Economic Evaluation of Capital Investment in Urban Public Transport

Report

This Report was prepared as the basis for the Standing Committee of Advisersí report to the Australian Transport Advisory Council on urban public transport needs in this decade.

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Bureau of Transport Economics

ECONOMIC EVALUATION OF CAPITAL INVESTMENT IN URBAN PUBLIC TRANSPORT

June, 1972

BUREAU OF TRANSPORT ECONOMICS

ECONOMIC EVALUATION OF

CAPITAL INVESTMENT IN URBAN PUBLIC TRANSPORT

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New South Wales

Department of Government Transport
New South Wales Government Railways
Sydney Area Transportation Study
State Planning Authority
Department of Main Roads

Victoria

Ministry of Transport *

Queensland

Department of Transport
Queensland Government Railways
Co-ordinator General's Department
Main Roads Department

South Australia

Director-General of Transport
Department of Transport
South Australian Railways
Municipal Tramways Trust
Highways Department

Western Australia

Director-General of Transport
Western Australian Government Railways
Metropolitan Transport Trust
Perth Regional Transportation Study
Main Roads Department

* The Ministry of Transport provided an estimate of capital expenditure.

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SUMMARY

This report was prepared as the basis for the Standing Committee of Advisers' report to the Australian Transport Advisory Council on urban public transport needs in this decade.

The role of the Bureau of Transport Economics was constrained by the circumstances of the study to a survey of capital expenditures considered necessary by State Authorities for the period 1973-74 to 1977-78, the social benefit-cost evaluation of a selected range of investment proposals and a supporting review of statistical and financial data.

The survey resulted in the estimates of capital expenditure requirements of $324m for Sydney, $276.3m for Melbourne, $58.8m for Brisbane, $43.15m for Adelaide and $57.5m for Perth; a total of $759.75m. These estimates only relate to public transport services within Capital City Statistical Divisions.

Social benefit-cost evaluations were made of proposals involving expenditures of $300.9m which could be considered representative of proposals for approximately $500m of capital expenditure.

At a discount rate of 7 per cent, the results indicated mean values of the benefit-cost ratio of 1.7 for replacing old public transport vehicles, 4.0 for track additions in congested sections of urban railway, 2.7 for electrifying well patronised railway services, 4.8 for bus and car interchanges at selected points on efficient rail systems, 7.0 for separate busways, 4.9 for a particular ferry service proposal and 2.1 for new rail links and route extensions.

As any benefit-cost ratio over 1.0 indicates a worthwhile public investment, these results strongly suggest that a substantial additional capital investment in urban public transport would yield a high rate of social return.

No analyses were made of proposed expenditures on central underground railways. These expenditures are included in the capital estimates, and amount to $112m in Melbourne, $10.8m in Adelaide and $39m in Perth. The Sydney Eastern Suburbs Railway, at a cost of $97m, also was not evaluated.

The review of statistical and financial data supported the view that public transport fulfills a vital function in capital cities, that current levels of capital expenditure are inadequate and that public transport authorities cannot finance an appropriate level of investment from current revenue sources.

CHAPTER 1. INTRODUCTION

ORIGIN OF THE STUDY

A study of urban public transport was initiated by the Thirty-Fifth Meeting of the Australian Transport Advisory Council in July, 1971. The relevant Minute of the meeting is as follows :

> "Council directed Advisers to prepare, as a matter of urgency and with the assistance of the Bureau of Transport Economics, a report on the overall need for investment in urban public transport services and prospective sources of finance for this purpose, in the years to 1979."

After considering the problem and the resources available to it, the B.T.E. suggested to the November 1971 Meeting of the Standing Committee of Advisers a study framework within which the B.T.E. could most effectively contribute to the Advisers' Report. This approach was accepted by the Standing Committee of Advisers.

In general the role of B.T.E. was envisaged as preparing a report embracing :

- a current assessment of the public transport improvements and developments considered necessary by State authorities;
- an assessment of the financial constraints which may inhibit implementation of these works;
- an analysis of the State proposals making possible a classification of them on a consistent national basis; and
- a broad indication of the level of priority which could be accorded proposed urban public transport investments compared to that for investment proposals in the public sector generally.

CONSTRAINTS

The B.T.E. did not set out to prepare a comprehensive treatise on the subject of urban public transport. It has refrained specifically from comment on the administration of urban public transport, transport planning, pricing policies, urban development policies, decentralisation and transport technology. As far as practicable, the report is confined to an objective presentation of information; in particular the results of evaluating a group of public transport improvement projects brought forward by State authorities.

The main constraint in the study has simply been time. The B.T.E. commenced work on the project in November; guidelines for State participation were completed in December; improvement projects were defined in January; analytical data requirements were established in February, and States generally compiled evaluation data during the period February to May. In May and June, the B.T.E. analysed projects for which detailed data were supplied by State authorities, to provide the central element of this report.

Urban public transport is a subject of considerable complexity and any analysis of it is bound to be constrained by the practical need to take a simplified view of the real world interactions between public and private transport, transport and land use, and transport pricing policies. For the study, the B.T.E. has generally accepted the present framework within which urban transport operates. This acceptance does not imply that the B.T.E. considers the existing institutional arrangements, pricing policies or urban development strategies to be optimal. Nor does it imply that the B.T.E. considers the range of projects proposed as exhaustive, or that the proposed projects are necessarily the best means of improving public transport in each particular circumstance. Thus, in this particular study, the B.T.E. role has been one of project evaluation, not of transport planning.

The evaluations are based on travel data, cost estimates and passenger forecasts provided by State authorities. Although this information was reviewed critically, and sensitivity tests were made on critical inputs, the accuracy of this information, to a large extent, was the responsibility of State authorities.

One reservation may be made about the benefit-cost type of analysis adopted for the study. While the B.T.E. believes that this provides the most meaningful basis for considering investment in urban transport, the specific procedures are still being developed and will inevitably be improved as better data become available. In particular, more accurate information is needed on the component costs of public transport operation, the value of time savings, the value of travel comfort and convenience, and patronage response to changes in the time and cost of travel.

Mention may also be made of the geographic coverage of the survey. Hobart and provincial cities were not surveyed, on the understanding that the investment potential would be indicated broadly by the comparative results for the large cities. At the wish of the Victorian authorities, the list of investment items provided for Melbourne was not reviewed by the B.T.E., nore were data provided for project evaluation as in the other participating cities. However the B.T.E. made some evaluations of investment in Melbourne urban public transport using published material.

CHAPTER 2. THE B T E STUDY

SOCIAL BENEFIT-COST ANALYSIS

The central element in the B.T.E. study is the evaluation of a variety of actual proposals for public transport improvement and development.

The basis for the evaluations is social benefit-cost analysis. This is a process of valuing, in dollars, all the more direct aspects in which a proposed investment in public transport (a 'project') will change existing travel characteristics and established trends in these characteristics. Essentially, the analysis adds all the costs of travel associated with a continuation of existing conditions (base case) and compares this with a corresponding total cost of travel associated with the project (project case). In doing so, costs to public transport passengers, private road users, and authorities responsible for providing public transport and road facilities are all included. The costs cover not only such direct costs as public transport vehicle purchase, public transport operation, road construction and the operating costs of cars and trucks, but also the value of travel time and traffic accident savings.

Where project case costs are lower than base case costs, the difference measures the benefits of the specified project. The comparison between the initial capital investment in the project (the 'costs') and the subsequent train of cost differences (the 'benefits') provides a measure of the social economic merit of the investment. If benefits exceed costs, after taking appropriate account of future costs by a discounting procedure, then the project is justifiable in the terms of the evaluation. The ratio of benefits to costs indicates the relative merit of one project compared to others.

SURVEY OF IMPROVEMENT PROJECTS

The study commenced with a survey of the public transport improvement projects which State Authorities consider should be undertaken, or substantially commenced, during the period 1973-74 to 1977-78. This period was adopted as being appropriate for indicating investment needs in this decade, while minimising practical difficulties of data assembly and the separation of committed and proposed works.

The survey was intended to provide a sound basis for the selection of representative projects for evaluation and also to provide relevant information on the amount and distribution of expenditures which could be involved in such works in the future. In accordance with these objectives, the B.T.E. prepared standard guidelines for project selection so that public authorities in each participating city could list projects on a comparable basis.

Generally, the survey conditions were that :

- investments should relate substantially to the period July 1973 to June 1978,
- projects should be within the Capital City Statistical Divisions,
- expenditures should be confined to capital works and equipment,
- projects should be restricted to those with a reasonable potential for justification according to benefit-cost evaluation based on community welfare, and
- in aggregate the programme for each city should be attainable with the resources of skilled labour and material likely to be available, taking realistic account of the time required for land acquisition, engineering design and equipment purchase.

From the projects identified in the survey (or from published information in the case of Melbourne), a representative range of projects was selected for evaluation. However, proposed central city underground systems (and the Sydney Eastern Suburbs Railway) were specifically excluded because the complexity of such systems, in terms of effects on railway networks, road networks and urban development, made evaluation impracticable at this stage.

PROJECT EVALUATIONS

The project evaluations carried out by the B.T.E. were essentially of two types: urban corridors and vehicle acquisition. The first was directed towards indicating the social-economic merit of improving public transport service in particular urban corridors, which by the nature of public transport, were generally radial to the central business district. The second type investigated the merit of replacing old buses, trams and trains with new vehicles.

Although interactions exist between public transport services throughout a city, individual decisions are normally made about improving specific parts of systems and about the relative priority of such improvements. As a rule, improvements can be constructed and brought into operation incrementally. Also, it is generally feasible to assess the main tributary area over which travel is likely to be affected by a proposed public transport improvement, because of geographic factors and the existing pattern of transport routes. Further, the survey projects were selected so as to rectify serious deficiencies in the level of service throughout entire urban areas. That is, the projects would be unlikely to markedly distort travel orientation in particular parts of a city.

These considerations indicate the urban corridor as the appropriate geographic unit for evaluation. The corridor approach makes possible a practicable analytical procedure for assessing the order of merit of individual projects, rather than confining analysis to global investment programmes.

The analysis of an urban corridor project involves a great deal of computation to take account of travel costs over an extended period of time for many route sections having different characteristics, for both base case and project case conditions. It also involves comparisons of costs and benefits for various test values of cost estimates, patronage forecasts and economic values. The task would be impracticable manually, so a computer program, or 'model', was developed for this phase of the study.

The analysis of public transport vehicle replacement is computationally less demanding, so it was not essential to write a computer program for this type of evaluation.

In addition to the survey of public transport projects, supporting statistical data were prepared relating to the task performed by public transport and the financial position of public transport authorities. The statistical information indicates the primary role of existing public transport systems, the relative importance of the main types of public transport service in each capital city and trends in public transport usage. The financial data provide a basis for assessing the capability of public transport authorities to generate funds for capital investment from fare revenues.

CHAPTER 3. CONCLUSIONS

The data assembly and the project evaluations carried out in the study enable a broad view to be taken of the merit of public transport investment in capital cities in the next decade. The role of the B.T.E. in the study precludes it from suggesting what should be done, either in relation to the general urban environment, of which urban public transport is only one facet, or in relation to the identification and the financing of specific proposals for public transport improvement. The results of the study, however, do provide a basis for decisions relating broadly to the need for investment in urban public transport services, the magnitude of funds required and prospective sources of finance for this purpose. The techniques of evaluation developed for the study provide a methodology for determining the relative merit of different public transport improvement projects, where appropriate data are available.

The investigations covered in the study and the analytical procedures adopted are detailed in the Annexes. Annex A presents statistical data relating to vehicle utilisation and passengers carried by various modes of public transport in each State capital. The figures substantiate the largely self-evident views that the urban public transport task is one of very real importance in major cities, that the most important role is service radial to central business districts and that rail service is of most significance in the larger cities.

Annex B contains details of trends in passenger service and in the financial results of public transport operation. The decline, over recent years, in total passengers carried and the deteriorating position reflected by the operating accounts of publicly operated services is apparent.

The tables in Annex B also show trends in capital investment in public transport. These can be contrasted with the estimates of capital investment needs which have been developed from transportation studies. Despite any reasonable reservations

in regard to the basis on which these estimates were derived, it is clear that a marked divergence exists between current levels of investment and the general magnitude of future needs.

Annex C indicates the complex financing and accounting situation involving urban public transport authorities. Setting aside questions relating to the most appropriate treatment of historical costs in the accounts and the effectiveness of current pricing policies, it is difficult to separate the financial position of the authorities from the overall financial position of the State governments. However, under existing circumstances it is clear that public transport authorities are unable to generate funds for capital investment from fare revenues. The ability of State governments to provide finance will depend on changes which may be made in State investment priorities to favour public transport, and on changes which may occur in the overall financial position of State governments. Even so, capital expenditure for public transport can only be provided after public transport operating deficits are met.

In view of these uncertainties it was inappropriate for the B.T.E. to attempt an elaborate analysis of possible sources of funds for capital investment in public transport. It was sufficient to observe that if there are no radical changes in State government policies and financing capabilities, the historical record makes it clear that the investment funds for public transport improvements will be severely limited.

Annex D describes the general principles involved in social benefit-cost evaluation and the reasons why this type of analysis is more appropriate than financial accounting for the purposes of the study. The Annex includes a description of the procedures adopted for the project evaluations.

A description of the survey of public transport improvement proposals and the detailed data used in the project evaluations is contained in Annex E. The estimates of investment needs supplied by State authorities in response to the survey guidelines are shown in Table 1.

TABLE 1 - ESTIMATED CAPITAL EXPENDITURES, 1973-74 to 1977-78

($ million)

Expenditure Item	Syd.	Melb.	Bris.	Adel.	Perth
Railways - Permanent Way					
Route upgrading (electrification, re-alignment, additional tracks)	87	30.1	19.8	2.0	
New routes - suburban	14	37.7	7.5	12.8	2.4
- central underground		112.3*		10.8*	39.0*
- Eastern Suburbs Rly	97*				
Signalling improvements	3	5.0		0.8	
Buses and Trams					
New busways					7.9
Tram route upgrading				0.2	
Bus operation pilot projects				2.8	
Rolling Stock					
Railways	90	70.0	23.7	3.0	
Trams, buses and ferries	12	14.4	3.3	6.0	4.9
Passenger Interchanges	20	6.3	2.5	1.6	2.2
Planning and Research	1	0.5	2.0	2.15	1.1
TOTAL	324	276.3	58.8	43.15	57.5

* Projects not represented in the project analyses.

Table 1 includes an item covering planning and research activities directed towards improving the efficiency of existing public transport facilities and deriving the maximum benefit from the proposed capital expenditures.

Details of the project evaluations are included in Annex F. For reasons described elsewhere in this report, the results of the evaluations are indicative only and should not be taken as a precise evaluation of the merit of any individual project. The results are summarised in Table 2.

TABLE 2 - SUMMARY OF PROJECT EVALUATION RESULTS

Project description	Cost in period 1973-74 to 1977-78	Benefit-cost ratio (a) 7%	Benefit-cost ratio (a) 10%	Internal rate of return (b)	Net present value at 7% (c)
	$'000			%	$'000
CORRIDOR PROJECTS					
Sydney					
1.* Redfern-Tempe Railway: two additional tracks for 2.6 miles	7,970	3.3	2.5	23	16,690
2.* Sutherland-Waterfall Railway: electrification of 8 miles of track	2,660	2.2	1.6	16	2,444
3. Illawarra Corridor: Project 2 and share of Project 1	9,200	4.9	3.7	30	32,782
4.* Tempe-East Hills Railway: one additional track for 4.2 miles	1,700	0.9	0.7	6	-102
5.* East Hills-Glenfield Railway: two new tracks for 4.5 miles	13,400	1.7	1.2	12	8,005
6. Campbelltown Corridor: Projects 4 and 5 and share of Project 1	17,089	3.4	2.5	20	37,052
7. North Sydney-Gordon Railway: two additional tracks for 7.6 miles	13,451	2.0	1.5	16	12,640
8. Strathfield-Epping Railway: two additional tracks for 7.2 miles	7,820	2.5	1.9	17	11,183
9. Cabramatta-Campbelltown Railway: two additional tracks for 14.3 miles	12,470	3.6	2.4	16	28,194
10. Seven Hills-Penrith Railway: two additional tracks for 14 miles	8,631	9.3	5.2	31	60,425

* Evaluations exclude some benefits taken into account in the corridor evaluations (Projects 3 and 6)

TABLE 2 - SUMMARY OF PROJECT EVALUATION RESULTS (CONTINUED)

Project description	Cost in period 1973-74 to 1977-78	Benefit-cost ratio (a) 7%	Benefit-cost ratio (a) 10%	Internal rate of return (b)	Net present value at 7% (c)
	$'000			%	$'000
11. Gladesville Ferry: two ferries	518	4.9	3.6	27	1,876
Melbourne					
12. East Doncaster Railway: two new tracks for 4.5 miles	18,500	1.1	0.9	9	2,566
Brisbane					
13. Northern Corridor Electrification: electrification of 20.1 miles of railway	16,755	2.9	2.1	16	24,248
14. Brunswick Street-Northgate Railway: additional track for 5 miles	1,547	3.4	2.5	22	2,350
15. Bus-Rail Interchanges: (a) two interchanges	1,965	4.7	3.6	36	6,737
(b) one interchange	827	7.1	5.5	54	4,749
16. Car-Rail Interchanges: parking areas at three stations	630	5.1	4.0	37	2,438
17. Merivale Street Bridge: new bridge to link rail systems	8,630	2.4	1.7	15	10,300
Adelaide					
18. Brighton-Christie Downs Railway: additional track for 4.5 miles, two new tracks for 4.2 miles	6,630	4.7	3.4	26	22,587
19. Glenelg Tramway: new vehicles and route improvements	3,174	0.8	0.6	5	- 401

TABLE 2 - SUMMARY OF PROJECT EVALUATION RESULTS (CONTINUED)

Project description	Cost in period 1973-74 to 1977-78	Benefit-cost ratio		Internal rate of return	Net present value at 7%
		7%	10%		
		(a)		(b)	(c)
	$'000			%	$'000
Perth					
20. Perth-Claremont Busway: replacement of railway by busway for 6 miles	5,083	8.1	6.0	45	30,889
21. Mitchell Freeway Busway: new busway for 2.8 miles	3,330	5.3	4.0	30	11,770
VEHICLE REPLACEMENT PROJECTS					
22. Sydney Buses: 500 new buses	11,000	1.4	1.3	19	3,800
23. Sydney Trains: 281 new units	90,000	1.7	1.5	23	51,500
24. Melbourne Trams: 100 new trams	7,500	1.4	1.2	15	2,200
25. Melbourne Trains: 75 new trains	52,500	1.7	1.5	21	28,600
26. Perth Buses: 186 new buses	5,000	1.4	1.3	22	1,700

(a) Ratio of discounted benefits to discounted costs. (b) Discount rate at which discounted costs equals discounted benefits. (c) Discounted benefits less discounted costs.

The results of the evaluations are striking. Despite any reasonable errors in the values used in the calculations, almost every project can be justified on social-economic grounds. As the projects were selected to be broadly representative of other projects of like categories in the survey list, there is a strong presumption that many of the other projects identified in preparing Table 2 would also be justifiable by economic evaluation.

TABLE 3 - SUMMARY OF EVALUATIONS BY PROJECT TYPE

Type of Project	No. of projects	Total cost	Approx. benefit-cost ratio		Net present value	
			7%	10%	7%	10%
		$m			$m	$m
Vehicle replacement	5	166.00	1.7	1.5	87.80	62.70
Additional rail tracks	7	53.58	4.0	2.6	131.38	70.47
Railway electrification	2	19.42	2.7	2.0	26.69	13.44
Bus-rail interchange (2)	1	1.97	4.7	3.6	6.74	3.41
Car-rail interchange (3)	1	0.63	5.1	4.0	2.44	1.69
New railways	4	47.16	2.1	1.7	43.46	19.45
Busways	2	8.41	7.0	5.1	42.66	27.33
Ferry service	1	0.52	4.9	3.6	1.88	1.22
Tram route improvement	1	3.17	0.8	0.6	-0.40	-0.94
TOTAL	24	300.86	2.2	1.9	342.65	198.77

Table 3 shows the results summarised by type of project. Although the projects are not a randomly selected sample, some broad generalisations may be made about the merit of different categories of project.

The evaluations indicate that the replacement of old public transport vehicles with modern equipment is a worthwhile investment. The returns appear lower than for other major types of project analysed, unless vehicle replacement is combined with direct savings in operating staff. However, there are two particular features of this type of investment which are relevant in decision making. First, much of the benefit is the result of reduced maintenance costs and thus accrues directly to operating authorities. Second, as the passenger benefits predominantly accrue to existing patrons there is little risk of over estimation of benefits through errors in passenger forecasting.

Investments in upgrading existing large railway systems by additional trackwork in congested sections, or electrification where patronage is substantial, appear well worthwhile. Here again a substantial part of the benefit would accrue to established patronage. However, the savings in costs for railway authorities would generally be small, except in isolated bottleneck situations, or where the improvement would lead to a considerable increase in patronage.

The provision of parking areas and the construction of bus-rail interchange facilities at carefully selected points on an efficient rail system appears to be a very good investment on social-economic grounds. In these cases much of the benefit would occur through reductions in the cost of alternative travel, by bus or car, on congested streets.

The analyses of new railway routes suggest that in situations where existing roads are reaching congested levels and if no major road works are carried out until after the project is well established, extensions of existing efficient railway systems are likely to be justifiable by social-economic analysis. The results are sensitive to the traffic forecasts and in cases where extensive land use changes are envisaged, the preliminary indication of merit should be substantiated by a more fundamental data assembly than was practicable in the framework of the study.

The analyses of two busway projects indicated a very high social return from this type of investment. The particular circumstances were replacement of a low patronage rail service by a busway, and the construction of a busway in the median of a freeway. The general nature of the results suggests that independent busways would also be worthy of evaluation.

The evaluation of a proposed new ferry service showed a high return for the particular circumstances of the project.

An analysis of the comprehensive modernisation of an existing tram route suggested that the project would not warrant the proposed scale of investment.

Attention is drawn to the important fact that the B.T.E. evaluations reported in this study are only concerned with benefits to the community. On this basis, additional expenditure on urban public transport is warranted. However, most of the calculated returns will not accrue directly to public transport operating authorities, and indeed operating deficits may well increase. This in no way qualifies the results because the nature of the administrative and pricing environment in which public transport now operates make it improbable that the continuing operation and expansion of public transport services could be financed from fare revenues. Comment on the extent to which this environment could be changed and on the most appropriate financial arrangements for public transport investment are beyond the terms of reference of this report.

ANNEX A

EXISTING URBAN PUBLIC TRANSPORT SERVICES

This Annex contains a brief review of urban public transport services in each State capital city, with statistics to show the task performed and the equipment used during the ten years to 1970-71.

Excluding taxi operations, urban public transport services in the six capital cities carried some 1,200m passengers in 1970-71. The equipment used for this task included approximately 2,180 electric train cars, numerous other railway cars, 6,700 buses and 720 tram cars.

In addition, there are about 9,000 taxis and hire cars which operate in the urban areas of these six capital cities. Of this total, some 3,300 are in Sydney and some 2,500 in Melbourne.

Sydney

In 1970-71, approximately 570m journeys were made on Sydney's public transport services. Of these, 42 per cent were made on suburban trains, 36 per cent on government buses, 19 per cent on private buses and 2 per cent on ferries.

Suburban electric railway tracks radiate from the Central Business District (C.B.D.) with termini located in the north at Cowan (30 miles), in the west at Penrith (34 miles), and in the south at Campbelltown (32 miles) and Cronulla (22 miles). The suburban electrified services are mainly engaged in moving passengers to and from the C.B.D.

Government bus services extend throughout the inner suburbs and to some outer suburbs, bringing people to and from the C.B.D. Private buses, owned by some 120 operators, provide 'feeder' services, generally in the more outlying areas, with routes terminating at railway stations and suburban shopping centres.

Ferry services are confined to Port Jackson where they move passengers between the C.B.D. and some inner and northern suburbs, particularly Manly.

The total number of passengers carried by Sydney's public transport services increased marginally by 2 per cent in the decade to 1970-71. Private bus services carried 83 per cent more passengers and ferries 2 per cent more, while government bus services showed a decline of 16 per cent in patronage and suburban rail services showed virtually no change in patronage over the decade.

Melbourne

Over 350m passenger journeys were made on Melbourne's public transport services in 1970-71. The greatest number (39 per cent) were carried on suburban trains, with some 31 per cent carried by trams, 6 per cent by semi-government buses, and 23 per cent by private buses.

The electric suburban railway network radiates from the C.B.D. with farthest termini being in the south at Frankston (27 miles), in the west at St. Albans (12 miles), in the north at Hurstbridge (23 miles), and in the east at Belgrave (26 miles). The main task of these railway services is to bring passengers to and from the C.B.D.

An extensive network of 138 route miles of tramway tracks services the inner Melbourne suburbs with nearly all routes extending into the C.B.D. The tramway undertaking is owned by a semi-governmental authority which also operates bus services to complement the trams. Private bus services operate mainly in outlying suburbs but some routes extend into the C.B.D.

In the decade to 1970-71 the total number of passengers carried by public transport services in Melbourne is estimated to have declined by 17 per cent. Only private bus services showed an increase (estimated at 8 per cent) during this period. The decline in patronage of trains during the same period was 5 per cent, trams 36 per cent, and semi-government buses 25 per cent.

Brisbane

Brisbane's public transport services carried 113m passengers in 1970-71. More than half of this total (57 per cent) was carried by municipal bus services, while trains accounted for 24 per cent, private buses 15 per cent, and ferries 3 per cent.

Suburban rail services extend in the west as far as Ipswich (24 miles), in the north as far as Caboolture (31 miles), and in the south as far as Beenleigh (24 miles).

Municipal bus services have increased both in route mileage and capacity since the same authority's tram and trolley-bus services ceased in 1969. Private bus services primarily serve the outlying suburbs and provide 'feeder' services to railway stations and municipal bus terminals.

Between 1960-61 and 1970-71 the number of passengers carried by all public transport services declined by 24 per cent. Over this period passengers carried by buses (including in 1960-61, trams and trolley-buses) declined by 31 per cent, from 119m to 82m. However, in the same decade the number of passengers carried by rail increased by 12 per cent.

Adelaide

In 1970-71 Adelaide's public transport services carried 69m passengers. Semi-government buses carried 57 per cent of this total, private buses 21 per cent, rail services 19 per cent, and trams 2 per cent.

The greatest number of rail services operate north-west of the city to Outer Harbour (14 miles), but other important rail services extend in the north as far as Gawler (26 miles), in the east as far as Bridgewater (23 miles) and in the south as far as Hallett Cove (14 miles).

Bus services carry most of the passengers in Adelaide (78 per cent) and operate between the C.B.D. and the inner suburbs.

The once-extensive tram services now operate on only a single route 7 miles long (to Glenelg) and carry only a small share of total passengers.

In the decade to 1970-71 the total number of passengers carried on Adelaide's public transport services declined by 14 per cent. The number of passengers carried by private bus services increased by 41 per cent but all other transport services carried fewer passengers (semi-government buses down 21 per cent, trains down 8 per cent, and trams down 36 per cent).

Perth

Approximately 69m passengers were carried on Perth's public transport services in 1970-71. Semi-government bus services carried 83 per cent of this total, while rail services accounted for 15 per cent and private buses only 1 per cent.

Bus routes operated by the semi-government authority are generally arranged so that they start or terminate in the C.B.D.

Suburban rail services cater for passengers moving to and from the C.B.D. These suburban routes terminate in the west at Fremantle (12 miles), in the east at Koongamia (13 miles) and in the south at Armadale (19 miles).

In the decade to 1970-71 the total number of passengers carried on all public transport services increased by 3 per cent. Semi-government bus services carried 25 per cent more passengers but there was a decrease of 12 per cent in numbers carried by rail. Private buses, which account for only a small share of total passengers, suffered a decline of 89 per cent because of

the loss of routes which are now included within the semi-government bus network.

Hobart

The total number of passengers carried by Hobart's public transport services is not known because of the lack of data for private bus services. In 1970-71 government bus services carried 15m passengers and suburban trains 636,000 passengers.

Government bus services radiate from the C.B.D. and serve the more populous inner suburbs. Private buses operate mainly between the C.B.D. and the outlying suburbs.

The only suburban rail line extends from the C.B.D. northwards to Brighton (17 miles).

Between 1960-61 and 1970-71 the total number of passengers carried by Hobart's public transport service appears to have declined. Passengers using suburban rail services were 66 per cent fewer while those using government bus services (including trolley-buses in 1960-61) decreased by 17 per cent.

GENERAL NOTE

In Annexes A and B the following footnotes have been used without explanation in individual tables :

e Estimated in B.T.E.
n.a. Not available

In these Annexes figures have been rounded. Any discrepancies that occur between totals and the sums of components are due to the effects of this rounding procedure.

TABLE A1 - SYDNEY URBAN PUBLIC TRANSPORT SERVICES: VEHICLES AVAILABLE FOR USE

At 30 June -	Electric train cars	Government buses	Private buses	Ferries	Taxis and hire cars
1961	1,113	1,595	892	30	2,862
1962	1,113	1,564	943	30	2,870
1963	1,100	1,554	995	30	2,902
1964	1,094	1,558	1,040	30	2,893
1965	1,114	1,562	1,112	31	3,153
1966	1,100	1,569	1,087	31	3,156
1967	1,097	1,570	1,119	32	3,157
1968	1,102	1,593	1,172	24	3,186
1969	1,105	1,574	1,213	28	3,263
1970	1,096	1,613	1,247	35	3,296
1971	1,095	1,684	n.a.	32	n.a.

TABLE A2 - SYDNEY URBAN PUBLIC TRANSPORT SERVICES: VEHICLE MILES TRAVELLED

('000)

Year	Trains (a)	Government buses	Private buses
1960-61	11,176	(b)39,613	16,067
1961-62	11,250	39,567	20,352
1962-63	10,915	38,680	19,129
1963-64	10,939	39,167	22,751
1964-65	10,888	39,546	24,704
1965-66	10,788	39,425	25,200
1966-67	10,782	39,871	25,973
1967-68	10,669	39,720	23,586
1968-69	10,226	39,458	26,224
1969-70	10,358	39,032	26,861
1970-71	10,416	38,774	n.a.

(a) Train-miles. (b) Includes trams.

TABLE A3 - SYDNEY URBAN PUBLIC TRANSPORT SERVICES: PASSENGER JOURNEYS

('000)

Year	Trains	Government buses	Private buses	Ferries	Total
1960-61	239,000	(a)249,016	59,953	13,260	561,229
1961-62	238,000	244,281	63,390	12,717	558,388
1962-63	242,000	240,971	53,211	12,746	548,928
1963-64	248,000	238,368	58,824	13,057	558,249
1964-65	246,000	237,598	63,857	13,233	560,688
1965-66	242,216	232,141	94,478	13,146	581,981
1966-67	239,986	223,855	99,215	13,108	576,164
1967-68	238,061	220,049	102,746	13,218	574,074
1968-69	233,211	221,005	106,631	13,384	574,231
1969-70	236,347	214,167	109,891	13,405	573,810
1970-71	238,800	208,008	e110,000	13,465	570,273

(a) Includes trams

TABLE A4 - MELBOURNE URBAN PUBLIC TRANSPORT SERVICES: VEHICLES AVAILABLE FOR USE

At 30 June-	Electric train cars	Trams	Government buses	Private buses	Taxis and hire cars
1961	1,045	784	209	625	2,202
1962	1,068	715	238	632	2,203
1963	1,080	712	238	670	2,214
1964	1,074	712	232	747	2,245
1965	1,080	703	223	763	2,430
1966	1,089	693	231	785	2,516
1967	1,116	693	223	879	2,520
1968	1,113	691	233	882	2,518
1969	1,110	698	226	892	2,519
1970	1,115	698	232	915	2,520
1971	1,090	696	235	n.a.	n.a.

TABLE A5 - MELBOURNE URBAN PUBLIC TRANSPORT SERVICES: VEHICLE MILES TRAVELLED

('000)

Year	Trains (a)	Trams	Government buses	Private buses
1960-61	7,902	19,296	5,926	17,671
1961-62	8,296	18,814	6,993	17,726
1962-63	8,303	17,708	7,341	18,389
1963-64	8,369	17,575	7,283	20,584
1964-65	8,480	16,920	7,267	21,280
1965-66	8,458	16,609	6,763	20,597
1966-67	8,504	16,571	6,931	21,623
1967-68	8,420	16,480	7,335	21,785
1968-69	8,139	16,069	7,099	21,754
1969-70	8,361	15,273	6,923	22,177
1970-71	8,315	14,899	7,018	n.a.

(a) Train miles

TABLE A6 - MELBOURNE URBAN PUBLIC TRANSPORT SERVICES: PASSENGER JOURNEYS

('000)

Year	Trains	Trams	Government buses	Private buses	Total
1960-61	145,558	172,055	30,282	74,218	422,113
1961-62	147,977	167,250	31,313	74,449	420,989
1962-63	147,587	162,692	32,634	77,233	420,146
1963-64	148,314	160,479	32,426	86,333	427,552
1964-65	144,846	147,891	29,812	83,274	405,823
1965-66	144,332	140,556	25,120	78,853	388,861
1966-67	141,593	131,876	25,107	83,562	382,138
1967-68	141,733	127,575	25,576	81,571	376,455
1968-69	140,788	119,009	24,271	80,031	364,099
1969-70	140,309	110,692	22,353	80,478	353,832
1970-71	138,131	109,779	22,753	e 80,000	350,663

TABLE A7 - BRISBANE URBAN PUBLIC TRANSPORT SERVICES: VEHICLES AVAILABLE FOR USE

At 30 June -	Suburban railway cars	Trams & trolley-buses	Government buses	Private buses	Ferries	Taxis hire & cars
1961	301	402	232	178	16	n.a.
1962	329	402	239	193	16	n.a.
1963	356	337	261	190	16	n.a.
1964	362	323	261	204	16	n.a.
1965	359	323	282	202	16	n.a.
1966	337	297	306	221	n.a.	n.a.
1967	335	273	346	286	n.a.	n.a.
1968	328	260	364	297	n.a.	n.a.
1969	327	..	629	285	n.a.	n.a.
1970	327	..	669	290	n.a.	n.a.
1971	325	..	635	305	n.a.	n.a.

TABLE A8 - BRISBANE URBAN PUBLIC TRANSPORT SERVICES: VEHICLE MILES TRAVELLED

('000)

Year	Trains (a)	Trams & trolley-buses	Government buses	Private buses	Ferries
1960-61	2,009	9,081	4,829	4,442	119
1961-62	1,850	9,008	5,181	4,579	120
1962-63	1,706	8,462	5,626	4,554	119
1963-64	1,742	7,925	5,956	4,519	118
1964-65	1,778	7,353	6,338	4,566	117
1965-66	1,820	7,079	6,367	4,819	117
1966-67	1,864	6,324	6,635	5,675	120
1967-68	1,885	5,743	6,864	5,942	120
1968-69	1,909	3,107	8,763	5,779	114
1969-70	1,979	..	14,264	5,437	127
1970-71	1,993	..	13,736	6,193	128

(a) Train miles

TABLE A9 - BRISBANE URBAN PUBLIC TRANSPORT SERVICES : PASSENGER JOURNEYS

('000)

Year	Trains	Trams & trolley-buses	Govern-ment buses	Private buses	Ferries	Total
1960-61	24,582	83,301	23,558	12,661	e5,600	149,702
1961-62	22,890	82,230	23,865	13,228	e5,700	147,913
1962-63	22,413	75,715	25,862	12,921	e5,500	142,411
1963-64	22,512	70,660	28,915	13,435	e4,900	140,422
1964-65	22,254	69,808	30,548	14,721	e6,400	143,731
1965-66	23,227	61,990	27,885	13,579	e6,200	132,881
1966-67	23,703	53,357	24,393	17,210	e3,100	121,763
1967-68	24,065	50,514	25,749	17,306	e3,400	121,034
1968-69	25,771	27,001	40,345	17,024	e3,800	113,941
1969-70	26,317	..	71,297	17,558	e3,800	118,972
1970-71	27,621	..	65,220	16,853	e3,800	113,494

TABLE A10 - ADELAIDE URBAN PUBLIC TRANSPORT SERVICES : VEHICLES AVAILABLE FOR USE

At 30 June-	Suburban rails cars	Trams	Government buses	Private buses	Trolley-buses	Taxis & hire cars
1961	112	30	333	125	56	746
1962	112	30	329	125	56	745
1963	113	30	329	128	39	746
1964	113	30	353	124	..	744
1965	113	30	353	132	..	832
1966	113	28	350	217	..	832
1967	113	28	350	224	..	835
1968	115	26	325	225	..	836
1969	137	26	333	230	..	836
1970	144	26	344	244	..	834
1971	146	26	376	253	..	837

TABLE A11 - ADELAIDE URBAN PUBLIC TRANSPORT SERVICES : VEHICLE MILES TRAVELLED

('000)

Year	Trains (a)	Trams	Government buses	Private buses	Trolley-buses
1960-61	2,082	543	10,315	3,494	707
1961-62	1,962	510	9,486	3,473	1,353
1962-63	1,941	497	10,234	3,584	704
1963-64	1,967	498	10,956	3,563	23
1964-65	1,951	495	10,972	3,600	..
1965-66	1,950	486	10,849	5,147	..
1966-67	2,028	471	10,772	5,963	..
1967-68	2,026	419	10,247	6,156	..
1968-69	2,012	416	10,262	5,975	..
1969-70	2,090	419	10,239	6,762	..
1970-71	2,098	e410	e10,390	6,645	..

(a) Train miles

TABLE A12 - ADELAIDE URBAN PUBLIC TRANSPORT SERVICES : PASSENGER JOURNEYS

('000)

Year	Trains	Trams	Government buses	Private buses	Trolley-buses	Total
1960-61	14,584	2,637	50,085	10,490	3,432	81,228
1961-62	14,211	2,477	48,908	10,394	6,565	82,555
1962-63	13,978	2,521	51,944	10,762	3,574	82,779
1963-64	14,332	2,542	55,912	10,926	117	83,829
1964-65	14,326	2,438	53,996	10,511	..	81,271
1965-66	14,671	2,279	50,833	13,693	..	81,476
1966-67	14,608	2,084	47,651	14,956	..	79,299
1967-68	14,447	1,879	45,934	15,400	..	77,660
1968-69	13,760	1,770	43,623	15,088	..	74,241
1969-70	13,441	1,703	41,642	15,202	..	71,988
1970-71	13,393	e1,700	e39,559	14,795	..	69,447

TABLE A13 - PERTH URBAN PUBLIC TRANSPORT SERVICES: VEHICLE AVAILABLE FOR USE

At 30 June -	Suburban rail cars	Government buses	Private buses	Trolley-buses	Ferries	Taxis & hire cars
1961	162	397	n.a.	75	4	703
1962	153	487	16	72	4	708
1963	142	511	16	68	4	713
1964	139	523	16	50	4	718
1965	138	540	20	50	5	723
1966	136	576	22	50	5	728
1967	136	602	23	50	5	727
1968	137	631	25	50	5	726
1969	127	638	25	50	5	749
1970	121	688	26	..	5	777
1971	101	729	31	..	5	786

TABLE A14 - PERTH URBAN PUBLIC TRANSPORT SERVICES: VEHICLE MILES TRAVELLED

('000)

Year	Trains (a)	Government buses	Private buses	Trolley-buses	Ferries
1960-61	1,357	15,288	2,850	1,164	22
1961-62	1,355	15,254	(b) 285	e 1,036	22
1962-63	1,334	14,771	(b) 285	e 922	22
1963-64	1,368	14,940	252	e 821	22
1964-65	1,375	15,788	360	e 731	22
1965-66	1,325	17,248	385	645	22
1966-67	1,280	18,058	443	650	22
1967-68	1,286	18,429	810	602	22
1968-69	1,327	19,250	742	486	23
1969-70	1,377	20,289	n.a.	66	22
1970-71	1,388	21,371	n.a.	..	e 22

(a) Train miles. (b) During the year some private services were included within the government bus network.

TABLE A15 - PERTH URBAN PUBLIC TRANSPORT SERVICES: PASSENGER JOURNEYS

('000)

Year	Trains	Government buses	Private buses	Trolley-buses	Ferries	Total
1960-61	12,026	45,862	7,317	6,387	180	71,772
1961-62	11,308	46,427	(a) 2,006	e 5,791	168	65,700
1962-63	10,937	45,791	(a) 444	e 5,195	192	62,559
1963-64	10,298	45,300	368	e 4,599	185	60,750
1964-65	9,911	45,964	658	e 4,003	201	60,737
1965-66	9,748	48,861	706	e 3,407	238	62,960
1966-67	9,468	50,326	748	2,800	253	63,595
1967-68	9,628	50,331	765	2,598	312	63,634
1968-69	9,832	52,675	811	2,038	336	65,692
1069-70	10,227	55,896	e 810	276	368	67,577
1970-71	10,557	57,538	e 810	..	e 400	69,305

(a) During the year some private services were included within the government network.

