Central North NSW Transport Alternatives

Report

In March 1982 the Northern Transport Study Committee presented a submission to the Bureau of Transport Economics (BTE) on the inadequacies of the transport system serving the Gwydir and Macintyre River Valleys, commonly referred to as the north-west slopes and plains area of New South Wales. Subsequently, in response to a Ministerial reference the BTE undertook this study in which the economic and financial implications of a range of transport alternatives for this region are examined.

Central North NSW Transport Alternatives

ISBN 0 644 03392 4

Printed in Australia by Canberra Publishing and Printing Co.

FOREWORD

In March 1982 the Northern Transport Study Committee presented a submission to the Bureau of Transport Economics (BTE) on the inadequacies of the transport system serving the Gwydir and Macintyre River Valleys, commonly referred to as the north-west slopes and plains area of New South Wales. Subsequently, in response to a Ministerial reference the BTE undertook this study in which the economic and financial implications of a range of transport alternatives for this region are examined.

Estimates of the road transport task to and from the region were established by direct enquiries by the BTE to private firms located in and around the region, local government authorities, primary producer associations, statutory organisations such as the Australian Wheat Board, Queensland State Wheat Board, Grain Handling Authority of New South Wales and coarse grain and oilseed marketing authorities. Rail freight data were supplied by the State Rail Authority of New South Wales and Queensland Railways. The BTE wishes to express its appreciation for the assistance given by all those contacted in the course of this study.

The study was carried out by staff in the Economic Assessment Branch of the BTE. The study team consisted of D. Short and M. Kennedy. The probabilistic cost benefit analysis contained in the Report was undertaken by M. Poole.

G.K.R. REID
Director

Bureau of Transport Economics
Canberra
May 1984

CONTENTS

TABLES

FIGURES

MAPS

CHAPTER 1—SCOPE AND PURPOSE OF THE REPORT

This Report was prepared in response to a Ministerial direction to the Bureau in March 1982 to examine transport alternatives for the north-west slopes and plains area of New South Wales. The Terms of Reference for the study are contained in Appendix 1. The Terms of Reference specifically refer to the concerns expressed by primary producers in the area, and to a submission on transport alternatives prepared by the MacIntyre Valley Transport Study Group.

STUDY ORIGINS

The MacIntyre Valley Transport Study Group is a small group of interested citizens who have put considerable effort into identifying potential improvements to the transport system serving this area. This group, together with representatives of the Shire Councils serving the region, formed the Northern Transport Study Committee which in March 1982 compiled 'A Submission on the Inadequate Transport System to the Gwydir and MacIntyre River Valleys'.

The Committee's Submission portrayed the present public transport (namely rail) system serving the region as costly and inadequate. In particular the Committee considered that grain growers and others in the region were financially disadvantaged due to relatively high transport costs resulting from the greater than Australian average rail distance to seaboard terminals.

The Committee placed considerable emphasis on actual and potential bottlenecks stemming from congestion, inefficiency and industrial disputes at the Port of Newcastle. A further concern arose from the increasing demand for rail services into Newcastle resulting from the rapid growth in the extraction of coal resources south of the study region, and industrial developments in the Hunter Valley. The Committee expressed the view that in the future, increased grain shipments from northern New South Wales 'will be hard put to find a place in the queue at the Port of Newcastle, where it will be in direct competition with coal shipments and the input and throughput of the heavy industry of the Hunter Valley Ruhr'. Concern was also expressed about the reduction in rail services for general freight in the study area, especially over the Moree to Inverell line.

A concurrent BTE study entitled 'Evaluation of Standard Gauge Rail Connections to Selected Ports' examines a number of investment options for standard gauge rail links to the Ports of Brisbane, Melbourne and Geelong. It includes an assessment of a standard gauge line from Tocumwal (on the Victoria-New South Wales Border) to Managlore (on the Albury-Melbourne mainline) which if built would provide a major alternative outlet for grain producers in southern New South Wales to deliver to Victorian ports. Hence there is a significant common thread in these two BTE Reports in that both examine in some detail transport options for the interstate movement of grain from New South Wales.

STRUCTURE OF THE REPORT

Chapter 2 provides a background to the Report with a description of the study region. The boundaries of the region are defined, and population trends and the nature and extent of major economic activities are examined.

The basic requirements for transport infrastructure to service the region are examined in Chapter 3. This embraces the estimated and projected freight flows to and from the study region. In addition, the transport and bulk grain storage facilities servicing the region, as well as the physical and institutional constraints affecting freight flows, are described.

The results of both financial and economic assessments of a range of transport alternatives for the study region are presented in Chapter 4. The transport options for the movement of freight include the use of rail or road transport, or a combination of these modes of transport, and also the use of a conveyor belt to tranship grain from bulk storage facilities in the study region to a Queensland railroad.

Chapter 5 contains concluding remarks on the implications of the study findings, and also on the possible need to reassess some of the transport options considered in the light of future developments such as the opening of new coal mines.

CHAPTER 2—CENTRAL NORTH NEW SOUTH WALES

This chapter describes the economic characteristics of the region which has been loosely defined for the purpose of this study as central north New South Wales. Trends in population and the nature and level of major economic activities are examined to indicate movements in the demand for transport services. Grain production is the dominant economic activity in the area, but the large coal reserves in and around the region may significantly affect future activity.

STUDY REGION

To facilitate the collection of data, the study region has been defined in terms of the Local Government Areas of Moree Plains, Inverell, Yallaroi, Bingara and Barraba. The region extends over 3.8 million hectares of the north-west slopes and plains area immediately south of the New South Wales and Queensland border. Map 2.1 shows the five Local Government Areas and the Northern Statistical Division in relation to the study region.

POPULATION TRENDS

The population of the study region over the five years to June 1981 increased slightly from 40 451 to 42 014. However, as Table 2.1 shows, intra-regional growth rates differed markedly over the period. The population in the Moree Shire, located in the west of the region, increased at an average annual rate of 2.3 per cent compared with 0.2 per cent in the Inverell Shire, in the east of the region. The population in the central and southern parts of the region remained relatively stable or declined slightly over the period. The growth in the study region's population at 0.8 per cent per annum was less than that in the New South Wales population which increased by 1.2 per cent per annum over the five years to June 1981.

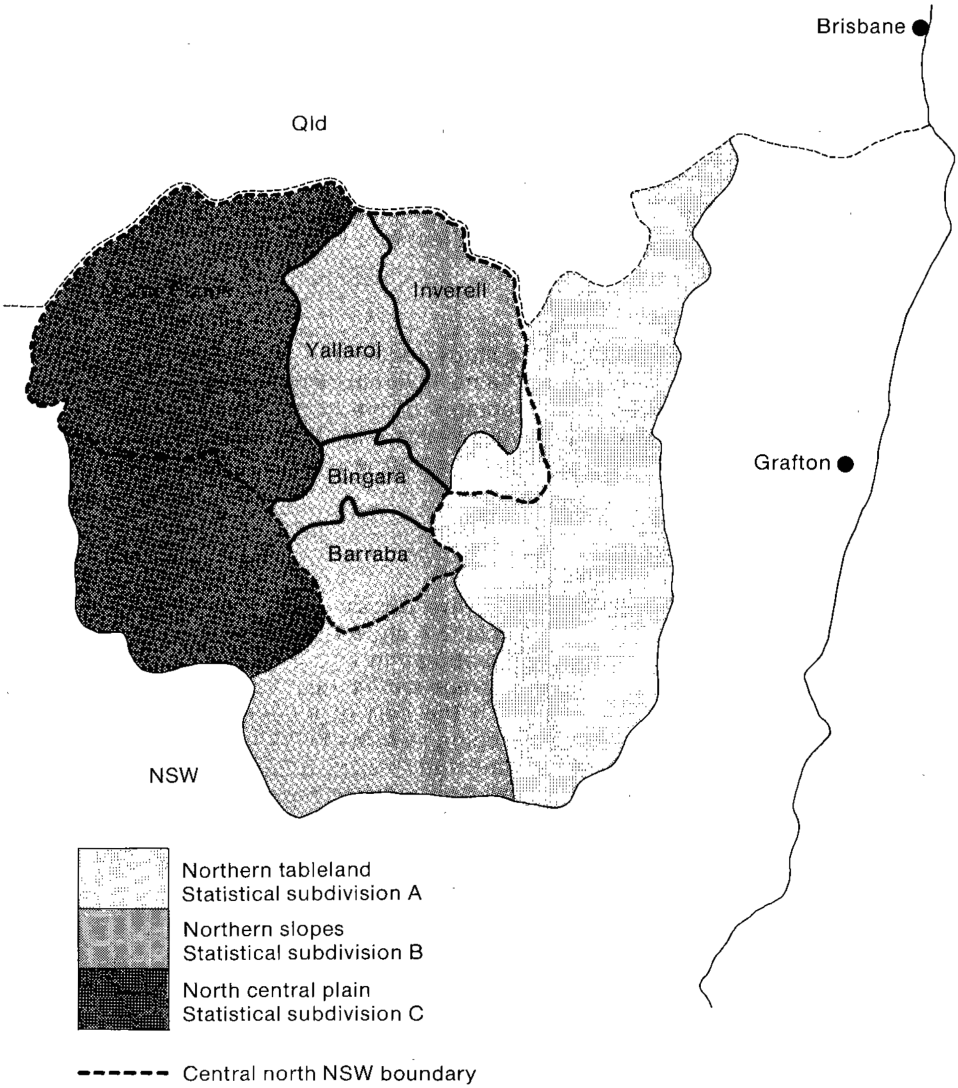
TABLE 2.1—POPULATION OF STUDY REGION BY LGA, 1976 AND 1981

LGA	*1976* Population	*1976* Per cent of study region	*1981* Population	*1981* Per cent of study region	*Average annual rate of growth 1976–81 (per cent)*
Inverell[a]	15 448	38	15 641	37	0.2
Moree Plains[b]	15 411	38	17 229	41	2.3
Barraba	3 246	8	2 933	7	–2.0
Bingara	2 245	6	2 264	5	0.2
Yallaroi	4 101	10	3 947	9	–0.8
Total	40 451	100	42 014	100	0.8

a. On 1.7.79 the Ashford, MacIntyre and Inverell Shires and Inverell Municipality were amalgamated to form the Inverell Shire.

b. On 1.1.81 the Boolooroo and Boomi Shires and the Moree Municipality were amalgamated to form the Moree Plains Shire.

Source: Australian Bureau of Statistics. (1977 and 1981a).



Map 2.1—Central north NSW by statistical division and local government area

The main population centres in the region at 30 June 1981 were Moree (10 459), Inverell (9734), Boggabilla (528) and Barraba (1679).

ECONOMIC ACTIVITY

The economic base of the study region is predominantly primary production, dominated by wheat, coarse grain, oilseed, cotton, wool and livestock production. Other primary production in the region includes forestry, saw-milling and pecan nuts.

An export abattoir specialising in beef processing is located at Inverell. Vegetable oil production is undertaken at a crushing plant in Moree. A cotton gin is located at Ashley, north-west of Moree. The electricity generating plant at Ashford in the north-east corner of the region obtains supplies of coal from the local coal mine. In the southern section of the region near Barraba asbestos mining operations are undertaken.

Table 2.2 shows grain, oilseed and cotton production in the study region and in New South Wales over the six year period to 1981-82. Production of wheat, the major grain produced in the region, constituted 10 per cent of the New South Wales wheat harvest, averaging nearly 700 000 tonnes per annum over the six year period. This share varied from under 5 per cent in 1981-82 to over 17 per cent in 1977-78. Average annual production of coarse grain over the six years was in excess of 130 000 tonnes and comprised over 6 per cent of coarse grain production in New South Wales.

Grain production was well below average in 1980-81 and again in 1982-83[1] reflecting adverse climatic conditions. Wheat production fell to 155 000 tonnes in 1980-81 after averaging over 800 000 tonnes per annum in the previous four years. The seasonal variation in wheat production is indicated by its standard deviation[2] which approximated 40 per cent of the average annual production over the six years to 1981-82.

Forecasts by various industry and government sources provide different estimates for future growth in grain production. From these sources it appears that for New South Wales the most likely long term rate of increase in production would be about 2 per.cent per annum.

Significant growth occured in both oilseed and cotton production in the study region over the six years to 1981-82. Oilseed production increased sixfold from 10 000 to 61 000 tonnes. In 1980-81 nearly 40 per cent of oilseed production in New South Wales was produced in the region. Cotton production increased from 2000 tonnes in 1976-77 to 90 000 tonnes in 1981-82. In 1980-81, cotton production in the region contributed nearly 45 per cent of the cotton crop in New South Wales.

The medium term outlook for oilseed is that Australian production could increase by at least 10 per cent per annum given sufficient economic incentive and normal seasonal conditions (BAE 1983a). Similarly for cotton, total Australian production could increase by up to 50 per cent by 1990 (BAE 1983b).

Table 2.3 shows livestock numbers and wool production in the study region from 1976-77 to 1981-82. Cattle, sheep and wool production represented 7.1, 4.3 and 3.7 per cent of New South Wales production respectively, over the six year period.

The Australian cattle herd is expected to decline from 24.5 million head in 1982 to 22.2 million head in 1984, and remain at about this level up to 1987 (BAE 1983c).

---

1. Preliminary figures from the Grain Handling Authority of NSW indicate that wheat production in the study area for the 1982-83 season will only be about 50 per cent of the past six year average of 689 000 tonnes.

2. Standard deviation is a measure of the absolute dispersion of the observations, in this case annual wheat production, around the average production for the period under consideration.

TABLE 2.2—GRAIN, OILSEED AND COTTON PRODUCTION IN STUDY REGION AND NEW SOUTH WALES, 1976-77 TO 1981-82

Year	Wheat			Coarse grains[a]			Other grains[b]			Oilseed[c d]			Cotton		
	Study region	NSW	SR/NSW	Study region	NSW	SR/NSW	Study region	NSW	SR/NSW	Study region	NSW	SR/NSW	Study region	NSW	SR/NSW
	('000 tonnes)		(per cent)	('000 tonnes)		(per cent)	('000 tonnes)		(per cent)	('000 tonnes)		(per cent)	('000 tonnes)		(per cent)
1976-77	869	5 141	16.9	122	1 286	9.5	1	5	20.0	10	73	13.7	2	61	3.3
1977-78	662	3 846	17.2	103	938	11.0	2	8	25.0	27	128	21.1	3	101	3.0
1978-79	996	6 640	15.0	181	1 733	10.4	3	16	18.8	31	165	18.8	8	116	6.9
1979-80	747	6 000	12.5	95	1 402	6.8	8	28	28.6	46	209	22.0	24	188	12.8
1980-81	155	2 865	5.4	78	916	8.5	2	17	11.8	52	133	39.1	75	173	43.4
1981-82	707	16 360	4.3	216	6 596	3.3	13	na	na	61	231	26.4	90	na	na
Total production	4 136	40 852	10.1	795	12 871	6.2	29	na	na	227	939	24.2	202	na	na
Average production	689.3	6 808.7	10.1	132.5	2 145.2	6.2	4.8	na	na	37.8	156.5	24.2	33.7	na	na
Standard deviation	288.5	4 879.0	..	54.2	2 201.7	..	4.7	na	..	18.7	57.8	..	38.9	na	..

a. Barley, sorghum, maize, oats.
b. Rye, buckwheat, canary seed, millet, triticale.
c. Rapeseed, sunflower, safflower, linseed, soyabeans, cotton seed.
d. Cotton seed estimated on the basis of 50 per cent of cotton production.

