National Highways Linking Sydney, Melbourne and Canberra, 1978 Second Report

Report

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BUREAU OF TRANSPORT ECONOMICS

NATIONAL HIGHWAYS LINKING SYDNEY, MELBOURNE AND CANBERRA, 1978,

(SECOND REPORT)

AUSTRALIAN GOVERNMENT PUBLISHING SERVICE

CANBERRA, 1978

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FOREWORD

The Bureau of Roads in its Report on Roads in Australia, 1973, recommended that the Commonwealth Government legislate to declare a system of National Highways throughout Australia and to provide grants of financial assistance to the states for the construction and maintenance of these highways. The Commonwealth Government accepted this recommendation and the National Roads Act, 1974, was introduced in September, 1974. A system of National Highways has subsequently been declared under that Act.

As part of the National Highway System the Bureau of Roads nominated the Hume Highway as the National Highway linking Sydney, Melbourne and Canberra. However, the route of the National Highway from Goulburn to south of Albury was, in the opinion of the Bureau of Roads, a matter for detailed examination.

The Bureau of Roads began work on such a study and reported on the section between Goulburn and Tabletop in 1975. This second report is concerned with the section between Bowna to Barnawatha in the vicinity of Albury.

The investigations for the report were carried out principally by the Bureau of Roads prior to its amalgamation with the Bureau of Transport Economics. The report has been finalized by the new Bureau of Transport Economics and is published under the aegis of this body.

The Bureau would like to express its appreciation to the NSW Department of Main Roads, the Victorian Country Roads Board, the Albury-Wodonga Development Corporation and all other authorities who contributed to the study.

G.K.R. Reid
Acting Director

Bureau of Transport Economics,
CANBERRA
February, 1978.

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SUMMARY AND CONCLUSIONS

The main issue relating to the Sydney-Melbourne National Highway in the vicinity of Albury-Wodonga concerns the relative worth of a bypass route. There are two broad options available for a bypass of Albury-Wodonga: a route internal to the urban boundary and a route external to the urban boundary.

A full internal bypass of Albury-Wodonga would include a central section, comprising a second Murray River Crossing and an Albury Centre Bypass, and also bypasses at either end of this central section, a Lavington Bypass and a Wodonga Bypass. The evaluative framework assumes that the central section will be needed in the near future and will be constructed regardless of whether or not it comprises part of the National Highway route.

The two broad bypass options therefore reduced to:

(i) a system consisting of the Wodonga and Lavington Bypasses;[1] and

(ii) an external bypass between Bowna and Barnawartha.

The study concentrated on decisions relating to the location, timing and staging of these options. It is assumed that the central section of a full internal bypass would be required regardless of which broad option was adopted.

Location of Upgraded Routes

It is concluded that replacing the existing Hume Highway approaches to Albury by the Wodonga and Lavington Bypasses would provide significant benefits to road users, whilst having a low social and environmental impact.

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(1) These bypasses commence outside the defined urban area and terminate at the first major intersection within the urban boundary, as is the practice for National Highways at most urban boundaries.

It is also concluded that the best route for an external bypass is Alternative 3a, leaving the existing National Highway at Bowna Creek, skirting the Black Range and passing south of Jindera. This route descends from the plateau, crosses the Murray River near Dights Hill and rejoins the Hume Highway near the intersection of the Murray Valley Highway. The northern termination point is not a fixed constraint on the route and should be adjusted to connect to any improvements of the Bowna-Table Top Section.

Standard and Timing of New Construction

The results of the evaluation show that it is more economically efficient to construct an internal bypass route and use this internal route as part of the National Highway network prior to constructing an external route.

The results also show that, at this time, there is no economic warrant for the Wodonga Bypass to be constructed to the standard proposed by the Country Roads Board although it would become warranted in two to three years time. However, a four lane facility not providing for ultimate development to six lanes as that proposed by the Country Roads Board and evaluated in this report would have a much more immediate warrant and would seem to be consistent with the likely traffic levels within the design period. It is therefore concluded that the ultimate requirement for a six lane facility be closely examined prior to construction of the first stage of the Wodonga Bypass.

The Lavington Bypass will have an economic warrant for construction as a two-lane arterial road within the next three to five years. If initially constructed as a four lane freeway it would not be warranted for eight to fifteen years, depending on funds availability. Therefore, the Lavington Bypass should be constructed within the next five years as a two-lane arterial road.

If the Wodonga and Lavington Bypasses are built, the external route will not be economically warranted before the 1990's when the first carriageway of an ultimate four lane road should be constructed. However, in the interim, the route should be the subject of a detailed investigation involving the public, the preferred alignment then being reserved until construction is warranted.

Impact on Other Road Projects

For any particular link the overall objective of the National Highways program is to provide the highest benefits over the link as a whole within the funds available. The Hume Highway, linking Sydney and Melbourne has many sections where the benefit-cost ratio of projected improvements is much greater than one. The Bureau of Roads' First Report on the Hume Highway in 1974 estimated (Table 3.11) that the benefit-cost ratio of the expenditure to bring the Hume Highway, between Goulburn and Table-Top, to an improved two-lane standard was 1.9.

In the light of that estimate, projects on the remainder of the Hume Highway with benefit-cost ratios close to unity, although warranted economically in the absolute sense, should be delayed until the major works between Goulburn and Table Top have been carried out. This implies that, while the Lavington and Wodonga Bypasses are justified within, say, five years, an external bypass should have a low priority in terms of the Hume Highway as a whole. Even if, for some reason, it were decided not to construct the internal route, the external route, with a benefit-cost ratio of about one, would still have a low priority.

The above considerations emphasise the merits of stage construction. With all expenditure the aim should be to eventually provide a road to National Highway design standard, bypassing congested areas. However, in many cases a road of intermediate standard is all that is warranted at this time. This is especially relevant to the present study which concludes that, whatever option is chosen, it should be constructed in stages. A reconstructed two lane road linking Sydney and Melbourne throughout would produce greater benefits than partial construction of the same link to four lane controlled access standard, as not all deficient sections could be upgraded to the higher standard, given the limited funds available.

Funding

In its Report on Roads in Australia, 1975, the Bureau of Roads recommended that Albury-Wodonga be declared an urban area for road funding purposes. Such declaration has not yet occurred. However, its future possibility is recognised and possible funding arrangements are viewed in this light.

Past practice has been to seek to avoid National Highway declarations in urban areas. This practice can be defended because the prime beneficiaries from road improvements on the urban sections of such highways tend to be urban travellers.

No firm assumptions have been made about what the urban boundaries of Albury-Wodonga should be if it is to be declared an urban area for road funding purposes. The urban area utilized in this study is the existing urban area of Albury-Wodonga as defined by the Australian Bureau of Statistics. Although this area would include sections of the Wodonga and Lavington Bypasses, the investigations conducted suggest that these bypasses would be of great benefit to National Highway traffic. It is concluded, therefore, that there are good arguments for funding the Wodonga and Lavington Bypasses from National Highway funds.

In the event that Albury-Wodonga is not declared an urban area for road funding purposes, National Highway funds could be employed to finance the construction of the total internal bypass route, that is, the Second Murray River crossing, the Albury Centre Bypass, the Lavington Bypass and the Wodonga Bypass.

The timing and construction priorities suggested in these conclusions are based on an evaluation of economic, engineering, social and environmental considerations alone. In practice, administrative and resource availability constraints may require some amendment to the priorities suggested in this report.

CHAPTER 1 - INTRODUCTION

Background

Following the enactment of the National Roads Legislation in 1974, the Commonwealth Government declared a set of routes to be National Highways. One of these was the Hume Highway between Sydney and Melbourne.

In April 1974, the Federal Minister for Transport requested the Bureau of Roads to conduct a detailed study "to determine the most desirable route for the Goulburn-Albury section of the Hume Highway". In February 1975, the Bureau of Roads submitted a report to the Minister entitled 'National Highways Linking Sydney, Melbourne and Canberra, 1975 (First Report)'.

The report considered the National Highway in the corridor from Goulburn to a point near Table Top, north of Albury. It recommended that:

> "The Government confirms that the future National Highway system in the Goulburn to north of Albury Corridor should be in the vicinity of the Hume/Federal/Barton Highways, on their present general routes, and directs that work proceed and/or commence immediately to construct or reconstruct these highways to Nationa. Highway (four lane divided) standard as quickly as possible".(1)

The Bureau of Roads then set up a study team to investigate the location, timing of construction and staging of improvements to the National Highway in the vicinity of Albury-Wodonga, in particular between Bowna and Barnawartha (see Figure 1.1). This Report details the results of this study.

Scope of Investigations

In accordance with the original terms of reference the study team carried out investigations to enable advice to be given on the following matters:-

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(1) National Highways Linking Sydney, Melbourne and Canberra (First Report), Commonwealth Bureau of Roads, 1975, Para. 2(a).

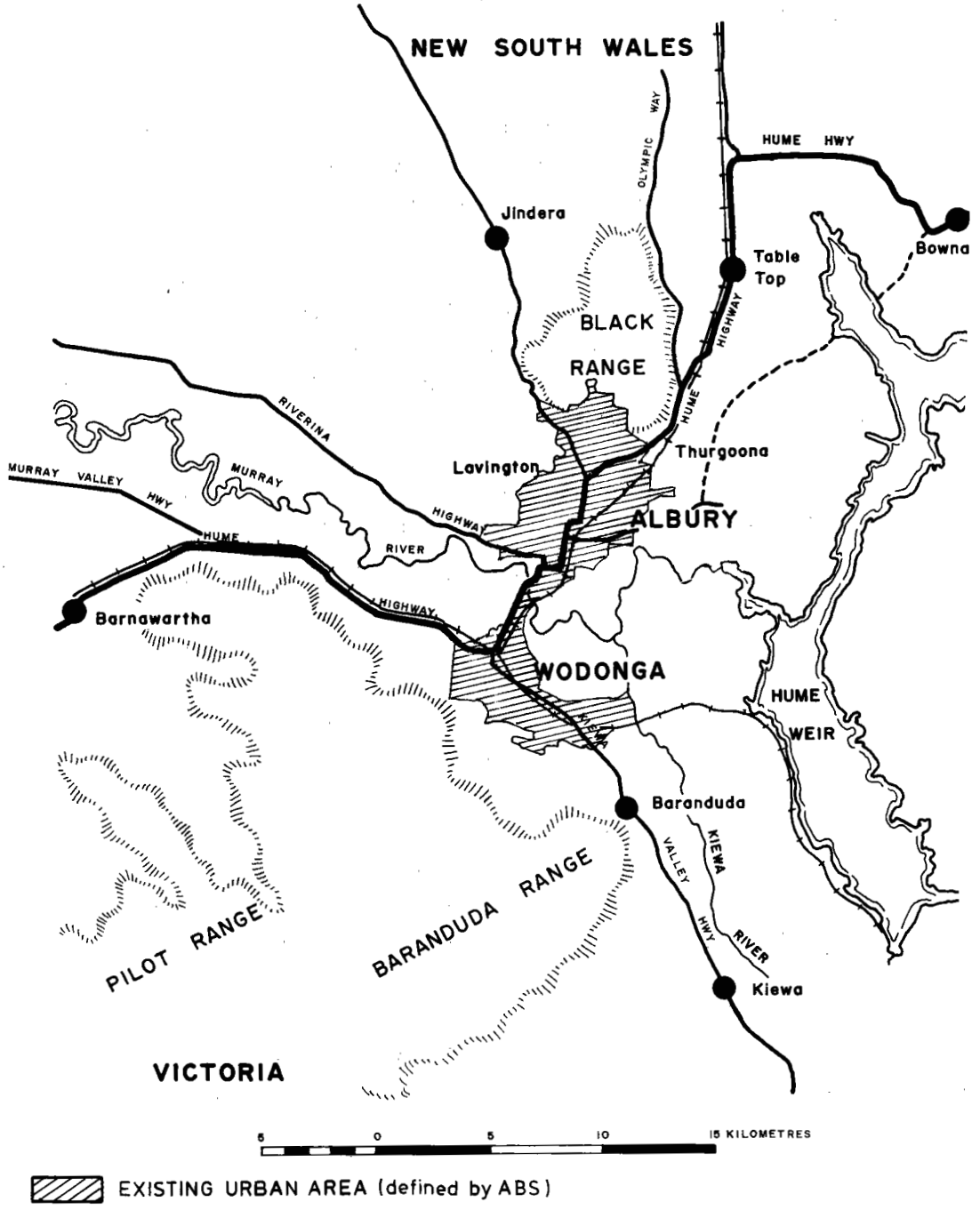

FIGURE 1.1 GENERAL STUDY AREA

(i) alternative locations and standards of National Highway routes;

(ii) an assessment for each of the alternative routes of the:
   a) construction costs;
   b) traffic consequences;
   c) environmental aspects; and
   d) the effect on the balance of development, including an assessment of the socio-economic impact;

(iii) a choice of routes for the National Highway; and

(iv) the timing of development.

Following these investigations an approximate route for the National Highway through the area and the approximate timing of development were determined. Further location and design work, including the preparation of an Environmental Impact Statement, is required before an exact alignment can be defined.

The Department of Main Roads (DMR) in New South Wales and the Country Roads Board (CRB) in Victoria provided essential engineering input to this study, in particular, the costing of the various alternatives. In addition, the Albury-Wodonga Development Corporation (AWDC) provided data and comment on the natural environment, future development and traffic projections. The New South Wales Water Conservation and Irrigation Commission (WCIC) provided information on the characteristics of the Murray River flood plain and the National Parks and Wildlife Service provided information on aboriginal sites. Discussions were held with representatives of the National Trust in Victoria and New South Wales.

Submissions received by the Bureau of Roads in connexion with the First Report on the Hume Highway Corridor Study were examined and taken into account. These submissions were appended to the Bureau's First Report.

The public at large have not had the opportunity to contribute directly to the investigations carried out for this report. The public was not consulted in any structured fashion because of the number and complexity of road and other development proposals presently pending in the Albury-Wodonga Development Area.

Not all of these proposals are mutually compatible, feasible or even likely to be built and, at this time, their public exposure would be premature. Nevertheless when the detailed planning of the National Highway is being undertaken the public should be invited to participate.

Bureau of Transport Economics

Since the study was initiated the Bureau of Roads was amalgamated into the new Bureau of Transport Economics and this report has been produced under the aegis of the new body.

CHAPTER 2 - STRUCTURE OF INVESTIGATIONS

As outlined in Chapter 1, the study investigations were concerned with four broad areas:

(i) generation of alternative route locations and standards;

(ii) assessment of the various impacts of the alternatives;

(iii) choice of preferred route (based on (i) and (ii)); and

(iv) timing of development.

An important prerequisite to the investigations was to assess the 'do-nothing' situation against which the various alternatives were to be compared. (This is particularly important for assessing the timing of development). For this study 'do-nothing' covered National Highway construction only as other road construction will be undertaken in Albury-Wodonga regardless of any National Highway construction.

The location alternatives generated fall into two broad classes; those external to the Albury-Wodonga urban area[1] and those within the Albury-Wodonga urban area.

At the forecast rate of development Albury-Wodonga would suffer from a general shortage of road capacity. Two principal bottlenecks would be the Murray River crossing between Albury and Wodonga and the north-south corridor bypassing the city centre. The Hume Highway currently performs both these functions. Regardless of funding, additional capacity would be required along this corridor and can be assumed in the 'do-nothing' situation. This is further discussed in Chapter 4.

This additional capacity is primarily required because of the development of Albury-Wodonga as a growth centre. The study team considered whether this additional capacity, which would be for urban traffic of a short-distance nature, should be funded from sources other than National Highways funds. This is further discussed in Chapter 5.

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(1) Urban area is the contiguous built up area as defined by the Australian Bureau of Statistics (ABS).

The existing National Highway fulfills an essentially urban function within Albury-Wodonga. Because of this the study team concentrated on the choice between upgrading the existing alignment as far as the urban boundary (i.e. constructing the Wodonga and Lavington Bypasses) and constructing a bypass external to the urban area for the National Highway function. This is discussed in Chapters 6 to 10.

CHAPTER 3 - DESCRIPTION OF STUDY AREA

This Chapter describes the study area, and the existing and projected urban development. It also describes the existing road network and the traffic characteristics on the existing Hume Highway.

Definition of Study Area

The Bureau of Roads' First Report on the National Highway linking Sydney and Melbourne was concerned with investigations carried out on the section of the highway between Goulburn and Table Top. Because of the uncertainty surrounding the future development pattern in Albury-Wodonga, investigations into the alignment of the Hume Highway in that area were deferred until the plans became more settled.