TABLE A16 - HOBART URBAN PUBLIC TRANSPORT SERVICES: VEHICLES AVAILABLE FOR USE

At 30 June -	Suburban railway cars	Government buses	Private buses	Trolley-buses	Ferries	Taxis & hire cars
1961	n.a.	122	n.a.	49	3	n.a.
1962	n.a.	130	n.a.	46	3	n.a.
1963	n.a.	130	n.a.	40	..	n.a.
1964	n.a.	134	71	41	..	n.a.
1965	n.a.	140	n.a.	41	..	n.a.
1966	n.a.	142	n.a.	41	..	n.a.
1967	n.a.	148	n.a.	40	..	n.a.
1968	n.a.	155	n.a.	34	..	n.a.
1969	n.a.	188	n.a.	..	..	n.a.
1970	n.a.	198	n.a.	..	..	n.a.
1971	n.a.	203	n.a.	..	..	n.a.

TABLE A17 - HOBART URBAN PUBLIC TRANSPORT SERVICES: VEHICLE MILES TRAVELLED

('000)

Year	Trains (a)	Government buses	Private buses	Trolley-buses	Ferries (b)
1960-61	202	2,774	n.a.	(c) 1,074	n.a.
1961-62	188	3,011	n.a.	851	n.a.
1962-63	135	2,955	n.a.	840	n.a.
1963-64	137	3,143	n.a.	846	..
1964-65	136	3,198	n.a.	787	..
1965-66	135	3,214	n.a.	696	..
1966-67	125	3,232	n.a.	697	..
1967-68	112	3,421	n.a.	538	..
1968-69	113	3,847	n.a.	177	..
1969-70	118	4,056	n.a.	..	..
1970-71	108	4,095	n.a.	..	..

(a) Train miles. (b) Hobart services ceased on 30 June 1963. (c) Includes trams.

TABLE A18 - HOBART URBAN PUBLIC TRANSPORT SERVICES: PASSENGER JOURNEYS

('000)

Year	Trains	Government buses	Private buses	Trolley-buses	Ferries	Total
1960-61	1,859	12,648	n.a.	(a) 5,631	266	n.a.
1961-62	1,585	13,082	n.a.	4,628	212	n.a.
1962-63	1,347	13,403	n.a.	4,122	200	n.a.
1963-64	1,229	13,329	n.a.	4,076	..	n.a.
1964-65	1,135	12,980	n.a.	3,801	..	n.a.
1965-66	1,097	12,342	n.a.	3,563	..	n.a.
1966-67	973	12,310	n.a.	3,326	..	n.a.
1967-68	870	12,620	n.a.	2,766	..	n.a.
1968-69	838	14,290	n.a.	752	..	n.a.
1969-70	712	14,687	n.a.	..	..	n.a.
1970-71	636	14,795	n.a.	..	..	n.a.

(a) Includes trams.

ANNEX B

TRENDS IN PUBLIC TRANSPORT

This Annex deals with trends in the operation of urban public transport services in the six State capitals over the years 1960-61 to 1970-71. To place the information on urban public transport in perspective, a brief outline of transport expenditure in the national economy has been included. Trends in the number of passengers carried by various transport modes are noted and these are compared with trends in the gross capital expenditure by public authorities. Published financial results are also given. As well, it contains forecasts of patronage and capital investment required for urban public transport. These have been taken from the latest transportation studies for the respective cities.

TRANSPORT COMPONENT OF GROSS NATIONAL EXPENDITURE

Particulars of the gross national expenditure on transport in Australia in recent years are set out in Table B.1.

TABLE B.1 - GROSS NATIONAL EXPENDITURE, AUSTRALIA

($ million)

Year	Expenditure on Transport (a)					Total gross national expenditure
	Private sector		Public sector		Total	
	Personal consumption	Gross capital expenditure	Net current expenditure on goods and services	Gross capital expenditure		
1960-61	1,174	118	24	438	1,754	15,133
1961-62	1,179	97	25	491	1,792	14,778
1962-63	1,371	110	27	490	1,998	16,348
1963-64	1,510	142	28	552	2,232	17,604
1964-65	1,644	181	32	653	2,510	20,188
1965-66	1,672	180	33	712	2,597	21,181
1966-67	1,794	176	40	739	2,749	22,987
1967-68	1,998	177	45	839	3,059	24,887
1968-69	2,163	201	49	885	3,298	27,629
1969-70	2,418	221	52	944	3,635	30,125
1970-71	2,673	243	59	1,017	3,992	33,132
Ten years 1961-62 to 1970-71	18,422	1,728	390	7,322	27,862	228,859

(a) Expenditure on transport and communication, less personal consumption expenditure on postal and telephone services, and less gross capital expenditure on the post office.

Source : Commonwealth Bureau of Census and Statistics, Australian National Accounts (Ref. 7.1).

Total expenditure on transport during the decade amounted to $27,862m. Of this amount, some $7,322 or 26 per cent represented expenditure on capital (for transport facilities and equipment) by public authorities. In the private sector over the same period gross capital expenditure (excluding purchases of private motor vehicles) was $1,728m or 6 per cent of total expenditure on transport.

The classification of the estimated $7,426m spent over the decade for purchase of private motor vehicles is significant. Added to the $1,728m mentioned in the previous paragraph, the total capital expenditure on transport by the private sector over the decade ($9,154m) is substantially more than the gross amount

spent on capital goods by the public sector ($7,322m). The latter includes provision of infrastructure to enable a large portion of the private transport sector to function.

Details of gross capital expenditure by sector on all forms of transport by all public authorities and enterprises in Australia for the decade to 1970-71 are shown in Table B.2. In that decade the greatest proportion of total expenditure was on roads (67.0 per cent), with railways accounting for 14.9 per cent, civil aviation 8.2 per cent, and buses and trams 0.9 per cent.

TABLE B.2 - GROSS CAPITAL EXPENDITURE ON TRANSPORT BY ALL PUBLIC AUTHORITIES AND ENTERPRISES, AUSTRALIA

($ million)

Year	Railways	Trams and buses	Civil aviation	Harbours	Roads	Other	Total
1960-61	73	6	20	27	306	6	438
1961-62	86	4	44	26	325	6	491
1962-63	83	3	16	28	347	13	490
1963-64	86	4	16	43	393	10	552
1964-65	88	6	67	48	431	13	653
1965-66	115	5	68	52	465	7	712
1966-67	118	5	54	46	502	14	739
1967-68	121	7	104	42	536	29	839
1968-69	126	6	62	57	578	56	885
1969-70	132	10	66	49	634	53	944
1970-71	136	14	102	49	695	21	1,017
Ten years 1961-62 to 1970-71	1,091	64	599	440	4,906	222	7,322

Source : Commonwealth Bureau of Census and Statistics, Australian National Accounts (Ref. No. 7.1).

Gross capital expenditure by public transport authorities on railways, buses and trams rose from $79m in 1960-61 to $150m in 1970-71 but, as a proportion of total capital expenditure, its share fell from 18.0 per cent to 14.8 per cent. This reflected the changing distribution of gross capital expenditure by public authorities. Civil aviation greatly increased its share. The total amount spent on all forms of transport more than doubled over the decade.

PERSONAL CONSUMPTION EXPENDITURE ON TRAVEL

Details of estimated personal consumption expenditure on travel in Australia during the years 1960-61 to 1970-71 are set out in Table B.3.

TABLE B.3 - PERSONAL CONSUMPTION EXPENDITURE ON TRAVEL, AUSTRALIA

($ million)

Year	Fares				Purchase of motor vehicles	Operation of motor vehicles	Total
	Rail	Bus and tram	Other	Total			
1960-61	77	103	159	339	481	355	1,175
1961-62	79	101	158	338	455	385	1,178
1962-63	79	102	167	348	601	423	1,372
1963-64	79	106	183	368	680	462	1,510
1964-65	82	111	208	401	730	513	1,644
1965-66	82	114	232	428	660	584	1,672
1966-67	88	124	250	462	680	652	1,794
1967-68	89	129	270	488	798	712	1,998
1968-69	91	136	300	527	842	794	2,163
1969-70	97	141	341	579	955	884	2,418
1970-71	99	146	410	655	1,025	993	2,673
Ten years 1961-62 to 1970-71	865	1,210	3,119	4,594	7,426	6,402	18,422

Source : Commonwealth Bureau of Census and Statistics, Australian National Accounts (Ref. 7.1).

During the ten year period to 1970-71 the proportions of total travel expenditure made up by various modes of travel changed significantly. In 1960-61, fares paid for transport services constituted 28.9 per cent of the total, with 40.9 per cent of total expenditure on travel being for the purchase of motor vehicles; in addition, some 30.2 per cent of the total was spent on their operation. By 1970-71, the proportion spent on fares had dropped to 24.5 per cent and the proportion spent on purchase of motor vehicles had fallen to 38.4 per cent, but expenditure on the operation of motor vehicles had risen to 37.1 per cent.

TRENDS IN PASSENGERS CARRIED

Between 1960-61 and 1970-71 the number of passengers carried on all forms of urban public transport in the six State capitals declined by 9 per cent from 1,312m to 1,195m (Table B.4). The number of passengers carried on trains decreased marginally, the number carried by public authority buses remained fairly constant, while the number carried by trams[1] declined markedly due to the phasing out of most systems. More passengers are now being carried by private buses (58m, or 35 per cent more) while the number of passengers carried by ferries had declined slightly. Total patronage on buses has increased 18.8 per cent.

(1) In this Annex the term 'tram' includes trolley-bus.

'ABLE B.4 - URBAN PUBLIC TRANSPORT IN THE SIX STATE CAPITALS: PASSENGER JOURNEYS

(Million)

Year	Public authority				Ferries	Private buses	Total
	Trains	Buses	Trams	Total			
1960-61	438	411	273	1,122	19	171	1,312
1961-62	436	408	269	1,113	19	169	1,301
1962-63	438	411	254	1,103	19	161	1,283
1963-64	445	414	243	1,102	18	176	1,296
1964-65	439	411	228	1,065	20	179	1,277
1965-66	435	397	212	1,044	20	208	1,272
1966-67	430	384	193	1,007	16	222	1,245
1967-68	429	380	185	994	17	225	1,236
1968-69	424	396	151	971	18	226	1,215
1969-70	427	420	113	960	18	231	1,209
1970-71	429	408	111	948	18	229	1,195

The proportion of passenger journeys made on each mode in 1960-61 and 1970-71 is shown in Table B.5. The decline in trams and the increase in bus travel are the most significant features.

TABLE B.5 - URBAN PUBLIC TRANSPORT IN THE SIX STATE CAPITALS: PROPORTION OF TOTAL PASSENGER JOURNEYS CARRIED BY EACH TRANSPORT MODE

(Per cent)

	1960-61	1970-71
Trains	33.4	35.9
Public authority buses	31.3	34.1
Trams	20.8	9.3
Ferries	1.5	1.5
Private buses	13.0	19.2
Total	100.0	100.0

During the decade to 1970-71 the total number of passengers carried by public authority services (excluding ferries and private buses) declined by 174m, or about 16 per cent (Table B.6). This table also shows that all capital cities except Perth experienced a decline in the number of passengers carried by public authority services. In Perth, the number of passenger journeys increased by about 4m, or 6 per cent. The decreases in passenger journeys in the other capitals were : Melbourne, 77m (22 per cent); Brisbane, 38m (29 per cent); Sydney, 41m (8 per cent); Adelaide, 17m (23 per cent) and Hobart, 5m (23 per cent).

TABLE B.6 - URBAN PUBLIC TRANSPORT TRAIN, BUS AND TRAM SERVICES OPERATED BY PUBLIC AUTHORITIES : PASSENGER JOURNEYS

(Million)

Year	Syd.	Melb.	Bris.	Adel.	Perth	Hob.	Six capitals
1960-61	488	348	131	71	64	20	1,122
1961-62	482	347	129	72	64	19	1,113
1962-63	483	343	124	72	62	19	1,103
1963-64	487	341	122	73	60	19	1,102
1964-65	481	322	123	71	60	18	1,065
1965-66	474	310	113	68	62	17	1,044
1966-67	464	299	101	64	62	17	1,007
1967-68	458	295	100	62	63	16	994
1968-69	454	284	93	59	65	16	971
1969-70	451	273	98	57	66	15	960
1970-71	447	271	93	54	68	15	948

The general decline in passengers carried by the public authority urban transport services during the ten year period takes on even more significance when it is compared with the increases in the populations of these cities that have occurred during the same period of time (Table B.7).

TABLE B.7 - CHANGES IN THE USE OF PUBLIC AUTHORITY TRANSPORT SERVICES AND IN URBAN POPULATION IN THE SIX STATE CAPITAL CITIES

		Syd.	Melb.	Bris.	Adel.	Perth	Hob.	Six capitals
Passenger journeys								
1960-61	Mill.	488	348	131	71	64	20	1,122
1970-71	Mill.	447	271	93	54	68	15	948
Change 1970-71 on 1960-61	%	-8.4	-22.1	-29.0	-22.5	+6.3	-25.0	-15.5
Urban population								
30 June 1961	'000	2,197	1,859	588	580	424	110	5,758
30 June 1971	'000	2,717	2,389	817	809	640	130	7,502
Change 1971 on 1961	%	+23.7	+28.5	+39.0	+39.5	+50.9	+18.2	+30.3

NOTE: Plus sign (+) denotes increase; minus sign (-) denotes decrease.

TRENDS IN GROSS CAPITAL EXPENDITURE

Most of the figures for gross expenditure on capital assets for urban public transport services have been derived from annual reports of the public authorities in the various States. In the case of bus and tram services there is generally only one authority for each city and capital expenditure figures were obtained from the annual reports of these authorities, supplemented in some instances with information taken from Auditor-General's reports.

In the case of suburban railways, separate data are not available because consolidated railway accounts embrace suburban, country and interstate passenger and freight services. It is only in recent years that the railway systems have started to separate out and publish estimates for operating revenues, expenses and deficits for urban passenger operations, but none has yet attempted to publish any details of investment in urban passenger services. The reason for this is the difficulty posed by the sharing of assets (e.g. track, signalling) between suburban and long distances services. The apportionment of part

of the value of every shared asset to each service would be a difficult task even assuming that consistent criteria could be selected.

The B.T.E. estimates of the proportion of capital expenditure on railways that is directed towards the urban passenger system have many deficiencies and are subject to some inaccuracy. Nevertheless, they should be broadly indicative of the trends in this type of expenditure in the public sector.

Table B.8 shows B.T.E. estimates of public authority gross capital expenditure on the provision of facilities and equipment for urban public transport systems. As would be expected, the total amount expended has fluctuated greatly from year to year with large amounts made available in some years for specific large projects such as railway construction, replacement of tram systems with buses, etc. It covers expenditure on assets used for urban passenger services, including expenditure on rolling stock, track and right-of-way, signalling, land and buildings, plant and equipment.

Gross expenditure is considered to be of most relevance to this study since it reflects the funds being made available from sources external to the operating accounts of the transport authorities. Varying disposal practices, and particularly variations in depreciation accounting from State to State, make the net expenditure figures unsuitable for comparison.

The $21.2m expenditure on assets for urban railway services in 1970-71 and the $8.8m for bus and tram services (Table B.8) represent 2.1 per cent and 0.9 per cent respectively of the $1,010m total public sector capital expenditure (Table B.2).

TABLE B.8 - URBAN PUBLIC TRANSPORT SERVICES OPERATED BY PUBLIC AUTHORITIES IN THE SIX STATE CAPITALS: ESTIMATED GROSS CAPITAL EXPENDITURE (a)

($ million)

Year	Trains	Buses and trams	Total
1960-61	14.4	7.4	21.8
1961-62	10.6	3.3	13.9
1962-63	9.8	2.7	12.5
1963-64	10.5	3.0	13.5
1964-65	12.5	4.6	17.1
1965-66	13.2	3.7	16.9
1966-67	14.4	3.6	18.0
1967-68	20.4	6.0	26.4
1968-69	18.8	5.7	24.5
1969-70	16.6	6.7	23.3
1970-71	21.2	8.8	30.0
Ten years 1961-62 to 1970-71	148.0	48.1	196.1

(a) Expenditure on capital assets including rolling stock, track and right of way (in the case of railways), land and buildings, plant and equipment.

A breakdown of the total expenditure on capital assets for buses and trams according to capital city is set out in Table B.9.

TABLE B.9 - URBAN PUBLIC TRANSPORT BUS AND TRAM SERVICES OPERATED BY PUBLIC AUTHORITIES: ESTIMATED GROSS CAPITAL EXPENDITURE (a)

($ million)

Year	Syd.	Melb.	Bris.	Adel.	Perth	Hob.	Six capitals
1960-61	2.3	0.8	0.6	0.5	2.7	0.5	7.4
1961-62	0.3	0.6	0.4	(b)	1.9	0.1	3.3
1962-63	0.1	0.4	0.6	0.3	1.2	0.1	2.7
1963-64	(b)	0.8	0.8	0.2	1.1	0.1	3.0
1964-65	0.1	2.4	0.8	(b)	1.2	0.1	4.6
1965-66	(b)	1.1	1.4	0.1	0.9	0.2	3.7
1966-67	0.5	0.7	1.0	0.1	1.1	0.2	3.6
1967-68	2.0	0.7	1.8	(b)	1.2	0.3	6.0
1968-69	1.8	0.3	1.7	0.5	1.1	0.3	5.7
1969-70	3.2	0.8	0.8	0.5	1.3	0.1	6.7
1970-71	3.6	0.6	0.6	2.6	1.3	0.1	8.8

(a) Expenditure on capital assets including rolling stock, land and buildings, plant and equipment. (b) Less than $50,000.

When comparing transport modes which own or construct their permanent way with those that do not, allowance should be made for the cost of providing the track. Buses (and cars) are able to utilise the road system which is provided under separate public expenditure arrangements. Table B.10 sets out the total expenditure on roads in Australia over the past ten years together with the estimated proportions that capital city urban road expenditures bore to total expenditures on all roads. These urban roads are used mainly by private passenger and commercial goods vehicles.

TABLE B.10 - GROSS CAPITAL EXPENDITURE ON ROADS, AUSTRALIA

Year	Total gross capital expenditure on roads (a)	Estimated proportion spent on roads in urban areas of six State capitals (b)
	$ million	%
1960-61	306	28
1961-62	325	29
1962-63	347	30
1963-64	393	30
1964-65	431	30
1965-66	465	29
1966-67	502	30
1967-68	536	30
1968-69	578	30
1969-70	634	38
1970-71	695	43

(a) Source: Commonwealth Bureau of Census and Statistics, Australian National Accounts (Ref. 7.1). (b) Source: Commonwealth Bureau of Roads Expenditure for Road Purposes, Associated Bureau Papers, No. 8, and B.T.E. estimates. Due to estimation difficulties, proportions are approximate and should be interpreted only as general indicators.

TRENDS IN FINANCIAL OPERATIONS

Published operating results

The railway data set out in Table B.11 are made up of a combination of published figures and B.T.E. estimates. Details are shown for only the three years 1968-69 to 1970-71 as the first published estimates available for the separate operations of urban passenger services were given by South Australia for 1968-69. New South Wales and Victoria now publish estimates of deficits on urban passenger services. The data provided in Table B.11 can only be taken as a broad indicator of the comparative operating results

of urban passenger services in the six capitals for reasons indicated in the footnotes to the Table.

TABLE B.11 - URBAN PUBLIC TRANSPORT RAILWAYS SERVICES: OPERATING RESULTS (a)

($ million)

Capital city and year	Revenue	Working expenses	Debt charges	Deficit
Sydney				
1968-69	(b)30.9	(c)39.9		(d)9.0
1969-70	(b)33.2	(c)41.1		7.9
1970-71	(b)34.2	(c)47.4		13.2
Melbourne				
1968-69	(b)23.0	(c)29.0	n.a.	(de)6.0
1969-70	(b)24.2	(c)30.5	n.a.	(e)6.3
1970-71	(b)24.0	(c)32.9	n.a.	(e)8.9
Brisbane				
1968-69	2.7	6.2	n.a.	(e)3.5
1969-70	2.8	7.1	n.a.	(e)4.4
1970-71	2.9	7.6	n.a.	(e)4.7
Adelaide				
1968-69	2.0	5.3	0.8	4.1
1969-70	2.1	5.8	0.9	4.6
1970-71	2.1	6.5	0.9	5.2
Perth				
1968-69	1.3		4.4	3.1
1969-70	1.5		4.7	3.2
1970-71	1.6		5.1	3.5
Hobart				
1968-69	0.1	0.5	n.a.	(de)0.4
1969-70	0.1	0.5	n.a.	(e)0.4
1970-71	0.1	0.5	n.a.	(e)0.4

(a) Figures between capital cities are not strictly comparable. See footnotes to individual figures. (b) Revenue from passenger ticket sales only. Excludes revenue from parcel traffic, rents, sales of electricity, catering and general miscellaneous sources. (c) Balancing item between deficit (published for 1969-70 and 1970-71) and revenue from ticket sales. Understated to the extent of revenue from items excluded from revenue - see note (b). (d) Estimated in B.T.E. (e) Excludes debt charges.

In all State capitals, the urban railway services failed to generate sufficient revenue to cover working expenses. In Sydney and Melbourne, where total revenues are substantial, the 1970-71 loss on operations would have been equivalent to more than

30 per cent of the revenues received.

In Brisbane, Adelaide and Perth the deficits resulting from suburban rail operations increased noticeably over the three years to 1970-71. For 1970-71, the deficits in these three cities were more than twice the amount of revenue received, and in Hobart the ratio was four times.

For buses and trams, estimates are provided for the years 1960-61 to 1970-71 in Table B.12. These figures have been taken mainly from the published annual reports of the authorities operating the services in each State capital.

TABLE B.12 - URBAN PUBLIC TRANSPORT BUS AND TRAM SERVICES OPERATED BY PUBLIC AUTHORITIES: OPERATING RESULTS

($ million)

Year	Revenue	Working expenses	Net earnings	Capital charges	Surplus/ deficit
		SYDNEY			
	(a)				
1960-61	22.7	26.5	-3.8	1.6	- 5.4
1961-62	22.4	26.1	-3.7	1.4	- 5.1
1962-63	22.3	25.0	-2.7	1.5	- 4.2
1963-64	22.4	24.9	-2.5	1.5	- 4.0
1964-65	22.3	25.1	-2.8	1.5	- 4.3
1965-66	22.7	26.0	-3.3	1.6	- 4.9
1966-67	24.3	27.4	-3.1	1.6	- 4.7
1967-68	24.8	28.7	-3.9	1.7	- 5.6
1968-69	27.9	30.9	-3.0	1.7	- 4.7
1969-70	29.5	32.6	-3.1	1.8	- 4.9
1970-71	28.9	37.1	-8.2	2.0	-10.2
		MELBOURNE			
1960-61	17.9	17.2	+0.7	1.0	-0.3
1961-62	17.6	16.8	+0.8	1.0	-0.2
1962-63	17.4	16.4	+1.0	1.0	+(b)
1963-64	16.9	16.7	+0.2	0.9	-0.7
1964-65	18.0	17.9	+0.1	1.0	-0.9
1965-66	18.0	18.4	-0.4	1.1	-1.5
1966-67	19.5	19.3	+0.2	1.2	-1.0
1967-68	19.3	19.6	-0.3	1.2	-1.5
1968-69	19.7	20.2	-0.5	1.3	-1.8
1969-70	20.6	21.0	-0.4	1.4	-1.8
1970-71	20.5	22.8	-2.3	1.4	-3.7

(a) Includes subsidy for concession fares. (b) Less than $50,000.
NOTE: Plus sign (+) denotes surplus; minus sign (-) denotes loss or deficit.

TABLE B.12 - URBAN PUBLIC TRANSPORT BUS AND TRAM SERVICES OPERATED BY PUBLIC AUTHORITIES: OPERATING RESULTS (continued)

($ million)

Year	Revenue	Working expenses	Net earnings	Capital charges	Surplus/ deficit
			BRISBANE		
1960-61	7.4	8.0	-0.6	0.3	-0.9
1961-62	7.7	8.3	-0.6	0.3	-0.9
1962-63	7.8	8.0	-0.2	0.3	-0.5
1963-64	7.6	8.3	-0.7	0.3	-1.0
1964-65	7.4	8.7	-1.3	0.3	-1.6
1965-66	7.7	8.7	-1.0	0.4	-1.4
1966-67	8.3	8.6	-0.3	0.4	-0.7
1967-68	8.2	9.1	-0.9	0.4	-1.3
1968-69	7.2	8.8	-1.6	0.8	-2.4
1969-70	7.8	9.9	-2.1	0.9	-3.0
1970-71	9.5	9.6	-0.1	1.5	-1.6
			ADELAIDE		
1960-61	5.5	5.3	+0.2	0.6	-0.4
1961-62	5.4	5.2	+0.2	0.5	-0.3
1962-63	5.4	5.2	+0.2	0.5	-0.3
1963-64	5.5	5.2	+0.3	0.5	-0.2
1964-65	5.9	5.5	+0.4	0.5	-0.3
1965-66	6.0	5.8	+0.2	0.5	-0.3
1966-67	6.3	5.9	+0.4	0.5	-0.1
1967-68	6.2	5.9	+0.3	0.4	-0.1
1968-69	6.5	6.1	+0.4	0.4	-(a)
1969-70	6.7	6.3	+0.4	0.4	-(a)
1970-71	6.9	7.0	-0.1	0.4	-0.5
			PERTH		
1960-61	3.9	4.6	-0.7	0.3	-1.0
1961-62	4.3	5.0	-0.7	0.3	-1.0
1962-63	4.8	5.5	-0.7	0.3	-1.0
1963-64	5.2	5.7	-0.5	0.3	-0.8
1964-65	5.4	6.0	-0.6	0.4	-1.0
1965-66	5.9	6.8	-0.9	0.4	-1.3
1966-67	7.0	7.2	-0.2	0.4	-0.6
1967-68	7.3	7.4	-0.1	0.5	-0.6
1968-69	7.5	8.0	-0.5	0.4	-0.9
1969-70	8.3	8.7	-0.4	0.5	-0.9
1970-71	8.8	10.1	-1.3	0.5	-1.8

(a) Less than $50,000

NOTE: Plus sign (+) denotes surplus; minus sign (-) denotes loss or deficit.

TABLE B.12 - URBAN PUBLIC TRANSPORT BUS AND TRAM SERVICES OPERATED BY PUBLIC AUTHORITIES: OPERATING RESULTS (continued)

($ million)

Year	Revenue	Working expenses	Net earnings	Capital charges	Surplus/ deficit
			HOBART		
1960-61	1.0	1.0	-0.3	0.1	-0.4
1961-62	1.4	1.8	-0.4	0.1	-0.5
1962-63	1.4	1.7	-0.3	0.1	-0.4
1963-64	1.4	1.8	-0.4	0.1	-0.5
1964-65	1.3	1.8	-0.5	0.1	-0.6
1965-66	1.4	1.9	-0.5	0.1	-0.6
1966-67	1.5	2.1	-0.6	0.1	-0.7
1967-68	1.6	2.2	-0.6	0.1	-0.7
1968-69	1.7	2.3	-0.6	0.1	-0.7
1969-70	1.7	2.4	-0.7	0.1	-0.8
1970-71	1.7	2.7	-1.0	0.1	-1.1
			SIX CAPITALS		
1960-61	58.8	63.3	- 4.5	3.9	- 8.4
1961-62	58.8	63.2	- 4.4	3.8	- 8.2
1962-63	59.1	61.8	- 2.7	3.9	- 6.6
1963-64	59.0	62.6	- 3.6	3.8	- 7.4
1964-65	60.3	65.0	- 4.7	3.9	- 8.6
1965-66	61.7	67.6	- 5.9	4.1	-10.0
1966-67	66.9	70.5	- 3.6	4.3	- 7.9
1967-68	67.4	72.9	- 5.5	4.4	- 9.9
1968-69	70.5	76.3	- 5.8	4.7	-10.5
1969-70	74.6	80.9	- 6.3	5.1	-11.4
1970-71	76.3	89.3	-13.0	6.1	-19.1

NOTE: Minus sign (-) denotes loss or deficit.

Sources of funds for buses and trams

Earlier sections of this Annex have shown estimates of trends in operating results of urban public transport authorities and estimates of trends in gross capital expenditure by these authorities. Funding of annual deficits and provision of facilities and equipment have been the two most significant uses of funds by public transport authorities in recent years. This section deals with the sources of funds used by public authorities operating bus and tram services in each State capital, together with the use made of these funds.

Table B.13 presents modified funds statements for the years 1960-61 to 1970-71 for authorities operating bus and tram services in Sydney, Melbourne, Adelaide, Perth and Hobart. Although a consistent approach has been followed in compiling the tables for each capital, a direct comparison of the figures between cities is not valid and should not be attempted because of the differing accounting methods used by each authority (often resulting in 'netting' of minor accounts before inclusion in the overall accounts) and because of the varying amount of detail that is published. The intended purpose of the information in Table B.13 is to provide broad indications of sources of funds used in each State and trends in the relative importance of the various sources over time.

TABLE B.13 - URBAN PUBLIC TRANSPORT BUS AND TRAM SERVICES OPERATED BY PUBLIC AUTHORITIES: MODIFIED FUNDS STATEMENTS

($'000)

Year	Source of funds				Uses of funds			
	Increase in capital	State grants	Other (a)	Total	Capital expenditure	Funding of annual deficit	Other (a)	Total
SYDNEY								
1960-61	3,370	7,342	123	10,835	2,257	5,398	3,180	10,835
1961-62	144	1,900	3,416	5,460	268	5,080	112	5,460
1962-63	20	1,300	3,198	4,518	62	4,274	182	4,518
1963-64	..	1,240	3,126	4,366	22	4,008	336	4,366
1964-65	62	2,066	2,485	4,613	99	4,344	170	4,613
1965-66	26	2,410	2,581	5,017	..	4,878	139	5,017
1966-67	360	1,750	3,220	5,330	544	4,659	127	5,330
1967-68	694	3,756	3,545	7,815	2,021	5,587	207	7,815
1968-69	468	2,800	3,576	6,844	1,826	4,687	331	6,844
1969-70	2,165	3,250	2,957	8,372	3,242	4,875	255	8,372
1970-71	2,162	7,750	4,172	14,084	3,646	10,212	226	14,084
MELBOURNE								
1960-61	..	..	1,320	1,320	782	..	538	1,320
1961-62	..	..	1,416	1,416	548	148	720	1,416
1962-63	..	..	1,594	1,594	362	..	1,232	1,594
1963-64	174	..	1,577	1,751	800	761	190	1,751
1964-65	2,453	..	910	3,363	2,440	861	62	3,363
1965-66	1,446	..	1,464	2,910	1,093	1,555	262	2,910
1966-67	1,000	..	998	1,998	738	981	279	1,998
1967-68	443	..	2,053	2,496	743	1,544	209	2,496
1968-69	383	..	1,789	2,172	325	1,777	70	2,172
1969-70	650	914	1,067	2,631	805	1,825	1	2,631
1970-71	1,136	2,150	1,126	4,412	607	3,447	358	4,412

(a) For details, see following paragraphs in the text.

TABLE B.13 - URBAN PUBLIC TRANSPORT BUS AND TRAM SERVICES OPERATED BY PUBLIC AUTHORITIES : MODIFIED FUNDS STATEMENTS (continued)

($'000)

Year	Sources of funds				Uses of funds			
	Increase in capital	State grants	Other (a)	Total	Capital expend-iture	Funding of annual deficit	Other (a)	Total
ADELAIDE								
1960-61	..	540	1,243	1,783	484	414	885	1,783
1961-62	..	540	560	1,100	37	338	725	1,100
1962-63	..	507	670	1,177	285	265	627	1,177
1963-64	..	540	1,091	1,631	185	237	1,209	1,631
1964-65	..	480	665	1,145	24	87	1,034	1,145
1965-66	..	800	695	1,495	104	241	1,150	1,495
1966-67	..	800	592	1,392	115	131	1,146	1,392
1967-68	..	500	692	1,192	..	65	1,127	1,192
1968-69	..	..	1,073	1,073	523	41	509	1,073
1969-70	..	1,000	788	1,788	515	6	1,267	1,788
1970-71	..	2,063	1,646	3,709	2,561	..	1,148	3,709
PERTH								
1960-61	2,557	912	914	4,383	2,478	946	959	4,383
1961-62	1,391	1,212	688	3,291	1,999	1,026	266	3,291
1962-63	630	1,068	838	2,536	1,319	1,026	191	2,536
1963-64	440	840	870	2,150	1,111	844	195	2,150
1964-65	380	956	1,103	2,439	1,230	994	215	2,439
1965-66	500	1,325	747	2,572	922	1,282	368	2,572
1966-67	400	618	909	1,927	1,147	620	160	1,927
1967-68	600	553	889	2,042	1,172	554	316	2,042
1968-69	567	925	919	2,411	1,051	924	436	2,411
1969-70	540	923	938	2,401	1,260	921	220	2,401
1970-71	746	1,791	917	3,454	1,337	1,792	325	3,454
HOBART								
1960-61	..	1,059	234	1,293	473	588	232	1,293
1961-62	..	823	1,370	2,193	136	671	1,386	2,193
1962-63	..	684	420	1,104	40	631	433	1,104
1963-64	..	849	316	1,165	100	702	363	1,165
1964-65	..	760	333	1,093	130	778	185	1,093
1965-66	..	760	681	1,441	150	754	537	1,441
1966-67	..	975	304	1,279	184	884	211	1,279
1967-68	..	875	478	1,353	310	964	79	1,353
1968-69	..	1,030	1,035	2,065	305	980	780	2,065
1969-70	..	1,011	376	1,387	78	1,026	283	1,387
1970-71	..	1,418	366	1,784	114	1,420	250	1,784

(a) For details, see following paragraphs in the text.

In Table B.13 the sources of funds listed under 'Other' in each capital were (with 1970-71 figures shown in brackets) -

Sydney: Mainly increases in reserves and provisions ($107,000) and increases in net current liabilities ($63,000);

Melbourne: Mainly increases in provisions for depreciation ($689,000) and amortisation ($40,000) increases in accrued liabilities ($294,000) and decreases in investments;

Adelaide: Mainly increases in provisions for depreciation, superannuation, amortisation, etc. ($480,000), increases in current liabilities ($644,000), and decreases in current assets ($501,000);

Perth: Mainly proceeds from sale of assets ($33,000), increases in provisions for depreciation, accrued leave and insurance (in total $883,000);

Hobart: Mainly decreases in current assets ($111,000) and increases in provisions for depreciation ($75,000).

The uses of funds under 'Other' in Table B.13 were (again with 1970-71 figures in brackets) -

Sydney: Mainly increases in current assets ($277,000);

Melbourne: Mainly decreases in liabilities, both current and accrued ($357,000);

Adelaide: Mainly decreases in capital ($1,148,000);

Perth: Mainly sinking fund investments ($165,000) and repayment of private loans ($161,000);

Hobart: Mainly depreciation fund investments ($193,000).

In general terms, the modified funds statements set out in Table B.13 show that funds made available to urban public transport authorities operating bus and tram services were used to cover the purchase of capital items, to cover annual operating deficits, and to reduce current liabilities.

For the five capitals considered, the urban public transport authorities obtained their funds from small loan allocations, State Treasury grants, and increases in reserves and provisions for depreciation, and sinking funds. In some instances funding also came from increases in current liabilities and decreases in investments.

Sources of Funds for Railways

No attempt has been made to produce final statements for railway suburban passenger operations on a similar basis to those produced for trams and buses because of the great difficulties involved. However, a discussion of the sources of funds for total railway operations should indicate the problems involved in obtaining funds for capital expenditure on suburban railways.

The deficits on suburban passenger operations in the six State capitals in the years 1968-69, 1969-70 and 1970-71 were $26.1m, $26.8m and $35.9m respectively. Total railway deficits in these same years were $53.0m, $48.6m and $95.0m respectively. These deficit figures understate the true loss on railway services because allowance has already been made for substantial State grants. Also, depreciation allowances have been understated.

Besides having to finance these large annual deficits, State governments have also to find additional funds for capital expenditure. In most States the financial position of railways is such that internal funds are insufficient to even meet normal replacement expenditure and loan funds have to be used for this purpose.

Loan funds provide the major source of funds for capital expenditure by railways. Of the total gross fixed capital expenditure on railways by all public authorities and enterprises ($136m in 1970-71), it is estimated that about 75 per cent have been provided from loan funds on which the railways are required to pay interest. The remaining funds were obtained from internal renewal and replacement funds and such sources as the Commonwealth Railways Standardisation Funds.

The most important point that emerges from the development of these modified funds statements is that sources of funds for use in urban public transport in the capital cities is very much dependent on the setting of priorities by State governments on loan fund allocations and the magnitude of grants made from State consolidated revenue funds. Funds available to the transport undertakings from an excess of earnings over working expenses over the years from 1960-61 to 1970-71 were extremely small.

FUTURE TRENDS INDICATED BY TRANSPORTATION STUDIES

In recent years comprehensive transportation studies, including analyses of urban public transport projects, have been made in all State capital cities except Sydney, where a study is currently in progress. The titles of the published results of these studies and the dates of publication are: Melbourne Transportation Study, 1969: Brisbane Region Public Transport Study, 1970; Metropolitan Adelaide Transportation Study, 1968; Perth Regional Transport Study, 1970; and Hobart Area Transportation Study, 1965.

Included in these studies are forecasts of passengers to be carried on urban public transport in future years and of the capital expenditure that will be required to carry out the proposed projects. These forecasts are set out in Tables B.14 and B.15.

TABLE B.14 - URBAN PUBLIC TRANSPORT SERVICES: FORECASTS OF PASSENGER JOURNEYS

Capital city	Passenger journeys in 1970-71	Forecast		Annual growth rate (a)
		Year	Passenger journeys	
	Millions		Millions	%
Melbourne	350.7	1985	(b)416.4	1.3
Brisbane	113.5	2000	291.0	3.4
Adelaide	69.4	1986	112.2	3.2
Hobart	22.4	1985	27.3	1.3

(a) Average annual growth rate from 1970-71 to year of forecast.
(b) Comprising trains 198.3m, buses and trams 218.1m.

TABLE B.15 - URBAN PUBLIC TRANSPORT SERVICES: FORECAST OF CAPITAL EXPENDITURE REQUIRED

($ million)

Capital city and period	Public authority transport	Other (a)	Total
Melbourne			
To 1985	355.0	2,261.0	2,616.0
Brisbane			
1971-1975	Dissection not published		57.7
1976-1980			29.0
1981-1985			24.0
1986-1990			46.2
1991-1995			47.7
1996-2000			34.7
Total			239.3
Adelaide			
1st priority	15.5	74.0	89.5
2nd priority	45.2	110.3	155.5
3rd priority	30.5	116.4	146.9
4th priority	16.3	135.8	152.1
Total to 1986	107.5	436.5	544.0
Perth			
1970-1974	29.0	77.5	106.6
1975-1979	11.1	112.5	123.6
1980-1984	6.6	80.0	86.6
1985-1989	4.7	91.6	96.3
Total	51.5	361.6	413.1
Hobart			
1966-1970	Dissection not published		9.0
1971-1975			12.6
1976-1980			15.0
1981-1985			14.1
Total to 1985			50.7

(a) Includes road and highway improvements.

Given the study forecasts of future patronage and of the consequent capital investment required, the past level of funds provided for urban public transport, if continued, will not be sufficient to provide the facilities.

ANNEX C

PUBLIC TRANSPORT FINANCE

Introduction

This Annex discusses public transport finance. The major topic is the provision of finance from State and Local Governments for public transport over the period 1960-61 to 1970-71. The sources of funds available to the State and Local Governments are also indicated. Whether finance in the future will be forthcoming from State Governments in sufficient quantities is also explored as well as possible variations in taxation bases from the traditional bases.

State and Local Government Authorities

Broad details of the total funds available and the total outlays of State and Local Government Authorities over the period 1961-62 to 1970-71 are set down in Tables C.1 and C.2 following.

TABLE C.1 - TOTAL STATE AND LOCAL GOVERNMENT AUTHORITY OUTLAYS

($ million)

Year	Rail, bus and tram enterprises		Other outlays (b)	Total outlays
	Working expenses (a)	Gross capital outlay		
1961-62	446	86	2,919	3,451
1962-63	443	79	3,096	3,618
1963-64	466	82	3,377	3,925
1964-65	486	87	3,767	4,341
1965-66	495	117	4,101	4,713
1966-67	512	112	4,399	5,024
1967-68	532	110	4,788	5,431
1968-69	565	122	5,236	5,923
1969-70	597	131	5,808	6,536
1970-71(c)	655	136	6,349	7,140

(a) Excludes interest and depreciation. (b) Total net current and capital outlays for all government departments plus working expenses and capital outlays of all public enterprises except rail, tram and bus operations. (c) Preliminary estimate.

Source : Commonwealth Bureau of Census and Statistics, Public Authority Finance (Ref. 5.33). Details for 1960-61 are not available on this basis.

TABLE C.2 - TOTAL FUNDS AVAILABLE TO STATE AND LOCAL GOVERNMENT AUTHORITIES

($ million)

Year	Taxes, fines, fees etc.	Operating revenue of rail, tram and bus operations	Commonwealth grants (current and capital)	Net borrowings (a)	Other revenue funds (b)	Total funds available
1961-62	602	461	800	700	880	3,451
1962-63	658	471	852	742	895	3,618
1963-64	730	506	895	771	1,023	3,925
1964-65	803	526	958	868	1,185	4,341
1965-66	866	517	1,076	888	1,366	4,713
1966-67	967	557	1,183	957	1,360	5,024
1967-68	1,081	570	1,312	1,051	1,416	5,431
1968-69	1,214	588	1,419	1,106	1,596	5,923
1969-70	1,342	636	1,621	1,093	1,845	6,536
1970-71(c)	1,411	655	2,207	1,119	1,758	7,140

(a) Government securities (Australia and Overseas), local and semi-government securities, net receipts of private trust funds, net advances from Commonwealth Government and other funds n.e.i. (b) Rent, royalties and dividends, interest, other current receipts, cash and bank balances, security holdings and the operating revenue of all public enterprises except railways, trams and buses. (c) Preliminary estimate.

