COMMONWEALTH DEPARTMENT OF TRANSPORT AND REGIONAL SERVICES

RTA

vicroads

Murray River Crossing at Echuca/Moama

Environment Effects Statement/Environmental Impact Statement

Technical Supplement

Volume 1 of 2

December, 2001

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Vol. 1

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- **Murray River Crossing at Echuca-Moama, Traffic & Economic Evaluation of Options, Phase 2 Report,** *Arup Transportation Planning, July 2000*
- **River Crossing at Echuca-Moama, Further Assessment of Options,** *Arup Transportation Planning, April 2001*
- **River Crossing at Echuca-Moama, C1 Staging Assessments,** *Arup Transportation Planning, May 2001*
- **Northern Highway, Murray River Bridge at Echuca, Traffic Analysis,** *VicRoads Design, May 2001*
- **Murray River Bridge at Echuca, Single Lane Merge prior to the Bridge,** *VicRoads Design, July 2001*
- **Northern Highway, Echuca-Moama Murray River Bridge, Francis Street Extension to Cobb Highway,** *VicRoads Design, July 2001*

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- **Murray River Crossing at Echuca-Moama, Traffic & Economic Evaluation of Options, Phase 2 Report,** *Arup Transportation Planning, July 2000*
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- **Northern Highway, Echuca-Moama Murray River Bridge, Francis Street Extension to Cobb Highway,** *VicRoads Design, July 2001*

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Murray River Crossing at Echuca-Moama

Detailed Traffic & Economic Evaluation of Options

Prepared for
VicRoads Planning Investigations

By
Arup Transportation Planning

February 2000

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REPORT ISSUE AUTHORISATION

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	17/02/00 29/02/00	Draft Final Report	JAF JAF	CAT

This report takes into account the particular instructions and requirements of our Client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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1. INTRODUCTION

Arup Transportation Planning was appointed in December 1999 by VicRoads Planning Investigations to undertake a detailed traffic and economic assessment of four river crossing options, taking into account the refinement of alignments and the proposed maintenance program of the existing bridge.

Arup have already undertaken preliminary traffic and economic assessments of each of the options, using the EMME/2 model developed by Arup for the region in the Echuca-Moama study (Arup, December 1998). The focus of this study is to undertake a more detailed assessment of the traffic and economic performance of each of the proposed four river crossings.

This report briefly outlines the traffic performance and economic evaluation undertaken for each of the proposed crossings, using costings provided by VicRoads. The analysis is based on the same methodology used in the previous economic evaluation estimates.

2. TRAFFIC PERFORMANCE

2.1 Option Description

Figure 2.1 indicates the refined alignments of the four options assessed as part of this study. There are several variations along the Western corridor, however only W1 is considered in this report, as the differences in traffic performance between these variations are unlikely to be significant.

2.1.1 Option W1

The western option includes a new 80 km/hr bridge connecting the Murray Valley Highway in Echuca and Perricoota Road in Moama.

Based on advice from the RTA NSW and VicRoads, a 14 month maintenance period was assumed for the existing bridge, commencing in 2004 immediately after construction of the new bridge. During the maintenance period the existing bridge was assumed to be one lane, operating with signals at either end. An average daily delay of 2.67 minutes was adopted. This was based on analysis of the proposed temporary signals using SIDRA, existing traffic flows and signal timing parameters based on the bridge length and capacity considerations.

A further assessment was undertaken on the western option, including an extension from Perricoota Road to the Cobb Highway.

2.1.2 Option C1

This option includes a new 70 km/hr bridge, with at grade intersections at Sturt Street in Echuca and Meninya Street in Moama. Duplication of Sturt Street to just south of Pakenham Street and the Cobb Highway from Meninya Street to Perricoota Road were included in this option.

During the 14 month maintenance period which commences in 2004, the existing bridge was assumed to be fully closed, with the new bridge operating as two way. After the maintenance period, the existing bridge is assumed to be one way for northbound traffic, with a speed limit of 70 km/hr. The new bridge operates as one way southbound.

2.1.3 Option C2

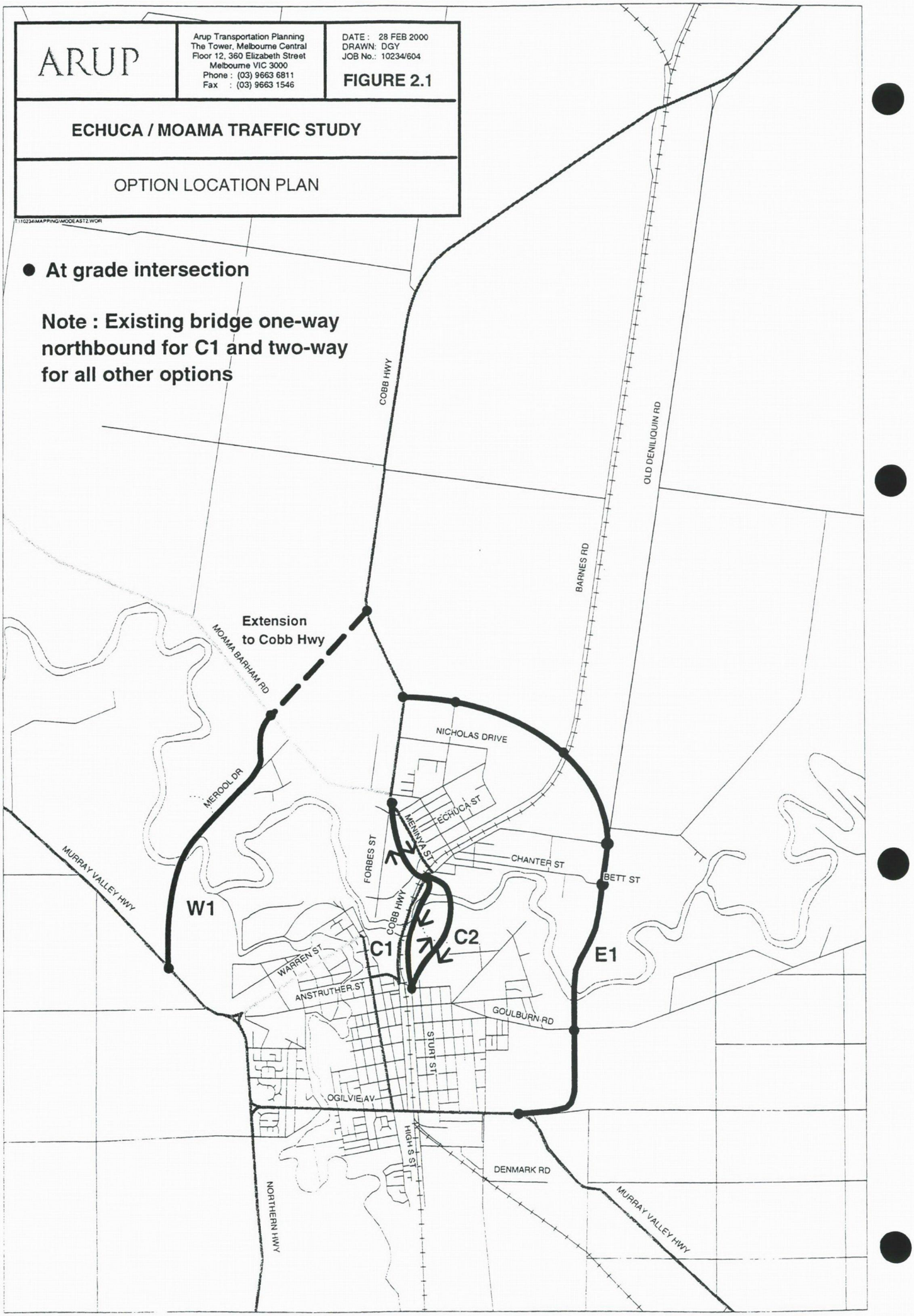
This is the second central option, including a new 70 km/hr bridge with at grade intersections at Sturt Street in Echuca, and Meninya Street in Moama. As in option C1, duplication of Sturt Street to south of Pakenham Street, and the Cobb Highway from Meninya Street to Perricoota Road were included in this option.

During the 14 month maintenance period which commences in 2004, the existing bridge was assumed to be fully closed, with the new bridge operating as two way. After the maintenance period, the existing bridge will operate as two way with a speed restriction of 60 km/hr.

2.1.4 Option E1

The eastern option includes a new 80 km/hr bridge connecting the Murray Valley Highway at the eastern end of Echuca and the Cobb Highway to the north of Nicholas Drive in Moama.

The existing bridge assumed a speed limit of 60 km/hr, with a 14 month maintenance period commencing in 2004. During the maintenance period, the same delay was assumed as for option W1, with the existing bridge operating as one lane only with signals at both ends.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DATE : 28 FEB 2000
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JOB No.: 10234/604
FIGURE 2.1
ECHUCA / MOAMA TRAFFIC STUDY
OPTION LOCATION PLAN
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● At grade intersection
Note : Existing bridge one-way northbound for C1 and two-way for all other options
COBB HWY
OLD DENILIQUIN RD
BARNES RD
Extension to Cobb Hwy
MOAMA BARHAM RD
NICHOLAS DRIVE
MEROOL DR
ECHUCA ST
MENINYA ST
FORBES ST
CHANTER ST
BETT ST
MURRAY VALLEY HWY
W1
COBB HWY
C1
C2
E1
WARREN ST
ANSTRUTHER ST
GOULBURN RD
STURT ST
OGILVIE AV
HIGH ST
DENMARK RD
NORTHERN HWY
MURRAY VALLEY HWY
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2.2 Traffic Volumes

2.2.1 2016 Traffic Flows

The estimated traffic flows on the existing bridge, the new bridge and the surrounding road network for each of the options in 2016 are shown on **Figure 2.2 – 2.7.**

The traffic flows on the bridges are summarised in **Table 2.1.**

Table 2.1 2016 Predicted Traffic Flows on Existing & New Bridges (vpd)

Option	Existing Bridge	% of Total Crossing Flows	New Bridge	% of Total Crossing Flows
Base	24,400	100%		
W1	16,400	67%	8,100	33%
C1	12,200	50%	12,200	50%
C2	13,200	54%	11,300	46%
E1	17,200	70%	7,300	30%
W1 Ext to Cobb Hwy	16,000	65%	8,500	35%

The table shows the range of attractiveness of the new bridges with between 30% and 50% of the total crossing traffic predicted on them. The central options attract the highest proportion of trips across the river, which is expected given their central location. The crossing traffic is divided equally between the bridges in option C1 as each bridge operates in one direction only.

The extension of W1 to the Cobb Highway attracts a further 400 vpd, or 2% of crossing traffic, to the new bridge.