Table Top was selected as the boundary between the two sections of the study as most alternative routes passed through that point. The construction of the Hume Weir caused the abandonment of the original alignment of the Hume Highway and the rerouting of traffic via Table Top (see Figure 1.1). This rerouting resulted in a circuitous approach to Albury and several options exist, within this area, for reducing the route distance to Albury. However, alternatives skirting the northern top of Hume Reservoir and rejoining the existing highway at Table Top are better than those along the old alignment which cross Lake Hume by a causeway and rejoin the Hume Highway at the top of the Lavington Bypass. (Although the latter have higher user benefits, this is more than outweighed by the extra construction costs associated with the crossing of Lake Hume).

Barnawartha is the most suitable location for the southern boundary. All alternatives rejoin the Hume Highway by that point. Although the terrain west of Howlong is favourable for highway construction any alternative in that area would be unlikely to attract long-distance traffic because of its extra travel time and distance.

Physical Setting

The most significant feature of the study area (Figure 1.1) is the Murray River. The Murray River rises in the Australian Alps south of Mount Kosciusko, and then flows generally westward through rugged gorge country. At the downstream end of this gorge the Hume Weir backs up water almost 50km. to the east. Downstream of the weir the Murray River, joined by the Kiewa River, meanders along a broad (3-5km wide) flood plain. The twin cities of Albury and Wodonga are located on low flat country immediately adjacent to and slightly above the existing flood plain, some 10km west of the Hume Weir.

Wodonga is surrounded by hills which rise over 300 metres above the plain to the south and west of the city. This range of hills is continuous with the mountainous country which extends south and east to the Victorian and New South Wales Alps. The Black Range north west of Albury rises only 200 metres above the plain but is steep and well forested. To the north near Jindera this range gives way to undulating country and plains which have been extensively cleared for pastoral and agricultural purposes. Near the western edge of the study area, the hills recede and the Murray River emerges onto a true river plain which extends westward across New South Wales and Victoria.

Flora and Fauna

Most of the land within the study area has been cleared for urban development or agriculture. However, there are some remaining semi natural areas including:

(i) the floodplain of the Murray River, which has been classified by the National Trust for its value as a wildlife habitat; and

(ii) the Black Range to the north west of Albury.

Below the Hume Weir the Murray River floodplain is a maze of anabranches and billabongs in the midst of an open woodland of river red gums. Although many of the original trees have been cleared and many of the native grasses replaced by introduced pasture species, the floodplain is still an important rookery area for a large range of birds which rely on the billabongs for food and nest sites and on the red gums for roosting and breeding. The most valuable waterfowl habitats are near the Hume Weir and the confluence of the Murray and Kiewa Rivers.

The Black Range is important because it is close to Albury and grazing has been restricted, particularly near Nail Can Hill where various species of wildflowers are abundant. The vegetation association found on the range is dry sclerophyll forest in which red stringybark, apple box and red box are common. The ground flora is mostly tussock grasses with kangaroo grass, wallaby grass and scattered shrubs. Little is known about the fauna but it is a breeding area for both the turquoise parrot and peregrine falcon.

Population

At the 1971 Census the population of the Albury-Wodonga urban area was 37,900. Results of the 1976 Census indicate a combined population for the urban area of 45,600 with 32,000 living in Albury and 13,600 in Wodonga, representing an annual growth rate of 3.8% per annum.(1) This growth rate has been maintained since the 1966 Census while surrounding towns such as Beechworth and Holbrook have been declining in population by about 2% per annum. The rural population generally has remained static during this period.

Urban Development

Albury-Wodonga Growth Centre

In January, 1973, the Commonwealth, Victorian and New South Wales Governments agreed that the Albury-Wodonga area should be nominated for accelerated growth and in October, 1973, the Albury-Wodonga Development Corporation (AWDC) was formed to plan and implement that growth. The AWDC became responsible for planning and development within the designated area shown in Figure 3.1. Since its inception the AWDC has produced a number of plans for development adjacent to the existing urban area. The two major proposed development areas are Thurgoona, east of Lavington and Barunduda, south of Wodonga (Figure 3.1). At June, 1977, prior to a major reduction in funding levels, the proposal was to develop the Victorian area (Baranduda) first followed by Thurgoona at a later date. The AWDC estimates that eventually up to 12,000 additional people would be accommodated by development within the existing urban area with up to 30,000 in each of Thurgoona and Baranduda.

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(1) Populations for the Local Government Areas were 32,900 in Albury and 15,700 in Wodonga.

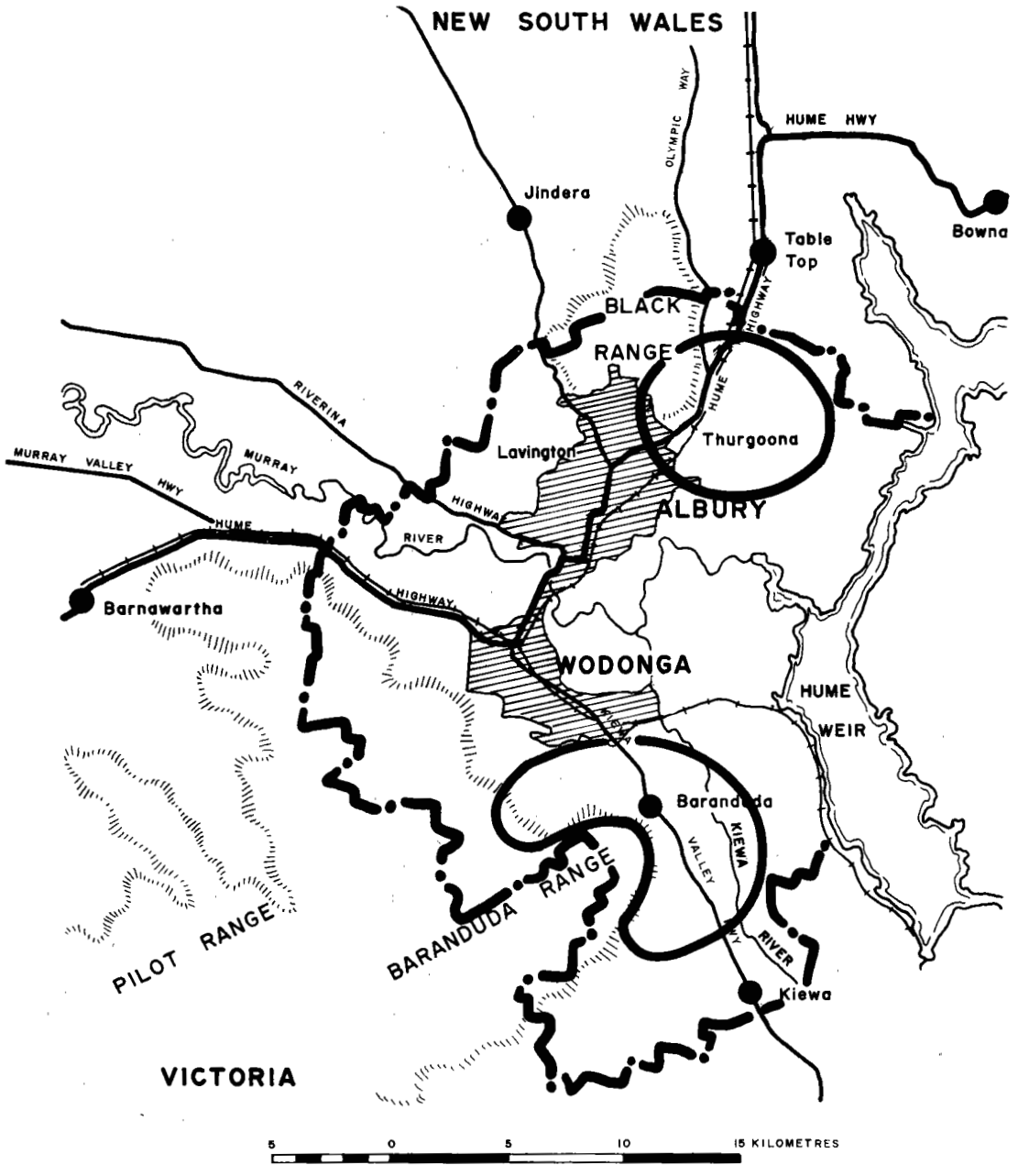

FIGURE 3.1 PROPOSED URBAN DEVELOPMENT

The AWDC has a target population of 96,000 persons by 1985 - an average growth rate of approximately 9% per annum. This growth depends on a continuing high level of support by governments, including the relocation of section of the public service in Albury-Wodonga. A lower population of 72,000 persons by 1985 (equivalent to an annual growth rate of 5.3% per annum) has also been evaluated in this study as a reflection of the possible restriction of growth centre funds in the immediate future[1].

Economic Activity

Albury-Wodonga services a hinterland noted for consistent production of commodities such as wool and wheat and more recently for beef. Its early prominence as a railhead and river port has given way to a city with growth in light industrial activities, such as the manufacture of wood and metal products and paper.

Existing Transport Sytem

National Highways

Albury-Wodonga lies on the Hume Highway which is the declared National Highway linking Sydney with Melbourne. North of Albury, the Hume Highway consists of two lanes, except for isolated sections approaching East Lavington where the existing carriageway has been duplicated. Characteristics of the Hume Highway within the built up area are shown in Figure 3.2, indicating those sections of the existing highway where four traffic lanes are provided, either divided or undivided. Although the Hume within Albury is generally a single carriageway some sections are sealed to a greater width than two lanes.

The Murray River flood plain is crossed via bridges over the Murray River and an anabranch in New South Wales and thence via the divided four lane Lincoln Causeway in Victoria. This crossing is almost 3 km long and has a total of 6 bridges involving almost 600 metres of structures. The bridges at the New South Wales end of the Causeway consist of four (undivided) lanes but south of the State border and the fruit fly inspection station the highway is divided.

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(1) In 1977, after completion of the study, the funding level was markedly reduced from the levels of previous years.

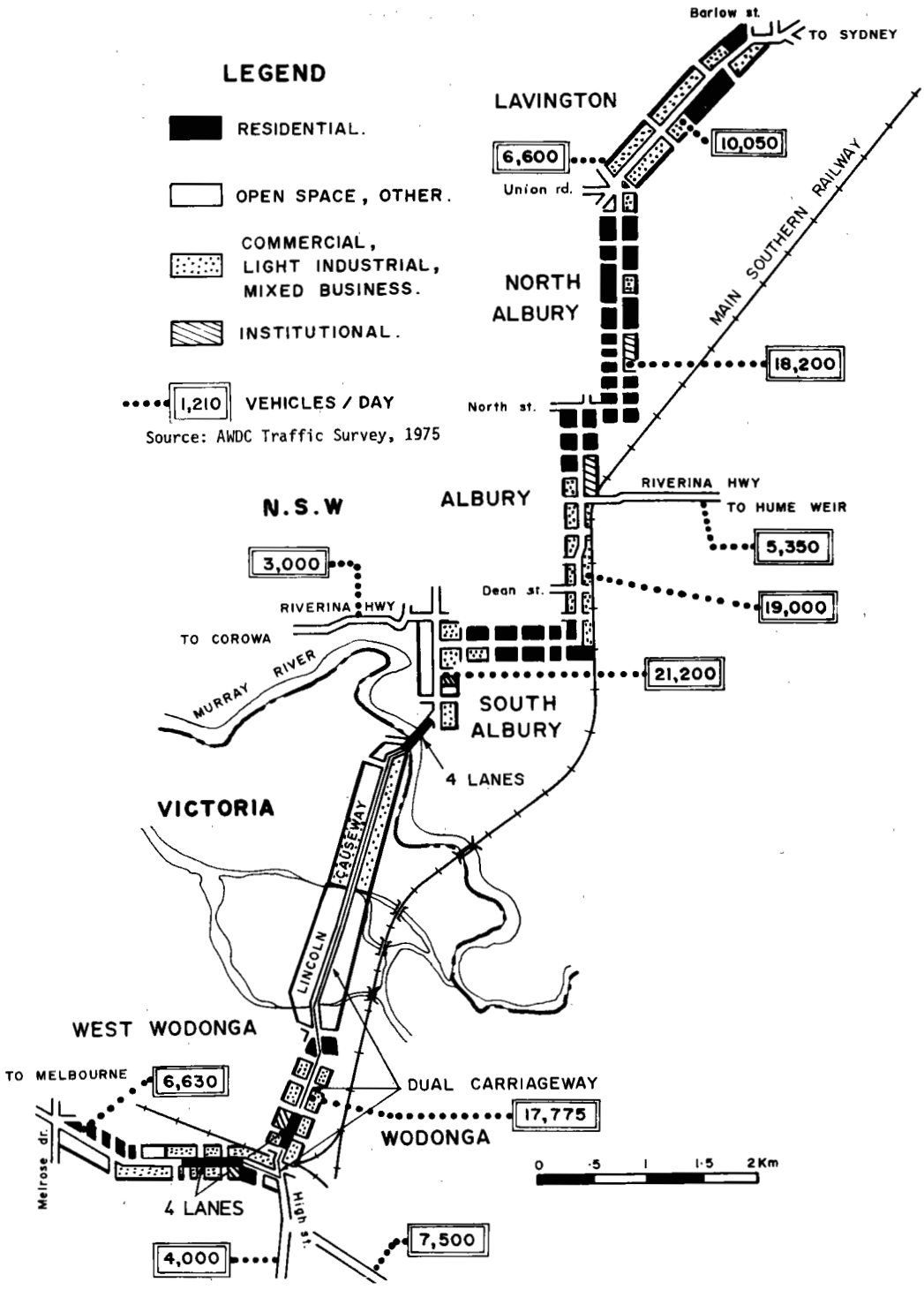

FIGURE 3.2 HUME HIGHWAY TRAFFIC AND LAND USE

In Wodonga, sections of the highway through the shopping centre are divided by a narrow median. The Highway crosses the Melbourne-Sydney railway at grade, turns west and then reverts to two lanes near the edge of the built up area.

Other Roads

The Murray River and its wide plain have significantly influenced road development in the Albury-Wodonga area. The nearest river crossings to the Lincoln Causeway, are 10km to the east (on the wall of the Hume Weir[1]) and 28km west at Howlong. The infrequent river crossings are connected by highways parallel to the Murray River. The Riverina Highway along the northern side extends into the south west of New South Wales while in Victoria the Murray Valley Highway follows the Murray from Corryong 100km to the east to Mildura 500km to the west.

Other major roads focussing on Albury-Wodonga are the Kiewa Valley Highway which extends south to the Victorian Alps and the Olympic Way which branches off the Hume Highway 11km north of Albury and continues north through Wagga Wagga to central New South Wales.

Although there is no fixed date for the commencement of the work, for several years DMR have planned an Albury Relief Route[2] and have acquired many properties along the route. The CRB have similar plans for a Wodonga Bypass. Both these proposals have the support, in principle, of AWDC and local councils. The Lavington and Wodonga Bypasses are described and evaluated in Chapters 6 to 10.

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(1) Heavy traffic is normally excluded from this crossing.

(2) Comprising the Lavington Bypass and a central relief route.

Railways

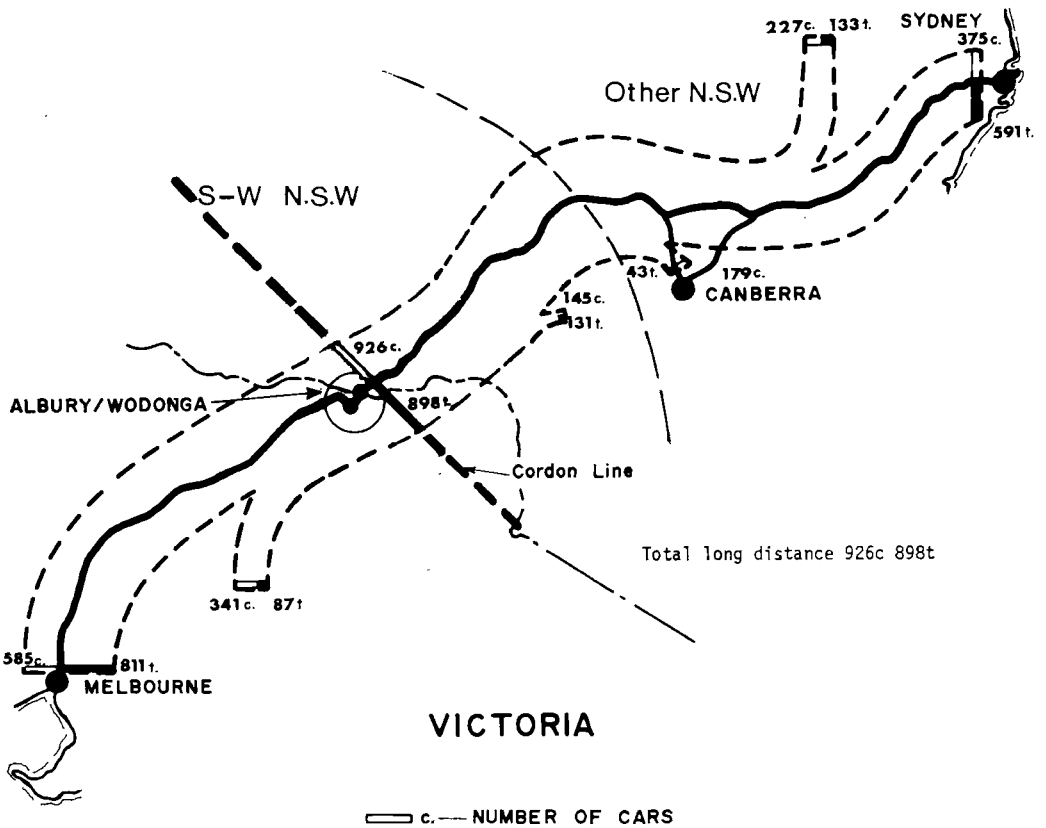
The Melbourne-Sydney railway passes through Albury-Wodonga. Before the standard gauge line between Albury and Melbourne was opened in 1961, rail freight and passengers were transhipped in Albury and the city's early development was influenced by the location of the railway line and associated facilities. Albury-Wodonga remains an important regional rail centre but since the opening of the standard gauge line the railway has not been as important to the development of Albury-Wodonga.