Source : Commonwealth Bureau of Census and Statistics, Public Authority Finance, (Ref. 5.33).
Details for 1960-61 are not available on this basis.

Although the working expenses of rail, bus and tram enterprises (Table C.1) have been increasing in money terms from $446m in 1961-62 to $655m in 1970-71, the proportion of total local government outlays made up by these transport expenses has decreased from 12.9 per cent to 9 per cent. A similar thing happened in capital outlays, $86m (2.4 per cent) in 1961-62 to $136m (1.9 per cent) in 1970-71.

The movement in operating revenue from $461m in 1961-62 (13.3 per cent of total funds available) to $655m (9.0 per cent) in 1970-71 is almost identical with the movement in working expenses. The increase in Commonwealth grants from $800m (23.1 per cent of total funds available) in 1961-62 to $2,207m (30.9 per cent) in 1970-71 is the most significant increase.

State Government Finances

Tables C.3 and C.4 show the importance of the transport undertakings in Consolidated Revenue Funds and Loan Funds. As some States do not include all the financial details of public transport undertakings in their Consolidated Revenue Fund and/or Loan Fund, interstate comparisons cannot be validly made.

In addition, it must be borne in mind that, where there are statutory authorities, the amount shown is only an indication of the absolute level. If an undertaking is controlled by a local government authority, all that will be shown in the Consolidated Revenue Fund or Loan Fund will be the amount transferred to these authorities either by grant or loan. Thus, in some States the importance of the transport undertakings with regard to State Government finance will be understated by using Consolidated Revenue and Loan Funds only. Sometimes, funds are also transferred through trust accounts, and this action can similarly result in understatement.

Some comments on the tables relating to each fund are:-

(a) Consolidated Revenue Fund (Tables C.3a and C.3b)

The States where the transport undertakings are most important, based on proportion of the total, are Queensland and New South Wales. In all States, except Tasmania, the importance of the transport undertakings in this fund in percentage terms has been declining.

(b) Loan Fund - Gross Loan Expenditure (Table C.4)

Although the overall trend has been a declining share to transport undertakings, the proportion is more irregular than that shown in the Consolidated Revenue Fund because of episodic increases due to special allocation for large projects.

The interesting point is that the decline in percentage terms is not as marked in the Loan Funds as it is in the Consolidated Revenue Funds.

TABLE C.3a - CONSOLIDATED REVENUE FUNDS : REVENUE

($ million)

	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas. (a)	Total
1960-61							
Rail/Bus/Tram	204.9	85.2	70.8	26.8	32.6	..	420.3
Total	564.7	370.2	217.6	164.0	138.7	55.6	1,510.8
% of Total	36.3	23.0	32.5	16.3	23.5	..	27.8
1961-62							
Rail/Bus/Tram	201.8	86.0	70.1	28.2	33.7	..	419.8
Total	591.2	392.6	234.7	178.2	149.9	62.6	1,609.2
% of Total	34.1	21.9	29.9	15.8	22.5	..	26.1
1962-63							
Rail/Bus/Tram	207.3	87.1	73.3	28.2	33.8	..	429.7
Total	625.3	414.1	247.0	187.4	157.1	63.3	1,694.2
% of Total	33.2	21.0	29.7	15.0	21.5	..	25.4
1963-64							
Rail/Bus/Tram	227.3	92.4	81.1	29.8	34.9	..	465.5
Total	684.5	444.4	260.9	203.0	167.9	68.4	1,829.1
% of Total	33.2	20.8	31.1	14.7	20.8	..	25.5
1964-65							
Rail/Bus/Tram	238.0	102.0	79.8	29.6	36.4	..	485.8
Total	729.1	480.7	267.1	214.2	180.1	75.8	1,947.0
% of Total	32.6	21.2	29.9	13.8	20.2	..	25.0
1965-66							
Rail/Bus/Tram	220.5	99.7	81.7	29.8	41.9	..	473.6
Total	771.6	508.6	294.5	228.8	206.7	84.9	2,095.1
% of Total	28.6	19.6	27.8	13.0	20.3	..	22.6
1966-67							
Rail/Bus/Tram	240.2	105.0	85.4	30.1	48.2	..	508.9
Total	830.7	559.6	323.8	250.8	228.1	93.8	2,286.8
% of Total	28.9	18.8	26.4	12.0	21.1	..	22.3
1967-68							
Rail/Bus/Tram	252.2	98.8	91.4	28.6	51.2	..	522.2
Total	888.1	601.3	357.2	264.5	250.7	101.5	2,463.3
% of Total	28.4	16.4	25.6	10.8	20.4	..	21.2
1968-69							
Rail/Bus/Tram	259.2	100.3	99.3	29.4	49.2	..	537.4
Total	966.7	664.2	387.9	287.4	275.1	106.7	2,688.0
% of Total	26.8	15.1	25.6	11.4	19.1	..	20.0
1969-70							
Rail/Bus/Tram	279.5	105.2	105.9	34.1	57.2	..	581.9
Total	1,076.4	726.9	441.1	323.8	318.2	123.7	3,010.1
% of Total	26.0	14.5	24.0	10.5	18.0	..	19.3
1970-71							
Rail/Bus/Tram	283.6	108.0	105.6	35.6	61.8	..	594.6
Total	1,247.2(b)	832.8	499.0	386.9	367.3	138.2	3,471.4
% of Total	22.7	13.0	21.2	8.7	16.8	..	17.1

(a) Tasmanian transport services are under the separate control of the Transport Commission. (b) Derived by deducting from total receipts items previously included in loan funds, eg. loan raisings $121.7m, loan repayments $5.9m and works grants $51.0m.

Source: Commonwealth Bureau of Census and Statistics, Official Year Book of the Commonwealth of Australia (Ref. 1.1).

TABLE C.3b - CONSOLIDATED REVENUE FUNDS : EXPENDITURE

($ million)

	N.S.W.	Vic.	Qld	S.A.	W.A.	TAS (a)	Total
1960-61							
Rail/Bus/Tram	177.3	79.8	74.8	28.0	35.0	2.6	397.5
Total	565.4	369.9	218.9	161.6	141.1	56.0	1,512.9
% of Total	31.4	21.6	34.2	17.3	24.8	4.7	26.3
1961-62							
Rail/Bus/Tram	177.1	81.0	74.3	28.5	35.9	3.5	400.3
Total	597.5	392.6	234.4	177.2	151.8	63.3	1,616.8
% of Total	29.6	20.6	31.7	16.1	23.6	5.6	24.8
1962-63							
Rail/Bus/Tram	174.5	81.6	75.0	28.2	35.3	3.3	397.9
Total	624.9	414.2	246.9	186.8	158.7	64.3	1,695.8
% of Total	27.9	19.7	30.4	15.1	22.2	5.2	23.5
1963-64							
Rail/Bus/Tram	186.0	86.3	80.8	28.1	36.3	3.1	420.6
Total	684.0	444.9	260.5	199.8	170.7	69.6	1,829.5
% of Total	27.2	19.4	31.0	14.1	21.3	4.4	23.0
1964-65							
Rail/Bus/Tram	198.9	92.9	82.2	28.8	37.9	3.3	444.0
Total	734.2	480.7	271.2	216.8	184.8	77.4	1,965.1
% of Total	27.1	19.3	30.3	13.3	20.5	4.2	22.6
1965-66							
Rail/Bus/Tram	194.7	94.9	86.3	29.3	42.0	3.9	451.1
Total	776.3	516.7	298.0	235.7	206.7	86.9	2,120.3
% of Total	25.1	18.4	29.0	12.5	20.3	4.5	21.3
1966-67							
Rail/Bus/Tram	201.1	97.0	87.7	31.1	46.4	3.8	467.1
Total	833.8	559.6	323.5	250.7	228.2	94.4	2,290.2
% of Total	24.1	17.3	27.1	12.4	20.3	4.1	20.4
1967-68							
Rail/Bus/Tram	211.8	98.5	90.9	31.3	53.0	4.0	489.5
Total	887.6	604.1	356.2	267.4	249.9	103.3	2,468.5
% of Total	23.9	16.3	25.5	11.7	21.2	3.9	19.8
1968-69							
Rail/Bus/Tram	224.1	104.4	98.5	32.8	52.7	4.6	517.1
Total	970.3	666.6	388.8	286.9	276.1	110.4	2,699.1
% of Total	32.1	15.7	25.3	11.4	19.1	4.2	19.2
1969-70							
Rail/Bus/Tram	237.5	111.3	104.1	35.2	58.1	2.2	548.4
Total	1,080.8	742.3	444.6	320.9	318.9	120.9	3,028.4
% of Total	22.0	15.0	23.4	11.0	18.2	1.8	18.1
1970-71							
Rail/Bus/Tram	285.2	129.4	101.6	38.7	64.8	4.9	624.6
Total	1,254.6	846.6	499.6	386.8	171.6	138.2	3,497.4
% of Total	22.7	15.3	20.4	10.0	17.4	3.6	17.9

(a) Tasmanian transport services are under the separate control of the Transport Commission. Figures shown for relevant items represent payments to the Commission. (b) Derived by deducting from total expenditure an amount for works and services ($164.8m) previously included in loan funds.

Source: C.B.C.S. Official Year Book of the Commonwealth of Australia (Ref. 1.1).

TABLE C.4 - STATE GOVERNMENT GROSS LOAN EXPENDITURE

($ million)

	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	Total
1960-61							
Rail/Bus/Tram	20.6	15.1	10.4	5.2	6.2	1.6	59.1
Total	130.4	103.4	59.4	62.8	38.7	33.5	428.2
% of Total	15.8	14.6	17.5	8.4	15.9	4.8	13.8
1961-62							
Rail/Bus/Tram	17.6	15.3	12.1	4.9	7.6	0.5	58.0
Total	135.1	106.8	61.4	61.3	41.5	32.2	438.3
% of Total	13.1	14.3	19.7	8.0	18.2	1.5	13.2
1962-63							
Rail/Bus/Tram	16.2	15.6	11.2	4.1	8.3	0.2	55.6
Total	140.6	110.7	62.9	59.6	44.3	32.9	451.0
% of Total	11.5	14.1	17.7	6.9	18.8	6.7	12.3
1963-64							
Rail/Bus/Tram	16.3	15.6	11.7	5.0	9.9	0.7	59.2
Total	148.9	117.8	69.6	63.5	47.3	34.9	482.0
% of Total	14.9	13.3	16.8	7.9	20.9	1.9	12.3
1964-65							
Rail/Bus/Tram	18.5	15.5	15.2	6.4	9.4	0.6	65.6
Total	160.4	127.9	77.6	73.6	50.7	35.7	525.9
% of Total	11.5	12.1	19.6	8.7	18.5	1.7	12.5
1965-66							
Rail/Bus/Tram	15.5	16.3	20.5	5.6	10.5	0.9	69.3
Total	170.4	130.8	77.6	75.0	52.6	39.2	545.6
% of Total	9.1	12.4	26.4	7.4	20.0	2.3	12.7
1966-67							
Rail/Bus/Tram	18.0	16.5	23.7	4.8	11.5	0.3	74.8
Total	177.3	137.6	81.1	77.6	55.3	39.7	568.6
% of Total	10.1	12.0	29.2	6.2	20.7	0.8	13.2
1967-68							
Rail/Bus/Tram	27.9	16.6	24.7	5.4	13.0	0.9	88.5
Total	189.9	144.4	87.5	77.1	60.4	44.8	604.1
% of Total	14.7	11.5	28.2	7.0	21.5	1.9	14.6
1968-69							
Rail/Bus/Tram	25.4	16.9	16.9	5.2	15.8	0.6	80.8
Total	209.1	154.7	92.8	86.9	64.4	42.5	650.4
% of Total	12.2	10.9	18.2	6.0	24.5	1.4	12.4
1969-70							
Rail/Bus/Tram	26.2	16.2	18.6	6.8	12.2	3.3	83.3
Total	211.2	161.4	99.0	101.0	70.0	49.3	691.9
% of Total	12.4	10.0	18.8	6.7	17.4	6.8	12.0
1970-71							
Rail/Bus/Tram	26.2	18.0	15.4	7.7	11.0	na	na
Total	214.9	159.6	101.3	110.2	72.2	na	na
% of Total	12.2	11.3	15.2	7.0	15.2	na	na

Source : C.B.C.S., Official Year Book of the Commonwealth of Australia (Ref. 1.1).

General Situation

Details of the operating results of the urban public transport services included in Annex B reveal that all services are currently operating at a deficit and the majority of the services have been operating on deficits for the past decade. Thus, to enable public transport authorities to keep operating, grants and/or loans have to be made, usually by the State Government. The section in Annex B on the source and the use of funds by urban public transport undertakings indicates the extent to which this has been occurring over the last decade.

As the funds available have not increased over the period at the same rate as price increases, the quantities (and perhaps quality) of goods and service purchased have been deteriorating over the decade. Thus, the amount made available in 1970-71, estimated as $30m, could effectively be used to purchase less goods and services than the amount made available in 1960-61, $21.8m.

The allocation of funds to various forms of government activity in each State is the responsibility of the government concerned and is the outcome of the priorities set by that government. The amount of finance from State government sources to urban public transport is a result of the relative weight placed on this activity in the context of the numerous demands made on the total financial resources of the State. The priorities decided each year in each State also affect charges (including transport charges) with consequential effects on the overall State expenditure pattern.

Whether finance in the future will be forthcoming in sufficient quantities from State government resources to meet the demands of urban public transport for both capital expenditure on equipment and facilities and the financing of deficits is a question that this study cannot answer. The size of funds made available is dependent on several factors including:-

(i) whether priorities accorded urban public transport vis-a-vis other forms of expenditure will be altered,

(ii) whether the overall financial resources of State governments in relation to their desired level of expenditure will be altered,

(iii) whether additional finance could be provided for urban public transport from variations in taxation bases closely related to advantages or betterment obtained from urban public transport.

In the context of this study, the first two of these factors do not require further expansion but the third factor does. Discussion will be about the possible types of taxes; the present or possible future pricing strategies of the transport undertakings will not be included as they fall within the ambit of (ii). This discussion is illustrative and not an exhaustive review of possible taxes nor of all the arguments concerning the taxes mentioned.

(a) Property Tax is a tax based on wealth in the form of land. The basis in Australia is some value associated with the land. It could be unimproved, improved, net annual value or some combination or variation on it. Problems inherent in the tax are the establishment of efficient and just procedures for its assessment and collection, difficulty of assessment due to infrequency of market transactions and problems of inequity due to the timing of assessments.

A specially assessed property tax could be used to provide finance for urban transport on the basis that the provision of this service benefits the property because of ease of access. The addition to the Melbourne City Council rate to finance its proportion of the underground loop is an example of the use of this principle.

The critical fact to be determined is that the area over which it is levied is the area that benefits. If it is not correctly levied, people and organisations see an advantage in moving into surrounding areas. Such a movement can accentuate the strains on limited financial resources because of increased demand for government services in these surrounding areas.

(b) Betterment Levies are based on the idea that the 'person benefited by public expenditure should contribute to such expenditure to the extent of the increased value of their property, and this is not only if the improvement effected by

the public authority was carried out for the purpose of conferring a benefit was purely accidental the expenditure having been undertaken for a totally different purpose'(1).

With regard to urban public transport there are three ways of recovering the 'betterment':-

1. Recoupment arises when the authority purchases more land than is necessary for the construction of the improvement and subsequently sells or leases the surplus at a higher figure reflecting the enhancement in value due to the improvement.

2. Set-off enables an acquiring authority to reduce the amount of compensation payable for 'injurious affection' on land taken. The owner is compensated by the increase in value of his adjoining lands that results from construction of the new public facility.

3. A Direct Charge is a levy on the betterment resulting from a specific public improvement. However, there is the practical difficulty of segregating the increased value due to a particular improvement from the general rise in values.

Recoupment and set-off are useable when a new work or improvement is taking place; although it may to some extent offset the cost of the improvement, it may not be a significant amount and will certainly not be a recurring amount. For a large operating system the method which could be most applicable is a direct charge.

The area to which 'betterment' applies is a difficult problem; so is the assessment of the value of betterment even when the area is determined. Local works may clearly improve access to private property but an appropriate charge is not easy to calculate. For system-wide works, the relation is even more complex because other changes often affect land values and make the assessment of the 'betterment' amount even more difficult.

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(1) Palgrave's Dictionary of Political Economy.

In operation, local betterment could be fairly clearly defined and, thus, a charge justified but there remain the practical problems of assessing and determining the level of charge. There could also be opposition to the transport improvement within the locality because of the betterment levy.

ANNEX D

SOCIAL BENEFIT-COST EVALUATION

USE IN THE STUDY

Social benefit-cost evaluation has been developed as a basis for decisions in fields of public investment where the benefits extend beyond the immediate financial effects on suppliers and users of services, or where it is difficult or undesirable to charge users the full cost of the services. These features are central to the public transport problem.

Consider, for example, improving a public transport service. Any patronage attracted from car usage, particularly at peak periods, would normally confer substantial benefits on remaining road users through reduced traffic congestion. However, under existing pricing, these indirect beneficiaries cannot be charged by the public transport authority.

The actual use made of an improved public transport service would reflect the various attributes of alternative travel modes as perceived by individual users. From the community viewpoint, the choice may be distorted in two important ways. First, individuals are not able to perceive the real cost of each alternative to themselves, and second, they do not allow for the effect of their choice on other members of the community. Specifically, peak period car travellers do not perceive correctly the community cost of traffic congestion, road construction, road maintenance, traffic control, traffic accidents and air pollution for which they are responsible.

If a public transport authority were to attempt to set fares so as to recoup the costs of improving a service, some patronage would be converted to car usage, because people do not count the cost to the community of such a change in travel mode. Hence the whole community may be worse off.

One possible approach to overcoming the problem of reconciling private choice with community welfare would be to change the existing pricing structure of all aspects of urban transport, so that all users and other beneficiaries paid the appropriate community costs of their locational and travel decisions. Some improvement of the existing situation could be made along these lines. However, the practical difficulties are formidable and this approach is not explored in this study.

As the most appropriate investment policy in regard to public transport cannot be assessed through user choice under existing circumstances, and as it is not practicable to establish pricing conditions so that user choice is entirely consistent with community welfare, an analytical aid to decision making is required. Of the various analytical techniques available to assist in making investment decisions, social benefit-cost evaluation is clearly the most comprehensive and rigorous.

DEFINITION

Social benefit-cost analysis involves systematically defining alternative courses of action and comparing all the effects of each. The viewpoint of the whole community is adopted, that is, all the costs and benefits are assessed, irrespective of who pays or gains. As far as possible, all effects, both immediate and future, are expressed in dollars. The values are discounted to the year in which a decision regarding the selection of the best alternative will be made. The sums of benefits and costs are then compared to determine whether or not a project is worthwhile to the community. The degree to which benefits exceed costs provides a measure of the relative worth of different projects on which the community can expend its resources, which are necessarily limited.

Social benefit-cost analysis, therefore, is different from a financial analysis, which might be made by a public transport authority, because it takes into account the costs of travel to the whole community and includes an assessment of the values of savings in non-market factors such as travel time and accidents. Determining the means of financing a project and deciding whether or not revenues will exceed costs, are problems

of financial analysis which are not considered in social benefit-cost analysis.

The key to the effective use of social benefit-cost analysis is the choice of alternatives. In every case, the alternative of continuing with the current course of action is the basic proposition against which any alternative proposal must demonstrate superiority.

COSTS

In evaluating a public transport improvement proposal (a'project') the initial capital expenditure is defined as the cost. Differences in subsequent costs between the current course of events (the 'base case') and the course of events expected to follow from the project (the 'project case') are defined as benefits. In considering costs, the concern is primarily with the value of resources consumed, rather than with money amounts. For this reason transfer payments, such as petrol tax, are not included in the analysis. One other basic principle is that past expenditures on capital works are no longer relevant to a calculation of the social merit of a current proposal. Generally, the value of previous investment is reflected in the base case alternative.

Normally the costs involved in evaluating a public transport project would be those incurred by the operating authority and would include items such as engineering investigation and design, land and property acquisition (including allowance for the cost to the community of using public land, such as parks), earthworks, bridge construction, tracklaying, installation of signalling and communications, station construction, purchase of rolling stock, construction of parking areas and the provision of vehicle servicing and storage facilities.

BENEFITS

Investment in a public transport improvement normally results in benefits (positive or negative) to the operating authority and to several categories of user and non-user. The various classes of benefits may be considered separately.

Operating Authority

Benefits to the operating authority are cost differences, between base case and project case, in operating and maintaining vehicles, and maintaining track, depots, passenger interchanges and other fixed works. Differences in future costs of vehicle additions and replacement are also treated as benefits. Sometimes these are negative.

Existing Passengers(1)

Benefits to existing users of the service would mainly be the value of time savings in complete door-to-door trips. There also may be benefits of increased comfort due to factors such as smoother riding, improved seating, or the provision of temperature control.

Converted Passengers

The benefits to people who previously used other modes of travel ('converted' passengers) would be the differences, in all the costs of journeys now made, between travel by the base case and project case modes. For example, converted car passengers may substitute a total cost made up of a fare and the values of walking time, waiting time and travel time in a public transport vehicle for a previous total cost made up of car operating costs, parking costs, and the values of travel time in the car and walking time. The difference in these sums, other things being equal, would be the resource saving to converted passengers.

Passengers on Other Public Transport Services

Passenger conversion from other public transport services may also affect the travel time and comfort of passengers remaining on those other services. Unless a project is designed specifically to replace or relieve other services these effects would be of second order importance in any well conceived investment proposal.

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(1) This term is applied throughout the report to the anticipated patronage, both present and future, that would be associated with the service in the absence of the specified capital improvement.

Operation of Other Public Transport Services

Passenger conversion could also affect the costs of operating other public transport services.

Road Users

Substantial benefits would accrue to traffic which continued to use roads from which significant numbers of travellers were converted to public transport. These benefits primarily would be time savings and reductions in vehicle operating and accident costs.

It may be argued that any traffic converted from road would be replaced by other road traffic and hence no benefits would result. This objection may be met by considering the possible circumstances. In the short run, traffic would not fully attain the previous level, so some real benefit must accrue to the original road users. Of the replacement traffic, some would be diverted from other roads at a benefit to itself - otherwise it would not have changed route - and to the traffic remaining on these other routes. Some would be new (generated) traffic. Again, these users must gain some benefit because they rejected the opportunity to travel at the former traffic level, yet accepted the opportunity at the new traffic level.

In the longer term, roads may attain previous traffic levels due to various factors, such as population growth and increasing real income, which cause travel demand to increase over time. Although this erodes the benefits to the original road users who continue to travel by road, the true comparison is between the circumstances which would have occurred at the same time period in both the base and project cases. In the base case, either the added traffic would not have been able to travel, with a corresponding loss of consumer surplus, or new road space would have been provided for it at a significant community cost.

Generated Passengers

An improved public transport service would normally generate some new travel and here again a benefit occurs. The amount of benefit to a generated passenger is less than the difference between total travel cost on the improved services in the project case and the total cost at which travel could have been made in the base case. Consequently, it is usual in such studies for the benefit to be taken as one-half of the difference between these travel costs. This procedure was adopted.

Intangibles

Public transport improvements normally involve benefits to passengers, such as improvement in comfort, service reliability and safety. Ideally, these factors should be taken into account in forecasting patronage changes, and in assessing the value of improvements to existing, converted and generated passengers. In the current study, lack of reliable empirical data restricted the degree to which the evaluations could take explicit account of changes in travel quality, other than the value of time savings. However, these other effects are reflected in the travel forecasts and are included directly in the assessment of user benefits associated with public transport vehicle replacements.

In other projects evaluated in the study the nature of the improvements would tend to reduce current quality differences between car and public transport travel. However, the omission of a direct valuation of quality differences, in itself, would tend to overstate the benefits to converted passengers. On the other hand, no benefits were assessed for the effects of better public transport in reducing vehicle ownership, or in making the cars, previously used by converted passengers, available for use by other people.

The community generally may also benefit from improved public transport through lower levels of noise, air pollution and environmental distrubance. Due to data limitations, it was not practicable to attribute values to these effects in the current study. There is little doubt, however, that they are of considerable magnitude.

Generally, the approach adopted in the study was to value intangibles where they appeared immediately relevant to the evaluation and were not offset by opposite effects. For example, the value of passenger comfort would be of central concern in determining the merit of acquiring modern rolling stock, so it was taken into account in the evaluations. On the other hand, while provision of an extra railway track may increase passenger comfort by reducing stopping and starting, the main concern would be the saving in travel time. Hence time was the only intangible valued in route improvement projects.

As far as can be judged at present, the treatment of intangibles in the study does not significantly bias the evaluation results.

TRANSPORT CORRIDOR MODEL

General Description

For the purposes of the study it was necessary to analyse a range of projects and to assess the effect, on the evaluation results, of variations in economic parameters, travel forecasts and cost estimates. The only feasible way in which this could be done was by developing an analytical model for evaluating a variety of improvement proposals.

Essentially the model is a computer program representing, in mathematical terms, the characteristics of urban transport on a discounted cost basis. Basic relationships, parameter values and discounting calculations are an integral part of the model. The individual characteristics of particular projects are coded as input. The output presents economic criteria for a specified range of discount rates, and the internal rate of return, together with the primary components of discounted costs and benefits.

Base Case and Project Case Alternatives

In transport project evaluation generally, specification of a valid base case is often a matter of some difficulty. Other than abandoning a service, which may be an unrealistically adverse alternative, some continuing expenditure is required to maintain the service. This expenditure is a function of the level of service specified.

In specifying the base case for corridor project evaluations it was assumed that public transport operation would continue and that new vehicles would be provided under a normal replacement programme. This same programme would also apply to the replacement of vehicles in the project case.

For the evaluation of new routes designed to serve developing areas it was assumed that base case travel would occur, consistent with the planned development. However, it would take place on other routes, or by other modes, as appropriate to the circumstances of the project.

Model Input

The input to the model is designed so that all aspects of travel cost in the corridor can be compared for the base case and the project case. The data preparation guidelines and the items of input information are described in some detail in the appendix.

More briefly, the input items can be considered in groups. Basic identification data describe the transport routes and route sections in the corridor. Information relating to the base case describes the characteristics of each route and the travel which takes place on it. Road routes are described, according to route section, by type, length, width and locality. Traffic is specified by average weekday volume, composition and growth trend.

Railway routes are described by length and number of tracks. Rolling stock information includes number of vehicles serving the route, annual mileage per vehicle and seats per vehicle. Passenger data includes average daily loading per route section, peak loading for the route, peak travel time per section and off-peak travel time per section. Bus and tram route information is generally comparable to that provided for trains.

For the project case, information for new or improved routes is of the same nature as in the base case. Forecasts of traffic and passenger levels are specified at the year in which

the project becomes operation (operational year) and a more distant year (forecast year) for which travel forecasts are available, usually from a transportation study.

The capital costs of the project are specified by categories such as the cost of land, route construction, vehicles and passenger interchanges. The time profile of each expenditure item is also specified.

In both base and project cases public transport expenditure continues throughout the evaluation period. Data are provided, therefore, on the estimated amount and timing of expenditures for the purchase, operation and maintenance of rolling stock and the maintenance of fixed works. These costs are provided in detail for a period of 20 years beyond the operational year. For the remaining part of the 50 year evaluation period used in the model, costs are first aggregated and are then provided to the model as a total discounted cost at a specified year.

In addition to the data necessary for the calculation of main route costs, input information is required to account for the costs of access to each route section (collection/ distribution costs). These costs represent a substantial part of door-to-door travel cost and vary considerably according to travel mode and corridor section.

The route section data relating to the collection/ distribution costs for cars includes the time and operating cost for travel on secondary routes, parking cost and walking time. In the central business district, which is usually defined as one of the corridor sections, a traffic interference cost is attributed to each car trip. This interference cost is taken as equal in value to the sum of the vehicle operating cost and the travel time value for collection/distribution travel associated with a car trip in the central city section.

Parking cost is most significant in the central city section and is assessed as the resource cost of providing parking space. Parking cost only affects the evaluation in respect of car users who may be converted to public transport users. Hence, it relates to the specific characteristics of such travellers. Based on an independent analysis of central city parking characteristics, parking fees, the costs of providing off-street parking and the traffic interference of on-street parking, the resource costs of parking adopted for the model, for one-way person trips, are Sydney 41 cents, Melbourne 23 cents, Adelaide 23 cents, Brisbane 18 cents and Perth 18 cents.

The collection/distribution data for train travel includes the number of trip ends in each corridor section, the proportion of passengers using each main mode of access to the rail service and the waiting time per passenger. For each of the access modes, the walk time, in-vehicle time, and the travel cost or fare (as appropriate), is provided. In certain circumstances the car operating cost associated with 'park and ride' travel is increased to allow for the cost of traffic interference caused by parking train passengers' cars on streets near suburban stations.

The collection/distribution data for bus and tram travel is similar to that provided for trains. For all modes, both base and project case information is required. All estimates take into account both directions of travel and a weighting of peak and off-peak travel.

Travel Costing

The model aggregates, for base case and project case separately, the costs of travel associated with each route, for each year of the evaluation period.

For public transport travel this involves calculating vehicle operating and maintenance costs from vehicle miles and unit costs, main-route passenger costs from travel times, and collection/distribution costs from the various components of travel associated with each route section. The person time value, used as an average over all circumstances, is 1 cent per person minute for in-vehicle time and 2 cents per minute for walking and waiting time. The calculated costs are added to the cost items specified directly as input.

The procedure for calculating the costs of road travel involves several steps. Hourly traffic volumes are calculated for peak periods and off-peak periods by applying factors, appropriate to the city and the location of each route section, to the daily traffic estimate. Travel speeds are assessed from relationships between travel speed, traffic volume, route characteristics and route section location. Account is also taken of the effect of public transport vehicles and the composition of other road traffic. Operating costs for each vehicle type and the time costs of occupants are then calculated as functions of vehicle speed. Accident costs are dependent on route type.

Road user costs are only calculated in this way up to the level of congestion at which it would be more economic to construct additional road space than to allow traffic congestion to increase. Beyond this point, road traffic continues, according to the relevant traffic forecasts, but it is served by the construction of additional road space. Road user costs are then valued as the sum of a maximum road user cost plus a road construction and maintenance cost.

As a basis for establishing the conditions under which it is economic to provide additional road space, a new freeway was assumed to be the most efficient way of increasing road space in

the type of corridor considered in the project evaluations. Estimates were obtained of freeway construction and maintenance costs in different cities and a representative discounted cost per mile was developed. It was assumed, for the purpose of the estimate, that space would be added incrementally in such a way that the new freeway would always operate near to the optimum level of traffic efficiency. This implied a particular road user cost per vehicle mile for the new freeway, for any specified traffic composition. Under these circumstances, the new freeway would be just warranted, on economic grounds, at one particular value of the difference between road user cost per vehicle mile on the freeway and road user cost per vehicle mile on the existing congested roads.

Consideration of the freeway cost value, typical traffic composition and the practicable traffic loading for maximum efficiency, led to the value of 6.9 cents per vehicle mile used in the model as the cost of providing new road space, on the basis of average daily traffic. In an evaluation, road user costs for congested existing roads and new freeways are compared at each year until this difference is attained, after which the new road space is assumed to be constructed. The cost of road travel in subsequent years remains constant at the operating cost per vehicle mile on an efficient freeway plus 6.9 cents. The actual stable value depends on the particular traffic composition and the ratio of peak to off-peak traffic relevant to the evaluation. Typically, however, new space is warranted when the road user cost difference is 9.8 and 4.9 cents per vehicle mile for peak and off-peak travel respectively.

Evaluation

The determination of costs and benefits in the model follow the principles described in earlier sections of this Annex.

Some amalgamation of benefit categories is used to avoid errors in the calculation of generated and converted traffic benefits, which could result from the independent treatment of transport users' and suppliers' costs. This was necessary in designing a current operational model. In a perfect pricing situation, however, all benefits could be calculated from user costs alone.

Existing public transport user benefit is defined as the difference between base and project case costs for patronage corresponding to the base case forecast of public transport passengers. It includes the benefits of travel conversion between alternative public transport services. The only costs included are time costs on route-sections and relevant collection/distribution costs.

Generated public transport user benefit is defined as one half of the existing public transport user benefit per trip, applied to the total generated public transport patronage.

Converted road user benefit is defined as the difference between road user costs (including road construction costs) in the base case and public transport user costs in the project case, applied to the total converted road users. It also includes a disbenefit due to the cost, to public transport operating authorities, of supplying extra services to carry the converted passengers.

Remaining road user benefit is defined as the difference between road user costs in the base and project cases, applied to the total project case road users.

Public transport operating benefit is defined as the difference between base case expenditure for public transport

operation and the proportion of the corresponding project case costs which can be attributed to existing public transport passengers.

Each of the classes of benefit described is only calculated for a period of 20 years from the year in which benefits commence. The difference in base and project case costs occurring between this year and the 50th year of the evaluation period (the 'residual period') is defined as the residual period benefit. This comprises two groups of cost. Intermittent costs, such as vehicle and capital works replacement, are specified directly as input to the model. All other benefits derive essentially from a subtraction of continuous cost relationships, such as user costs. The time profile of these benefits in the residual period is estimated from a curve which fits the discounted values of benefits at years 15 and 20, is zero at year 50, and is not negative.

In the evaluation, the costs and benefits occurring over the entire evaluation period are each discounted, aggregated and compared.

Model Output

The key output of the model is the benefit-cost ratio for the project at discount rates of 5 per cent, 7 per cent and 10 per cent, the net present value and the estimated internal rate of return. The time profile of discounted costs and benefits is provided with benefits categorised separately as existing public transport user, generated public transport user, converted road user, remaining road user, public transport operation and residual period. Details are provided of the more important input data and program options allow for the presentation of details of travel time and travel cost by route section at any year of the evaluation period.

Operating System

The computer programs associated with the model are designed for the IBM CALL/360 system. Essentially, there are

four phases in the operation of the model.

Data Entry. Project data are entered directly from the prepared forms, and a permanent data file is established.

Editing. Values in the permanent data file may be corrected, or altered for the purpose of sensitivity testing.

Computation. Annual costs for various use categories are calculated for each corridor section. Temporary files of costs and other relevant information are established.

Economic Evaluation. The annual costs for various user categories are assembled according to the standard benefit types. The benefits and the project costs are discounted, and results of the evaluation are tabulated.

The operating system for the model is totally interactive, that is, input data is supplied from a typewriter terminal in response to a series of questions typed out as computer messages. Error checking proceeds with the input of data. The interactive system was selected in preference to other operating systems to minimise data assembly work, to reduce errors, and to provide a rapid turnaround time, particularly for sensitivity testing.

Model Application

In the application of the model to data provided by the survey, the aspects of the evaluation which appeared most prone to error were the traffic and passenger forecasts and the assessment of the value of passenger conversion and generation. The B.T.E. chose to take a conservative position on both of these aspects. Generally the procedure adopted was to review critically the traffic forecasts, particularly those unrelated to current trends. Careful consideration was also given to the cost estimates and the forecasts of travel speed changes. Evaluations

were then carried out on the B.T.E. assessment of the most probable data set, using selected alternative assumptions regarding the traffic estimates.

In regard to the traffic estimates, two situations were considered. The first was that the passenger forecasts could be incorrect; in which case alternative patronage forecasts were tested. The second was that the passenger forecasts were correct but the source of new patronage (and hence the value of benefits) could be incorrect; in which case alternative sources of new patronage were tested.

Generally three evaluations were carried out for each project. The first was based on the most probable passenger estimates (the 'central case'). Normally this involved both passenger generation and passenger conversion. The second evaluation adopted the same total passenger forecast, but assumed that all patronage was generated. The third evaluation assumed that the project case patronage would be the same as the base case.

On the basis of these tests and the circumstances of each project, the B.T.E. assessed the most probable values of benefit-cost ratios and net present value as well as an estimated internal rate of return.

PUBLIC TRANSPORT VEHICLE REPLACEMENT

General

Of the total sum of $638m for capital investment identified in the survey, $206m or 32 per cent was estimated for the purchase of new trains, buses, trams and ferries. Some of this expenditure would be required for vehicles to operate over proposed new route construction, or for service expansion in developing suburban areas. A substantial amount, however,

represents investment in replacing old rolling stock. In the view of the B.T.E. an assessment of the related economic merit of this type of investment was necessary for the purposes of the study.

The essence of the analysis is clearly a comparison of the cost of acquiring new rolling stock against the total value of differences in the costs, for the operating authority and for the public, of using new vehicles instead of old. As a practical matter, however, the B.T.E. found a paucity of existing data on almost all of the factors relevant to such an evaluation. Consequently, the assessments included a significant component of judgement, as far as practicable exercised by the B.T.E. in associated with public transport authorities.

Base Case and Project Case Alternatives

The problem of specifying a base case arises in a particularly acute form in vehicle replacement evaluation. Vehicles can be maintained in operation virtually forever, if maintenance expenditure is extended to the replacement of every component of the vehicle. The costs of a maintenance programme of this nature is most difficult to assess, as is also the effect of extremely old vehicles on patronage, safety and the time ('down time') vehicles are out of service due to breakdown, or for maintenance.

In these circumstances the B.T.E. adopted the view that the most appropriate base case is to assume that vehicles would have to be replaced in ten years time anyway, consistent with safety and increasing maintenance expenditure over time.

Costs

The framework of the vehicle replacement evaluations

is similar to the one adopted for the corridor projects. The evaluation period is 50 years. Costs are taken to be vehicle purchases during the period 1973-74 to 1977-78. Later cycles of vehicle purchase in the project case, and all vehicle purchases in the base case, are incorporated in the assessment of benefits.

Travel Estimates

The travel estimates made in each replacement study were derived in two steps. First, it was assumed that there was an underlying level of patronage ('existing' passenger miles) which would be the same irrespective of the age of the rolling stock. Each unit of both old and new rolling stock was assumed to perform a traffic task equal to the system wide average per vehicle(1). In the case of trams and trains, which have been retaining their patronage (in terms of passenger miles) reasonably constant in recent years, this present level of 'existing' patronage was applied throughout the study period. In the case of buses, which have lost patronage in recent years, a declining trend was applied over the study period.

The second step was to superimpose on this underlying level of patronage a responsiveness to new vehicles. Specifically, it was assumed that with new vehicles patronage would be higher to the extent of one per cent for every ten years' difference in age. Thus, for example, replacement of 50 year old Melbourne trams with new trams was assumed to lead to a 5 per cent increase in patronage (in respect of the trams under consideration). In ten years time, when new trams would be introduced in the base case (and they would be 10 years newer than project case trams), base case patronage was assumed to be one per cent higher than project case patronage.

For the purpose of estimating benefits, it was necessary to divide this new patronage into generated and converted categories. From travel demand elasticity considerations,

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(1) In the case of Melbourne trams, actual vehicle numbers were adjusted to reflect lower availability of old trams due to the need for more maintenance/repair work to be done on them.

one fifth of all new patronage was assumed to be generated and four fifths converted from car usage.

Benefits

The quantifiable benefits, other than differences in vehicle purchase cycles, are taken to be :

- savings in vehicle maintenance costs,
- savings in vehicle operating costs,
- benefits to existing passengers,
- benefits to new passengers, and
- road traffic savings due to passenger conversion.

The following benefits are considered to be significant (though each one is not necessarily relevant to each replacement case), but not quantifiable :

- improved conditions for operating staff,
- improved safety,
- reduced track maintenance costs, and
- reduced interference to other road traffic.

The calculation of savings in vehicle maintenance and operating costs is peculiar to each circumstance. However, calculation of the other benefits involved procedures and values which are common to all replacement cases, and these are discussed below.

Benefits to Existing Passengers: It has been assumed throughout all the vehicle replacement evaluations that passengers attach a value to improved travel conditions. The improvement in travel conditions resulting from replacement of Melbourne trains(1) and trams(2) would be quite marked, and has been valued at 1 cent per passenger mile. The improvement in travel conditions with bus replacement(3) would not be so great, and has been valued at 0.5 cents per passenger mile.

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(1) The advantages of new trains relative to old trains include forced air ventilation, heating, power closing doors, better seating and standing conditions, and a smoother, quieter ride.

(2) Advantages of new trams include faster schedule speeds, heating, easier boarding, better passenger flow characteristics generally, and a smoother, quieter ride.

(3) Advantages of new buses compared with the ones they are replacing include forced air ventilation, demisting, and a smoother, quieter ride due to better braking and semi-automatic transmission.

For consistency, it is also assumed that when replacement occurs in the base case, the new rolling stock would be preferable to the project case rolling stock which at that time, would have been in service for ten years. However, the contrast in travel conditions would not be so great as the initial project case contrast (a 50-80 year age difference in the case of Melbourne trains and trams), so the quality difference has been valued proportionately lower. That is, the quality difference when there is a ten-year difference in rolling stock age is one-fifth of the 1 cent per passenger mile which applies when the age difference is fifty years.