AUTO VOLUMES

emme/2

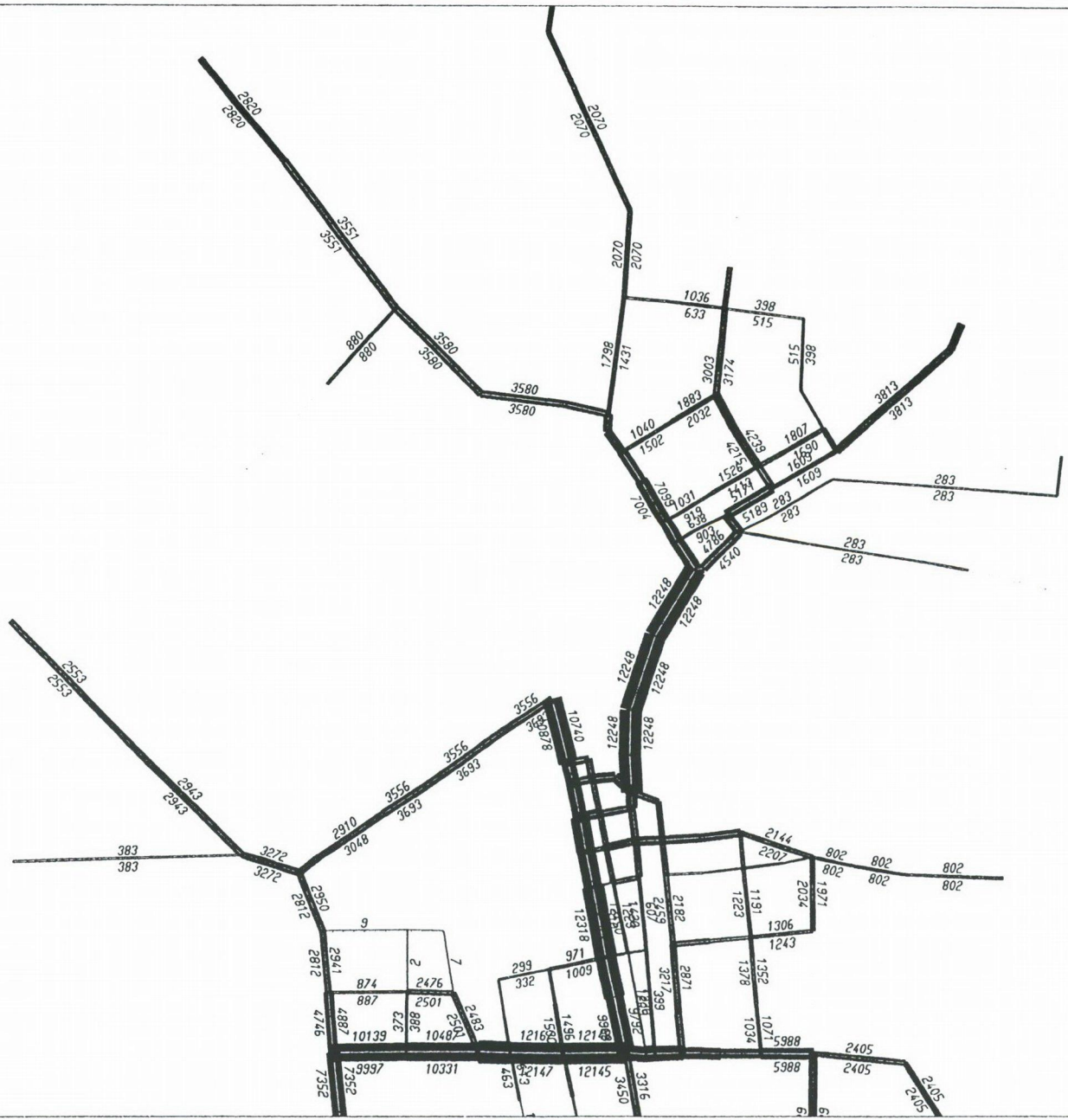

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Figure 2.2

SCALE: 2000

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25000

WINDOW:
293054/5997421
302070/6004183

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 26: 2016 Base Network

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AUTO VOLUMES

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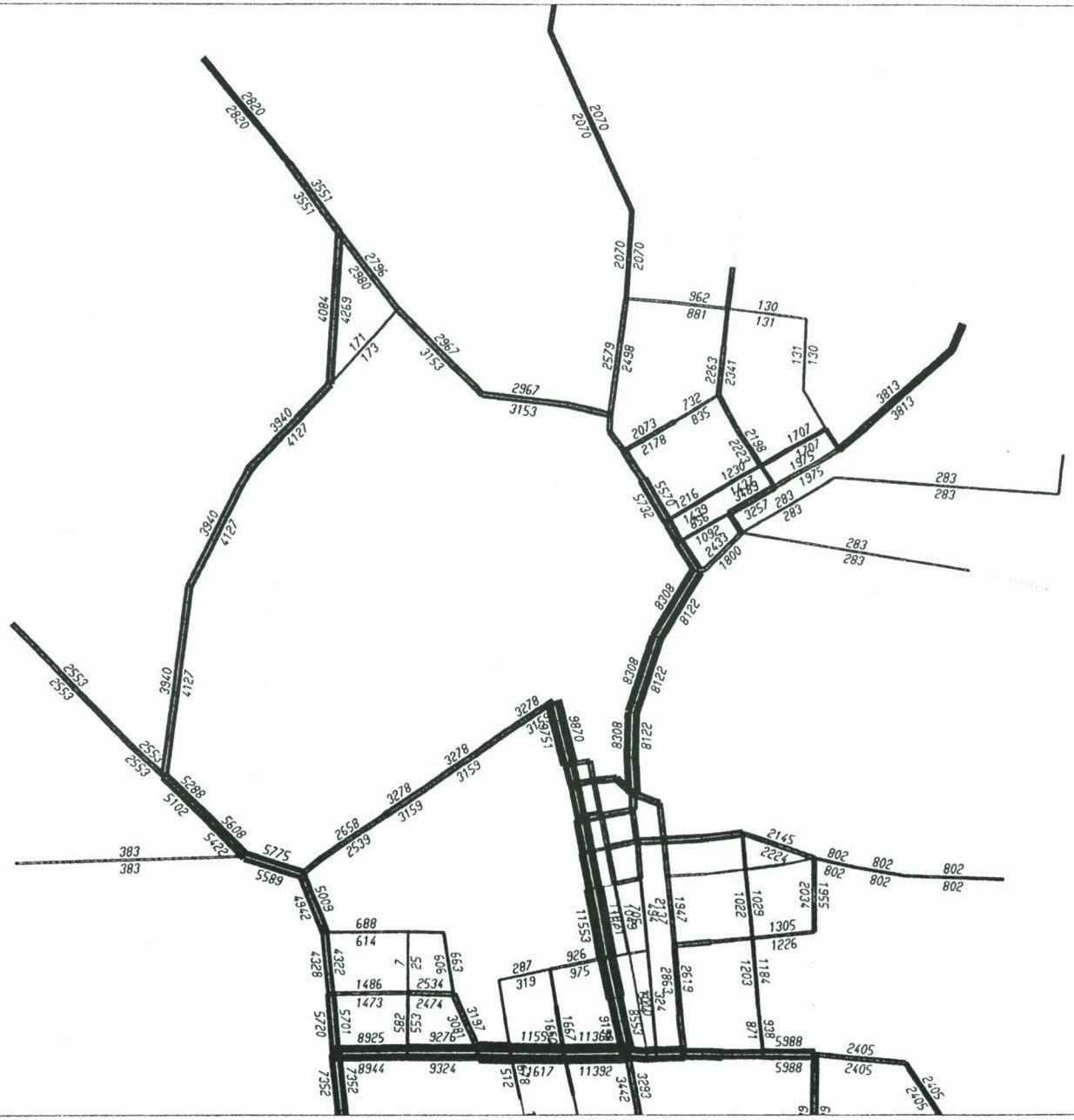

Figure 2.3

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15000

20000

25000

WINDOW:
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302070/6004183

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 444: 2016 W1

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AUTO VOLUMES

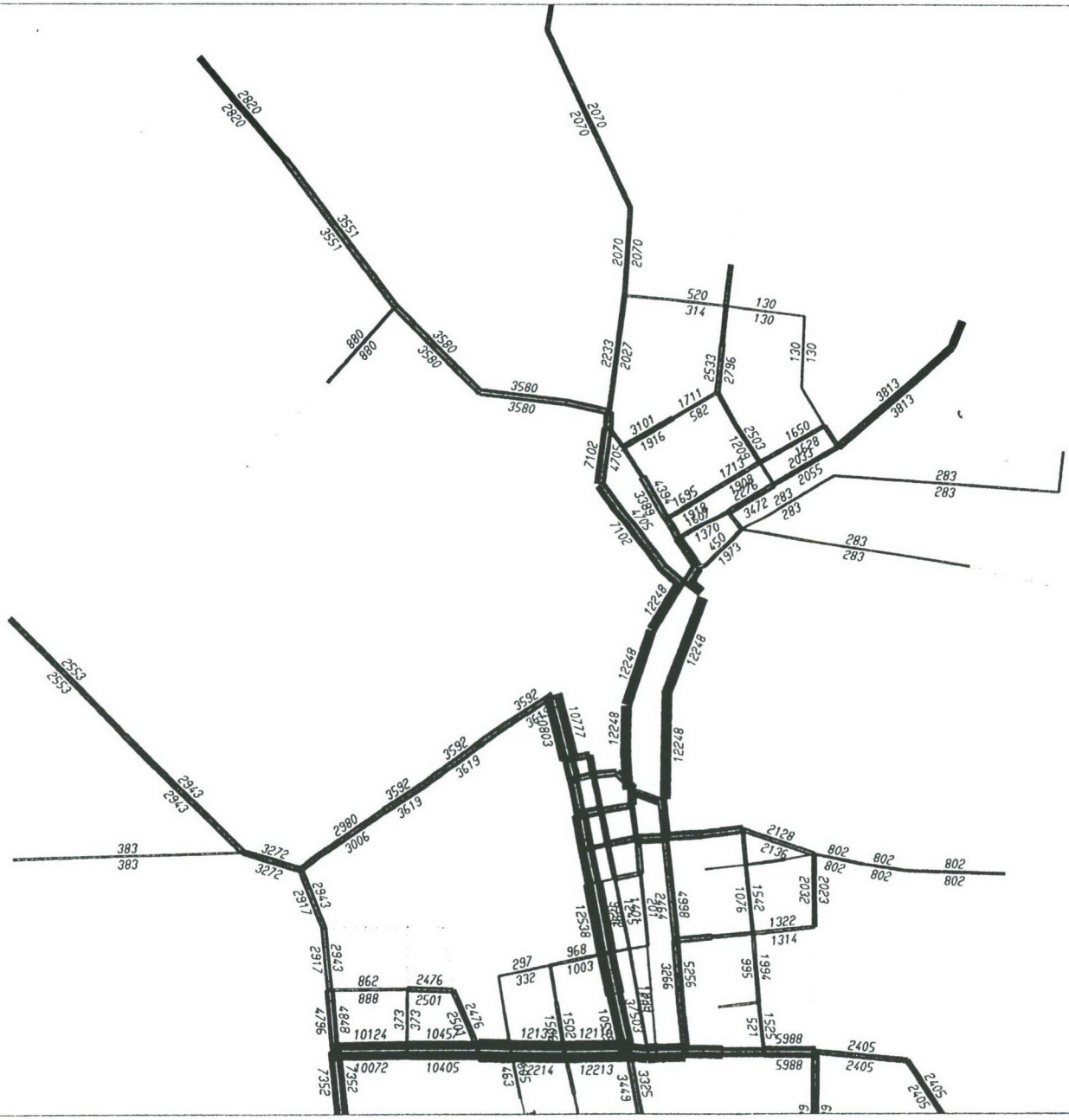

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Figure 2.4

SCALE: 2000

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25000

WINDOW:
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302070/6004183

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 434: 2016 C1

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AUTO VOLUMES

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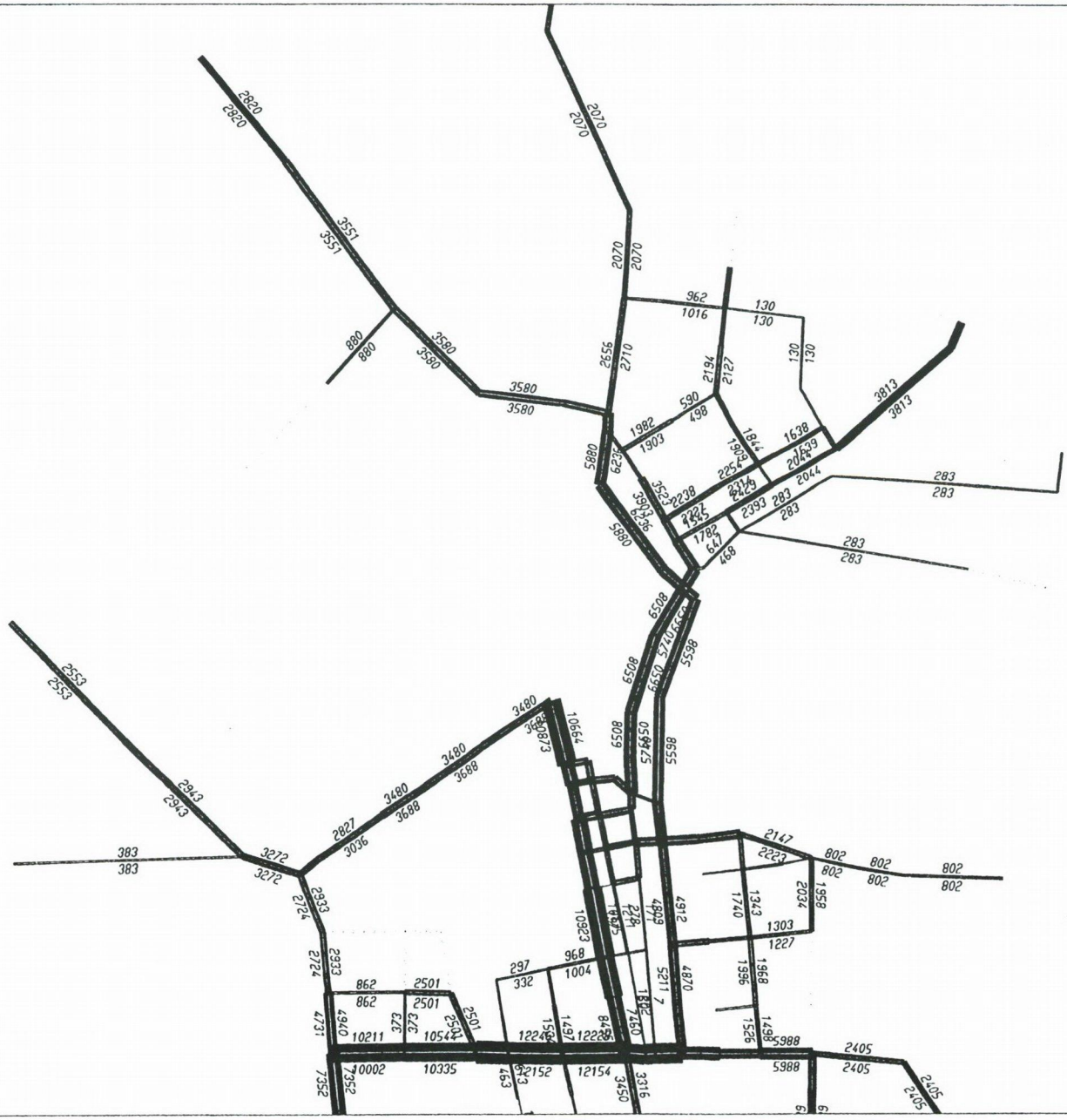

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Figure 2.5

SCALE: 2000

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20000
25000

WINDOW:
293054/5997421
302070/6004183

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 424: 2016 C2

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AUTO VOLUMES

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LINKS:
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Figure 2.6

SCALE: 2000

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10000
15000
20000
25000

WINDOW:
293054/5997421
302070/6004183

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 414: 2016 E1

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AUTO VOLUMES

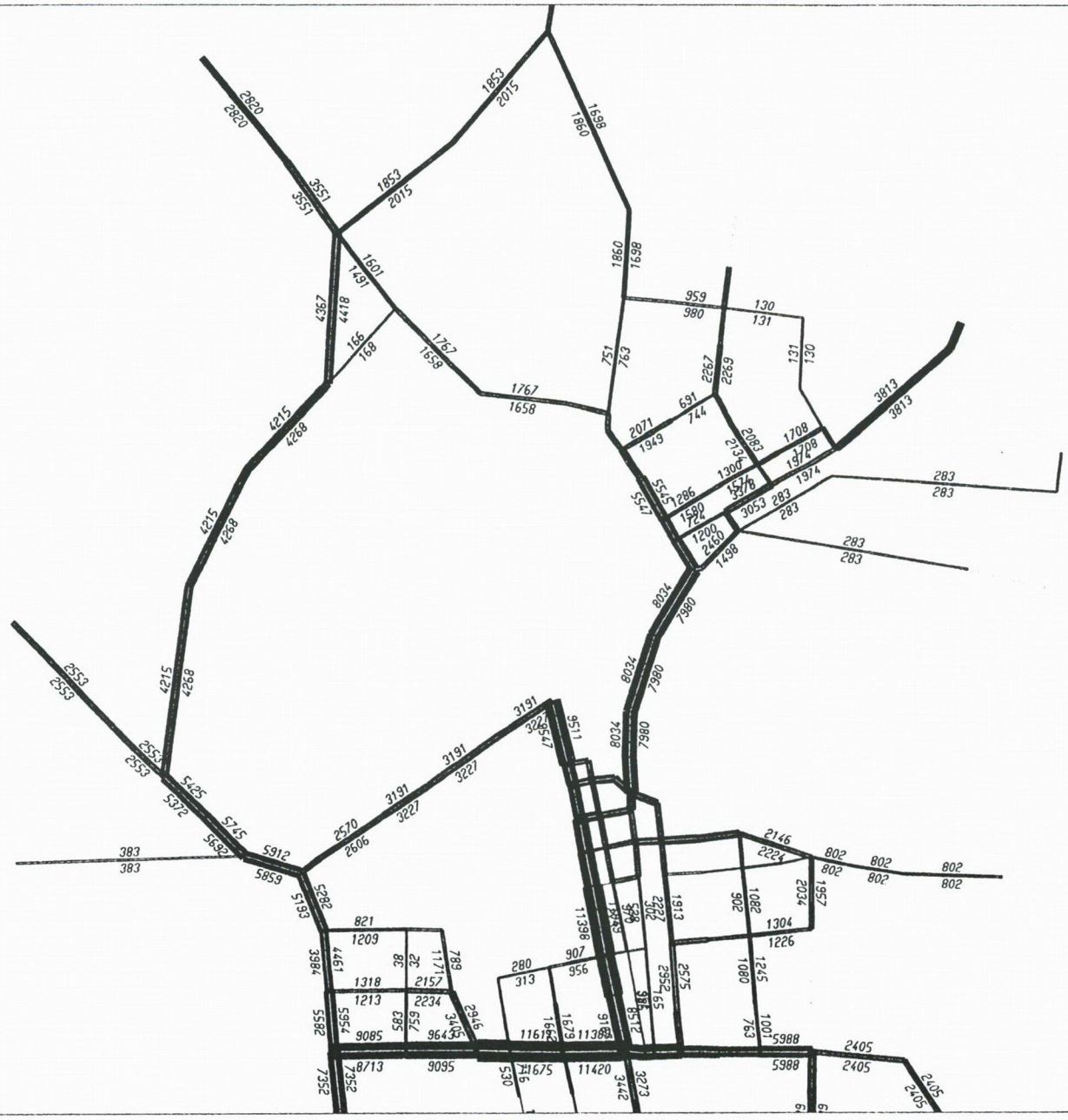

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Figure 2.7

SCALE: 2000

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10000
15000
20000
25000

WINDOW:
293054/5997421
302070/6004183

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 408: 2016 W1 - Extension to Cobb Hwy

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MODULE: 6.12
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2.2.2 Traffic Flows during maintenance

During the maintenance period traffic will divert from the existing bridge to the new bridge. **Table 2.2** highlights the expected diversion of 1997 traffic flows if the bridge were subject to the relevant maintenance regime. This gives an indication of the predicted diversion of existing (1997) traffic flows.