SR Study region
na not available
.. not applicable

Sources: Australian Bureau of Statistics (1978-1982a), personal communications with ABS Canberra and Sydney offices

TABLE 2.3—LIVESTOCK NUMBERS AND WOOL PRODUCTION IN STUDY REGION AND NEW SOUTH WALES, 1976-77 TO 1981-82[a]

Year	*Cattle and calves*			*Sheep and lambs*			*Wool*[b]		
	Study region	*NSW*	*SR/NSW*	*Study region*	*NSW*	*SR/NSW*	*Study region*	*NSW*	*SR/NSW*
	('000)		*(per cent)*	*('000)*		*(per cent)*	*(tonnes)*		*(per cent)*
1976-77	581	8 350	7.0	2 230	49 700	4.5	8 752	232 883	3.8
1977-78	545	7 372	7.4	2 000	48 000	4.2	7 904	230 991	3.4
1978-79	488	6 477	7.5	2 143	48 400	4.4	9 063	239 649	3.8
1979-80	446	6 099	7.3	2 111	48 600	4.3	8 706	232 476	3.7
1980-81	360	5 459	6.6	1 917	46 000	4.2	7 896	220 609	3.6
1981-82	356	5 429	6.6	2 040	48 700	4.2	8 562	235 000	3.6
Total production	2 776	39 186	7.1	12 441	289 400	4.3	50 883	1 391 608	3.7
Average production	462.7	6 531	7.1	2 073.5	48 233.3	4.3	8 480	231 934.6	3.7
Standard deviation	93.4	1146	..	111.1	1 230.7	..	478	6 312.9	..

a. Year ending 31 March.
b. Comprising shorn wool, dead and fellmongrl wool and wool exported on skins.

SR Study region
.. not applicable

Sources: Australian Bureau of Statistics (1978-1982b), (1978-1982c).

The sheep flock on the other hand, is expected to increase at a rate of 2 to 3 per cent per annum between 1983 and 1987 (BAE 1983c).

COAL PRODUCTION

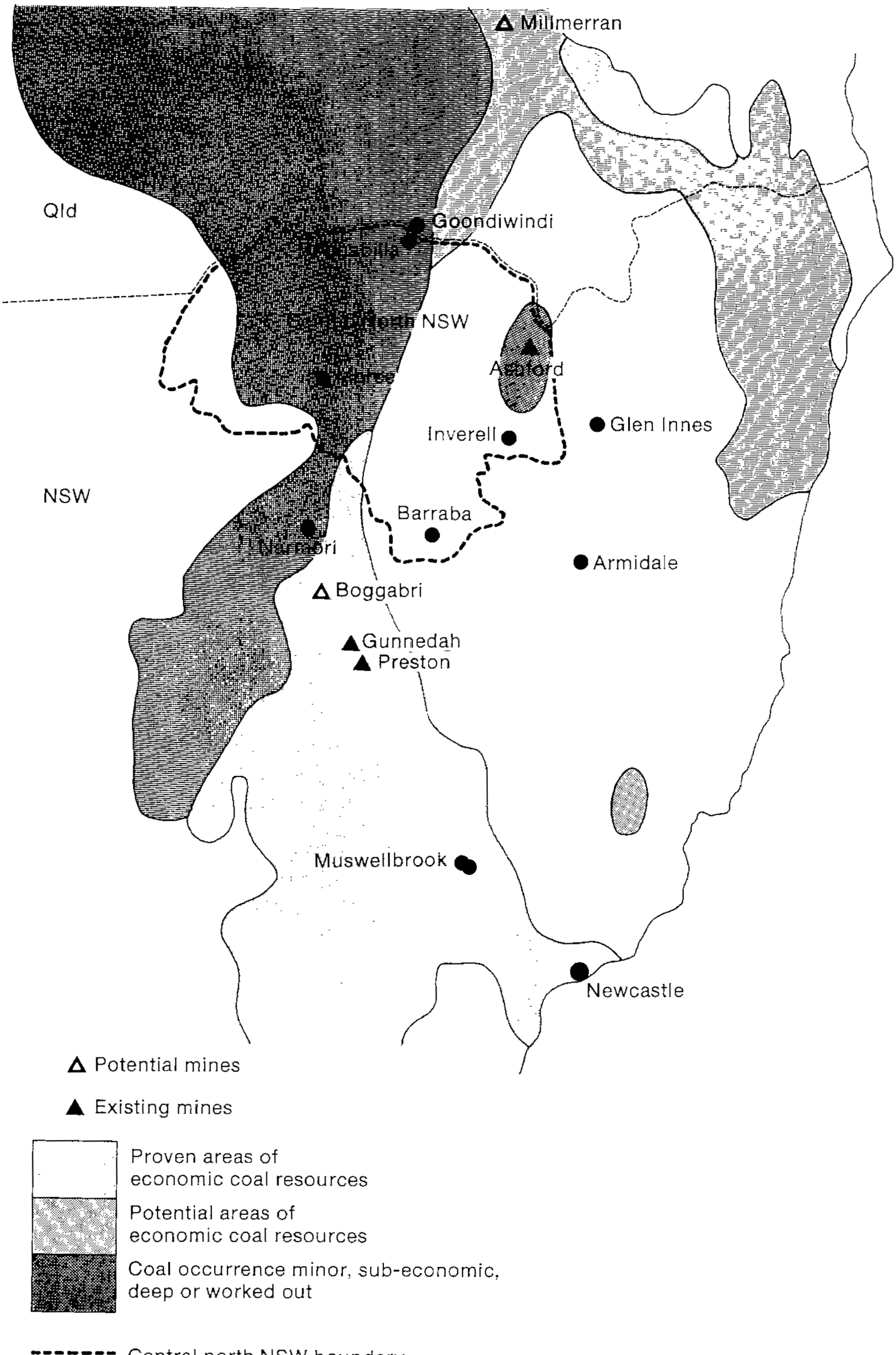
A major factor in investment in transport infrastructure in recent years, particularly in railways, has been the exploitation of national coal resources. Map 2.2 shows coal resources in and around the study region.

Except for a relatively small coal mining operation at Ashford, the coal resources in the study region are subeconomic under current market conditions.

The major area of proven economic coal resources lies to the south of the region. Production around the Gunnedah and Preston mines in 1983 was over 700 000 tonnes[1] and a recent prediction for coal production in this seam, between Muswellbrook and Gunnedah, suggests that production could increase at an average annual rate of 15 to 16 per cent (Coal Resources Development Commission, 1981). However, this increase in the extraction rate will depend heavily on international demand for coal. Coal extracted from this seam and sold on the export market is transported to the Port of Newcastle by the State Rail Authority of New South Wales.

The coal seam extending from Millmerran to Goondiwindi in Queensland, north of the study region, is not expected to be exploited under present market conditions as the quality of the coal is inferior to that presently being exported[1].

1. Bureau of Mineral Resources, personal communication.



Map 2.2—Coal resources in and around central north New South Wales

CHAPTER 3—FREIGHT TRANSPORT TASK

This chapter outlines the existing transport and bulk grain handling infrastructure servicing the region and the physical and institutional constraints affecting traffic flows. This is followed by a description of the estimated freight flows to and from the study region, and projections of the likely growth in the traffic task.

ROAD NETWORK

Map 3.1 shows the major road network servicing the study region. The region is traversed by two State highways, the Bruxner and Gwydir Highways, connecting the area with eastern and coastal centres. The major routes connecting the region with southern regional centres are the Newell Highway, passing through Moree, and the trunk road extending from Yetman in the north, through Barraba in the south of the region to Tamworth located on the New England Highway. The main route used by the road transport industry servicing the area to and from Brisbane is via the Cunningham Highway, either through Goondiwindi to Moree or via Texas and Ashford to Inverell.

The Newell and Cunningham Highways have become a major route for interstate trade. Traffic from southern and central Queensland pass through the study region using this route for southern destinations. Conversely, trade originating outside the study area in New South Wales, as well as in the States of Victoria and South Australia, ply this route to Queensland destinations.

RAILWAY SERVICES

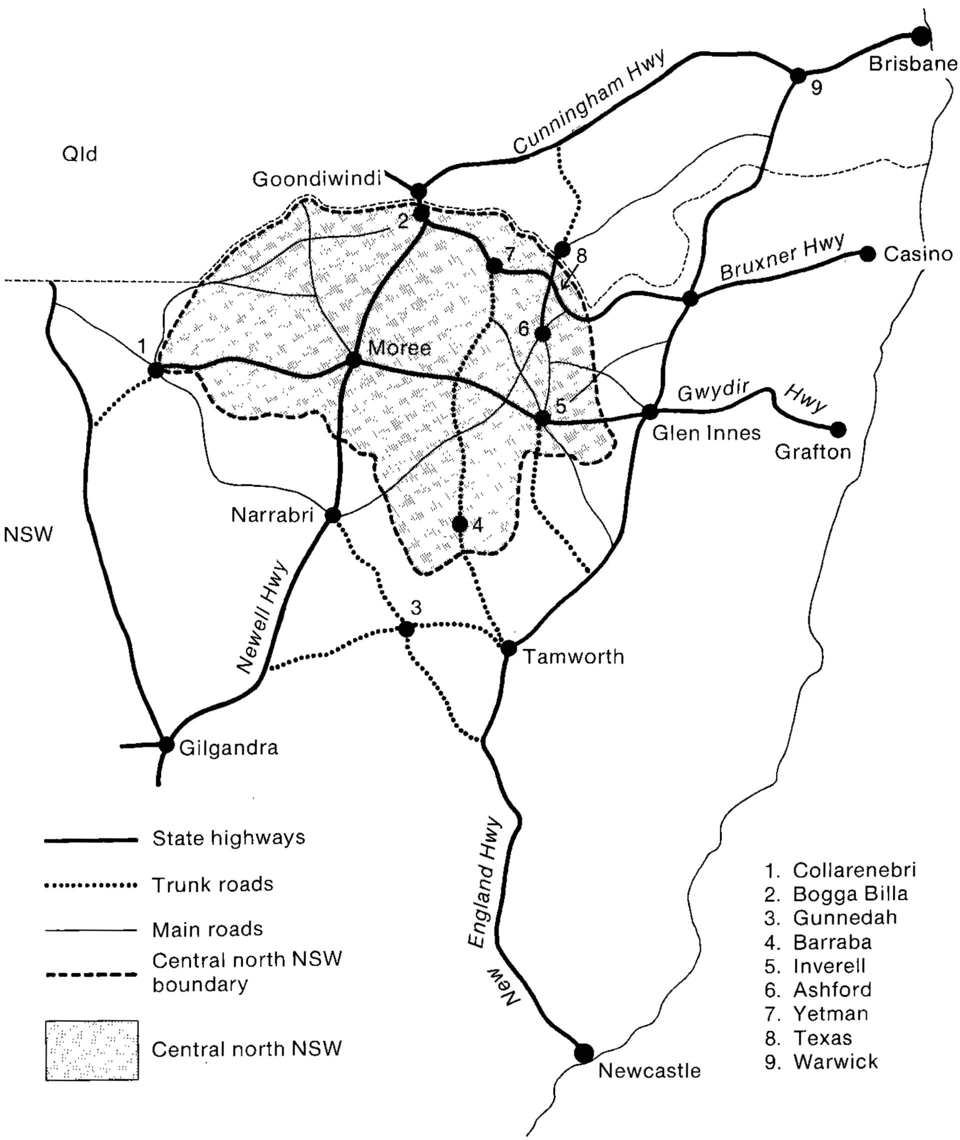
The rail network servicing the study region, and the traffic task classification on this network as defined by the Railways of Australia Committee (Railways of Australia, June 1979), are illustrated in Map 3.2.

The study region is directly serviced by the standard gauge (1435mm) rail network operated by the State Rail Authority of New South Wales (SRA). A main line runs from Newcastle through Werris Creek to Moree. Three rail links radiate from Moree and terminate at Weemalah, Boggabilla and Inverell in the study region, and these are classified by the SRA as branch lines. The link to Boggabilla is currently being upgraded to mainline standard. The rail link terminating at Barraba and connecting with the rail line passing through Tamworth is also classified as a branch line.

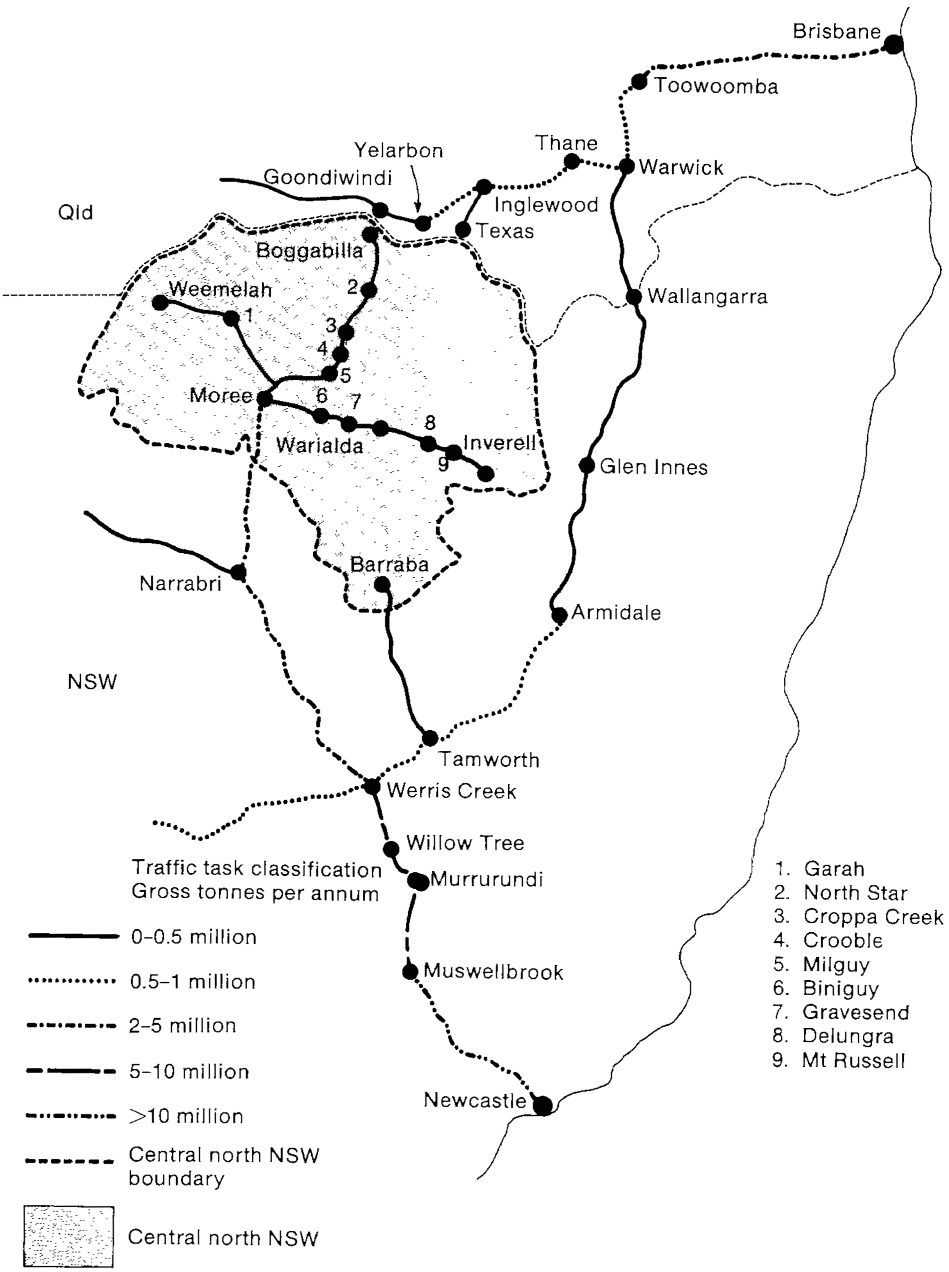
On the main line from Moree to Newcastle, the length of trains and hence the quantity of freight carried on each train on the section of track between Moree and Muswellbrook is limited by the length of crossing loops, which range from 360 metres to approximately 400 metres.

Special speed restrictions apply to trains over various sections of the rail network due to the standard of either bridges or the railway line. The weight of the railway line over the network varies from 30 kg to 50 kg per metre.