Benefits to New Passengers: New passengers also benefit from the improved travel conditions associated with modern rolling stock, These new passengers fall into two categories, generated and converted traffic. Generated traffic benefits have been estimated in the conventional way (half the unit rate applying to existing traffic). Benefits to converted passengers may be estimated by comparing project case travel costs with base case travel costs on the mode from which the traffic has been attracted. However, this method of estimation, which was used in the corridor studies, could not be used in the studies of vehicle replacement in city-wide transport systems, because costs of travelling by the base case mode could not be identified. Accordingly, converted traffic benefits were estimated in the same way as generated traffic benefits, though this can be shown to be an underestimate of the benefits[1].

Road Traffic Benefits: In addition to the benefits which accrue to the new public transport passengers themselves, conversion also benefits remaining road users. In the corridor evaluations, these benefits were estimated using road user cost relationships up to a specified congestion level, after which, in effect, a general value of deferred road construction was used. In the replacement studies it was not possible to use the first phase of estimation

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(1) H. Neuburger, 'User Benefit in the Evaluation of Transport and Land Use Plans', Journal of Transport Economics and Policy, Vol. V. No. 1, January, 1971, pp. 57-63.

because, the precise routes from which traffic would be converted could not be identified. Thus, all road user benefits were calculated using the general value of deferred road construction, viz., 9.8 cents per peak vehicle mile and 4.9 cents per off-peak vehicle mile. In the case of trams and buses, half the converted traffic would be in peak hours (applying the time distribution which characterises present patronage), so the value to apply per vehicle mile of converted traffic was a straight average of the above two figures, i.e. 7.35 cents. Peak patronage of trains, on the other hand, constitutes 65 per cent of the total, so that the peak and off-peak figures of 9.8 cents and 4.9 cents were weighted appropriately, giving an average value of 8.1 cents per vehicle mile.

ANNEX D
Appendix

URBAN CORRIDOR MODEL - DATA INPUT

A considerable amount of input information is necessary for the evaluation of public transport improvement projects by the urban corridor model. Even a complete set of forms and instructions is voluminous, so this appendix was prepared to briefly describe the items of input information and their assembly.

The following sets of forms are used in assembling project information :

(i) data preparation guidelines
(ii) identification plan
(iii) base case corridor information
(iv) base case route information
(v) project case corridor information
(vi) project case route information - unaltered routes
(vii) project case route information - project routes
(viii) comments

(i) Data Preparation Guidelines

The guidelines describe the inter-relationship between forms, define the terms used, provide guidance on cost estimating and explain the questions set out on each form.

(ii) Identification Plan

The plan identifies the project, the corridor, main roads, public transport routes, stations and bus terminals.

(iii) Base Case Corridor Information

The information contained on this form relates either to the entire corridor, or to the characteristics of a specific mode in each section of the corridor. The main items include :

(a) Corridor items
starting year for analysis
finishing year for analysis

(b) Section items (road)

week day parking cost

collection/distribution time by car for car travellers

collection/distribution time by walking for car travellers

collection/distribution cost by car for car travellers

(c) Section items (rail)

rail passenger trip ends per week-day

percent 'walk and ride' rail passengers

percent 'park and ride' rail passengers

percent 'kiss and ride' rail passengers

percent 'bus/tram and ride' rail passengers

walking time 'walk and ride' rail passengers

walking time 'bus/tram and ride' rail passengers

travel time 'park and ride' rail passengers

travel time 'kiss and ride' rail passengers

travel time 'bus/tram and ride' rail passengers

waiting time 'walk and ride' rail passengers

waiting time 'park and ride' rail passengers

waiting time 'kiss and ride' rail passengers

waiting time 'bus/tram and ride' rail passengers

transport cost 'park and ride' rail passengers

transport cost 'kiss and ride' rail passengers

fare 'bus/tram and ride' rail passengers

(d) Section items (bus)

bus passenger trip ends per week day

percent 'bus/tram and ride' bus passengers

walking/waiting time bus passengers

travel time 'bus/tram and ride' bus passengers

interchange time 'bus/tram and ride' bus passengers

transport cost 'bus/tram and ride' bus passengers

(e) Section items (tram)

(items correspond to those for bus travel)

(iv) Base Case Route Information

The information contained on this form can be classified as relating to entire sections, to entire routes, or to the characteristics of specific routes in each section of the corridor. The main items include :

(a) Section items

- length
- locality type

(b) Route items (road)

- data year for road traffic

(c) Route items (rail)

- data year for rail traffic
- rail vehicles serving route
- annual mileage per rail vehicle
- seats per rail vehicle
- peak rail passengers at peak load point
- annual operating and maintenance cost per rail vehicle
- annual operating and maintenance cost per rail passenger interchange
- annual maintenance cost rail fixed works
- addition of rail vehicles (type, no., cost, year)
- replacement of rail vehicles and capital items (item, cost, year)

(d) Route items (bus, tram)

- (items correspond to those for rail routes)

(e) Route section items (road)

- type of road
- width of road
- week day traffic
- percent light trucks
- percent heavy trucks
- annual traffic trend

(f) Route section items (rail)

- rail tracks

week day rail passengers
annual trend rail passengers
peak travel time rail passengers
off-peak travel time rail passengers
fare rail passengers

(g) Route section items (bus, tram)

buses in peak period
buses in off-peak period
(other items correspond to those for rail route sections)

(v) Project Case Corridor Information

The main items of information include :

commencement year
operational year
forecast year
land cost profile
route construction cost profile
passenger interchange cost profile
other capital costs profile
(section items for each mode as for base case data)

(vi) Project Case Route Information - Unaltered Routes

The items of information are restricted to those, such as traffic volume, passengers and vehicles to serve the route, which are different in the base case and project case.

(vii) Project Case Route Information - Altered Routes

The items of information are essentially comparable to those in the base case route information. Those which replace similar base case items include :

week day traffic in operational year
week day traffic in forecast year
rail vehicles serving route in operational year

rail vehicles serving route in forecast year

rail passengers operation year

rail passengers forecast year

(items for bus and tram routes correspond to those for train travel)

ANNEX E

THE B.T.E. SURVEY

The general form of the survey was proposed by the B.T.E. and agreed upon at the October Meeting of the Public Transport Study Working Committee of S.C.A. Guidelines were prepared by the B.T.E. and subsequently discussed with transport authorities designated by S.C.A. members in Sydney, Brisbane, Adelaide and Perth. A copy of these guidelines is included as an appendix to this annex.

The objective of the guidelines was to provide State authorities with the opportunity of defining a very broad range of investment proposals relating to public transport. It was expected that these proposals would be drawn mainly from capital works programmes and transportation study plans, but would also include proposals excluded from current plans because of limited funds.

The survey was limited to the period 1973-74 to 1977-78 and to the Capital City Statistical Divisions. Consequently some significant commuter passenger services, such as Sydney-Gosford and Sydney-Blue Mountains, were excluded from consideration.

The projects initially identified by State authorities were discussed with the B.T.E. with a view to making the results as fully comparable as practicable. However, the selection of projects remained the responsibility of State Authorities. Particular attention was given to using a standard basis for cost estimating, and attention was given to constraints, such as time for land acquisition, or availability of engineering manpower, which might curtail work programmes even if new funds became available.

After the range of projects was established, selected projects were identified for evaluation by the B.T.E. The selection was representative of a large proportion of the

estimated expenditure and a significant range of project categories. Central city underground railways were not selected, largely due to the difficulty of evaluation in the framework of the study.

Replacement of old rolling stock with modern vehicles was treated as a project and new rolling stock was also taken into account in projects where it was associated with route upgrading. However, the general acquisition of new vehicles to serve anticipated growth in patronage was not identified as a project.

Most of the selected projects were of the corridor improvement or vehicle replacement types to which the B.T.E. evaluation procedures were primarily directed. The B.T.E. designed special forms for recording project data of relevance to the evaluations. Working groups, generally involving representatives from several authorities, compiled the necessary data in each co-operating city.

In assessing the merit of representative projects the emphasis was on social, or resource, costs, so some adjustment was made by the B.T.E. to the cost estimates initially recorded in the survey. For example, a value was attributed to the cost of using land in public ownership. Further, the B.T.E. considered that contingency allowances should be made in circumstances where the project cost estimating was not based on firm information such as detailed engineering investigations, property valuations, or recent vehicle purchases. The contingency allowance ranged from zero, where estimates were quite firm, to a maximum of 15 per cent where estimates were only preliminary.

For corridor projects it was necessary to estimate the cost and timing of the replacement of vehicles and fixed works for both base and project cases. State authorities provided estimates over a 20 year period from the operational year, and the B.T.E. extended this information to cover a 50 year evaluation period. A consistent approach to the replacement of vehicles and fixed works was adopted, based on the assessed economic life of particular types of asset.

After the completed data forms were reviewed by the B.T.E., discussions were held with State authorities to resolve inconsistencies, to establish details of capital expenditure profiles and to obtain travel details for the portion of journeys not on main-routes. These discussions established the most appropriate assumptions regarding the inter-relationships between the evaluations for the specified projects, and for taking account of the effects of individual projects on the total urban transport system.

Considerable attention was given to the problem of forecasting travel associated with base case and project case conditions for each project. The procedures varied according to the data and travel forecasting models available, and included use of existing transportation study forecasts, special forecasts from transportation study models, trend forecasts and estimates based on travel demand elasticity. In the latter case the responsiveness of public transport patronage to a change in public transport travel time was estimated using the formula:

$$P = (0.3\ r + 0.15)\ T$$

where P = per cent increase in patronage

r = ratio of car person trips to public transport person trips, and

T = per cent decrease in travel time.

ANNEX E
Appendix

GUIDELINES FOR PROJECT SELECTION (1)

INTRODUCTION

The Urban Public Transport Study is being carried out, in response to a request from the Australian Transport Advisory Council, by the Standing Committee of Advisers (S.C.A.) with the assistance of the Bureau of Transport Economics.

The October meeting of the Public Transport Study Working Committee of S.C.A. agreed that a list of public transport improvement projects should be prepared for each capital city, as a basis for designing the economic evaluations which will be carried out by the B.T.E. The evaluations are expected to provide general information on the community value of investment in public transport improvements and to provide some guidance in identifying the types of improvements which appear most advantageous for early implementation. It is not intended that the B.T.E. evaluations will necessarily be sufficiently detailed to positively rank individual projects in order of investment merit.

The following guidelines have been prepared to assist State public transport authorities in the selection of improvement projects for the purposes of the Study. They are not expected to be exhaustive of the possibilities for economically justifiable improvements of urban public transport services.

In each capital city a representative of the B.T.E. will be made available to discuss the general background of the study and the application of the project selection guidelines by public transport authorities. After a list of projects has been prepared, guidelines for costing various types of improvement and for supplying evaluation data will be prepared by the B.T.E. and discussed with public transport authority representatives.

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(1) Copy of the guidelines used in the survey.

GUIDELINES

1. A project is an essentially self contained investment directed towards -

   (a) the improvement of an existing service at the current level of passenger demand,

   (b) the extension of an existing service,

   (c) the development of a new service,

   (d) the improvement of the current financial position of a public transport agency, or

   (e) planning and research activities which would aid in investigating and implementing items (a) to (d).

2. A project must be expected to yield community benefits in excess of costs.

3. A project should be capable of completion or at least substantial implementation within the period 1973-74 to 1977-78. It may be started prior to 1973-74.

4. Projects which are expected to be completed, in the normal course of events, prior to 1973-74 should not be included.

5. Projects should lie within the boundaries defined by the Capital City Statistical Divisions.

6. As far as practicable projects which involve large expenditures, or an extended construction period, should be subdivided into sections which can be constructed and operated as independent entities.

7. Projects, other than planning and research activities, which involve expenditures of less than $50,000 should not be listed unless several projects of a similar nature can be aggregated to a greater amount.

8. Mutually exclusive alternative projects may be listed either individually or in sets as appropriate.

9. Typical projects could include the following:

(a) Train, Bus or Tram Services

(i) replacement of vehicles to improve travel speeds, reduce loading and unloading times, reduce the costs of operating and maintaining existing vehicles, or to attract additional patronage by improving standards of comfort;

(ii) purchase of additional vehicles to extend existing services, or to establish new services such as express bus operation;

(iii) installation of automatic signalling, control or communications equipment to increase travel speed at constant levels of safety, or to reduce passenger delays;

(iv) construction of parking areas to increase passenger patronage;

(v) construction of modern terminals for intermodal transfer where a substantial passenger demand is forecast;

(vi) installation of automatic ticket issuing equipment to reduce operating costs;

(b) Train Services

(i) construction of additional tracks or provision of track loops to allow introduction of express services;

(ii) addition or extension of platform space to reduce passenger loading and unloading times;

(iii) construction directed towards separating passenger and freight services so that passenger services can operate more efficiently;

(iv) construction of route extensions or new routes where a substantial passenger demand is forecast;

(v) electrification of existing tracks to reduce operating costs and increase speeds;

(c) Bus Services

(i) construction of busways in part of an existing road, as a replacement for an existing lightly utilised rail service, or in a new right-of-way;

(ii) provision of control equipment or other devices to provide priority routing for buses;

(d) Tram Services

route construction for operating in exclusive right-of-way in circumstances where tram operation is economically preferable to train or bus operation;

(e) Ferry Services

(i) construction or reconstruction of terminals where a substantial improvement in passenger service is forecast; and

(ii) replacement of ferries to improve operating speeds or to reduce the costs of operating or maintaining existing ferries;

(f) Planning and Research Studies

Estimates may be provided of the funds required in the period 1973-74 to 1977-78 for planning and other investigations directly related to public transport development or operation. The nature of the activities should be specified. Typical projects could include:

(i) operations research studies directed towards improving bus routing or scheduling, location of stops, or driver rostering;

(ii) operations research studies of train or tram scheduling and the operation of passenger terminals and transport vehicle storage areas;

(iii) studies of the feasibility of preparing timetables and staff rosters by computer;

(iv) demonstration projects designed to test new operating procedures before substantial investments are committed;

(v) planning the co-ordination of public transport services with respect to routes, timetables, transfer facilities and fare collection; and

(vi) research to determine the optimum vehicle design for use in a particular system.

10. The selection of improvement projects and a preliminary assessment of the types of project and the total funds involved is the initial phase of the study. Subsequently, data such as passenger loadings, travel times and operating and maintenance costs will be requested.

PROJECT EVALUATIONS

This annex contains summaries of the project evaluations carried out as part of the urban public transport study. The selection of the projects and the assembly of basic data are described in Annex E. The principles underlying the evaluations and the procedures adopted for the analyses of corridor type projects and vehicle replacement projects are described in Annex D.

The projects included in the study are as follows :

CORRIDOR PROJECTS

Sydney

Project 1	Redfern - Tempe Railway
Project 2	Sutherland - Waterfall Railway
Project 3	Illawarra Corridor
Project 4	Tempe - East Hills Railway
Project 5	East Hills - Glenfield Railway
Project 6	Campbelltown Corridor
Project 7	North Sydney - Gordon Railway
Project 8	Strathfield - Epping Railway
Project 9	Cabramatta - Campbelltown Railway
Project 10	Seven Hills - Penrith Railway
Project 11	Gladesville Ferry

Melbourne

Project 12	East Doncaster Railway

Brisbane

Project 13	Northern Corridor Electrification
Project 14	Brunswick Street - Northgate Railway
Project 15	Bus-Rail Interchanges
Project 16	Car-Rail Interchanges
Project 17	Merivale Street Bridge

Adelaide

Project 18 Brighton - Christie Downs Railway
Project 19 Glenelg Tramway

Perth

Project 20 Perth - Claremont Busway
Project 21 Mitchell Freeway Busway

VEHICLE REPLACEMENT PROJECTS

Project 22 Sydney Buses
Project 23 Sydney Trains
Project 24 Melbourne Trams
Project 25 Melbourne Trains
Project 26 Perth Buses

The descriptions of the evaluations are brief. A great deal of detailed information was used in each analysis, particularly of the corridor projects. This could not feasibly be reported at length.

Throughout the descriptions the terminology follows that used in Annex D. As some of the terms could be misinterpreted, they are summarised here.

The 'project' is the proposed capital investment.

'Base case' refers to the conditions which would apply, over an extensive period of years, without the project. 'Project case' refers to the conditions which would apply if the proposed investment were made.

'Existing passengers', or 'existing patronage', are terms used in reference to the present and future users of a public transport service in the base case. The corresponding term, 'existing road users', is also used in the descriptions.

'Remaining road users' are the present and future road users in the project case. This travel is a part of the base case road traffic.

The difference between base case and project case forecasts of public transport patronage is due to 'converted passengers' (those who would use other public transport modes in the base case), 'converted road users' (those who would travel by car in the base case), and 'generated passengers' (those who would not travel in the corridor in the base case).

A table of discounted costs and benefits is included with most of the corridor type project descriptions. As this table is a summary of a computer print-out, the columns do not necessarily total correctly, as shown, due to the rounding of figures.

The column headings describe specific categories of benefit. 'Operation benefit' is the difference between base case expenditure for all public transport operation in the corridor and the proportion of the corresponding project case costs which can be attributed to existing public transport users.

'Existing P.T. user benefit' is the difference between base and project case costs for all base case public transport passengers.

'Generated P.T. user benefit' is one-half of the existing public transport user benefit per trip, applied to the total generated public transport patronage.

'Converted road user benefit' is the difference per trip, between road user costs in the base case and public transport user costs in the project case, applied to the total converted road users. It includes the benefits of deferred road construction due to the project. Also included, as a negative benefit, is the additional public transport cost due to the converted passengers.

'Remaining road user benefit' is the difference, per trip, between road user costs in the base and project cases, applied to the total project case road users.

Three economic criteria are presented in the evaluation results. The benefit-cost ratio compares the discounted benefits and costs. Values are calculated for 7 per cent and 10 per cent. The internal rate of return is the discount rate which would make discounted benefits equal to discounted costs. The net present value (calculated for a 7 per cent discount rate) is the difference between discounted benefits and costs. Each criterion shows a particular aspect of the results. The benefit-cost ratio is the usual method of presenting the results of social-economic evaluations. The internal rate of return provides a measure of the return, to the community, which would be yielded by the project, compared to prevailing rates of interest in the capital market. The net present value is a measure of the amount of benefit associated with a project.

ANNEX F

Project 1

REDFERN - TEMPE RAILWAY

Description

The railway between Redfern and Tempe is a key link in the railway network serving extensive areas to the south and south-west of central Sydney. The southern area (termed the Illawarra Corridor in the project descriptions) is served by a line to Sutherland, which has extensions to Cronulla and Waterfall. The south-western area is served by a line between Tempe and East Hills. A line to the Bankstown area joins the Illawarra and East Hills routes in the section of railway between Redfern and Tempe.

Project 1 deals with a proposed upgrading of the Redfern - Tempe railway as an isolated improvement. Project 2 considers, individually, a proposed improvement of the Sutherland - Waterfall Railway. The combined effects of the two improvements are evaluated in Project 3. The evaluations of Projects 1 and 2 are simplified by not taking account of passenger generation or conversion. However, these effects are evaluated in Project 3.

Project 1 is based on increasing to six the number of tracks available between Redfern and Tempe (a distance of approximately 2.5 miles). At present, this section consists of four tracks for most of its length. The new tracks would be part of a programme for providing an improved rail service in the Illawarra Corridor and in the Campbelltown Corridor (Projects 4, 5 and 6). It would also provide additional capacity to meet anticipated future travel demand. The existing services using the Tempe - Redfern railway suffer congestion during peak periods, with resultant delays in train schedules. Additional tracks would lead to significant benefits due to reductions in travel times, particularly as a more efficient combination of express and local services could be implemented. A diagram of the rail and road network relating to the project is shown in Figure P.1.

Costs

The estimated costs of the project are itemised in Table P.1.1. It is anticipated that all expenditure would be incurred in 1973 and 1974.

TABLE P.1.1. - COST ESTIMATES

Item	Cost
	($'000)
Route construction	5,000
Signalling equipment	1,000
Electrical equipment	930
Contingency allowance	1,040
TOTAL	7,970

Benefits

The only benefits applying to the project, as specified, would be time savings for existing rail passengers. There would be some railway operation disbenefits due to increased track maintenance costs.

Travel Estimates

At present approximately 120,000 passengers per day pass through Tempe. At Redfern, approximately 135,000 passengers per day would benefit directly from the project. Existing patronage is stable and for the purpose of this individual analysis it is assumed that there is no growth in patronage due to the project.

Evaluation

The evaluation understates the benefits of the project because the reduced travel times, taken together with the effects of Project 2, would lead to some passenger generation and conversion. Thus there would be passenger benefits in addition to those calculated. There would also be benefits to road users through traffic relief, and possibly benefits to road authorities through the postponing of new road construction.

Details of the discounted costs and benefits derived in the evaluation are shown in Table P.1.2.

Conclusions

The benefit-cost ratios calculated for the project are 3.3 and 2.5 at 7 per cent and 10 per cent discount rates, respectively. The net present values of the project at these discount rates are $16.690m and $10.398m. The internal rate of return is 23 per cent.

TABLE P.1.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS: REDFERN-TEMPE RAILWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	(a)	(a)	(a)	..	..
1973	..	..				..	3,724
1974	..	..				..	3,481
1975	-46	1,640				1,594	..
1976	-43	1,519				1,476	..
1977	-40	1,407				1,367	..
1978	-37	1,307				1,270	..
1979	-35	1,215				1,180	..
1980	-33	1,129				1,097	..
1981	-30	1,050				1,019	..
1982	-28	976				947	..
1983	-27	912				885	..
1984	-25	852				827	..
1985	-23	796				773	..
1986	-22	744				723	..
1987	-20	696				675	..
1988	-19	650				631	..
1989	-18	608				590	..
1990	-17	568				551	..
1991	-15	531				515	..
1992	-14	496				481	..
1993	-14	464				450	..
1994	-13	433				421	..
Residual continuous benefit						6,422	
Residual intermittent benefit						..	
TOTAL	-518	17,992				23,895	7,205

(a) Not applicable

Benefit-cost ratio	3.316
Net present value ($'000)	16,690

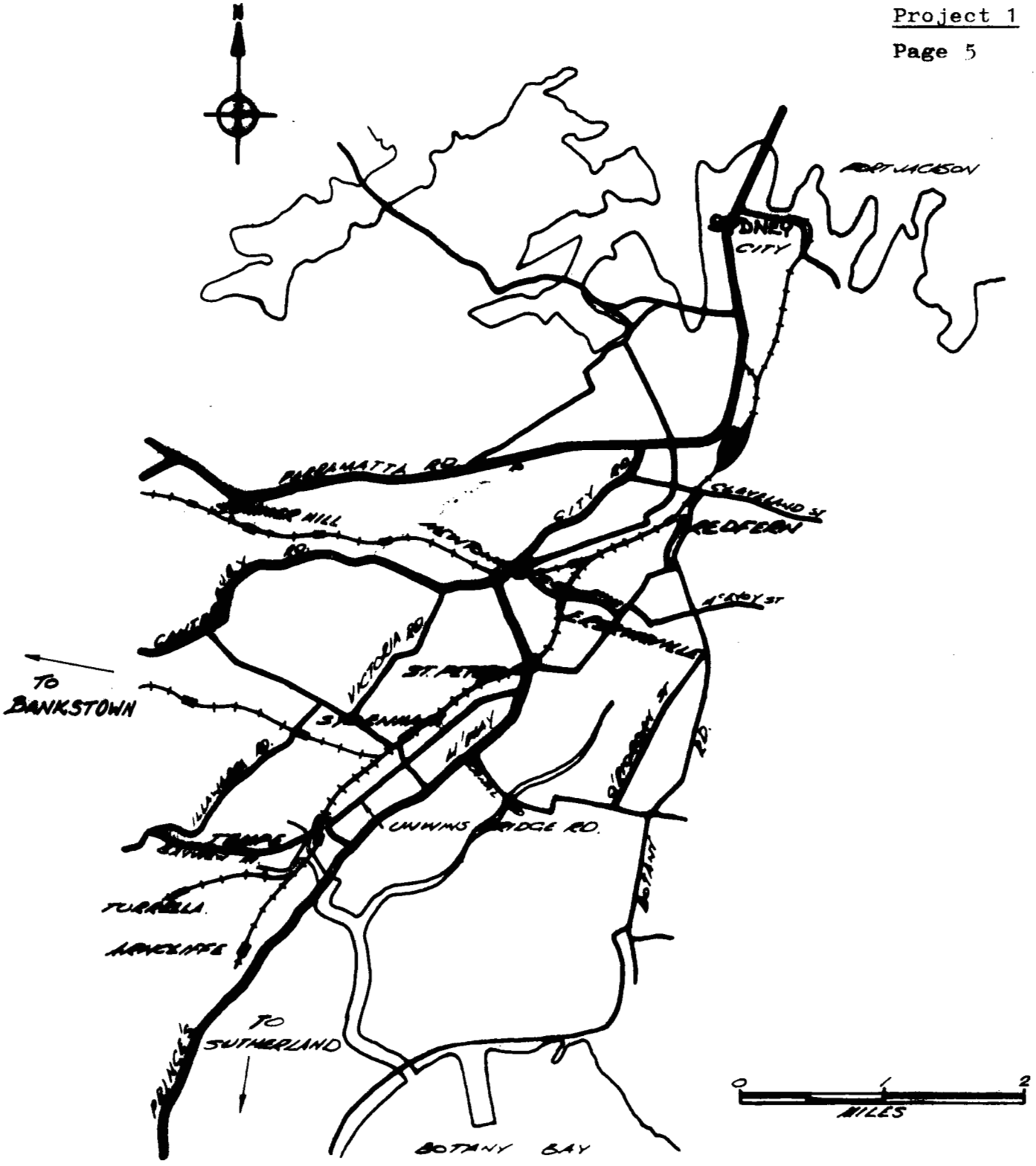

FIGURE P.1 - REDFERN - TEMPE RAILWAY

ANNEX F

Project 2

SUTHERLAND - WATERFALL RAILWAY

Description

The Illawarra railway provides services for the southern areas of Sydney. At present, the service operates on electrified track from Sydney to Sutherland, with a diesel shuttle service from Sutherland to Waterfall. The electrified tracks continue beyond Sutherland to Loftus.

The project is the electrification of the existing track between Loftus and Waterfall (a distance of approximately 8 miles). This would provide a generally improved rail service for suburbs south of Sutherland. The rail and road network relating to the project is shown in Figure P.2.

In this evaluation the only benefits considered are reductions in railway operating costs and time savings to existing patrons of the Waterfall service. The overall aspects of rail service improvements in the Illawarra corridor are treated in Project 3.

Costs

The costs of the project are itemised in Table P.2.1. It is anticipated that all expenditure would be incurred in 1974 and 1975.

TABLE P.2.1. - COST ESTIMATES

Item	Cost
	($'000)
Route alteration	370
Passenger interchanges	250
Electrical wiring and substations	1,130
Signalling and interlocking	630
Rolling stock modifications	20
Contingency allowance	260
TOTAL	2,660

Benefits

The main benefits of the project would be railway operation savings. The existing diesel stock is more expensive than electric rolling stock to operate. It is also very expensive to maintain, particularly as special facilities are required at Sutherland just to service these vehicles. After electrification of the railway, the Sutherland depot could be closed.

The existing railway passengers would benefit from time savings resulting from the faster travel times of electric vehicles and the elimination of transfer times in the peak period (an electric shuttle service would operate in the off-peak period).

Travel Estimates

At present approximately 2,600 passengers per day, from the Waterfall service, pass through Sutherland. Passenger data indicate that there was a linear growth in railway patronage of approximately 1 per cent per annum in 1971. This trend is assumed to continue in both the base case and the project case.

Evaluation

The evaluation understates the benefits of the project because no passenger generation or conversion has been taken into account.

Details of the discounted costs and benefits derived in the evaluation are shown in Table P.2.2.

Conclusion

The benefit-cost ratios calculated for the project are 2.2 and 1.6 at 7 per cent and 10 per cent discount rates, respectively. The net present values at these discount rates are $2.444m and $1.232m. The internal rate of return is 16 per cent.

TABLE P.2.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS: SUTHERLAND-WATERFALL RAILWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	(a)	(a)	(a)	..	..
1973	..	..				..	..
1974	..	..				..	1,087
1975	..	..				..	1,016
1976	266	78				343	..
1977	248	73				321	..
1978	232	68				300	..
1979	217	64				281	..
1980	203	60				263	..
1981	190	56				246	..
1982	177	53				230	..
1983	166	50				216	..
1984	155	47				202	..
1985	-649	44				-605	..
1986	136	42				177	..
1987	127	39				166	..
1988	119	37				156	..
1989	111	35				146	..
1990	104	33				136	..
1991	97	31				128	..
1992	91	29				120	..
1993	85	27				112	..
1994	79	26				105	..
1995	74	24				98	..
Residual continuous benefit						1,406	
Residual intermittent benefit						..	
TOTAL	2,226	917				4,546	2,103

Benefit-cost ratio 2.162
Net present value ($'000) 2,444

(a) Not applicable

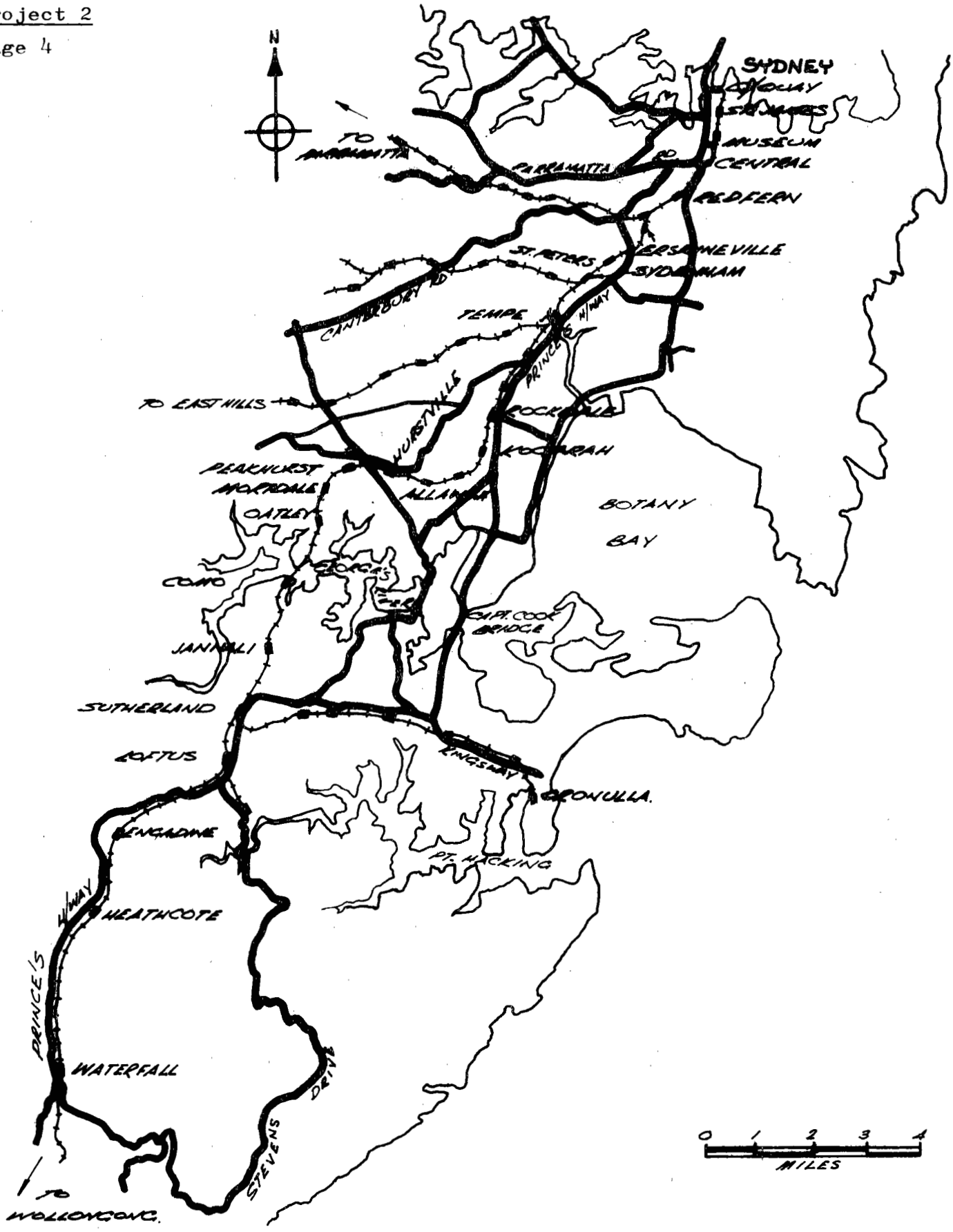

FIGURE P.2 - SUTHERLAND - WATERFALL RAILWAY

ANNEX F

Project 3

ILLAWARRA CORRIDOR

Description

The Illawarra Corridor extends south from Sydney, through densely populated suburban areas, and encompasses developing regions south of Sutherland. At present, travel in the corridor is served by a system of major roads, of which the most important is Prince's Highway, and by a rail service. These facilities are shown in Figure P.2.

Prince's Highway is heavily congested during peak periods. The rail service is also congested between Redfern and Tempe, where it joins with other parts of the Sydney rail network. The railway is electrified only as far as Sutherland. The diesel shuttle service which operates between Sutherland and Waterfall is both slow and costly to maintain. Neither the road system nor the railway will be adequate to serve anticipated population growth in the corridor.

Transport service in the corridor could be significantly improved by constructing two extra tracks between Redfern and Tempe, and electrifying the railway between Sutherland and Waterfall. Individual elements of this upgrading have been evaluated as Projects 1 and 2, but this corridor evaluation combines the individual projects and investigates their overall value.

Costs

The costs relevant to the evaluation are taken to be $2.66m for the Sutherland - Waterfall electrification, $5.96m for new tracks in the Redfern - Tempe section, and $0.58m for new rolling stock to serve anticipated additional patronage. The cost of the Redfern - Tempe works is allocated between this project and Project 6 (which would also benefit from the new tracks), according to anticipated patronage. The total cost used in the evaluation is $9.2m.

Benefits

The project would yield benefits in each of the categories listed in the output of the evaluation model. Improved travel times and increased capacity would be advantageous to existing rail passengers, as well as to generated and converted passengers. Reductions in road traffic in the corridor would improve conditions for remaining road users, while the railway authority would benefit from closure of the diesel depot at Sutherland. There would be some operation disbenefit due to increased track maintenance costs in the Redfern - Tempe section.

Travel Estimates

The present level of rail patronage on the Illawarra line varies from approximately 3,900 passengers per day at Sutherland to 86,000 passengers per day at Redfern. There is no significant growth in rail patronage. If the projects are implemented, it is estimated that daily rail patronage, in the operational year, will increase by 100 passengers at Sutherland and 7,000 at Redfern.

Traffic on Prince's Highway varies from 18,000 vehicles per day at Sutherland to 34,000 vehicles per day at Newtown, with a peak volume of 52,000 vehicles per day at Tempe. The current growth rate for road traffic in the corridor varies from 1 per cent per annum at Newtown to 6 per cent per annum at Sutherland.

Evaluation

The central analysis of the project takes account of both conversion of road users and generation of rail passengers. Discounted costs and benefits for this analysis are shown in Table P.3.1. The results are compared, in Table P.3.2, with the results of an evaluation in which all new patronage is assumed to be generated.

TABLE P.3.1 - ANNUAL DISCOUNTED BENEFITS AND COSTS: ILLAWARRA CORRIDOR - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	4,300
1974	..	..	..	..	..	..	4,018
1975	426	1,220	30	682	201	2,559	..
1976	398	1,132	28	638	192	2,388	..
1977	372	1,050	26	597	183	2,228	..
1978	576	977	24	472	183	2,233	..
1979	325	909	23	523	184	1,963	..
1980	304	846	21	490	183	1,844	..
1981	284	787	20	459	182	1,732	..
1982	265	732	18	430	181	1,626	..
1983	411	684	17	342	184	1,637	..
1984	232	639	16	379	185	1,451	..
1985	217	597	15	355	186	1,370	..
1986	260	558	14	333	187	1,352	..
1987	197	522	13	313	187	1,232	..
1988	301	488	12	250	175	1,225	..
1989	172	456	11	277	163	1,080	..
1990	161	426	11	261	152	1,010	..
1991	151	398	10	245	142	945	..
1992	141	372	9	231	132	884	..
1993	132	348	9	219	123	829	..
1994	123	325	8	207	114	778	..
Residual continuous benefit						10,732	
Residual intermittent benefit						..	
TOTAL	5,447	13,466	335	7,702	3,417	41,100	8,318

Benefit-cost ratio 4.941
Net present value ($'000) 32,782

TABLE P.3.2 - SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumptions	Benefit-cost ratio		Internal rate of return	Net present value (7%)
	7%	10%	(%)	($'000)
Generation and conversion (central analysis)	4.9	3.7	30	32,782
Generation only	3.1	2.3	17	17,716
No new patronage	3.0	2.2	16	14,960

Conclusions

The calculated benefit-cost ratios for the project are 4.9 at a 7 per cent discount rate and 3.7 at 10 per cent discount rate. The results of this evaluation and those for Project 1 and 2 indicate that improvements to rail services in the Illawarra Corridor would be justifiable on social-economic grounds.

A comparison of the results of the central analysis with those for Project 1 and 2 shows the degree to which omission of passenger conversion and passenger generation benefits led to underestimates of the merit of these projects. The application of adjustment factors, based on the corridor analysis, indicates the following corrected values for the economic criteria.

Project	Benefit-cost ratio		Net present value	
	7%	10%	7%	10%
			($'000)	
1	5.5	3.8	35,729	21,221
2	3.6	3.3	5,986	5,257

ANNEX F

Project 4

TEMPE - EAST HILLS RAILWAY

Description

The Campbelltown Corridor may be defined as the area of Sydney extending south-west from Redfern, through East Hills to Campbelltown. Rail service in the corridor is provided by the Redfern - Tempe - East Hills line.

Planning authorities in Sydney anticipate a very large expansion of population in the Campbelltown area. Rail service for the area could be provided by adding new tracks in the Redfern - Tempe section (Project 1), improving the existing Tempe - East Hills route (Project 4) and constructing a new railway link between East Hills and Glenfield (Project 5). Each of these projects is analysed individually. They are also evaluated together as the Campbelltown Corridor improvement (Project 6). In the individual analyses of Project 4 no allowance is made for passenger generation or conversion.

At present, the line between Riverwood and East Hills (a distance of about 4.2 miles) consists of a single electric track. Project 4 is a proposal to duplicate this track. The duplication would reduce existing travel times and provide additional capacity to serve anticipated future growth in patronage. The road and rail networks relating to the project are shown in Figure P.4.

Costs

The estimated costs of the project are shown in Table P.4.1. It is anticipated that the project would be completed during 1973 and 1974.

TABLE P.4.1 - COST ESTIMATES

Item	Cost
	$'000
Route construction	400
Electrical masts and wiring	630
Signalling equipment	400
Other works	50
Contingency allowance	220
TOTAL	1,700

Benefits

The only benefits applying to the project, as specified, would be time savings for existing rail passengers. There would be railway operation disbenefits due to increased track maintenance costs.

Travel Estimates

At present, approximately 14,000 passengers per day use the Tempe - East Hills railway at Riverwood. Patronage is projected to increase linearly at about 1 per cent of current patronage per annum - approximately the current rate of increase.

Evaluation

The evaluation understates the benefits of the project because no passenger generation or conversion has been estimated.

Details of the discounted costs and benefits derived in the evaluation are shown in Table P.4.2.

Conclusions

The benefit-cost ratios calculated for the project are 0.9 and 0.7 at 7 per cent and 10 per cent discount rates, respectively. The net present values of the project at these discount rates are minus $102,000 and minus $465,000. The internal rate of return is 6 per cent.