Table 2.2 Predicted 1997 Traffic Diversion Flows from the Existing to the New Bridge During Maintenance

Option	Existing Bridge (vpd) Without Maintenance	Diversion (vpd) due to Maintenance	Existing Bridge (vpd) With Maintenance	% of Total Crossing Flows
W1	11,400	3,600	7,800	23%
C1	7,900	7,900	-	50%
C2	7,900	7,900	-	50%
E1	12,600	4,000	8,600	25%
W1 Cobb Hwy Extension	11,000	4,000	7,000	26%

Table 2.3 summarises the diversion of traffic from the existing to the new bridge during maintenance, highlighting the predicted flows on each bridge during maintenance.

Table 2.3 Predicted 1997 Traffic Flows on Existing & New Bridges During Maintenance

Option	Existing Bridge (vpd)	% of Total Crossing Flows	New Bridge (vpd)	% of Total Crossing Flows
W1	7,800	50%	7,900	50%
C1	-	-	15,700	100%
C2	-	-	15,700	100%
E1	8,600	54%	7,200	46%
W1 Cobb Hwy Extension	7,000	44%	8,700	56%

The two central options assume full closure of the existing bridge under maintenance, which means all traffic crossing the river must divert to the new bridge.

Some 3,600 vpd are predicted to divert to the new bridge as a result of the maintenance regime for option W1. The level of diversion increases to 4,000 vpd when the extension to the Cobb Highway is included, with the new bridge carrying approximately 800 vpd more than W1 alone during maintenance. 4,000 vpd divert to the new bridge during maintenance in option E1.

2.2.3 Annual Cost of Diversion

The annual cost of the diversion due to the proposed maintenance regime of the existing bridge was estimated, by comparing the total road user savings in 2004 with and without maintenance. These results are summarised in **Table 2.4.**

Table 2.4 Predicted Annual Cost (2004) of Traffic Diversion due to Maintenance

Option	Annual Savings Without Maintenance ($M)	Annual Savings During Maintenance ($M) [1]	Annual Road User Costs due to Maintenance ($M)
W1	4.6	1.1	3.5
C1	5.0	4.0	1
C2	4.4	2.6	1.8
E1	2.6	-0.5	3.1
W1 Ext to Cobb Hwy	5.3	1.6	3.7

Notes:
1. These twelve month savings accrued during maintenance are factored to represent a fourteen month period. The savings accrued in 2005 are similarly factored down to a ten month period. Refer to the benefits streams in Appendix A.

The cost of the diversion due to maintenance is less in the central options, despite the full closure of the existing bridge. This can be explained by the smaller distances involved in the diversion, whilst the longer distances required in diverting to E1 and W1, are shown by the higher road user costs in these scenarios.

It should be noted that there may be an opportunity to reduce the maintenance period for C1 and C2 because of the full closure of the existing bridge. If this is the case, the annual road user costs due to maintenance would be reduced and result in a slight increase in the total benefits of these options.

3. ECONOMIC EVALUATION

3.1 Option Costing

Preliminary estimated costs for each of the alignments were provided by VicRoads Planning Investigations Department, as shown in **Table 3.1.**

Table 3.1 Preliminary Estimated Alignment Costs

Option	Estimated Cost ($M)
W1	33.3
C1	35.1
C2	44.5
E1	43.5
Extension to Cobb Hwy (Western)	3.0

3.2 Results

A standard approach to economic evaluation of road user benefits has been applied for assessment of the economic performance of projects.

The results of the benefit calculations, including the road user benefit and cost streams are summarised in **Table 3.2**, and detailed in **Appendix A**. All values ($M) assume 1999 prices exclusive of GST and are based on a discount rate of 7%.

Table 3.2 Costs and Benefits of Each Option

Comparison Factor	W1	C1	C2	E1	W1 – Ext to Cobb Hwy
Total Construction Costs	33	35	45	44	36
PV Project Costs	**25**	**26**	**33**	**32**	**27**
PV Vehicle Operating Cost Savings	16	12	10	6	19
PV Travel Time Savings	76	82	80	66	80
PV Freight Time Savings	5	6	6	5	5
PV Accident Cost Savings	2	5	5	4	2
PV Road User Benefits	**98**	**105**	**100**	**80**	**106**
Benefit Cost Ratio	4.0	4.0	3.1	2.5	4.0
Net Present Value	74	79	67	47	79

The benefit cost ratios (BCR) suggests options W1 and C1 are the most economically viable options. These are the least expensive options and provide substantial benefits. Option C1 delivers higher benefits than W1, although this is offset by its higher capital cost as the BCR for these two options are virtually the same.

The central options deliver the highest travel time savings, while the western option has the highest savings in vehicle operating costs.

The feasibility of a $3M extension of the western option to the Cobb Highway was also assessed. The table shows the expected additional benefits from this extension are approximately $8M, delivering a BCR of 3.5.

Appendix A

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option W1

As at 02/02/00

					1997	0.7	2.0	0.1	0.1	2.9		
	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(16.7)	0.0	0.0	0.0	(16.7)	0.0	0.0	0.0	0.0	0.0	(16.7)	(13.3)
2003	(16.7)	0.0	0.0	0.0	(16.7)	0.0	0.0	0.0	0.0	0.0	(16.7)	(25.9)
2004	0.0	0.0	0.0	0.0	0.0	0.2	1.1	(0.0)	0.0	1.3	1.3	(23.2)
2005	0.0	0.0	0.0	0.0	0.0	0.8	2.9	0.2	0.1	4.0	4.0	(20.6)
2006	0.0	0.0	0.0	0.0	0.0	**1.1**	**3.6**	**0.3**	**0.1**	**5.1**	5.1	(18.0)
2007	0.0	0.0	0.0	0.0	0.0	1.1	4.2	0.3	0.2	5.7	5.7	(15.3)
2008	0.0	0.0	0.0	0.0	0.0	1.2	4.7	0.3	0.2	6.4	6.4	(12.4)
2009	0.0	0.0	0.0	0.0	0.0	1.3	5.2	0.4	0.2	7.0	7.0	(9.5)
2010	0.0	0.0	0.0	0.0	0.0	1.4	5.7	0.4	0.2	7.6	7.6	(6.6)
2011	0.0	0.0	0.0	0.0	0.0	1.5	6.2	0.4	0.2	8.3	8.3	(3.6)
2012	0.0	0.0	0.0	0.0	0.0	1.6	6.7	0.5	0.2	8.9	8.9	(0.6)
2013	0.0	0.0	0.0	0.0	0.0	1.7	7.2	0.5	0.2	9.6	9.6	2.5
2014	0.0	0.0	0.0	0.0	0.0	1.7	7.7	0.5	0.2	10.2	10.2	5.5
2015	0.0	0.0	0.0	0.0	0.0	1.8	8.2	0.6	0.2	10.8	10.8	8.5
2016	0.0	0.0	0.0	0.0	0.0	**1.9**	**8.7**	**0.6**	**0.2**	**11.5**	11.5	11.4
2017	0.0	0.0	0.0	0.0	0.0	2.1	10.0	0.7	0.2	13.0	13.0	14.6
2018	0.0	0.0	0.0	0.0	0.0	2.3	11.2	0.8	0.2	14.5	14.5	17.8
2019	0.0	0.0	0.0	0.0	0.0	2.4	12.5	0.8	0.2	16.0	16.0	21.2
2020	0.0	0.0	0.0	0.0	0.0	2.6	13.7	0.9	0.2	17.5	17.5	24.7
2021	0.0	0.0	0.0	0.0	0.0	2.8	14.9	1.0	0.2	19.0	19.0	28.1
2022	0.0	0.0	0.0	0.0	0.0	3.0	16.2	1.1	0.3	20.5	20.5	31.7
2023	0.0	0.0	0.0	0.0	0.0	3.1	17.4	1.2	0.3	22.0	22.0	35.2
2024	0.0	0.0	0.0	0.0	0.0	3.3	18.6	1.2	0.3	23.5	23.5	38.7
2025	0.0	0.0	0.0	0.0	0.0	3.5	19.9	1.3	0.3	25.0	25.0	42.2
2026	0.0	0.0	0.0	0.0	0.0	**3.7**	**21.1**	**1.4**	**0.3**	**26.5**	26.5	45.7
2027	0.0	0.0	0.0	0.0	0.0	3.9	22.4	1.5	0.3	28.0	28.0	49.2
2028	0.0	0.0	0.0	0.0	0.0	4.0	23.6	1.5	0.3	29.5	29.5	52.5
2029	0.0	0.0	0.0	0.0	0.0	4.2	24.8	1.6	0.3	31.0	31.0	55.9
2030	0.0	0.0	0.0	0.0	0.0	4.4	26.1	1.7	0.3	32.5	32.5	59.1
2031	0.0	0.0	0.0	0.0	0.0	4.6	27.3	1.8	0.3	34.0	34.0	62.3
PV @ Discount Rate												
4%	-28	0	0	0	-28	28	140	9	3	180	152	
7%	-25	0	0	0	-25	16	76	5	2	98	74	
10%	-22	0	0	0	-22	9	44	3	1	57	35	
					% of Benefits	16%	77%	5%	2%	100%		

NPV = ($mill)	73.72
IRR=	19%
NPV/CC=	3.00
BCR=	4.00

Capital cost 33.3

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1
As at 02/02/00

					1997	0.4	2.2	0.2	0.4	3.2		
	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(17.6)	0.0	0.0	0.0	(17.6)	0.0	0.0	0.0	0.0	0.0	(17.6)	(11.7)
2003	(17.6)	0.0	0.0	0.0	(17.6)	0.0	0.0	0.0	0.0	0.0	(17.6)	(22.6)
2004	0.0	0.0	0.0	0.0	0.0	0.2	3.4	0.3	0.8	4.6	4.6	(19.7)
2005	0.0	0.0	0.0	0.0	0.0	0.6	3.2	0.2	0.4	4.4	4.4	(16.9)
2006	0.0	0.0	0.0	0.0	0.0	**0.7**	**4.0**	**0.3**	**0.5**	**5.5**	5.5	(14.1)
2007	0.0	0.0	0.0	0.0	0.0	0.8	4.5	0.3	0.5	6.1	6.1	(11.2)
2008	0.0	0.0	0.0	0.0	0.0	0.9	5.1	0.4	0.5	6.8	6.8	(8.1)
2009	0.0	0.0	0.0	0.0	0.0	0.9	5.6	0.4	0.5	7.5	7.5	(5.1)
2010	0.0	0.0	0.0	0.0	0.0	1.0	6.1	0.5	0.5	8.1	8.1	(1.9)
2011	0.0	0.0	0.0	0.0	0.0	1.1	6.7	0.5	0.5	8.8	8.8	1.3
2012	0.0	0.0	0.0	0.0	0.0	1.1	7.2	0.5	0.5	9.4	9.4	4.4
2013	0.0	0.0	0.0	0.0	0.0	1.2	7.7	0.6	0.5	10.1	10.1	7.6
2014	0.0	0.0	0.0	0.0	0.0	1.3	8.3	0.6	0.5	10.7	10.7	10.8
2015	0.0	0.0	0.0	0.0	0.0	1.4	8.8	0.7	0.5	11.4	11.4	13.9
2016	0.0	0.0	0.0	0.0	0.0	**1.4**	**9.3**	**0.7**	**0.5**	**12.0**	12.0	17.1
2017	0.0	0.0	0.0	0.0	0.0	1.6	10.6	0.8	0.6	13.5	13.5	20.3
2018	0.0	0.0	0.0	0.0	0.0	1.8	11.8	0.9	0.6	15.0	15.0	23.7
2019	0.0	0.0	0.0	0.0	0.0	2.0	13.1	0.9	0.6	16.6	16.6	27.2
2020	0.0	0.0	0.0	0.0	0.0	2.1	14.3	1.0	0.6	18.1	18.1	30.8
2021	0.0	0.0	0.0	0.0	0.0	2.3	15.6	1.1	0.6	19.6	19.6	34.4
2022	0.0	0.0	0.0	0.0	0.0	2.5	16.8	1.2	0.6	21.1	21.1	38.0
2023	0.0	0.0	0.0	0.0	0.0	2.7	18.1	1.3	0.6	22.6	22.6	41.7
2024	0.0	0.0	0.0	0.0	0.0	2.8	19.3	1.4	0.6	24.1	24.1	45.3
2025	0.0	0.0	0.0	0.0	0.0	3.0	20.6	1.4	0.6	25.7	25.7	48.9
2026	0.0	0.0	0.0	0.0	0.0	**3.2**	**21.8**	**1.5**	**0.6**	**27.2**	27.2	52.5
2027	0.0	0.0	0.0	0.0	0.0	3.4	23.1	1.6	0.6	28.7	28.7	56.0
2028	0.0	0.0	0.0	0.0	0.0	3.6	24.3	1.7	0.7	30.2	30.2	59.5
2029	0.0	0.0	0.0	0.0	0.0	3.7	25.6	1.8	0.7	31.7	31.7	62.9
2030	0.0	0.0	0.0	0.0	0.0	3.9	26.8	1.9	0.7	33.2	33.2	66.2
2031	0.0	0.0	0.0	0.0	0.0	4.1	28.0	1.9	0.7	34.7	34.7	69.4
PV @ Discount Rate												
4%	-29	0	0	0	-29	22	149	11	8	190	161	
7%	-26	0	0	0	-26	12	82	6	5	105	79	
10%	-23	0	0	0	-23	7	48	3	3	61	39	
					% of Benefits	12%	78%	6%	5%	100%		