Road Travel Characteristics

Figure 3.2 shows the average weekday traffic on major roads in Albury-Wodonga. A large amount of this traffic can be directly linked with the development which has traditionally been clustered about the Hume Highway. East of the railway in Albury, there is less development, reflected in the low traffic volumes. The traffic volume on the Lincoln Causeway between Wodonga and Albury is four times that on the Hume Highway near the outskirts of the urban area. 30% of traffic on the Hume Highway at the edge of the urban area is trucks but on the Lincoln Causeway this proportion is about 10% as local traffic contains a much smaller component of heavy commercial vehicles than does external traffic.

Traffic volumes on the Hume Highway drop sharply outside the Albury-Wodonga urban boundary. In 1975 the daily volume north of Albury was estimated at 3600 vehicles/day of which nearly 40% were heavy vehicles. South of Wodonga the estimated 1975 daily volume was 4800 vehicles/day, of which about 30% were heavy vehicles.

The origins and destination of long-distance traffic passing through Albury-Wodonga are shown on Figure 3.3. Approximately 1800 long distance vehicles pass through Albury-Wodonga daily. 50% of these are freight vehicles (mostly semi-trailers). Some 45% of the total through traffic is between Sydney and Melbourne. Detailed figures are given in Table 3.1.



Source: DMR, Bureau of Roads Roadside interview survey, 1974

FIGURE 3.3 REGIONAL TRIP ENDS OF TRAFFIC PASSING THROUGH ALBURY-WODONGA ON HUME HIGHWAY

TABLE 3.1 - VEHICLE TRIPS ON THE HUME HIGHWAY NORTH OF ALBURY-WODONGA

Between[1]	Sydney	Canberra/ Queanbeyan	SW NSW	Other NSW	Total
Cars					
Melbourne	239	117	87	142	585
Other	136	62	58	85	341
Trucks[2]					
Melbourne	554	34	99	124	811
Other	37	9	32	9	87
Total	966	222	276	360	1824

Notes: (1) Zones illustrated in Figure 4.

(2) Vehicles having 2 axles with dual rear tyres and those having 3 or more axles.

Source: DMR, Bureau of Roads Roadside Interview Survey, 1974.

CHAPTER 4 - THE DEVELOPMENT OF THE ALBURY-WODONGA INTERNAL ROAD SYSTEM

For some years Albury-Wodonga has experienced rapid population growth and, as a result, internal traffic has increased at a high rate. Pressures have built up on the existing road system and plans have been developed to improve and extend it. This chapter discusses aspects of the development of the Albury-Wodonga road system that are relevant to this study.

A simple traffic model of Albury-Wodonga was used to help assess the likely development of the internal road system[1] The model is described in detail in Annex A. It consists of five zones, representing the existing development centres of Albury, Wodonga and Lavington, and the proposed development centres of Baranduda and Thurgoona (see Figure 4.1).

Projected Urban Development

Table 4.1 gives the existing and projected 1985 and 2000 populations by zone. As Thurgoona and Baranduda become more fully developed (at about 1990 on the high growth forecast and 1995 on the medium growth forecast) further areas will have to be developed. For simplicity it is assumed that the most favoured locations are extensions of Baranduda to the south or east, and extensions of Thurgoona to the north.

Two 1985 population forecasts have been used in the study; the high forecast reflects the AWDC 1985 target population of 96,000 whilst the medium forecast represents a slower growth resulting from a reduction in the rate of government funding.[2]

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(1) AWDC have currently commissioned PG Pak Poy & Associates to develop a detailed model of Albury-Wodonga. The output from this work was not available for this report.

(2) Since the study was completed, such a reduction has occurred. As yet, however, the implications of this on the rate of development have not been fully assessed.

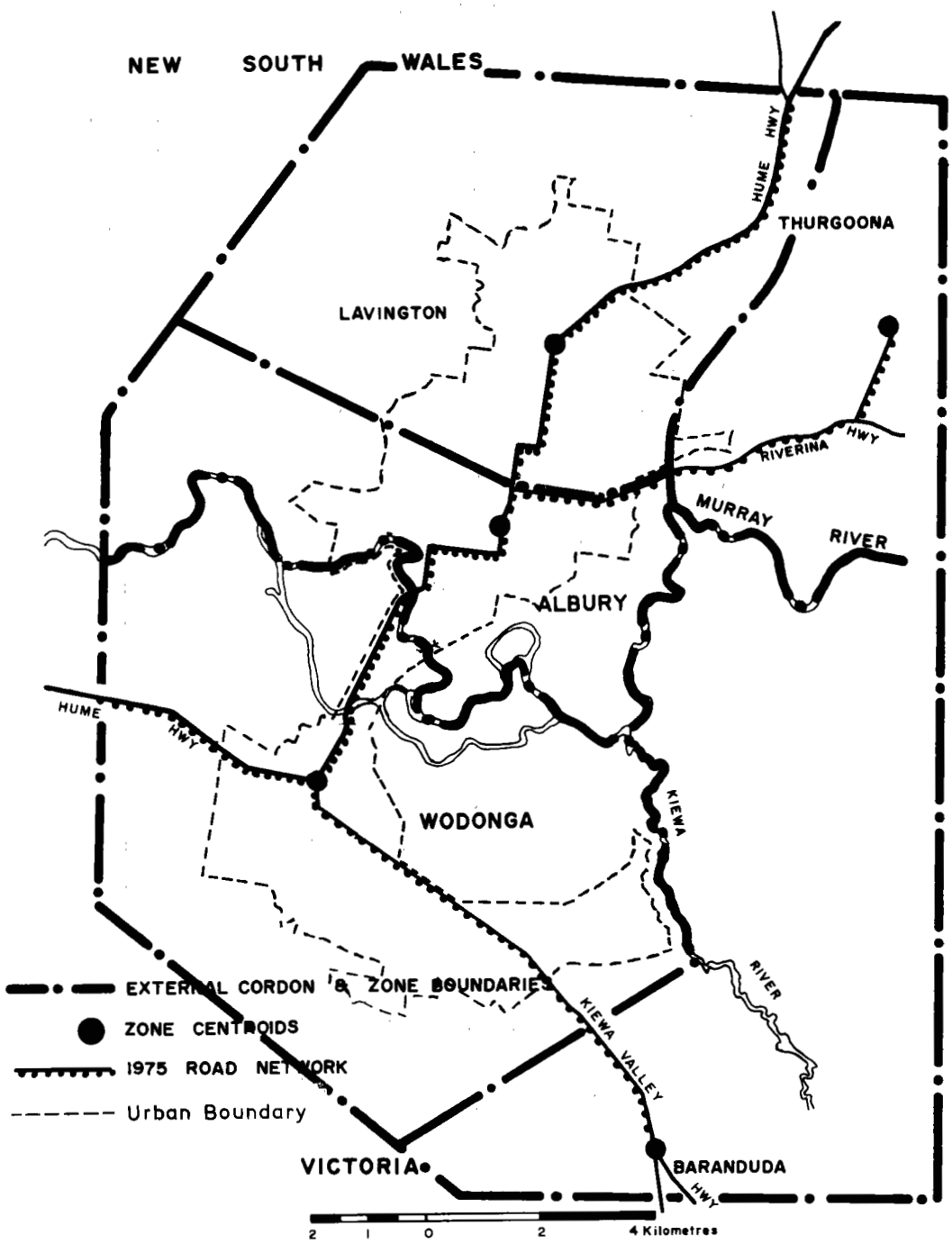

FIGURE 4.1 ROAD NETWORK AND ZONES in 1975 AS USED IN TRAFFIC MODEL

TABLE 4.1 - POPULATION BY ZONE 1974-2000

Zone[1]	Population ('000)			
	1974[2]	1985[3]		2000[3]
		Medium	High	
Lavington	16	22	22	33
Albury	14	14	12	14
Wodonga	12	18	18	33
Baranduda	-	18	30	75
Thurgoona	-	-	12	55
Total	42	72	96	210

Notes: (1) Refer to Figure 4.1.
(2) ABS population count.
(3) Source: Bureau estimates.

The distribution of employment is also important in determining broad travel patterns. AWDC propose to develop the new areas so as to provide, in the long term, a balanced distribution of jobs and services. Hence the present balance of jobs and services is assumed to continue into the future.

Traffic Forecasts

In 1975, 23000 vpd crossed the Lincoln Causeway. About 16000 of these were estimated to have been travelling from Wodonga to Albury and Lavington. Based on this figure, and on work carried out within the Bureau on intertown travel, cross-river flows for 1985 and 2000 were estimated as shown in Table 4.2 (the flow from Lavington to Albury is not included in this analysis). Details of the estimation procedures used are given in Annex A.

TABLE 4.2 - FORECAST CROSS-RIVER TRAFFIC FLOWS 1985-2000

Trips between zones ('000 vehicles/day)	1985		2000
	Medium	High	
Albury-Wodonga	27	31	87
Lavington-Wodonga	7	7	16
Thurgoona-Wodonga	-	2	11
Albury-Baranduda	7	10	34
Lavington-Baranduda	3	4	10
Thurgoona-Baranduda	-	2	18
External traffic(1)	12	12	25
Total cross-river	56	68	201

(1) Entering and leaving Albury Wodonga by all routes. Includes terminating traffic.

The estimates in Table 4.2 assume that the necessary road capacity would be provided to accommodate them and are based on the networks of Figure A.1. (A third river crossing has been provided by 2000, between Baranduda and Thurgoona). The 2000 estimates must be regarded as tentative; they are sensitive to the internal distribution of population (particularly in Wodonga, the town closest to the river crossings), and are also based on a vehicle ownership level of 0.80 vehicles per person. A lower assumed ownership level would reduce the traffic estimates in direct proportion.

Future road network

River Crossings

The capacity of the Lincoln Causeway is around 45000 vehicles/day.(1) Traffic will reach this level in the early 1980's and a new river crossing will be required regardless of whether or not an external bypass is built. (See Table 4.2). The demand for river crossings to and from the Wodonga region is dominant until the 1990's but the demand from the Baranduda area, including external trips, is also significant (about 10000-16000 trips daily in 1985, depending on the pace of development). Any new crossing should also service this demand.

(a) The causeway's capacity is currently limited by the NSW approaches, and some improvements would be necessary in order to attain this figure.

The demand for river crossings from the Baranduda area will increase through the 1990's and the total demand is such that a third river crossing could be required towards the end of the period. If it were built some distance to the east of the Lincoln Causeway it would attract the traffic between Baranduda and Thurgoona/Lavington. However, the timing and location of a third crossing are very tentative. It is very unlikely that a third crossing would ever carry a significant amount of National Highway traffic.

Other Corridors

By 1990 there would be a substantial volume of internal traffic wishing to travel north-south through the centre of Albury (see Table 4.2). This corridor would be used by traffic between Hume Highway North, Thurgoona and Lavington and Wodonga, Baranduda and Hume Highway South. Estimates of these flows in 1985 and 2000 are set out in Table 4.3.

TABLE 4.3 - FORECAST DAILY TRAFFIC IN ALBURY CENTRAL CORRIDOR 1985-2000(1)

Year	Between	Hume Highway (north)	Thurgoona(3)	Lavington
1985	Hume Highway (south)	2000	0	1000
	Wodonga	-(2)	0	7000
	Baranduda	-(2)	0	3000
2000	Hume Highway (south)	5000	2000	1000
	Wodonga	1000	11000	1600
	Baranduda(4)	0	0	0

Notes: (1) Assuming medium population forecast of Table 4.1.

(2) Less than 1000.

(3) Thurgoona not developed by 1985.

(4) Diverts to direct Thurgoona-Baranduda route when third crossing provided.

Table 4.3 shows that the internal through traffic increases from the present level of about 3000 vehicles/day (estimated in Table A.1) to 13000 vehicles/day in 1985 and 3600 vehicles/day in 2000. Existing routes through Albury will be inadequate to cater for this traffic by the early 1990's and additional road capacity will be required for through traffic between the Riverina Highway and the Murray River crossings.

Summary

Assuming that the pace of development in Albury-Wodonga is maintained:

(i) by the mid 1980's there will be a need for additional cross-river capacity, located approximately along the Albury-Wodonga axis;

(ii) by 2000 there may be a need for a third river crossing, located along the Baranduda-Thurgoona axis; and

(iii) by the mid 1990's additional capacity will be required for through traffic bypassing the centre of Albury.

If Albury-Wodonga were instead to grow at its long-term historic rate, these needs will be much delayed. Additional river crossing capacity will not be required until the early 1990's and additional capacity bypassing the centre of Albury will not be needed until towards the turn of the century. The accelerated development of Albury-Wodonga is advancing the need for additional capacity along the existing Hume corridor by at least seven to ten years. The following chapter considers alternative methods of funding the provision of this extra capacity.

CHAPTER 5 - THE FUNDING OF NEW ROAD CONSTRUCTION IN THE ALBURY-WODONGA URBAN AREA[1]

Chapter 4 demonstrated that the accelerated development of the Albury-Wodonga growth centre will result in the need for additional road capacity crossing the Murray River and bypassing the town centre some seven to ten years before it would otherwise have been required. This chapter discusses the alternatives open for funding this additional capacity.

There are three principal alternatives[2] for funding new road capacity within the Albury-Wodonga urban area:

(i) National Highways funds;

(ii) Urban arterial funds; and

(iii) Growth centre development funds.

When the National Highway System was declared, National Highways terminated as they approached the built-up area of a capital city, or major provincial city. The reason for this was first stated in the Bureau of Roads' 1973 Report on Roads in Australia and restated in paragraph 8.28 of the 1975 Report on Roads in Australia:

> "When traffic travelling on a National Highway is proceeding to a destination within a capital or major provincial city, it may wish to take one of the many routes within the built-up area of the city. It is considered that in the initial stage of a National Highways System the routes should terminate near the boundary of the built-up area of these cities. However, the system should provide at some stage for the bypassing of many built up areas".

This view was accepted by the Commonwealth Government.

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(1) For this report urban area is defined as the contiguous built-up area as used by the ABS. It should not be confused with 'urban area' as used for roads grants purposes.

(2) A fourth alternative, rural arterial funds, is not consistent with the concept of a National Highway system.

Although not explicitly stated at that time, an associated reason for such end points is that local urban traffic benefits most from any new construction works even where National Highway traffic is concentrated on a single major route. The need for new construction is usually a result of demand from local urban traffic. As National Highways funds are primarily intended to promote the objectives of a National Highways system rather than to benefit urban traffic (for whom urban arterial funds are available) it was considered that National Highways should terminate at the first major intersection inside the urban area of major urban centres.

Thus, at present, the declared National Highways terminate at or near the built-up boundaries of the following cities in addition to the State capitals: Launceston, Newcastle, Rockhampton, Townsville, Toowoomba and Ballarat. All of these cities are specified as urban areas for the purposes of roads legislation. (A population of 40,000 has been used in past years as a defacto definition).

When the Hume Highway was declared a National Highway in 1974, Albury-Wodonga was still regarded as a 'rural area' for purposes of road legislation. Accordingly the whole length of the Hume Highway in Albury-Wodonga was declared a National Highway. However, since that time the population of the Albury-Wodonga urban area has passed 40000 (the June 1976 Census estimate is 45600 for the urban area as defined by the Australian Bureau of Statistics), and the Bureau of Roads in its 1975 Report on Roads in Australia recommended that (recommendation 61, p. 9):

> "Albury-Wodonga be included as an 'urban area' for purposes of future legislation as the population is close to 40000".