TABLE P.4.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS: TEMPE-EAST HILLS RAILWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	(a)	(a)	(a)	..	..
1973	..	..				..	794
1974	..	..				..	742
1975	79	152				73	..
1976	72	142				71	..
1977	65	133				68	..
1978	59	125				66	..
1979	54	117				63	..
1980	49	109				61	..
1981	44	103				58	..
1982	40	96				56	..
1983	36	90				54	..
1984	33	85				53	..
1985	121	80				40	..
1986	27	75				49	..
1987	24	71				47	..
1988	22	67				45	..
1989	20	64				43	..
1990	18	60				42	..
1991	16	56				40	..
1992	14	53				38	..
1993	13	50				37	..
1994	12	47				35	..
Residual continuous benefit						475	
Residual intermittent benefit						..	
TOTAL	-815	1,774				1,434	1,537

(a) Not applicable

Benefit-cost ratio 0.933
Net present value ($'000) -102

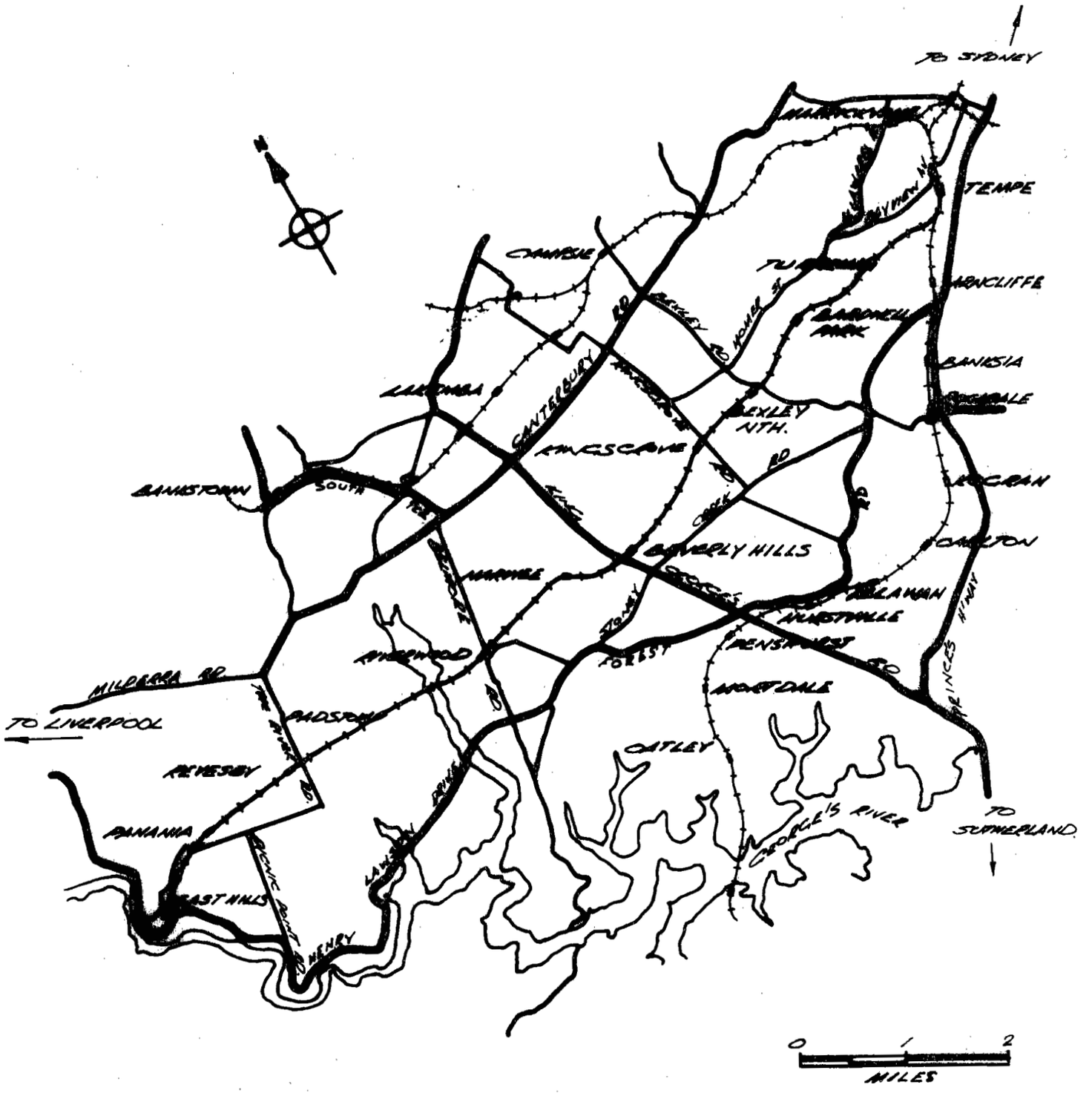

FIGURE P.4 - TEMPE - EAST HILLS RAILWAY

ANNEX F

Project 5

EAST HILLS - GLENFIELD RAILWAY

Description

An electrified railway provides service between central Sydney and East Hills, in the south-western suburbs. Planning authorities in Sydney expect that the Campbelltown area, beyond East Hills, will develop rapidly. The population forecast for Campbelltown is 200,000 in 1985 and 500,000 in 2000.

At present the rail service between Campbelltown and central Sydney is via Cabramatta. This route is heavily used and suffers congestion during peak periods, with resultant delays in passenger train schedules.

Project 5 is a proposal for constructing a new electrified dual-track railway between East Hills and Glenfield (a distance of about 4.5 miles). This would provide a faster and slightly more direct route for travel in the Campbelltown corridor. More importantly, it would provide additional capacity for anticipated future demand for rail travel between Campbelltown and Sydney. The proposed route is shown in Figure P.5.

Costs

The estimated costs of the project are shown in Table P.5.1. All expenditures would be incurred between 1973 and 1975.

TABLE P.5.1 - COST ESTIMATES

Item	Cost
	($'000)
Route construction	960
Land acquisition	1,600
Electrical masts and wiring	1,350
Bridges	2,600
Signalling equipment	600
Rolling stock	5,220
Contingency allowance	1,070
TOTAL	13,400

Benefits

The benefits of the project would be time savings for rail passengers travelling between Campbelltown and inner areas of Sydney, and benefits associated with new patronage made possible by construction of the route. There would also be significant benefits in railway operation due to more efficient utilisation of rolling stock and railway staff.

The project would allow for the more efficient routing, within the Sydney area, of trains using the main south line. No allowance is made for these benefits in the evaluation.

Travel Estimates

Approximately 5,000 passengers a day who now pass through Cabramatta would transfer to the new service. A linear growth rate of 8 per cent of current patronage is anticipated for the base case, in which existing congested routes would be used. For the project case, a passenger growth rate of 22 per cent of operational year patronage per annum is estimated.

Evaluation

The basis for the evaluation is that the difference between base case and project case passenger forecasts represents generated patronage. This would tend to understate benefits, as some conversion from road could be expected. (Refer Project 6). Details of the discounted costs and benefits derived in the evaluation are shown in Table P.5.2. The distribution of benefits, as tabulated, are 53 per cent to existing patronage, 26 per cent to generated passengers, and 21 per cent to railway operation.

Conclusions

The benefit-cost ratios calculated for the project are 1.7 and 1.2 at 7 per cent and 10 per cent discount rates, respectively. The net present values of the project at these discount rates are $8.005m and $2.587m. The internal rate of return is 12 per cent.

TABLE P.5.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS: EAST HILLS-GLENFIELD RAILWAY - DISCOUNT RATE 7%

($'000)

Year	Operation Benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	1,028
1974	..	..	..	..	..	..	3,088
1975	..	..	..	..	..	..	7,155
1976	137	451	130	..	..	717	..
1977	143	442	144	..	..	729	..
1978	1,014	434	157	..	..	1,605	..
1979	- 290	424	167	..	..	301	..
1980	110	414	175	..	..	698	..
1981	109	403	181	..	..	693	..
1982	- 271	391	185	..	..	306	..
1983	697	381	189	..	..	1,267	..
1984	76	371	191	..	..	638	..
1985	- 216	360	192	..	..	337	..
1986	613	349	193	..	..	1,154	..
1987	102	338	192	..	..	632	..
1988	314	327	191	..	..	831	..
1989	77	316	189	..	..	581	..
1990	74	305	186	..	..	564	..
1991	70	294	193	..	..	547	..
1992	- 223	283	180	..	..	239	..
1993	29	272	176	..	..	477	..
1994	28	262	172	..	..	462	..
1995	333	251	168	..	..	752	..
Residual continuous benefit						5,917	
residual intermittent benefit						- 171	
TOTAL	2,925	7,065	3,540	..	..	19,276	11,271
					Benefit-cost ratio		1.710
					Net present value ($'000)		8,005

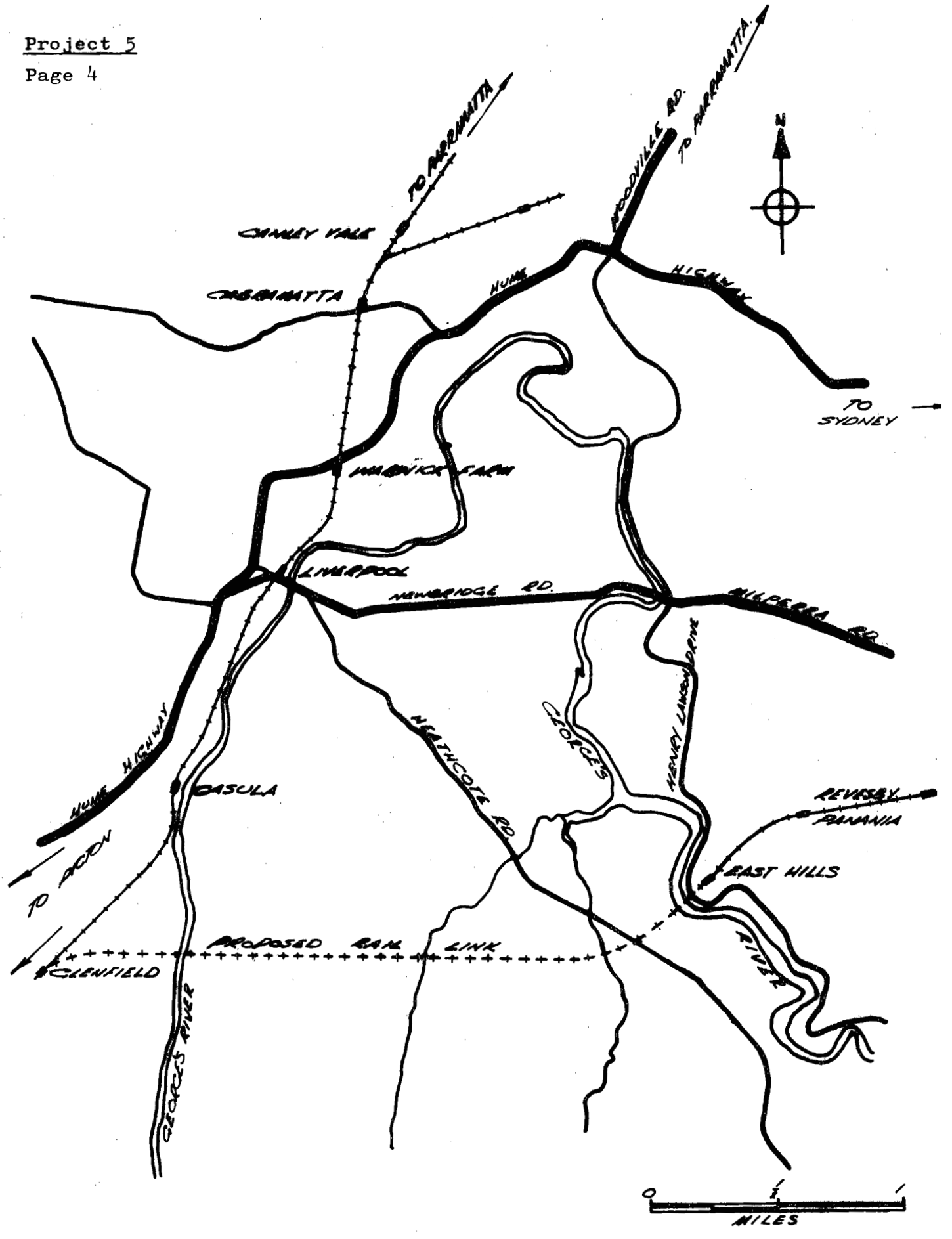

FIGURE P.5 - EAST HILLS - GLENFIELD RAILWAY

ANNEX F

Project 6

CAMPBELLTOWN CORRIDOR

Description

The Campbelltown Corridor extends south-west from the inner city area of Sydney to Campbelltown, which is planned to become a major satellite city. Existing transport services in the corridor will need expansion as Campbelltown develops. Proposals for providing improved rail service in the corridor are described as Projects 1, 4 and 5.

The individual evaluations of these projects did not take account of all the benefits which would be associated with the co-ordinated implementation of the projects. The effect of the proposed improvements on the whole corridor are considered, therefore, in Project 6. The works included in Project 6 are the addition of two electrified tracks between Redfern and Tempe, the addition of one electrified track between Riverwood and East Hills, and the construction of a new railway between East Hills and Glenfield. These routes and the major road network in the corridor are shown in Figure P.6.

Costs

The costs relevant to the project are taken to be $1.7m for the Tempe - East Hills project, $13.4m for the East Hills - Glenfield project and $1.99m for the proportional cost of the Redfern - Tempe project; a total of $17.09m. The remaining share of the Redfern - Tempe costs are allocated to the Illawarra Corridor (Project 3).

Benefits

The project would yield benefits to existing, converted and generated rail passengers through time, distance and travel cost savings. Remaining road users would benefit through reduced traffic congestion. The railway authority would achieve benefits through more efficient operation of services in the corridor, but these would be partly off-set by increased costs of track maintenance and the costs of serving additional patronage.

TABLE P.6.1. - ANNUAL DISCOUNTED BENEFITS AND COSTS: CAMPBELLTOWN CORRIDOR - DISCOUNT RATE 7 %

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	4,715
1974	..	..	..	..	..	..	10,520
1975	-2,681	881	390	35	64	-1,311	..
1976	427	838	404	266	58	1,993	..
1977	430	796	414	265	52	1,956	..
1978	3,939	758	421	263	63	5,443	..
1979	423	721	426	260	74	1,903	..
1980	- 77	686	428	216	83	1,335	..
1981	404	653	427	252	92	1,828	..
1982	391	620	425	248	100	1,785	..
1983	2,881	592	423	244	119	4,260	..
1984	364	565	419	240	137	1,725	..
1985	- 8	539	414	204	152	1,302	..
1986	567	514	408	202	167	1,858	..
1987	342	490	401	224	180	1,637	..
1988	2,111	467	393	221	143	3,334	..
1989	311	444	384	217	109	1,465	..
1990	80	423	375	193	77	1,149	..
1991	280	403	366	209	48	1,306	..
1992	266	383	356	205	20	1,230	..
1993	252	364	346	198	21	1,181	..
1994	239	347	335	191	22	1,133	..
Residual Continuous Benefit						16,073	
Residual Intermittent Benefit						- 299	
TOTAL	10,941	11,485	7,952	4,353	1,782	52,287	15,235
					Benefit-cost ratio		3.432
					Net present value ($'000)		37,052

Travel Estimates

The travel forecasts used in the evaluation were derived by State authorities from estimates of future population in the corridor. The forecasts took into account the likely effect of improved transport facilities on the growth in travel demand.

It is estimated that for the project case in the operational year, 10,000 passengers per day at Campbelltown and 48,000 passengers per day at Redfern would use rail services in the corridor.

Evaluation

Travel costs by both rail and road routes in the corridor are considered in the evaluation. The analysis also takes account of the estimated savings to the railway authority by using the East Hills route, instead of the congested northern routes, for non-metropolitan train service.

Details of the evaluation results are shown in Table P.6.1. Table P.6.2 shows comparative results for the same patronage forecasts, but assuming that all passengers are generated.

TABLE P.6.2 - SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumption	Benefit-cost ratio		Internal rate of return	Net present value (7%)
	7%	10%	(%)	($'000)
Conversion and generation (central analysis)	3.4	2.5	19.5	37,052
Generation only	2.9	2.1	17.6	28,844

Conclusions

The results for the corridor evaluation indicate that the investment in improving and extending the railway facilities would be justifiable on social-economic grounds, providing that the Campbelltown development takes place as planned. The individual evaluations of the separate projects, which did not take full account of passenger conversion and generation, indicated that the Tempe-East Hills project would not be warranted. However, this project is a prerequisite for the efficient operation of the East Hills - Glenfield railway, and taken together, the projects would be justifiable. The corridor analysis can be used to provide a better estimate of the individual merit of these projects, as shown in Table P.6.3.

TABLE P.6.3 - ADJUSTED VALUES OF THE ECONOMIC CRITERIA

Project	Benefit-cost ratio		Net present value	
	7%	10%	7%	10%
			($'000)	
4	1.8	1.3	1,273	256
5	3.4	2.4	26,500	15,244

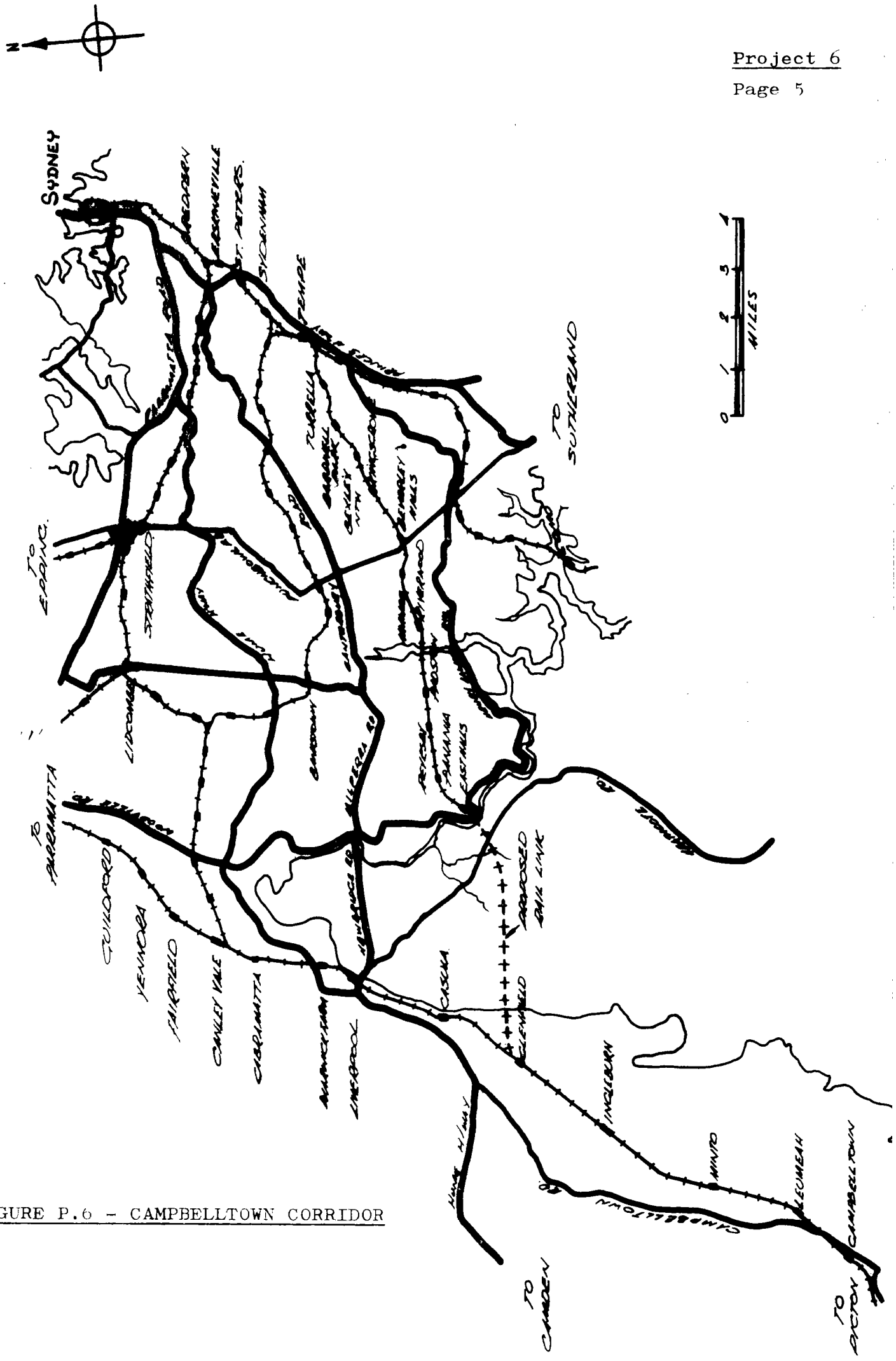

FIGURE P.6 - CAMPBELLTOWN CORRIDOR

ANNEX F

Project 7

NORTH SYDNEY - GORDON RAILWAY

Description

The North Shore line runs from central Sydney, across the Sydney Harbour Bridge and then to Hornsby, following the route of the Pacific Highway fairly closely. At Hornsby, it meets the main north line which connects Hornsby to the southern railway system at Strathfield, in the western suburbs. The main north line continues beyond the metropolitan area, and is used by country and interstate trains. The suburban part of the North Shore line, together with the associated system of major roads, is shown in Figure P.7.

The project is based on quadruplication of the line between North Sydney and Gordon (a distance of approximately 7.5 miles). At present, this section consists of two tracks for most of its length. Quadruplication would provide a generally improved rail service for the northern suburbs and would provide sufficient capacity tc meet anticipated future requirements. The existing service suffers congestion during peak periods, with resultant delays in train schedules. Thus, significant benefits would arise from improvements in travel times, and express and local services could be more efficiently combined. Further benefits would arise from relief of congestion on the heavily-used major road network around this line, in particular on the Sydney Harbour Bridge and its approaches.

Costs

The main inner city station for the North Shore line is Wynyard. This station now operates at capacity and platform works, at a cost of $3m, would be necessary if patronage were to increase significantly. The need for expenditure at Wynyard would depend on circumstances applying to other routes, as well as to the North Shore line. However, a cost of $1.5m was attributed to the project as a share of the Wynyard improvements due to additional patronage associated with the North Shore quadruplication.

The costs for the project are shown in Table P.7.1. It is anticipated that all capital expenditure would be incurred in 1973 and 1974.

TABLE P.7.1 - COST ESTIMATES

Item	Cost
	$'000
Route construction	3,300
Passenger interchanges	450
Wynyard improvements (apportioned)	1,500
Signalling equipment	800
Electrical masts and wiring	1,230
Substations and bridgeworks	4,612
Contingency allowance	1,559
TOTAL	13,451

Benefits

The major benefits of the quadruplication would be time savings for existing public transport passengers and savings due to converted road users. There would also be some generated passenger benefits.

Travel Estimates

From current patronage trends it is estimated that patronage on this section of the North Shore line is increasing linearly at 2.1 per cent of current patronage per annum. This indicates an operational year patronage of 43,000 passengers per day at Gordon, and 69,000 passengers per day at North Sydney.

Road traffic on the Pacific Highway is estimated at approximately 41,000 vehicles per day at both Gordon and North Sydney, with slightly lower levels between these centres. Linear growth rates of 3.7 per cent of current traffic per annum are estimated for this area.

TABLE P.7.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS: NORTH SYDNEY-GORDON RAILWAY - DISCOUNT RATE 7 %

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	5,531
1974	..	..	..	..	..	..	6,579
1975	- 21	837	13	433	332	1,594	..
1976	- 13	791	13	418	216	1,425	..
1977	- 7	747	13	403	106	1,262	..
1978	202	706	13	195	2	1,117	..
1979	4	668	12	373	2	1,060	..
1980	8	632	12	359	2	1,013	..
1981	11	597	12	345	2	968	..
1982	14	568	12	332	2	928	..
1983	193	540	12	189	2	935	..
1984	18	513	11	306	2	850	..
1985	-105	487	11	287	2	683	..
1986	9	463	11	281	2	765	..
1987	10	440	10	269	2	731	..
1988	157	417	10	169	2	755	..
1989	12	396	10	246	2	667	..
1990	- 75	376	10	231	2	544	..
1991	6	356	9	225	7	603	..
1992	6	338	9	215	11	579	..
1993	7	321	9	205	15	556	..
1994	8	304	8	196	14	529	..
Residual continuous benefit						7,302	
Residual intermittent benefit						-116	
TOTAL	445	10,497	220	5,674	729	24,751	12,111

Benefit-cost ratio 2.044

Net present value ($'000) 12,640

Converted and generated rail patronage levels, if the project is implemented, were derived by applying elasticity relationships. This led to an estimated patronage of 44,900 passengers per day at Gordon and 72,200 passengers per day at North Sydney for the project case at the operational year.

Evaluation

Table P.7.2. details discounted costs and benefits for the central analysis of the project. A summary of the results, together with results of various sensitivity tests, is shown in Table P.7.3. For the evaluations with passenger generation only, the project case forecasts are the same as in the central analysis, but the result reflects a more conservative estimate of benefits.

TABLE P.7.3. - SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumptions	Benefit-cost ratio		Internal rate of return	Net present value (7%)
	7%	10%		
			(%)	($'000)
Generation and conversion with Wynyard costs (central analysis)	2.0	1.5	15.9	12,640
Generation and conversion without Wynyard costs	2.3	1.7	17.0	13,947
Generation only with Wynyard costs	1.3	1.0	9.6	3,729
Generation only without Wynyard costs	1.5	1.1	11.0	5,035
No new patronage	1.4	1.0	10.0	4,020

Conclusion

The evaluation indicates that the project would be justifiable under a variety of patronage and cost assumptions. The benefit-cost ratio is estimated to be 2.0 and 1.5 at discount rates of 7 per cent and 10 per cent, respectively. The corresponding net present values are $12.640m and $6.116m.

The distribution of benefits, according to the central analysis, is existing users 60 per cent, converted passengers 32 per cent, remaining road users 4 per cent, generated passengers 1 per cent and public transport operation 3 per cent.

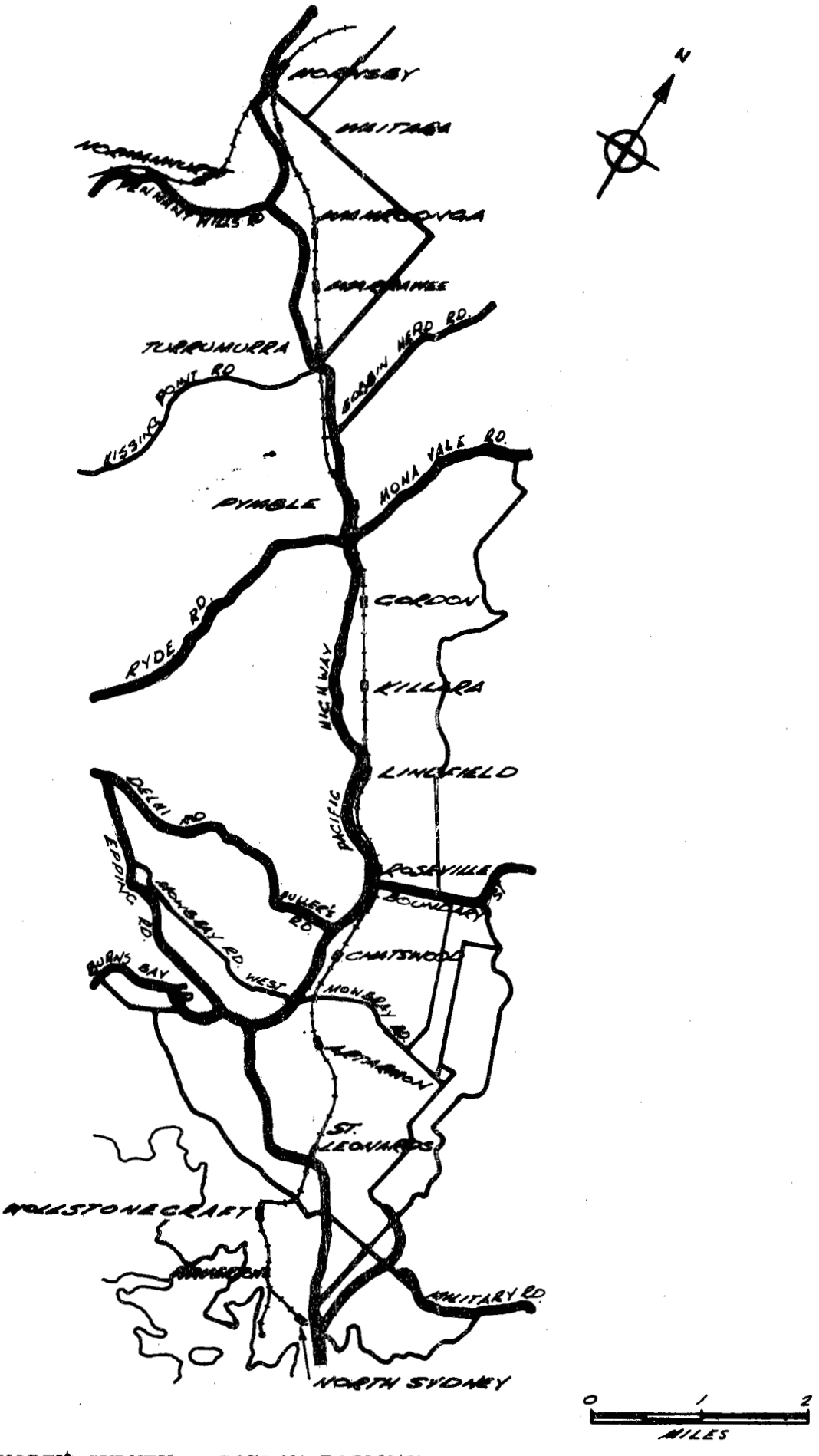

FIGURE P.7 - NORTH SYDNEY - GORDON RAILWAY

ANNEX F

Project 8

STRATHFIELD - EPPING RAILWAY

Description

The section of the Sydney railway network between Strathfield and Epping is part of the main north line. The route serves passengers travelling between the north-western sector of the city and central Sydney. It also carries passengers and freight trains operating between Sydney and northern areas.

At present suburban passenger trains are delayed by interstate and country passenger trains during peak periods. This interference, together with the general congestion experienced on this heavily utilised line, results in a relatively slow service for urban passengers.

The project is based on quadruplication of the line between Strathfield and Epping. The additional tracks would reduce travel times by allowing a more efficient scheduling of express and local trains, and reducing interference between country and suburban trains.

The rail route, together with major roads in the corridor, is shown in Figure P.8. The roads considered in the analysis are Concord Road, Victoria Road and Parramatta Road.

Costs

The project would involve construction of approximately 7.2 miles of dual-track railway, together with the installation of associated signalling and electrical equipment. Only half of the cost of the bridge over the Parramatta River has been included, since major bridgeworks would be required even if the extra tracks were not constructed. The cost estimates for the project are given in Table P.8.1, and it is anticipated that all capital expenditure on the project would be incurred between 1973 and 1975.

TABLE P.8.1 - COST ESTIMATES

Item	Cost
	($'000)
Route construction	3,200
Bridgeworks	1,500
Electrification	800
Signalling equipment	800
Passenger interchanges	500
Contingency allowance	1,020
TOTAL	7,820

Benefits

The major benefits of the project would accrue to existing train travellers and to converted road users. The benefits to remaining road users would be small, because the reduction in road traffic, particularly on Parramatta Road and Victoria Road, would be marginal. Significant additional railway costs would result from maintaining the increased track and from serving a higher patronage. Although it is unlikely that generated patronage would be high, there would be minor benefits in this category.

Travel Estimates

Road traffic on the relevant sections of Victoria Road and Parramatta Road varies from 50,000 to 63,000 vehicles per day, and from 35,000 to 50,000 vehicles per day respectively. The current traffic growth rate is estimated as 5 per cent per annum throughout the corridor.

It is estimated that approximately 30,000 passengers use rail services between Strathfield and Epping each day. The current growth in patronage is at a linear rate of 1.5 per cent of the current patronage per annum.

TABLE P.8.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS : STRATHFIELD-EPPING RAILWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	3,117
1974	..	..	..	..	..	..	3,954
1975	-55	632	13	547	..	1,136	377
1976	-79	592	12	556	..	1,082	..
1977	-74	555	11	520	..	1,012	..
1978	-70	522	10	487	..	949	..
1979	-65	491	9	456	..	890	..
1980	-37	461	9	384	..	817	..
1981	-57	434	8	397	..	781	..
1982	-54	407	7	371	..	732	..
1983	-50	386	7	348	..	690	..
1984	-47	365	6	325	..	649	..
1985	-28	345	6	277	..	600	..
1986	-41	327	6	284	..	575	..
1987	-39	309	5	266	..	541	..
1988	-36	292	5	248	..	509	..
1989	-34	277	5	233	..	480	..
1990	-21	262	4	199	..	444	..
1991	-30	247	4	203	..	425	..
1992	-28	234	4	190	..	399	..
1993	-26	221	4	177	..	376	..
1994	-17	209	3	153	..	348	..
Residual continuous benefit						5,227	
Residual intermittent benefit						-29	
TOTAL	-889	7,568	138	6,621	..	18,632	7,448

Benefit-cost ratio	2.502
Net present value ($'000)	11,183

Evaluation

The central analysis of the project is based on the assumption that increased rail patronage is derived from both generated and converted road users. Discounted costs and benefits for the analysis are given in Table P.8.2. The sensitivity of the results of the evaluation to different patronage assumptions is shown in Table P.8.3.

TABLE P.8.3 - SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumption	Benefit-cost ratio		Internal rate of return	Net present value (7%)
	7%	10%	(%)	($'000)
Generation and conversion (central analysis)	2.5	1.9	17	11,183
Generation only	1.3	1.0	10	2,037
No new patronage	1.4	1.1	11	2,884

Conclusion

The benefit-cost ratio for the project is estimated to be 2.5 at a 7 per cent and 1.9 at a 10 per cent discount rate, respectively. The corresponding net present values are $11.183m and $6.291m.

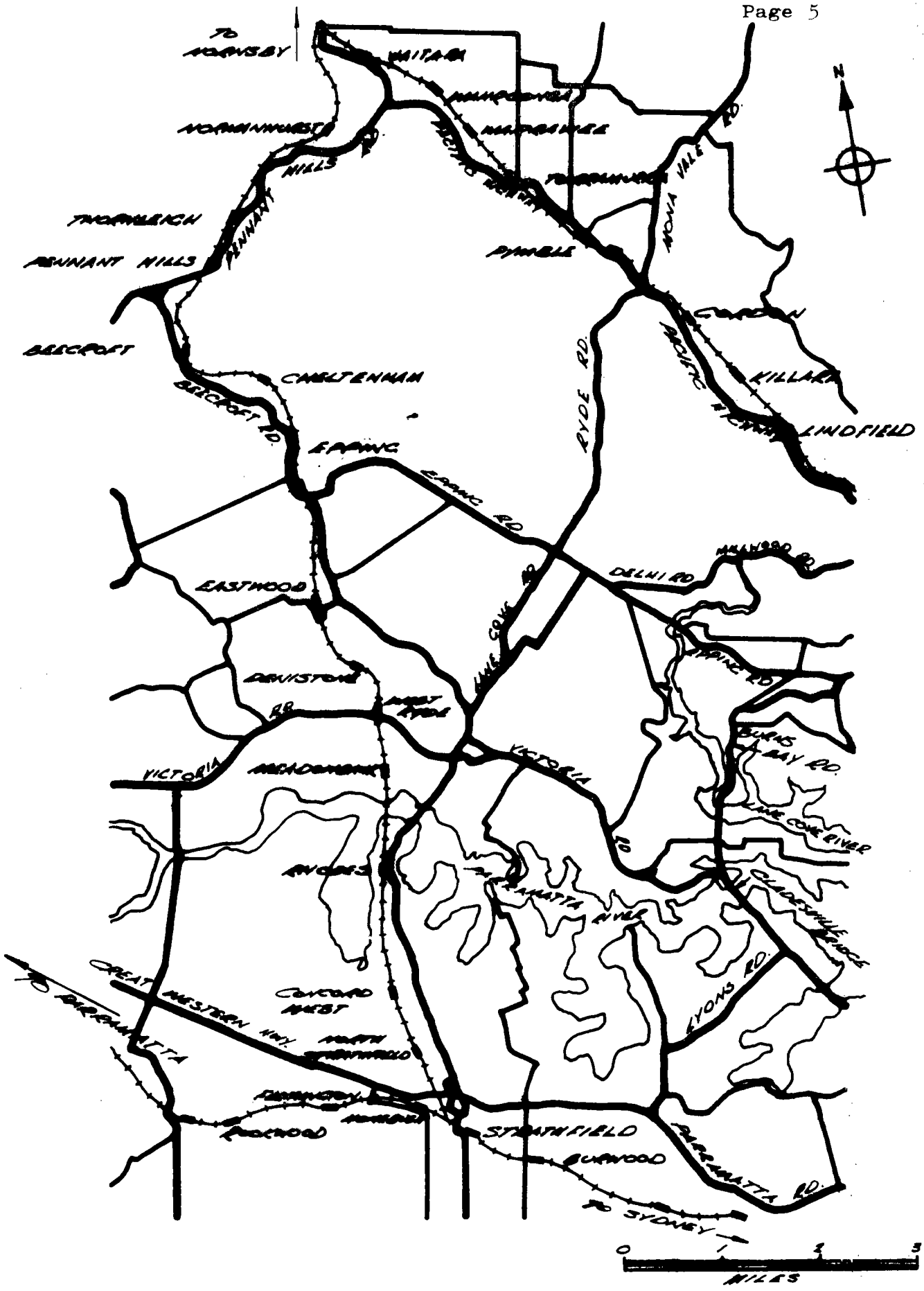

FIGURE P.8 - STRATHFIELD-EPPING RAILWAY

CABRAMATTA - CAMPBELLTOWN RAILWAY

Description

Travel between the central area of Sydney and the planned satellite city of Campbelltown is described in Projects 1,4, 5 and 6. The railway and road systems in the area are shown on Figure P.9.

As part of the development of the western suburban area, Sydney planning authorities visualise Parramatta as a major regional centre. Taken with the anticipated high population of Campbelltown, this would lead to a considerable demand for travel between the two areas. The extent to which this demand could be served by the existing dual track railway is limited by the heavy use now made of the Campbelltown - Cabramatta section by passenger and freight services from outside the metropolitan area.

The project is a proposal to add two tracks of electrified railway to the existing railway between Campbelltown and Cabramatta (a distance of about 14.3 miles).

Costs

The estimated costs of the project are shown in Table P.9.1. The project would be constructed between 1973 and 1975.

TABLE P.9.1 - COST ESTIMATES

Item	Cost
	($'000)
Route construction	4,100
Passenger interchanges	800
Electrical installations	2,400
Signalling equipment	1,000
Viaducts	2,520
Contingency allowance	1,600
TOTAL	12,470

Benefits

The project would benefit rail travel between Campbelltown and Parramatta, and between Campbelltown and the central Sydney area. In the absence of rail improvements in the Campbelltown area, road use would be much greater, so the project (in conjunction with other works described in Project 6) would reduce travel costs for remaining road users and could postpone road construction.

Travel Estimates

Patronage on the railway between Campbelltown and Parramatta is currently between 300 and 1,000 passengers per day, depending on the section. For the base case, growth would be constrained by the peak capacity of the line, to a linear rate estimated at one per cent of patronage in the operational year. In the project case it is assumed that the Glenfield - East Hills rail link and other related projects in the Campbelltown Corridor would be constructed. In this case a linear passenger growth rate of 4 per cent of patronage in the operational year is forecast.

Road traffic on Campbelltown Road is currently about 14,000 vehicles per day. Traffic on the Hume Highway, Woodville Road and Church Street varies from 25,000 to 40,000 vehicles per day. Linear growth rates between 4 and 6 per cent of current traffic, per annum, are estimated to apply to road traffic in the corridor.

Evaluation

The central analysis is based on the assumption that increased rail patronage would be derived from converted road travellers and from generated rail passengers. The evaluation takes into consideration the effects of the improvement on road traffic in the corridor.

Details of the discounted costs and benefits derived for the central analysis are shown in Table P.9.2. The results are compared, in Table P.9.3., with the results obtained from assuming that all additional passengers are converted road users.

TABLE P.9.2. - ANNUAL DISCOUNTED BENEFITS AND COSTS: CABRAMATTA-CAMPBELLTOWN RAILWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	2,331
1974	..	..	..	..	..	..	4,357
1975	..	..	..	..	..	..	4,072
1976	- 272	426	2	..	..	156	..
1977	- 190	402	5	96	65	378	..
1978	- 835	378	8	81	124	-244	..
1979	- 127	357	11	259	177	676	..
1980	- 81	336	13	333	224	825	..
1981	- 45	319	15	409	308	1,006	..
1982	- 17	302	17	480	384	1,166	..
1983	6	286	18	546	451	1,306	..
1984	- 689	271	19	275	510	387	..
1985	351	257	20	445	534	1,606	..
1986	2	244	21	743	553	1,561	..
1987	14	231	21	820	567	1,653	..
1988	25	218	21	892	578	1,734	..
1989	33	207	22	909	540	1,710	..
1990	- 298	196	22	627	504	1,050	..
1991	19	185	22	904	470	1,599	..
1992	25	175	21	906	438	1,566	..
1993	29	166	21	905	408	1,530	..
1994	33	157	21	900	380	1,491	..
1995	36	149	21	893	353	1,451	..
Residual continuous benefit						17,248	
Residual intermittent benefit						-902	
TOTAL	-1,983	5,261	340	11,422	7,566	38,953	10,759

Benefit-cost ratio	3.620
Net present value ($'000)	28,194

TABLE P.9.3 - SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumption	Benefit-cost ratio		Internal rate of return	Net present value (7%)
	7%	10%		
			(%)	($'000)
Generation and conversion (central analysis)	3.6	2.4	16.3	28,194
Conversion only	4.1	2.7	17.3	33,200

Conclusions

The evaluation indicates that the project, as specified, would be justifiable on social-economic grounds, providing that the development of Parramatta and Campbelltown occur as planned.