NPV = ($mill)	78.72
IRR=	20%
NPV/CC=	3.04
BCR=	4.04

Capital cost 35.1

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C2
As at 02/02/00

					1997	0.2	2.0	0.2	0.4	2.8		
	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(22.3)	0.0	0.0	0.0	(22.3)	0.0	0.0	0.0	0.0	0.0	(22.3)	(14.8)
2003	(22.3)	0.0	0.0	0.0	(22.3)	0.0	0.0	0.0	0.0	0.0	(22.3)	(28.7)
2004	0.0	0.0	0.0	0.0	0.0	(0.2)	2.3	0.2	0.7	3.0	3.0	(26.1)
2005	0.0	0.0	0.0	0.0	0.0	0.4	2.9	0.2	0.4	3.9	3.9	(23.5)
2006	0.0	0.0	0.0	0.0	0.0	**0.5**	**3.7**	**0.3**	**0.5**	**4.9**	4.9	(21.0)
2007	0.0	0.0	0.0	0.0	0.0	0.6	4.3	0.3	0.5	5.6	5.6	(18.4)
2008	0.0	0.0	0.0	0.0	0.0	0.6	4.8	0.4	0.5	6.3	6.3	(15.6)
2009	0.0	0.0	0.0	0.0	0.0	0.7	5.4	0.4	0.5	7.0	7.0	(12.7)
2010	0.0	0.0	0.0	0.0	0.0	0.8	5.9	0.4	0.5	7.6	7.6	(9.7)
2011	0.0	0.0	0.0	0.0	0.0	0.8	6.5	0.5	0.5	8.3	8.3	(6.7)
2012	0.0	0.0	0.0	0.0	0.0	0.9	7.1	0.5	0.5	9.0	9.0	(3.7)
2013	0.0	0.0	0.0	0.0	0.0	1.0	7.6	0.6	0.5	9.7	9.7	(0.6)
2014	0.0	0.0	0.0	0.0	0.0	1.0	8.2	0.6	0.5	10.4	10.4	2.5
2015	0.0	0.0	0.0	0.0	0.0	1.1	8.7	0.6	0.6	11.0	11.0	5.5
2016	0.0	0.0	0.0	0.0	0.0	**1.2**	**9.3**	**0.7**	**0.6**	**11.7**	11.7	8.5
2017	0.0	0.0	0.0	0.0	0.0	1.3	10.6	0.8	0.6	13.2	13.2	11.7
2018	0.0	0.0	0.0	0.0	0.0	1.5	11.8	0.8	0.6	14.7	14.7	15.1
2019	0.0	0.0	0.0	0.0	0.0	1.7	13.1	0.9	0.6	16.3	16.3	18.5
2020	0.0	0.0	0.0	0.0	0.0	1.9	14.3	1.0	0.6	17.8	17.8	22.0
2021	0.0	0.0	0.0	0.0	0.0	2.0	15.6	1.1	0.6	19.3	19.3	25.6
2022	0.0	0.0	0.0	0.0	0.0	2.2	16.8	1.2	0.6	20.8	20.8	29.1
2023	0.0	0.0	0.0	0.0	0.0	2.4	18.1	1.3	0.6	22.3	22.3	32.7
2024	0.0	0.0	0.0	0.0	0.0	2.5	19.3	1.3	0.6	23.8	23.8	36.3
2025	0.0	0.0	0.0	0.0	0.0	2.7	20.6	1.4	0.6	25.3	25.3	39.9
2026	0.0	0.0	0.0	0.0	0.0	**2.9**	**21.8**	**1.5**	**0.7**	**26.8**	26.8	43.4
2027	0.0	0.0	0.0	0.0	0.0	3.0	23.1	1.6	0.7	28.3	28.3	46.9
2028	0.0	0.0	0.0	0.0	0.0	3.2	24.3	1.7	0.7	29.9	29.9	50.3
2029	0.0	0.0	0.0	0.0	0.0	3.4	25.6	1.8	0.7	31.4	31.4	53.7
2030	0.0	0.0	0.0	0.0	0.0	3.6	26.8	1.8	0.7	32.9	32.9	57.0
2031	0.0	0.0	0.0	0.0	0.0	3.7	28.1	1.9	0.7	34.4	34.4	60.2
PV @ Discount Rate												
4%	-37	0	0	0	-37	19	147	10	8	184	146	
7%	-33	0	0	0	-33	10	80	6	5	100	67	
10%	-29	0	0	0	-29	6	46	3	3	58	29	
				% of Benefits		10%	80%	6%	5%	100%		

NPV = ($mill)	67.48
IRR=	16%
NPV/CC=	2.05
BCR=	3.05

Capital cost 44.5

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option E1

As at 02/02/00

					1997	0.1	0.8	0.1	0.2	1.1		
	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(21.8)	0.0	0.0	0.0	(21.8)	0.0	0.0	0.0	0.0	0.0	(21.8)	(14.5)
2003	(21.8)	0.0	0.0	0.0	(21.8)	0.0	0.0	0.0	0.0	0.0	(21.8)	(28.0)
2004	0.0	0.0	0.0	0.0	0.0	(1.0)	(0.2)	0.0	0.6	(0.5)	(0.5)	(26.5)
2005	0.0	0.0	0.0	0.0	0.0	0.2	1.8	0.2	0.2	2.3	2.3	(25.0)
2006	0.0	0.0	0.0	0.0	0.0	**0.2**	**2.3**	**0.2**	**0.3**	**3.0**	3.0	(23.5)
2007	0.0	0.0	0.0	0.0	0.0	0.3	2.8	0.2	0.3	3.6	3.6	(21.7)
2008	0.0	0.0	0.0	0.0	0.0	0.3	3.3	0.3	0.3	4.2	4.2	(19.9)
2009	0.0	0.0	0.0	0.0	0.0	0.3	3.9	0.3	0.3	4.8	4.8	(17.8)
2010	0.0	0.0	0.0	0.0	0.0	0.4	4.4	0.3	0.3	5.4	5.4	(15.7)
2011	0.0	0.0	0.0	0.0	0.0	0.4	4.9	0.4	0.4	6.0	6.0	(13.5)
2012	0.0	0.0	0.0	0.0	0.0	0.5	5.4	0.4	0.4	6.6	6.6	(11.3)
2013	0.0	0.0	0.0	0.0	0.0	0.5	5.9	0.4	0.4	7.3	7.3	(9.0)
2014	0.0	0.0	0.0	0.0	0.0	0.6	6.4	0.5	0.4	7.9	7.9	(6.7)
2015	0.0	0.0	0.0	0.0	0.0	0.6	6.9	0.5	0.4	8.5	8.5	(4.3)
2016	0.0	0.0	0.0	0.0	0.0	**0.6**	**7.4**	**0.5**	**0.5**	**9.1**	9.1	(2.0)
2017	0.0	0.0	0.0	0.0	0.0	0.8	8.7	0.6	0.5	10.6	10.6	0.6
2018	0.0	0.0	0.0	0.0	0.0	0.9	10.0	0.7	0.5	12.1	12.1	3.3
2019	0.0	0.0	0.0	0.0	0.0	1.1	11.3	0.8	0.5	13.6	13.6	6.2
2020	0.0	0.0	0.0	0.0	0.0	1.2	12.6	0.9	0.5	15.2	15.2	9.2
2021	0.0	0.0	0.0	0.0	0.0	1.4	13.9	0.9	0.5	16.7	16.7	12.2
2022	0.0	0.0	0.0	0.0	0.0	1.5	15.2	1.0	0.5	18.2	18.2	15.4
2023	0.0	0.0	0.0	0.0	0.0	1.7	16.4	1.1	0.5	19.7	19.7	18.5
2024	0.0	0.0	0.0	0.0	0.0	1.8	17.7	1.2	0.5	21.2	21.2	21.7
2025	0.0	0.0	0.0	0.0	0.0	2.0	19.0	1.2	0.5	22.8	22.8	24.9
2026	0.0	0.0	0.0	0.0	0.0	**2.1**	**20.3**	**1.3**	**0.5**	**24.3**	24.3	28.1
2027	0.0	0.0	0.0	0.0	0.0	2.3	21.6	1.4	0.6	25.8	25.8	31.3
2028	0.0	0.0	0.0	0.0	0.0	2.4	22.9	1.5	0.6	27.3	27.3	34.4
2029	0.0	0.0	0.0	0.0	0.0	2.6	24.2	1.5	0.6	28.8	28.8	37.5
2030	0.0	0.0	0.0	0.0	0.0	2.7	25.4	1.6	0.6	30.4	30.4	40.6
2031	0.0	0.0	0.0	0.0	0.0	2.9	26.7	1.7	0.6	31.9	31.9	43.5
PV @ Discount Rate												
4%	-36	0	0	0	-36	11	125	9	6	150	114	
7%	-32	0	0	0	-32	6	66	5	4	80	47	
10%	-28	0	0	0	-28	3	37	3	2	45	16	
					% of Benefits	7%	82%	6%	5%	100%		

NPV = ($mill)	47.47
IRR=	13%
NPV/CC=	1.48
BCR=	2.48

Capital cost 43.5

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option W1 - Extension to the Cobb Hwy
As at 02/02/00

					1997	0.9	2.3	0.2	0.1	3.5		
	Costs ($millions)					Benefits ($millions)						
Year	Capital Costs	Maintenance Rout	Per	Rehab	Total Costs	VOC	TT	Freight	Acc	Total	Cost -Benefit	NPV @ 7%
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(18.2)	0.0	0.0	0.0	(18.2)	0.0	0.0	0.0	0.0	0.0	(18.2)	(13.3)
2003	(18.2)	0.0	0.0	0.0	(18.2)	0.0	0.0	0.0	0.0	0.0	(18.2)	(25.9)
2004	0.0	0.0	0.0	0.0	0.0	0.4	1.4	0.0	0.1	1.9	1.9	(22.8)
2005	0.0	0.0	0.0	0.0	0.0	1.1	3.1	0.2	0.1	4.6	4.6	(19.9)
2006	0.0	0.0	0.0	0.0	0.0	**1.4**	**3.9**	**0.3**	**0.2**	**5.8**	5.8	(16.9)
2007	0.0	0.0	0.0	0.0	0.0	1.5	4.4	0.3	0.2	6.4	6.4	(13.9)
2008	0.0	0.0	0.0	0.0	0.0	1.6	5.0	0.4	0.2	7.1	7.1	(10.7)
2009	0.0	0.0	0.0	0.0	0.0	1.7	5.5	0.4	0.2	7.8	7.8	(7.5)
2010	0.0	0.0	0.0	0.0	0.0	1.8	6.1	0.4	0.2	8.5	8.5	(4.2)
2011	0.0	0.0	0.0	0.0	0.0	1.8	6.6	0.5	0.2	9.2	9.2	(0.9)
2012	0.0	0.0	0.0	0.0	0.0	1.9	7.1	0.5	0.3	9.8	9.8	2.5
2013	0.0	0.0	0.0	0.0	0.0	2.0	7.7	0.5	0.3	10.5	10.5	5.8
2014	0.0	0.0	0.0	0.0	0.0	2.1	8.2	0.6	0.3	11.2	11.2	9.1
2015	0.0	0.0	0.0	0.0	0.0	2.2	8.8	0.6	0.3	11.9	11.9	12.4
2016	0.0	0.0	0.0	0.0	0.0	**2.3**	**9.3**	**0.7**	**0.3**	**12.5**	12.5	15.6
2017	0.0	0.0	0.0	0.0	0.0	2.5	10.5	0.7	0.3	14.1	14.1	19.0
2018	0.0	0.0	0.0	0.0	0.0	2.7	11.8	0.8	0.3	15.6	15.6	22.5
2019	0.0	0.0	0.0	0.0	0.0	2.9	13.0	0.9	0.3	17.1	17.1	26.1
2020	0.0	0.0	0.0	0.0	0.0	3.0	14.3	1.0	0.3	18.6	18.6	29.8
2021	0.0	0.0	0.0	0.0	0.0	3.2	15.5	1.0	0.4	20.1	20.1	33.5
2022	0.0	0.0	0.0	0.0	0.0	3.4	16.7	1.1	0.4	21.6	21.6	37.2
2023	0.0	0.0	0.0	0.0	0.0	3.6	18.0	1.2	0.4	23.2	23.2	41.0
2024	0.0	0.0	0.0	0.0	0.0	3.8	19.2	1.3	0.4	24.7	24.7	44.7
2025	0.0	0.0	0.0	0.0	0.0	4.0	20.5	1.4	0.4	26.2	26.2	48.4
2026	0.0	0.0	0.0	0.0	0.0	**4.2**	**21.7**	**1.4**	**0.4**	**27.7**	27.7	52.0
2027	0.0	0.0	0.0	0.0	0.0	4.4	22.9	1.5	0.4	29.2	29.2	55.6
2028	0.0	0.0	0.0	0.0	0.0	4.6	24.2	1.6	0.4	30.7	30.7	59.1
2029	0.0	0.0	0.0	0.0	0.0	4.7	25.4	1.7	0.4	32.3	32.3	62.6
2030	0.0	0.0	0.0	0.0	0.0	4.9	26.7	1.8	0.4	33.8	33.8	66.0
2031	0.0	0.0	0.0	0.0	0.0	5.1	27.9	1.8	0.4	35.3	35.3	69.3
PV @ Discount Rate												
4%	-30	0	0	0	-30	33	146	10	4	193	163	
7%	-27	0	0	0	-27	19	80	5	2	106	79	
10%	-24	0	0	0	-24	11	46	3	1	62	38	
					% of Benefits	18%	75%	5%	2%	100%		

NPV = ($mill)	79.33
IRR=	19%
NPV/CC=	2.96
BCR=	3.96

Capital cost 36.3

ARUP

Murray River Crossing at Echuca-Moama

Traffic & Economic Evaluation of Options – Phase 2 Report

Prepared for
VicRoads Planning Investigations

By
Arup Transportation Planning

July 2000

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REPORT ISSUE AUTHORISATION

PROJECT: Murray River Crossing at Echuca-Moama **Project No:** 10234/606

Rev	Date	Purpose of Issue/Nature of Revision	Prepared by	Issue Authorised by
	27/06/00	Draft	JAF	CAT
	13/07/00	Final Report	JAF	BAJ

This report takes into account the particular instructions and requirements of our Client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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1. INTRODUCTION

Arup Transportation Planning was appointed in April 2000 by VicRoads Planning Investigations to undertake further traffic and economic assessments of options C1, C3 and W1.

Arup have already undertaken preliminary traffic and economic assessments for each of the options, using the EMME/2 model developed by Arup for the region in the Echuca-Moama study (Arup, December 1998). The focus of this study is to undertake a further detailed assessment of the traffic and economic performance of options C1, C3 and W1, incorporating the following:

- the latest refinement of alignments;
- delays at existing level crossings;
- delays at new rail crossings at either end of the central option;
- delays at signalised intersections associated with options;
- sensitivity testing of forecasted population growth; and
- the proposed maintenance program of the existing bridge.

This report briefly outlines the traffic performance and economic evaluation undertaken for each of the currently proposed crossings, using cost estimates provided by VicRoads. The analysis is based on the same methodology used in the previous economic evaluation estimates.

2. TRAFFIC PERFORMANCE

2.1 Option Description

Figure 2.1 indicates the refined alignments of the options assessed as part of this study. These are described in detail in the following section.

2.1.1 Base Case

The base case depicts the existing situation, with 60kph speed limits on the bridge. Delays at the existing rail level crossings were modelled. These include Shaw Street, Francis Street, Anstruther Street, Pakenham Street and Ogilivie Street.

A 14 month maintenance period for rehabilitation of the existing bridge was assumed (as estimated by RTA-NSW), commencing in 2004. The cost of the rehabilitation is estimated by RTA-NSW to be $10.5M and has been included in the economic evaluation. During the maintenance period the existing bridge was assumed to be one lane, operating with signals at either end. An average delay of 2.67 minutes per vehicle was adopted. This was based on analysis of the proposed temporary signals using SIDRA, existing traffic flows and signal timing parameters based on the bridge length and capacity considerations.

Additional sensitivity tests were run, with similar assumptions to the above applied, but with 50% of the forecast population growth.