The potential rapid growth in coal extraction from the Gunnedah Basin in New South Wales could place considerable strain on the existing rail network servicing the study region. However, substantial upgrading work is underway, or planned by the SRA. A planned expenditure programme of $119m on track upgrading and signalling on the Newcastle to Muswellbrook line commenced in 1982–83 and is expected to take approximately five years. On the next leg from Muswellbrook to Werris Creek, plans



Map 3.1—Road links with central north New South Wales



Map 3.2—Rail links with central north New South Wales

to increase line capacity through 'centralised traffic control' are at the detailed design stage. Investment in the line north of Werris Creek is heavily dependent on developments in the Gunnedah coal basin; the SRA has had the consulting firm Transmark draw up definite plans for upgrading, but the timing is dependent on coal tonnages[1]. The upgrading of these parts of the line should lead to a more efficient transport system for grain from the study region to Newcastle, and help to reduce the level of congestion.

A typical grain train operating between Boggabilla and Newcastle consists of 26 NGTY class hopper wagons, one brakevan and a range of locomotives depending over which section of track the train is travelling. Between Boggabilla and Moree two branch line locomotives (48 class locomotives) are used. Over the section Moree to Willow Creek two mainline locomotives (44 class locomotives) haul the grain. Due to the gradient (1 in 40) approaching the Ardglen tunnel on the Liverpool Range between Willow Creek and Murrurundi, two additional locomotives are required, one mainline and one branch line locomotive. For the remainder of the trip from Murrurundi to Newcastle two mainline locomotives are used. A typical train hauls about 1500 tonnes of grain. The average turnaround time for the journey is 60 hours with each train performing an average 1.5 trips per week[1].

A narrow gauge (1067mm) Queensland rail track is located just north of the study region extending from Goondiwindi through Inglewood to Brisbane, with a spur line extending south from Inglewood to Texas. There is no direct link between the Queensland and New South Wales railway systems which could conveniently service the study region. However, the two networks are approximately nine kilometres apart, the distance between Goondiwindi and Boggabilla, at the northern extremity of the New South Wales railway system.

The rail link extending from Goondiwindi to Thane, west of Warwick, is classified by the Queensland Railways (QR) as a 'specified B' line, as the gross axle load restriction on this section of line is 11 gross tonnes. The link extending from Thane to Brisbane is classified by QR as an 'A' class line. The maximum load on this section of track is 15.75 gross tonnes per wagon axle[2].

Similar to the New South Wales railway system, special speed restrictions apply to trains over various sections of the Queensland rail link due to the standard of either bridges or the railway line. The weight of the railway line between Goondiwindi and Brisbane varies from 21 kg to 47 kg per metre.

A recommendation was made to the Queensland Government in 1981 that the railway link between Goondiwindi and Thane be upgraded to 'A' class standard to cater for the expected growth in grain traffic over the ensuing 20 years (Queensland Planning Committee 1981). The basis on which this recommendation was made specifically excluded any allowance for possible additional grain traffic originating in New South Wales that could be transported on the Queensland railway system.

A typical grain train operating between Goondiwindi and Brisbane consists of two 1720 class locomotives, 29 QGX class hopper wagons plus a brakevan. The train hauls about 870 tonnes of grain. The average turnaround time for the trip is 60 hours with each train performing on average 1.5 trips per week. It is not uncommon for additional freight cars to be added to the train at either Warwick or Toowoomba due to the higher standard of the remaining section of rail track to Brisbane.[2]

Comparing these two alternative rail routes for grain from the study area, it is noted that the trip time to the seaboard is the same on both routes, but a typical grain train on route to Newcastle carries about 70 per cent more grain than its counterpart on the Brisbane run.

1. State Rail Authority, personal communication.
2. Queensland Railways, personal communication.

BULK GRAIN HANDLING FACILITIES

The Grain-Handling Authority of New South Wales (GHA) operates a bulk grain storage system in the study region to cater for wheat, sorghum and barley production. Table 3.1 shows the storage facilities by location, type of storage and storage capacity. All the bulk storage facilities are located on the rail network.

In 1981 there was a nominal bulk storage capacity in the region of 636 000 tonnes. This capacity constituted approximately 11 per cent of the total country elevator capacity operated by the GHA in New South Wales. Of the region's bulk storage capacity about 58 per cent was located on the Moree-Boggabilla line, 31 per cent on the Inverell line and 11 per cent on the Weemelah line.

Table 3.2 shows nominal storage capacity and total grain received into bulk storage in the study region by the GHA over the five years to 1980-81. Averaged over this five year period annual grain receivals were approximately equal to nominal storage capacity. However, in 1978-79, the year of peak receivals during this period, grain receivals exceeded nominal storage capacity by nearly 50 per cent. Conversely, in 1980-81 receivals constituted only 15 per cent of nominal storage capacity.

This study does not examine the adequacy of the storage system to handle the seasonal variations in grain receivals. This would require additional information, not available to the Bureau, relating to carry-over stocks each year, loss of potential storage capacity due to grain segregation, the timing and rate of delivery of grains and similar information on the disbursement of stocks.

Because the GHA handles different types of grain and is also required to segregate the different grades of particular grains, a subterminal has been constructed at Moree to assist in consolidating grain movements to port terminals and other mainland destinations. At all other receival points growers deliver their harvest by road transport directly from farm into the silos.

GRAIN HANDLING AUTHORITY BULK GRAIN RECEIVALS

The quantities by type of grain delivered to GHA bulk storage facilities in the study region over the five year period to 1980-81 are shown in Table 3.3. Wheat was the dominant grain delivered to the storage system, constituting in excess of 95 per cent of total grain deliveries over the five year period.

Table 3.4 details the quantities of wheat delivered to each bulk storage facility in the study region between 1976-77 and 1980-81. Deliveries ranged from 867 000 tonnes for the 1978-79 harvest to 90 000 tonnes for the 1980-81 season. Average annual wheat deliveries were in excess of 550 000 tonnes over the five year period.

Under an arrangement with the Queensland State Wheat Board (SWB), New South Wales wheat growers deliver relatively small quantities of wheat harvested in the study region adjacent to the New South Wales and Queensland border to the Queensland bulk grain storage system. For the purpose of administration of bulk handling and storage of wheat the New South Wales wheat producers operating under this arrangement are classified as Queensland producers, and pay the charges levied by the SWB for storage and handling of wheat and not those levied by the GHA of New South Wales. Between 1976-77 and 1981-82, the SWB received on average just over 10 000 tonnes of wheat per annum under this arrangement[1]. Growers made these deliveries by road transport directly from the farm.

In addition to the above mentioned movements of wheat from the study region to Queensland, the Australian Wheat Board (AWB) has authorised, on an irregular basis,

---

1. State Wheat Board, personal communication.

TABLE 3.1—COUNTRY ELEVATOR CAPACITY OPERATED BY THE GRAIN HANDLING AUTHORITY OF NSW FOR THE 1981-82 HARVEST

Location	*Type of storage*	*Storage capacity (tonnes)*
Barraba	Concrete bin silo	8 450
	Depot, D Type	14 950
Biniguy	Concrete bin silo	800
	Bulkhead (timber framed)	2 700
	Depot, C Type	40 800
Boggabilla	Depot, D Type	14 950
	Depot, C Type	28 600
	Concrete bin silo	6 000
Crooble	Depot, C Type	40 800
Croppa Creek	Concrete bin silo	12 250
	Depot, C Type	54 450
	Concrete bin silo	6 000
Delungra	Concrete bin silo	4 100
	Bulkhead (timber framed)	2 700
	Depot, E Type	27 200
Garah	Depot, C Type	40 800
Gravesend	Concrete bin silo	1 650
	Bulkhead (timber framed)	2 700
	Depot, D Type	14 950
Inverell	Concrete bin silo	17 150
Milguy	Depot, A Type	19 050
	Bulkhead (timber framed)	2 200
	Depot, C type	28 600
Moree	Concrete bin silo	12 250
	Depot, E Type	27 200
	Depot, E Type	16 350
	Sub-terminal	29 000
Mount Russell	Concrete bin silo	4 100
	Depot, A Type	28 600
North Star	Depot, A Type	19 050
	Depot, C Type	40 800
	Concrete bin silo	15 000
Warialda	Concrete bin silo	6 000
	Bulkhead (timber framed)	2 700
	Depot, D Type	14 950
Weemelah	Depot, C Type	28 600
Total study region		636 450
Total New South Wales		5 747 750

Source: Grain Handling Authority of New South Wales, 1981.

TABLE 3.2—NOMINAL STORAGE CAPACITY AND TOTAL GRAIN RECEIVALS BY GRAIN HANDLING AUTHORITY OF NSW[a] IN STUDY REGION, 1976-77 TO 1980-81

('000 tonnes)

Year	*Nominal storage capacity*	*Total grain receivals*
1976-77	562	742
1977-78	562	520
1978-79	606	893
1979-80	636	594
1980-81	636	97
Five year average	600	569

a. Prior to 1980-81 the Authority operated as the Grain Elevators Board of New South Wales.

Source: Grain Handling Authority of New South Wales (1981 and 1982). Grain Elevators Board of New South Wales (1977-80).

the transfer of wheat between New South Wales and southern Queensland in both directions. Details for the 10 years to 1982-83 are contained in Table 3.5.

Significant quantities of wheat were transferred from New South Wales to Queensland in the years 1973-74 to 1976-77 and these consignments were mainly to meet export requirements. All consignments of wheat from New South Wales for export, except in 1975-76, were transferred to the bulk storage facilities operated by the Queensland SWB. In 1975-76 out of a total movement of 109 000 tonnes of wheat, 27 000 tonnes were transported directly to the Brisbane grain terminal by road transport. These transfers of export wheat to Queensland ceased in the latter half of the 1970s, presumably reflecting the ability of the Newcastle grain terminal to handle all of the export wheat produced in the area in this period. There were also small transfers of wheat from New South Wales to Queensland for domestic comsumption in each year except in 1974-75 and 1982-83. These domestic consignments of grain were made directly to flour mills located in Toowoomba and Brisbane.

The largest movement of wheat from New South Wales occurred in 1975-76 when in excess of 100 000 tonnes was moved to Queensland. The consignments of wheat during that year constituted 15 per cent of the total wheat delivered to the GHA by growers in the study area, and about 3 per cent of total New South Wales wheat deliveries.

The only AWB authorised transfers of wheat from Queensland to New South Wales during the last decade occurred in 1981-82 and 1982-83. These movements were made for the purpose of feeding drought affected stock in New South Wales. While the quantity of wheat transferred to New South Wales was quite significant, this appears to reflect special circumstances and not a continuing transport task.

PHYSICAL FACTORS AFFECTING MOVEMENT OF WHEAT BETWEEN NEW SOUTH WALES AND QUEENSLAND

The interstate transfer of wheat[1] authorised by the AWB between New South Wales and Queensland was undertaken either directly by road or rail transport or by a combination of road/rail transport. Where rail transport was used, wheat had to be transferred from one railway system to the other due to the different track gauges.

There are two locations where this exchange took place. The first is a Goondiwindi to Boggabilla transfer, or vice-versa, depending on which direction the grain was travelling. The transfer of wheat between the two railway systems at this border

1. The discussion in this section is based on information provided by the AWB.

TABLE 3.3—TOTAL GRAIN RECEIVALS BY GRAIN HANDLING AUTHORITY OF NSW IN STUDY REGION BY TYPE OF GRAIN, 1976-77 TO 1980-81

('000 tonnes)

Station	1976-77		1977-78		1978-79		1979-80		1980-81	
	Barley	Sorghum	Barley	Sorghum	Barley	Sorghum	Barley	Sorghum	Barley	Sorghum
Barraba	–	1.2	–	1.3	–	2.9	–	0.1	–	–
Biniguy	–	–	–	–	–	0.7	–	–	–	–
Boggabilla	–	–	0.3	–	1.5	–	–	–	–	–
Crooble	–	–	–	–	–	–	–	–	–	–
Croppa Creek	–	–	–	2.0	3.1	4.0	–	–	–	5.4
Delunga	2.1	–	2.5	–	2.6	–	–	–	–	–
Garah	–	–	–	–	–	–	–	–	–	–
Gravesend	–	0.7	0.3	1.3	–	–	–	–	–	–
Inverell	–	4.0	0.3	1.6	–	4.1	–	0.1	–	–
Milguy	–	0.7	–	–	1.4	–	–	–	–	–
Moree	–	–	–	–	–	–	–	–	–	–
Mount Russell	–	2.4	–	1.3	–	–	–	–	–	1.0
North Star	–	–	–	–	–	–	–	–	–	0.8
Warialda	2.0	2.3	0.5	1.2	0.9	3.5	–	–	–	–
Weemelah	–	–	–	–	–	–	–	–	–	–
Barley & sorghum receivals	4.1	11.3	3.6	7.7	10.8	15.2	–	0.2	–	7.2
Total coarse grain receivals	15.4		11.3		26.0		0.2		7.2	
Wheat receivals[a]	726.7		508.7		866.8		593.7		89.9	
Total grain receivals	742.1		520.0		892.8		593.9		97.1	

a. Details of wheat received by stations is provided in Table 3.4.

– nil or rounded to zero

Source: Grain Handling Authority of New South Wales (1981 and 1982). Grain Elevators Board of New South Wales (1979 and 1980).

TABLE 3.4—WHEAT RECEIVALS BY GRAIN HANDLING AUTHORITY OF NSW IN STUDY REGION, 1976-77 TO 1980-81

('000 tonnes)

Station	*1976-77*	*1977-78*	*1978-79*	*1979-80*	*1980-81*	*Mean*	*Standard deviation*
Barraba	13	9	13	12	1	9.6	5.0
Biniguy	47	39	35	35	13	33.8	12.6
Boggabilla	62	34	78	34	1	41.8	29.6
Crooble	41	30	45	33	11	32.0	13.2
Croppa Creek	110	77	123	68	9	77.4	44.5
Delungra	21	15	24	15	7	16.4	6.5
Garah	65	51	102	66	-	58.5	42.0
Gravesend	15	14	17	14	4	12.8	5.1
Inverell	12	7	14	11	1	9.0	5.1
Milguy	48	32	55	33	11	35.8	17.0
Moree	106	72	118	116	7	83.8	46.7
Mount Russell	5	6	8	19	2	8.0	6.5
North Star	117	76	148	74	15	86.0	50.2
Warialda	23	21	29	24	8	21.0	7.8
Weemelah	42	26	58	40	-	33.4	21.7
Total wheat receivals[a]	727	509	867	594	90	557.6	294.4

a. Totals do not coincide exactly with those in Table 3.3 due to rounding.
\- nil or rounded to zero

Source: Grain Handling Authority of NSW (1981 and 1982). Grain Elevators Board of New South Wales (1977-80).

crossing required its movement by road transport over approximately nine kilometres, the distance between Boggabilla and Goondiwindi.

Movements of wheat from New South Wales on to the Queensland railway system at Goondiwindi occurred in 1973-74, 1975-76 and 1981-82. Consignments in the reverse direction occurred in both 1981-82 and 1982-83 (refer to Table 3.5).

Where interstate consignments of export wheat originating in New South Wales were undertaken solely by road transport, the deliveries were made directly to the grain terminal operated by the SWB at Pinkenba in Brisbane. Interstate movements of grain originating in Queensland were delivered to GHA bulk storage facilities.

The second point at which the transfer of wheat between the two rail systems occurred was at Wallangarra, located on the New South Wales and Queensland border east of the study region. At this town the two railway systems are serviced by a common grain transfer facility. The grain is transferred directly from one system to the other via drag conveyor and elevator. Throughput is limited by the capacity of the equipment which can handle about 80 tonnes per hour. There is no direct rail access to this border crossing point from the study region; rail access from Moree would require going south to Werris Creek and then north through Armidale and Glen Innes to Wallangarra (Map 3.2).

Additional constraints affecting the interstate transfer of wheat include the availability of sufficient rail and/or road transport capacity to meet AWB demand. Capacity constraints probably become important only in years of peak production, but these years will tend to correspond for northern New South Wales and southern Queensland grain harvests.

