. intrastate and interstate) shipments. Almost three-quarters of this traffic involved the movement of bauxite from Weipa to Gladstone. Alumina, cement clinker, petroleum products and cement accounted for most of the other coastal traffic.

SHIPPING ACTIVITY

The level of shipping activity at the Port of Gladstone has increased significantly over the last five years, from 771 ship calls in 1995-96 to 933 ship calls in 1999-2000 (GPA pers. com. Sep. 2000). The compound growth rate over this period was 5 per cent per annum.

TABLE 2.3 DESTINATIONS AND ORIGINS OF CARGO HANDLED AT THE PORT OF GLADSTONE, 1999-2000

('000 tonnes)

Country	Outbound	Inbound	Total traffic
Overseas			
Japan	17 542	468	18 010
Korea	3 217	140	3 357
India	2 074	1	2 075
Taiwan	1 873	10	1 883
Brazil	1 321	0	1 321
France	564	0	564
China	562	16	578
Belgium	518	0	518
United States	516	265	781
Spain	465	0	465
New Zealand	387	53	440
Saudi Arabia	0	386	386
Other	2 957	133	3 090
Total overseas	31 996	1 472	33 468
Australia	2 869	9 611	12 480
All countries	34 865 ^a	11 083	45 948 ^a

a. Excludes bunker coal.

Source GPA (pers. com. Sep. 2000).

There were 597 calls by ships carrying overseas cargoes and 336 calls by ships carrying coastal cargoes in 1999-2000. The ships comprised:

- bulk carriers (717 calls);
- multi-purpose vessels (92 calls);

- tankers (83 calls);
- breakbulk vessels (23 calls); and
- LPG carriers (18 calls).

The average cargo loaded/discharged per ship call in 1999-2000 was around 50 000 tonnes. This figure reflects the relatively large ships used in many of the bulk trades, particularly for coal and bauxite. The largest ship ever to use the port was a 231 850 dwt vessel (GPA 2000c, p. 26).

CHAPTER 3 PORT INFRASTRUCTURE AND OPERATIONS

The Port of Gladstone comprises a natural deep-water harbour and associated facilities for the handling of ships and cargo. This chapter provides an overview of the operation of the port in terms of infrastructure and facilities, institutional arrangements, payments flows, and planning and coordination.

INFRASTRUCTURE AND FACILITIES

The first major wharf at Gladstone was built in 1885 (Australian Geographic 1996, p. 1502). Exports through the port initially included meat, butter, wool, sugar, horses and cattle. Coal shipments commenced in the early 1920s, ceased in 1931, re-commenced on a larger scale in the 1940s, and grew substantially from 1961 (GPA 1988, p. 4).

A bulk coal loader came into operation in 1954, and a grain export terminal was opened in 1971. Facilities to service the growing requirements of industrial processing activities at Gladstone were constructed from the late 1960s. Traffic handled at the port increased from 206 000 tonnes in 1960 to more than 10 million tonnes in 1970 (Australian Geographic 1996, p. 1501).

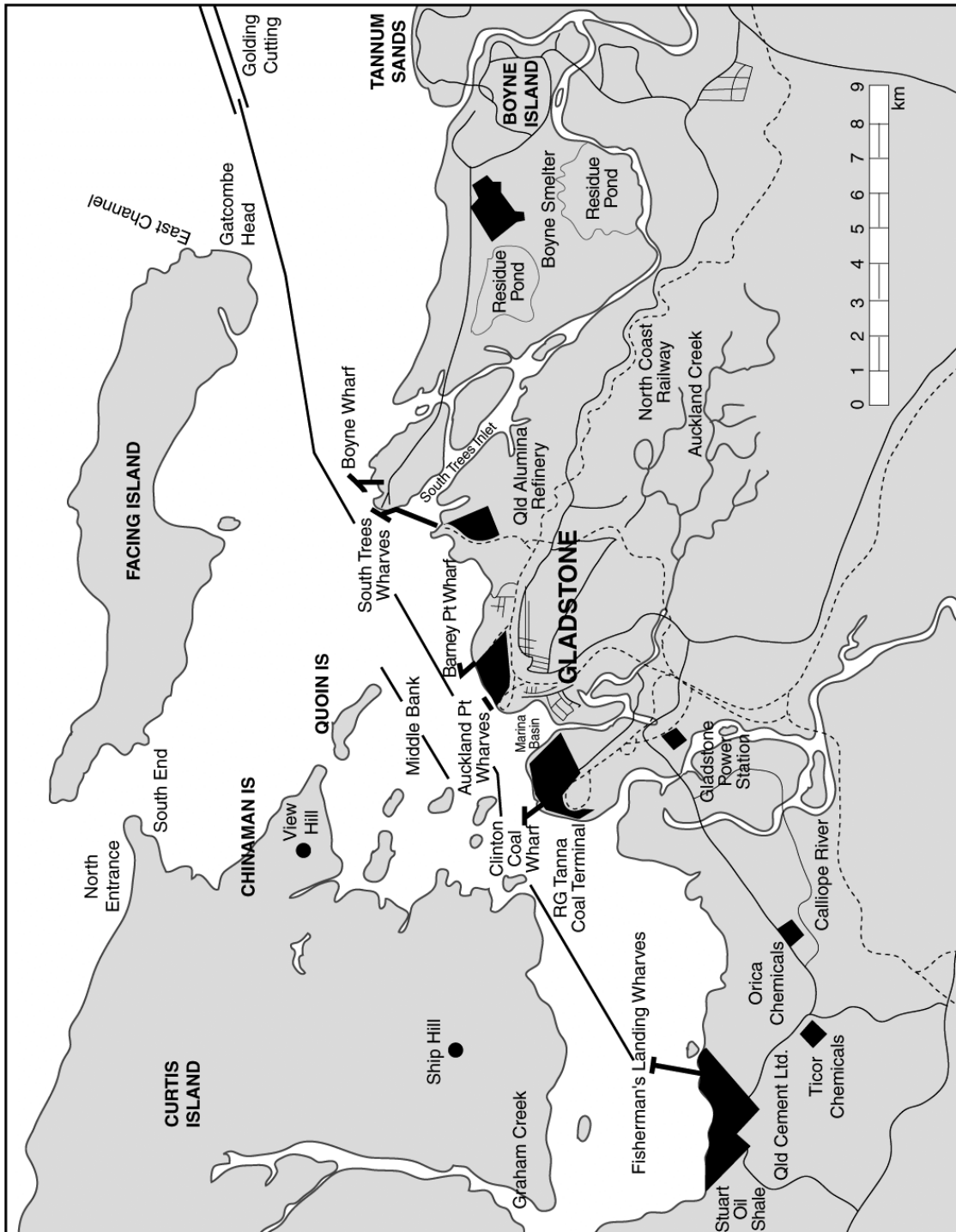
A larger coal loader, with an annual capacity of 10 million tonnes, was completed in 1980. The capacity of the loader (to be known as the R.G. Tanna Coal Terminal) was subsequently expanded to more than 30 million tonnes. Construction of additional facilities to meet the requirements of industrial processing activities also continued during this period. Capital expenditure by the GPA alone totalled \$480 million over the 20 years to 1998 (GPA 1998, p. 3).

Wharves and berths

Figure 3.1 provides an overview of the current facilities at the Port of Gladstone. The 12 berths are grouped in six wharf centres:

- Clinton Wharves, comprising two berths at the R.G. Tanna Coal Terminal (coal);
- Barney Point Terminal (mainly coal, with some other dry bulk cargoes);
- South Trees Wharves, comprising two berths that service the alumina refinery (bauxite, caustic soda, alumina, bunker coal, fuel oil);

FIGURE 3.1 MAJOR FACILITIES AT THE PORT OF GLADSTONE



Source GPA (2000b, p. 3).

- Boyne Wharf, servicing the aluminium smelter (petroleum coke, liquid pitch, aluminium);
- Auckland Point Wharves, comprising four berths that handle a range of cargoes (grain, petroleum products, cement gypsum, LP gas, caustic soda, woodchip, calcite, magnesia, containers, general cargo);
- Fisherman's Landing Wharves, containing two berths that handle a range of cargoes (caustic soda, cement clinker, cement, fly ash, ammonia).

The Clinton Wharves accounted for 59 per cent of the total tonnage shipped through the port in 1999-2000 (GPA pers. com. Sep. 2000). The remaining traffic was handled at South Trees (28 per cent), Barney Point (5 per cent), Fisherman's Landing (4 per cent), Auckland Point (3 per cent) and Boyne Wharf (1 per cent).