2.1.2 Option W1

The western option includes a new 80 kph bridge connecting the Murray Valley Highway in Echuca and Perricoota Road in Moama. This is in accordance with the latest design, along Merool Road to Perricoota Road only.

A 14 month maintenance period was assumed (as estimated by RTA-NSW), commencing in 2004 immediately after construction of the new bridge. The cost of the rehabilitation is estimated by RTA-NSW to be $10.5M – similar to the base case - and has been included in the economic evaluation. During the maintenance period the existing bridge was assumed to be one lane, operating with signals at either end. As in the base case, an average delay of 2.67 minutes was adopted, based on the assumptions used in the base case.

Additional delays were modelled at the new roundabout on the Murray Valley Highway, the signalised intersection at Merool Road and as in all options, delays at the existing rail level crossings were modelled. These include Shaw Street, Francis Street, Anstruther Street, Pakenham Street and Ogilivie Street.

In the calculation of the existing delays at rail level crossings, Freight Australia were contacted for advice on the current operation of freight trains in Echuca. There are currently six trains a day, all year round at 05:00, 12:30, 14:00, 17:30, 20:05 and 00:00. Based on advice from Freight Australia it is assumed the boom gates close for an average of five minutes with each train.

The average delay at each rail crossing was calculated based on the proportion of existing bridge traffic that is subject to delay at the scheduled train times. It was assumed each vehicle would suffer a delay of 2.5 minutes, as vehicles would arrive throughout the entire period the boom gates are closed. The proportion of traffic experiencing a delay was applied to existing AADT at each of the rail level crossings

allowing an average delay to be calculated. It was calculated that each vehicle on average would be subject to a delay of 0.06 minutes at each rail level crossing.

Additional sensitivity tests were run, with similar assumptions to the above applied, but with 50% of the forecast population growth.

2.1.3 Option C1

This option includes a new 70 kph bridge, with at grade intersections at Sturt Street/ Anstruther Street in Echuca and Meninya Street in Moama (via Forbes Street). Duplications of Sturt Street to just south of Pakenham Street, of the Sturt Street/ Ogilvie Avenue intersection and the Cobb Highway from Meninya Street to Perricoota Road were included in this option.

A 9 month maintenance period was assumed which commences in 2004. The cost of the rehabilitation is estimated by RTA-NSW to be $9.3M and has been included in the economic evaluation. This is $1.2M less than the base case. During this time the existing bridge was assumed to be fully closed, with the new bridge operating as two way. After the maintenance period, the existing bridge is assumed to be one way for northbound traffic, with a speed limit of 70 kph. The new bridge operates as one way southbound.

The existing bridge also connects into Sturt Street/ Anstruther Street in Echuca. A connection is provided over the railway line along Anstruther Street, and a link from Annesley Street into Heygarth Street is added. The existing roundabout at Annesley Street/ Heygarth Street will close.

Delays were modelled at the existing rail level crossings, along with delays at signalised intersections at Sturt Street/ Ogilvie Ave, Sturt Street/ Pakenham Street, Sturt Street/ Anstruther Street and at the new intersection at the north end of the bridge.

In addition delays at the new rail crossing at either end of the new bridge were calculated based on the delays for the existing crossings.

Additional sensitivity tests were run, with similar assumptions to the above applied, but with 50% of the forecast population growth.

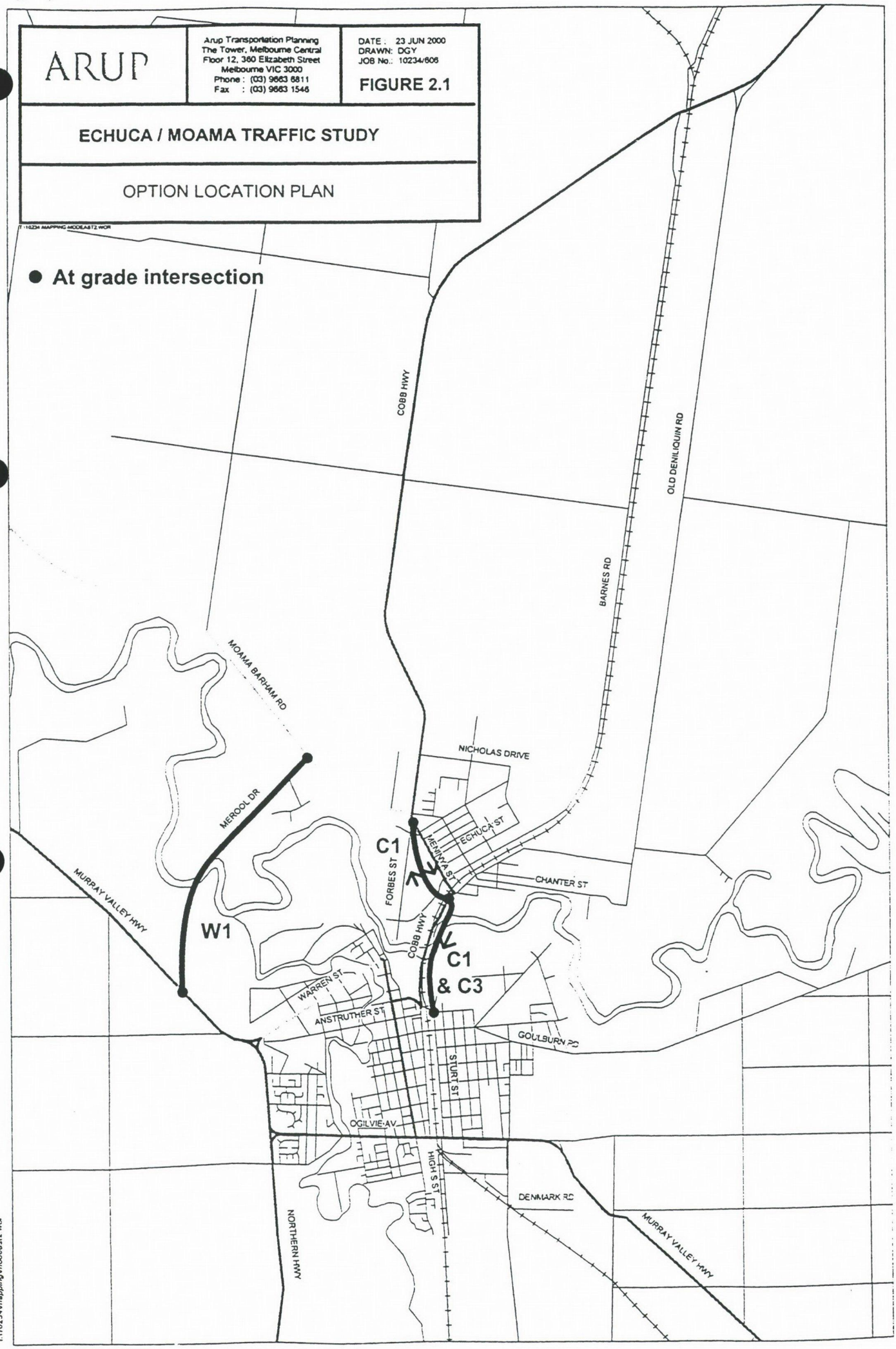
2.1.4 Option C3

This option includes the same crossing of the river as C1. The speed assumptions for the existing and new bridge are similar to option C1, however the new bridge is assumed to connect to the existing roundabout on the Echuca side and the existing floodway bridge on the Moama side. In addition upgrading of the existing floodway bridge and Meninya Street to four lanes is assumed.

As in all options, delays were modelled at the existing rail level crossings and at the new rail crossing at either end of the new bridge. The later was calculated based on the delays for the existing crossings. A signalised intersection was modelled at Meninya Street/ Blair Street.

A 9 month maintenance period was assumed which commences in 2004. The cost of the rehabilitation is estimated by RTA-NSW to be $9.3M and has been included in the economic evaluation. During this time the existing bridge was assumed to be fully closed, with the new bridge operating as two way. After the maintenance period, the existing bridge is assumed to be one way for northbound traffic, with a speed limit of 70 kph. The new bridge operates as one way southbound.

Additional sensitivity tests were run, with similar assumptions to the above applied, but with 50% of the forecast population growth.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DRAWN: DGY
JOB No.: 10234/606
FIGURE 2.1
ECHUCA / MOAMA TRAFFIC STUDY
OPTION LOCATION PLAN
At grade intersection
COBB HWY
OLD DENILIQUIN RD
BARNES RD
MOAMA BARHAM RD
NICHOLAS DRIVE
MEROOL DR
MURRAY VALLEY HWY
W1
C1
HENNYA ST
ECHUCA ST
CHANTER ST
FORBES ST
COBB HWY
C1
& C3
WARREN ST
ANSTRUTHER ST
GOULBURN RD
STURT ST
OGILVIE AV
HIGH ST
DENMARK RD
NORTHERN HWY
MURRAY VALLEY HWY

2.2 Traffic Volumes

2.2.1 2016 Traffic Flows

The estimated traffic flows on the existing bridge, the new bridge and the surrounding road network for each of the options in 2016 are shown on **Figures 2.2 – 2.5.**

The traffic flows on the bridges are summarised in **Table 2.1.**

Table 2.1 2016 Predicted Traffic Flows on Existing & New Bridges (vpd)

Option	Existing Bridge	% of Total Crossing Flows	New Bridge	% of Total Crossing Flows
Base	24,500	100%		
W1	16,500	67%	8,000	33%
C1	12,250	50%	12,250	50%
C3	12,250	50%	12,250	50%

The table shows the range of attractiveness of the new bridges with between 33% and 50% of the total crossing traffic predicted on them. The crossing traffic is divided equally between the bridges in central options as each bridge operates in one direction only.

Sensitivity tests were undertaken assuming 50% of forecast population growth. The estimated traffic flows on the existing bridge, the new bridge and the surrounding road network for each of the options in 2016, assuming 50% of growth are shown on **Figures 2.6 – 2.9**. **Table 2.2** summarises the traffic flows on the bridges with the reduced growth.

Table 2.2 2016 Predicted Traffic Flows on Existing & New Bridges (vpd) : 50% Reduction in Population Growth

Option	Existing Bridge	% of Total Crossing Flows	New Bridge	% of Total Crossing Flows
Base	19,400	100%		
W1	13,500	70%	5,900	30%
C1	9,700	50%	9,800	50%
C3	9,700	50%	9,800	50%

As expected the overall total crossing flows in 2016 are some 5,100 vpd less. However the proportion of traffic using the new bridge in option W1 is slightly less during the lower growth scenario, since congestion in Echuca and over the existing bridge is less and hence the existing bridge is slightly more attractive than with full growth.

AUTO VOLUMES

emme/2

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Figure 2.2

WINDOW
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301369/6003702

EMME/2 PROJECT Echuca Moama Traffic Study
SCENARIO 522 2016 Base Case

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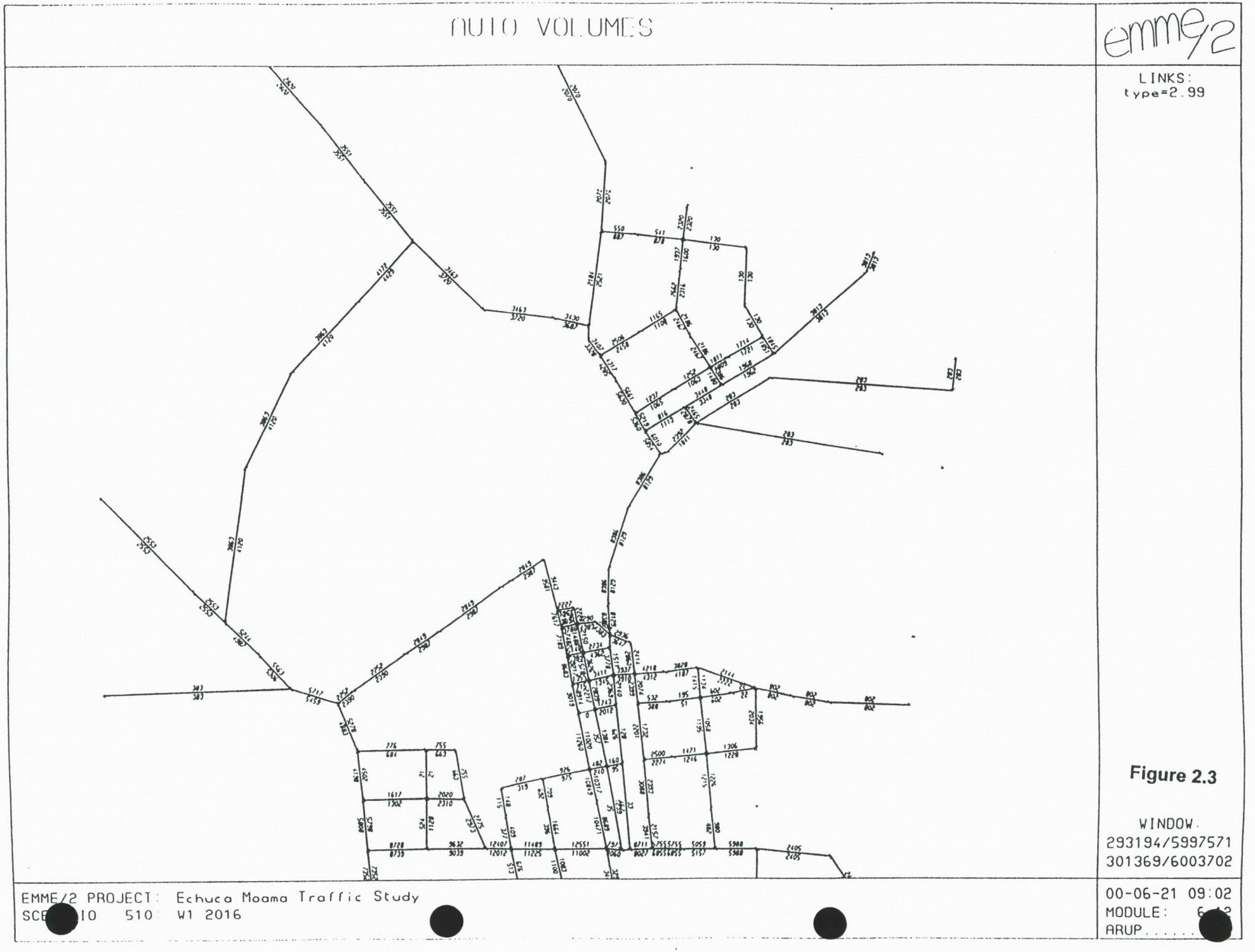
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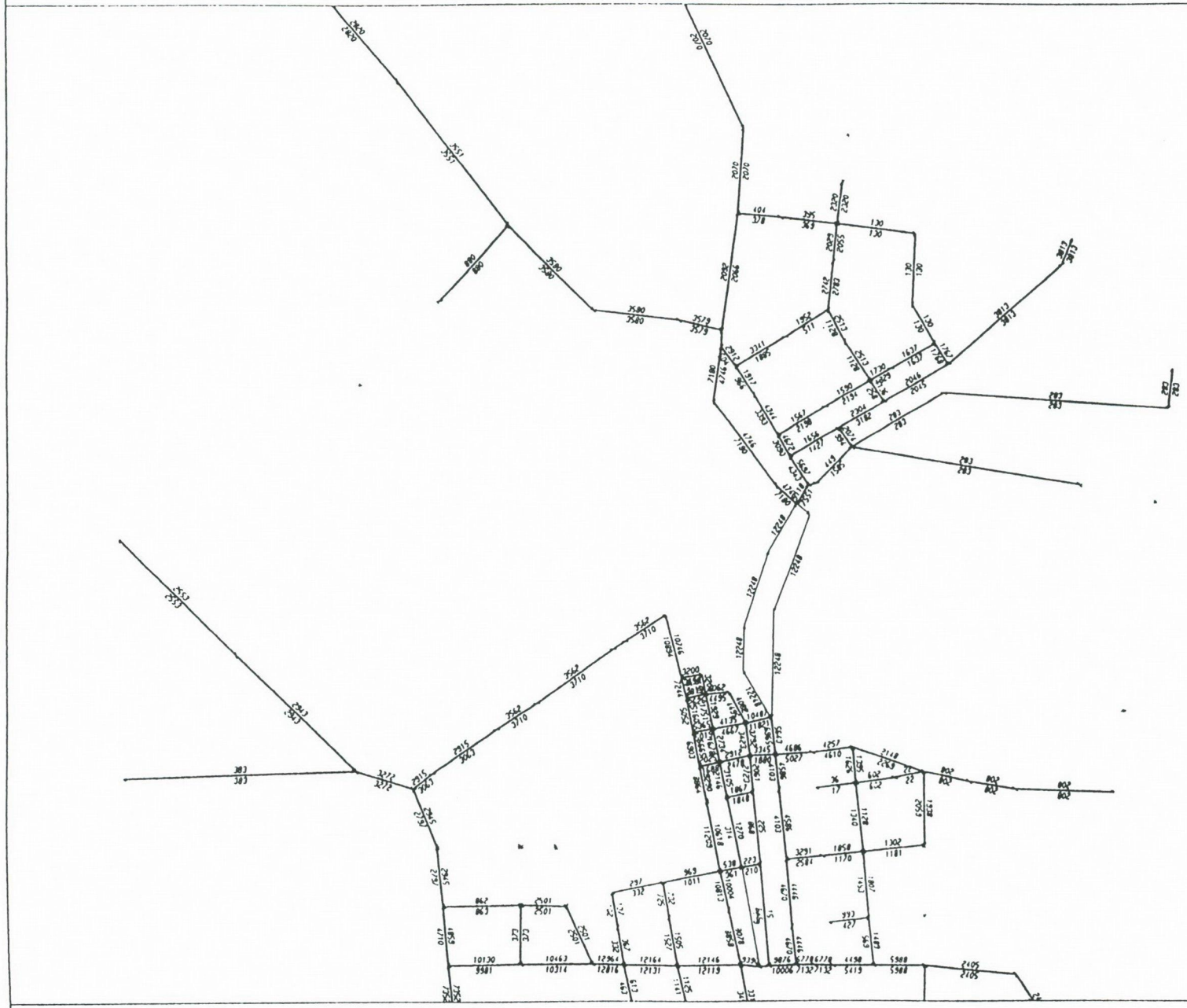