TABLE 3.5—INTERSTATE TRANSFER OF WHEAT BETWEEN NEW SOUTH WALES AND SOUTHERN QUEENSLAND, 1973-74 TO 1982-83

('000 tonnes)

Year	*New South Wales to Queensland*			*Queensland to New South Wales*[a]		
	Tonnage	*Usage*	*Mode of transport*	*Tonnage*	*Usage*	*Mode of transport*
1973-74	48.5[b]	export	road/rail	–	–	–
	0.2[b]	domestic	road/rail	–	–	–
1974-75	20.1	export	road	–	–	–
1975-76	80.4[b]	export	road/rail	–	–	–
	27.4	export	road	–	–	–
	1.6[b]	domestic	road/rail	–	–	–
1976-77	27.4	export	road	–	–	–
1977-78	0.8[c]	domestic	road/rail	–	–	–
1978-79	1.2[c]	domestic	road/rail	–	–	–
1979-80	0.7[c]	domestic	road/rail	–	–	–
1980-81	0.6	domestic	road/rail	–	–	–
1981-82	1.0[b]	export	road/rail	(45.1	feed	road/rail
	0.8[c]	domestic	road/rail	(		
	0.2	domestic	road	(32.2[c]	feed	road/rail
1982-83	–	–	–	(25.0[b]	feed	road/rail

a. Details of movements from Qld to NSW for 1981-82 and 1982-83 are not available separately.
b. Via Goondiwindi.
c. Via Wallangarra.

– nil or rounded to zero

Source: Australian Wheat Board, personal communication.

Furthermore, export consignments of wheat transferred from northern New South Wales to Queensland must be of compatible types with Queensland wheat to ensure that any shortfall or surplus of a particular consignment can be blended with exports of Queensland wheat. Finally, the quantity of any particular consignment of export wheat tranferred from New South Wales to Queensland is further constrained by the capacity of the relatively small ships plying both the Japanese and Russian trades out of Brisbane. The capacity of the vessels on the Japanese route range from 14 000 to 19 000 tonnes, while vessels of 7500 to 13 000 tonnes capacity are not uncommon on the Russian route.

INSTITUTIONAL ARRANGEMENTS AFFECTING INTERSTATE GRAIN MOVEMENTS

As well as the physical factors outlined above which inhibit interstate freight flows of grain from the study region, there are institutional arrangements relating to the marketing of grains that affect not only the direction in which the grains are transported, but may also influence the mode of transport.

The marketing of grains other than wheat is outlined first. Legislation in New South Wales relating to orderly marketing of coarse grains and oilseeds empower the respective marketing boards with the right of total acquisition of the crops.

Similar legislation applies in Queensland for the marketing of barley. In addition, the Queensland Graingrowers Association, a limited liability company, markets grains and oilseeds not covered by a statutory marketing authority.

When a marketing authority acquires and markets grain, the authority generally determines both the directional flow of grain and the means by which the grain is transported. In the case of intrastate movements of grain, the transport function is normally part of the orderly marketing arrangements. While interstate movements of grain are not subject to marketing agreements, the BTE understands that some State marketing authorities do arrange such sales through private traders.

Not all marketing authorities invoke the power of acquisition of the crop. In such cases, alternative marketing strategies such as voluntary pool arrangements or the marketing of grain through licensed agents are used. Furthermore, situations have arisen in recent years where a marketing authority has not marketed grain due to a small harvest and the virtual absence of international demand.

In contrast to other grains, the marketing arrangements for wheat operate nationally. Under this marketing arrangement the mode and direction of transport are influenced by three institutions:

- the Australian Wheat Board, the legally constituted sole marketing authority for the harvest;
- the State bulk handling authorities, the principal licensed receival agents of the AWB who arrange, on behalf of the Board, for the storage and handling of the crop and the distribution of receivals to final Australian destinations; and
- the State railway systems, the major mode for line haul transport from the hinterland to mainland outlets.

The nexus between these institutions arises as a result of legislative arrangements and the policy of bulk handling authorities. The link between the AWB and the bulk handling authorities is based on Federal and complementary State legislation, which is necessary to meet constitutional requirements for a national central marketing operation. The policy of bulk handling authorities to predominantly locate their storage facilities on railway property has influenced the way in which the railways and bulk handling authorities have been associated.

In addition, intersystem rail consignments of wheat have been restricted over the years as a result of State Governments developing their railway systems as independent State entities with networks centred on State capitals and ports. Furthermore, the State railways have actively discouraged the intersystem transfer of wheat by generally setting intersystem rail freight rates at a higher level than those for intrasystem journeys of a comparable distance[1].

The effect of the interaction of these institutions is that wheat moves predominantly by rail and that the direction of movement, with relatively minor exceptions, is to terminals in the State in which the wheat is grown, even though an interstate outlet may be closer. The most notable exception, that is the major flow of interstate wheat, is that from the Riverina district in southern New South Wales to Victorian ports.

Movements of wheat from southern New South Wales to Victorian ports have varied markedly from nearly 800 000 tonnes in 1979-80 to under 80 000 tonnes in 1980-81, reflecting variations in production in relation to handling capacity in New South Wales. In recent years, the GHA and the Grain Elevators Board of Victoria have negotiated separate agreements each year which nominate specific delivery stations in southern New South Wales as forming a Buffer Zone (renamed as the Adjustment

---

1. Australian Wheat Board, personal communication.

Area in 1982-83). Wheat deliveries in this area have been subject to a special handling charge below the New South Wales GHA average charge. In 1981-82, 172 000 tonnes of wheat from this area was transported through the Victorian grain handling system to Geelong. By contrast none of the drought affected 1982-83 crop moved to Victorian ports, and the State Rail Authority of New South Wales offered rail charges for wheat to Sydney equivalent with those to Geelong.

ESTIMATED ANNUAL FREIGHT TASK

Tables 3.6 and 3.7 show the estimated annual freight flows out of and into the study region respectively. The rail figures were derived from the average tonnages moved by the SRA between 1977-78 and 1980-81[1].

TABLE 3.6—ESTIMATED OUTWARD ANNUAL FREIGHT FLOWS FROM STUDY REGION

('000 tonnes)

Commodity	*Mode of transport*		*Total*
	Road	*Rail*	
Wheat	10	499.5	509.5
Coarse grains[a]	175	-	175
Oilseeds	41[b]	-	41
Fertiliser	40	-	40
Meat	17.5	2.5	20
Livestock	32	3	35
Vegetable oils	32	-	32
Cotton	46[c d]	-	46
Cotton seed derivatives[e]	36	-	36
Wool	5	2.5	7.5
General freight	8	2.5	10.5
Containers[f]	-	48.5	48.5
Total	442.5	558.5	1 001.0

a. Predominantly sorghum and barley.
b. Includes 30 000 tonnes of cottonseed transported from Ashley to Narrabri.
c. Excludes 14 000 tonnes of cotton transported through the region to Brisbane from Wee Waa/Narrabri area.
d. Includes 14 600 tonnes of unginned cotton transported to gins in Wee Waa area.
e. Includes meal, husks and linters.
f. Carried by rail as 'overseas containers'.
\- nil or rounded to zero

Sources: State Rail Authority of NSW, personal communication. BTE estimates.

The road figures are estimates derived from direct enquiries in and around the study region, and should be interpreted as approximate orders of magnitude.

The estimated total transport task of 1.3 million tonnes is comprised of an outflow of one million tonnes and an inflow of 0.3 million tonnes of freight. Grain was the major commodity exported from the region totalling 0.7 million tonnes. Fuel and fertiliser together comprised over half (172 000 tonnes) the estimated imports to the region.

There was an imbalance between the overall outward and inward freight flows, and this imbalance was greater on rail than on road. The ratio of outward to inward freight flows on rail was 18:1 compared with 1.5:1 on road transport.

1. Excludes commodity flows of less than 200 tonnes per annum.

TABLE 3.7—ESTIMATED INWARD ANNUAL FREIGHT FLOWS TO STUDY REGION

('000 tonnes)

Commodity	Mode of transport		Total
	Road	Rail	
Fuel	75	17.5	92.5
Livestock	17	–	17
Fertiliser	79.5	–	79.5
Cement	4.5	–	4.5
Oilseeds	40	–	40
Agricultural machinery	5	–	5
Motor vehicles	2	–	2
Beverages	6.5	–	6.5
Containers	–	5.5	5.5
General freight	47.5	8	55.5
Total	277	31	308

– nil or rounded to zero

Sources: State Rail Authority of NSW, personal communication. BTE estimates.

A graphical presentation illustrating the destinations of outward freight flows and the origins of inward freight flows by mode of transport is contained in Figures 3.1 and 3.2 respectively.

In terms of the outward traffic task (Figure 3.1), rail was the major mode of transport, accounting for nearly 60 per cent of the task. Conversely, the railways undertook approximately 10 per cent of the inward freight task (Figure 3.2).

The major destinations for the outputs of the region were Newcastle (32 per cent), other New South Wales (33 per cent), Sydney (20 per cent) and Brisbane (10 per cent). The major traffic transported to Newcastle was grain, while grain and vegetable oils constituted the major freight items moving to Sydney. The freight transported to other destinations in New South Wales was mainly oilseeds, livestock, cotton and fertiliser[1]. Coarse grains, meat and cotton made up the bulk of the freight moving to Brisbane.

Over 45 per cent of inward taffic originated in Brisbane (Figure 3.2) and was made up of fuel (45 per cent), fertiliser (43 per cent), general freight (11 per cent) and agricultural machinery (1 per cent). Oilseeds, comprising 4.5 per cent of total inflows constituted the freight originating in central, south-west and south-east Queensland. Newcastle was a major source from which fuel and fertiliser were drawn. Fertiliser was brought into the region from Newcastle by road transport while rail accounted for the fuel flows. Nearly 40 per cent of general freight that moved into the region originated in Sydney. Road transport accounted for nearly 80 per cent of this traffic flow. Relatively small quantities of fuel also originated in Sydney, the majority of which was brought into the region by road transport.

Interstate movements of freight to and from the study region amounted to around 240 000 tonnes, or about 18 per cent of the total traffic task. This freight task was performed by road transport.

1. The study region is a major distribution point for fertiliser to surrounding areas.

Detailed forecasts for the expected growth in the traffic task, especially for inward freight flows, are not available. The outward traffic task will continue to be dominated by grain shipments, and as discussed in the previous Chapter, the future growth in grain shipments is expected to be about 2 per cent per annum. For the purposes of the subsequent evaluation of transport alternatives, the total outward traffic task is assumed to increase at 2 per cent per annum over the evaluation period. Furthermore, the evaluation of the transport alternatives in the report have been based on outward traffic flows only, as it is not expected that the implementation of any transport option would affect the modal split of the relatively small inward freight task. Finally, due to the seasonal variation in agricultural production, continued strong variability in the outward freight task is expected.

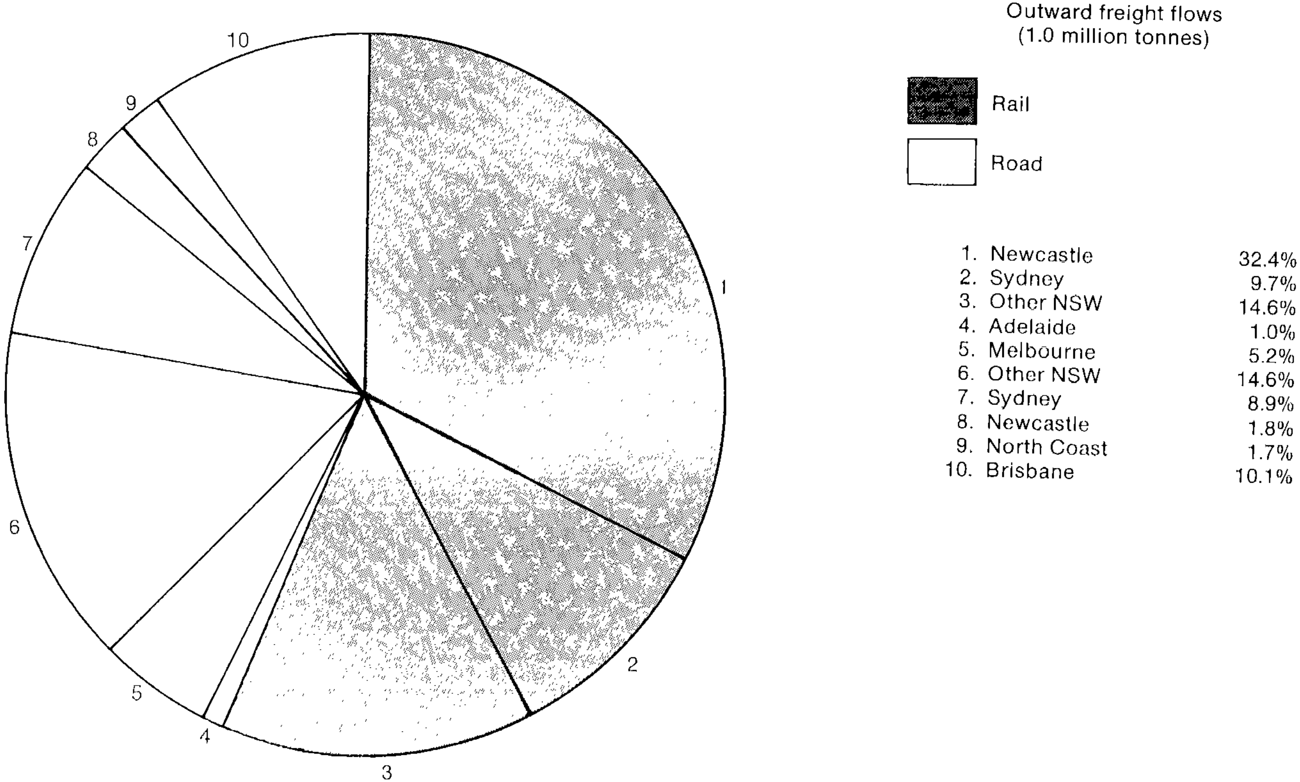


Figure 3.1—Distribution of outward freight flows from study region by mode and destination

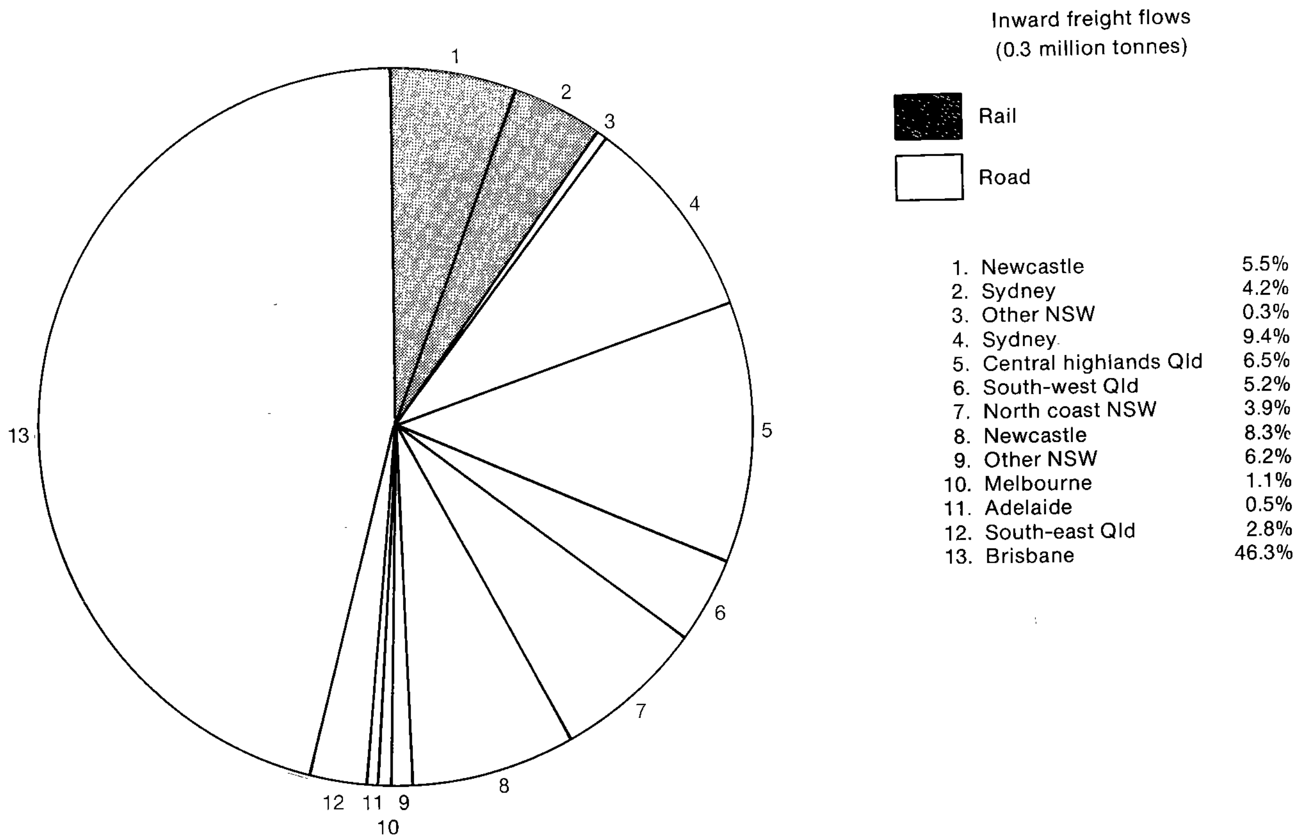


Figure 3.2—Distribution of inward freight flows to study region by mode and origin

CHAPTER 4—EVALUATION OF TRANSPORT ALTERNATIVES FOR CENTRAL NORTH NSW

In this chapter the results of the evaluations of a range of transport alternatives for central north New South Wales are presented.