Other facilities in the port area

The Gladstone Port Authority (GPA) established a container terminal at the port in 1996. The terminal includes storage areas, a storage/packing shed, container washdown and pre-tripping facilities, and outlets for refrigerated containers. There is also provision for a wharf-based container crane, extension of the wharf, and additional storage areas.

The GPA has constructed a marina which incorporates facilities for small craft such as yachts and tourist vessels. The marina's open spaces also include various community use areas such as a recreational park.

Industrial land around the port is controlled by the GPA. The land is leased by various users including operators of industrial processing facilities, providers of port-related services, and the Gladstone campus of Central Queensland University.

Land transport facilities

Around 65 per cent of the cargo shipped through the Port of Gladstone in 1999-2000 was moved to the port by rail transport. The traffic involved coal, woodchip and grain. All of this traffic was moved from locations in Queensland, with few prospects for interstate rail movements due to the current change of rail gauge at Brisbane. The main connection to Queensland's rail network is at Callemondah, with a separate link (via Byelle Junction) being used for coal from the Moura mines. The facilities with rail access are the R.G. Tanna Coal Terminal, the Barney Point Terminal, the Auckland Point Berths, and Fisherman's Landing No. 4 Berth.

Conveyors or pipelines are used to transfer various bulk cargoes between ship loaders/unloaders and industrial processing facilities at the port. The commodities include bauxite, alumina, petroleum coke, cement clinker, caustic soda, fuel oil and liquid ammonia. They accounted for around 31 per cent of the cargo shipped through the Port of Gladstone in 1999-2000.

The remaining 4 per cent of cargo was moved to or from the port by road transport. In some cases (e.g. petroleum, LP gas) the cargo is pumped from the ship to storage facilities in the port area, with road transport being used for subsequent distribution in the Fitzroy region.

INSTITUTIONAL ARRANGEMENTS

Facilities and services at the Port of Gladstone are provided by the GPA, private operators and several government agencies. Table 3.1 lists the port-related activities that are undertaken at the port.

Gladstone Port Authority

The GPA is a statutory government-owned corporation which is constituted under the provisions of the *Government Owned Corporations Act 1993* (GPA 2000a, p. 4). Equal numbers of shares are held by the Treasurer and by the Minister for Transport and Minister for Main Roads, on behalf of the Queensland Government.

The mission of the GPA is to ensure that the Port of Gladstone operates effectively, efficiently and on a commercial basis for the continuing benefit of the region's community, port users, and the State of Queensland (GPA 1999, p. 2). In broad terms, the functions of the GPA involve:

- providing port facilities and services in the Port of Gladstone;
- ensuring the availability of land for purposes consistent with the operation of the port;
- ensuring the provision of ancillary services or works for the effective and efficient operation of the port;
- maintaining appropriate levels of safety and security;
- providing other services that are incidental to the performance of the GPA's other functions or that are likely to enhance the usage of the port;
- performing any other functions conferred on the GPA by legislation.

The GPA carries out the typical functions of a strategic port manager and port landlord (e.g. strategic management and planning of the port area, provision of berths, general maintenance and harbour works). Other activities include land reclamation, pilotage, some mooring/unmooring services, and operation of the marina.

In addition, the GPA owns and operates the two coal terminals and the Auckland Point No. 1 Berth (including an associated ship loader). Other berths owned by the GPA are operated by Boyne Smelters (Boyne Wharf), by Globex International (Auckland Point No. 2 Berth), or on a multi-user basis (Auckland Point No. 3 and No. 4 Berths, Fisherman's Landing No. 4 and No. 5 Berths). The Gladstone Container Terminal is also operated as a multi-user facility.

TABLE 3.1 GLADSTONE PORT-RELATED ACTIVITIES

<i>Categories</i>	<i>Activities/components</i>
Port authority operations	Planning, co-ordination and promotion Development and leasing of land for port activities Port authority wharves, berths, etc. ^a Coal terminals and Auckland Pt. Berth No.1 loader Shipping channels and berth approaches (maintenance) Ship scheduling and berth allocation at GPA-owned/operated berths Pilotage Mooring/unmooring at GPA-operated facilities Power, water, garbage disposal for ships Road infrastructure within the port Security, safety and emergency response at GPA-owned facilities
Ship operations	Shipping lines/agents Towage Line boats Mooring/unmooring at non-GPA facilities Bunkering Ship survey Ship cleaning Ship repairs and maintenance ^b Ship supplies ^c Container repairs, maintenance and servicing
Ship loading and unloading	Private wharves, berths etc ^a Container and breakbulk stevedoring Bulk cargo loading/unloading (excl. coal and Auckland Pt. No.1 Berth)
Cargo services	Customs brokers/freight forwarders Container packing/unpacking Cargo survey Fumigation
Land transport and storage ^d	Road transport Rail transport Transfer between road/rail and port-related storage Port-related storage Conveyor/pipeline transfer between storage facilities and wharf
Government agencies	Customs Quarantine Ship safety Port safety ^e Environmental management Port policy administration

a. Operation and maintenance.

b. Only for vessels in the port for the purpose of bringing in or taking out cargo or passengers.

c. Sometimes called chandlery or providoring. Excludes supplies to commercial fishing and recreational boating.

d. Includes movement of cargo within the port, movement of cargo between the port and closest inland points (e.g. warehouses, bonded storage, processing plant, other storage facilities), and port-related storage.

e. Includes harbour master, channel markers, navigation aids and vessel traffic system.

The GPA controls around 800 hectares of industrial land located adjacent to the port. Most of this land has been created through a reclamation program involving earthworks operations, maintenance dredging, and fly ash residue from the power station. Current reclamation activities include projects near Fisherman's Landing, Clinton Wharf and Auckland Point/Barney Point.

The GPA earned operating revenue of \$86.3 million in 1999–2000 (GPA 2000c, p. 10). The sources of revenue were:

- cargo handling—62 per cent;
- wharves and shipping—31 per cent;
- small craft—4 per cent;
- land and property—1 per cent;
- other—2 per cent.

Profit (after abnormal items and income tax equivalent) was \$7.9 million in 1999-2000. This compared with a loss of \$77.8 million in the previous year, when the operating profit was more than offset by a write-down of non-current assets.

Other organisations

Gladstone port-related activities are also undertaken by various private operators and government agencies.

Private operators provide a range of services to shipping lines/agents and shippers at the port. Some of the major services and operators are:

- container and breakbulk stevedoring (Patrick the Australian Stevedore, P&O Ports, Total Stevedoring Services);
- towage (Gladstone Tug Services);
- line boats (Gladstone Port Services, Line Running Services);
- mooring/unmooring services at non-GPA facilities (Hetherington Kingsbury, QAL, Ticor, Line Running Services); and
- bunkering (BHP Transport).

QAL owns and operates the two berths at South Trees and the associated loading/unloading facilities. As noted earlier, various other berths are operated by single users (Boyne Smelters, Globex International) or on a multi-user basis.

Several Commonwealth agencies undertake Gladstone port-related activities. They comprise the Australian Customs Service, the Australian Maritime Safety Authority (AMSA) and the Australian Quarantine and Inspection Service (AQIS).

The major State government agency involved in port operations is Queensland Transport (Maritime Division). Its responsibilities include maritime safety, maintenance of navigation aids, operation of the vessel traffic system, licensing of pilots and receipting of pilotage/conservancy fees. The Environmental

Protection Agency administers legislation that requires the GPA to hold a licence for environmentally relevant activities (e.g. involving dust, noise, water quality) carried out at the port.

Queensland Rail provides rail services to and from the port, and also has some involvement in the unloading of trains at the coal terminals.

PAYMENTS FLOWS

Figure 3.2 outlines the major payments flows to providers of port-related services at the Port of Gladstone in 1999-2000.

Shippers and shipping lines/agents pay the GPA for certain infrastructure and port services. The GPA also receives payments from some providers of port services that lease port authority land or other facilities.

The Australian Customs Service collects payments from shipping lines/agents on behalf of the central offices of AMSA and AQIS. The Gladstone offices of these two agencies may also receive some payments (e.g. for inspections of certain ships) direct from local shippers or from agents for ships calling at the port.

Queensland Transport collects conservancy dues on behalf of the State Government. These dues are levied to cover the cost of navigation aids but are not directly retained by Queensland Transport, which is funded from consolidated revenue. Queensland Transport pays the GPA an agreed sum to operate the pilotage service at the Port of Gladstone and at Port Alma.