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301369/6003702

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SCENARIO 504: C1 2016

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AUTO VOLUMES

emme/2

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Figure 2.5

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301369/6003702

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 534: C3 2016

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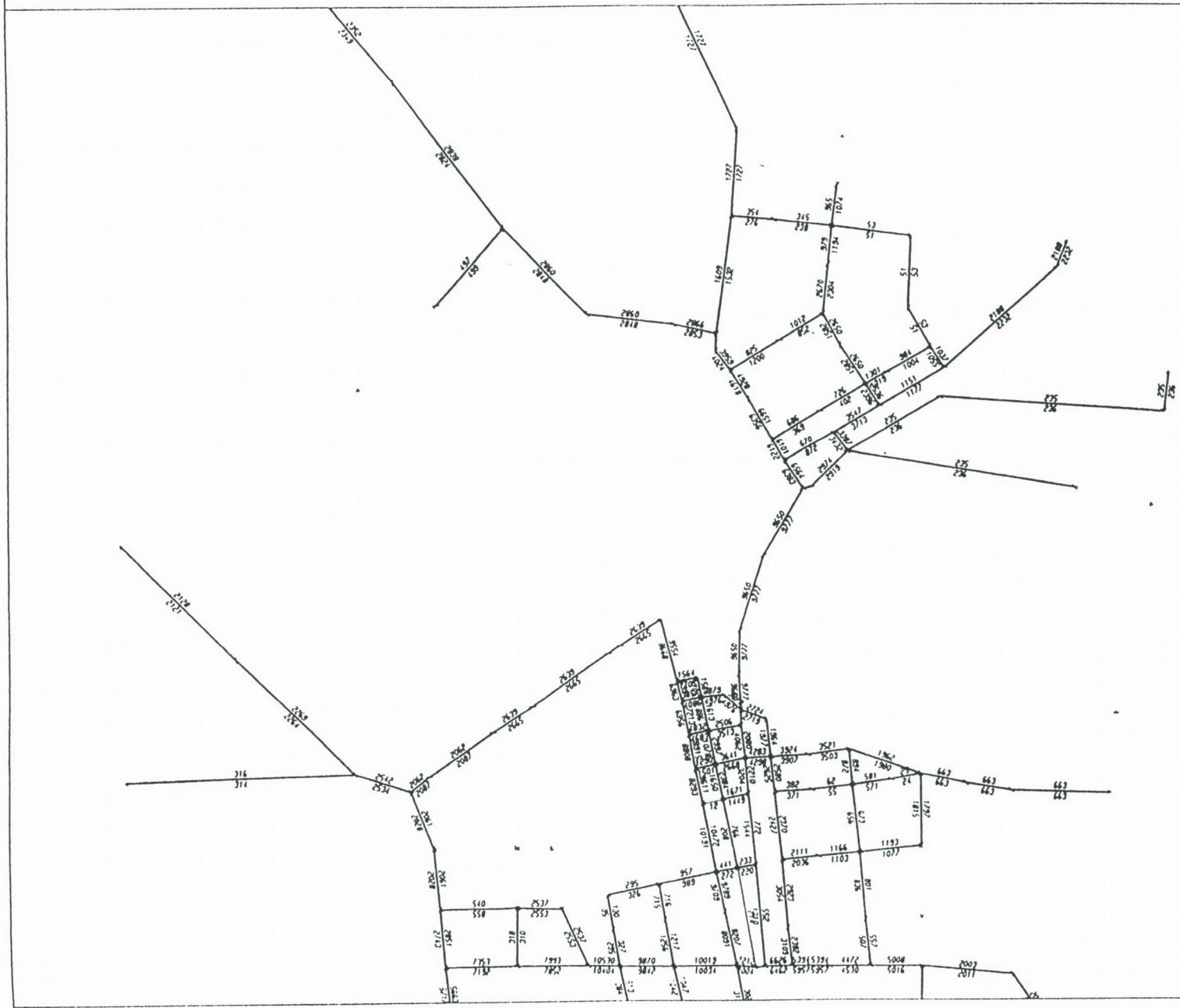
MODULE: 6.12
ARUP

AUTO VOLUMES

emme/2



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301369/6003702

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 522: 2016 Base Case Sensitivity Test with 50% Growth

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emme/2

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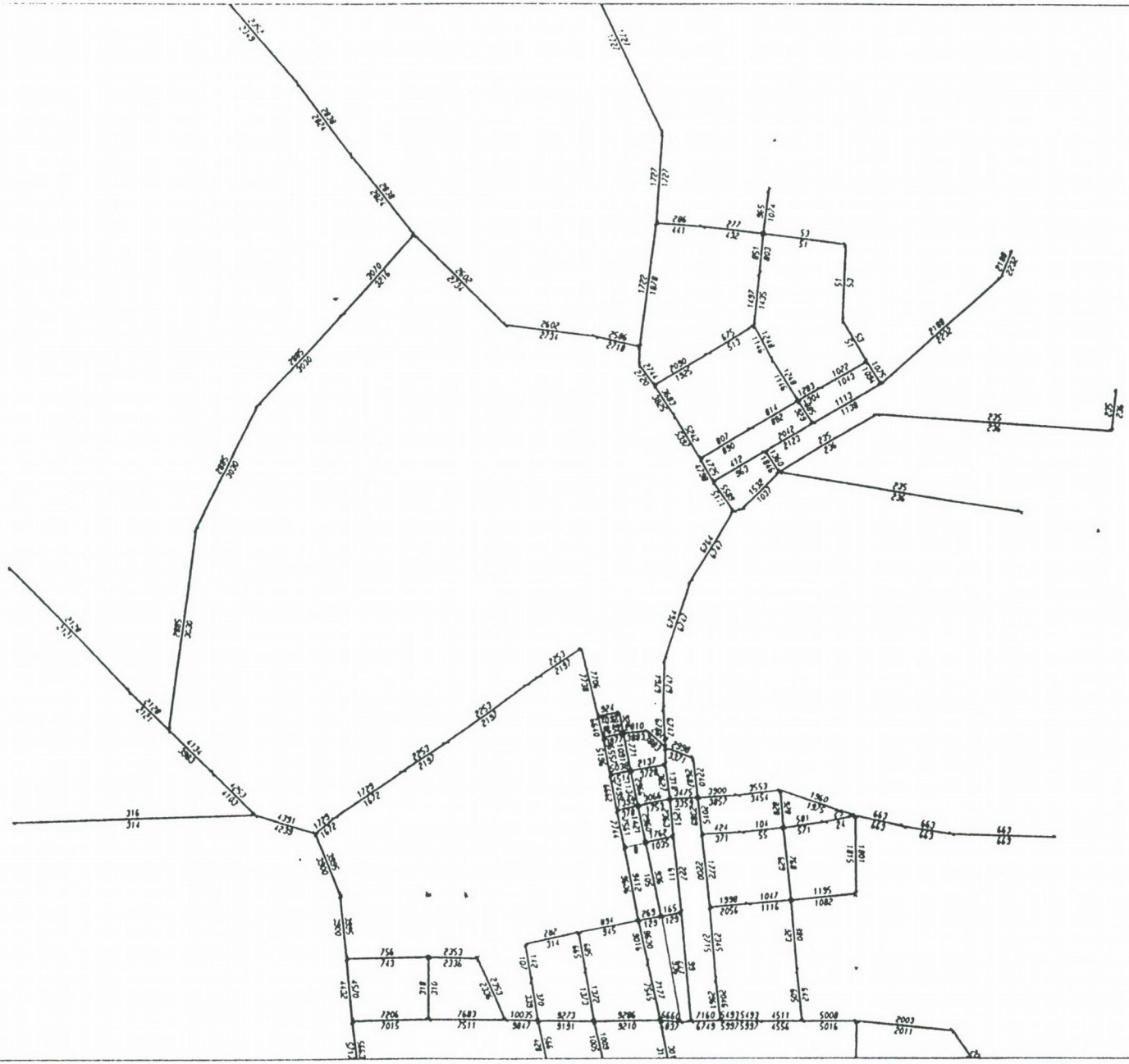

Figure 2.7

WINDOW:
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301369/6003702

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 510: W1 2016 Sensitivity Test 5% Growth

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MODULE: 12
ARUP.....jr

AUTO VOLUMES

emme/2

LINKS:
type=2.99

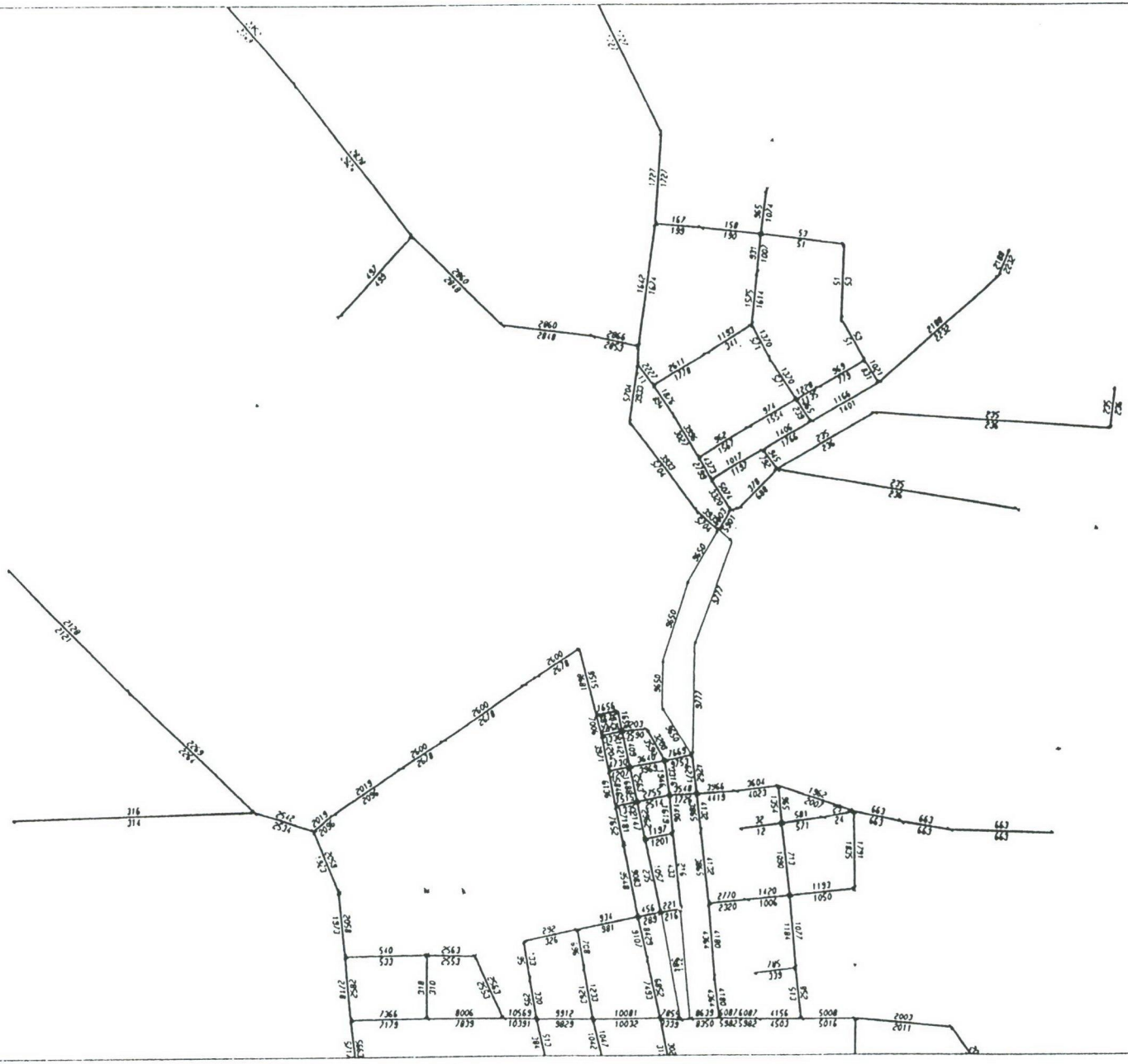

Figure 2.8

WINDOW:
293194/5997571
301369/6003702

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 504 C1 2016 Sensitivity Test 50% Growth