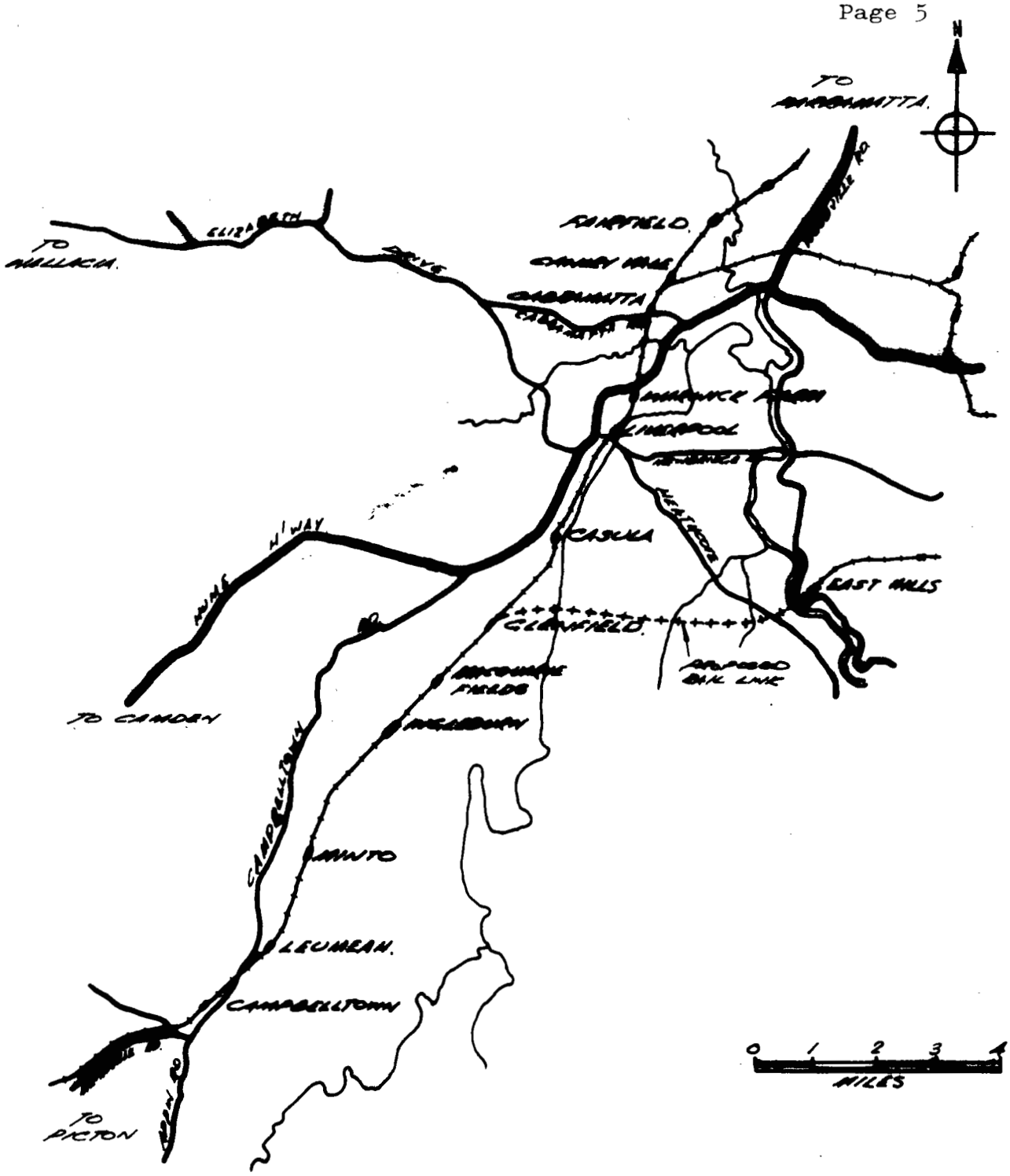

FIGURE P.9 - CABRAMATTA - CAMPBELLTOWN RAILWAY

ANNEX F

Project 10

SEVEN HILLS - PENRITH RAILWAY

Description

The railway between Parramatta and Penrith provides passenger service for residents of the outer western suburbs of Sydney. The population in this region is growing rapidly, and Parramatta is developing into a major commercial and industrial centre. The railway, therefore, serves travel between the western suburbs and Sydney, and within the Parramatta - Penrith area. With the planned expansion of Parramatta, it is expected that the latter category of travel will increase rapidly, while the former will remain relatively stable.

The Parramatta - Penrith railway currently has four tracks for most of the distance between Parramatta and Blacktown, but has only two tracks between Seven Hills and Penrith. The two track section restricts current train operation because an efficient combination of express and local trains is not possible. A further disadvantage is that suburban services are disrupted by long-distance trains. These deficiencies of the existing service result in high travel times and limit the capacity available to serve future travel demand. The project is a proposal to overcome these deficiencies by providing a four track line over the entire Parramatta - Penrith route.

The major road system in the corridor focusses on the Great Western Highway, which is heavily congested and carries a large volume of heavy commercial vehicles. The road and rail services in the corridor are shown in Figure P.10.

Costs

The project would involve construction of approximately 14 miles of dual-track railway, together with the appropriate signalling and electrical equipment. Some alterations would be required at stations on the route.

The cost estimates for the project are given in Table P.10.1, and it is anticipated that all capital expenditure would be incurred in 1974 and 1975.

TABLE P.10.1 - COST ESTIMATES

Item	Cost
	($'000)
Route construction	5,000
Passenger interchanges	70
Electrical masts and wiring	1,250
Footbridges	180
Signalling equipment	1,000
Contingency allowance	1,131
TOTAL	8,631

Benefits

The project would decrease travel times between Penrith and Parramatta from 40 minutes to 33 minutes. This would benefit existing train passengers and those car travellers, now using the Great Western Highway, who would convert to rail travel. There also would be benefits in deferring road construction which would otherwise be necessary to serve travel generated by the planned urban development in the corridor.

The project would result in some increase in railway operating and maintenance costs.

Travel Estimates

The Great Western Highway currently carries approximately 26,000 vehicles per day at Penrith, increasing to 43,000 vehicles per day at Parramatta. The current growth rate for road traffic in the corridor is about 5 per cent of the current traffic per annum.

TABLE P.10.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS: SEVEN HILLS-PENRITH RAILWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	..
1974	..	..	..	..	..	..	3,769
1975	..	..	..	..	..	..	3,523
1976	-172	1,459	..	..	..	1,287	..
1977	- 66	1,356	18	432	..	1,740	..
1978	14	1,260	34	812	..	2,120	..
1979	76	1,171	47	1,142	..	2,436	..
1980	-3,621	1,088	58	637	..	-1,837	..
1981	-108	1,015	68	1,606	..	2,581	..
1982	- 47	947	76	1,813	..	2,790	..
1983	1	884	83	1,990	..	2,958	..
1984	39	824	89	2,137	..	3,089	..
1985	-2,801	769	93	912	..	-1,026	..
1986	-175	718	97	2,277	..	2,916	..
1987	-132	670	100	2,354	..	2,991	..
1988	- 96	625	102	2,413	..	3,043	..
1989	- 67	583	103	2,455	..	3,074	..
1990	-986	544	104	1,601	..	1,263	..
1991	- 90	507	104	2,426	..	2,947	..
1992	- 65	473	103	2,430	..	2,942	..
1993	- 44	442	103	2,424	..	2,925	..
1994	- 27	412	102	2,409	..	2,896	..
1995	-1,405	384	100	1,669	..	749	..
Residual continuous benefit						31,911	
Residual intermittent benefit						-6,079	
TOTAL	-9,769	16,131	1,583	33,939	..	67,717	7,292
					Benefit-cost ratio		9.286
					Net present value ($'000)		60,425

Rail patronage is approximately 10,000 passengers per day at Penrith, and 36,000 passengers per day at Parramatta. With the planned development of Parramatta, Sydney planning authorities expect that there will be a five fold increase in demand for rail travel by the end of the century. This estimate was adopted for the project case. For the base case it was assumed that the forecast growth would be reduced by 20 per cent due to travel constriction. Rail patronage would be limited to the capacity of the route, so the remaining travel was assumed to take place by road.

Evaluation

Passenger conversion and generation for the central analysis are defined by the travel forecasts. Details of the results of this analysis are shown in Table P.10.2. The sensitivity of the results to the interpretation of the composition of new patronage, is shown in Table P.10.3.

TABLE P.10.3. - SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumption	Benefit-cost ratio		Estimated internal rate of return	Net present value (7%)
	7%	10%	(%)	($'000)
Generation and conversion (central analysis)	9.3	5.2	31	60,425
Conversion only	10.5	5.8	32	69,398

Conclusions

The central analysis indicated a benefit-cost ratio for the project of 9.3 at a 7 per cent discount rate and 5.2 at a 10 per cent discount rate. Essentially the project indicates the potential value of serving new development by increasing the capacity and attractiveness of an existing rail service rather than by only expanding road capacity.

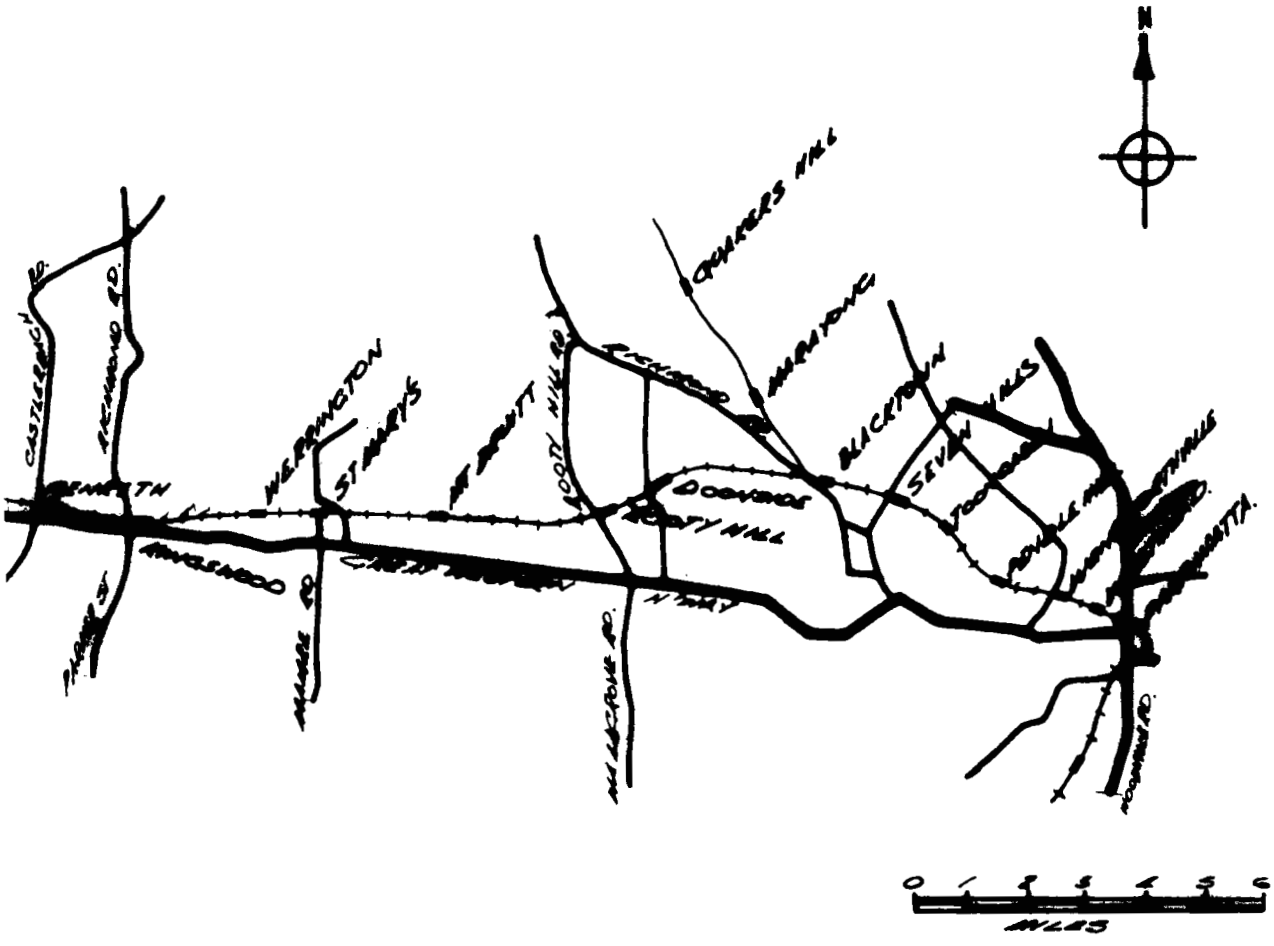

FIGURE P.10. - SEVEN HILLS - PENRITH RAILWAY

ANNEX F

Project 11

GLADESVILLE FERRY

Description

The basis of this project is provision of a ferry service between Huntley's Point on the northern side of the Parramatta River (at Gladesville Bridge) and the Sydney ferry terminal at Circular Quay. The service has been variously described as using conventional ferries or hydrofoil craft. Extensions of the service to Silverwater (to the west) and to intermediate points between Gladesville and Circular Quay have also been suggested. The service analysed in this study is based on the use of conventional ferries, and no extensions or intermediate stops have been considered.

The primary objectives of the proposed ferry service are to provide a better public transport service between Gladesville and central Sydney and to defer road improvements required to relieve traffic congestion on the existing road system. The road network at the outer end of the route is shown in Figure P.11. The main impact of the ferry service would be on traffic using Victoria Road, a heavily congested major arterial route serving extensive areas north of the Parramatta River.

Costs

The project would require provision of two ferries and suitable mooring and passenger transfer facilities at the Gladesville terminal. The ferries would have a seated capacity of 200 passengers and a maximum capacity of 250 passengers. The allowance for terminal facilities includes signposting and pavement work so that the existing street reserve can be used efficiently for car parking and feeder bus operation. This would provide spaces for about 200 cars. Future growth of patronage would require construction of off-street parking space, using part of an existing reserve, to provide for an additional 200 cars. Allowance is made in the evaluation for the opportunity cost of this land, taking into account that it would be developed progressively over the evaluation period. An allowance is also included for traffic control measures at the intersection of

Victoria Road with Huntley's Point Road, which provides access to the terminal area. Table P.11.1 summarises cost estimates for 1973.

TABLE P.11.1 - COST ESTIMATES

Item	Cost
	($'000)
Two ferries	300
Wharf construction	90
On-street parking development	8
Land acquisition (equivalent value)	70
Off-street parking development	15
Traffic control measures	15
Contingencies (5%)	20
TOTAL	518

Benefits

The major benefits from the project would be to passengers converted to the service from car or bus. Benefits to passengers converted from bus travel will be high because of time savings provided by the ferry service, and because the operating and maintenance costs of the bus service, per passenger trip, are much higher than for the ferry. The cost of car travel is also high due to the level of traffic congestion on Victoria Road and the cost of parking in central Sydney.

Travel Estimates

The ferry service would only operate during peak periods, and each ferry would make one round trip per hour. Thus, there would be four round trips in each peak period. At an estimated average patronage of 100 passengers per ferry, patronage for the first year of operation (1974) would be 800 trips per day. It is estimated that the patronage would increase linearly to 1200 trips per day in 1984.

Existing traffic in Victoria Road is taken to vary, according to section, between 43,000 and 64,000 vehicles per day.

The estimated growth rate is 5 per cent per annum. Bus patronage is estimated at 5,000 trips per day, and it is assumed that there is no growth in patronage.

Evaluation

The central analysis of the project is based on the assumption that ferry patronage is derived from equal proportions of converted car and bus passengers. The viability of the project under other circumstances is also evaluated.

The focus of the analysis is on the ferry route and the corresponding road route comprising Victoria Road and its extension into central Sydney. Appropriate allowance, for each of the modes, ferry, bus and car, is made for the time and cost associated with travel other than on the specified main-routes.

Details of discounted costs and benefits for the central analysis are shown in Table P.11.2.

TABLE P.11.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS: GLADESVILLE FERRY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	(a)	..	..	..	..
1973	..	..		..	..	..	484
1974	33	35		21	..	89	..
1975	34	34		21	..	89	..
1976	36	33		21	..	90	..
1977	36	32		21	..	89	..
1978	37	31		21	..	89	..
1979	37	30		20	..	88	..
1980	38	29		20	..	87	..
1981	38	28		20	..	85	..
1982	37	27		19	..	84	..
1983	37	26		19	..	82	..
1984	36	26		18	..	80	..
1985	36	25		18	..	78	..
1986	35	24		17	..	76	..
1987	34	23		17	..	74	..
1988	34	22		16	..	71	..
1989	33	21		16	..	69	..
1990	32	20		15	..	67	..
1991	31	20		15	..	65	..
1992	30	19		14	..	62	..
1993	29	18		14	..	60	..
Residual continuous benefit						817	
Residual intermittent benefit						-28	
Total	693	516		361	..	2,360	484

Benefit-cost ratio	4.876
Net present value ($'000)	1,876

(a) Not applicable

It is assumed that the ferries will be replaced after 30 years and that they will have a salvage value of 10 per cent of the original cost. Table P.11.3 shows evaluation results for the same estimate of ferry patronage, but according to alternative assumptions regarding the source of this patronage.

TABLE P.11.3 - RESULTS OF EVALUATION

Patronage assumptions	Benefit-Cost Ratio		Estimated internal rate of return	Net present value (7%)
	7%	10%		
			(%)	($'000)
Conversion from bus and car (central analysis)	4.9	3.6	27	1,875
Conversion from car only	5.3	3.9	29	2,100
Conversion from bus only	4.1	3.0	23	1,500
Generated traffic only	3.5	2.6	21	1,200

Conclusions

The most probable benefit-cost ratios for the project are 4.9 at 7 per cent discount rate and 3.6 at 10 per cent discount rate. The project is viable, on social-economic grounds, under a range of patronage conditions. It is most attractive if patronage is mainly converted from car or bus travel, and would be less satisfactory if patronage were primarily generated, which is most unlikely in the circumstances of the project.

The results are valid only for conventional ferries. The introduction of hydrofoil craft would alter the evaluation significantly, since the patterns of operating and maintenance costs, as well as the travel times, would be dissimilar to those used in this evaluation.

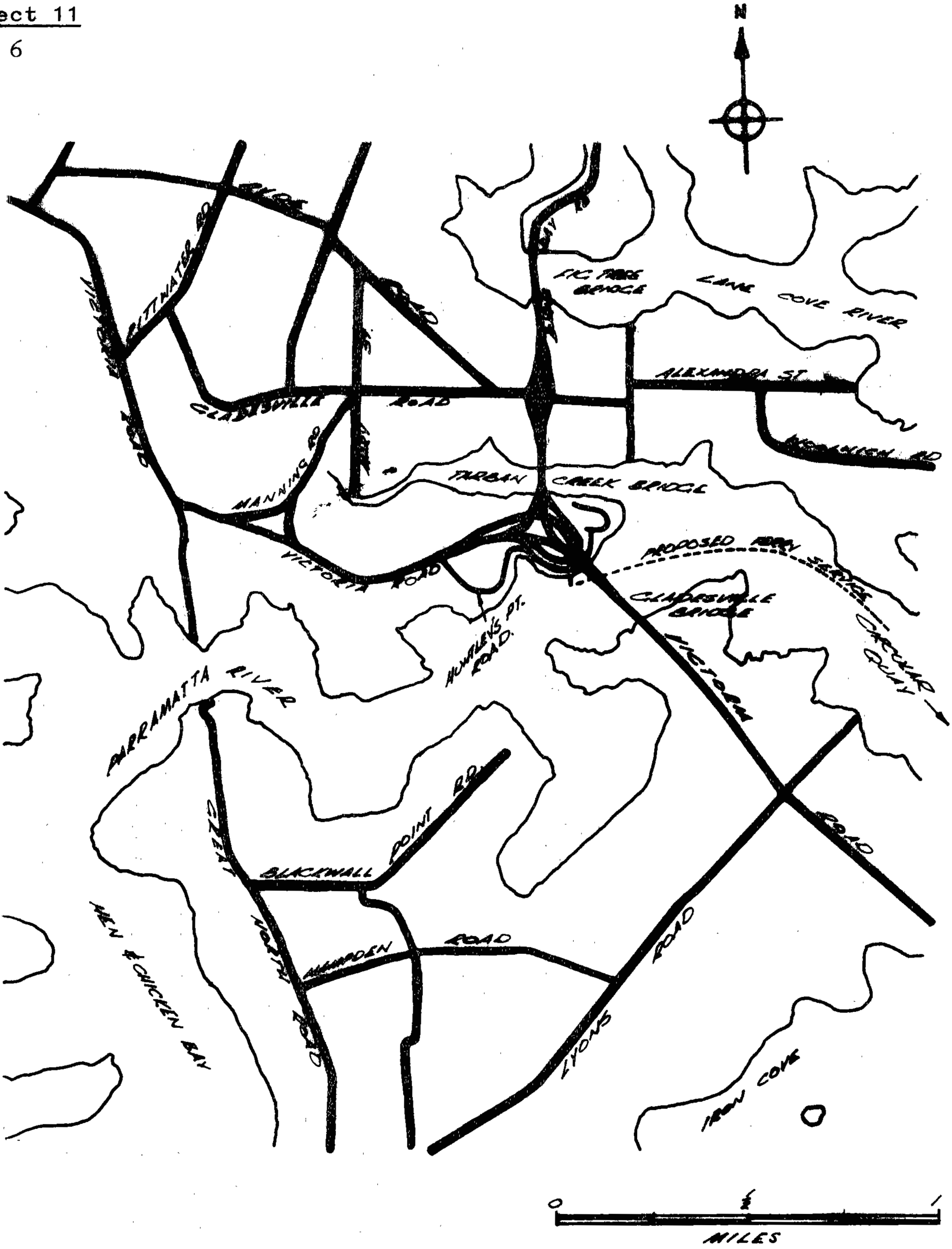

FIGURE P.11 - GLADESVILLE FERRY

EAST DONCASTER RAILWAY[1]

Description

The Doncaster area of Melbourne is developing rapidly and the road system linking it to the central city is heavily congested at peak periods. Additional transport capacity in the corridor appears warranted and both a freeway and a new railway are proposed in the Melbourne Transportation Plan. Although eventually both of these facilities may be warranted, for analytical purposes, the immediate alternatives are to construct neither, to construct both together, to construct the freeway only, or to construct the railway only.

This evaluation is confined to assessing the economic merit of constructing the railway first. The passenger forecasts and the treatment of road costs in the evaluation, however, are consistent with construction of the freeway towards the end of the evaluation period. Only the inner section of the proposed railway is considered in the evaluation. The results do not necessarily indicate the merit of the outer section of the route.

The project involves the construction of a new branch line from near Clifton Hill Station to the intersection of Bulleen Road and Thompson's Road. Two stations would be constructed on the new route with special provision for the convenient transfer of passengers between bus and train, and between car and train. The railway and the roads which would be most directly affected by the project are shown in Figure P.12.

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(1) The evaluation is based on traffic forecasts published in Melbourne Transportation Study reports. The cost estimate was derived from Melbourne newspaper reports. The estimates of railway operating costs were developed from annual reports of Australian railways and other comparative cost data available to the B.T.E.

Costs

The project would involve construction of about 4.5 miles of dual track railway, together with electrification and signalling equipment. Much of the route would be on embankment. Bridging of the Yarra River and river diversion work would be required. Some private property would be required and a substantial area of parkland also would be converted to railway use. Additional rolling stock would be necessary to operate the service. The project would also involve costs of increasing route capacity on the inner section of the Melbourne railway network.

Details of these costs are not available to the B.T.E. so the evaluation is based, simply, on the published estimated cost of the project, which is $18.5m.

Benefits

The new railway would benefit existing public transport passengers who would convert to rail, travellers who would otherwise use cars and remaining road users. There would be benefits of postponing road construction and a substantial saving would follow from a reduction in bus operation on the more congested roads in the corridor.

Travel Estimates

Heidelberg Road and Studley Park Road are the routes which would be most directly affected by the project. At present traffic on Heidelberg Road varies from30,000 to 45,000 vehicles per day across the corridor. The highest volume section of Studley Park Road carries about 40,000 vehicles per day, and other major roads in the corridor have traffic volumes ranging from 10, 000 to 25,000 per day. The total traffic flow at the inner end of the corridor is approximately 87,000 vehicles per day. Current traffic growth in the corridor is approximately linear at about 5 per cent of current traffic per annum.

It is estimated that the inner section of the project would carry 13,500 passengers per day in the first year of operation (1975). Patronage is estimated to increase linearly to 16,000 passengers per day in 1985. Patronage on the outer section is estimated at 9,000 passengers per day in 1975, and 10,700 passengers per day in 1985.

TABLE P.12.1 - ANNUAL DISCOUNTED BENEFITS AND COSTS: EAST DONCASTER RAILWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	8,140
1973	..	..	..	..	..	..	5,360
1974	..	..	..	..	..	..	4,040
1975	306	370	..	479	101	1,253	..
1976	293	351	..	458	101	1,197	..
1977	280	324	..	438	101	1,143	..
1978	267	309	..	418	113	1,104	..
1979	255	290	..	399	123	1,067	..
1980	243	273	..	381	133	1,030	..
1981	232	251	1	363	141	994	..
1982	221	241	2	346	149	960	..
1983	211	227	3	331	116	888	..
1984	200	210	4	316	84	819	..
1985	102	203	5	256	55	621	..
1986	99	191	5	245	27	569	..
1987	96	181	6	235	2	519	..
1988	93	171	6	222	2	494	..
1989	89	161	7	210	2	469	..
1990	86	152	7	199	2	445	..
1991	83	143	7	188	1	423	..
1992	80	130	7	178	1	401	..
1993	77	127	8	168	1	381	..
1994	73	120	8	159	1	361	..
Residual continuous benefit						5,120	
Residual intermittent benefit						152	
TOTAL	3,387	4,426	77	5,991	1,257	20,105	17,539
					Benefit-cost ratio		1.146
					Net present value ($'000)		2,566

Evaluation

The evaluation is based on the assumption that all of the estimated rail patronage would be derived from converted bus and car travellers. Discounted costs and benefits are shown in Table P.12.1.

Conclusions

The evaluation indicates benefit-cost ratios for the project of 1.1 at a 7 per cent discount rate and 0.9 at a 10 per cent discount rate. The corresponding net present values are $2.566m and minus $2.516m. The internal rate of return is about 9 per cent.

On the basis of the data used for the evaluation the project would be marginally justified. In the absence of more detailed information on the cost estimates it is not practicable to confirm that this result is comparable to those for other projects.

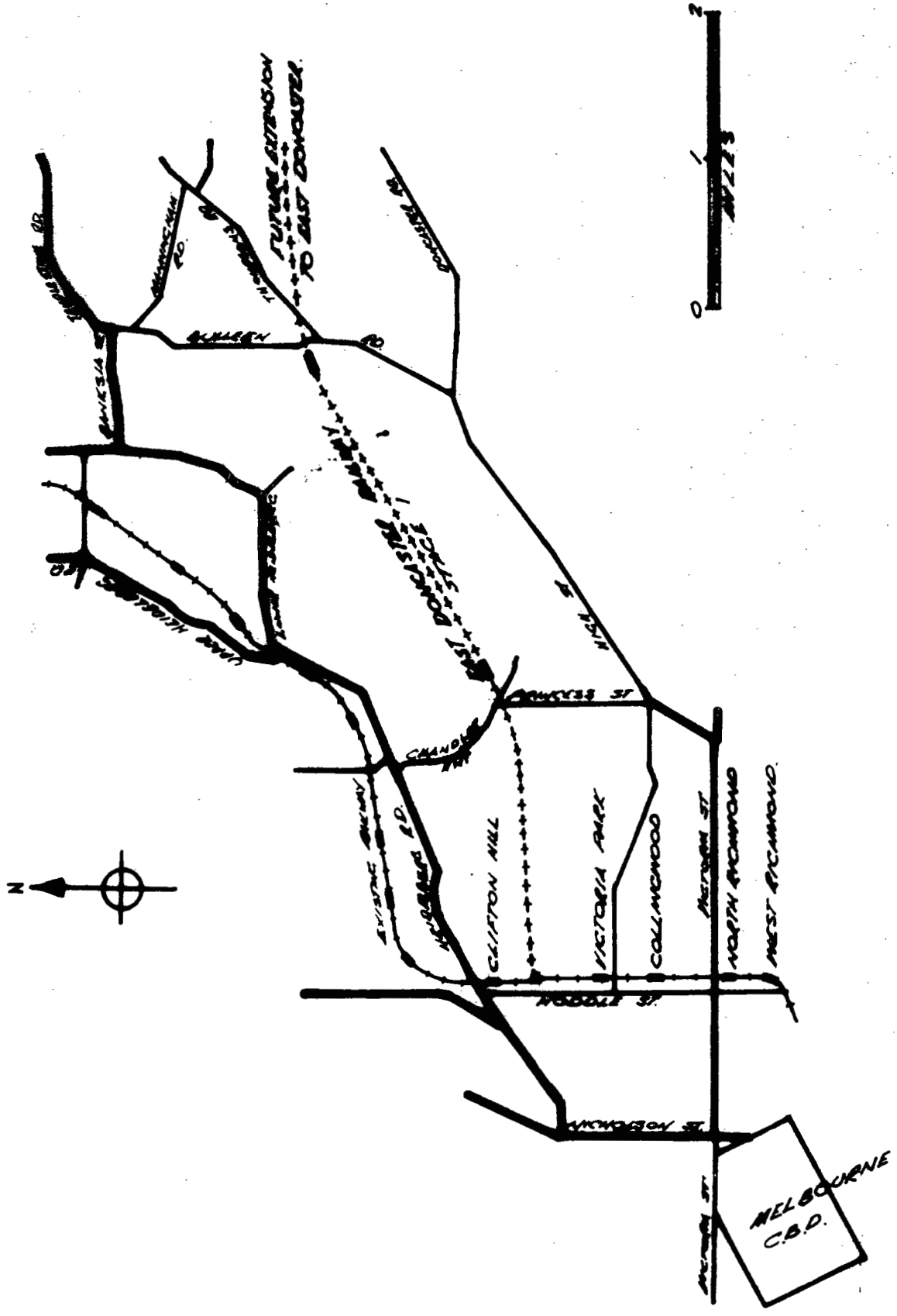

FIGURE P.12. - EAST DONCASTER RAILWAY

ANNEX F

Project 13

NORTHERN CORRIDOR ELECTRIFICATION

Description

The railway passenger services in the corridor extending northwards from central Brisbane consist of the Central to Shorncliffe line (13 miles), the line from Northgate to Zillmere (3.8 miles), the Pinkenbah line from Eagle Junction to Hendra (1 mile) and the Ferny Grove line from Mayne to Newmarket (2.2 miles). At present the system operates with diesel electric rolling stock which is expensive to maintain and operate, and which has relatively low performance characteristics.

The project consists of the electrification of the rail system in the corridor. This would be part of the electrification of the entire urban passenger train service and, as a practical matter, the project would not necessarily be constructed as an entity, or prior to the electrification of other parts of the system. However, the project has characteristics which make it appropriate for a representative evaluation, and it allows for the integration of data assembly with other projects (Projects 14-16).

Costs

Cost estimates for the project, including contingency allowances, are shown in Table P.13.1.

TABLE P.13.1. COST ESTIMATES

Item	Cost
	($'000)
Electrification	6,764
Servicing facilities	1,218
Central control building and equipment	115
Rolling stock	8,658
Total	16,755

Benefits

The initial benefits of the project would be reductions in main-route travel times by about 25 per cent over the system. This would lead to patronage increases, with corresponding benefits of traffic conversion and generation. Other benefits, not quantified in the evaluation, are a quieter and smoother ride for existing passengers, a reduction in noise levels in neighbourhoods adjacent to the line and a reduction in air pollution.

An important benefit of the project would be a reduction in the level of operating costs. These costs are $8,250 annually per vehicle for the existing rolling stock, but are estimated to be only $7,000 per vehicle for new electric rolling stock.

Travel Estimates

Travel estimates for the project were derived from a special application of the Brisbane Transportation Study models, combined with data from previous studies[1] and consideration of recent trends in public transport patronage and road traffic.

Typical daily patronage levels on the railway services in 1971 were 40,000 at Central, 30,000 at Mayne, 22,000 at Northgate and 2,000 at Sandgate. For the base case it was assumed that growth in patronage would continue at the same linear rate as for the past six years; 4.2 per cent of 1971 patronage per annum. Patronage for the project case was based on the South-East Queensland Study forecast for the year 2000. This indicated increases of 40 per cent to 65 per cent above the corresponding base case forecasts.

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(1) Brisbane Transportation Study, Wilbur Smith and Associates, 1965. South East Queensland - Brisbane Region Public Transport Study, Wilbur Smith and Associates, 1970.

TABLE P.13.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS: NORTHERN CORRIDOR ELECTRIFICATION - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	1,513
1974	..	..	..	..	..	..	1,764
1975	..	..	..	..	..	..	1,431
1976	..	..	..	..	..	..	1,032
1977	..	..	..	..	..	..	7,138
1978	379	691	22	400	27	1,518	..
1979	1,588	656	23	384	28	2,680	..
1980	-1,369	623	24	293	30	- 399	..
1981	316	591	24	485	32	1,448	..
1982	316	564	25	508	33	1,446	..
1983	313	538	25	527	35	1,439	..
1984	965	513	25	475	36	2,016	..
1985	451	489	25	546	32	1,544	..
1986	349	466	25	562	27	1,430	..
1987	340	444	25	570	23	1,402	..
1988	- 260	422	25	493	19	698	..
1989	939	402	25	529	15	1,908	..
1990	350	382	24	553	11	1,321	..
1991	276	363	24	557	9	1,229	..
1992	181	345	24	537	7	1,093	..
1993	249	328	23	543	5	1,147	..
1994	712	311	22	506	5	1,557	..
1995	331	295	22	518	5	1,170	..
1996	- 90	280	21	448	5	664	..
1997	210	266	21	496	5	997	..
Residual continuous benefit						11,361	
Residual intermittent benefit						- 545	
Total	6,546	8,968	477	9,931	388	37,126	12,878
Benefit-cost ratio							2.883
Net present value ($'000)							24,248

TABLE P.13.3. SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumptions	Benefit-cost ratio 7%	10%	Internal rate of return	Net present value (7%)
			(%)	($'000)
Generation and conversion	2.9	2.1	16	24,248
Generation only	1.9	1.4	12	12,090
No generation or conversion	1.8	1.3	11	9,310

The calculated benefits with passenger generation and conversion are distributed between existing public transport passengers 34 per cent, generated passengers 2 per-cent, passengers converted from road 37.5 percent, remaining road users 1.5 percent and public transport operation 25 percent. While 37 percent of the benefits under this patronage assumption accrue from conversion from road to rail, these passengers are only 17 percent of total rail passengers.

Conclusions

The project would represent a major change in the existing rail system. Passenger forecasts, therefore, should be considered as only approximate and they may well be high. Taking account of the various evaluation results, the benefit-cost ratios for the project are estimated to be of the order 2.5 and 1.8 at 7 percent and 10 percent discount rates respectively.

As the project is representative of the general proposal for the electrification of the Brisbane suburban railway system there is a strong indication that this programme would be justifiable on community grounds.

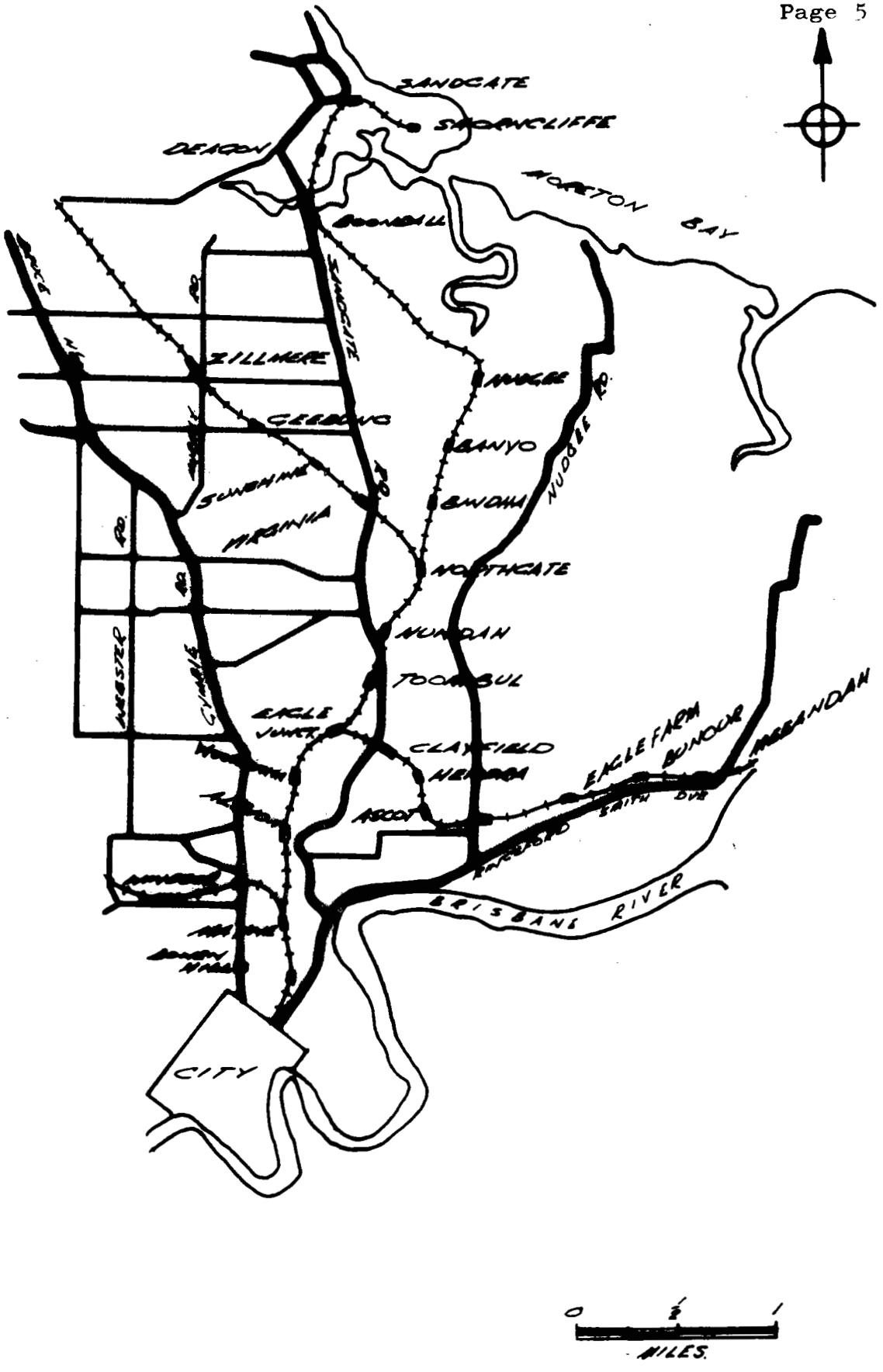

FIGURE P.13 - NORTHERN CORRIDOR ELECTRIFICATION

BRUNSWICK STREET - NORTHGATE RAILWAY

Description.

A two track railway extends from Brunswick Street in the central area of Brisbane, to Northgate, where the Sandgate and Petrie branches meet (Fig. P.13). The current level of patronage makes it desirable to run trains non-stop between Brunswick Street and Northgate but this is not practicable because of the need for local service. A third track is proposed, therefore, so that express service can be provided.

The circumstances of the project depend on its relationship with the electrification of the route (Project 13). Two primary alternatives exist; the third track could be used with continuing diesel train operation, or it could be added after the existing tracks are electrified. Preliminary assessments indicate that the first alternative would show a higher investment return. However, the second alternative is considered a more realistic basis for analysis in view of the sequence of works envisaged by Queensland Railways.

Costs

The project could be commenced in 1975 and completed in 1977. The new track would be electrified, consistent with the assumption that the existing tracks would also be electrified by this time. The estimated costs of the project, including a 15 percent contingency allowance, are shown in Table P.14.1.

TABLE P.14.1 COST ESTIMATES

Item	Cost ($'000)
Track	1,364
Electrical	463
Signalling	420
Rolling stock	-700
Total	1,547

The reduced round trip times made possible by the additional track would allow some return trips to be made during a peak period, thus reducing rolling stock requirements. If the track is brought into service concurrently with the electrification of the northern corridor, this would save the purchase of 7 cars at a cost of $700,000. The total project cost, therefore, would be $1.547m.

Benefits

The time savings from express running between Brisbane and Northgate would be 4 minutes in a base case trip time of 13 minutes. Taking account of the proportion of stopping trains to express trains on the route, the average time saving would be 2 minutes per passenger. This saving would increase slightly over the evaluation period, but this is not taken into account in the evaluation.

The third track would also provide greater flexibility in freight operations, permitting goods trains to pass through the system at peak periods instead of being delayed as at present. This benefit has not been included in the evaluation.

Travel Estimates

At present the railway carries about 22,000 passengers per day at Northgate and about 40,000 passengers per day at Brunswick Street. The growth rate over the last five years is equivalent to 4.2 per cent linear based on the 1971 patronage.

Any generated or converted patronage resulting from the project would be small compared to the results of the proposed electrification. In view of the uncertainties of separating the effects of the two projects, new traffic was not estimated directly for the construction of a third track. Instead, evaluations were made for two patronage levels. The higher is that resulting from generated and converted patronage in the electrification project. The lower is based on a continuation of the current patronage growth rate.