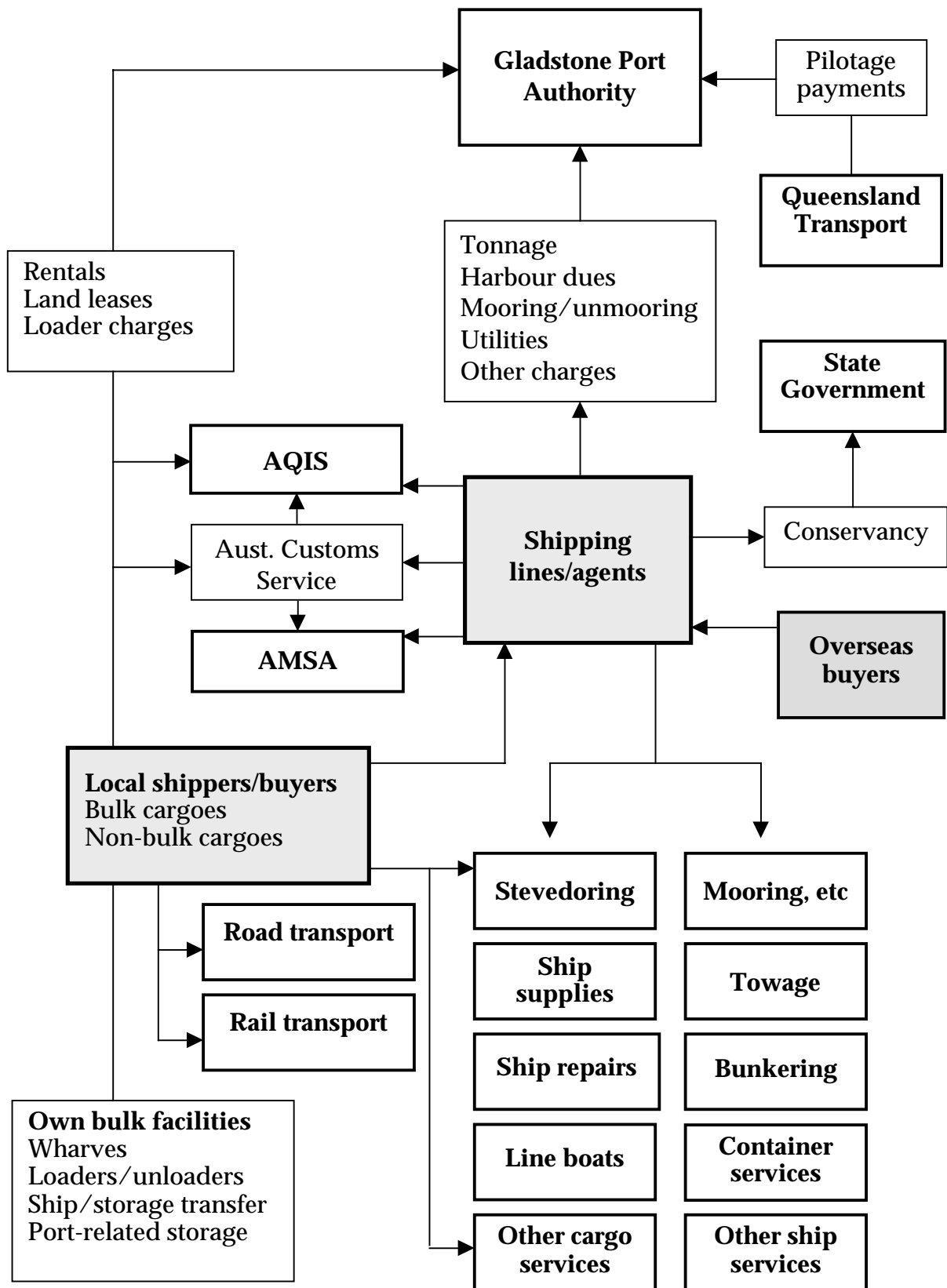
PLANNING AND COORDINATION

A 50-Year Strategic Plan for the Port of Gladstone was launched by the GPA in 1992, and updated in 1997 (GPA 1998). The development of the Plan included extensive consultation with port users, State and local governments, and the local community. It also took into account earlier GPA plans and studies.

The forecasts in the Plan include annual throughput of 133.5 million tonnes at the Port of Gladstone by 2047, and a potential requirement for 20 additional wharves to handle this traffic. Other components of the Plan involve environmental monitoring, land use planning, provision of recreation services, buffer zone and foreshore development, and road and rail linkages.

The GPA has a community support program that provides financial assistance and in-kind support for the Gladstone and regional community. Other community activities include recreational fishing enhancement, a mangrove compensation program, and a community access program.

FIGURE 3.2 MAJOR GLADSTONE PORT-RELATED PAYMENTS BY SHIPPERS AND SHIPPING LINES/AGENTS, 1999-2000



Source BTE analysis.

CHAPTER 4 CONDUCT OF THE STUDY

The study of the Port of Gladstone was undertaken using the general framework for port impact studies presented in BTE (2000, pp. 35-52).

The direct effects of the Port of Gladstone comprise the initial round of output, value added, income and employment generated by Gladstone port-related activities. The flow-on effects are the additional output, value added, income and employment that result from purchases by organisations and employees involved in these activities. The flow-on effects were calculated using multipliers, which indicate the changes in activity that result from an initial change in economic activity.

A survey of organisations involved in Gladstone port-related activities provided most of the data for the estimation of the direct effects of the port. Input-output tables, which quantify the linkages and transactions between different sectors of the regional economy, were used to calculate the flow-on effects to other industry sectors.

This chapter describes the conduct of the port impact study in terms of the key parameters, estimation of the direct and flow-on effects, and calculation of payments to government.

KEY PARAMETERS

Several definitions and components of the study were agreed with the GPA prior to the commencement of detailed work by the BTE.

Port-related activities

The BTE's general framework for port impact studies incorporates all activities that are required for the movement of ships and their cargoes and passengers through the port. It does not include the economic benefits of exports and imports handled at the port, or the impact of industrial activities in the port area (e.g. power generation) that are not involved in the movement of cargo.

The Gladstone port-related activities covered in the study are described in table 3.1 (see page 17). They involve port authority operations, activities for the movement of ships through the port, ship loading and unloading, cargo services, land transport and storage, and activities of government agencies.

Land transport and storage

In practice, it is difficult to accurately identify the components of land transport that are port-related. The BTE's general approach in port impact studies therefore focuses on land transport activities in the vicinity of the port. Port-related land transport is broadly defined as the movement of cargo between port-related facilities and the nearest warehouse, terminal, customer premises or processing plant in the local region (excluding retail distribution).

Following discussions with the GPA, the following land transport activities were included in the Gladstone port impact study:

- conveyor and pipeline transfers of cargo between ship loaders/unloaders and industrial processing plants or storage facilities at the port;
- road transport of calcite, magnesite and magnesia, incorporating movements within the port area and from stockpiles at the mine or processing plant;
- road transport of general cargo between the port and nearby facilities; and
- rail transport of coal, grain and woodchip between Callemondah Yards/Byelle Junction and loading facilities at the port.

Cargoes are moved by rail to the Port of Gladstone from locations as far as 370 kilometres away. It could be argued that the impact of rail activities should incorporate the full journey from the point of origin (e.g. stockpiles at the mine). However, the resulting impact estimates would not be consistent with the primary purpose of a port impact study, which is to indicate the effects on the community immediately affected by the physical operation of the port. In addition, the inclusion of the full rail journey would result in impact estimates for port-related rail transport that would exceed the impact of all other components of Gladstone port-related activities. As the data for rail activities are only approximate, the incorporation of the full rail journey would therefore introduce a large margin of error into the overall estimates of port impact.

Period covered

The period covered by the study was 1999-2000. This was the most recent year for which data on Gladstone port-related activities were available.

Impact measures

The standard impact measures identified in the general framework were included in the study:

- output, incorporating gross revenue of commercial activities and gross expenditure for non-commercial activities (e.g. government departments);
- value added, calculated as gross revenue less the cost of intermediate inputs into production and imported goods and services;
- household income, incorporating wages, salaries and other payments to management and employees; and

- employment, expressed in terms of the number of full-time equivalent jobs.