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MODULE: 6.12
ARUP.....jf

AUTO VOLUMES

emme/2

LINKS:
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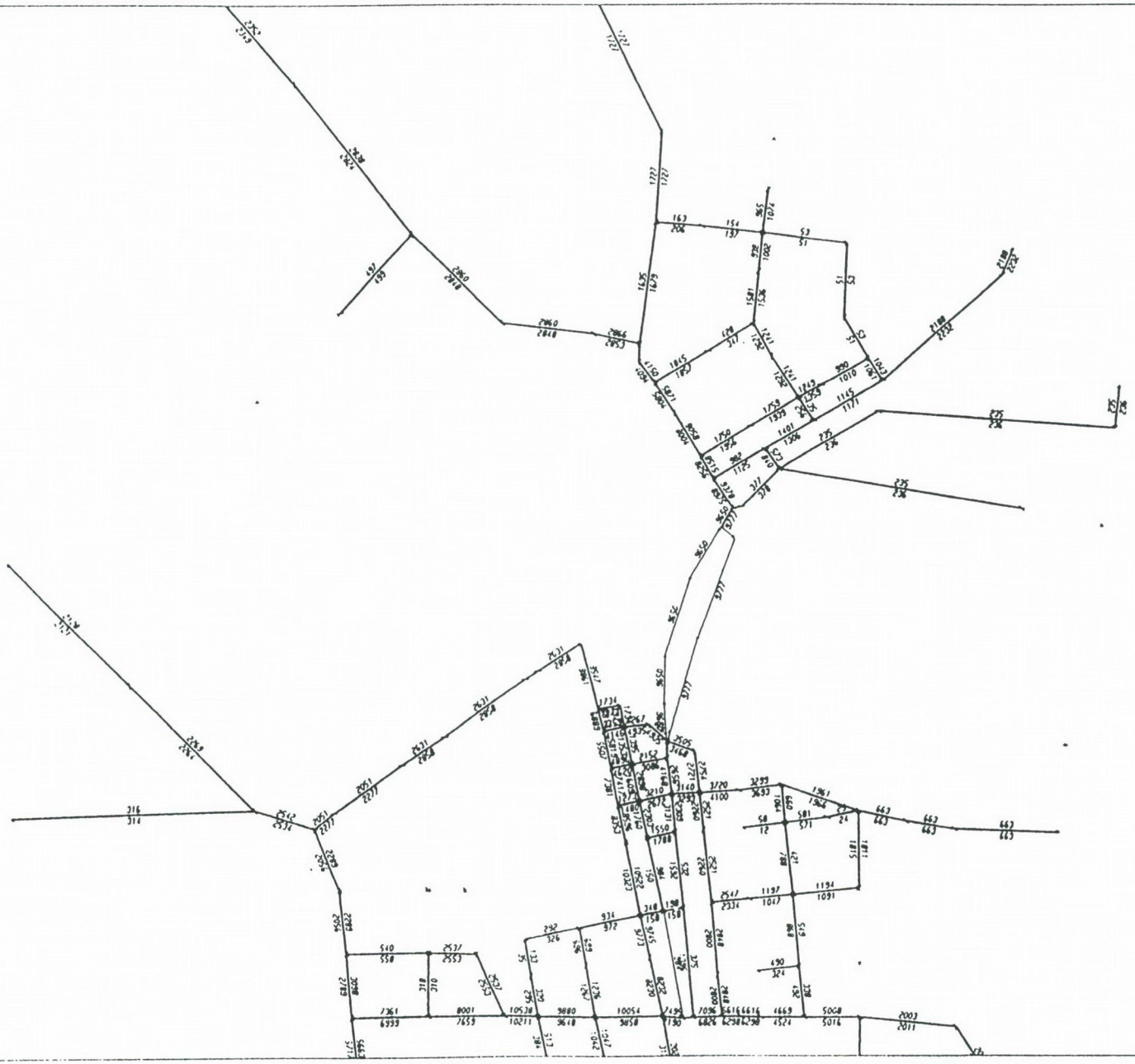

Figure 2.9

WINDOW:
293194/5997571
301369/6003702

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 534: C3 2016 Sensitivity Test 50% Growth

00-06-21 09:04
MODULE: 6.12
ARUP.....

2.2.2 Traffic Flows during Rehabilitation of Existing Bridge

During the maintenance period traffic will divert from the existing bridge to the new bridge. **Table 2.3** highlights the expected diversion of 2004 traffic flows if the existing bridge were subject to the relevant maintenance regime.

Table 2.3 Predicted 2004 Traffic Diversion Flows from the Existing to the New Bridge During Maintenance

Option	Existing Bridge Without Maintenance (vpd)	Diversion due to Maintenance (vpd)	Existing Bridge With Maintenance (vpd)	% of Traffic Diverting
Base	18,600	0	18,600	0
W1	13,000	3,600	9,400	28%
C1	9,300	9,300	-	100%
C3	9,300	9,300	-	100%

Table 2.4 summarises the diversion of traffic from the existing to the new bridge during maintenance, highlighting the predicted flows on each bridge during maintenance.

Table 2.4 Predicted 2004 Traffic Flows on Existing & New Bridges During Maintenance

Option	Existing Bridge With Maintenance (vpd)	% of Total Crossing Flows	New Bridge With Maintenance (vpd)	% of Total Crossing Flows
Base	18,600	100%	N/A	N/A
W1	9,400	51%	9,200	49%
C1	-	-	18,600	100%
C3	-	-	18,600	100%

The two central options assume full closure of the existing bridge under maintenance, which means all traffic crossing the river must divert to the new bridge.

Some 3,600 vpd are predicted to divert to the new bridge as a result of the maintenance regime for the existing bridge for option W1, resulting in approximately half of existing flows remaining on the existing bridge during maintenance.

3. ECONOMIC EVALUATION

3.1 Option Costing

Preliminary estimated costs for each of the alignments were provided by VicRoads Planning Investigations Department, as shown in **Table 3.1.**

Table 3.1 Preliminary Estimated Alignment Costs

Option	Estimated Cost ($M) 1
W1	34
C1	36
C3	22

1 Costs exclude maintenance costs of the existing bridge

3.2 Results

A standard approach to economic evaluation of road user benefits has been applied for assessment of the economic performance of projects.

The results of the benefit calculations, including the road user benefit and cost streams are summarised in **Table 3.2**, and detailed in **Appendix A**. All values assume 2000 prices exclusive of GST and are based on a discount rate of 7%.

Table 3.2 Option Economic Performance ($M)

Comparison Factor	W1	C1	C3
Total Construction Costs	34	36	22
Change in Rehabilitation Costs	0	-1.2	-1.2
PV Project Costs	**27**	**28**	**17**
PV Vehicle Operating Cost Savings	20	18	5
PV Travel Time Savings	87	98	92
PV Freight Time Savings	6	7	7
PV Accident Cost Savings	2	5	0
PV Road User Benefits	**115**	**128**	**104**
Benefit Cost Ratio	4.3	4.7	6.3
Net Present Value	87.7	100.5	87.4

The benefit cost ratios (BCR) suggests option C3 is the most viable option. This is the least expensive option and provides substantial benefits. However, option C1 results in the highest NPV, suggesting this option provides the highest economic benefits over the thirty year assessment period.

The additional $11M investment for option C1 over C3 creates benefits of $24M, providing an incremental BCR of 2.2. This indicates the extra investment provides a good return. The value of this investment should be compared to alternative rates of return that may be achieved on other projects.

The central options provide the most direct routes between the two town centres and therefore deliver the highest travel time savings. However, the western option has the highest savings in vehicle operating costs, as this route avoids the town centres and the associated congestion in the surrounding road network.

The change in maintenance costs is the difference between the cost of maintenance in the base case ($10.4M) and the option. For central options this represents a saving of $1.2M, which is shown in the cost streams in the appendix.

Further economic evaluations were undertaken as part of a sensitivity test, assuming 50% of the existing growth. **Table 3.3** summarises these results.

Table 3.3 Option Economic Performance with Reduced Population Growth

Comparison Factor	W1	C1	C3
Total Construction Costs	34	36	22
Change in Rehabilitation Costs	0	-1.2	-1.2
PV Project Costs	**27**	**28**	**17**
PV Vehicle Operating Cost Savings	12	9	-1
PV Travel Time Savings	35	40	35
PV Freight Time Savings	3	3	3
PV Accident Cost Savings	1	5	0
PV Road User Benefits	**51**	**57**	**37**
Benefit Cost Ratio	1.9	2.1	2.2
Net Present Value	23.8	29.4	20.4

With only 50% of the assumed growth rate, the BCR is again greater in C3. As expected, the benefits in option C3 are substantially less than in option C1 but the lower cost means the BCR is greater than in C1. The NPV of option C1 is higher, suggesting option C1 has greater economic benefits overall. The additional $11M investment in option C1 over C3 creates benefits of $20M, providing a BCR of 1.8.

Appendix A

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option W1
NPV Calculated from 2000

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(13.9)
2003	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(26.8)
2004	0.0	0.0	0.0	0.0	0.0	0.1	4.5	0.4	0.0	5.1	5.1	(19.9)
2005	0.0	0.0	0.0	0.0	0.0	1.1	3.7	0.3	0.1	5.2	5.2	(19.9)
2006	0.0	0.0	0.0	0.0	0.0	**1.3**	**3.7**	**0.3**	**0.1**	**5.4**	5.4	(16.5)
2007	0.0	0.0	0.0	0.0	0.0	1.4	4.2	0.3	0.1	6.1	6.1	(12.9)
2008	0.0	0.0	0.0	0.0	0.0	1.5	4.7	0.3	0.1	6.7	6.7	(9.3)
2009	0.0	0.0	0.0	0.0	0.0	1.6	5.3	0.4	0.2	7.4	7.4	(5.5)
2010	0.0	0.0	0.0	0.0	0.0	1.7	5.8	0.4	0.2	8.0	8.0	(1.7)
2011	0.0	0.0	0.0	0.0	0.0	1.8	6.3	0.5	0.2	8.7	8.7	2.1
2012	0.0	0.0	0.0	0.0	0.0	1.9	6.8	0.5	0.2	9.3	9.3	6.0
2013	0.0	0.0	0.0	0.0	0.0	1.9	7.3	0.5	0.2	10.0	10.0	9.8
2014	0.0	0.0	0.0	0.0	0.0	2.0	7.8	0.6	0.2	10.6	10.6	13.7
2015	0.0	0.0	0.0	0.0	0.0	2.1	8.3	0.6	0.2	11.2	11.2	17.5
2016	0.0	0.0	0.0	0.0	0.0	**2.2**	**8.8**	**0.6**	**0.2**	**11.9**	11.9	21.3
2017	0.0	0.0	0.0	0.0	0.0	2.4	10.0	0.7	0.2	13.3	13.3	25.2
2018	0.0	0.0	0.0	0.0	0.0	2.6	11.2	0.8	0.2	14.8	14.8	29.3
2019	0.0	0.0	0.0	0.0	0.0	2.7	12.4	0.9	0.2	16.2	16.2	33.5
2020	0.0	0.0	0.0	0.0	0.0	2.9	13.6	0.9	0.2	17.7	17.7	37.8
2021	0.0	0.0	0.0	0.0	0.0	3.1	14.8	1.0	0.2	19.1	19.1	42.1
2022	0.0	0.0	0.0	0.0	0.0	3.3	16.0	1.1	0.3	20.6	20.6	46.4
2023	0.0	0.0	0.0	0.0	0.0	3.4	17.2	1.2	0.3	22.0	22.0	50.8
2024	0.0	0.0	0.0	0.0	0.0	3.6	18.4	1.2	0.3	23.5	23.5	55.1
2025	0.0	0.0	0.0	0.0	0.0	3.8	19.6	1.3	0.3	24.9	24.9	59.4
2026	0.0	0.0	0.0	0.0	0.0	**4.0**	**20.8**	**1.4**	**0.3**	**26.4**	26.4	63.6
2027	0.0	0.0	0.0	0.0	0.0	4.1	21.9	1.5	0.3	27.8	27.8	67.8
2028	0.0	0.0	0.0	0.0	0.0	4.3	23.1	1.6	0.3	29.3	29.3	71.9
2029	0.0	0.0	0.0	0.0	0.0	4.5	24.3	1.6	0.3	30.7	30.7	76.0
2030	0.0	0.0	0.0	0.0	0.0	4.7	25.5	1.7	0.3	32.2	32.2	79.9
2031	0.0	0.0	0.0	0.0	0.0	4.8	26.7	1.8	0.3	33.7	33.7	83.8
2032	0.0	0.0	0.0	0.0	0.0	5.0	27.9	1.9	0.3	35.1	35.1	87.6
PV @ Discount Rate												
4%	-30	0	0	0	-30	34	156	11	3	204	175	
7%	-27	0	0	0	-27	20	87	6	2	115	88	
10%	-24	0	0	0	-24	12	52	4	1	69	44	
				% of Benefits		17%	76%	5%	1%	100%		