The evaluations involve both financial and economic assessments of each transport option. The financial analyses assess the monetary effects of each option on both the suppliers and users of transport services. The economic analyses assess, from a national viewpoint, the resource costs and benefits of each transport option.

All proposals are evaluated over a 20 year period to the year 2001. The evaluations are based on the estimated outward freight flows and their anticipated growth as outlined in Chapter 3.

Before presentation of the results of the evaluations there is a discussion of the various transport alternatives evaluated in the report, and also several options which were considered but judged not to justify a formal evaluation.

TRANSPORT ALTERNATIVES

Overall the BTE looked at 16 options for improving transport services to and from the study region. Ten of these options were included in the March 1982 submission from the Northern Transport Study Committee (NTSC). A further six options covering several road/rail transport possibilities, and also a conveyor belt link between Boggabilla and Goondiwindi, were considered by the BTE to be worthy of evaluation. The NTSC submission contained four options which, following preliminary examination, were not formally evaluated. These four options and the reasons for not evaluating them are examined first.

The first proposal related to the construction of a deep water port at the mouth of the Clarence River located on the north coast of New South Wales. This proposal also included the construction of an east-west rail link connecting the proposed port with the study region at Inverell. An evaluation of this proposal was recently undertaken by an enquiry[1] set up by the New South Wales Government. The enquiry concluded

> '...that the development of the Clarence River Port and the rail link to it is not an option which can be economically justified on the basis of grain industry requirements'.[2]

There is no evidence available to the Bureau to suggest that re-evaluation of this option would draw a different conclusion to that of the New South Wales enquiry. Therefore, the Bureau has not undertaken an independent assessment of this option.

The second proposal contained in the NTSC submission involved the construction of a standard gauge rail link to connect the port of Brisbane to the study area, at a location determined by the transport requirements of the Gwydir and MacIntyre Valleys, and designed to match national and State transportation planning strategies.

There are two alternatives relating to this particular proposal. The first is the construction of a standard gauge rail link between Brisbane and Goondiwindi and

1. New South Wales Grain Handling Enquiry, 1980.
2. New South Wales Grain Handling Enquiry, 1980, p80.

extending across the New South Wales and Queensland border to connect with the New South Wales railway network at Boggabilla. The second alternative embraces the laying of a third rail on the existing narrow gauge infrastructure in Queensland to form a standard gauge rail system in Queensland. Again this alternative would require the extension of the standard gauge rail track across the New South Wales and Queensland border to link up with the New South Wales railway system.

Preliminary analyses of both alternatives for providing standard gauge track to Brisbane indicated that the standard gauge option would not be viable due to the relatively small traffic task compared with the level of capital expenditure; capital expediture approaching $100 million would be required.

For the third rail option, there would appear to be technical difficulties and hence potentially high costs associated with the operation of trains. Each railway system has different wheel profiles on their rolling stock, conical wheels are used in New South Wales compared with cylindrical wheels in Queensland, and therefore the railway track of each system has a different cant.

The Bureau has been advised that where the cant of the track and the wheel profile are not fully compatible, it is possible to operate trains over short distances at slow speeds and relatively light axle loads without undue wear to either the track or wheels. However, the relatively long distance between the study region and Brisbane (in excess of 450 km), the comparatively high axle loads (around 11 gross tonnes per axle for grain trains), together with the speeds required on 'specified B' class railway lines in Queensland to maintain time schedules (up to 60 km per hour), suggest that significant costs, in addition to initial capital expenditures, would be incurred due to excessive wear to track and wheels if the third rail option was implemented.

The third proposal contained in the NTSC submission related to linking the New South Wales and Queensland railway systems by constructing a narrow gauge rail link between Boggabilla and Goondiwindi, and extending the narrow gauge track to Moree by laying a third rail inside the existing standard gauge rail link between Boggabilla and Moree.

Evaluation of the first part of this proposal, the construction of a narrow gauge rail link to connect the two railway systems, has been undertaken in this report. However, assessment of the second section of the proposal, the extension of the narrow gauge track to Moree, has not been undertaken for basically the same reasons cited for the previous proposal. That is, the relatively small traffic task compared with the high costs of operations, particularly the costs associated with the technical difficulties of operating freight trains where there are different track and rolling stock configurations. Furthermore, for freight originating south of Boggabilla it would be considerably less expensive to transfer the freight from the New South Wales railway system to an extended Queensland system at Boggabilla, than to extend the narrow gauge rail track to Moree.

The fourth proposal submitted by the NTSC related to upgrading the present New South Wales railway systems between Werris Creek and Newcastle to double track standard.

As noted in Chapter 2, a substantial investment in upgrading the Newcastle to Muswellbrook line is now being implemented. The upgrading of the Muswellbrook to Werris Creek line has been evaluated by the SRA of New South Wales, but the timing of investment is largely dependent on developments in the Gunnedah coal basin. The BTE does not have forecasts of the freight tasks, or the necessary cost information, to evaluate this proposal. Moreover, further investment in this rail link is clearly dependent to a significant extent on developments outside the study region.

Both financial and economic assessments of the remaining proposals contained in the NTSC submission have been undertaken. These options are:

- Construction of a rail link between Boggabilla and Goondiwindi to connect the New South Wales and Queensland railway systems (see below).
- Construction of additional bulk grain storage facilities on Queensland railway property for use by New South Wales grain growers at Yelarbon and Texas in Queensland, but limiting the traffic task for New South Wales grain carried on Queensland rail to 100 000 tonnes of grain per annum[1]. Growers would deliver their grain direct from farm to these facilities by road transport.
- Construction of a north-south rail link within the study region between Warialda and Barraba to provide a more direct rail link between the study region and the Newcastle/Sydney area; the main purpose of this proposal is to reduce the rail distance and hence freight rates, particularly for grain growers located in the eastern section of the study region.

Evaluation of the construction of a rail link between Boggabilla and Goondiwindi involved the assessment of the following four options:

- the construction of a standard gauge rail link with a grain transfer facility located at Goondiwindi;
- as above, but limiting the traffic task to 100 000 tonnes of wheat per annum;
- the construction of a narrow gauge rail link; this option does not include a grain transfer facility as it is postulated that the transfer of grain between the two railway systems would occur at the existing bulk storage facilities at Boggabilla;
- as above, but limiting the traffic task to 100 000 tonnes of wheat per annum.

Further to the six transport options mentioned above, assessment of an additional six options has been undertaken. These options are:

- the use of road transport to move wheat onto Queensland rail from those bulk storage facilities located in the study region which are closer by this route to Brisbane than by rail to Newcastle; this option includes the construction of additional bulk grain storage in Queensland to receive the grain;
- as above, but limiting the traffic task to 100 000 tonnes of wheat per annum;
- the use of road transport to move wheat to Brisbane from bulk storage facilities located in the study region which are closer to Brisbane by road than to Newcastle by rail;
- the construction of a covered grain conveyor belt between Boggabilla and Goondiwindi to tranship wheat from New South Wales to Queensland bulk storage; this option includes the construction of additional bulk grain storage at Goondiwindi;
- as above, but limiting the traffic task to 100 000 tonnes of wheat per annum; and
- the construction of a standard gauge rail link between Inverell and Glen Innes to transport wheat to Brisbane via Wallangarra; this option includes the construction of additional rail transfer facilities at Wallangarra.

The 12 options selected for evaluation are listed in Table 4.2. Before presenting the results of the financial and economic assessments, it is necessary to explain the choice of these options, and in particular, the benefits conferred in terms of the freight task affected and the access distance to ports under each option.

ROAD AND RAIL DISTANCES TO PORTS

Table 4.1 shows the road and rail distances from grain receival centres in the study region and Narrabri. to the ports of Newcastle and Brisbane.

---

1. All options limiting the traffic task to 100 000 tonnes of grain per annum would not require upgrading of the existing rail system in Queensland. This point is expanded later in the chapter.

TABLE 4.1—DISTANCE BY ROAD AND RAIL BETWEEN CENTRES IN THE STUDY REGION (AND NARRABRI) AND MAJOR OUTLETS

(km)

	Destination by mode of transport							
	Road			Rail				
Origin	*Brisbane via Goondiwindi*[a]	*Brisbane via Inverell/ Texas*	*Brisbane via Yetman/ Texas*	*Brisbane via Goondiwindi*[b]	*Brisbane via Wallangarra*[c]	*Newcastle via Glen Innes*[d]	*Newcastle via Moree*	*Newcastle via Warialda*
Boggabilla[e]	400*	..	..	484**	..	..	629	..
North Star	453*	..	..	523**	..	..	590	..
Croppa Creek	478*	..	..	547**	..	..	566	..
Crooble	510*	..	..	563	..	..	550**	..
Milguy	512*	..	..	574	..	..	539**	..
Moree	514	..	..	615	708	734	498*	567
Biniguy	552	577	521*	653	670	696	536	529**
Gravesend	568	564	508*	670	653	679	553	512**
Warialda	593	536	480*	693	630	656	576	489**
Delungra	621	508*	508*	729	594	620	612	525**
Mt Russell	642	500*	528	741	582	608	624	537**
Inverell	654	475*	529	769	554**	580	652	565
Narrabri	613	..	..	717	..	..	..	..

a. Based on road distance Brisbane—Fisherman Island of 10 km.
b. Based on rail distance Goondiwindi—Fisherman Island of 475 km.
c. Based on rail distance Wallangara—Fisherman Island of 376 km.
d. Based on road distance Glen Innes—Inverell of 67 km.
e. Based on rail distance Goondiwindi—Boggabilla of 9 km.
* Shortest route to grain terminal.
** Shortest rail route to grain terminal.
.. not applicable

Sources: NRMA road maps SRA NSW rail map. Distances to Newcastle via Glen Innes supplied by personnel at Glen Innes SRA Freight Terminal. Queensland Railways rate book. D.C. Jones, Consulting Engineer, Inverell.

The shortest route to a seaboard grain terminal from centres located in the study region is indicated by a single asterisk against the distance. Double asterisks indicate the shortest rail route to a seaboard grain terminal. Key features are:

- Road distances to Brisbane are about 50 to 100km shorter than rail distances, reflecting the deviation through Toowoomba of the rail route to Brisbane and the indirect rail route from Moree to Boggabilla.
- All centres located in the study region, with the exception of Moree, are closer to the grain terminal in Brisbane by road than the alternative rail route to the grain terminal at Newcastle.
- Comparing existing rail access to the two ports, however, only three centres in the region Boggabilla, North Star and Croppa Creek are closer by rail to the Brisbane grain terminal than to the Newcastle terminal.
- The maximum distance saved by linking the New South Wales and Queensland rail systems at Goondiwindi would be 145km with respect to freight from Boggabilla to Brisbane rather than to Newcastle.
- For the six centres east of Moree, the shortest existing route is by road to Brisbane, followed by rail to Newcastle. If the proposed rail link from Warialda to Barraba was built, this would significantly reduce the rail distance to Newcastle.
- Finally, it is noted that the proposal to extend the Moree-Inverell line east to Glen Innes and hence provide an alternative access to Newcastle, and to Brisbane (via Wallangarra), would provide a shorter rail route to a port compared with the existing route for only three centres in the region Inverell, Mount Russell and Delungra.

FREIGHT TASK UNDER EACH OPTION

Boggabilla-Goondiwindi Rail Link (Options 1 to 4)

The unrestricted traffic task used in assessing these options comprises wheat receivals at Boggabilla, North Star and Croppa Creek (which are the only three centres in the study region located closer to Brisbane than Newcastle by rail), plus other bulk rural commodities currently going by road to Brisbane. This traffic is comprised of coarse grains originating in the study region (40 000 tonnes) and cotton and vegetable oil production originating both in the study region and at Narrabri (46 000 tonnes). The trend of the traffic task at the beginning of the evaluation period (1981-82) is estimated at 291 000 tonnes, and it is assumed to grow at about 2 per cent per annum over the 20 year evaluation period.

Queensland Railways advised the BTE that, based on the above projection of the unrestricted traffic task, an upgrading program for the rail link from Goondiwindi to Brisbane at an estimated cost of $33 million would be required. Queensland Railways further advised that provided the traffic task did not exceed 100 000 tonnes per annum, upgrading of the rail link between Goondiwindi and Brisbane would not be required. Consequently, in a number of options, the traffic task is restricted to 100 000 tonnes per annum over the 20 year time frame.

Road Haulage (Options 5 to 8)

Options 5 and 6 involving road haulage of grain from bulk storage facilities at Boggabilla, North Star and Croppa Creek cover the same route, and the same traffic task, as the Boggabilla-Goondiwindi rail link options referred to above. That is, in option 5 the grain traffic task is unrestricted while for option 6 the traffic task is limited to 100 000 tonnes per annum.

Option 7 involves road haulage of wheat from farms that are geographically closer to Queensland silos at Texas and Yelarbon than to New South Wales silos. This freight task has been constrained to 100 000 tonnes of wheat per annum with approximately 25 per cent going to Texas and 75 per cent to Yelarbon.

Option 8 involves road haulage to Brisbane of a freight task of 374 000 tonnes of wheat in 1981-82. This figure is based on the average receivals in the proceeding five years at all bulk grain receival points in the study region, except Moree. This reflects the fact noted above that all centres except Moree are closer to Brisbane by *road* than the alternative *rail* route to Newcastle.

Conveyor Belt (Options 9 and 10)

Options 9 and 10 involve carrying the same freight task as that referred to in Options 1 to 6, from Boggabilla to Goondiwindi by a covered conveyor belt.

Standard Gauge Rail Links from Eastern Study Region (Options 11 and 12)

Option 11 involves extending the standard gauge rail eastwards from Inverell to Glen Innes which would shorten the rail route to port for only three centres Inverell, Mount Russell and Delungra. Based on average receivals at these centres for the previous five years the 1981-82 wheat task for this option is 33 000 tonnes.

Option 12 involves a rail link from Warialda south to Barraba which would shorten the rail route to Newcastle from the six receival centres to the east of Moree and including Inverell. The 1981-82 wheat traffic task is 101 000 tonnes, based on average wheat receivals for the previous five years.

EVALUATION OF TRANSPORT ALTERNATIVES

In this section the results of both the financial and economic evaluations of the transport alternatives for central north NSW are presented.

Financial Evaluations

Table 4.2 presents the capital costs[1] plus the discounted value of any future investment for the 12 options. The Table also shows the discounted financial gains or losses to each of the major parties affected if a particular option is implemented compared with the current situation. The affected parties identified are rural producers located in the study region, railway and grain handling authorities in New South Wales and Queensland truck operators and State authorities responsible for road maintenance.