The Bureau did not recommend particular urban area boundaries for Albury-Wodonga. However, for the purposes of this study, the study team used the ABS defined urban area as depicted in all Figures. The Wodonga and Lavington Bypasses commence outside this defined area and end at the first major intersection within the area.

The implication of the Bureau's recommendation is that no road construction totally within the urban area should be financed from the National Highways funds. Specifically, in this study projects such as the second Murray River crossing and the Albury Centre Bypass which are within the urban area and which mainly benefit local urban traffic should be funded from other sources.

This broad principle is supported by the traffic forecasts prepared for this study. These indicate that, for practical purposes, under 10% of the traffic crossing the Murray River and 25% of the potential users of an Albury Centre Bypass could be classed as National Highways traffic,(1) and less than 5% and 15% respectively would be through traffic. These proportions would be approximately halved during peak periods. In addition, were it not for the anticipated accelerated urban development in Albury-Wodonga, the existing facilities would be adequate for probably fifteen to twenty years, rather than eight to ten years.

It might be argued that because Albury and Wodonga are in different States they would become two urban areas for roads grants purposes, and that their inclusion as urban areas should therefore wait until their individual populations reach 40000. However, Table 4.1 shows that this too would have occurred by the time the additional capacity noted in (i) above would be required.

The question of whether urban arterial funds or development funds should finance the construction is not considered in this report.

Given that Albury-Wodonga is not declared an urban area for road funding purposes in line with the Bureau of Roads recommendation, the funding of an internal bypass, (including the Albury Centre Bypass and the second Murray River crossing) could be funded from National Highway funds.

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(1) Traffic which has entered Albury-Wodonga via the Hume Highway. See Tables 3.2 and 4.3.

CHAPTER 6 - GENERATION AND DESCRIPTION OF ROUTE OPTIONS

This chapter generates route options for a bypass of Albury-Wodonga. They fall into two broad groups:

(i) those utilising part of the internal road network of Albury-Wodonga (Alternative 1); and

(ii) those completely external to the urban area (Alternatives 2, 3, 3a).

Following the conclusions of Chapter 5, this chapter does not consider those segments of the first group that are wholly within the urban area.

The main constraints on route development are listed below:

(i) The Murray River and its wide flood plain pose a major problem for any alternative. Because of the high cost of bridging, alternatives were generated which keep bridge and causeway construction to a minimum. These alternatives also have the least environmental impact on the flood plain.

(ii) Lake Hume limits options to the east of Albury Wodonga.

(iii) The urban area of Albury-Wodonga has developed northwards to the base of the Black Range. Although this range is only 200m above the plain, it is steep and well forested. A route located near this range would pose engineering difficulties and have severe environmental impact. Beyond the Black Range are undulating plains where routes which reduce distances can also be located.

Although the ultimate standard for the Melbourne to Sydney National Highway is a four lane divided freeway with a formation width of 11.6m for each carriageway[1], several opportunities exist for stage construction. The reduction in initial cost brought about by stage construction can improve the viability of an alternative and also permit location of an alternative in an alignment which would otherwise prove too costly.

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(1) Design Standards for National Highway between Sydney and Melbourne, Document NH DS 1 1976. Department of Transport, Canberra.

DESCRIPTION OF ALTERNATIVES

Internal Bypass

Alternative 1

The nature and pattern of development of Albury-Wodonga limits major improvements that can be made to the existing Hume Highway. The DMR and the CRB have developed plans for diverting traffic from the Highway in the built-up areas of Albury and Wodonga respectively. The DMR plans involve the construction of a Traffic Relief Route bypassing Lavington and Albury to the east while the CRB propose a bypass north of Wodonga. The locations of these proposals are shown in Figure 6.1.

The DMR proposal consists of two continuous bypasses:

(i) A Lavington Bypass, providing an alternative to the Hume Highway between Gerogery Road, East Lavington and the Riverina Highway in Albury; and

(ii) An Albury Centre Bypass, providing an alternative to the Hume Highway between the Riverina Highway and the bridge across the Murray River. This proposal would also require the improvement of some arterial roads in South Albury to divert local trips from the Hume Highway.

The CRB proposal, connecting to the southern end of the Lincoln Causeway, bypasses the centre of Wodonga, and the High Street railway level crossing.

Initially the Lavington Bypass would be constructed as a two lane urban arterial road with some access control and at-grade intersections with ultimate development to a four-lane dual carriageway urban freeway. The route leaves the existing highway near the Borg-Warner factory and follows a line due south, along an existing road reservation, as far as the main Albury-Sydney rail line. After crossing the rail line by an overbridge, it runs parallel to it until the Riverina Highway. No interchanges are planned along this route.

The proposed Albury Centre bypass would lie wholly within the urban area and is not considered further in this report.

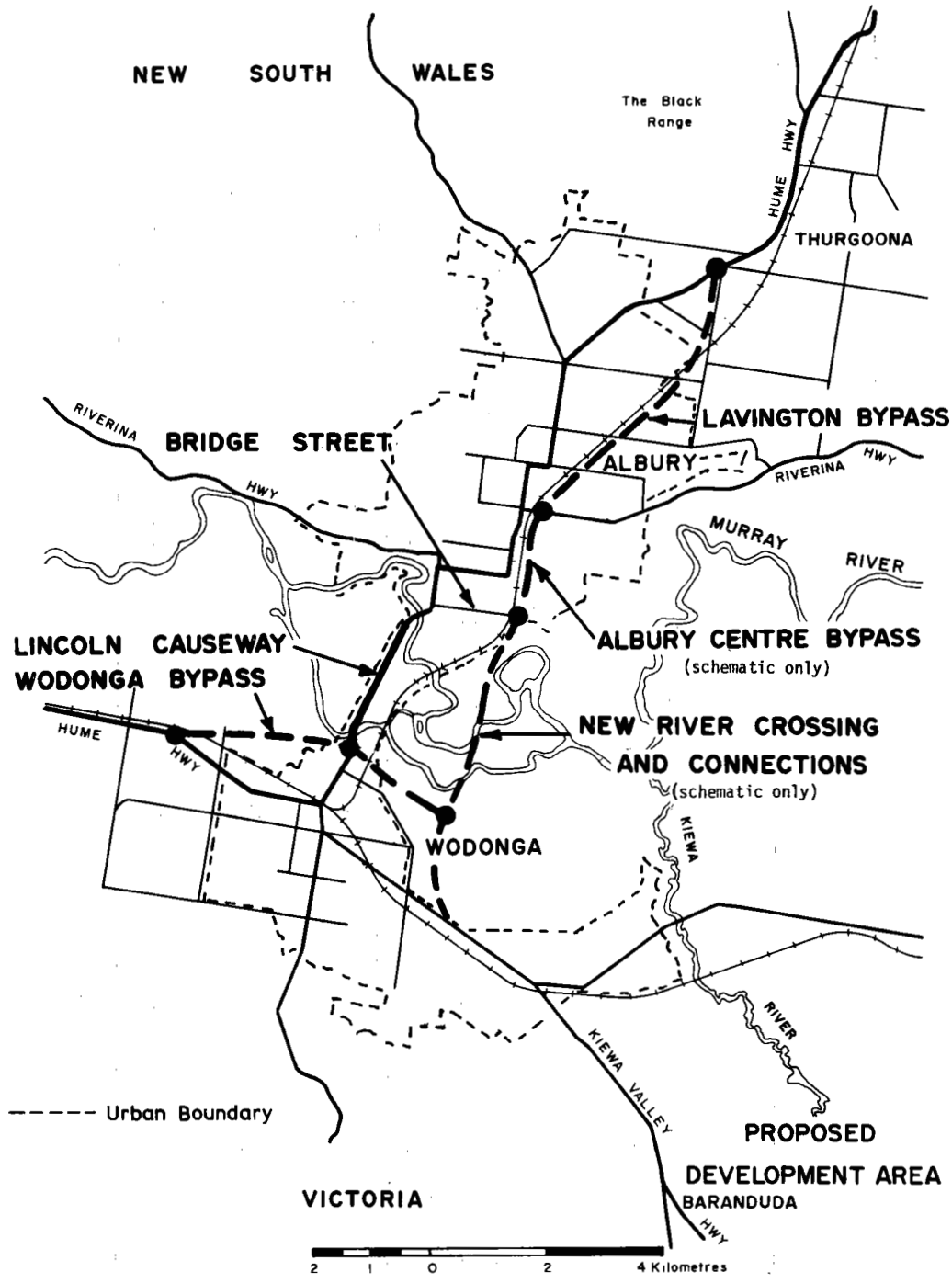

FIGURE 6.1 ROUTE OPTIONS WITHIN ALBURY-WODONGA

The Wodonga Bypass is planned to be constructed as a two carriageway four-lane facility, representing the first stage of an eventual six-lane expressway. It leaves the existing Hume Highway before its entry into urban Wodonga, crosses the rail line by an overpass and rejoins the existing route at the beginning of the Lincoln Causeway.

External Bypasses

In constrast to the route through Albury-Wodonga, the whole length of the external bypass alternatives are distinct routes on new alignments (see Figure 6.2). All the bypass alternatives divert from the existing Hume Highway south of Bowna Creek in New South Wales (18km north of Albury) and join the Hume Highway north of Barnawartha in Victoria (16km south of Wodonga). These end points are used for comparison of the alternative routes. Three alternatives bypassing Albury-Wodonga to the west were considered.

Routes east of Albury-Wodonga would be much longer than the existing highway and extremely costly to build because of the difficulties involved in constructing bridges in unfavourable terrain. There would be considerable environmental impact in return for no travel time improvement. A bypass located on the western fringe of Albury Wodonga is impractical because development has extended as far as the base of the Black Range, and road construction through these hills would be much more costly than construction in the surrounding undulating plains. These options were not investigated further.

It was assumed that the routes would be constructed as a two-lane single carriageway road with full access control which could later be upgraded to a four-lane dual-carriageway National Highway. The crossing of the Murray would be a bridge constructed as one carriageway of a dual carriageway structure designed to National Highway Design Standards.

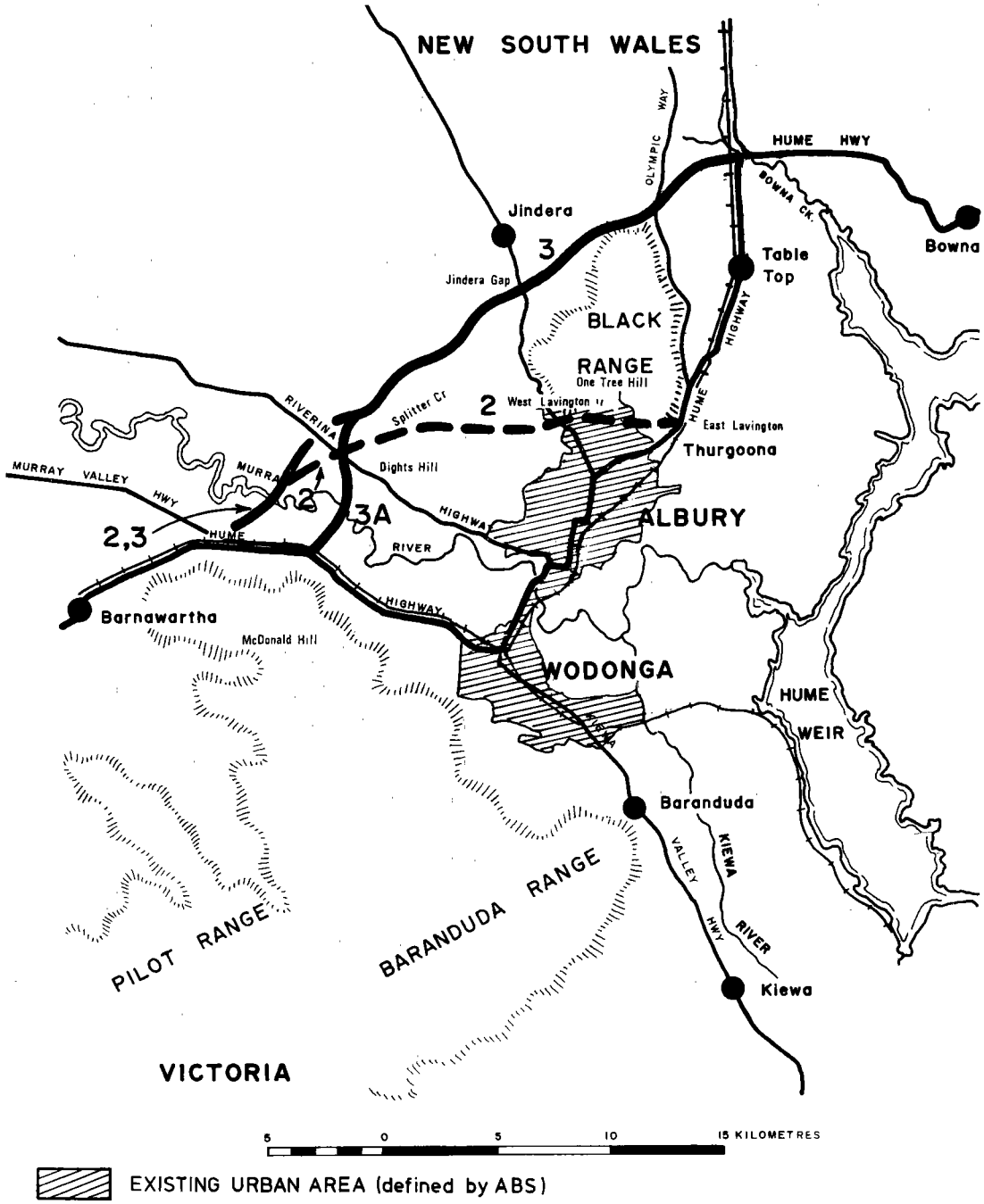

FIGURE 6.2 EXTERNAL ROUTE ALTERNATIVES

Alternative 2

This option joins the Hume just north of the urban area, minimising new road construction but still bypassing Albury-Wodonga. This alternative is located north of Lavington and would pass south of the Black Range, replacing the existing Hume Highway between (approximately) Kaitlers Road, East Lavington and Barnawartha North. The route would cross the Murray River, and the 5km wide flood plain, at the same point as alternative 3.

Alternative 3

This route maximizes distance savings and approximates the straight line joining Barnawartha and Table Top. The route would cross the Murray at the same place as Alternative 2 but would pass to the north of the Black Range.

Alternative 3a

Alternative 3 was modified to take advantage of a natural constriction in the Murray flood plain near Dights Hill where it is 2km wide. The routing of Alternative 3a through this constriction of the plain would reduce bridge costs and also reduce the length of new roadworks. However, the total route would be slightly longer than Alternative 3. Alternative 3a leaves the Hume at the Murray Valley Highway junction, crosses the Murray near Dights Hill and joins the route of Alternative 3 about 2km north of the Riverina Highway.

Timing and Development

There are several options for the timing of construction. The external options would have to be built as one stage because of the relative isolation of the routes but the Wodonga and Lavington bypasses would be built independently of other road construction.

Two alternative cases for the timing of the external bypass have been considered, depending on whether or not Alternative 1 (the internal bypass) is constructed first. The case for constructing Alternative 1 after the external bypass has been built has not been evaluated as it would then be funded as either an urban or rural arterial.

The internal bypass is considered in two sections:

(i) The Lavington Bypass; and

(ii) The Wodonga Bypass.

As explained in Chapter 5, it is assumed that sufficient cross-river and central town road capacity is provided independently as part of the urban development of Albury-Wodonga and that this would roughly follow the alignments shown in Figure 6.1 for the Albury Centre Bypass and the new River crossing and connections.

CHAPTER 7 - SOCIAL AND ENVIRONMENTAL IMPACT OF ALTERNATIVES

This and succeeding chapters evaluate the alternatives described in Chapter 6. The following impacts are assessed:

(i) social and environmental (Chapter 7);

(ii) engineering (including construction cost) (Chapter 9); and

(iii) road user (Chapter 9).

These are then combined in an overall evaluation (Chapter 10).

As the alternatives are not all at the same stage of planning their analysis differs in detail and is deliberately not exhaustive. Nevertheless the key factors which contribute to the social and environmental impact of each alternative and allow them to be compared are discussed.

In urban areas these factors are:

(i) the number of housing acquisitions required for each route. This reflects the disruptive effect of road construction on traditional residential areas;

(ii) the area of public park lands required for each route. This is most important in areas where alternative recreational facilities may be in short supply or where existing development may prevent their establishment;

(iii) severance of links between existing residential areas and activity centres. This is a subjective assessment of the divisive effect of new and existing roads and streets; and

(iv) the number of houses exposed to high noise levels on each route. This is an index of the effects of traffic on the adjacent population. 60 dbA has been assumed as the maximum outside noise level acceptable in residential areas. UK studies suggest that noise from the average motorway has reduced to 60 dbA by 200m from the road verge.