TABLE P.14.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS: BRUNSWICK ST-NORTHGATE RAILWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	(a)	(a)	(a)	..	..
1973	..	..				..	..
1974	..	..				..	..
1975	..	..				..	..
1976	..	..				..	411
1977	..	..				..	576
1978	-43	151				108	..
1979	-41	144				103	..
1980	242	136				379	..
1981	-24	129				111	..
1982	-22	122				100	..
1983	-21	118				97	..
1984	194	113				307	..
1985	-10	108				99	..
1986	- 9	104				95	..
1987	- 8	100				91	..
1988	119	96				214	..
1989	- 3	92				89	..
1990	- 3	88				85	..
1991	- 3	84				81	..
1992	149	80				229	..
1993	4	77				81	..
1994	4	73				77	..
1995	4	70				74	..
1996	77	67				144	..
1997	6	63				69	..
Residual continuous benefit						775	
Residual intermittent benefit						-62	
TOTAL	612	2,014				3,338	987

(a) Not applicable

Benefit-cost ratio 3.382
Net present value ($'000) 2.351

Evaluation

Table P.14.2 shows details of the central analysis based on the patronage forecasts for the electrification project. The results are compared with those for the lower patronage forecast in Table P.14.3.

TABLE P.14.3. SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumption	Benefit-cost ratio		Internal rate of return	Net present value (7%)
	7%	10%		
			(%)	($'000)
Electrification forecast (central analysis)	3.4	2.5	22	2,350
Trend forecast	1.8	1.3	13	850

Conclusion

In the central analysis, base case passengers are probably overestimated. This means that the benefits calculated for existing patronage are too high, by an amount approximately equal to the correct benefits to generated passengers. However, this relatively small error would be compensated, at least, by the omission of road user benefits and freight operation benefits. Hence the central analysis provides a reasonable estimate of the project merit.

ANNEX F

Project 15

BUS-RAIL INTERCHANGES

Description

At present there are bus-rail interchanges at Zillmere and Sandgate on the northern railway corridor in Brisbane. These interchanges allow faster travel times for public transport passengers than would otherwise be provided by bus alone. The project is aimed at extending rail-bus co-ordination in the corridor by constructing additional interchanges at Eagle Junction and Northgate. The locations of these two stations are shown on Figure P.13.

Costs

The costs of land and buildings for the two interchanges would be $0.415m. Additional rolling stock to serve the anticipated increased patronage would cost $1.55m.

Benefits

The benefit of the project would mainly be reduced travel time for people who now travel by bus, between northern suburbs and the inner city, on routes which pass near Eagle Junction and Northgate. The amount of time saving would depend on the relationship between this project and other proposals for rail improvement in the corridor (Projects 13 and 14).

For the purpose of this individual analysis, it is assumed that no change is made from the existing diesel train operation on the existing tracks, and that no traffic generation or conversion is associated with the project.

The peak period travel times from Northgate and Eagle Junction by train are now 17 minutes and 12 minutes, respectively. The present bus times are correspondingly 36 minutes and 32 minutes. The potential time savings to passengers would be reduced due to waiting time at stations, additional walking

time (on average)in the central city and the diversion of buses into the station areas.

At off-peak periods the difference in train running times would not be sufficient to offset the interchange delays, so the project is confined to peak period operation of the interchanges. At other times all buses would continue through to the central city.

Some through buses would also operate at peak periods to serve intermediate areas. Overall, bus operating costs would be reduced. Additional rail costs would be involved in serving the co-ordinated passengers.

Travel Estimates

Allowing for local bus travel and a proportion of bus travellers who would find the central rail stations particularly inconvenient, 2,500 passengers a day are expected to use the Northgate interchange in 1974. Correspondingly, 3,800 passengers a day are expected to use the Eagle Junction interchange. As the bus routes serving the interchange would have a geographically limited tributary area, patronage is assumed to remain constant over the study period.

Evaluation

The evaluation underestimates the project benefits by neglecting bus-rail passenger generation, passenger conversion other than from the existing bus services, and road user savings. The calculated benefits would be considerably greater if this project were combined with railway electrification and track improvement.(Projects 13 and 14).

Details of the discounted costs and benefits derived in the evaluation are shown in Table P.15.1.

TABLE P.15.1 - ANNUAL DISCOUNTED BENEFITS AND COSTS: BUS-RAIL INTERCHANGES - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	(a)	(a)	(a)	..	..
1973	..	..				..	1,836
1974	656	175				831	..
1975	329	160				489	..
1976	307	146				453	..
1977	287	134				421	..
1978	389	123				512	..
1979	251	114				365	..
1980	235	105				340	..
1981	219	97				316	..
1982	205	89				294	..
1983	277	83				360	..
1984	179	78				257	..
1985	167	73				240	..
1986	156	68				224	..
1987	146	64				210	..
1988	198	59				257	..
1989	128	56				184	..
1990	119	52				171	..
1991	111	49				160	..
1992	104	45				149	..
1993	141	42				183	..
Residual continuous benefit						2,248	
Residual intermittent benefit						-91	
TOTAL	4,606	1,813				8,573	1,836

(a) Not applicable

Benefit-cost ratio 4.672

Net present value ($'000) 6,737

Although the results appear favourable, some doubt may exist that transfer at the inner interchange would be acceptable to bus passengers. A separate evaluation was made, therefore, of the Northgate interchange. In this case the costs would be $0.207m and land and $0.62m for additional rolling stock.

The results of the two evaluations are summarised in Table P.15.2.

TABLE P.15.2 - EVALUATION RESULTS

Project	Benefit-cost ratio		Internal rate of return	Net present value (7%)
	7%	10%		
			(%)	($'000)
Two interchanges	4.7	3.6	36	6,737
Outer interchange only	7.1	5.5	54	4,749

Conclusions

The evaluations indicate that construction of the bus interchanges would be a sound investment on social-economic grounds. In the case of the inner interchange, there would be relatively little advantage to passengers. However, the savings to public transport authorities would be considerable, because the present high costs of operating buses on inner city streets would be exchanged for the much lower incremental costs of providing additional services on the existing railway.

The development of the outer interchange would lead to substantial time savings to bus passengers and would substantially reduce public transport operating costs.

CAR-RAIL INTERCHANGES

Description

At present there are only limited parking facilities for passengers using the northern corridor railway in Brisbane. However, a recent survey revealed that park-and-ride passengers have been increasing at a rate of 14 per cent per annum since 1968, largely through the use of on-street parking. The project aims to encourage more people to park-and-ride through the provision of a 300 car parking area at each of the stations Wooloowin, Eagle Junction and Northgate. The locations of these stations are shown on Figure P.13.

Park-and-ride railway patrons consist of two main categories; those who drive from home to the nearest station, and those who drive until road congestion is experienced and then park at a convenient station. The locations of the proposed parking areas were selected to attract the latter category of user. All three car-parks would have ready access from major road routes.

The evaluation has been confined to three stations as this type of facility can be provided at additional stations if it is demonstrated that an adequate demand exists for the car-parks provided initially.

Costs

The costs of the project are estimated to comprise $150,000 for the three parking areas and $480,000 in railway carriages to serve the anticipated additional patronage. All expenditure would be incurred in 1973.

Benefits

Benefits to converted road users would result from reduced travel times and reduced parking costs. These savings would be partly offset by increased walking times in the central city and the addition of transfer and waiting times. Some benefits would accrue to remaining road users through reduced congestion. In the longer term, road construction costs may be postponed.

TABLE P.16.1 - ANNUAL DISCOUNTED BENEFITS AND COSTS: CAR-RAIL INTERCHANGES - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	(a)	(a)	(a)	..	..	..	..
1973				..	..	..	589
1974				207	..	207	..
1975				192	..	192	..
1976				178	..	178	..
1977				165	..	165	..
1978				146	..	146	..
1979				142	..	142	..
1980				131	..	131	..
1981				122	..	122	..
1982				113	..	113	..
1983				101	..	101	..
1984				97	..	97	..
1985				90	..	90	..
1986				83	..	83	..
1987				77	..	77	..
1988				70	..	70	..
1989				67	..	67	..
1990				62	..	62	..
1991				57	..	57	..
1992				53	..	53	..
1993				48	..	48	..
Residual continuous benefit						827	
Residual intermittent benefit						..	
TOTAL				2,201	..	3,028	589

Benefit-cost ratio 5.100
Net present value ($'000) 2,438

(a) Not applicable

Travel Estimates

Based on trend information and experience in other parts of the Brisbane rail system it is estimated that provision of the car parks would attract an additional 2,160 railway passenger trips daily, taken over the evaluation period.

Evaluation

The evaluation assumed continuation of the present diesel train operation over the study period. Details of the discounted costs and benefits are shown in Table P.16.1.

No benefits to remaining road users appear in this table as the roads are already above the level of traffic at which it is economical to add new road capacity. Road benefits are therefore included, in the form of construction cost savings, in the column showing benefits to converted public transport users.

Conclusion

The evaluation indicates benefit-cost ratios for the project of 5.1 at a 7 per cent and 4.0 at a 10 per cent discount rate. The corresponding net present values are $2.438m and $1.693m, and the internal rate of return is approximately 37 per cent. The returns would be higher if the project were associated with electrification of the corridor (Project 13).

ANNEX F

Project 17

MERIVALE STREET BRIDGE

Description

The railway system in Brisbane is severed by the Brisbane River. Northern and western trains terminate at Central Station, while southern trains (including the inter-state standard gauge services) terminate at South Brisbane Station. Railway passengers from the south must either catch a bus or walk across Victoria Bridge to reach the main business area. This has resulted in very limited use being made of the railway system on the southern side. It carries only 6,000 people per day compared with 40,000 per day from the northern corridor, which has a similar catchment area.

The project is to construct a railway bridge connecting the northern and southern narrow gauge systems and providing standard gauge access to Roma Street Station, for passenger and freight services. Ancillary works involve the removal of South Brisbane terminal facilities, such as goods and parcels handling, and raising platform levels at stations on the southern side so that they can be used by the newer rolling stock now confined to north-side operation.

A comprehensive evaluation of the project would entail analysis of the complete south side transport network. However, an initial indication of the merit of the project can be obtained from a simplified evaluation, taking account only of costs to the railway authority and benefits for rail passenger travel between South Brisbane and the central city.

Costs

The estimated costs of the project, in 1972 values, are detailed in Table P.17.1. The project would be constructed during the period 1973 to 1975.

TABLE P.17.1 - COST ESTIMATES

Item	Cost
	($'000)
Main bridge	2,992
Approach bridging	2,492
Trackwork	531
Signalling	875
Ancillary works	614
Contingencies (15%)	1,126
TOTAL	8,630

Benefits

At present it takes about 12 minutes, on average, for a train passenger to walk from South Brisbane Station to the central city. With the project, it is estimated that this time would be reduced to 4 minutes riding time and 5 minutes walking time. This time saving would be the main benefit of the project to existing train passengers.

The absence of a central city connection adds considerably to the costs of existing railway operations. Instead of operating 'through' suburban services, some dead-end running is necessary at both South Brisbane and Central, often involving a change of driving units from one end of a train to the other. Even at the present patronage level for the southern railway system, the project would yield significant savings by enabling 'through' running.

The nearest north-south link of the existing railway systems is at Corinda and a considerable freight movement takes place by that route. This freight would be carried across Merivale Bridge, with a consequent saving in travel distance. The project would also lead to savings in vehicle mileage associated with rolling stock maintenance and train crew movement.

An additional benefit of the project would follow from the closing of the refreshment rooms at South Brisbane. There would also be a reduction in railway maintenance costs due to the elimination of track at South Brisbane.

A detailed estimate of the benefits of the project to the operating authority is shown in Table P.17.2.

TABLE P.17.2 - ESTIMATE OF ANNUAL OPERATIONAL BENEFITS

Item	Annual benefit
	($'000)
Narrow Gauge	
Station staff and stores	184
Fettlers	7
Refreshment room staff	9
Train crews	107
Goods train travel	55
Passenger train travel	110
Light engine miles	29
Standard Gauge	
Station staff and stores	123
Refreshment room staff	13
TOTAL	637

The project could also lead to benefits through postponing road and bridge construction. Although these benefits may be substantial, they could not be estimated with any precision without a transport network analysis.

Travel Estimates

The Brisbane Public Transport Study forecast (for a diesel system) of patronage for the year 2000 was used as the basis for the central analysis. The Study estimated that 40,000 people per day would cross the railway bridge. This estimate is conservative in view of the likelihood of electrification, for which the Study forecast 67,000 passengers per day in the year 2000.

TABLE P.17.3 - ANNUAL DISCOUNTED BENEFITS AND COSTS: MERIVALE STREET BRIDGE - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	1,614
1974	..	..	..	..	..	..	2,260
1975	..	..	..	..	..	..	3,521
1976	421	245	35	..	..	701	..
1977	403	238	63	..	..	704	..
1978	383	230	88	..	..	701	..
1979	362	222	110	..	..	693	..
1980	604	214	128	..	..	946	..
1981	289	206	143	..	..	639	..
1982	275	198	156	..	..	629	..
1983	260	190	167	..	..	617	..
1984	246	183	175	..	..	604	..
1985	678	175	182	..	..	1,035	..
1986	203	168	187	..	..	558	..
1987	192	161	190	..	..	544	..
1988	181	154	193	..	..	528	..
1989	171	148	194	..	..	512	..
1990	563	141	194	..	..	898	..
1991	143	135	193	..	..	472	..
1992	135	129	192	..	..	456	..
1993	127	123	190	..	..	440	..
1994	120	117	187	..	..	425	..
1995	268	112	184	..	..	565	..
Residual continuous benefit						5,178	
Residual intermittent benefit						-149	
TOTAL	6,025	3,489	3,152	..	..	17,695	7,395

Benefit-cost ratio	2.392
Net present value ($'000)	10,300

Evaluation

Table P.17.3 shows details of the central analysis. In this it was assumed that the patronage increase would result only from trip generation. Table P.17.4 summarises the results of the central analysis and for an evaluation assuming that there is no new patronage.

TABLE P.17.4. - SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumption	Benefit-cost ratio		Estimated internal rate of return	Net present value (7%)
	7%	10%		
			(%)	($'000)
Generation only (central analysis)	2.4	1.7	15	10,300
No new patronage	1.5	1.1	11	3,930

The benefits calculated in the central analysis are distributed between existing passengers 27 per cent, generated passengers 25 per cent and railway operation 48 per cent.

Conclusion

The central analysis provides a conservative estimate of the merit of the project, as rail patronage with the proposed electrification is expected to be higher than the estimate used in the evaluation. Also, no benefits were calculated for savings in road or bridge construction costs.

The benefit-cost ratio for the project is estimated to be not less than 2.4 at a 7 per cent discount rate or 1.7 at a 10 per cent discount rate. The corresponding net present values are $10.3m and $5m. The estimated internal rate of return is 14 per cent.

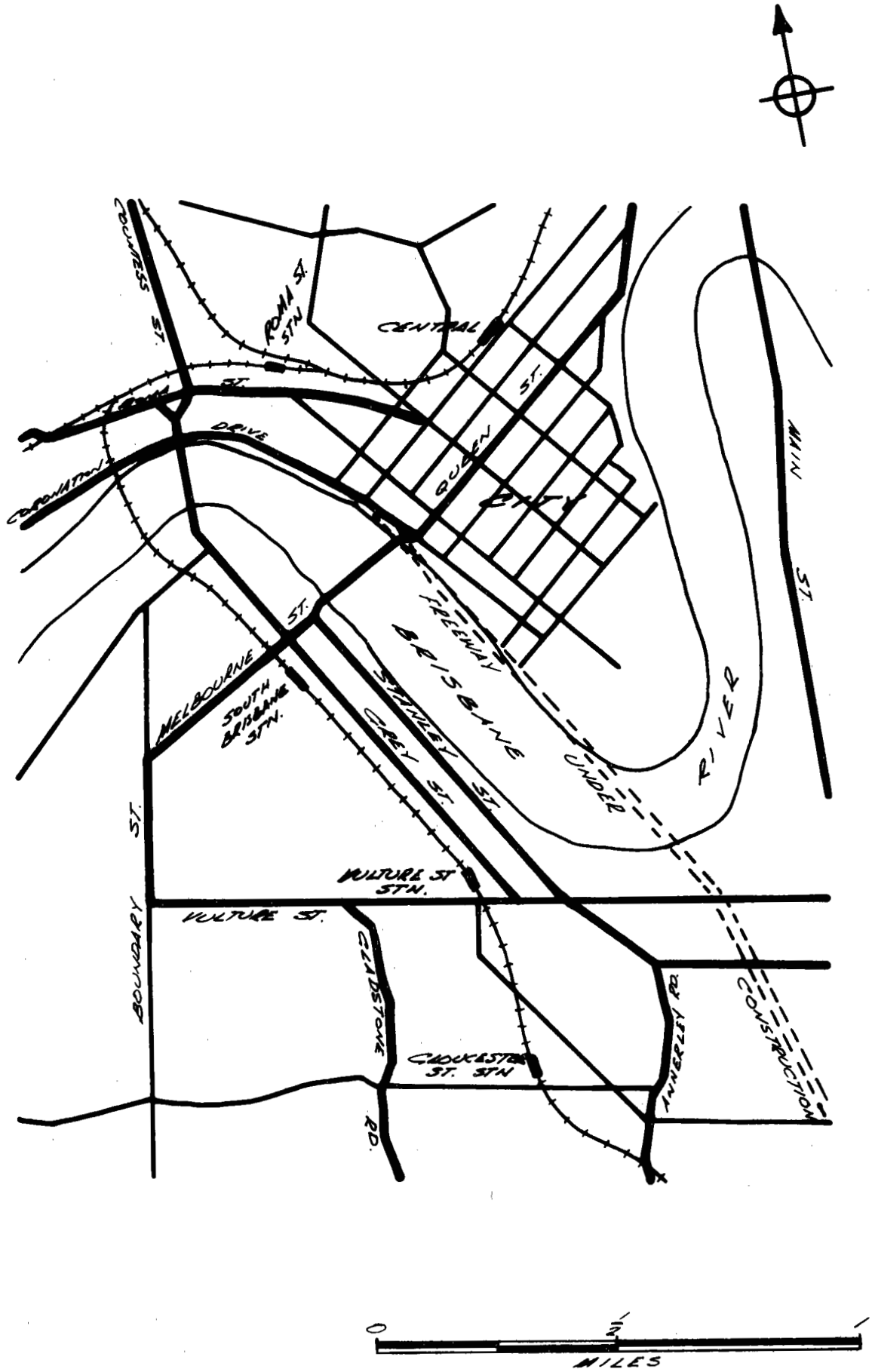

FIGURE P.17 - MERIVALE STREET BRIDGE

BRIGHTON - CHRISTIE DOWNS RAILWAY

Description

At present a double track railway connects central Adelaide to Brighton. A single track extends further almost to Lonsdale, but passenger services run only to Hallet Cove.

The project consists of duplicating the existing track and extending it to Lonsdale, a total construction distance of 8.7 miles. The total distance of Lonsdale to the central Adelaide station is 18.4 miles. The road and rail services in the corridor are shown in Figure P.18.

The purpose of the project is to provide rail service to a rapidly developing coastal area on the southern fringe of Adelaide. The alternative public transport service would be by bus, which is considerably slower than could be provided by train using the extended tracks.

Costs

The estimated cost of the project is $6.63m, including $1.374m for new rolling stock. Construction could commence in 1973-74 and be completed two years later.

Benefits

The main benefits of the project would follow from the reduced travel times available by train. In 1975 it is estimated that the peak period travel time from Christie Downs to central Adelaide would be 41 minutes. The corresponding travel time by bus would be 60 minutes. This travel time difference would lead to traffic conversion and traffic generation benefits.

Travel Estimates

Estimates for road and rail travel in the project case were derived from the Metropolitan Adelaide Transport Study forecasts. Base case travel was estimated by modifying these forecasts to take account of the estimated passenger conversion and generation due to the project. Accordingly, patronage on the proposed

railway service was estimated at 2,000 per day at Christie Downs and 16,000 per day at central Adelaide for the year 1975, with linear growth rates of 23 and 1.9 per cent of the 1975 estimates respectively.

Evaluation

Details of discounted costs and benefits for the analysis are shown in Table P.18.1.

Forty one per cent of benefits accrue to transport operations, largely as a result of replacement of buses by rail. Conversion of road users to rail results in 42 per cent of the total benefits, which include road construction cost savings. Remaining road users would receive 13 per cent of total benefits.

Conclusions

The estimated benefit-cost ratios for the project are 4.7 at a 7 per cent and 3.4 at a 10 per cent discount rate, respectively. The corresponding net present values are $22.587m and $14.383m. The internal rate of return is approximately 26 per cent.

TABLE P.18.1 - ANNUAL DISCOUNTED BENEFITS AND COSTS: BRIGHTON-CHRISTIE DOWNS RAILWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	1,734
1973	..	..	..	..	..	..	1,621
1974	..	..	..	..	..	..	2,761
1975	441	92	..	860	153	1,541	..
1976	456	73	2	771	146	1,451	..
1977	465	62	8	693	141	1,369	..
1978	469	51	13	651	108	1,292	..
1979	503	41	18	571	78	1,211	..
1980	458	33	23	583	50	1,147	..
1981	452	24	27	562	24	1,090	..
1982	444	17	31	546	..	1,037	..
1983	290	12	34	267	46	649	..
1984	477	8	36	377	91	989	..
1985	408	4	38	383	134	968	..
1986	395	1	40	341	175	952	..
1987	382	- 2	42	303	213	937	..
1988	334	- 4	43	59	197	628	..
1989	408	- 7	43	203	181	829	..
1990	340	- 8	44	235	166	776	..
1991	326	-10	44	218	151	729	..
1992	312	-11	44	203	137	685	..
1993	298	-12	44	193	147	669	..
1994	332	-13	44	133	156	652	..
Residual continuous benefit						9.172	
Residual intermittent benefit						-71	
TOTAL	7,988	352	618	8,151	2,494	28,703	6,116

Benefit-cost ratio 4.693
Net present value ($'000) 22,587

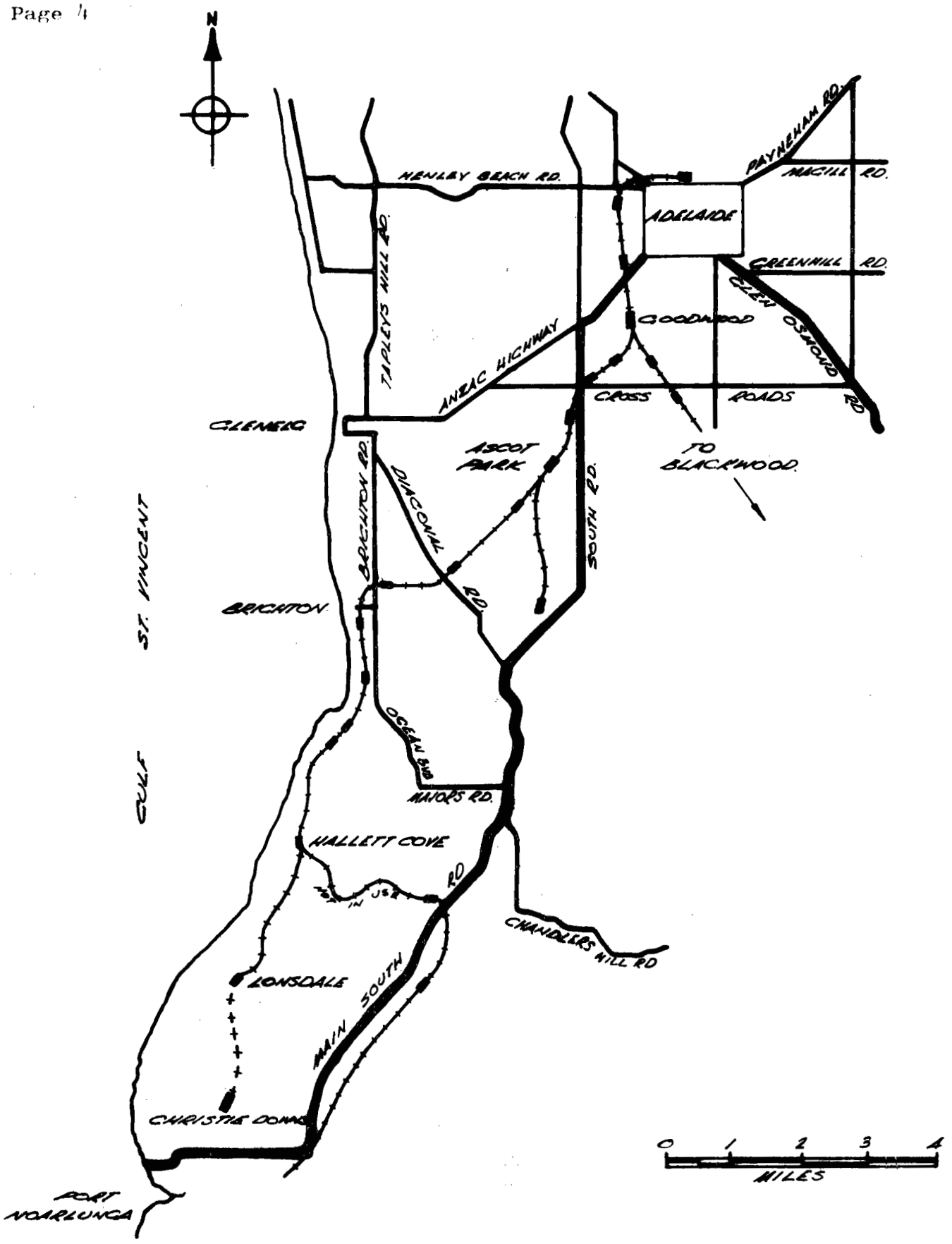

FIGURE P.18 - BRIGHTON - CHRISTIE DOWNS RAILWAY

GLENELG TRAMWAY

Description

The Glenelg tramway is a dual track line, mainly in separate right-of-way, which serves the suburbs between Glenelg and central Adelaide.

The project consists of the provision of new trams, improved level crossing protection and passenger interchange facilities so that better use could be made of the inherent travel speed advantage of the tramway compared to buses operating on the existing street system. As part of the project, buses serving the southern suburbs would transfer passengers to the tramway at suitable interchange points.

The general location of the project is shown in Figure P.19.

Costs

The costs used in the evaluation are detailed in Table P.19.1. These costs would be incurred in 1974 and 1975.

TABLE P.19.1 - COST ESTIMATES

Item	Cost
	($'000)
Land for passenger interchanges	360
Passenger interchange construction	100
Level crossing protection	140
Trams	2,160
Contingencies	414
TOTAL	3,174

Travel Estimates

The patronage on the tramway is approximately 7,000 passengers per day at the city terminal and 400 passengers per day on the section between Plympton and Glenelg. In the project

case, bus passengers transferring to the line would increase total patronage by approximately 5,000 passengers per day. There is not expected to be any additional change in patronage.

Benefits

The project would reduce travel time for existing passengers both through higher travel speed and through reduced waiting time, due to more frequent service. There would be an increased comfort benefit, estimated at 0.25 cents per vehicle mile (Refer Projects 22 and 26). The time savings which transferred bus passengers would gain on main route travel would be almost entirely off-set by the time involved in passenger interchange, and in some cases, by a less conveniently located inner city terminal.

The new trams would reduce operating costs, as they would be more suitable for one-man operation. Maintenance costs would also be lower than for existing rolling stock. Removal of some bus services from inner city streets would decrease road user costs.

Evaluation

Table P.19.2 shows details of the evaluation results. Twenty two per cent of the benefits would accrue to the operating authority, 76 per cent to existing passengers and 2 percent to remaining road users. Transfer from bus at the inner section of the route would be a disadvantage to most bus passengers, so in this respect the passenger forecasts could be high.

Conclusion

The benefit-cost ratios calculated for the project are 0.8 and 0.6 at 7 per cent and 10 per cent discount rates respectively. The corresponding net present values are minus $0.401m and minus $0.937m. The internal rate of return is approximately 5 per cent.

TABLE P.19.2 - ANNUAL DISCOUNTED BENEFITS AND COSTS: GLENELG TRAMWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	..
1974	..	..	..	..	..	..	482
1975	..	..	..	..	..	..	2,140
1976	120	127	..	..	3	250	..
1977	6	117	..	..	3	126	..
1978	5	108	..	..	3	116	..
1979	5	99	..	..	2	106	..
1980	5	92	..	..	2	99	..
1981	86	86	..	..	2	174	..
1982	4	80	..	..	2	86	..
1983	4	75	..	..	2	81	..
1984	4	70	..	..	2	76	..
1985	3	68	..	..	2	73	..
1986	61	61	..	..	2	124	..
1987	3	57	..	..	1	61	..
1988	3	53	..	..	1	57	..
1989	3	50	..	..	1	54	..
1990	3	46	..	..	1	50	..
1991	43	43	..	..	1	87	..
1992	2	41	..	..	1	44	..
1993	2	38	..	..	1	41	..
1994	2	36	..	..	1	39	..
1995	33	33	..	..	1	67	..
Residual continuous benefit						410	
Residual intermittent benefit						..	
TOTAL	397	1,380	..	..	34	2,221	2,622

Benefit-cost ratio 0.847
Net present value ($'000) - 401

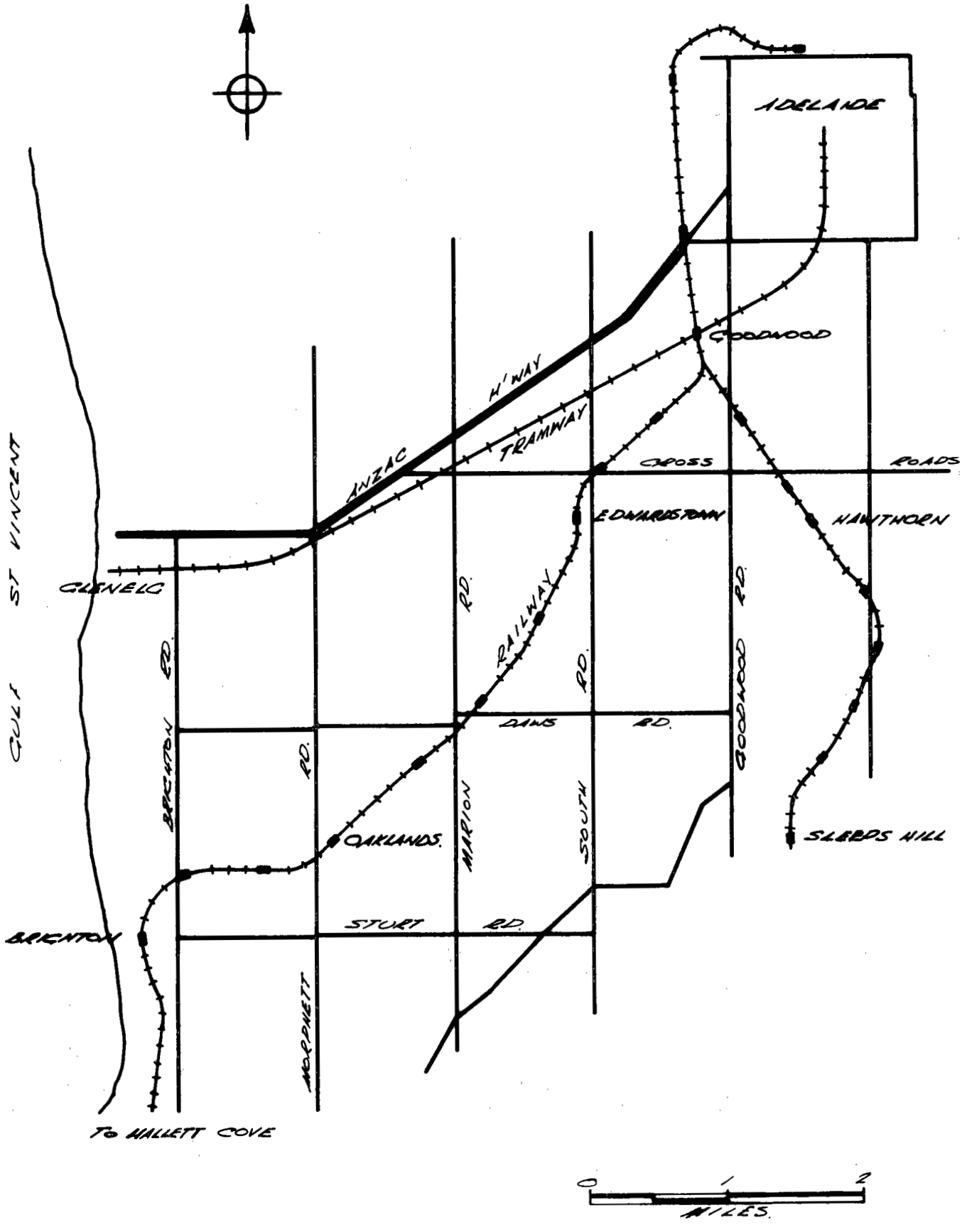

FIGURE P.19 - GLENELG TRAMWAY

ANNEX F

Project 20

PERTH - CLAREMONT BUSWAY

Description

At present public transport in the corridor between Perth, Claremont and Fremantle is provided by diesel hydraulic rail vehicles operating on a narrow gauge railway and by buses operating on the main road system. The diesel rail units are relatively expensive to operate and the current level of rail patronage (6,400 passengers per day) suggests that buses operating in a reserved right-of-way may be a more economical means of providing public transport service in the corridor. Hence it is proposed that the rail service be discontinued and that a busway be constructed on the same alignment between Perth and Claremont, a distance of 6 miles. Beyond this point the main parallel road is relatively uncongested at present. The busway could be extended subsequently as required.

A bus terminal would be provided at the Perth end of the busway. As currently planned, the terminal would be constructed integrally with a central city redevelopment scheme which involves extensive landscaping, as well as the construction of a grade separated walkway and a new arcade. Buses serving other parts of the city would also use the terminal. For the evaluation, it was assumed that all the transport oriented costs of the terminal, and all the corresponding savings in bus operating costs, would be attributed to the Perth-Claremont Busway project.

The existing railway serves industries and port facilities at Fremantle. Alternative railway access to Fremantle would be provided by the construction of a narrow gauge railway between Kenwick and Cockburn Junction on the same alignment as the existing standard gauge line.

The Perth - Fremantle railway also serves some industries along its route. However few are in the section which would be replaced by the Perth - Claremont busway. The nature of these industries indicates that they could be served by road at

negligible change in social costs. The other industries would retain rail service from Fremantle, at no significant disadvantage compared to the existing service.

Costs

Converting 6 miles of railway into a busway is estimated to cost $2.056m. and the freight diversion railway is estimated to cost $2.76m. After discussion with planning authorities in Perth it was estimated that an expenditure of $0.267m. on the bus station could be attributed directly to transport service. The total cost of the project, for purposes of the evaluation is therefore $5.083m.

Benefits

The user benefits of the project would follow from the effect of the busway in reducing to 10 minutes the travel times between Perth and Claremont, which are now 17 minutes by rail and 24 minutes by bus. The time savings from diverting parts of existing bus services to the busway would lead to higher utilization of buses, which initially would provide much of the additional capacity necessary to carry the displaced rail passengers. The extensive penetration of buses into the residential areas of the corridor would enable many people to take advantage of the time savings due to the busway, with subsequent increased in patronage.

A benefit would also be obtained from the release of rail vehicles, which could be utilised elsewhere in the urban rail system. This is estimated at $1.75m.

A disbenefit of $60,000 per annum in railway operating costs would follow from the construction of the new narrow gauge freight railway, as the route distance would be increased.

Travel Estimates

Project case estimates of public transport usage were derived from a special application of the Perth Regional Transport Study models. Elasticity relationships were applied to estimate the proportions of converted and generated patronage.

TABLE P.20.1 - ANNUAL DISCOUNTED BENEFITS AND COSTS: PERTH CLAREMONT BUSWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	..
1974	..	..	..	..	..	..	2,852
1975	..	..	..	..	..	..	1,483
1976	1,309	928	64	234	34	2,568	..
1977	582	872	63	215	39	1,770	..
1978	927	822	62	195	48	2,053	..
1979	697	774	60	186	57	1,774	..
1980	488	729	59	177	64	1,517	..
1981	449	687	58	167	71	1,431	..
1982	422	647	56	157	76	1,359	..
1983	470	612	55	116	84	1,336	..
1984	512	579	53	135	90	1,369	..
1985	374	547	52	131	96	1,199	..
1986	356	518	51	124	101	1,149	..
1987	328	489	49	118	105	1,089	..
1988	439	463	47	75	98	1,121	..
1989	447	437	46	99	91	1,120	..
1990	292	413	44	100	84	933	..
1991	269	391	43	96	78	876	..
1992	279	369	41	91	72	852	..
1993	299	349	40	53	67	808	..
1994	241	330	38	78	62	749	..
1995	207	311	37	75	57	688	..
Residual continuous benefit						9,244	
Residual intermittent benefit						220	
TOTAL	9,383	11,266	1,019	2,623	1,472	35,225	4,336

Benefit-cost ratio 8.124

Net present value ($'000) 30,889

The forecast figures were reconciled with existing passenger and road traffic data, taking account of probable re-routings of the existing bus service. The busway was estimated to carry 28,000 passengers per day in the operational year, 1976.

Evaluation

The routes taken into account in the evaluation are shown in Figure P.20. Table P.20.1 shows details of discounted costs and benefits for the central analysis, in which total patronage includes both generated and converted passengers. Table P.20.2 shows values of the economic criteria for the central analysis. Results are also shown for an evaluation with the same patronage level, but assuming that all new patronage is generated, and for an evaluation with the lower patronage level corresponding to no passenger generation or conversion.

TABLE P.20.2. SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumption	Benefit-cost ratio		Estimated internal rate of return	Net present value (7%)
	7%	10%	(%)	($'000)
Generation and conversion (central analysis)	8.1	6.0	45	30,889
Generation only	7.3	5.4	42	27,141
No generation or conversion	6.7	5.0	42	24,808

The calculated benefits are distributed between existing passengers 44 per cent, generated passengers 4 percent, converted passengers 10 percent, remaining road users 6 percent and public transport operation 36 percent. Only 16 percent of all benefits are due to the 25 percent of total passengers who are either generated or converted.

The evaluations only take account of that part ($0.267m.) of the total cost ($1.7m.) of the Perth bus terminal, which can be directly attributed to improving transport service. If all terminal costs are included in the project the benefit-cost ratio would be 6.2 at a 7 percent discount rate.

Conclusion

The calculated benefit-cost ratio for the project, at a 7 percent discount rate, varied between 6.2 and 8.1 for a quite extensive range of evaluation assumptions. The results indicate, therefore, that the project is a very attractive investment on community grounds.

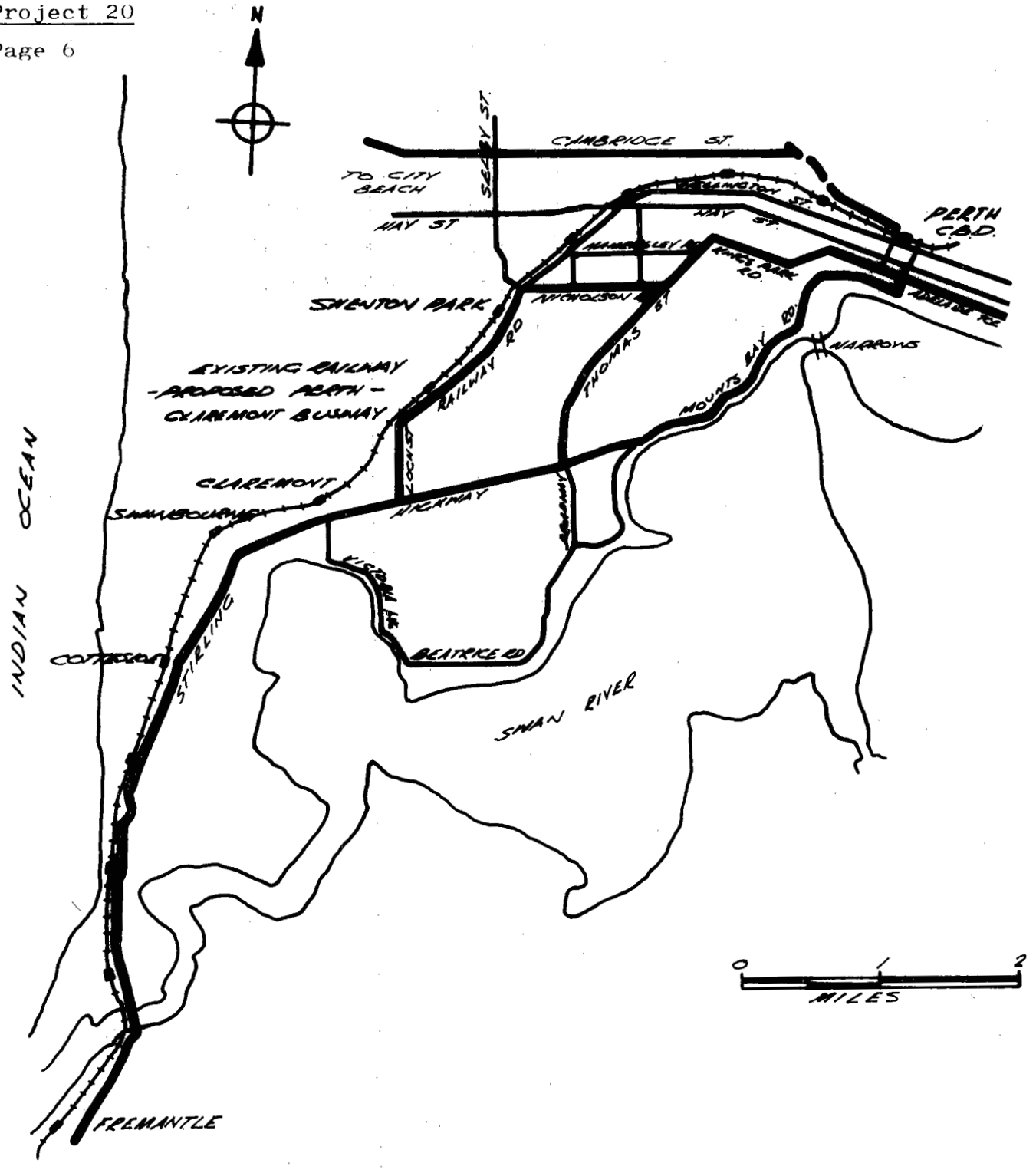

FIGURE P.20 - PERTH - CLAREMONT BUSWAY

ANNEX F

Project 21

MITCHELL FREEWAY BUSWAY

Description

The Mitchell Freeway, which extends in a north-westerly direction from the centre of Perth, is currently under construction. The busway project is concerned with the merit of committing additional funds so that a busway can be provided within the median of the freeway. The busway would be connected to the suburban street system by special ramps. It also would link with the Perth - Claremont busway (Project 20) at the approach to the Perth bus terminal.