In addition to the capital costs of infrastructure, the Table shows the gains or losses which are based on rail transfer and storage facility charges, and the changes in operating revenues and costs associated with each option. Details of the costs and revenues and the assumptions underlying the analyses are contained in Appendix II. For rail and road authorities and truck operators, the gains or losses relate to net revenue results, that is, to gross receipts less costs. By contrast, the results for the bulk handling authorities measure the change in gross revenue, as specific cost data relating to their operations are not available to the Bureau. This means that the magnitude of the revenue changes shown for bulk handling authorities is much greater than if measured in terms of net revenue, and therefore are not comparable with the gains or losses to other parties.

The annual costs and revenues for each option have been discounted to present values using a 7 per cent real discount rate and then added over the 20 year study period. Similar evaluations for discount rates of 4 and 10 per cent were also undertaken but have not been presented in the report as the general conclusions are identical to that for the 7 per cent discount rate; only the order of magnitude of the results differ.

---

1. For further details of the composition of the capital costs associated with each option refer to Appendix II, Table II.1.

TABLE 4.2—PRESENT VALUES OF FINANCIAL EVALUATIONS OF TRANSPORT ALTERNATIVES[a] IN 1981-82 PRICES; 7 PER CENT DISCOUNT RATE

($ million)

Option	Capital costs of options	Gain (loss) to producers[b]	Gain (loss) to SRA of NSW[c]	Gain (loss) to Queensland Railways	Gain (loss) to GHA of NSW[d]	Gain (loss) to QSWB[e]	Gain (loss) to truck operators	Gain (loss) to State Road Authority[f]
1. Standard gauge link between Boggabilla-Goondiwindi; unconstrained traffic task	40.8	(0.61)	(22.65)	(12.45)	(17.56)	12.16	(9.17)	7.1
2. Narrow gauge link between Goondiwindi-Boggabilla; unconstrained traffic task	37.2	2.32	(19.94)	(17.26)	(17.56)	12.16	(9.17)	7.1
3. Standard gauge link between Boggabilla-Goondiwindi; traffic task 100 000 tonnes grain per annum	5.9	0.45	(15.0)	5.06	(7.36)	5.1	..	..
4. Narrow gauge link between Goondiwindi-Boggabilla; traffic task 100 000 tonnes grain per annum	4.2	2.97	(12.79)	0.74	(7.36)	5.1	..	..
5. Road haulage to Queensland rail from Boggabilla, North Star and Croppa Creek; unconstrained grain traffic task	35.9	5.92	(33.64)	(20.95)	(17.56)	12.16	5.17	(2.0)

TABLE 4.2(Cont)—PRESENT VALUES OF FINANCIAL EVALUATIONS OF TRANSPORT ALTERNATIVES[a] IN 1981-82 PRICES; 7 PER CENT DISCOUNT RATE

($ million)

Option	*Capital costs of options*	*Gain (loss) to producers*[b]	*Gain (loss) to SRA of NSW*[c]	*Gain (loss) to Queensland Railways*	*Gain (loss) to GHA of NSW*[d]	*Gain (loss) to QSWB*[e]	*Gain (loss) to truck operators*	*Gain (loss) to State Road Authority*[f]
6. Road haulage to Queensland rail from Boggabilla, North Star and Croppa Creek; traffic task 100 000 tonnes grain per annum	1.0	3.65	(16.25)	5.06	(7.36)	5.1	2.08	(0.52)
7. Road haulage to silos at Texas and Yelarbon by NSW grain growers; traffic task 100 000 tonnes grain per annum	1.0	9.95	(17.76)	7.03	(7.36)	5.1	..	..
8. Road haulage from study region to Brisbane; unconstrained grain traffic task	..	4.37	(61.5)	..	(32.04)	22.18	35.22	(27.18)
9. Conveyor belt between Goondiwindi-Boggabilla; unconstrained grain traffic task	47.9	(36.43)	(23.27)	(20.95)	(17.56)	12.16	..	..

TABLE 4.2(Cont)—PRESENT VALUES OF FINANCIAL EVALUATIONS OF TRANSPORT ALTERNATIVES IN 1981-82 PRICES; 7 PER CENT DISCOUNT RATE

($ million)

Option	*Capital costs of options*	*Gain (loss) to producers*[b]	*Gain (loss) to SRA of NSW*[c]	*Gain (loss) to Queensland Railways*	*Gain (loss) to GHA of NSW*[d]	*Gain (loss) to QSWB*[e]	*Gain (loss) to truck operators*	*Gain (loss) to State*[f] *Road Authority*[f]
10. Conveyor belt between Goondiwindi-Boggabilla; traffic task 100 000 tonnes grain per annum	13.0	(20.24)	(12.79)	5.06	(7.36)	5.1	..	..
11. Standard gauge link between Inverell-Glen Innes; unconstrained grain traffic task	30.8	(3.82)	(30.93)	2.57	(2.82)	1.95	..	..
12. Standard gauge link between Warialda-Barraba; unconstrained grain traffic task	47.8	0.96	(47.77)	..	..	..	..	..

a. The assumptions underlying the evaluations are presented in Appendix II.
b. Wheat producers only.
c. State Rail Autority of New South Wales.
d. Grain Handling Authority of New South Wales.
e. Queensland State Wheat Board.
f. Estimate of combined costs or savings to State Road Authorities in New South Wales and Queensland.
.. not applicable

Source: BTE estimates.

As the objective of the study is to seek ways to lower transport costs and/or increase the transport services available to producers in the study region, it is appropriate to examine first the financial impact of the options on producers. The results for producers indicate the change in the costs of transporting their produce to Brisbane rather than Newcastle (apart from option 12 where a new rail link within the study region between Warialda and Barraba shortens the route to Newcastle).

Producers, mainly wheat growers, would obtain a reduction in transport costs under eight of the 12 options. The greatest gains are under the four road haulage options (options 5 to 8) with gains over the 20 year period ranging from $3.65m to $9.95m. The largest gain is for road haulage to new silos at Texas and Yelarbon (option 7). The new rail links (options 1 to 4, 11 and 12) provided relatively small gains under four options (the maximum being $2.97m) and losses under two options. The increase in costs for option 11 mainly reflects the assumption that higher intersystem rail freight rates would apply to wheat traffic being transported to Brisbane via Wallangarra. The high capital and operating costs of a conveyor belt underlie the significant increase in costs that grain producers would incur in options 9 and 10.

In each of the 12 options the State Rail Authority of New South Wales would incur a loss, ranging from $61m for option 8 to nearly $13m for options 4 and 10. The main determinant of these losses is the size of the wheat traffic transferred from the New South Wales to Queensland railway systems, and the associated loss of revenue to the SRA. In addition to these traffic revenue losses, the SRA would incur capital costs of $4.9m to build a standard gauge link between Boggabilla and Goondiwindi under options 2 and 3.

The Queensland Railways would incur losses ranging from $12m to in excess of $20m if either options 1, 2, 5 or 9 were implemented. The main reason for the loss in each option is the relatively high capital cost of $33m to upgrade the rail link between Goondiwindi and Brisbane to cater for the unconstrained traffic task. For the remaining options, the traffic task is 100 000 tonnes of grain per annum or less, and this avoids the need for Queensland Railways to upgrade the rail links to Brisbane either via Goondiwindi or via Wallangarra. These options result in gains to Queensland Railways ranging from $7m in option 7 to less than $1m in option 4.

Due to the decreased throughput of wheat at the Newcastle grain terminal, the Grain Handling Authority of New South Wales would incur reductions in gross revenues on all options where the wheat traffic is redirected through the Queensland bulk storage system. The losses vary from $32m under option 8 to $3m under option 11, in line with the volume of grain being directed to the Queensland system under each option. Conversely, the Queensland State Wheat Board would show a gain in gross revenues in each option where New South Wales wheat is channelled through the SWB bulk storage system. The gains range from nearly $2m for option 11 to over $22m for option 8. The above estimates are based on the grain handling charges applying in New South Wales and Queensland in 1981-82 as shown in Appendix II, Table II.2.

Road hauliers would gain under options 5, 6 or 8. The gains, due to the increased road haulage task, range from $2m for option 6 to $35m for option 8. However, because of the shift in the coarse grains, cotton and vegetable oils freight from road to rail in Options 1 and 2, road hauliers would incur losses of around $9m if either of these options were implemented.

Because of the increase in the road traffic task for options 5, 6 and 8, the State Road Authorities of New South Wales and Queensland together would incur increases in road maintenance costs, ranging from $0.5m for option 6 to around $27m for option 8. Conversely, because of the reduction in the road freight tasks in options 1 and 2, the State Road Authorities would achieve cost reductions of approximately $7m if either option were implemented.

The general conclusions that can be drawn from these financial analyses are that firstly producers, particularly wheat growers, would be the major beneficiaries in most options. Secondly, the major loser in all options would be the State Rail Authority of New South Wales. However, it should be borne in mind that the results are the present values of a 20 year stream of gains or losses and therefore the annual gains or losses would be relatively small. Queensland Railways losses are mainly attributable to the capital costs required to carry the unconstrained traffic task, which more than offset the revenue gains from additional traffic.

The gains and losses to the affected parties have not been added across the rows in Table 4.2 to show the net financial gain or loss for each option. As noted above, the gains and losses to the bulk handling authorities are gross revenues, and these should not be added to the net revenues accruing to other parties. However, if we ignore for the moment the financial returns to the bulk handling authorities, it is apparent that the net gains to wheat producers are significantly smaller than the combined losses to the two railway systems, with the exception of option 7 where they are approximately equal.

Economic Evaluations

The 12 transport options considered in the previous section have been subjected to an economic assessment in the form of a benefit cost analysis. However, six of the options in Table 4.2, that is options 5, 6, 8, 9, 10 and 11, had negative net benefits. This means that even if there was no capital cost involved in implementing these options, the cost of resources to ship the assumed traffic task via these options would be higher than those incurred under the existing situations. The options concerned are three of the four road haulage options, two conveyor belt options and the Inverell-Glen Innes rail link. These options are clearly not economically justified.

Options 5, 6 and 8 involve the use of commercial road haulage to move wheat from New South Wales silos either onto Queensland rail at Goondiwindi or direct to the grain terminal at Brisbane. The negative benefits for these options arose basically because of the relatively high costs of road transport compared with the alternative of transporting the grain to Newcastle over the existing New South Wales rail system. Similarly for options 9 and 10, the comparatively high costs of operating a conveyor belt to tranship wheat onto Queensland rail, compared with the existing New South Wales transport arrangements, preclude these options from being economically viable. Finally, for option 11 the net savings in rail costs of transporting relatively small quantities of wheat to Brisbane by rail, via Glen Innes and Wallangarra, rather than to Newcastle are more than offset by the costs of transferring the grain between the two railway systems at Wallangarra. As all of these options have negative benefits they are not discussed any further in this Report.

The results of the benefit cost analyses for the remaining six options at discount rates of 4, 7 and 10 per cent, are presented in Table 4.3. An important assumption in the evaluation is the expected size of the freight task under each option over the 20 year study period. The benefit cost ratios have been estimated for the expected average or trend values of the freight task, but it is also possible to demonstrate how the benefit cost ratios would vary around the mean value with fluctuations in the freight task.

The approach taken to measure the likely dispersion in the benefit cost ratios was to measure the year to year variation in the wheat harvest in the study area over the previous 30 years. This provided the parameters for a beta distribution which in turn was used to generate random traffic flows consistent with the past pattern of variability in the wheat harvest. The aproach was to express the benefit cost ratio as an average of 100 randomly generated traffic flows. The variation in the benefit cost ratios in response to these randomly generated traffic flows is measured by their standard deviations, which in turn were expressed as a ratio of the mean benefit cost ratios, to provide the measure of relative dispersion shown in Table 4.3. Appendix III provides further details of the methodology.

TABLE 4.3—BENEFIT COST RATIOS FOR TRANSPORT ALTERNATIVES IN CENTRAL NORTH NEW SOUTH WALES

(per cent)

Option	*Benefit cost ratio Discount rate*		
	4	*7*	*10*
1. Standard gauge rail link between Boggabilla-Goondiwindi; unconstrained traffic task	0.11 (9.5)	0.08 (9.3)	0.06 (8.8)
2. Narrow gauge rail link between Goondiwindi-Boggabilla; unconstrained traffic task	0.11 (9.3)	0.09 (8.9)	0.07 (8.3)
3. Standard gauge rail link between Boggabilla-Goondiwindi; traffic task 100 000 tonnes grain per annum	0.14	0.10	0.07
4. Narrow gauge link between Goondiwindi-Boggabilla; traffic task 100 000 tonnes grain per annum	0.16	0.11	0.08
7. Road haulage to silos at Texas and Yelarbon by NSW grain growers; traffic task 100 000 tonnes grain per annum	2.43	1.89	1.52
12. Standard gauge rail link between Warialda-Barraba; unconstrained grain traffic task	0.05 (8.6)	0.03 (8.1)	0.02 (8.2)

Note: *The figures in brackets are a measurement of the variability in the benefit cost ratios in response to changes in the size of the wheat traffic task. The measure is the ratio of the standard deviations of the benefit cost ratios to their mean value expressed as a percentage (see text for explanation).*

Source: BTE estimates.

Based on the assumptions underlying the analysis of each option, it can be seen from Table 4.3 that only option 7 would be economically viable at real discount rates of 4, 7 and 10 per cent. All other options would be uneconomic at any of the three discount rates, as the benefit cost ratio are less than unity.

At the lower discount rate of 4 per cent the benefit cost ratios range from 0.05 for option 12, the construction of a standard gauge rail link between Warialda and Barraba, to 2.43 for option seven, the construction of bulk grain storage facilities in Queensland for use by New South Wales grain producers. At the 10 per cent discount rate the benefit cost ratio for option 7 fell to 1.52.

Option 7 will yield benefits in terms of reduced road and rail costs. The road task (and hence the road haulage costs to wheat growers and the road maintenance cost to the State Road Authorities would be reduced, as grain from farms geographically closer to Texas and Yelarbon that to New South Wales silos would move to the Queensland silos. This saving in road costs however, could not be estimated due to the lack of information about the distribution of the location of wheat properties in the catchment area for the proposed silos in Queensland.

The benefits of option 7 indicated in Table 4.3 arise from savings in rail costs, which stem from the significantly shorter rail distances from Texas and Yelarbon to Brisbane than from the alternative New South Wales silos on the Moree-Inverell line (where the grain must move west to Moree before going south) to Newcastle. The exclusion of the savings in road costs means that the results for option 7 in Table 4.3 would be conservative.

The capital cost of constructing bulk grain storage facilities in Queensland has been estimated at $1m. However, a more detailed study of the distribution of wheat production in the proposed catchment area is required to determine more accurately the size of the traffic task and hence the level of investment in grain storage facilities at Texas and Yelarbon.

Table 4.3 also illustrates the relative dispersion of the benefit cost ratios to their mean values for those options where the grain traffic task was randomly generated to measure the effects of variability in the traffic task on the viability of the option. The relative dispersion of the benefit cost ratios around their mean value was only 8 to 9 per cent, signifying the relatively small impact the variability of the traffic task has on the viability of the proposed option.

The interpretation of the above results from the quantitative evaluations, and some limitations to them, are discussed in the following chapter.

CHAPTER 5—DISCUSSION OF RESULTS

In this concluding chapter the main findings of the analyses of a range of transport alternatives for central north New South Wales are discussed. Both the financial and economic aspects of each of the transport options are examined. In the former type of analysis the financial impact of each option on both the suppliers and users of transport services is assessed, while in the latter the economic efficiency, from a national viewpoint, of the particular traffic tasks is addressed.

Because of the considerable excess of outward over inward freight flows, as well as the primarily bulk character of outward flows and their need for relatively specialised transport equipment, assessment of the range of transport options was in terms of outward freight movements only. In addition, it is not expected that the implementation of any transport option would influence the modal split of the inward traffic task. While freight such as vegetable oils and cotton are included in the evaluation of the options relating to the construction of a rail link between Boggabilla and Goondiwindi, the fundamental point that has been assessed in the study is the effect of redirecting the flow of wheat away from Newcastle to the grain terminal at the Port of Brisbane.