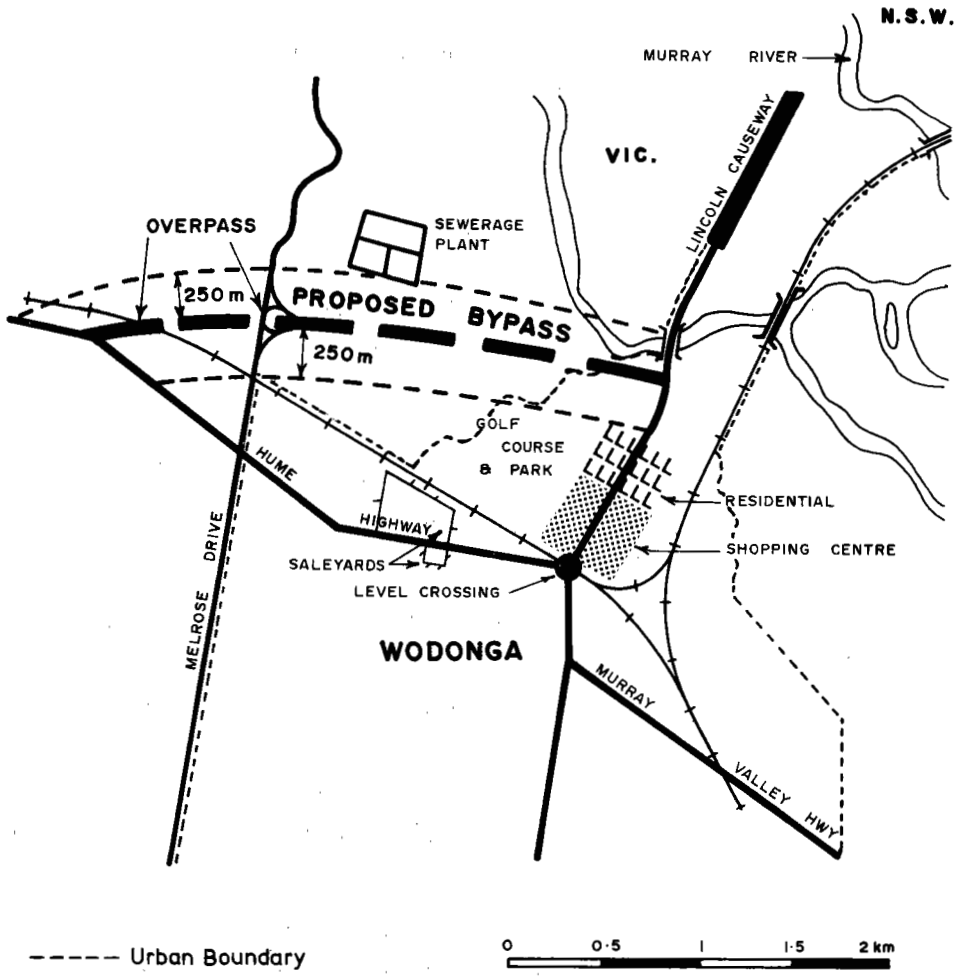

FIGURE 7.1 WODONGA BYPASS

In rural areas the factors include:

(i) the nature of the terrain and any alterations to drainage patterns that would result;

(ii) the conservation or otherwise of areas where the natural ecosystem is relatively undisturbed;

(iii) severance of farm properties and interference with access to land;

(iv) effects on flora and fauna;

(v) interference with aboriginal sites;

(vi) visual impact; and

(vii) impact on development patterns.

In addition, the alternative river crossings should also be assessed in terms of:

(i) interference with flood waters;

(ii) stability of foundations; and

(iii) effects on the spread of insect pests.

Wodonga Bypass

The Wodonga Bypass is a new route which would not coincide with any existing roads. Most of the route is through grazing land adjacent to the Murray River flood plain (see Figure 7.1). Some of this land, an old flood terrace slightly elevated above the present flood plain, is likely to be rezoned for industrial development in West Wodonga. No significant natural areas would be directly affected but two houses would have to be demolished to make way for the route. There are homes as close as 100m to the centreline and altogether 15 homes would be within 250m. These homes are all south of the route and although noise could be a problem social severance is not an issue.

Immediately west of the Lincoln Causeway the route would cross Wodonga Golf Course for almost 1km. About 5ha of the course would be affected and arrangements are believed to have been made for the Golf Course to be re-established elsewhere in the Albury-Wodonga area. If this results in the small public park adjacent to the lagoon and Golf Course being enlarged it

would benefit nearby residents and others. There is insufficient data on recreation in local parks in Wodonga to estimate the disbenefits due to location of the Wodonga Bypass adjacent to remaining (and possibly future expanded) parklands in Wodonga. Even though the park is located in a hollow around an attractive lagoon the present noise environment of the park is poor because of the proximity of the Hume Highway. Particular attention should be given to the design in this area to minimise noise in the park and nearby homes.

Lavington Bypass

The Lavington Bypass (Figure 7.2) is 5.5km long. 2.6km coincides with existing roads while the remainder is a new reservation. Most of the route is located east of the Main Southern Railway, and passes through substantially undeveloped land of which about 50% is currently used for pastoral purposes and a further 15% is public parkland. It is essentially outside the built-up area.

The nearest homes to the new route would be 80 metres away. Altogether some 50 homes would be within 250m of the route. East of the Main Southern Railway, part of the racecourse reserve and a large part of Alexandra Park lie within 250 metres of the route. West of the railway are Aquinas College, Albury Grammar School and the Albury Trotting Ground. Alexandra Park is likely to be developed for sportsfields and together with the trotting ground and the racecourse is not considered particularly noise sensitive. The school and college buildings are generally as close to the existing Hume Highway as they would be to the new route but in the school grounds noticeable increases in traffic noise could occur.

Access across the new route and the existing railway would remain substantially as it is now, as overpasses are planned at a number of locations. No crossings are planned at Racecourse Road, North Albury and Vickers Street, East Lavington. There is little development each of the route and few pedestrians and cyclists would be inconvenienced although this situation might change with future development.

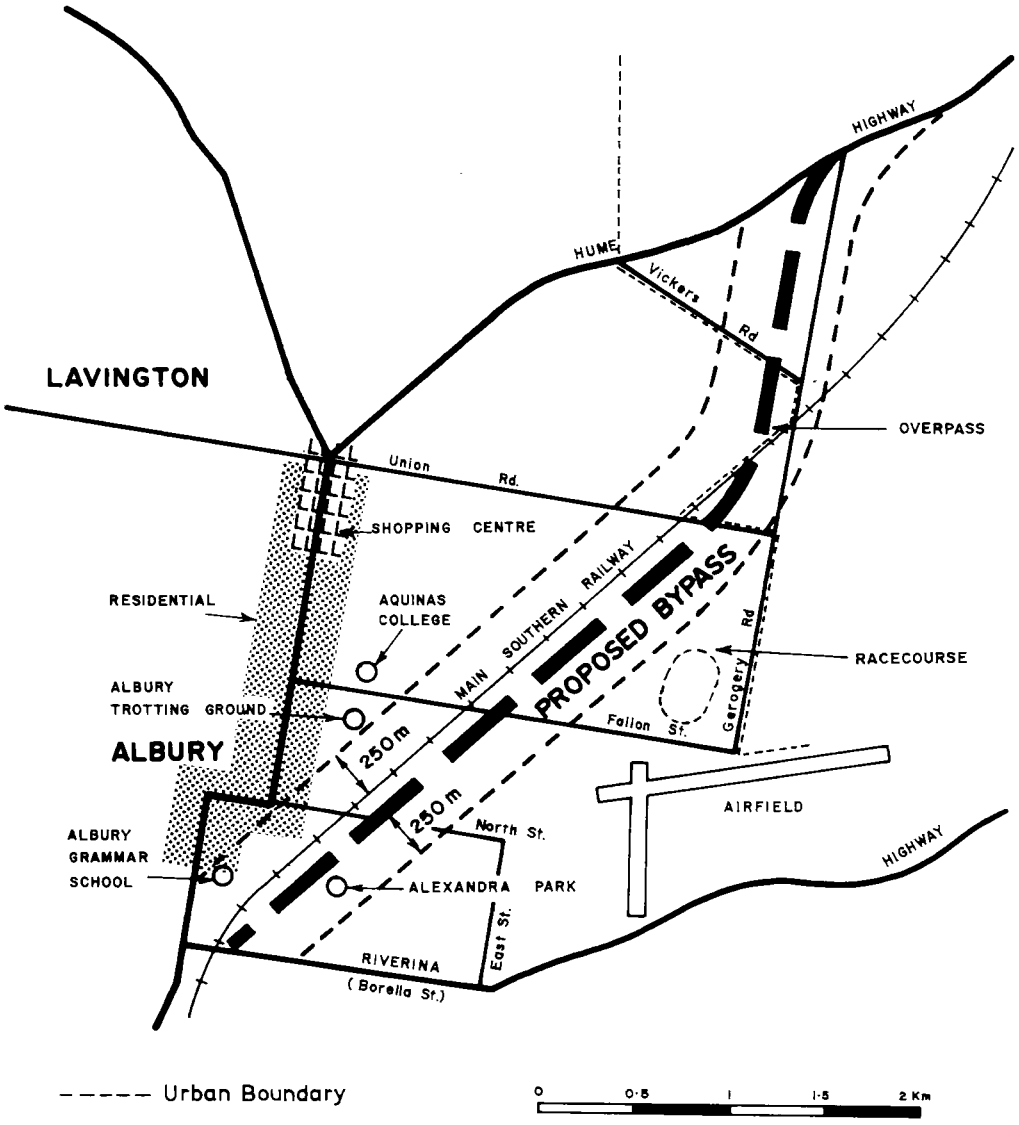

FIGURE 7.2 LAVINGTON BYPASS

Alternative 2

Alternative 2 passes through valuable industrial land in East Lavington. It is also close to new housing development on the northern outskirts of the urban area in West Lavington. Construction would require some housing acquisition, disrupt existing development and restrict future northward growth of the urban area. In addition the steep, relatively unstable, terrain of the area would limit the range of location options available and depressing the highway to reduce traffic noise in adjacent residential areas may not be possible.

Alternative 2 separates the undeveloped eastern part of the Black Range around One Tree Hill, north of East Lavington, from the industrial area to the south; and the area around Jindera Gap from residential development to the south. If it was proposed to actively manage conservation of Black Range this separation could be a useful planning tool. However, alternative 2 would make the future conservation of semi-natural areas between the National Highway and the city more difficult and accordingly less likely. This particularly applies to the important conservation area of Nail Can Hill, west of Lavington, which would be severed from the Black Range to the north.

The route crosses the ridge between Nail Can Hill and the northern part of Black Range through a saddle produced by the headward migration of Hamilton Valley Creek in the east and Splitters Creek in the west. The country is rugged and very large earthworks, with cuts of up to 25m, would be required in an area prone to erosion and landslips. The country around the headwaters of Splitters Creek, to the west of the saddle, is forested while slightly further west there are a number of farmlets. As Alternative 2 would be parallel to and very close to Splitters Creek in this area the present environment would be greatly altered.

The crossing of the Murray River is considered later in this Chapter.

Alternatives 3 and 3a[1]

These routes would disrupt farming, especially around Jindera, but between Bowna Creek and Glenholm the terrain is good for road building and the alignment could be planned to minimise severance of farm properties or interference with traditional access rights. As the National Highway would have controlled access it would be unlikely to induce development in this area.

The cut through the hills south west of Glenholm and the descent into the Murray River valley would be the most difficult part of the route. Large earthworks, with cuts of up to 10m, would be required in a small creek valley to achieve acceptable grades, but they are not as great as required by Alternative 2 in the Splitters Creek region. Nevertheless, large earthworks should be avoided and, if undertaken, should take account of the inherent instability of the weathered surface materials by allowing extra width for possible laying back of batters.

Alternatives 3 and 3a generally skirt Albury-Wodonga, including the areas earmarked for future development and would not require any housing acquisition. The route does not pass through, or near, areas of particular conservation significance throughout the length north of the flood plain.

Crossing of the Murray River Flood Plain

The crossing of the Murray River flood plain would be the major construction on any new north-south route in the Albury-Wodonga area. The integrity of the flood plain is especially sensitive to interference and the crossing would contribute greatly to the overall environmental impact of any alternative route. In addition, the Victorian and New South Wales branches of the National Trust of Australia have classified the Murray River flood plain because of its significance as an environmental and scenic feature. Particular attention has been given to the location and nature of possible crossings and the interchanges with the Riverina Highway in New South Wales and with the Murray Valley and Hume Highways in Victoria.

(1) Alternatives 3 and 3a are identical over the section from Bowna to the Riverina Highway.

The criteria for assessing river crossings earlier are well established and in general there is a high degree of coincidence between techniques for the minimisation of cost and those for minimisation of environmental impact.

Interference with flood waters

At present restricted floods on the Murray River flood plain do little damage to fences and fields but any future crossing could interfere with flood waters and cause fences to be flattened or torn out, paddocks to be eroded and pasture ruined. Embankments or causeways interrupt and redirect natural flows. Occasionally they bank up flood water and exacerbate upstream flooding but more often they reduce the flood channel width, increasing the velocity of flood waters and their capacity to do damage. Compared with an embankment, the piers of a bridge represent very much smaller restrictions on flood although they can induce eddying which may result in local erosion and sedimentation. A crossing involving mostly bridge and little causeway would be preferable environmentally but the economics of bridge construction demand that structure length be minimised and that causeway length be maximised, consistent with the safety and satisfactory performance of the crossing.

Alternatives 2 and 3 would cross the Murray River where the flood plain is almost 5km wide and their construction would involve more than 1.5km of causeway. By constrast, Alternative 3a would cross the flood plain by way of a natural constriction, less than 2km. wide and would require very little causeway, thus causing less interference with natural flooding and the integrity of the flood plain.

Stability of foundations

Detailed consideration must be given to the amount of fill likely to be required for a river crossing. The Murray River alluvium is over 75m deep with sediments ranging from boulders and coarse gravels to fine muds, silts and sands. The upstream erosion which supplied the alluvium is related to the climatic history of the region and resulted in cycles of deposition of fairly uniformly sized materials. The present cycle is one of predominantly fine material which has little capacity to directly support large structures or large amounts of fill. Embankments would have to be carefully located to avoid later subsidence.

Effects on flora and fauna

The ecological value of the Murray River flood plain could be affected directly by the removal of vegetation and indirectly where water bird breeding areas are exposed to traffic noise. Any future crossing should be at least a kilometre from the areas of highest conservation value. These areas have been located by consultants to the AWDC and are generally east of the Lincoln Causeway. However, care and study, involving the appropriate experts in consultation with the National Trust, would be required to determine a precise location for any of the alternative bypasses.

Interference with aboriginal sites

National Parks and Wildlife Service in New South Wales recommend that a preliminary archaeological survey of any proposed road reservations should be undertaken when its location has been determined. A more detailed survey would be required during detailed road location and design to enable route adjustment to be made should valuable sites be discovered. In some cases salvage of affected sites would be undertaken but this would depend on the type of site and its proximity to the future roadway.

Visual impact

The appearance of any future crossing would depend on its location. A low profile bridge deck would be compatible with the flat plain and be somewhat lower than the adjacent Murray River Red Gums. Alternatives 2 and 3 would bisect a broad basin and require interchanges at both ends to be built up from the flat plain. Conversely, Alternative 3a would extend the lines of the natural constriction between Dights Hill and McDonald Hill. In addition the interchanges between the new route and the Hume and Riverina Highways could be constructed in cut, involving considerable earthworks but enabling the existing profile of the topography to be substantially retained.

The National Trust should be consulted on the effect of any new crossing on the landscape (as well as flora and fauna, as previously indicated) during location and design studies.

Effects on the spread of insect pests

The Murray River between New South Wales and Victoria is policed to prevent vehicles carrying fruit, or other items which would assist the spread of the Queensland Fruit Fly, into Victoria. Quarantine operations are also performed along the Murray at various other locations. An additional river crossing would increase the staff requirements of the Department of Agriculture and would marginally increase the risk of the spread of pests and disease. However, in the long term buffer zones rather than border inspections are likely to be used to quarantine sensitive parts of Victoria and elsewhere. The significance of river crossings in the operation will then be very much reduced.