Costs

Perth authorities advised that the marginal cost of constructing a busway within the freeway would be $2.93m.; including a 15 per cent contingency allowance.

Benefits

Compared to bus operation on the freeway, busway travel would be more direct, travel on the main-route would be faster, and use of inner city streets would be avoided. The net effect of these differences is estimated to save 4.5 minutes for each passenger using the busway. The removal of buses from the freeway would also reduce travel costs for other road users.

Travel Estimates

Travel estimates for the project were based on a redistribution of current travel to allow for the effect of the freeway, and a 1989 forecast of travel on the combined freeway and busway. Base case and project case forecasts were reconciled taking account of current trends in traffic growth. At the operational year (1977), 40,000 people per day would use the busway at the maximum load point. The freeway would serve 55,000 people per day at the corresponding section.

TABLE P.21.1 - ANNUAL DISCOUNTED BENEFITS AND COSTS: MITCHELL FREEWAY BUSWAY - DISCOUNT RATE 7%

($'000)

Year	Operation benefit	Existing P.T. user benefit	Generated P.T. user benefit	Converted road user benefit	Remaining road user benefit	Total benefit	Total cost
1972	..	..	..	..	..	..	..
1973	..	..	..	..	..	..	..
1974	..	..	..	..	..	..	..
1975	..	..	..	..	..	..	598
1976	..	..	..	..	..	..	1,676
1977	255	393	4	..	30	681	..
1978	236	373	3	..	31	643	..
1979	444	355	3	..	22	824	..
1980	264	337	3	..	30	634	..
1981	245	320	3	..	30	598	..
1982	243	304	3	..	31	580	..
1983	214	283	3	..	37	537	..
1984	332	265	3	..	35	634	..
1985	227	247	2	..	45	521	..
1986	211	230	2	..	50	493	..
1987	196	214	2	1	53	466	..
1988	182	203	2	1	49	437	..
1989	275	192	2	..	42	511	..
1990	186	182	2	1	42	413	..
1991	173	172	2	2	38	387	..
1992	161	163	2	2	35	363	..
1993	150	154	2	2	33	341	..
1994	237	146	2	..	30	414	..
1995	150	138	1	2	30	321	..
1996	140	131	1	2	28	302	..
Residual continuous benefit						3,919	
Residual intermittent benefit						24	
TOTAL	4,521	4,802	46	13	721	14,045	2,274

Benefit-cost ratio 6.176
Net present value ($'000) 11,770

Evaluation

The routes taken into account in the evaluation are shown in Figure P.21. Table P.21.1 shows details of discounted costs and benefits for the central analysis, in which total patronage includes both generated and converted passengers. Table P.21.2 shows results for the central analysis and for the same patronage level, but assuming that all new passengers are generated. Results are also shown for the lower patronage corresponding with no passenger generation or conversion.

TABLE P.21.2 - SENSITIVITY OF RESULTS TO PATRONAGE ASSUMPTIONS

Patronage assumption	Benefit-cost ratio		Estimated internal rate of return	Net present value (7%)
	7%	10%		
			(%)	($'000)
Conversion and generation (central analysis	6.2	4.6	35	11,770
Generation only	6.0	4.4	34	11,339
No generation or conversion	5.9	4.3	34	11,151

The calculated benefits are distributed between existing passengers 47 per cent, generated and converted passengers one per cent, remaining road users 8 per cent and public transport operation 44 per cent.

The results in Table P.21.2 follow from the assumption that the busway could be provided without increasing the width of the freeway alignment, and that its presence would cause no disbenefit to freeway users. It was considered that a more realistic assumption would be that the busway should share part of the freeway land cost. Hence an evaluation was carried out, attributing $0.4m. to the busway out of a total freeway land cost of $2.3m. The total cost of the project, therefore, was taken to be $3.33m.

In this case the benefit-cost ratios for the project are 5.3 and 4.0 at 7 per cent and 10 per cent discount rates respectively. The net present values at these discount rates are $11.42m and $7.04m. The internal rate of return is approximately 30 per cent.

Conclusion

The evaluation indicates that the project would be a very satisfactory investment taken over a considerable range of cost and patronage estimates.

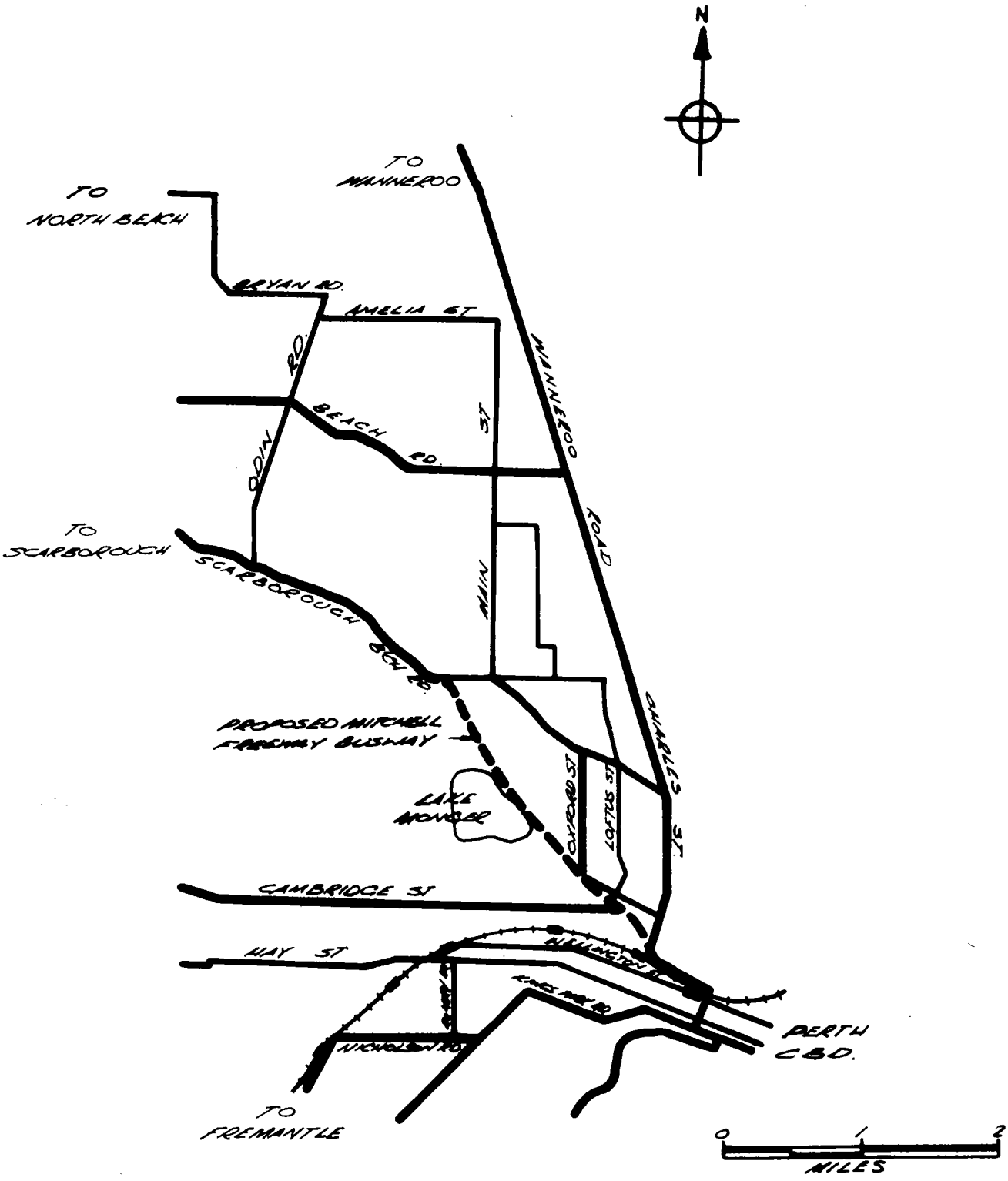

FIGURE P.21 - MITCHELL FREEWAY BUSWAY

ANNEX F

Project 22

REPLACEMENT OF SYDNEY BUSES (1)

Project Description

The New South Wales Department of Government Transport has approximately 850 buses, representing 45 percent of its fleet, which were purchased during the 1950's and earlier, and which would become at least 20 years old during the period 1973-74 to 1977-78. Four hundred of these are old-style double deckers which are completely unsuitable for one-man operation. Due largely to the effects of the Eastern Suburbs Railway, the Department plans to gradually reduce its fleet by about 350 anyway, so that the oldest of these buses will be withdrawn. However, replacement during 1973-74 to 1977-78 would lead to earlier withdrawal for buses of any given age, and would result in more old buses being withdrawn.

The evaluation compares two alternative courses of action over a 50-year period:

(i) undertaking no replacement for a decade, then during 1983-84 to 1987-88 replacing the oldest 500 buses (then about 30 years old) with single-deck Leyland Leopards, and replacing these buses, in turn, after another 30 years;

(ii) between 1973-74 and 1977-78 replacing 500 20-year old buses with Leyland Leopards, and replacing these buses, in turn, at 20-year intervals.

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(1) This evaluation is based on material supplied by the New South Wales Department of Government Transport.

Costs

The capital cost of the project is 500 buses at $23,000 each, less salvage value of $1,000 each for the replaced buses, a total net cost of $11,000 million.

The cycles of equipment purchase and disposal, other than the initial investment in the project case, are treated in the calculation of benefits. For this purpose, 20 year old buses are assumed to have a salvage value of $1,000 each; the salvage value of 30 year old buses is considered negligible.

Benefits

The new buses would have advantages, compared with the old ones, of reduced maintenance costs, semi-automatic transmission, power steering and passenger benefits from better design, automatic doors, and forced ventilation. Also, immediate replacement would permit faster withdrawal of the old two-decker buses, which are unsuitable for one-man operation.

Travel Estimates

The passenger forecasts used in the evaluation are shown, at 10 year intervals, in Table P.22.1 below. The general assumptions underlying the forecasts were discussed above (Annex D). In addition, it was assumed that there is an underlying tendency for patronage on Sydney buses to decline at 2 per cent per annum.

TABLE P.22.1 - PASSENGER FORECASTS, SYDNEY BUSES

(Millions of passenger miles)

Year	Base case				Project case			
	Existing	Generated	Converted	Total	Existing	Generated	Converted	Total
1978-79	181.7	..	..	181.7	181.7	0.7	2.9	185.3
1988-89	149.2	0.6	2.4	152.2	149.2	0.3	1.2	150.7
1998-99	122.2	0.2	1.0	123.4	122.2	0.5	1.9	124.6
2008-09	100.4	..	..	100.4	100.4	0.2	0.8	101.4
2018-19	82.2	0.3	1.3	83.8	82.2	0.3	1.3	83.8

Evaluation

(i) Bus Maintenance

There are certain elements of bus maintenance which are the same irrespective of age of bus (for example, daily inspections, 1,000 mile services, and accident repairs). However, overhaul costs would be lower with new buses. Buses of 1950-60 vintage require complete stripping and rebuilding (major overhaul) every 80,000 to 90,000 miles with minor overhauls around 50,000 miles. Present day buses, on the other hand, are designed such that major overhauls are only needed every 400,000 miles, supplemented by a minor overhaul at 200,000 miles. Maintenance savings from introducing new buses therefore occur because of the lesser need for costly overhauls ($5,000 for major overhauls, $2,000 for minor overhauls).

The costs of all major and minor overhauls required each year under base and project cases were calculated assuming vehicles each travel 30,000 miles per annum. Net maintenance savings under the project case are shown, in five-year totals, in Table P.22.2.

(ii) Operating Savings

A programme of replacement during the period 1973-74 to 1977-78 enables earlier withdrawal of old two-decker buses than in the base case. Specifically, the base case would still have 100 double deckers in 1973-74 and 34 in 1974-75, whereas in the project case these buses would be replaced by Leyland Leopards, suitable for one-man operation. In 1973-74 this would save 120 conductors, but require 23 kerbside ticket-sellers, a net labour saving of 97 men at $3,700 each, or $359,000. However, higher wages to drivers would cost $32,000, and ticket selling machines another $15,000, so the net saving would be $312,000. In 1974-75, the net saving would be

$\frac{34}{100}$ x $327,000 = $111,000.

(iii) Benefits to Existing Passengers

The new buses have several features which improve passenger comfort, safety, and convenience, including automatic doors, forced air ventilation, better braking and demisting equipment, and smoother ride (due to semi-automatic transmission, and improved suspension). The benefits of these improved conditions, valued as described in Annex D, are shown in Table P.22.2. It will be noted that there is a period of negative benefits when buses under the base case are younger than in the project case.

(iv) Benefits to New Passengers

New passengers also receive the benefit of improved travel conditions, and this has been included at half the rate per passenger mile applicable to existing passengers. Again, the benefit is negative for a period when buses are younger in the base case than in the project case.

(v) Road Traffic Benefits

In addition to the benefits experienced by new bus travellers themselves, there are external benefits to remaining road users when travellers convert to public transport from private cars. As explained in Annex D this 'external benefit' is estimated to be 7.35 cents per vehicle mile, which is applied to converted passenger miles (summarised in Table P.22.1 above) by dividing by 1.25, the average car occupancy. This benefit averages around $170,000 per annum once replacement is completed in 1977-78, then becomes negative during the second decade of the study period, before becoming positive at around $50,000 per annum after 1988-89.

Results

Details of undiscounted costs and benefits, plus totals discounted to 1972 present values at 7 per cent and 10 per cent, are shown in Table P.22.2. The respective benefit-cost ratios are 1.4 and 1.3, and the respective net present values are $3.8m and $2.4m. The internal rate of return is 19 per cent.

TABLE P.22.2 - COMPARISON OF COSTS AND BENEFITS, SYDNEY BUSES

($'000)

Period	Costs	Benefits						Total benefits
		Bus purchase	Bus maintenance	1-man operation	Benefits to Existing passengers	Benefits to New passengers	Road savings	
1973-74 to 1977-78	11,000	..	3,465	423	1,764	19	324	5,995
1978-79 to 1982-83		..	2,508	..	4,590	48	863	8,009
1983-84 to 1987-88		11,500	785	..	397	1	91	12,767
1988-89 to 1992-93		..	-700	..	-1,792	-9	-337	-2,838
1993-94 to 1997-98		-11,000	1,200	..	324	2	351	-9,123
1998-99 to 2002-03		..	1,100	..	1,471	8	277	2,856
2003-04 to 2007-08		..	-100	..	1,333	1	251	1,485
2008-09 to 2012-13		..	-900	..	1,207	6	227	540
2013-14 to 2017-18		500	400	..	1,093	1	93	2,087
2018-19 to 2022-23		..	..	..	..	..	..	..
Discounted :								
at 7%	9,020							12,844
at 10%	8,340							10,736

NOTE: Minus sign (-) indicates negative benefit.

ANNEX F

Project 23

REPLACEMENT OF SYDNEY TRAINS

The New South Wales Railways operate a Sydney suburban passenger fleet of 555 units (a unit being defined as a motor car and trailer). The majority of these units (444, or 80 per cent) were purchased in the late 1920's and are thus 45 years old. The B.T.E. has evaluated the returns from spending $90 million on replacing 281 of these old units in the period 1973-74 to 1977-78. Two alternative courses of action have been compared over a 50 year study period :

(i) deferring replacement for another 10 years
(ii) proceeding with the above replacement programme.

Costs

Each unit is estimated to cost $320,000 consisting of $200,000 for the motor cars and $120,000 for the trailer cars. Salvage value of the old units is assumed to be negligible.

Benefits

The new double deck units have several advantages over those they will replace. They will be less costly to maintain, and passenger comfort would be improved due to air ride bogies, insulation, power closing doors and greater carrying capacity (both seated and standing). They also have superior acceleration which would permit higher schedule speeds, though this improved performance would be at the expense of higher power consumption.

Travel Estimates

The passenger forecasts used in the evaluation, made according to the general assumptions in Annex D, are shown at 10 year intervals in the following Table. The double deck units have almost double the seating capacity and 50 per cent more total capacity, so the new passengers could be accommodated without any need for larger trains or more services.

TABLE P.23.1 - PASSENGER FORECASTS, SYDNEY TRAINS

(Millions of Passenger Miles)

Year	Base				Project			
	Existing	Generated	Converted	Total	Existing	Generated	Converted	Total
1978-79	1,214	..	..	1,214.0	1,214	10.9	43.7	1,268.6
1988-89	1,214	10.9	43.7	1,269.6	1,214	8.5	34.0	1,256.5
1998-99	1,214	8.5	34.0	1,256.5	1,214	6.1	24.2	1,244.3
2008-09	1,214	6.1	24.2	1,244.3	1,214	3.6	14.6	1,232.2
2018-19	1,214	3.6	14.6	1,232.2	1,214	1.2	4.9	1,220.1

Evaluation

(i) Train Maintenance

It is estimated that the difference in annual maintenance costs of the new and old units over the next decade would be about $10,000 per train, giving total annual savings of $2,810,000. After that, the only difference in base case and project case maintenance costs would be due to the fact that units in the project case would be 10 years older (though of the same general design). This maintenance cost difference is expected to be $1,300 per unit, or $365,000 per annum.

(ii) Power Costs

New units are estimated to consume more power than the older units. The extra power cost per unit for the new trains is estimated to be $1,700 giving a total annual increase in power costs of $478,000. This increase in costs only applies for the first decade after which new units are introduced anyway.

(iii) Benefits to Existing Passengers

The new units offer passengers several advantages over the old units. One of these would be additional seating and standing capacity, which would result in improved comfort for existing passengers (even after allowing for the effect of new passengers). Valuing the benefit to existing passengers at 1c per passenger mile existing passenger benefits would be worth

$12,140,000 per annum in the first decade. In later decades with project case units 10 years older than base case ones, it is assumed that there would be project case passenger benefits of minus 0.2c per passenger mile or minus $2,428,000 per annum in total.

(iv) Benefits to New Passengers

Valuing benefits to new passengers at half the rate applying to existing passengers, these benefits are calculated to be $273,000 per annum for the first 10 years, then minus $12,000 per annum thereafter when project case units are 10 years older than base case ones.

(v) Road Traffic Benefits

Any increase in train patronage resulting from conversion of private car users results in savings in road costs. These savings are calculated to be 8.1c per vehicle mile (see Annex D), and vehicle miles were calculated by dividing converted passenger miles (as shown in Table P.23.1 above) by 1.25, the average car occupancy. Hence road traffic benefits are valued at $2,832,000 per annum in the first decade, then minus $629,000 per annum for the rest of the study period, when project case units are older than base case ones.

Results

Details of undiscounted costs and benefits, together with totals discounted to 1972 present values at seven and ten per cent, are shown in Table P.23.2. The benefit-cost ratios at these discount rates are 1.7 and 1.5 respectively, and the net present values are $51.5m and $36.7m respectively. The internal rate of return is 23 per cent.

TABLE P.23.2 - COMPARISON OF COSTS AND BENEFITS, SYDNEY TRAINS

($'000)

Period	Costs	Benefits						Total
		Train purchase	Train maintenance	Power savings	Passenger benefits		Road savings	
					Existing	New		
1973-74 to 1977-78	90,000	..	8,430	-1,434	36,420	819	8,496	52,731
1978-79 to 1982-83	..	..	14,050	-2,390	60,700	1,365	14,160	87,885
1983-84 to 1987-88	..	90,000	4,525	- 956	16,996	510	3,777	114,772
1988-89 to 1992-93	..	..	-1,825	..	-12,140	-60	-3,145	-17,170
1993-94 to 1997-98	..	..	-1,825	..	-12,140	-60	-3,145	-17,170
1998-99 to 2002-03	..	..	-1,825	..	-12,140	-60	-3,145	-17,170
2003-04 to 2007-08	..	..	-1,825	..	-12,140	-60	-3,145	-17,170
2008-09 to 2012-13	..	..	-1,825	..	-12,140	-60	-3,145	-17,170
2013-14 to 2017-18	..	..	-1,825	..	-12,140	-60	-3,145	-17,170
2018-19 to 2022-23	..	..	-1,825	..	-12,140	-60	-3,145	-17,170
Discounted:								
at 7%	73,704							125,180
at 10%	68,130							104,876

NOTE: Minus sign (-) indicates negative benefit.

ANNEX F

Project 24

REPLACEMENT OF MELBOURNE TRAMS [1]

Project Description

The present rolling stock of the Melbourne and Metropolitan Tramways Board (M.M.T.B.) consists of 696 trams, varying in age from 16 to almost 50 years. Approximately half of the fleet is over 40 years old, and since at least 1964 the Board has expressed its desire to call tenders for 100 new trams to replace some of the oldest stock. However, the Board has not been in the financial position to proceed with this replacement. In its latest Annual Report[2], the Board

> .... makes no apology for once again stressing its opinion that the replacement of obsolete and costly (maintenance-wise) rolling stock (both tram and bus) remains its most pressing problem ... the progressive replacement of some 320 of its vintage tramcars would do more to assist its ailing finances and, at the same time, attract passengers than any other single project ... If adequate funds are made available the Board will be able to invite tenders for the purchase of 100 new tramcars without further delay.

The evaluation compares two alternative courses of action :

(i) retaining existing trams, but in 10 years' time replacing some of the oldest (W2 design) with 100 new trams (PCC-type) and running the replacement trams to the end of the 50-year study period; or

(ii) immediately replacing some of the old W2 trams with 100 new PCC-type trams, and in turn replacing these trams after 30 years.

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(1) The main sources of data for the evaluation are M.M.T.B. Annual Reports, Metropolitan Melbourne Transportation Study reports, recent newspaper reports and B.A. Weedon, The Advantages to the Operator and User of Replacing old Tramway Rolling Stock by that of more Modern Design , Report of the Head of the Civil Engineering Department, University of Melbourne, 1970.

(2) Melbourne and Metropolitan Tramways Board, Report and Statement of Accounts, 1970-71.

In recent years many public transport authorities have introduced into service new vehicles especially designed to reduce manning costs, which are a high proportion of the cost of public transport operation. In view of the fact that the M.M.T.B.'s intentions regarding manning of the new trams are unknown, the BTE considered that for comparative purposes, the evaluation could usefully be carried out on two alternative assumptions, namely one-man or two-man operation.

Costs

The capital cost of the project is the acquisition of 100 trams at $75,000 each.

The cycles of equipment purchase and disposal, other than the initial investment in the project case, are treated in the calculation of benefits. For this purpose the salvage value of the existing W2 trams is considered negligible. Each new tram is estimated to have a residual value of $2,000 after 30 years.

Benefits

The new trams would have advantages, relative to the old trams, of larger capacity, better acceleration and deceleration, design features to reduce maintenance costs, improved passenger comfort, and more efficient design for passenger loading, internal movement and unloading. These positive benefits would be offset to some extent by higher power costs for operating the new trams.

Travel Estimates

Recent statistics suggest that patronage on Melbourne trams may have reached a relatively stable level of about 330 million passenger miles per year. This service is provided by the 696 trams operating over a total of 14.9 million vehicle miles.

On average 89 per cent of trams are now available for service in peak periods. The availability of the oldest trams would be approximately 85 per cent. It is estimated that peak period availability of new trams would be 98 per cent. Hence, on this basis, 100 new trams would do the work of the 115 oldest trams (98% x 100 = 85% x 115).

The passenger miles served initially by the new trams may be estimated from the current utilisation of the 115 oldest trams. Taking account of differences in availability between the oldest trams and the fleet average, annual passenger miles:

$$= \frac{85}{89} \times \frac{115}{696} \times 330 \text{ million} = 52 \text{ million}$$

In addition to this basic level of existing patronage, it is assumed that new rolling stock would attract extra patronage (as explained in Annex D). The resulting passenger forecasts for base and project cases are shown, at 10 year intervals, in the following Table.

TABLE P.24.1 - PASSENGER FORECASTS, MELBOURNE TRAMS

(Millions of passenger miles)

Year	Base case				Project case			
	Existing	Generated	Converted	Total	Existing	Generated	Converted	Total
1978-79	52.0	0	0	52.0	52.0	0.5	2.1	54.6
1988-89	52.0	0.5	2.1	54.6	52.0	0.4	1.7	54.1
1998-99	52.0	0.4	1.7	54.1	52.0	0.3	1.3	53.6
2008-09	52.0	0.3	1.3	53.6	52.0	0.5	2.1	54.6
2018-19	52.0	0.2	0.9	53.1	52.0	0.4	1.7	54.1

The new trams would have a maximum capacity 15 per cent greater than the old trams. Even after allowing for declining availability with age this reserve capacity would be sufficient to cater for the project case patronage without involving additional trams.

Evaluation

(i) Tram Maintenance

The average maintenance cost for all trams in 1970-71 was $4,357. Maintenance on the oldest trams would have been higher, say $5,000, or about $5,500 in 1972 values. In 1970 Weedon predicted that the cost of maintaining old W2 trams would rise to $6,000 'within a few years because of ever increasing attention needed to guard against fatigue failures'. He further states that on the basis of overseas experience, maintenance costs for new trams would be $2,500 per year.

From these considerations, it is assumed that the average annual maintenance cost for retaining old trams a further 10 years would be $6,500 (in 1972 values). Annual maintenance cost of new trams (introduced in 1973-74 to 1977-78 and 2003-04 to 2007-08 in the project case, and 1983-84 to 1987-88 in the base case) is assumed to average $3,000 in the first decade of use, increasing $500 every decade thereafter.

(ii) Operating Costs

The introduction of new trams, as currently proposed, is not expected to change the overall labour costs of operating the system or the mileage travelled. The potential savings associated with greater capacity would be offset, approximately, by the anticipated additional patronage.

More power is required to operate the new trams, however, and this is estimated at 2c per vehicle mile, or a total of $47,000 per year for the first ten years, after which new trams are introduced in the base case.

(iii) Benefits to Existing Passengers

Passenger benefits include faster schedule speeds (up to 10 per cent faster), modern decor, heating, better riding qualities and better passenger flow characteristics. The better riding qualities include better suspension, quieter operation and automatic (and thus smoother) acceleration and deceleration.

In total it is estimated that the time, comfort and convenience benefits are worth 1c per mile to existing passengers. The annual value of this benefit is $520,000 when initial replacement is completed, but becomes negative when tram age is lower in the base case, before becoming positive again in the fourth decade of the study period.

(iv) Benefits to New Passengers

New passengers also benefit from improved travel time, comfort and convenience, and this item has been included at half the unit rate applying to existing passengers.

(v) Road Traffic Benefits

In addition to the benefits which accrue to tram travellers converted from road usage, conversion may also benefit remaining road users. As explained in Annex D, this benefit is calculated at 7.35c per vehicle mile, vehicle miles being calculated by dividing converted passenger miles (see Table P.24.1 above) by 1.25, the average car occupancy. Hence the road traffic benefits are $123,000 per annum for the first decade, minus $24,000 per annum for the next two decades (when project case patronage is less than base case patronage), then $47,000 per annum for the remainder of the study period.

(vi) One-man Operation

It is estimated that if the new trams could be operated on a one-man basis, there would be a saving of 119 conductors. However, one-man operation during peak times would require 25 street ticket sellers at points of heavy embarkation, so the net manpower savings would be 94 men @ $3,700 each = $347,800. It is also necessary to take account of higher payments to drivers for one-man operation - estimated to cost $34,000 per annum - and, initially, the cost of ticket-selling machines, say another $14,000. Thus the net savings from one-man operation rises to $314,000 per annum once replacement is completed, until 1983-84 when new trams would begin to be introduced in the base case.

Results

Details of undiscounted costs and benefits, plus totals discounted to 1972 present values at 7 and 10 per cent, are shown in Table P.24.2. The benefit-cost ratios at these discount rates are 1.4 and 1.2 respectively, and the net present values are $2.2m and $1.2m respectively. The internal rate of return is 15 per cent.

If one-man operation were practicable, the respective benefit-cost ratios would be 1.7 and 1.5, and the respective net present values would be $4.1m and $2.8m. The internal rate of return would be 20 per cent.

TABLE P.24.2 - COMPARISON OF COSTS AND BENEFITS, MELBOURNE TRAMS

($'000)

Period	Costs	Benefits							Total Benefits	
		Tram purchase	Tram maint-enance	Power	Benefits to -		Road savings	1-man oper-ation	2-man oper-ation	1-man oper-ation
					Existing passengers	New pass.				
1973-74 to 1977-78	7,500	..	1,344	-141	1,560	39	369	928	3,171	4,099
1978-79 to 1982-83	..	..	2,240	-235	2,600	65	615	1,570	5,285	6,855
1983-84 to 1987-88	..	7,500	746	- 94	728	23	174	628	9,077	9,705
1988-89 to 1992-93	..	..	-250	..	-520	-5	-120	..	- 895	- 895
1993-94 to 1997-98	..	..	-250	..	-520	-5	-120	..	- 895	- 895
1998-99 to 2002-03	..	..	-250	..	-520	-5	-120	..	- 895	- 895
2003-04 to 2007-08	..	-7,300	200	..	416	4	93	..	-6,587	-6,587
2008-09 to 2012-13	..	..	500	..	1,040	10	235	..	1,785	1,785
2013-14 to 2017-18	..	..	500	..	1,040	10	235	..	1,785	1,785
2018-19 to 2022-23	..	..	500	..	1,040	10	235	..	1,785	1,785
Discounted:										
at 7%	6,150								8,384	10,299
at 10%	5,687								6,879	8,463

NOTE: Minus sign (-) indicates negative benefit.

ANNEX F

Project 25

REPLACEMENT OF MELBOURNE TRAINS

Victorian Railways operate a fleet of 155 suburban trains, of which 138 are available for peak hour service. Two-thirds of the fleet comprises wooden-bodied trains, nearly all of which are at least 45 years old, and some of which are 80 years old. The programme evaluated is replacement during the period 1973-74 to 1977-78 of the 75 oldest trains in the fleet, which would average 60 years old.

Only the replacement element of the proposed purchase programme is evaluated. Two alternative courses of action are compared over a 50 year study period, namely:

(i) deferring replacement another 10 years; or

(ii) proceeding with the above replacement programme.

Costs

The new trains are estimated to cost $700,000 each, or $52.5 million altogether. Salvage value of the present trains is negligible.

Benefits

The new stainless steel trains would have several advantages over the old wooden-bodied trains. They would be less costly to maintain and operate, would have greater carrying capacity, and would provide more comfortable and safer travelling conditions for passengers.

Travel Estimates

The passenger forecasts used in the evaluation, made according to the general assumptions discussed in Annex D, are shown, at 10 year intervals, in the following Table. The new trains would have a maximum capacity 15 per cent greater than the old ones, which would be sufficient to cater for project case patronage without requiring extra train services.

TABLE P.25.1. - PASSENGER FORECASTS, MELBOURNE TRAINS

(Millions of passenger miles)

Year	Base case				Project case			
	Existing	Generated	Converted	Total	Existing	Generated	Converted	Total
1978-79	609.0	..	..	..	609.0	7.3	29.2	645.5
1988-89	609.0	7.3	29.2	645.5	609.0	6.1	24.4	639.5
1998-99	609.0	6.1	24.4	639.5	609.0	4.9	19.5	633.4
2008-09	609.0	4.9	19.5	633.4	609.0	3.7	14.6	627.3
2018-19	609.0	3.7	14.6	627.3	609.0	2.4	9.8	621.2

Evaluation

(i) Train Maintenance

The new stainless steel trains would be considerably cheaper to maintain and clean than the old wooden-bodied trains, with their many doors and windows, rotting timber members, and corrosion of metal parts. In addition, the seats in the new trains would be less susceptible to damage by vandals. Further, early replacement would avoid work which is now becoming necessary on the traction motors, wiring and control equipment, and mechanical and brake gear of the old trains. It is estimated that the difference in annual maintenance costs of the new and old trains over the next decade would be about $20,000 per train, or $1,500,000 in total. After that, the only difference in base case and project case maintenance costs would be due to the fact that trains in the project case would be ten years older (though of the same general design). This maintenance cost difference is estimated to be $2,500 per train or $188,000 per annum altogether.

(ii) Operating Costs

The old trains weigh more than their modern counterparts, and thus require more electrical energy. It is estimated that the annual energy cost for each new lightweight train would be $1,400 less than for an old train, or $105,000 in total. This benefit

only applies for the first decade, after which new trains would be introduced anyway.

(iii) Benefits to Existing Passengers

The new trains would offer passengers several advantages over the old wooden-bodied trains, including forced air ventilation, heating, power-closing doors, smoother running, and insulation to reduce noise. Assuming passengers value these improvements at 1c per passenger mile, existing passenger benefits would be worth $6,090,000 per annum in the first decade. In later decades, with project case trains 10 years older than base case ones, it is assumed that there would be project case passenger benefits of minus 0.2c per passenger mile, or minus $1,218,000 per annum in total.

(iv) Benefits to New Passengers

New passengers also benefit from improved travel conditions with modern rolling stock, and, at half the unit rate applying to existing passengers, these benefits are estimated to be $183,000 per annum in the first decade, then minus $6,000 per annum thereafter when project case trains are ten years older than base case ones.

(v) Road Traffic Benefits

Any increase in train patronage resulting from conversion of private car users results in savings in road costs. This benefit is calculated to be 8.1c per vehicle mile (see Annex D) and vehicle miles were calculated by dividing converted passenger miles (as shown in Table P.25.1 above) by 1.25, the average car occupancy. Hence, road traffic benefits are valued at $1,892,000 per annum in the first decade, then minus $311,000 per annum for the rest of the study period, when project case trains are older than base case ones.

Results

Details of undiscounted costs and benefits, plus totals discounted to 1972 present values at 7 and 10 per cent, are shown in Table P.25.2. The benefit-cost ratios at these discount rates are 1.7 and 1.5 respectively, and the net present values are $28.6m and $19.7m respectively. The internal rate of return is 21 per cent.

TABLE P.25.2 - COMPARISON OF COSTS AND BENEFITS, MELBOURNE TRAINS

($'000)

Period	Costs	Benefits						Total benefits
		Train purchase	Train maint-enance	Power savings	Benefits to - Existing passengers	Benefits to - New pass.	Road savings	
1973-74 to 1977-78	52,500	..	4,500	315	18,270	549	5,676	29,310
1978-79 to 1982-83		..	7,500	525	30,450	915	9,460	48,850
1983-84 to 1987-88		52,500	2,436	210	8,526	348	2,851	66,871
1988-89 to 1992-93		..	-940	..	-6,090	-30	-1,555	-8,615
1993-94 to 1997-98		..	-940	..	-6,090	-30	-1,555	-8,615
1998-99 to 2002-03		..	-940	..	-6,090	-30	-1,555	-8,615
2003-04 to 2007-08		..	-940	..	-6,090	-30	-1,555	-8,615
2008-09 to 2012-13		..	-940	..	-6,090	-30	-1,555	-8,615
2013-14 to 2017-18		..	-940	..	-6,090	-30	-1,555	-8,615
2018-19 to 2022-23		..	-940	..	-6,090	-30	-1,555	-8,615
Discounted:								
at 7%	43,052							71,628
at 10%	39,803							59,478

NOTE: Minus sign (-) indicates negative benefit.

ANNEX F

Project 26

REPLACEMENT OF PERTH BUSES[1]

Project Description

Since the inception of the Metropolitan (Perth) Passenger Transport Trust (M.(P)P.T.T.) in 1957, the bus fleet has increased from 577 to 729 as at June 30th, 1971. The M.(P)P.T.T. would like to purchase 195 buses over the period 1973-74 to 1977-78, 186 of these being to replace buses which would be 20 years old.

Only the replacement element of the purchase programme is evaluated. Two alternative courses of action are compared over a 50 year study period :

(i) undertaking no replacement for a decade, then during 1983-84 to 1987-88 replacing the oldest 186 buses (then around 30 years old) with new buses and replacing these buses, in turn, after another 30 years;

(ii) between 1973-74 and 1977-78 replacing the oldest 186 buses with new buses, and replacing these buses, in turn, at 20 year intervals.

Cost

The capital cost of the project is 186 buses at an average of approximately $26,000 each (several types are being purchased) less salvage value of $200 each for the replaced buses giving a total net cost of approximately $5 million.

Benefits

The new buses would have advantages, compared with the old ones, of reduced maintenance costs, better design, increased comfort and faster acceleration.

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(1) This evaluation is based on the Annual Reports of, and material supplied by, The Metropolitan (Perth) Passenger Transport Trust.

Travel Estimates

The passenger forecasts used in the evaluation are shown, at 10 year intervals, in the following Table. The forecasts were made according to the general assumptions discussed in Annex D, together with an assumption that there is an underlying tendency for patronage to decline by 550,000 passenger miles per decade (based on experience from 1961-62 to 1970-71).

TABLE P.26.1 - PASSENGER FORECASTS, PERTH BUSES
(Millions of passenger miles)

Year	Base case				Project case			
	Existing	Generated	Converted	Total	Existing	Generated	Converted	Total
1978-79	43.8	..	..	43.8	43.8	0.2	0.7	44.7
1988-89	43.2	0.2	0.7	44.1	43.2	0.1	0.3	43.6
1998-99	42.7	0.1	0.3	43.1	42.7	0.2	0.7	43.6
2008-09	42.2	..	..	42.2	42.2	0.1	0.3	42.6
2018-19	41.6	0.2	0.6	42.4	41.6	0.2	0.6	42.4

Evaluation

(i) Bus Maintenance

There are certain elements of bus maintenance which are the same irrespective of age of bus (for example, daily inspections, 1,000 mile services, and accident repairs). However, overhaul costs would be lower with new buses. Buses of 1950-60 vintage require complete stripping and rebuilding (major overhaul) every 80,000 to 90,000 miles with minor overhauls around 50,000 miles. Present day buses, on the other hand, are designed such that major overhauls are only needed every 400,000 miles, supplemented by a minor overhaul at 200,000 miles. Maintenance savings from introducing new buses therefore occur because of the lesser need for costly overhauls ($5,000 for major overhauls, $2,000 for minor overhauls).

The costs, of all major and minor overhauls required each year under base and project cases were calculated assuming vehicles each travel 30,000 miles per annum. Net maintenance savings under the project case are shown, in five-year totals, in Table P.26.2.

(ii) Benefits to Existing Passengers

New buses have several features which improve passenger comfort and safety, including forced air ventilation, better braking, smoother and quieter ride (due to semi-automatic transmission and improved suspension). These improved conditions have been valued at 0.5 cents per passenger mile in the first decade, when project case buses are 20 years newer than base case buses. The benefit (or disbenefit when base case buses are newer than project case buses) is proportionately lower when the age difference is less.

(iii) Benefits to New Passengers

New passengers also receive the benefit of improved travel conditions, and this has been included at half the rate per passenger mile applicable to existing passengers. Again, there are negative benefits when buses under the base case are newer than buses under the project case.

(iv) Road Traffic Benefits

As well as the direct benefits accruing to passengers, there are external benefits to remaining road users when travellers convert from private cars to public transport. This external benefit is estimated to be 7.35 cents per vehicle mile and this figure is applied to converted passenger miles (Table P.26.1), after dividing by 1.25, the average car occupancy.

Results

Details of undiscounted costs and benefits together with totals discounted to 1972 present values at seven and ten percent are shown in Table P.26.2. The respective benefit-cost ratios are 1.4 and 1.3, and the respective net present values are $1.7m and $1.1m. The internal rate of return is 22 per cent.

TABLE P.26.2 - COMPARISON OF COSTS AND BENEFITS, PERTH BUSES

($'000)

Period	Costs	Benefits					Total Benefits
		Bus purchase	Bus maintenance	Benefits to Existing Passengers	Benefits to New Passengers	Road savings	
1973-74 to 1977-78	5,371	..	2,580	657	7	117	3,361
1978-79 to 1982-83	..	..	2,130	1,095	10	196	3,431
1983-84 to 1987-88	..	5,371	-510	567	5	28	5,461
1988-89 to 1992-93	..	..	-572	-237	-1	-84	-894
1993-94 to 1997-98	..	-5,371	510	-152	-1	33	-4,981
1998-99 to 2002-03	..	..	620	363	2	113	1,098
2003-04 to 2007-08	..	..	-186	530	3	95	442
2008-09 to 2012-13	..	..	-100	527	3	84	514
2013-14 to 2017-18	..	..	534	336	1	33	904
2018-19 to 2022-23	..	..	..	..	..	..	..
Discounted :							
at 7%	4,347						6,008
at 10%	3,995						5,135

NOTE: Minus sign (-) indicates negative benefit.