KEY RESULTS

The transport alternatives for central north New South Wales for which the results of economic assessments have been presented in this Report included four options. These involved the establishment of an additional rail link between the New South Wales and Queensland railway systems via Goondiwindi (see options 1 to 4, Table 4.3). These options would provide additional rail services to and from the region. A fifth option relates to the construction of bulk grain storage facilities in Queensland for use by New South Wales grain producers. A sixth option established an alternative rail route for grain movements from the study area to Newcastle.

Only option 7, the construction of bulk grain storage facilities in Queensland for use by New South Wales grain producers, gave a benefit cost ratio greater than one at 4, 7 and 10 per cent real discount rates. The result indicates that such a project could be economically viable. However, it was postulated that the traffic task for this option be limited to 100 000 tonnes of wheat per annum as any significant increase in the task above this level would, on the advice of the Queensland Railways, require significant investment in the rail line to Brisbane, and this would reduce the benefit cost ratio to well below unity. Furthermore, a more detailed study would be required to determine the quantity of wheat, and hence the size of the traffic task that would be available in the catchment area of the proposed silos, so that the level of investment in bulk grain storage facilities in Queensland could be more accurately assessed.

The financial assessments revealed that grain producers would gain under eight of the twelve options. The best return to producers would be under option 7 which involves the construction of silos at Texas and Yelarbon for use by New South Wales wheat growers.

The State Rail Authority of New South Wales would incur significant losses if any of the options were implemented, due to the loss of traffic to Queensland Railways or to road. Queensland Railways would either gain or lose depending on which option is implemented. Under the four options (options 1, 2, 5 and 9) involving the movement of the unconstrained (over 100 000 tonnes) traffic task from Goondiwindi to Brisbane, Queensland Railways would incur losses due to the need for major investment in upgrading this line. In all options where wheat traffic is diverted to the Queensland bulk storage system, the Grain Handling Authority of New South Wales would suffer a financial loss greater than the gain to the Queensland State Wheat Board. While road hauliers would make significant financial gains of around $35m if the bulk of the wheat harvests in the study region were transported directly by road to the grain terminal at Brisbane (option 8), these gains would be more than offset by the combined losses of the State Road Authorities and the railways and bulk handling authority of New South Wales.

REASONS FOR NON-VIABILITY

The failure of the transport alternatives examined (apart from option 7) to be either financially or economically viable appears to result from the following main factors:

- the distance savings in transporting grain to Brisbane rather than Newcastle are not great;
- the distance savings to Brisbane are greater by road than rail, but the use of road transport to move significant quantities of freight originating in the study region to Brisbane is clearly not an economically viable option;
- only three grain receival depots in the study region (Boggabilla, North Star and Croppa Creek) are closer by rail to Brisbane, and the maximum distance saved is 145 km.
- the freight cost savings stemming from a shorter rail route to Brisbane are more than offset by higher capital costs; and
- the common practice of the railways of charging higher rates for intersystem than for intrastate traffic, adds to the financial cost of the Queensland options.

UNQUANTIFIED BENEFITS

It has not been possible for the BTE to quantify all the potential benefits and costs associated with the construction or upgrading of rail links in options concerned with linking the New South Wales and Queensland railway systems. On the cost side, no information is available to the BTE on the possible reduction in train operating costs which might flow from investments in new rail links and the upgrading of the existing Goondiwindi to Brisbane line.

A potential benefit from the construction of a rail link connecting the Queensland and New South Wales rail system could stem from the additional flexibility provided by an alternative outlet. This flexibility could take a number of forms but generally it is not possible to quantify the resultant benefits.

The report has noted that intersystem traffic in grain has occurred in the past to a limited extent in response to bumper crops in New South Wales and, more recently, to the movement of feed grain out of Queensland for drought assistance. Connection of the rail systems would provide an incentive to intersystem traffic, but decisions concerning the direction of movement of most grain traffic would rest with State bulk handling authorities. These authorities can be expected, in general, to prefer the transport and handling facilities of their own State so long as they are adequate for the task. However, some agreement between the New South Wales and Queensland authorities, perhaps similar to that operating in the Adjustment Area in southern New South Wales (referred to in Chapter 3) may be justified to promote the orderly movement of grains across the New South Wales/Queensland border.

Such a rail link would also provide the opportunity to divert relatively large quantities of export traffic, in either direction, where the need arose due to dislocations at major ports. Benefits from the alternative outlet would include such items as lower inventory costs and reduced demurrage charges.

Other possible benefits which it has not been possible to incorporate in the evaluations relate to possible reduction in costs of northbound shipping should grain traffic be exported through Brisbane rather than Newcastle. However, these benefits could be offset by the restriction of the size of ships that ply the grain trade out of the Port of Brisbane.

Finally, the construction of a rail link to connect the New South Wales and Queensland railways systems may yield additional benefits in times of national emergency by providing greater flexibility to move defence personnel and equipment.

Given the relatively small benefit cost ratios for the investment options involving the linking of the New South Wales and Queensland railway systems it is unlikely that inclusion of the benefits discussed above would be sufficient to make these options economically viable.

STABILITY OF RESULTS

It was not considered necessary to undertake formal sensitivity analyses of the results of the financial assessment of options due to their conclusive nature. In the economic evaluations of options where the traffic task was unconstrained, the sensitivity of the results with respect to seasonal fluctuations in grain harvests was examined; the benefit cost results appear to be relatively stable in the face of marked fluctuations in the grain traffic task.

A more difficult question is the likely stability of the results through time. Major coal developments are anticipated to the south of the region in the Gunnedah coal basin, and possibly to the north east in the Darling Downs. These developments would require investments in the rail lines to Newcastle and Brisbane but it is not clear how such investment would affect the transport options examined in this Report. However, any major developments in the network servicing the region would probably justify further monitoring of the transport services to central north New South Wales.

SUMMARY

Over a number of years residents of the north-west slopes and plains area of New South Wales have expressed their concern about the transport services to and from the area. In more recent times the concern has been exacerbated by a number of issues relating particularly to railway services.

One issue has been the reduction in rail services for general freight especially over the Moree to Inverell rail link. More recently, concern has been expressed regarding delays in railway services for export grain arising from dislocations at the Port of Newcastle. A related issue is the lack of an alternative rail service to offset such problems. A further concern expressed by grain producers arises out of the increase in demand for railway services as a result of the rapid growth in the extraction of coal resources south of the area. Grain producers appear to be of the opinion that there has been a lag in upgrading railway services to cater for this demand and this has impeded the services for their traffic.

In 1982, as a result of these concerns, the then Minister for Transport directed the Bureau of Transport Economics (BTE) to undertake a study of transport alternatives for central north New South Wales. The analysis undertaken in this report examines both the economic and financial aspects of a range of transport options for the region.

Economic evaluations were conducted for 12 transport options. These options included the construction of additional rail links to connect the New South Wales and Queensland railway systems, the use of road transport to move wheat out of the region either on to the Queensland railway system or direct to the grain terminal at the Port of Brisbane, the use of a conveyor belt to transport wheat on to Queensland rail, the construction of bulk grain storage facilities in Queensland for use by grain producers in New South Wales and the construction of a rail link between Warialda and Barraba to provide a shorter rail link between the region and Newcastle than the existing link via Moree.

However, six of these options produced negative net benefits from the initital investment and these results have not been included in the report. The remaining six alternatives included four options relating to the construction of a rail link between Boggabilla and Goondiwindi, the construction of a standard gauge rail link from Warialda to Barraba, and the provision of bulk grain storage facilities in Queensland for use by grain growers in New South Wales. The analysis found that the only option that appeared economically viable was the construction of silos in Queensland to accept grain direct from farms in New South Wales. A more detailed study of this option would be required to assess the appropriate level of investment in such facilities.

None of the remaining five options subjected to evaluation were economically viable. The benefits, which accured because of the small reduction in the distance freight had to be transported, were not sufficient to justify the required level of investment.

Sensitivity analysis of the economic evaluations to assess the effect of variations in the traffic task due to seasonal variability in grain production revealed that this would have little impact on the economic viability of the options examined.

It has not been possible to quantify any benefits which could flow from a linking of the New South Wales and Queensland rail systems in the form of additional flexibility for the movement of goods provided by an additional outlet. This flexibility is likely to be beneficial when, for example, the grain handling and transport system in one State develops bottlenecks due to bumper harvests or port dislocation at a time when excess capacity exists in the other State.

Even if it had been possible to include the potential benefits of such flexibility in the analyses and if the potential benefits could be realised in practice, it is doubtful whether they would have been sufficient to justify investment in the options which specified connection of the two rail systems.

Financial analyses indicates that for 8 of the 12 options wheat growers in the study area would receive financial gains. However, financial losses would be incurred by both the State Rail Authority and the Grain Handling Authority of New South Wales due primarily to the diversion of wheat traffic away from these authorities. The Queensland State Wheat Board would gain under each option where grain is diverted from the New South Wales bulk storage system, while Queensland Railways would gain or lose depending on the option chosen. A major diversion of the wheat traffic from Newcastle to Brisbane would require significant upgrading of the Queensland railway line between Goondiwindi and Brisbane; this does not appear to be financially justified by the wheat traffic likely to flow from the study area.

APPENDIX I—TERMS OF REFERENCE

Director
Bureau of Transport Economics

NORTH-WEST NSW TRANSPORT ALTERNATIVES

I refer to your recent discussion with Mr W. Murray MLA and Mr J.B. Black, Chairman of the MacIntyre Valley Transport Study Group.

I understand that you were presented with a submission on transport alternatives in the North-West slopes and plains area of NSW.

Primary producers in this area have also expressed concern at their continuing dependence on port facilities in Sydney and Newcastle.

I therefore direct the Bureau to examine the alternatives for the transport of stock, produce and community necessities to and from the North-West slopes and plains area of NSW, and to examine the feasibility of including this area in current studies on access to ports.

(RALPH J. HUNT)

APPENDIX II—ASSUMPTIONS UNDERLYING FINANCIAL AND ECONOMIC ANALYSES

This appendix contains the assumptions relating to the analyses of the 12 transport alternatives discussed in Chapter 4.

In all analyses prices and costs are at December 1981 values; real discount rates of 4, 7 and 10 per cent have been used; and each analysis is conducted over a 20 year time frame.

In the financial analyses involving railway operations, rail rates for interstate freight (subject to the exception below) were calculated by adding the rates applying to the distances travelled over each railway system. As rates are set on a sliding scale related to distance, the rate for a combined trip on the New South Wales and Queensland systems will be more than the rate for the same distance on one of the systems. The exception relates to the bulk rural commodities (cotton, coarse grains and vegetable oils) in options 1 and 2 currently going by road transport to Brisbane and which were postulated to transfer to rail if option 1 or 2 was implemented. The rates used in the analyses are the road rates that applied to this traffic in 1981–82 ($22 per tonne ex Moree and $26 per tonne ex Narrabri), as these rates are significantly lower than the intersystem rail freight rates. The revenue accruing to each railway system from this traffic was apportioned according to the distance travelled over each railway system.

Assumptions underlying all evaluations covering railway operations are as follows:

- cost of constructing a standard gauge rail link would be $455 000 per km, based on information supplied by Queensland Railways and personal contact with the Australian Railway Research and Development Organisation; this excludes land acquisition costs;
- cost of constructing a narrow gauge rail link would be $369 000 per km, based on information supplied by Queensland Railways, but excluding land acquisition costs;
- cost of operating a freight train, including capital charges is 2 cents per net tonne-km; cost data relating to the specific operations evaluated in the report are not available to the Bureau; the rate of 2 cents per net tonne-km is a composite figure based on a range of information available to the BTE; and
- no backhauling of freight to the study region by railway authorities.

Queensland Railways advised the BTE that provided the traffic task did not exceed 100 000 tonnes per annum, upgrading of the rail link between Goondiwindi and Brisbane would not be required. Consequently, in a number of options the traffic task is restricted to 100 000 tonnes per annum over the 20 year time frame. Queensland Railways have also advised the BTE that based on the projection of the unrestricted traffic task an upgrading program for the rail link to Brisbane would cost $33 million.

In the option where there is no restriction on the size of the traffic task it has been assumed that the growth in traffic task will increase at a compound rate of 2 per cent per annum over the time frame for the project.

The basis for the unrestricted traffic task, except for options 8 and 12, is as follows:

- 205 000 tonnes of wheat in 1981-82
  —based on the average receivals for the previous five years at silos operated by the Grain Handling Authority of NSW located at Boggabilla, North Star and Croppa Creek.
- Additional traffic task
  —64 000 tonnes of cotton, coarse grains and vegetable oils originating in the study area; and
  —22 000 tonnes of cotton and vegetable oils from the Narrabri area.
- This additional freight task was shipped to Brisbane by road transport in 1981-82 and industry sources advised the BTE that this freight would move to rail if facilities were available.

The basis for the unrestricted traffic task in option 8, road transportation of the wheat harvest in the study region to Brisbane, is 374 000 tonnes of wheat in 1981-82. This figure was based on the average receivals for the previous five years at all bulk grain receival points in the region, except Moree.

The basis for the traffic task in option 12, construction of a standard gauge rail link between Inverell and Glen Innes, is 33 000 tonnes of wheat in 1981-82. This figure is based on the average receivals for the previous five years of bulk wheat at Inverell, Mount Russell and Delungra.

In options 1 to 4, relating to the construction of a rail link between Boggabilla and Goondiwindi, the cost of constructing a bridge spanning the MacIntyre River is set at $0.8m. This figure was provided by the Queensland Railways.

In a number of options it was necessary to include the construction of a bulk grain transfer facility to facilitate the transfer of grain either between the two railway systems or from road to rail transport. Based on information contained in the report by the Queensland Planning Committee on Future Grain and Oilseed Handling, Storage and Transport, a throughput to capacity ratio of 20:1 has been used. On information supplied by the Queensland State Wheat Board, the cost of constructing a grain transfer facility has been set at $200 per capacity tonne with an operating cost per tonne of throughput of $1.50.

A summary of the composition of the capital costs associated with each option is contained in Table II.1.

In options 5, 6 and 7, the transportation of wheat by road on to Queensland rail for transhipment to Brisbane, commercial short haul road rates were calculated on the basis of the following Long Distance Road Transport Association formula:

$$(L+U)\,S + (2D\,R)\,\frac{1}{TC} = \text{Rate/Tonne}$$

where

L = Loading time (average estimate) in hours
U = Unloading time (average estimate) in hours
S = Standing time ($ per hour)
D = One way distance
R = Vehicle operating cost in $ per km
TC = Tonnes carried/truck

The following assumptions were used in the evaluation of option 8, the use of road transport to move the bulk of the wheat harvests from the study region to the Brisbane grain terminal:

- capital cost of prime mover: $97 000
- capital cost of trailer: $23 000
  —capital costs provided by a range of commercial vehicle retailers.

- variable operating costs of vehicle: 32.5 cents per km
  —based on vehicle operating costs contained in the BTE publication, Occasional Paper 36; *The Road Transport Business: A Guide to Some Financial Aspects* and adjusted for inflation.
- vehicles travel 150 000 km per annum but do not backhaul freight.

The following cost data for options 9 and 10, the construction of a covered conveyor belt between Boggabilla and Goondiwindi, were supplied by Cable Belt (Aust) Pty Ltd, Sydney:

- cost of construction: $12m
- operating costs: $1.50 per tonne-kilometre

Table II.2 details the payments made by producers to the bulk handling authorities for the movement and storage of wheat on the bulk handling systems and the stopover charges levied by the SRA of New South Wales.

The intersystem grain transfer charge is the operating cost of the transfer facility (capital costs are not included in the charge). The stopover charge is the rate per tonne levied by the SRA of New South Wales to offset the costs of unloading and reloading grain hoppers when the SRA is required to relocate grain within the bulk handling system. This levy is in addition to the normal freight rate.