Impact on development

The existing and future use of the flood plain is important in the selection of route locations particularly if routes change the accessibility of areas through which they pass. A new National Highway through this area would not be accessible from, and would not provide access to, adjacent properties. This would prevent ribbon development on the flood plain such as occurred beside the Lincoln Causeway. Nevertheless consultation with local property owners and other authorities would be required to determine the precise location of any future route and to ensure that it is compatible with the intended future management of the flood plain, whether it be for farming, recreation or conservation.

CHAPTER 8 - ROAD USER IMPACT OF ALTERNATIVES

This chapter estimates the comparative benefits that would accrue to road users following construction of the alternative routes. Forecasts of the traffic that would use each route were developed using data collected in various surveys together with estimates of internal traffic obtained from a simple model. These forecasts were combined with the standard road user costs used by the Bureau to produce estimates of total benefits.

Road user benefits in bypass studies such as this fall into two groups:

(i) benefits to through traffic as a result of avoiding urban congestion; and

(ii) benefits to local traffic resulting from the removal of a significant component of traffic from the town.

This study concentrates on the first group of benefits. In Albury-Wodonga through traffic is a small proportion of total traffic (certainly under 20% on any road which is likely to be congested) and the effect on local traffic of the removal of the through traffic will be small.

In this study, the difficulties are compounded by uncertainty as to the future nature, distribution and rate of development in Albury-Wodonga. Forecasts of urban traffic, which depend on the rate of growth and distribution of population and economic activity, and the provision made for road traffic, are correspondingly uncertain. This problem is addressed in Chapter 10, where certain sensitivity tests are applied to the results.

The base population forecasts and internal traffic levels were discussed in Chapter 4. Table 4.1 gives the population distribution adopted for the study, with extensive urban development at the new towns of Baranduda (Vic.) and Thurgoona (NSW). Table 4.2 gives the projected traffic flows used to determine the 'do-nothing' internal road network. The year 2000 flows are based on a vehicle ownership level of 0.8 vehicles per person which must be regarded as an upper limit. (This estimate is equivalent to 1 private vehicle for each person of driving age plus a 50% increase in the present per capita level of commercial vehicles).

Traffic Surveys

Three surveys have been carried out in recent years in Albury-Wodonga to determine the characteristics of traffic entering the Albury-Wodonga area. The results of these surveys form the basis of the external traffic forecasts.

In September, 1974, the Bureau of Roads, in conjunction with DMR, carried out a survey of traffic on the Hume Highway just south of its junction with the Olympic Way. The survey was carried out from 7 a.m. to 7 p.m. and collected information on trip origin, destination and purpose, together with details of any stops in Albury-Wodonga made by through traffic. The broad pattern of long-distance movement identified by this survey is shown in Figure 3.3.

In March, 1975, the AWDC commissioned an external cordon survey of traffic entering and leaving Albury-Wodonga on the seven major entry and exit routes, collecting detailed information on the trip origin and destination within Albury-Wodonga. As with the CBR/DMR survey this survey was also carried out between 7 a.m. and 7 p.m. only. Figure 8.1 shows in diagrammatic form the origins and destinations of traffic entering Albury-Wodonga via the Hume Highway North and Hume Highway South respectively.

Traffic on the Hume Highway is characterised by the large number of commercial vehicles and an external bypass of Albury-Wodonga would carry an extremely high proportion of heavy commercial vehicles. A large number of these travel at night and would thus not have been identified in either the AWDC or CBR/DMR surveys. In December, 1975, the Bureau of Roads, in conjunction with CRB and DMR, carried out a 24 hour truck number plate survey to verify the results of the previous surveys and to gain further information on truck movements.

Growth Rates

It is convenient to divide external traffic into terminating traffic and through traffic. There is not a strict direct correspondence but this can also be thought of as a division into short-distance traffic and long-distance traffic.

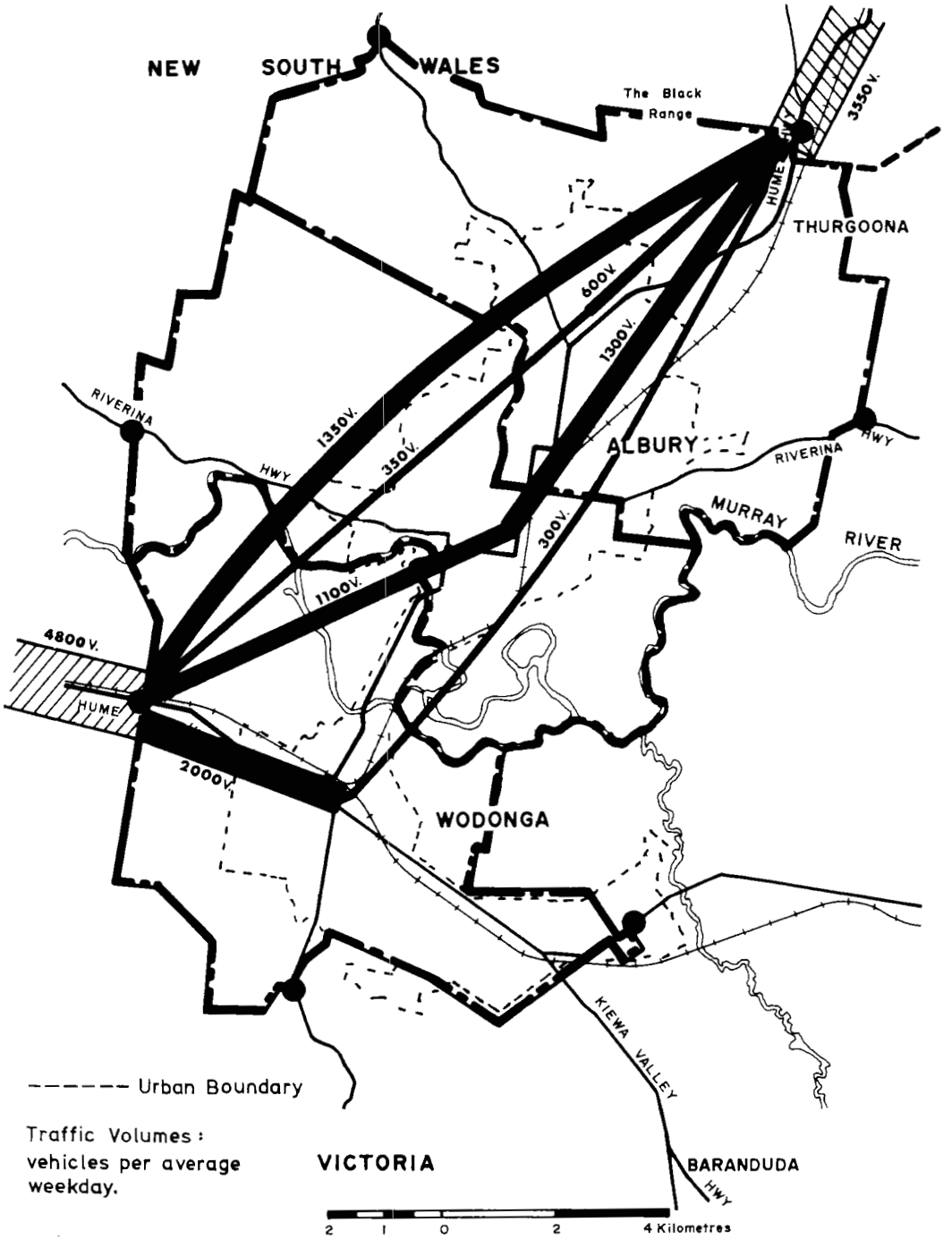

FIGURE 10 ORIGINS AND DESTINATIONS OF TRAFFIC USING HUME HIGHWAY

Source: AWDC Traffic Survey, 1975.

For a regional centre such as Albury-Wodonga the bulk of terminating traffic has its origin or destination within a radius of about 50km from the town, and is mainly associated with the role of Albury-Wodonga as a regional centre. Research undertaken by the Bureau of Roads has shown that traffic to and from a rural centre of population P is approximately proportional to $P^{0.7}$. Such traffic is also influenced by the pattern of development within the hinterland of the rural centre. In the case of Albury-Wodonga it is unclear what the regional development policy is, apart from controlling development in the immediate vicinity of Albury. However, there are several small towns just outside this area (Jindera, Beechworth, Howlong, Holbrook) and if their population increased external traffic would increase at a corresponding rate.

On balance, such growth is considered unlikely for the towns along the Hume Highway and the main stimulus to traffic growth will derive from the growth of Albury-Wodonga. The medium population forecast of Table 4.1 gives population growth rates of 5% p.a. from 1974 to 1985 and 7.4% thereafter. Combined with the assumed increase in per capita vehicle ownership of 3% p.a. from 1974 to 1985 and 2% p.a. thereafter, these give a growth rate for terminating traffic of about 6.5 p.a.

External through traffic in Albury-Wodonga, which in the main is long-distance traffic and includes a substantial Sydney-Melbourne flow, contains two classes of traffic whose growth has been above average in recent years: interstate freight and long-distance leisure travel. The growth of these has been significant in maintaining the growth of through traffic at a level estimated to be well in excess of 5% p.a. The growth in long-distance freight has been, in large part, at the expense of the railways, and a more realistic long-term trend, assuming it maintains its modal share, is 3% p.a. Because freight benefits play such an important role in the evaluation the assumed growth rate of total through traffic has been biassed towards this long term trend at 4% p.a. to 1985 and 3% p.a. thereafter.

Route Forecasts

Wodonga Bypass

This section will be used by all traffic entering Wodonga on the Hume Highway whose destination is Central Albury and beyond. In 1975 this was 42% of the terminating traffic entering Wodonga (see Figure 8.1). Wodonga now contains 29% of the population of Albury-Wodonga. After 1985 Wodonga and Baranduda are forecast to contain 50% of the Albury-Wodonga population (see Table 4.1). Bypassing traffic is assumed to reduce in proportion to 24% of the terminating traffic. The relevant calculations are summarised in Table 8.1.

TABLE 8.1 -FORECAST OF TRAFFIC ON WODONGA BYPASS

	Traffic Volumes		
	1975	1985	2000
Terminating traffic entering Wodonga	3450	6800	17500
% bypassing Wodonga	42	24	24
Vol. using Wodonga bypass	1450	1600	4200
Through traffic	1350	2100	3200
Total using Wodonga Bypass	2800	3700	7400

Lavington Bypass

This section will be used by all traffic entering Albury on the Hume Highway whose destination is Central Albury and beyond. In 1975 this was 73% of the terminating traffic entering Albury (see Figure 8.1). Lavington now contains 38% of the population of Albury-Wodonga. By 1985 this is forecast to be 30% and by 2000 16% (see Table 4.1). It was assumed that, in 1985 and 2000, 78% and 88% respectively of the terminating traffic would use the Lavington Bypass. The calculations are summarised in Table 8.2.

TABLE 8.2 - FORECAST OF TRAFFIC ON LAVINGTON BYPASS

	Traffic Volume		
	1975	1985	2000
Terminating traffic entering Albury	2200	4400	11300
% bypassing Lavington	73	78	88
Vol. using Lavington Bypass	1600	3400	9900
Through Traffic	1350	2100	3200
Total using Lavington Bypass	2950	5500	13100

External Bypass

The forecasts of traffic using the external bypass are based on the three surveys described in the earlier part of this chapter. The same forecast is assumed for all three external bypasses.

During the 1974 Survey, the average daily traffic on the Hume Highway north of Albury was estimated to be 3400 vehicles, of which 1820 were passing through Albury-Wodonga. Of these 1820 vehicles, 1320 vehicles stopped in Albury-Wodonga. Table 8.3 sets out the reasons for stopping. Half the vehicles that stopped for leisure purposes and all the vehicles stopping for fuel, refreshments and rest were considered likely to have used a bypass of Albury-Wodonga if one had existed. About 55% of the potentially bypassible vehicles were trucks. Of the 680 cars per day estimated to be potentially bypassable 30% were undertaking business trips and 70% private trips.

TABLE 8.3 - ESTIMATED BYPASSABLE TRAFFIC: ALBURY (1974)

	Cars and Light Commercials	Heavy[1] Commercials	Total
Vehicles Not Stopping	303	192	495
Vehicles Stopping			
Purpose of stop			
- work	14	33	47
- personal business	137	-	137
- leisure	34	-	34
- overnight stop	77	42	119
- fuel, refreshments, etc.	361	631	992
Total Volume Passing Albury-Wodonga	926	898	1824
Estimated Bypassable Traffic[2]	682	822	1504

(1) 2 axle 6 tyre trucks and larger

(2) Estimated as vehicles not stopping, half the vehicles that stopped for leisure purposes, and all the vehicles stopping for fuel, refreshments, etc.

SOURCE: DMR and Bureau of Roads Roadside Interview Survey, 1974.

These estimates are supported by the results of the AWDC Cordon Survey which estimated, that in March, 1975, about 1340 vehicles per day travelled through Albury along the Hume Highway without a significant stop. The number-plate survey also provided a further estimate of about 800 trucks per day passing through Albury-Wodonga, of which only about 5% took more than 3 hours. (About 40-50% of the through trucks are estimated to pass between 7 p.m. and 7 a.m.). Based on the results of these surveys the following traffic forecast for the external routes was assumed.

TABLE 8.4 - FORECAST TRAFFIC - EXTERNAL ROUTES

Year	AADT
1975	1350
1985	2100
2000	3200

Vehicle Composition

Table 8.3 shows that about 55% of the bypassable traffic is heavy commercial vehicles. The proportion of heavy commercial vehicles in the terminating traffic, by contrast, is about 30%. 50% of vehicles on the external bypass and 40% of vehicles on the Wodonga and Lavington bypasses are assumed to be heavy commercial vehicles. Table 8.5 gives the assumed split between types of heavy commercial vehicle, based on the classification counts obtained during the number plate survey.

TABLE 8.5 - ASSUMED MIX OF HEAVY COMMERCIAL VEHICLES

Type of vehicle	%
2 axle 6 tyre	30
3 axle	19
4 axle	19
5 and 6 axle	32

30% of all cars and vans on all routes are assumed to be travelling on business purposes.

Estimation of User Benefits

User benefits were calculated for the route alternatives using standard Bureau procedures and parameters.(1) In the remainder of this chapter user benefits are estimated for the two sections of the internal route as compared to the do-nothing situation. User benefits for the external bypass are estimated under two alternatives:

(i) base case which assumes some form of Albury centre Bypass and new river crossing and connections; and

(ii) assuming that the full internal bypass is built initially, i.e., the base case plus the Lavington and Wodonga Bypasses.

(1) See for example G.J. Both, C. Bayley; Evaluation Procedures for Rural Road and Structure Projects, Eighth ARRB Conference, 1976.

User benefits comprise three main components:

(i) variation in vehicle operating costs due to alterations in the speed and distance of travel;

(ii) time savings to vehicle occupants due to reduced travel time; and

(iii) variations in accident costs following changes in the distance travelled, the standard of the road and the volume of traffic.

The first two of these benefits and costs have been estimated using standard Bureau procedures and parameters. Details are given in Annex B. Lack of data has prevented a comprehensive analysis of user benefits resulting from reduced accidents. Typically, accident costs represent between 2% and 5% of total user benefits. This is well within the margin of errors inherent in the analysis.

Average travel speeds were estimated for each route and these, together with the traffic estimates and unit time costs, gave the time savings benefits for each route. A similar procedure was used to estimate savings in vehicle operating costs. The operating and time benefits per vehicle for each alternative are set out in Table 8.6.

TABLE 8.6 - USER BENEFITS OF ALTERNATIVE ROUTES (cents/veh, 1976 prices)

	Benefit/vehicle (¢) compared to base case (1)				Benefit/vehicle (¢) assuming internal bypass is in existence (2)			
	Car		Truck		Car		Truck	
	Time	Operating	Time	Operating	Time	Operating	Time	Operating
Internal								
Wodonga Bypass	39.1	5.7	42.4	22.5				
Lavington Bypass								
- arterial	15.8	6.2	12.9	26.7				
- freeway	22.1	4.6	18.9	24.0				
External								
Alternative 2	90.1	25.3	107.9	80.3	35.3	11.4	45.4	31.1
Alternative 3	108.4	45.1	136.7	165.1	53.6	33.2	74.2	115.9
Alternative 3a	97.6	33.4	119.3	115.0	42.8	21.5	56.8	65.8

(1) Assumes Albury Centre Bypass and new river crossing and connections.

(2) Assumes Wodonga and Lavington Bypasses in addition to base case.

The total road user benefits from construction of the alternative routes were estimated under the following assumptions:

(i) construction of the routes commences in 1978;

(ii) construction proceeds at a constant yearly rate of expenditure until completion in 1981;

(iii) an evaluation period of 30 years from 1978;

(iv) traffic uses the routes from 1982 onwards;

(v) road user benefits increase in line with traffic growth and at 2% per annum in real terms, reflecting the assumed increase of 3% per annum in the real value of passengers time (in this study time benefits average about 2/3 of total benefits); and

(vi) a discount rate of 10% and a discount year of 1978.