On the basis of advice from the GPA, the estimates of port impact were disaggregated in terms of:

- port function (see table 3.1 for components); and
- commodity/cargo type (coal, other dry bulk cargoes, liquid bulk cargoes, and containers and other general cargo).

The BTE also prepared an estimate of the taxes and other payments to government generated by Gladstone port-related activities.

Region

Flow-on effects (and total impact) were estimated for the Fitzroy region, as requested by the GPA. This region is the source of most outward traffic, and the destination for most inward traffic, moved through the port. As noted in chapter 2, it comprises:

- Gladstone City;
- Rockhampton City; and
- the Shires of Livingstone, Calliope, Fitzroy, Mount Morgan, Banana, Duaringa, Peak Downs, Emerald, Bauhinia and Jericho.

ESTIMATION OF THE DIRECT EFFECTS

The survey provided the basis for estimating the direct effects of the Port of Gladstone. The BTE also used other industry data to prepare estimates for some port-related activities.

Survey

The objective of the survey was to contact all organisations with significant Gladstone port-related activities. The mailing list, which was prepared by the GPA, included 59 firms and government agencies.

Survey process

The data requested from each organisation included the number of employees, components of current operating expenses, and aspects of revenue. Three versions of the questionnaire were developed, in order to reflect the varying characteristics of the organisations included in the survey. Appendix I contains the version sent to firms whose activities were wholly or primarily port-related.

The questionnaires were mailed out in early September 2000. A covering letter outlined the background and objectives of the study, explained why the survey was required, described the BTE, and indicated that all survey data would be treated in confidence. The BTE subsequently undertook detailed follow-up

activities, in order to ensure that all organisations on the mailing list had received the questionnaire and to encourage their participation.

Survey outcome

Table 4.1 summarises the overall outcome of the survey. A total of 36 organisations submitted detailed responses, involving full or substantial completion of the questionnaire. The activities covered by these responses accounted for around 80 per cent of the Gladstone port-related employment identified by the BTE during the study.

BTE staff checked each completed questionnaire to ensure that the data were internally consistent and of the expected magnitude. If there appeared to be a significant inconsistency, a BTE officer discussed the data with the organisation that had submitted the completed questionnaire.

A further 23 organisations included in the survey process provided partial responses, either by telephone or in the form of a partly completed questionnaire. All of these responses included information on employment. In some cases, they also contained some other data (e.g. total revenue, proportion of total revenue by cargo type). The activities covered by these responses accounted for around 20 per cent of the Gladstone port-related employment identified by the BTE during the study.

Most of the organisations that provided a partial response to the survey were matched with one or more comparable organisations that had provided a detailed response. This approach enabled the BTE to prepare output and income estimates for these organisations. In a small number of cases, the BTE used other industry information to supplement the employment data.

Land transport

As a result of the fragmented nature of the road transport industry, it was not possible to identify all road transport operators involved in Gladstone port-

TABLE 4.1 RESPONSES TO GLADSTONE PORT INDUSTRY SURVEY

<i>Outcome</i>	<i>Number of organisations</i>
Detailed response	36
Partial response	23
Total	59

Source BTE analysis.

related activities. Although the major operators were included in the survey, the impact estimates may be conservative due to the likely omission of some

small operators. However, as road transport accounted for only 4 per cent (in tonnage terms) of port-related land transport in 1999-2000, this factor is unlikely to have a significant effect on the general accuracy of the overall results of the study.

As noted earlier, the analysis of port-related rail transport was based on movements along two sections of track:

- from Callemondah Yards to the R.G. Tanna Coal Terminal (7 kilometres);
- from Byelle Junction to Barney Point Terminal (14 kilometres).

The BTE prepared approximate estimates of output, value added, income and employment for rail transport, as official data on revenues and costs for coal transport in Queensland are not publicly available. This process involved several steps. An estimate of port-related rail tonne-kilometres was developed using the above distances and information on tonnages moved to the port by rail in 1999-2000. Output was calculated by combining the tonne-kilometre figure with an estimate of the average freight rate per tonne-kilometre. Associated cost components and employment were then estimated using system-wide financial information from several sources, including the annual reports of Queensland Rail and a North American railroad.

GPA data

The GPA provided a substantial amount of data for the study. Major inputs included the mailing list for the survey, a fully completed questionnaire, and various published documents. Staff of the GPA also responded to numerous BTE requests for information and assistance at various stages of the study.

The GPA implemented several initiatives to build community support for the study. Senior executives of the GPA announced the study at a meeting of the Gladstone Area Industry Network, which comprises the chief executive officers of major local companies. Other initiatives included a media release which described the study and its potential benefits, and interviews with the GPA's Marketing Manager on local radio. In addition, senior management of the GPA wrote to all Gladstone port-related organisations at the beginning of the study, seeking their cooperation in providing data for the survey.

ESTIMATION OF THE FLOW-ON EFFECTS

Flow-on effects to other industry sectors result from purchases of goods and services by the providers of port-related services and by their employees. Input-output tables, modified to incorporate specific rows and columns for the Gladstone port industry, were used to calculate the multipliers for the study. Appendix II provides an overview of input-output analysis.

Input-output tables

The Queensland Government's Office of Economic and Statistical Research (OESR) prepares detailed input-output tables for individual regions in Queensland. The latest tables available at the time of the BTE study covered 1989-90.

The BTE was able to obtain more recent tables for the Fitzroy region from the Regional and Urban Economics Research Unit at the University of Queensland (RUERU 1998). The RUERU had prepared 1995-96 tables, which incorporated changes in industry structure since 1989-90, by updating the earlier OESR tables. The updated tables contained 19 industry sectors. The BTE used the RUERU tables, as they were prepared by recognised analysts and were the most recent tables available at the time of the study.

As the input-output tables covered an earlier year than the survey responses, the data were aligned by inflating the input-output tables to 1999–2000 prices. This adjustment did not affect the relationships between the direct effects, flow-on effects and total impact.

The input-output tables included most Gladstone port-related activities, together with various other activities, in the transport sector. It was therefore necessary to develop modified tables that separately identified the Gladstone port industry and the sub-sectors for the detailed impact measures. The components of the 17 industry sectors used in the BTE's analysis are listed in appendix III.

The process of modifying input-output tables and preparing port-specific multipliers for a port impact study is described in BTE (2000, pp. 96-97).

Multipliers

Table 4.2 presents the multipliers for Gladstone port-related activities in terms of the impact of an initial amount of output in these activities. For example, \$1.00 of output in the Gladstone port industry leads to output of \$0.66 in other

TABLE 4.2 MULTIPLIERS FOR GLADSTONE PORT INDUSTRY, 1999–2000

<i>Measure</i>	<i>Direct effects</i>	<i>Flow-on effects</i>	<i>Total impact</i>
Output ^a	1.00	0.66	1.66
Value added ^a	0.69 ^c	0.34	1.03
Household income ^a	0.32	0.18 ^c	0.50
Employment ^b	5	8	13

a. Dollar impact of \$1.00 of output in port industry.

b. Number of jobs (full-time equivalent) per \$ million of output in port industry.

c. Rounded figure for purposes of exposition, incorporating a small adjustment to provide consistency between components of multipliers.

Source BTE analysis.

industries, resulting in total output of \$1.66. Alternatively, \$1.00 of output generates \$0.69 of value added in Gladstone port-related activities, \$0.34 in other industries and a total value added of \$1.03. Similar relationships can be identified for household income.

The employment effects are expressed in terms of the number of full-time jobs per million dollars of output in Gladstone port-related activities. Table 4.2 indicates that \$1 million of output generates around 5 jobs in the Gladstone port industry, 8 jobs in other industries and a total impact of 13 jobs.

Table 4.3 presents the multipliers for components of the port industry. It indicates that there is significant variation in the multipliers. For example, the output multiplier is 1.62 for coal and 1.77 for other dry bulk cargoes. Disaggregated multipliers are presented in appendix IV.

PAYMENTS TO GOVERNMENTS

The survey provided only limited information on taxes and other payments to governments. The BTE therefore prepared indicative estimates of total payments on the basis of GPA data and information for the broader economy.