TABLE II.1—CAPITAL COSTS USED IN THE EVALUATION OF TRANSPORT ALTERNATIVES

($ million)

Option 1	
Construction of a 9 km standard gauge rail link, including bridge	4.9
Upgrading Queensland Railways	33.0
Construction of grain transfer facility	2.9
Total	40.8
Option 2	
Construction of a 9 km narrow gauge rail link, including bridge	4.2
Upgrading Queensland Railways	33.0
Total	37.2
Option 3	
Construction of a 9 km standard gauge rail link, including bridge	4.9
Construction of grain transfer facility	1.0
Total	5.9
Option 4	
Construction of a 9 km narrow gauge rail link, including bridge	4.2
Option 5	
Upgrading Queensland Railways	33.0
Construction of grain transfer facility	2.9
Total	35.9
Option 6	
Construction of grain transfer facility	1.0
Option 7	
Construction of grain transfer facility	1.0
Option 8	
No fixed capital costs	

TABLE II.1(Cont)—CAPITAL COSTS USED IN THE EVALUATION OF TRANSPORT ALTERNATIVES
($ million)

Option 9	
Upgrading Queensland Railways	33.0
Construction of a 9 km conveyor belt	12.0
Construction of grain transfer facility	2.9
Total	47.9
Option 10	
Construction of a 9 km conveyor belt	12.0
Construction of grain transfer facility	1.0
Total	13.0
Option 11	
Construction of a 67 km standard gauge rail link	30.5
Construction of grain transfer facility	0.3
Total	30.8
Option 12	
Construction of a 105 km standard gauge rail link	47.8

Source: BTE estimates.

TABLE II.2—GRAIN HANDLING CHARGES BY BULK HANDLING AUTHORITES AND STATE RAIL AUTHORITY OF NSW, 1981-82

($ per tonne)

Option	*Charge by GHA of NSW*[a]	*Charge by Queensland SWB*[b]	*Intersystem grain transfer charge*[c]	*Rail stopover charge*
1. Standard gauge rail link between Boggabilla-Goondiwindi; unconstrained traffic task	5.50	4.50	1.50	..
2. Narrow gauge rail link between Goondiwindi-Boggabilla; unconstrained traffic task	5.50	4.50	1.50	1.50
3. Standard gauge rail link between Boggabilla-Goondiwindi; traffic task 100 000 tonnes grain per annum	5.50	4.50	1.50	..
4. Narrow gauge rail link between Goondiwindi-Boggabilla; traffic task 100 000 tonnes grain per annum	5.50	4.50	1.50	1.50
5. Road haulage to Queensland rail from Boggabilla, North Star and Croppa Creek; unconstrained grain traffic task	5.50	4.50	..	..
6. Road haulage to Queensland rail from Boggabilla and North Star; traffic task 100 000 tonnes grain per annum	5.50	4.50	..	..
7. Road haulage to silos at Texas and Yelarbon by NSW grain growers; traffic task 100 000 tonnes per annum	..	16.00	..	..
8. Road haulage study region to Brisbane; unconstrained grain traffic task	5.50	4.50	..	..
9. Conveyor belt between Goondiwindi-Boggabilla; unconstrained grain traffic task	5.50	4.50	1.50	1.50
10. Conveyor belt between Goondiwindi-Boggabilla; traffic task 100 000 tonnes grain per annum	5.50	4.50	1.50	1.50

TABLE II.2(Cont)—GRAIN HANDLING CHARGES BY BULK HANDLING AUTHORITES AND STATE RAIL AUTHORITY OF NSW, 1981-82

($ per tonne)

Option	*Charge by GHA of NSW*[a]	*Charge by Queensland SWB*[b]	*Intersystem grain transfer charge*[c]	*Rail stopover charge*
11. Standard gauge rail line between Inverell-Brisbane; unconstrained grain traffic task	5.50	4.50	1.50	..
12. Standard gauge rail link between Warialda-Barraba; unconstrained grain traffic task	12.00	..	..	..

a. Grain Handling Authority of New South Wales total charge for storage and handling of $12.00 per tonne of which it has been assumed that the country storage charge was $5.50 per tonne.
b. *Queensland* State Wheat Board total charge for storage and handling of $16.00 per tonne of which $4.50 per tonne comprises the terminal charges.
c. Excludes capital cost.

.. not applicable

Sources: Grain Handling Authority of New South Wales Annual Report (1981). Queensland State Wheat Board, personal communication.

APPENDIX III—PROBABILISTIC COST BENEFIT RATIOS

An important characteristic of wheat harvests is the variability in the size of the harvests from year to year in response to factors such as the weather and the expected price of wheat. To see how this variability would affect the benefit cost ratio, a number of simulations were done with a random variability imposed on the expected long term mean of the harvest size.

The cost benefit analysis was carried out over a 20 year study period from 1980–81 to 2000–01. For each year in the study period a forecast of the size of the harvest was produced by combining the estimated long term trend of the harvest size with a random factor. A cost benefit ratio was then calculated. One hundred such analyses were simulated, each time with different random factors. The mean and variance of the resulting one hundred cost benefit analysis simulations were then computed.

This procedure differs in some important aspects from the probabilistic cost benefit analysis of Jackson and Linard (1980). In that study a probabilistic distribution is attached to parameters in the analysis whose values carry a degree of uncertainty or subjective judgement. By performing a number of simulations with the uncertain parameters taking values drawn from a probabilistic distribution, Jackson and Linard were able to calculate a distribution of the benefit cost ratio. By comparison, the distribution of the benefit cost ratio in the present study is caused by an inherent variability from year to year in one of the parameters, the crop size, which is assumed to be a random variable with a known probability density function.

The Beta Distribution

The family of two parameter beta distributions from which the random factor is drawn is composed of all distributions with probability density functions of the form

$$P(y) = \frac{1}{B(r,s)} \frac{(y-a)^{r-1}(b-y)^{s-1}}{(b-a)^{r+s-1}} \quad a<y<b$$

with $r>o$ and $s>o$. $B(r,s)$ is the beta function. The shape of the distribution varies considerably as r and s take different values. These range from bell shaped curves with varying degrees of skewness, to U shaped curves, to monotonically increasing or decreasing functions. Some of these distributions are illustrated in Johnson and Kotz (1970).

Making the transformation

$$x = \frac{y-a}{b-a} \tag{1}$$

the following probability density functions are obtained

$$p(x) = \frac{1}{B(r,s)} x^{r-1}(1-x)^{s-1} \quad o<x<1$$

which have mean

$$\mu = \frac{r}{r+s},$$

and variance

$$\delta^2 = \frac{rs}{(r+s^2)\ (r+s+1)}$$

Using these equations to solve for r and s results in

$$r = \frac{\mu^2}{\delta^2} \frac{(1-\mu-\delta^2)}{\mu}, \text{ and} \tag{2}$$

$$s = \frac{r(1-u)}{\mu} \tag{3}$$

Estimating Possible Crop Variability

The amount of variability induced in the crop size was based on the recorded size of wheat harvests in the study region over the last 30 years. An ordinary least-squares regression was performed on the wheat harvest with respect to time to obtain trend values. The ratio of the actual crop size to the trend value was calculated for each of the last 30 years. The maximum value (a), the minimum value (b) of this factor as well as its mean $(\overline{x})$ and variance (Var) were calculated.

The factor was assumed to be distributed as the beta distribution and the transformations

$$\mu = \frac{\overline{x}-a}{b-a}, \text{ and} \tag{4}$$

$$\delta^2 = \frac{Var}{(b-a)^2} \tag{5}$$

were performed to give values standardised on 0, 1 . The parameters r and s were then calculated from (2) and (3). (For a more sophisticated method of calculating the parameters using the first four moments, see Johnson and Kotz 1970).

Simulating Future Crop Variability

The factors applied in the expected harvest were calculated by drawing random numbers x_i from a beta distribution on 0, 1 with parameters r and s and applying the reverse transformation to (1)

$$F_{t,i} = (b-a)\ x_i + a \tag{6}$$

Such a factor was multiplied by the expected long term trend of the wheat harvest for each year during the forecast period. A cost benefit ratio was calculated for 100 realisations of the randomised wheat harvest. The mean, variance and coefficient of variation of these cost benefit ratios were then calculated. The results are reported in Chapter 4.

Suitability of the Beta Distribution

To see how well the beta distribution fits the observed data, Figure III.1 shows a histogram of the residual factors from the regression together with the beta distribution derived by the above method. This histogram indicates a satisfactory fit.

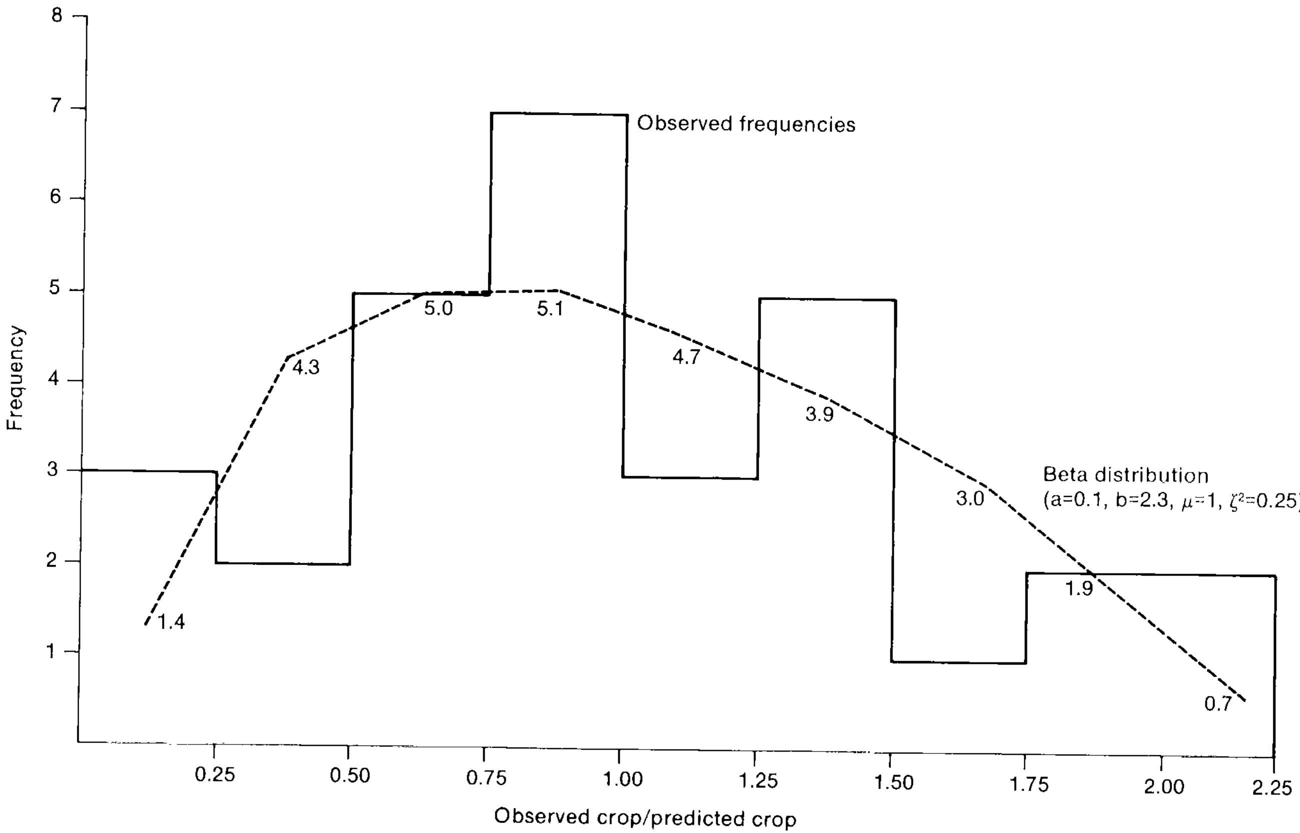


Figure III.1—Comparison of a beta distribution with the distribution of wheat production

REFERENCES

Australian Bureau of Statistics (ABS) (1977), *Characteristics of Population in Local Government Areas, New South Wales, 1976*, Cat No 2427.0, Canberra.

____(1978), *Roads in Statistical Divisions and Local Government Areas as at 30 June 1978*, Cat No 9202.1, NSW.

____(1978-82a), *Crops, Australia, 1976-77 to 1980-81*, Cat No 7302.0, Canberra.

____(1978-82b), *Livestock, Australia, 1976-77 to 1980-81*, Cat No 7203.0, Canberra.

____(1978-82c), *Wool, Australia, 1976-77 to 1980-81*, Cat No 7212.0, Canberra.

____(1978-82), *Winter—Growing Grains and Seeds, Queensland, 1976-77 to 1980-81*, Cat No 7305.3, Brisbane.

____(1978-82), *Summer—Growing Grains and Seeds, Queensland, 1976-77 to 1980-81*, Cat No 7304.3, Brisbane.

____(1978-82), *Miscellaneous Crops, Queensland, 1976-77 to 1980-81*, Cat No 7309.3, Brisbane.

____(1978-82), *Livestock on Rural Holdings, Queensland, 1977 to 1981*, Cat No 7202.3, Brisbane.

____(1978-82), *Wool Production, Queensland, 1976-77 to 1980-81*, Cat No 7205.3, Brisbane.

____(1978-82), *Artificial Fertiliser Used on Rural Holdings, Queensland, 1976-77 to 1980-81*, Cat No 7402.3, Brisbane.

____(1978-82), *Agriculture Section: Land Use, Artificial Fertilisers and Other Improvements, New South Wales, 1976-77 to 1980-81*, Cat No 7104.1, Sydney.

____(1978-82), *Meat, Australia, 1976-77 to 1980-81*, Cat No 7206.0, Canberra.

____(1978-82), *Agriculture Section: Crops and Pastures, New South Wales, 1976-77 to 1980-81*, Cat No 7305.1, Sydney.

____(1982a), *The 1981 Census of Population and Housing*, Cat No 2137.0, Canberra.

____(1982), *Interstate Freight Movement, Australia, 1980-81*, Cat No 9212.0, Canberra.

____(1983), *Consumer Price Index, Dec 1982*, Cat No 6401.0, Canberra.

____(1983), *Average Weekly Earnings, States and Australia, Dec 1981*, Cat No 6302.0, Canberra.

____(1983), *Rail Transport, Australia 1980-81*, Cat No 9213.0, Canberra.

Australian Railway Research and Development Organisation (AARDO) (1981), *National Rail Investment Study: Methodology*, Melbourne.

Australian Wheat Board (AWB) (1982), *Annual Report 1980-81*, Melbourne.

Bureau of Agricultural Economics (BAE) (1983a), *Situation and Outlook 1983 Oilseeds*, AGPS, Canberra.

____(1983b), *Situation and Outlook 1983 Cotton*, AGPS, Canberra.

____(1983c), *Situation and Outlook 1983 Meat*, AGPS, Canberra.

____(1983d), *Situation and Outlook 1983 Wheat*, AGPS, Canberra.

____(1983e), *Situation and Outlook 1983 Wool*, AGPS, Canberra.

Grain Elevators Board of New South Wales (1977-80), *Annual Report, 1976-77 to 1979-80*, Sydney.

Grain Handling Authority of New South Wales (1981), *Annual Report 1980-81*, Sydney.

____(1982), *Annual Report 1981-82*, Sydney.

Industries Assistance Commission (IAC) (1983), *Draft Report on the Wheat Industry*, AGPS, Canberra.

Jackson, A. and Linard, K. (1980), 'Project Appraisal Under Uncertainty -Probabilistic Cost-Benefit Analysis', *Sixth Australian Transport Research Forum: Forum Papers*, Metropolitan Transit Authority, Brisbane.

Johnson, N.L. and Kotz, S. (1970), *Continuous Univariate Distribution—2*, Houghton Mifflin Company, Boston.

Joint Coal Board (1982), *Thirty-Fourth Annual Report 1980-81*, Sydney.

Michael Read and Associates, (1982) 'Grain Handling Transport in Victoria', Geelong.

New South Wales Grain Handling Enquiry (1981), *Final Report, 1981*, Sydney.

Queensland Coal Board (1981), *The 30th Annual Report*, Brisbane.

Queensland Planning Committee on Future Grain and Oilseed Handling, Storage and Transport (1981), Report, Brisbane.

Railways of Australia (1979), *Classification of Railways*, Melbourne.

State Rail Authority of New South Wales (SRA) (1981), *Annual Report 1981*, Sydney.

____(1982), *Annual Report 1982*, Sydney.