Total road user benefits over the evaluation period, discounted to 1978, are set out in Table 8.7.

TABLE 8.7 - TOTAL ROAD USER BENEFITS ($M, 1976 prices, discounted to 1978)

	Total road user benefits ($M)	
	vs. Base Case[1]	Internal Bypass Built[2]
Internal routes		
Wodonga Bypass	9.0	-
Lavington Bypass - arterial	7.4	-
- freeway	8.5	-
External routes		
Alternative 2	11.7	4.7
Alternative 3	17.6	10.8
Alternative 3a	14.1	7.2

(1) Assumes Albury Centre Bypass and new river crossing and connections.

(2) Assumes Wodonga and Lavington Bypass in addition to base case.

CHAPTER 9 - CONSTRUCTION COSTS OF ALTERNATIVES

This chapter discusses the enginering costs and standards for the various alternatives described in Chapter 6. The engineering costs are divided into construction costs and maintenance costs. Discussion on the internal route is followed by discussion on the external alternatives. All costs in this chapter are at 1976 price levels.

Construction Costs

Alternative 1

Wodonga Bypass

The proposed Wodonga Bypass is 3.3km of a new alignment over an old flood terrace of the Murray River slightly above the present flood plain. The CRB have estimated construction costs to be $10.5 million on the basis that the bypass would be a four-lane divided highway development leading eventually to a six-lane facility. Allowance has been made in the costs for an overpass of the Main Southern Railway and grade separation of Melrose Drive with a half diamond interchange, although separate costs for these works have not been provided.

An alternative four-lane development proposed by the Bureau of Roads using a single carriageway with 17m. pavement and a temporary median barrier, but with earthworks and structure suitable for conversion to National Highway standards was costed by the CRB at $10.1 million.

Lavington Bypass

The Lavington Bypass would be 5.5km long, 2.5km of which coincides with the existing roads with the remainder on a new reservation. DMR have costed the bypass at $4.6 million assuming that the facility would initially be a 11.5m two-lane carriageway with some access control and most intersections at-grade. Allowance has been made for construction of an interchange at the northern junction with the Hume Highway and the bypass would cross over the railway at a point where the railway line is already in cut. Provision has been made in the estimate to allow for improvements to the intersection of the bypass with the Riverina Highway (Borella Street). The DMR and AWDC have acquired 80% of the land necessary for the bypass.

The DMR originally proposed that the Lavington Bypass be constructed as a four-lane divided freeway with interchanges at the northern junction and Riverina Highway, and grade separation at Union Road and North Street. The total cost for a facility of this standard was estimated by DMR as $8.2m.

Alternative 2

Although this is the shortest of the external routes in terms of new construction (24.6km), the terrain is more undulating than for the other routes. Assuming the road would be constructed initially as a 13.5m wide two-lane carriageway to National Highway Design Standard DMR estimated the cost of road construction would be $9.9 million. The route would cross the Murray River by a 3.4km long bridge of one carriageway, designed to National Highway Standards and costing a further $9.1 million. All the external routes have been costed to this standard of construction.

Although Alternative 2 joins the Hume Highway at East Lavington and traffic would have to use the existing Hume Highway to reach the common point at Bowna Creek, this section has recently been realigned and duplicated.

Alternative 3

This alternative involves the greatest amount of new construction (31.2km) although in more accommodating terrain. The estimated cost of a two-lane highway constructed on this alignment is $12.0 million. Alternative 3 crosses the Murray by the same bridge as costed for Alternative 2 and the cost of Alternative 3 includes $9.1 million for these bridge works.

Alternative 3a

Alternative 3a was selected as having the most favourable alignment for both road and bridge construction. Although the total route length is longer than for Alternative 3, road construction is reduced to 27.5km by using the Hume Highway in Victoria as far north as the Murray Valley Highway junction before diverting to a new alignment. The CRB did not include the cost of improvements to the Hume Highway between Barnawartha North and this function as these improvements are independent of the construction of Alternative 3a. The DMR and CRB estimated the new road construction would cost $10.9 million and the shorter bridge $5.2 million, based on the standards of Alternative 2.

TABLE 9.1 - CONSTRUCTION COSTS

(1976 prices)

	New Road Const. (km)	Road Const. Cost ($m)	Bridge Length (km)	Bridge Cost ($m)	Total Const. Cost ($m)
Wodonga	3.3	10.5	-	-	10.5
Lavington					
2 lane	5.5	4.6	-	-	4.6
4 lane	5.5	8.2	-	-	8.2
Alternative 2	21.2	9.9	3.4	9.1	19.0
Alternative 3	27.8	12.0	3.4	9.1	21.1
Alternative 3a	25.6	10.9	1.9	5.2	16.1

Maintenance Costs

Maintenance costs, using the 1976 traffic assignments, are estimated at $1600/km per annum for the rural bypasses, $2500/km per annum for the two-lane urban arterial and $3500/km per annum for the four-lane urban freeway. In the evaluations any savings in maintenance costs arising from réduction in traffic on the existing route were neglected.

TABLE 9.2 - MAINTENANCE COSTS

(1976 prices)

Route	New Length for Maintenance (km)	Cost per annum ($'000)
Wodonga	3.3	8.3
Lavington		
2 lane	5.5	13.8
4 lane	5.5	19.3
Alternative 2	24.6	39.4
Alternative 3	31.2	49.9
Alternative 3a	27.5	44.0

CHAPTER 10 - EVALUATION OF ALTERNATIVES

In this Chapter the social, environmental, traffic and construction considerations discussed in Chapters 7, 8 and 9 are brought together. Using this information the options available for the route of the National Highway in the vicinity of Albury-Wodonga are evaluated.

The following alternatives were developed in Chapter 6:

(i) a base case which assumed that a second crossing of the Murray River would be built in the mid-1980's and that additional road capacity along a north-south corridor bypassing the centre of Albury would also be provided at about that time.(1)

(ii) an internal route (Alternative 1) consisting of the Lavington Bypass and the Wodonga Bypass; and

(iii) an external bypass west of Albury-Wodonga along the route of either Alternative 2, Atlernative 3 or Alternative 3a.

In addition to the route location options there are two timing options:

(i) should the internal route be developed before an external route and if so, when; and

(ii) if the internal route is constructed first, when is an external route warranted.

It is assumed that if an external route were developed first, any road construction in Albury Wodonga would then cease to be funded out of National Highway funds.

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(1) For the purpose of estimating user benefits the Albury Centre Bypass and new river crossing and connections shown schematically in Figure 6 were assumed.

Overall Evaluation

The alternative routes are compared in Table 10.1. The remainder of this section discusses the likely eventual timing of an external bypass and the sensitivity of the evaluation to the underlying assumptions.

TABLE 10.1 - OVERALL EVALUATION OF ROUTE OPTIONS

	Economic Analysis			Social and Environmental Analysis		
Route	Discounted[1] Const. Cost ($m) & Maint. Cost	Discounted[1] Road-user Benefits ($m)	BCR	Envir. Impact	Social Impact	Remarks
Existing Route	-	-		Low	Medium	Heavy trucks in resid. areas
Internal						
Wodonga Bypass	9.6	9.0	0.9	Low	Low	Golf course being reloc. 7 houses within 100m
Lavington Bypass						
2 lane	4.2	7.4	1.8	Low	Low	Possible problem with Aquinas College along exst. corridor
4 lane	7.5	8.5	1.1			
External						
Alternative 2	16.5	11.7	0.7	High	Medium	Severance of Albury from Black Range
Alternative 3	18.3	17.6	1.0	Medium	Low	Bridging Difficulties
Alternative 3a	14.0	14.1	1.0	Low	Low	Attention needed for descent from plateau to Murray

(1) Costs and benefits in 1976 prices discounted to 1978.

Table 10.1 shows that, at this time, the Wodonga Bypass is not economically warranted whereas the Lavington Bypass is. Both have low environmental and social impacts. Of the three external bypasses, Alternative 3a is marginally superior economically to the others, and is also better on environmental and social grounds. However, Alternative 3a, the best of the external routes, is still inferior to the internal route combination of the Wodonga Bypass and 2 lane Lavington Bypass which has a BCR or 1.2. The internal route should therefore be constructed before an external bypass.

Timing of external route

The economic analysis of the external routes, assuming the Wodonga and Lavington Bypasses are constructed, is shown in Table 10.2.

TABLE 10.2 - ECONOMIC EVALUATION OF EXTERNAL ROUTES - INTERNAL BYPASS ASSUMED

Route	Discounted[1] Construction and Maintenance Cost ($M)	Discounted[1] Road-user Benefits ($m)	BCR
Alternative 2	16.5	4.1	0.2
Alternative 3	18.3	10.8	0.6
Alternative 3a	14.0	7.2	0.5

(1) Costs in 1976 prices discounted to 1978.

There is little to choose economically between Alternatives 3 and 3a. However, because of the environmental impact on the River Murray and bridging uncertainties associated with Alternative 3, Alternative 3a should be the preferred external route.

However, the route is not warranted at this time, having a benefit-cost ratio of about 0.5. Currently, the lowest BCR for National Highway projects in New South Wales is around 1.5 to 2.0, suggesting that an external bypass of Albury would not be warranted until sometime in the mid-1990's, the exact date depending on the rate of traffic growth and the funds available in the intervening period for National Highway projects.

Certain aspects of the evaluation are now discussed in more detail, particularly the robustness of the conclusions. As the economic warrant for a route is directly related to the predicted traffic volume and the standard of facility provided particular attention is paid to these two aspects.

Wodonga Bypass

The Wodonga Bypass, with a benefit-cost ratio of 0.9, is not economically warranted for two or three years. The principal reason for this is that, whilst the bypass is both shorter than the existing route through the centre of Wodonga and also eliminates an at-grade rail crossing, the facility is designed so as to suit ultimate conversion to a six-lane highway and, correspondingly, has higher construction costs.

This is in response to a CRB traffic forecast of about 10,000 vehicles per day in 1985 and 26,000 in 2000. These traffic forecasts, which assume a very high diversion to the new facility of traffic using the existing Hume Highway, are an order of magnitude higher than the Bureau of Transport Economics' estimates of 3700 in 1985 and 7400 in 2000. (Table 8.1). These latter forecasts reflect the fact that a large proportion of traffic entering Wodonga via the Hume Highway terminates in Wodonga (42% in 1975). This proportion is expected to increase as the proportion of the population south of the Murray grows. (Even if this traffic were diverted onto the new facility, the benefits derived from doing so would be very small. In some circumstances user costs may increase).

Even if the design traffic forecasts of 26,000 vehicles per day in 2000 are accepted, the provision of six lanes seems generous. The peak hour flow in one direction is unlikely to exceed 8% of the AADT, or about 2100 vehicles/hr. The effect of providing three rather than two lanes for this flow is to increase average travel speed in the peak from 72km/h to 80km/h, and overall from about 82km/h to 86km/h.

The CRB have costed a Bureau of Transport Economics proposal to initially construct a single carriageway only. However, because of the need to locate structures to suit ultimate conversion to six lanes a number of crossover transitions are required and the total cost of $10.1 million (June 1976 prices) is little different to the two carriageway proposal.

In summary, the Wodonga bypass as proposed is economically a marginal proposition. However, this could be improved if the facility were redesigned to an ultimate four-lane standard. Existing and projected traffic volumes seem unlikely to warrant a higher standard facility than this.

Lavington Bypass

Table 10.1 shows that construction of the Lavington Bypass is economically warranted in the near future as a two-lane arterial road. However, if built as a four-lane freeway, the warrant is deferred until the mid 1980's taking into consideration other projects on the Hume Highway in New South Wales. Initially the Lavington Bypass should be constructed as a two-lane urban arterial with possible future upgrading to four lanes if warranted by traffic growth. The traffic forecasts used in the evaluation suggest this could occur in the early 1990's.

In contrast to the Wodonga Bypass, it is expected that, in 1985, 78% of the traffic entering Albury via the Hume Highway would use the Lavington Bypass if it were to be constructed.

External Bypasses

As Alternatives 3 and 3a offer greater distance savings to road users than Alternative 2 they emerge as preferred routes in Table 10.2 and this dominance is reinforced by their lower social and environmental impact.

The major difference between Alternatives 3 and 3a lies in the choice of bridge site over the Murray River, in which route distance is traded against ease of bridging. The reduction in construction cost is almost exactly balanced by the reduction in user benefits. The environmental impact of Alternative 3 is more severe. There is a greater element of risk involved and the bridging costs are correspondingly less robust. Accordingly, Alternative 3a is considered to be the most suitable alignment for the external bypass.

Alternative 3a has been connected to the existing Hume Highway at Bowna Creek only for convenience of analysis. Paragraph 3.3 discussed the possible relocation of the Hume Highway between Bowna and Table Top, skirting the northern tip of Lake Hume at some time in the future. The terrain in the area does not pose any constraints on route location and the northern end of the external bypass should be located taking this eventual realignment into consideration. Any such change in the northern termination of the external bypass will not invalidate the above conclusions on location or timing.

The exact timing of the external bypass will depend on two factors, the growth rate of through traffic and the proportion that uses the bypass. The traffic forecasts derived in Table 8.3 assumed that 82% of the current through traffic would use the bypass. If this estimate were incorrect, and in practice only 60% would do so that would delay the warrant by about five years. On the other hand a growth rate of 3% per annum for through traffic was assumed. If instead it maintains its recent growth of 5% per annum the warrant for the external bypass is advanced by about eight years, to the late 1980's, although the exact date will depend on the availability of funds in the interim.

As a large proportion of the benefits derived from an external bypass are attributed to freight vehicles, many of which are travelling between Melbourne and Sydney, the timing is also susceptible to major shifts in freight modal split in that corridor. If the present approximate split of 2:1 in favour of road were reversed, this would reduce the freight vehicles using the bypass by about 300, total benefits by about 25% and delay the warrant by about a further eight years.

ANNEX A - INTERNAL TRAFFIC FORECASTS

Introduction

Although Albury-Wodonga ia administratively a single area, the nature of the present and proposed development is such that it may be treated for traffic purposes as a series of small towns some 5 to 13 kilometres apart.

Use of such an approach has a number of implications in terms of the land use within the town. It assumes that within each town the population and employment opportunities are approximately in balance, so that there is no large scale migration of workers between towns (although there will still be a certain amount of commuting). It also assumes that each town has sufficient facilities to provide for most daily and weekly demands and services (supermarkets, hardware stores, hotels, doctors, etc.). The major settlement, the present Albury, is however expected to continue to provide specialised and centralised services such as department stores, theatre, hospital, technical college, etc.

Bureau model

The Bureau has developed a set of models, for predicting intertown travel, from 1971 data on trips between 93 pairs of Victorian country towns (whose population ranged from 5000 to 100,000 and which were from 10 to 320 kilometres apart).

$$V = k \left(\frac{P_1^{0.5} P_2^{0.65}}{D^{1.7}} + \frac{P_2^{0.5} P_1^{0.65}}{D^{1.7}} \right)$$

where V = 1975 vehicle trips/day between two centres of population P_1 and P_2, distance D km apart, (P_1 and P_2 in '000s) and k is a calibration constant.

The first term of the model represents traffic generated by town P_1 and attracted by town P_2, and the second term the complementary traffic. The formulation makes sense intuitively. The numbers of functions in a town, which reflect its attractiveness, are roughly proportional to its population to the 0.6 power. A declining external trip rate as population increases is also realistic. A reassuring feature is the distance exponent of -1.7, in line with any urban transportation studies.

However, if the pairs of towns for which the model is used are within the range on which is was calibrated, the traffic estimates will be much the same whatever the precise estimate of the functional form.

Model application

The model was calibrated using the existing flow over the Lincoln Causeway. The distances from the centres of Albury and Lavington to the centre of Wodonga were taken as 5.7 and 10.4km respectively and the population figures of Table 4.1 used. Using the estimated 1975 internal traffic crossing the Lincoln Causeway (16000) gave an estimate for k in 1975 of 4182 (see Table A1 for inter-district flows).

TABLE A1 - ESTIMATED FLOWS 1975 (1971 ownership levels)

	1975 flows
Lavington-Wodonga	3,300
Albury-Wodonga	12,700
TOTAL	16,000

Forecast Traffic Volumes

Forecasts were derived for 1985 (for both the medium and high growth forecasts), and for the 2000 growth target, based on the population distribution of Tables 4.1 and the road network and distances of Figure A.1. The 2000 forecasts assume a direct Baranduda-Thurgoona link. Only cross-river flows were forecast (see Table 2 for details).