The GPA supplied information on payments to the Commonwealth (fringe benefits tax, employee income tax), the State Government (payroll tax, income

TABLE 4.3 MULTIPLIERS FOR COMPONENTS OF GLADSTONE PORT INDUSTRY, 1999–2000

<i>Port component</i>	<i>Output^a</i>	<i>Value added^a</i>	<i>Household income^a</i>	<i>Employment^b</i>
Function				
Port authority operations	1.56	0.97	0.44	11
Ship operations	1.86	1.17	0.68	18
Ship loading/unloading	1.83	1.09	0.59	15
Cargo services	1.62	1.01	0.58	16
Land transport and storage	1.70	1.09	0.48	13
Government agencies	2.08	1.27	0.93	26
<i>Total</i>	<i>1.66</i>	<i>1.03</i>	<i>0.50</i>	<i>13</i>
Cargo type/commodity				
Coal	1.62	1.01	0.48	12
Other dry bulk cargoes	1.77	1.08	0.57	15
Liquid bulk cargoes	1.65	0.94	0.43	12
Containers, other general cargo	1.69	1.15	0.60	15
<i>Total</i>	<i>1.66</i>	<i>1.03</i>	<i>0.50</i>	<i>13</i>

a. Dollar impact of \$1.00 of output in same component of port industry.

b. Number of jobs per \$ million of output in same component of port industry.

Source BTE analysis.

and sales tax equivalents, stamp duty, motor vehicle registration) and local government (rates). Dividend and interest payments to the Queensland Treasury were not included in the BTE's analysis.

The analysis of other providers of port-related services and of firms involved in flow-on activities was based on data published by the ABS. It incorporated the ratio of State and local government revenues to Gross State Product, and the ratio of Commonwealth Government revenue to Gross Domestic Product. Modified ratios were used to analyse port-related activities (excluding the GPA), as firms involved in these activities would not pay certain taxes (e.g. casino tax, liquor tax) due to the nature of their operations. In view of the diverse nature of the organisations involved in flow-on activities, unadjusted proportions for the wider economy were used to estimate payments by these organisations.

CHAPTER 5 ECONOMIC IMPACT OF PORT OF GLADSTONE

This chapter presents the estimates of the regional impact of the Port of Gladstone in terms of output (gross revenue/expenditure), value added (payments to primary inputs of production), household income and employment. Detailed impact measures indicate the impact attributable to individual port functions and commodities/cargo types.

It should be noted that output does not indicate the net contribution of Gladstone port-related activities to the Fitzroy region, since it includes inputs produced inside the region and inputs produced outside the region. Value added is a more appropriate indicator of the port's relative contribution to the regional economy, as it can be directly compared to gross regional product.

OVERALL IMPACT

Table 5.1 presents the estimates of the overall impact of the Port of Gladstone, incorporating the direct effects and the flow-on effects.

Direct effects

Gladstone port-related activities (i.e. the direct effects) involved output of \$135 million and value added of \$93 million in 1999–2000. These activities generated household income of \$44 million and 738 jobs (full-time equivalent).

Employment in Gladstone port-related activities accounted for around 1.0 per cent of total employment in the Fitzroy region in 1999–2000. Average household

TABLE 5.1 ECONOMIC IMPACT OF THE PORT OF GLADSTONE, 1999–2000

<i>Impact measure</i>	<i>Direct effects</i>	<i>Flow-on effects</i>	<i>Total impact</i>
Output (\$m)	135	89	224
Value added (\$m)	93	46	139
Household income (\$m)	44	24	68
Employment (no.) ^a	738	1 020	1 758

a. Number of full-time equivalent jobs.

Source BTE analysis.

income for these activities was \$59 000 per employee, which was well above the region's average (all industries) income of around \$35 000 per annum.

Flow-on effects

The BTE estimated the flow-on effects to other industry sectors in the Fitzroy region using the multipliers described in chapter 4. These effects result from purchases of goods and services by organisations involved in Gladstone port-related activities and from expenditure by households that receive income from employment in these sectors.

The flow-on effects of the port involved output of \$89 million, value added of \$46 million, household income of \$24 million and 1020 jobs (full-time equivalent) in 1999–2000.

Table 5.2 provides information on the flow-on effects to individual industry sectors. The four sectors most affected by the operation of the port were wholesale and retail trade etc., finance and business services, community

TABLE 5.2 FLOW-ON EFFECTS OF THE PORT OF GLADSTONE BY INDUSTRY SECTOR, 1999–2000

<i>Sector^a</i>	<i>Output (\$m)</i>	<i>Value added (\$m)</i>	<i>Household income (\$m)</i>	<i>Employment (no.)</i>
Wholesale and retail trade, etc.	23.8	13.7	7.8	368
Finance, business services	17.4	9.8	3.4	118
Community services	7.0	5.0	3.9	126
Other transport	8.1	4.8	2.5	99
Recreation, personal services	8.2	3.6	1.7	123
Electricity, gas, water	5.7	2.5	0.6	10
Primary	2.7	1.6	0.4	34
Food manufacturing	4.7	1.1	0.7	25
Construction	2.3	1.1	0.6	39
Public administration	1.9	0.9	0.8	17
Metal products	2.7	0.7	0.3	11
Wood and paper manufacturing	1.3	0.6	0.5	25
Other manufacturing	1.9	0.6	0.3	17
Mining	0.5	0.3	0.1	2
Machinery, appliances, equipment	0.4	0.2	0.1	7
Non-metallic mineral products	0.2	0.1	0.1	1
Total	88.7	46.5	23.7	1 020

a. Individual sectors are ranked by value added.

Note Components may not sum to totals due to rounding.

Source BTE analysis.

services, and other transport activities. These sectors generally accounted for at least 70 per cent of the flow-on effects, the only exception being output (63 per cent).

Total impact

The operation of the Port of Gladstone generated a total impact (direct and flow-on effects) of \$224 million in terms of output in 1999-2000.

Value added attributable to the operation of the port was \$139 million. This was equivalent to 3.0 per cent of gross regional product, which provides a measure of the overall level of economic activity in the Fitzroy region.

Household income generated by the operation of the port totalled \$68 million. Employment involved 1758 jobs (full-time equivalent), which represented 2.3 per cent of total employment in the Fitzroy region.

As noted in chapter 2, there were 933 calls at the Port of Gladstone by commercial cargo vessels in 1999-2000. The results of the study therefore indicate that, on average, each ship call at the Port of Gladstone involved the following impact (direct and flow-on effects) on the Fitzroy region:

- \$240 000 of output;
- \$149 000 of value added;
- \$73 000 of household income;
- 1.9 full-time equivalent jobs for one year.

Taxes and other payments to governments attributable to the operation of the port are estimated at \$34 million in 1999-2000. This is an approximate figure, which covers direct and flow-on activities. It comprises payments to Commonwealth, State and local governments (excluding duties and taxes on imports handled at the Port of Gladstone). The 1999-2000 figure is probably lower than payments in some previous years, as the GPA's income tax equivalent payment in 1999-2000 was nil as a result of a depreciation write-off.

COMPONENTS OF PORT IMPACT

Detailed measures of port impact identify the relative contributions of individual port functions and commodities/cargo types. The proportion for a particular component often varies according to the impact measure being used. This variation reflects differences in factors such as profitability, capital intensity, average income and labour intensity.

Port functions

Table 5.3 provides information on the impact attributable to individual port functions.

Port authority operations had the largest impact. They contributed 49-60 per cent of the direct effects and 51-57 per cent of total impact, with the exact proportion depending on the impact measure. The proportions reflect the scope of the GPA's activities, which incorporate the operation of major bulk cargo terminals as well as traditional strategic port management and landlord activities.

Land transport and storage undertaken by operators other than the GPA generated 12-14 per cent of the direct effects and total impact. The land transport activities include transfers by conveyor, pipeline, rail transport and road transport.

Ship loading and unloading undertaken by operators other than the GPA accounted for 10-12 per cent of the direct effects and 11-13 per cent of total impact. These operators include shippers (eg QAL, Boyne Smelters) and contractors (eg stevedores).

Ship operations generated 12-18 of the direct effects, and 13-17 per cent of total impact. The major activities in this category include towage, ship's agency, ship survey, ship supplies and pilotage.

The other port functions were *cargo services* (3-4 per cent of port impact) and activities of *government agencies* (2-3 per cent of port impact).

TABLE 5.3 ECONOMIC IMPACT OF THE PORT OF GLADSTONE BY FUNCTION, 1999–2000

<i>Function</i>	<i>Output (\$m)</i>	<i>Value added (\$m)</i>	<i>Household income (\$m)</i>	<i>Employment (no.)</i>
Direct effects				
Port authority operations	81	55	23	364
Ship operations	16	12	7	135
Ship loading/unloading	14	9	5	80
Cargo services	4	3	2	40
Land transport and storage	18	13	5	93
Government agencies	2	1	1	26
<i>Total</i>	<i>135</i>	<i>93</i>	<i>44</i>	<i>738</i>
Total impact				
Port authority operations	127	79	35	893
Ship operations	30	19	11	296
Ship loading/unloading	26	16	9	220
Cargo services	7	4	3	70
Land transport and storage	30	19	8	228
Government agencies	4	3	2	51
<i>Total</i>	<i>224</i>	<i>139</i>	<i>68</i>	<i>1 758</i>

Note Components may not sum to totals due to rounding.

Source BTE analysis.

Table 5.4 provides modified impact estimates which exclude the GPA's bulk cargo terminals from the port authority operations category. Activities at the GPA's terminals are reallocated to land transport and storage (60 per cent of these activities) and ship loading and unloading (40 per cent of these activities).

The modified estimates indicate that, in terms of value added, port authority operations (excluding the GPA's bulk cargo terminals) accounted for 19 per cent of total impact. The other changed proportions are 36 per cent for land transport and storage (i.e. including GPA receipt and storage activities) and 26 per cent for ship loading and unloading (i.e. including loading activities at the GPA's terminals).

Commodities/cargo types

Table 5.5 contains information on the impact attributable to individual commodities/cargo types handled at the Port of Gladstone.

Coal accounted for 64-67 per cent of the direct effects and 64-66 per cent of total impact. It comprised 64 per cent of the total tonnage moved through the port in 1999-2000.

Other dry bulk cargoes generated 19-23 per cent of the direct effects and 21-23 per cent of total impact. These cargoes accounted for around 31 per cent of the total tonnage moved through the port in 1999-2000. The lower proportions for port impact partly reflect the use of conveyor systems, which are highly efficient, for short transfers between the wharf and several processing facilities.

Liquid bulk cargoes contributed 6-7 per cent of the direct effects and total impact. These cargoes represented 4 per cent of the total tonnage moved through the port. The higher contribution to port impact probably reflects the inclusion of some road transport activities in the responses of survey respondents.

TABLE 5.4 MODIFIED ESTIMATES OF THE TOTAL IMPACT OF THE PORT OF GLADSTONE BY PORT FUNCTION, 1999-2000

<i>Function</i>	<i>Output (\$m)</i>	<i>Value added (\$m)</i>	<i>Household income (\$m)</i>	<i>Employment (no.)</i>
Port authority operations (excl. GPA bulk cargo terminals)	43	27	12	306
Ship operations	30	19	11	296
Ship loading/unloading (incl. GPA bulk cargo terminals)	60	37	18	457
Cargo services	7	4	3	70
Land transport and storage (incl. GPA bulk cargo terminals)	80	50	22	578
Government agencies	4	3	2	51
<i>Total</i>	<i>224</i>	<i>139</i>	<i>68</i>	<i>1 758</i>

Note Components may not sum to totals due to rounding.

Source BTE analysis.

Containers and other general cargo generally accounted for 6-7 per cent of port impact, although they represented only 1 per cent of total traffic in tonnage terms. The high impact per tonne reflects the relatively resource-intensive nature of the handling arrangements, particularly for aluminium and containers.

INTERPRETING THE RESULTS

The estimates of regional impact indicate the general magnitude of the effects associated with the Port of Gladstone. They do not provide precise estimates, as only approximate data were available for some parts of the analysis.

The results of the study provide estimates of the impact attributable to activities required for the movement of ships and cargoes through the port. They do not include the economic benefits of exports and imports handled at the port, or the impact of industrial activities in the port area that are not involved in the transport of cargo.

It should also be noted that the estimates of regional impact focus on output, value added, income and employment. They do not measure net economic benefits, technical efficiency, competitiveness, trade facilitation effects or the contribution of port infrastructure to regional development.

The results of the study indicate the effects of the port on the Fitzroy region. These effects will generally differ from the net effects on the broader (e.g. national) economy, as there may be reduced activity in other regions from which resources are drawn.

TABLE 5.5 ECONOMIC IMPACT OF THE PORT OF GLADSTONE BY COMMODITY/CARGO TYPE, 1999–2000

<i>Commodity/cargo type</i>	<i>Output (\$m)</i>	<i>Value added (\$m)</i>	<i>Household income (\$m)</i>	<i>Employment (no.)</i>
Direct effects				
Coal	91	63	29	472
Other dry bulk cargoes	27	18	10	167
Liquid bulk cargoes	10	6	3	46
Containers, other general cargo	8	6	3	53
<i>Total</i>	<i>135</i>	<i>93</i>	<i>44</i>	<i>738</i>
Total impact				
Coal	148	92	44	1 122
Other dry bulk cargoes	47	29	15	407
Liquid bulk cargoes	16	9	4	117
Containers, other general cargo	13	9	5	113
<i>Total</i>	<i>224</i>	<i>139</i>	<i>68</i>	<i>1 758</i>

Note Components may not sum to totals due to rounding.

Source BTE analysis.

APPENDIX I SURVEY QUESTIONNAIRE

This appendix contains the version of the questionnaire that was sent to firms whose activities were wholly or primarily Gladstone port-related.

APPENDIX II INPUT-OUTPUT ANALYSIS

This appendix provides an overview of input-output analysis. For more detailed information, see West (1993, 1995, 1999).

ECONOMIC IMPACT

The effects of an economic activity usually extend beyond the initial impact generated by the activity. For example, stevedoring firms purchase inputs such as electricity from local suppliers. The production of these inputs generates additional output, income and employment in the local economy. The suppliers in turn purchase goods and services from other local firms. There are then further rounds of local re-spending as part of the chain of production.

Similarly, households that receive income from employment in stevedoring and related activities spend some of their income on local goods and services. These purchases result in additional local jobs. Some of the household income from these additional jobs is in turn spent on local goods and services, thereby creating further jobs and income for local households. There are then further rounds of income generation as part of the chain of household expenditure.

As a result of these successive rounds of re-spending (i.e. local purchases), the overall impact on the economy exceeds the initial round of output, income and employment generated by stevedoring. However, each successive round of re-spending is smaller than the preceding round, as some of the spending involves goods and services that are produced outside the region. These 'leakages' of expenditure eventually limit the number of rounds of re-spending.

The total impact of a specific economic activity is the sum of the direct effects and the flow-on effects to other sectors of the regional economy. The direct effects involve the initial round of output, income and employment generated by the activity being studied. The flow-on effects are the other activities in the region that are generated by the initial expenditure.

MULTIPLIERS

Multiplier analysis is one approach that can be used to estimate the economic impact of a particular activity.

In broad terms, a multiplier is a ratio that indicates the overall change in the level of activity that results from an initial change in activity. It effectively adds up all of the successive rounds of re-spending, assuming that major factors such as input prices are unchanged and that there are no resource limitations.

INPUT-OUTPUT ANALYSIS

Input-output analysis is a well-established technique for estimating economic impact.

The fundamental component of input-output analysis is the *transactions table*. This table records the production and disposal of goods and services in an economy over one year. A simplified transactions table is presented in table II.1.

The transactions table is constructed as a matrix. It consists of four sub-matrices which cover intermediate usage (flows between industries), final demand (disposition of output into categories of final demand), primary inputs to production, and primary inputs to final demand.

Each row of a transactions table indicates the distribution of an industry's output to other local industries and to final demand. For example, in table II.1, sales of agriculture's products involve \$5 million for its own use, \$112 million to manufacturing, \$1 million to services, and \$168 million to final demand.

Each column shows the amounts of inputs purchased from other industries and the amounts of primary inputs that are purchased. In table II.1, agriculture purchases \$5 million of its own output, \$19 million from manufacturing, \$16 million from service industries and \$246 million of primary inputs.

TABLE II.1 SIMPLIFIED INPUT-OUTPUT TRANSACTIONS TABLE
(\$ million)

<div style="display: inline-block; transform: rotate(-45deg);"> <i>Outputs</i> <i>Inputs</i> </div>	<i>Agr</i>	<i>Min</i>	<i>Man</i>	<i>Ser</i>	<i>Household consumption</i>	<i>Other final demand^p</i>	<i>Total output</i>
Agriculture	5	-	112	1	46	122	286
Mining	-	4	74	1	-	40	119
Manufacturing	19	10	1 395	622	1 116	2 497	5 659
Services	16	10	689	1 026	3 036	2 183	6 960
Wages & salaries	120	52	999	3 161	-	-	4 332
Other value added and imports ^a	126	43	2 390	2 149	1 456	182	6 346
Total inputs	286	119	5 659	6 960	5 654	5 024	23 702

a. Interest, depreciation, taxes, profits and imports.

b. Government expenditure, investment and exports.