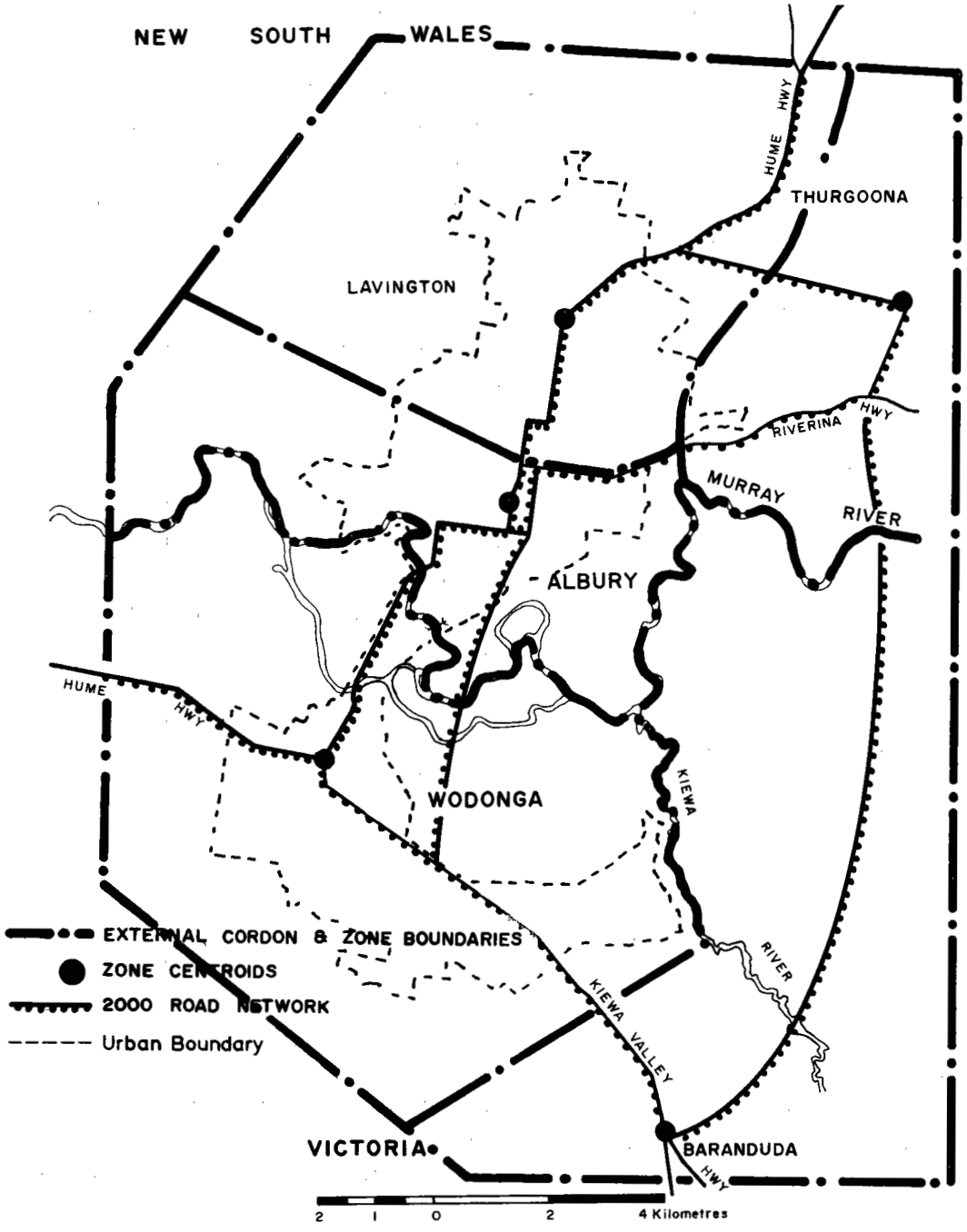

FIGURE A.1 ROAD NETWORK AND ZONES IN 2000 AS USED IN TRAFFIC MODEL

TABLE A2 - FORECAST CROSS-RIVER TRAFFIC FLOWS 1985 - 2000 ('000 Veh/day)

Flow	1985		2000
	Medium	High	
Albury-Wodonga	27	31	87
Lavington-Wodonga	7	7	16
Thurgoona*-Wodonga	-	2	11
Albury-Baranduda	7	10	34
Lavington-Baranduda	3	4	10
Thurgoona*-Baranduda	-	2	18
External traffic	12	12	25
Total cross-river	56	68	201

* Includes Thurgoona extension in 2000.

The forecasts assume an increase in motor vehicle ownership of 3% p.a. to 1985, and a further increase of 2% p.a. to 2000. Vehicle trips are assumed to increase in proportion ot vehicle ownership, as a first approximation. External traffic is assumed to grow at 5% p.a. throughout the period.

ANNEX B - ROAD USER COST CALCULATION

This appendix contains the detailed calculations of the road user costs and benefits associated with the alternative routes. All costs quoted are resource costs at December 1976 price levels.

Alternative 1 (Internal Route)

Wodonga Bypass

The existing route of 4.2km via the Hume Highway and Wodonga centre (see Fig. 8) is replaced by 3.3km of new construction, saving 0.9km in journey distance. The average speed of traffic on the existing road is assumed to be 30 km/h by the date of opening of the facility. Traffic on the Wodonga Bypass is assumed to travel at 90 km/h for cars and 70 km/h for trucks. The calculation of benefits is set out in Table 2.1.

TABLE B1 CALCULATION OF ROAD USER BENEFITS - WODONGA BYPASS

	Car		Truck	
	Existing route	Bypass	Existing route	Bypass
Distance (km)	4.2	3.3	4.2	3.3
Unit op. cost (c/km)	4.8	4.4	19.5	18.0
Total op. cost (c)	20.2	14.5	81.9	59.4
Travel speed (km/h)	30.0	90.0	30.0	70.0
Travel time (mins)	8.4	2.2	8.4	2.8
Time savings (mins)		6.2		5.6
Unit time cost ($/hr)		3.8		4.6
Time cost saving (c)		39.1		42.4
Op. cost saving (c)		5.7		22.5
Total cost saving (c)		44.8		64.9

Lavington Bypass

The existing route of 6.0 km via the Hume Highway (see Fig. 9) is replaced by 5.5 km of new construction. The average speed of traffic on the existing road is assumed to be 50 km/h. Traffic on the Lavington Bypass is assumed to travel at 90 km/h (cars) and 70 km/h (trucks) if constructed as a freeway and at 70 km/h (cars) and 60 km/h (trucks) if constructed as an urban arterial. The calculation of user benefits is set out in Table A2.2

TABLE B.2 CALCULATION OF ROAD USER BENEFIT - LAVINGTON BYPASS

	Cars			Truck		
	Existing	Arterial	F/way	Existing	Arterial	F/way
Distance (km)	6.0	5.5	5.5	6.0	5.5	5.5
Unit op. cost (c/h)	4.8	4.1	4.4	20.5	17.5	18.0
Total op. cost (c)	28.8	22.6	24.2	123.0	96.3	99.0
Travel speed (km/h)	50.0	70.0	90.0	50.0	60.0	70.0
Travel time (mins)	7.2	4.7	3.7	7.2	5.5	4.7
Time saving (mins)		2.5	3.5		1.7	2.5
Unit time cost ($/hr)		3.8	3.8		4.6	4.6
Time cost saving (c)		15.8	22.1		12.9	18.9
Op. cost saving (c)		6.2	4.6		26.7	24.0
Total cost saving (c)		22.0	26.7		39.6	42.9

For the purposes of comparison, user benefit calculations were carried out for the remainder of the internal route between common points. Traffic is assumed to travel the 5.8 km between the Wodonga and Lavington Bypasses over new urban arterial connection and river crossing averaging 70 km/h for cars and 60 km/h trucks. For those sections of the existing highway connecting the Wodonga and Lavington Bypasses with the external route speeds were assumed to be 90 km/h for cars and 70 km/h for trucks. Table A2.3 gives total costs for the internal route.

TABLE B.3 ESTIMATED USER COST - INTERNAL ROUTE

	Car		Truck	
	Do-nothing	Improved[1]	Do-nothing	Improved[1]
Distance (km)[2]	42.1	40.7	42.1	40.7
Total op. cost (c)	185.5	173.6	767.3	718.1
Travel Time (min)	38.0	29.3	43.8	36.5
Total Time Cost (c)	239.4	184.6	338.7	276.2
Total Cost (c)	423.9	357.2	1106.0	994.3

(1) Lavington Bypass to arterial standard only.

(2) Distance between connection points - Bowna Creek - Barnawartha.

Alternatives 2, 3 and 3a (External Routes)

The three external bypasses each involve about 20 km of new construction, and save up to 12 km compared with the existing route through Albury. Traffic on the bypasses is assumed to travel at average speeds of 90 km/h for cars and 70 km/h for trucks. The calculation of user costs on each of the three external bypasses is set out in Table A2.4.

TABLE B.4 ESTIMATED USER COST - EXTERNAL ROUTES

Route	Car			Truck		
	2	3	3a	2	3	3a
Distance (km)[1]	35.6	31.2	33.8	35.6	31.2	33.8
Unit op. cost (c/km)	4.5	4.5	4.5	19.3	19.3	19.3
Total op. cost (c)	160.2	140.4	152.1	687.0	602.2	652.3
Travel speed (km/h)	90.0	90.0	90.0	70.0	70.0	70.0
Travel time (mins)	23.7	20.8	22.5	30.5	26.7	29.0
Unit time cost ($/hr)	3.8	3.8	3.8	4.6	4.6	4.6
Time cost (c)	149.3	131.0	141.8	230.8	202.0	219.4
Total cost (c)	309.5	271.4	293.9	917.8	804.2	871.7

(1) Distance between common points - Bowna Creek-Barnawartha

ANNEX C - COMMENTS ON REPORT

As part of the process of preparing this report the Bureau requested comments on the draft from the Victorian Country Roads Board, the New South Wales Department of Main Roads, the Albury-Wodonga Development Corporation, the City Engineers of the Rural City of Wodonga and the City of Albury and the Shire Engineer of Hume Shire.

Where appropriate these comments have been incorporated in the report. The report has also been modified for clarity where misunderstandings arose. However, there are certain areas where the organisations consulted have dissented from the findings of the report. The purpose of this Annex is to summarize the dissenting views and, where necessary, to comment on them.

Department of Main Roads - NSW

The Department does not agree that the Lavington Bypass should be the only section of the internal route in New South Wales financed from National Highways funds.

The Department disagrees with the proposal that the National Highway be broken by the Albury-Wodonga urban boundary leaving part of the internal route to be funded from other sources. The Department considers that the situation is different to capital cities where National Highway traffic disperses over many routes because the internal route would attract virtually all through traffic. The Department considers it should be classified, throughout, as the National Highway.

Because of the proposal that the National Highway be broken by the Albury-Wodonga urban area, it is the Department's view that the report takes a segmented approach to the State Road Authorities traffic relief route. The Department considers that the assessment of benefits and costs should be based on an investigation of the route as a single entity.

In addition the Department considers that traffic volumes quoted in the Report contain inconsistencies and seem based on inadequate data. They consider the estimate of 201,000 cross river vehicle trips per day in 2000 to be quite unbelievable.

Albury-Wodonga Development Corporation

Although the Corporation provided an extensive paper criticizing the Report many of the criticisms put forward are not actually in conflict with the Report. However, there are some areas of fundamental disagreement.

The Corporation disagrees with the conclusion that Albury-Wodonga be considered as an urban area for road funding purposes and that internal roadworks not be funded from National Highways funds.

The Corporations attitude is that, if the internal route is the better proposition then National Highways funds should be allocated to it. Because funds from other sources are not, and are unlikely to be, available for internal roadworks in Albury-Wodonga, National Highways funds should be provided.

The Corporation puts forward arguments against considering Albury-Wodonga as one urban area:

- the two cities are in different States.
- they are separated by the Murray River floodplain.
- the ABS boundary does not reflect the proposed development pattern.
- Albury,Wodonga, Thurgoona and Baranduda are all separate areas and should not be regarded as parts of one urban area.

The Corporation also criticized the Report for its:

- assessment of bypassable traffic.
- failure to include a benefit cost ratio for the complete internal bypass.
- cost assessment attributed to the construction of the roads.

These criticisms are not detailed in the Corporation's paper.

The Corporation put forward an alternative bypass proposal to those considered in the Report. The main difference is that it includes alterations to the Hume Highway alignment north of the Lavington Bypass which reduce the length of the internal route by about 4 kilometres. The Corporation's route has grades generally less than 1.5% whereas the grades are up to 5% on the external route, but is 3 or 4 kilometres longer.

Advantages of the Corporation's internal route are:

- benefits to local as well as through traffic.
- flatter grades and lower fuel consumption partly compensate for extra length.
- internal route can be progressively implemented whereas external route must be constructed as one stage.

Country Roads Board - Victoria

The Board considers that the Bureau made no genuine attempt to evaluate and compare the external bypass with a total internal bypass consisting of the State Road Authorities existing and planned projects.

The conclusion that a full internal bypass of Albury-Wodonga would contain a central section totally within the defined urban boundary is disagreed with. The new River crossing and connections are, for a greater extent, outside the ABS urban area. Therefore National Highways funds could be used to fund the total internal bypass.

The Board strongly disagrees with the conclusion that, at this time, the economic warrant for the CRB proposal for the Wodonga Bypass is weak. The Board's criticism is based on a disagreement over the forecast traffic on the bypass.

The Board has established through its traffic prediction analysis for the Wodonga Bypass that a four lane divided facility at a cost of $10.5 million is warranted in the initial stage (Highway Planning Report submitted to Commonwealth Minister for Transport).

The Board's traffic forecasts for the Wodonga Bypass are:

1975 - 5600 vehicles per day
1985 - 10000 "
2000 - 26000 "

The Board's higher traffic figures would increase the user benefits and benefit cost ratio.

It is normal Board practice to make provision for an ultimate cross-section of six lanes and this only marginally increases the costs of the initial stage. The Board believes the timing of an external bypass may be beyond 2000 and not the mid 1990's. The Board disagrees with the Bureau's estimate of bypassable traffic; in particular the assumption that half the vehicles stopping for leisure purposes and all vehicles stopping for fuel, refreshments etc. are bypassable, the Board's estimate being 495 to 1000 vehicles per day.

The Board considers it unrealistic to compare costs of the internal and external projects because of the varying amount of investigation on which the estimates are based. The benefit cost ratio for the external bypass would be lower.

Rural City of Wodonga

Comments made by the City Engineer of the Rural City of Wodonga are similar to those made by the Albury Wodonga Development Corporation and the areas of dissent are the same.

Hume Shire Council

The Shire Engineer of Hume Shire expressed no dissent from the report.

Council of the City of Albury

The only area of dissent expressed by the City Engineer of the City of Albury concerned funding of the internal bypass. The council considered that National Highway funds should be used for a portion of the cost of the construction of the bypass through the urban area of Albury-Wodonga.

Bureau Comments

Many of the concerns expressed above relate to the evaluation approach adopted in the report and the implications this might have for funding of road improvements. The evaluation approach adopted does not in fact presuppose a particular method of financing potential improvements, that is, it is independent of funding considerations.

The evaluative framework assumes that the central section of the internal bypass route, including the second river crossing, will be needed in the near future and will be constructed regardless of whether or not it comprises a part of the National Highway route. This improvement is thus incorporated into the base case against which the alternatives, or project cases, are compared. The project cases consider additional improvements, an external bypass on the one hand and an internal bypass on the other, where, in the latter case, the bypass differs from the base case in that the Lavington and Wodonga bypass sections are added.

The results of the evaluation show that it is more economically efficient to construct an internal bypass and use this as part of the National Highway network prior to constructing an external bypass. This is so regardless of the source of funds employed and hence regardless of whether or not Albury-Wodonga is declared an urban area for road funding purposes and of the urban area definition used in the declaration.

The alternative bypass route proposed by the Albury-Wodonga Development Corporation differs from the routes evaluated in this report mainly by including a more direct alignment of the Hume Highway between Bowna and Table Top. It does not alter the conclusion that an internal bypass should be constructed prior to an external bypass.

Several comments related to forecast total and bypassable traffic volumes. The data employed in making these forecasts derived from the State Road Authorities, the Albury-Wodonga Development Corporation and surveys carried out by the Bureau. The analyses performed with this data are considered to provide the best forecasts available for the evaluation.

The Albury-Wodonga Development Corporation were critical of the construction costs employed in the analysis. These were provided by the State Road Authorities for the purpose of comparing the external and internal bypasses and were the best available for this purpose.

The Country Roads Board proposal to make provision in the first stage for an ultimate six lane cross section for the Wodonga Bypass would increase the cost but would not increase user benefits. In this situation the economic warrant will only be improved by reducing the cost.