Source Morison and Jensen (1987, p. 20).

There are two other important tables in the input-output system. The *table of direct requirements coefficients* is calculated from the transactions table by dividing each column entry by the associated column total. The *table of total requirements coefficients* (sometimes called the table of interdependence coefficients) is calculated by obtaining the inverse matrix, of the identity matrix² minus the direct requirements coefficients matrix. This inverse matrix can be used to calculate the multipliers for economic impact studies.

LIMITATIONS OF INPUT-OUTPUT ANALYSIS

Input-output analysis incorporates various assumptions which potentially affect the rigour of the results (Butler and Mandeville 1981, pp. 109-110; West 1993, pp. 2.19-2.20). It provides a static analysis which assumes that input requirements are directly proportional to output (the linearity assumption) and that relative prices are fixed. It does not incorporate:

- supply-side constraints (e.g. labour or foreign exchange shortages);
- economies or diseconomies of scale;
- substitution between inputs;
- synergistic effects;
- external economies or diseconomies; or
- changes in technology.

The impact of these assumptions depends on the activity and the region being analysed. Input-output analysis is most suitable for analysing small regional economies which can readily draw resources from other regions without affecting relative prices. Similarly, Mills and Morison (1993, p. 27) noted that the linearity assumption did not pose a significant problem in their Sydney Ports study as port-related activity was a long-established, permanent and integrated part of the regional economy.

Input-output analysis does not indicate whether a particular activity should be undertaken, given the potential benefits from alternative uses of the resources. In addition, it does not measure technical efficiency (resources required per unit of output), the competitiveness of an activity, trade facilitation effects or the contribution of infrastructure services to regional development.

It should also be noted that a regional impact study will not indicate net effects on the broader (e.g. national) economy. Impact in the region being studied may be offset by reduced activity in other regions from which resources are drawn.

² The identity matrix is a square matrix, with 1's as elements on the diagonal and 0's as the off-diagonal elements.

APPENDIX III INPUT-OUTPUT SECTOR DEFINITIONS

<i>Fitzroy region industry sectors</i>	<i>Corresponding Queensland input-output table sectors</i>
1. Primary	0101 Sheep 0102 Grains 0103 Beef cattle 0104 Dairy cattle 0105 Pigs 0106 Poultry 0107 Other agriculture 0200 Services to agriculture; hunting and trapping 0300 Forestry and logging 0400 Commercial fishing
2. Mining	1100 Coal; oil and gas 1301 Iron ores 1302 Non-ferrous metal ores 1400 Other mining 1500 Services to mining
3. Food manufacturing	2101 Meat and meat products 2102 Dairy products 2103 Fruit and vegetable products 2104 Oils and fats 2105 Flour mill products and cereal foods 2106 Bakery products 2107 Confectionery 2108 Other food products 2109 Soft drinks, cordials and syrups 2110 Beer and malt 2111 Wine and spirits 2112 Tobacco products
4. Wood and paper manufacturing	2301 Sawmill products 2302 Plywood, veneer and fabricated wood 2303 Other wood products 2304 Pulp, paper and paperboard 2305 Paperboard containers; paper bags and sacks 2306 Other paper products 2401 Printing and services to printing 2402 Publishing; recorded media and publishing

<i>Fitzroy region industry sectors</i>	<i>Corresponding Queensland input-output table sectors</i>	
5. Machinery, appliances, equipment	2801	Motor vehicles and parts; other transport equipment
	2802	Ships and boats
	2803	Railway equipment
	2804	Aircraft
	2805	Photographic and scientific equipment
	2806	Electronic equipment
	2807	Household appliances
	2808	Other electrical equipment
	2809	Agricultural machinery
	2810	Mining and construction machinery; lifting and material handling equipment
	2811	Other machinery and equipment
6. Metal products	2701	Iron and steel
	2702	Basic non-ferrous metal and products
	2703	Structural metal products
	2704	Sheet metal products
	2705	Fabricated metal products
7. Non-metallic mineral products	2601	Glass and glass products
	2602	Ceramic products
	2603	Cement and lime
	2604	Concrete slurry
	2605	Plaster and other concrete products
	2606	Other non-metallic mineral products
8. Other manufacturing	2201	Wool scouring
	2202	Textile fibres, yarns and woven fabrics
	2203	Textile products
	2204	Knitting mill products
	2205	Clothing
	2206	Footwear
	2207	Leather and leather products
	2501	Petroleum and coal products
	2502	Fertilisers
	2503	Other basic chemicals
	2504	Paints
	2505	Medicinal and pharmaceutical products; pesticides
	2506	Soap and other detergents
	2507	Cosmetics and toiletry preparations
	2508	Other chemical products
	2509	Rubber products
	2510	Plastic products
	2901	Prefabricated buildings
	2902	Furniture
	2903	Other manufacturing

<i>Fitzroy region industry sectors</i>	<i>Corresponding Queensland input-output table sectors</i>	
9. Electricity, gas, water	3601	Electricity supply
	3602	Gas supply
	3701	Water supply; sewerage and drainage services
10. Construction	4101	Residential building construction
	4102	Other construction
11. Wholesale and retail trade, etc.	4501	Wholesale trade
	5101	Retail trade
	5401	Mechanical repairs
	5402	Other repairs
12. Transport (excl. port)	6101	Road transport
	6201	Rail, pipeline and other transport
	6301	Water transport
	6401	Air and space transport
	6601	Services to transport; storage
	7101	Communication services
13. Port		This sector is a composite of parts of a number of other sectors including 6601, 6101 and 6201.
14. Finance, business services	7301	Banking
	7302	Non-bank finance
	7303	Financial asset investors
	7401	Insurance
	7501	Services to finance, investment and insurance
	7701	Ownership of dwellings
	7702	Other property services
	7801	Scientific research, technical and computer services
	7802	Legal, accounting, marketing and business management services
	7803	Other business services
15. Public administration	8101	Government administration
	8201	Defence
16. Community services	8401	Education
	8601	Health services
	8701	Community services
17. Recreation, personal services	5701	Accommodation, cafes and restaurants
	9101	Motion picture, radio and television services
	9201	Libraries, museums and the arts
	9301	Sport, gambling and recreational services
	9501	Personal services
	9601	Other services

APPENDIX IV DISAGGREGATED MULTIPLIERS

TABLE IV.1 DISAGGREGATED OUTPUT MULTIPLIERS

<i>Sector^a</i>	<i>Initial</i>	<i>First^b</i>	<i>Indust.^b</i>	<i>Total</i>	<i>(%)</i>	<i>Consumption</i>	<i>Total</i>	<i>(%)</i>
Primary	0.00	0.00	0.00	0.00	0.07	0.02	0.02	1.20
Mining	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.21
Food manufacturing	0.00	0.00	0.00	0.00	0.07	0.03	0.03	2.10
Wood and paper manufacturing	0.00	0.00	0.00	0.00	0.13	0.01	0.01	0.57
Machinery, appliances, equipment	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.19
Metal products	0.00	0.01	0.01	0.01	0.98	0.01	0.02	1.20
Non-metallic mineral products	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.08
Other manufacturing	0.00	0.01	0.00	0.01	0.89	0.00	0.01	0.86
Electricity, gas, water	0.00	0.02	0.01	0.02	1.94	0.02	0.04	2.55
Construction	0.00	0.02	0.00	0.02	1.26	0.00	0.02	1.01
Wholesale and retail trade, etc.	0.00	0.06	0.01	0.07	6.06	0.10	0.18	10.61
Other transport	0.00	0.04	0.01	0.05	3.71	0.01	0.06	3.63
Port	1.00	0.00	0.00	1.00	80.99	0.00	1.00	60.41
Finance, business services	0.00	0.01	0.02	0.03	2.45	0.10	0.13	7.74
Public administration	0.00	0.00	0.01	0.01	0.44	0.01	0.01	0.83
Community services	0.00	0.00	0.00	0.00	0.28	0.05	0.05	3.14
Recreation, personal services	0.00	0.00	0.00	0.01	0.43	0.06	0.06	3.67
Total	1.00	0.17	0.07	1.23	100.00	0.42	1.66	100.00

a. Sector definitions are given in appendix III.

b. First-round + industrial-support effects = production-induced effects.

Note Components may not sum to totals due to rounding.

Type I Multiplier 1.23

Type II Multiplier 1.66

Source BTE analysis.

TABLE IV.2 DISAGGREGATED VALUE ADDED MULTIPLIERS

<i>Sector^a</i>	<i>Initial</i>	<i>First^b</i>	<i>Indust.^b</i>	<i>Total</i>	<i>(%)</i>	<i>Consumption</i>	<i>Total</i>	<i>(%)</i>
Primary	0.00	0.00	0.00	0.00	0.06	0.01	0.01	1.18
Mining	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.22
Food manufacturing	0.00	0.00	0.00	0.00	0.03	0.01	0.01	0.79
Wood and paper manufacturing	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.45
Machinery, appliances, equipment	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.11
Metal products	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.47
Non-metallic mineral products	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.05
Other manufacturing	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.45
Electricity, gas, water	0.00	0.01	0.00	0.01	1.31	0.01	0.02	1.82
Construction	0.00	0.01	0.00	0.01	0.89	0.00	0.01	0.75
Wholesale and retail trade, etc.	0.00	0.04	0.01	0.04	5.34	0.06	0.10	9.83
Other transport	0.00	0.02	0.00	0.03	3.34	0.01	0.04	3.45
Port	0.68	0.00	0.00	0.68	84.84	0.00	0.68	66.61
Finance, business services	0.00	0.01	0.01	0.02	2.12	0.06	0.07	7.04
Public administration	0.00	0.00	0.00	0.00	0.33	0.00	0.01	0.65
Community services	0.00	0.00	0.00	0.00	0.30	0.03	0.04	3.56
Recreation, personal services	0.00	0.00	0.00	0.00	0.29	0.02	0.03	2.56
Total	0.68	0.09	0.03	0.81	100.00	0.22	1.03	100.00

a. Sector definitions are given in appendix III.

b. First-round + industrial-support effects = production-induced effects.

Note Components may not sum to totals due to rounding.

Type I Multiplier 1.19

Type II Multiplier 1.51

Source BTE analysis.

TABLE IV.3 DISAGGREGATED INCOME MULTIPLIERS

<i>Sector^a</i>	<i>Initial</i>	<i>First^b</i>	<i>Indust.^b</i>	<i>Total</i>	<i>(%)</i>	<i>Consumption</i>	<i>Total</i>	<i>(%)</i>
Primary	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.58
Mining	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.16
Food manufacturing	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.96
Wood and paper manufacturing	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.69
Machinery, appliances, equipment	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.17
Metal products	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.45
Non-metallic mineral products	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.07
Other manufacturing	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.44
Electricity, gas, water	0.00	0.00	0.00	0.00	0.62	0.00	0.00	0.85
Construction	0.00	0.00	0.00	0.00	1.11	0.00	0.00	0.92
Wholesale and retail trade, etc.	0.00	0.02	0.00	0.02	6.37	0.03	0.06	11.55
Other transport	0.00	0.01	0.00	0.01	3.67	0.00	0.02	3.73
Port	0.32	0.00	0.00	0.32	84.05	0.00	0.32	64.95
Finance, business services	0.00	0.00	0.00	0.01	1.55	0.02	0.03	5.06
Public administration	0.00	0.00	0.00	0.00	0.60	0.00	0.01	1.16
Community services	0.00	0.00	0.00	0.00	0.50	0.03	0.03	5.76
Recreation, personal services	0.00	0.00	0.00	0.00	0.28	0.01	0.01	2.51
Total	0.32	0.04	0.02	0.39	100.00	0.11	0.50	100.00

a. Sector definitions are given in appendix III.

b. First-round + industrial-support effects = production-induced effects.

Note Components may not sum to totals due to rounding.

Type I Multiplier 1.22

Type II Multiplier 1.56

Source BTE analysis.

TABLE IV.4 DISAGGREGATED EMPLOYMENT MULTIPLIERS^a

<i>Sector^b</i>	<i>Initial</i>	<i>First^c</i>	<i>Indust.^c</i>	<i>Total</i>	<i>(%)</i>	<i>Consumption</i>	<i>Total</i>	<i>(%)</i>
Primary	0.00	0.00	0.01	0.01	0.13	0.24	0.25	1.93
Mining	0.00	0.00	0.01	0.01	0.08	0.00	0.01	0.09
Food manufacturing	0.00	0.00	0.00	0.00	0.06	0.18	0.18	1.40
Wood and paper manufacturing	0.00	0.02	0.01	0.03	0.38	0.15	0.18	1.41
Machinery, appliances, equipment	0.00	0.02	0.00	0.02	0.25	0.03	0.05	0.37
Metal products	0.00	0.02	0.03	0.05	0.60	0.03	0.08	0.62
Non-metallic mineral products	0.00	0.00	0.00	0.00	0.04	0.01	0.01	0.07
Other manufacturing	0.00	0.10	0.00	0.10	1.23	0.03	0.13	0.99
Electricity, gas, water	0.00	0.03	0.01	0.04	0.53	0.03	0.08	0.59
Construction	0.00	0.26	0.01	0.27	3.34	0.02	0.29	2.23
Wholesale and retail trade, etc.	0.00	0.97	0.19	1.16	14.33	1.56	2.72	20.95
Other transport	0.00	0.45	0.10	0.55	6.85	0.17	0.73	5.60
Port	5.44	0.00	0.00	5.44	67.30	0.00	5.44	41.96
Finance, business services	0.00	0.10	0.10	0.20	2.53	0.66	0.87	6.68
Public administration	0.00	0.00	0.05	0.05	0.60	0.07	0.12	0.95
Community services	0.00	0.01	0.05	0.06	0.77	0.87	0.93	7.18
Recreation, personal services	0.00	0.02	0.06	0.08	0.98	0.83	0.91	6.99
Total	5.44	2.00	0.64	8.09	100.00	4.89	12.98	100.00

a. Jobs per million dollars.

b. Sector definitions are given in appendix III.

c. First-round + industrial-support effects = production-induced effects.

Note Components may not sum to totals due to rounding.

Type I Multiplier 1.49

Type II Multiplier 2.38

Source BTE analysis.

GLOSSARY

Direct effects	Initial round of output, value added, income and employment generated by port-related activities.
Economic impact	Output, value added, income and employment attributable to activities required for the movement of ships, cargoes and passengers through the port.
Employment	Number of working proprietors, managers, directors and other employees (in terms of the number of full-time equivalent jobs).
Flow-on effects	Sum of the indirect effects and the induced effects.
Household income	Wages, salaries and other payments to labour (including overtime payments and income tax, but excluding payroll tax).
Indirect effects	Additional output, value added, income and employment resulting from re-spending by firms that receive income from the sale of goods and services to firms undertaking port-related activities.
Induced effects	Additional output, value added, income and employment resulting from re-spending by households that receive income from employment in direct and indirect activities.
Input-output analysis	Analysis based on a set of tables that quantify the linkages and transactions between different sectors of the economy.
Multiplier	An index (ratio) indicating the overall change in the level of activity that results from an initial change in economic activity.

Output	Gross revenue of goods and services produced by commercial organisations plus gross expenditure of non-commercial organisations.
Port industry	All activities that are required for the movement of ships and their cargoes and passengers through a port. Excludes naval ships, fishing vessels, recreational boating activities, and other users of the port.
Port-related activities	Activities that comprise the port industry.
Region	The geographic area for which the flow-on effects and total impact of a port are estimated.
Total impact	The sum of the direct effects and the flow-on effects.
Type I multiplier	$(\text{direct effects} + \text{indirect effects}) / \text{direct effects}$.
Type II multiplier	$(\text{direct effects} + \text{indirect effects} + \text{induced effects}) / \text{direct effects}$.
Value added	Payments to the primary inputs of production (labour, capital, land). Equal to gross revenue less the cost of intermediate inputs into production and imported goods and services.

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ABBREVIATIONS

AAPMA	Association of Australian Ports and Marine Authorities
ABS	Australian Bureau of Statistics
AMSA	Australian Maritime Safety Authority
AQIS	Australian Quarantine and Inspection Service
BTE	Bureau of Transport Economics
DWT	Deadweight tonnes
GPA	Gladstone Port Authority
OESR	Office of Economic and Statistical Research
QAL	Queensland Alumina Limited
RUERU	Regional and Urban Economics Research Unit

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