NPV = ($mill)	87.68
IRR=	20%
NPV/CC=	3.27
BCR=	4.27

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1
NPV Calculated from 2000

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(18.0)	0.0	0.0	0.0	(18.0)	0.0	0.0	0.0	0.0	0.0	(18.0)	(14.7)
2003	(18.0)	0.0	0.0	0.0	(18.0)	0.0	0.0	0.0	0.0	0.0	(18.0)	(28.4)
2004	0.0	0.0	0.0	1.2	1.2	0.9	1.5	0.7	0.6	3.7	4.9	(5.8)
2005	0.0	0.0	0.0	0.0	0.0	1.0	4.8	0.4	0.5	6.7	6.7	(15.5)
2006	0.0	0.0	0.0	0.0	0.0	**1.0**	**4.4**	**0.3**	**0.5**	**6.2**	6.2	(11.6)
2007	0.0	0.0	0.0	0.0	0.0	1.1	5.0	0.4	0.5	6.9	6.9	(7.6)
2008	0.0	0.0	0.0	0.0	0.0	1.1	5.6	0.4	0.5	7.6	7.6	(3.5)
2009	0.0	0.0	0.0	0.0	0.0	1.2	6.2	0.5	0.5	8.4	8.4	0.8
2010	0.0	0.0	0.0	0.0	0.0	1.3	6.8	0.5	0.5	9.1	9.1	5.1
2011	0.0	0.0	0.0	0.0	0.0	1.4	7.4	0.5	0.5	9.8	9.8	9.5
2012	0.0	0.0	0.0	0.0	0.0	1.5	7.9	0.6	0.5	10.6	10.6	13.9
2013	0.0	0.0	0.0	0.0	0.0	1.6	8.5	0.6	0.5	11.3	11.3	18.2
2014	0.0	0.0	0.0	0.0	0.0	1.7	9.1	0.7	0.5	12.0	12.0	22.6
2015	0.0	0.0	0.0	0.0	0.0	1.8	9.7	0.7	0.5	12.8	12.8	26.9
2016	0.0	0.0	0.0	0.0	0.0	**1.9**	**10.3**	**0.8**	**0.6**	**13.5**	13.5	31.2
2017	0.0	0.0	0.0	0.0	0.0	2.0	11.6	0.8	0.6	15.1	15.1	35.6
2018	0.0	0.0	0.0	0.0	0.0	2.2	13.0	0.9	0.6	16.7	16.7	40.3
2019	0.0	0.0	0.0	0.0	0.0	2.4	14.3	1.0	0.6	18.3	18.3	45.0
2020	0.0	0.0	0.0	0.0	0.0	2.6	15.6	1.1	0.6	19.9	19.9	49.8
2021	0.0	0.0	0.0	0.0	0.0	2.8	16.9	1.2	0.6	21.5	21.5	54.6
2022	0.0	0.0	0.0	0.0	0.0	2.9	18.3	1.3	0.6	23.1	23.1	59.5
2023	0.0	0.0	0.0	0.0	0.0	3.1	19.6	1.4	0.6	24.7	24.7	64.4
2024	0.0	0.0	0.0	0.0	0.0	3.3	20.9	1.5	0.6	26.3	26.3	69.2
2025	0.0	0.0	0.0	0.0	0.0	3.5	22.2	1.5	0.6	27.9	27.9	74.0
2026	0.0	0.0	0.0	0.0	0.0	**3.7**	**23.6**	**1.6**	**0.7**	**29.5**	29.5	78.8
2027	0.0	0.0	0.0	0.0	0.0	3.9	24.9	1.7	0.7	31.1	31.1	83.5
2028	0.0	0.0	0.0	0.0	0.0	4.0	26.2	1.8	0.7	32.7	32.7	88.1
2029	0.0	0.0	0.0	0.0	0.0	4.2	27.5	1.9	0.7	34.3	34.3	92.6
2030	0.0	0.0	0.0	0.0	0.0	4.4	28.8	2.0	0.7	35.9	35.9	97.0
2031	0.0	0.0	0.0	0.0	0.0	4.6	30.2	2.1	0.7	37.5	37.5	101.3
2032	0.0	0.0	0.0	0.0	0.0	4.8	31.5	2.2	0.7	39.1	39.1	105.5
PV @ Discount Rate												
4%	-31	0	0	1	-30	31	177	13	8	229	198	
7%	-28	0	0	1	-28	18	98	7	5	128	101	
10%	-26	0	0	1	-25	11	58	5	3	77	52	
				% of Benefits		14%	76%	6%	4%	100%		

NPV = ($mill)	100.54
IRR=	21%
NPV/CC=	3.65
BCR=	4.65

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C3 (Upgrade at Meninya St)
NPV Calculated from 2000

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(11.0)	0.0	0.0	0.0	(11.0)	0.0	0.0	0.0	0.0	0.0	(11.0)	(9.0)
2003	(11.0)	0.0	0.0	0.0	(11.0)	0.0	0.0	0.0	0.0	0.0	(11.0)	(17.4)
2004	0.0	0.0	0.0	1.2	1.2	0.6	1.3	0.6	0.2	2.7	3.9	4.9
2005	0.0	0.0	0.0	0.0	0.0	(0.2)	4.3	0.3	0.0	4.5	4.5	(6.6)
2006	0.0	0.0	0.0	0.0	0.0	**(0.3)**	**3.9**	**0.3**	**0.0**	**3.9**	3.9	(4.2)
2007	0.0	0.0	0.0	0.0	0.0	(0.2)	4.4	0.3	0.0	4.6	4.6	(1.5)
2008	0.0	0.0	0.0	0.0	0.0	(0.1)	5.0	0.4	0.0	5.3	5.3	1.3
2009	0.0	0.0	0.0	0.0	0.0	(0.1)	5.6	0.4	0.0	5.9	5.9	4.4
2010	0.0	0.0	0.0	0.0	0.0	(0.0)	6.2	0.4	0.0	6.6	6.6	7.5
2011	0.0	0.0	0.0	0.0	0.0	0.1	6.8	0.5	0.0	7.3	7.3	10.7
2012	0.0	0.0	0.0	0.0	0.0	0.1	7.3	0.5	(0.0)	8.0	8.0	14.0
2013	0.0	0.0	0.0	0.0	0.0	0.2	7.9	0.6	(0.0)	8.6	8.6	17.4
2014	0.0	0.0	0.0	0.0	0.0	0.3	8.5	0.6	(0.0)	9.3	9.3	20.8
2015	0.0	0.0	0.0	0.0	0.0	0.3	9.1	0.6	(0.0)	10.0	10.0	24.2
2016	0.0	0.0	0.0	0.0	0.0	**0.4**	**9.7**	**0.7**	**(0.0)**	**10.7**	10.7	27.5
2017	0.0	0.0	0.0	0.0	0.0	0.5	11.0	0.8	(0.0)	12.2	12.2	31.2
2018	0.0	0.0	0.0	0.0	0.0	0.7	12.3	0.9	(0.0)	13.8	13.8	35.0
2019	0.0	0.0	0.0	0.0	0.0	0.9	13.6	0.9	(0.0)	15.3	15.3	38.9
2020	0.0	0.0	0.0	0.0	0.0	1.0	14.9	1.0	(0.1)	16.9	16.9	43.0
2021	0.0	0.0	0.0	0.0	0.0	1.2	16.2	1.1	(0.1)	18.4	18.4	47.2
2022	0.0	0.0	0.0	0.0	0.0	1.4	17.5	1.2	(0.1)	20.0	20.0	51.4
2023	0.0	0.0	0.0	0.0	0.0	1.5	18.8	1.3	(0.1)	21.5	21.5	55.6
2024	0.0	0.0	0.0	0.0	0.0	1.7	20.1	1.4	(0.1)	23.1	23.1	59.9
2025	0.0	0.0	0.0	0.0	0.0	1.9	21.4	1.5	(0.1)	24.7	24.7	64.1
2026	0.0	0.0	0.0	0.0	0.0	**2.0**	**22.7**	**1.5**	**(0.1)**	**26.2**	26.2	68.4
2027	0.0	0.0	0.0	0.0	0.0	2.2	24.0	1.6	(0.1)	27.8	27.8	72.5
2028	0.0	0.0	0.0	0.0	0.0	2.4	25.3	1.7	(0.1)	29.3	29.3	76.7
2029	0.0	0.0	0.0	0.0	0.0	2.5	26.6	1.8	(0.1)	30.9	30.9	80.7
2030	0.0	0.0	0.0	0.0	0.0	2.7	27.9	1.9	(0.1)	32.4	32.4	84.7
2031	0.0	0.0	0.0	0.0	0.0	2.9	29.3	2.0	(0.1)	34.0	34.0	88.6
2032	0.0	0.0	0.0	0.0	0.0	3.0	30.6	2.1	(0.1)	35.5	35.5	92.4
PV @ Discount Rate												
4%	-19	0	0	1	-18	10	167	12	-0	189	171	
7%	-17	0	0	1	-17	5	92	7	-0	104	87	
10%	-16	0	0	1	-15	3	54	4	0	61	46	
						% of Benefits	5%	89%	7%	0%	100%	

NPV = ($mill)	87.37
IRR=	24%
NPV/CC=	5.29
BCR=	6.29

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option W1 Sensitivity Test Assuming 50% of Forecast Growth
NPV Calculated from 2000

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(13.9)
2003	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(26.8)
2004	0.0	0.0	0.0	0.0	0.0	0.1	3.6	0.3	0.0	4.1	4.1	(21.0)
2005	0.0	0.0	0.0	0.0	0.0	1.0	2.7	0.2	0.1	4.0	4.0	(21.4)
2006	0.0	0.0	0.0	0.0	0.0	**1.2**	**2.6**	**0.2**	**0.1**	**4.1**	4.1	(18.8)
2007	0.0	0.0	0.0	0.0	0.0	1.2	2.7	0.2	0.1	4.2	4.2	(16.4)
2008	0.0	0.0	0.0	0.0	0.0	1.2	2.8	0.2	0.1	4.3	4.3	(14.0)
2009	0.0	0.0	0.0	0.0	0.0	1.2	2.9	0.2	0.1	4.5	4.5	(11.8)
2010	0.0	0.0	0.0	0.0	0.0	1.2	3.0	0.2	0.1	4.6	4.6	(9.6)
2011	0.0	0.0	0.0	0.0	0.0	1.3	3.2	0.2	0.1	4.8	4.8	(7.4)
2012	0.0	0.0	0.0	0.0	0.0	1.3	3.3	0.2	0.1	4.9	4.9	(5.4)
2013	0.0	0.0	0.0	0.0	0.0	1.3	3.4	0.3	0.1	5.0	5.0	(3.5)
2014	0.0	0.0	0.0	0.0	0.0	1.3	3.5	0.3	0.1	5.2	5.2	(1.6)
2015	0.0	0.0	0.0	0.0	0.0	1.3	3.6	0.3	0.1	5.3	5.3	0.2
2016	0.0	0.0	0.0	0.0	0.0	**1.3**	**3.7**	**0.3**	**0.1**	**5.5**	5.5	2.0
2017	0.0	0.0	0.0	0.0	0.0	1.4	3.9	0.3	0.1	5.7	5.7	3.7
2018	0.0	0.0	0.0	0.0	0.0	1.4	4.1	0.3	0.1	6.0	6.0	5.3
2019	0.0	0.0	0.0	0.0	0.0	1.4	4.4	0.3	0.1	6.2	6.2	6.9
2020	0.0	0.0	0.0	0.0	0.0	1.5	4.6	0.3	0.1	6.5	6.5	8.5
2021	0.0	0.0	0.0	0.0	0.0	1.5	4.8	0.3	0.1	6.7	6.7	10.0
2022	0.0	0.0	0.0	0.0	0.0	1.5	5.0	0.4	0.1	7.0	7.0	11.5
2023	0.0	0.0	0.0	0.0	0.0	1.6	5.2	0.4	0.1	7.2	7.2	12.9
2024	0.0	0.0	0.0	0.0	0.0	1.6	5.4	0.4	0.1	7.5	7.5	14.3
2025	0.0	0.0	0.0	0.0	0.0	1.6	5.6	0.4	0.1	7.8	7.8	15.6
2026	0.0	0.0	0.0	0.0	0.0	**1.7**	**5.8**	**0.4**	**0.2**	**8.0**	8.0	16.9
2027	0.0	0.0	0.0	0.0	0.0	1.7	6.0	0.4	0.2	8.3	8.3	18.2
2028	0.0	0.0	0.0	0.0	0.0	1.7	6.2	0.4	0.2	8.5	8.5	19.4
2029	0.0	0.0	0.0	0.0	0.0	1.8	6.4	0.5	0.2	8.8	8.8	20.5
2030	0.0	0.0	0.0	0.0	0.0	1.8	6.6	0.5	0.2	9.0	9.0	21.6
2031	0.0	0.0	0.0	0.0	0.0	1.8	6.8	0.5	0.2	9.3	9.3	22.7
2032	0.0	0.0	0.0	0.0	0.0	1.9	7.0	0.5	0.2	9.5	9.5	23.7
PV @ Discount Rate												
4%	-30	0	0	0	-30	19	58	4	2	83	54	
7%	-27	0	0	0	-27	12	35	3	1	51	24	
10%	-24	0	0	0	-24	8	23	2	1	33	8	
				% of Benefits		23%	70%	5%	2%	100%		

NPV = ($mill)	23.81
IRR=	13%
NPV/CC=	0.89
BCR=	1.89

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - Sensitivity Test assuming 50% forecast population growth
NPV Calculated from 2000

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(18.0)	0.0	0.0	0.0	(18.0)	0.0	0.0	0.0	0.0	0.0	(18.0)	(14.7)
2003	(18.0)	0.0	0.0	0.0	(18.0)	0.0	0.0	0.0	0.0	0.0	(18.0)	(28.4)
2004	0.0	0.0	0.0	1.2	1.2	0.7	1.1	0.6	0.6	2.9	4.1	(8.0)
2005	0.0	0.0	0.0	0.0	0.0	0.8	3.6	0.3	0.5	5.2	5.2	(17.4)
2006	0.0	0.0	0.0	0.0	0.0	**0.8**	**3.1**	**0.2**	**0.5**	**4.7**	4.7	(14.5)
2007	0.0	0.0	0.0	0.0	0.0	0.8	3.3	0.3	0.5	4.8	4.8	(11.7)
2008	0.0	0.0	0.0	0.0	0.0	0.8	3.4	0.3	0.5	5.0	5.0	(9.0)
2009	0.0	0.0	0.0	0.0	0.0	0.8	3.5	0.3	0.5	5.1	5.1	(6.4)
2010	0.0	0.0	0.0	0.0	0.0	0.9	3.7	0.3	0.5	5.3	5.3	(3.8)
2011	0.0	0.0	0.0	0.0	0.0	0.9	3.8	0.3	0.5	5.4	5.4	(1.4)
2012	0.0	0.0	0.0	0.0	0.0	0.9	3.9	0.3	0.5	5.6	5.6	0.9
2013	0.0	0.0	0.0	0.0	0.0	0.9	4.1	0.3	0.5	5.8	5.8	3.1
2014	0.0	0.0	0.0	0.0	0.0	0.9	4.2	0.3	0.5	5.9	5.9	5.3
2015	0.0	0.0	0.0	0.0	0.0	0.9	4.3	0.3	0.5	6.1	6.1	7.3
2016	0.0	0.0	0.0	0.0	0.0	**0.9**	**4.4**	**0.3**	**0.5**	**6.2**	6.2	9.3
2017	0.0	0.0	0.0	0.0	0.0	1.0	4.7	0.4	0.5	6.5	6.5	11.2
2018	0.0	0.0	0.0	0.0	0.0	1.0	4.9	0.4	0.5	6.8	6.8	13.1
2019	0.0	0.0	0.0	0.0	0.0	1.1	5.1	0.4	0.5	7.1	7.1	14.9
2020	0.0	0.0	0.0	0.0	0.0	1.1	5.4	0.4	0.5	7.4	7.4	16.7
2021	0.0	0.0	0.0	0.0	0.0	1.2	5.6	0.4	0.5	7.7	7.7	18.4
2022	0.0	0.0	0.0	0.0	0.0	1.2	5.8	0.4	0.5	7.9	7.9	20.1
2023	0.0	0.0	0.0	0.0	0.0	1.2	6.0	0.5	0.5	8.2	8.2	21.7
2024	0.0	0.0	0.0	0.0	0.0	1.3	6.3	0.5	0.5	8.5	8.5	23.3
2025	0.0	0.0	0.0	0.0	0.0	1.3	6.5	0.5	0.5	8.8	8.8	24.8
2026	0.0	0.0	0.0	0.0	0.0	**1.4**	**6.7**	**0.5**	**0.5**	**9.1**	9.1	26.3
2027	0.0	0.0	0.0	0.0	0.0	1.4	6.9	0.5	0.5	9.4	9.4	27.7
2028	0.0	0.0	0.0	0.0	0.0	1.4	7.2	0.5	0.5	9.7	9.7	29.1
2029	0.0	0.0	0.0	0.0	0.0	1.5	7.4	0.6	0.5	10.0	10.0	30.4
2030	0.0	0.0	0.0	0.0	0.0	1.5	7.6	0.6	0.5	10.2	10.2	31.6
2031	0.0	0.0	0.0	0.0	0.0	1.6	7.8	0.6	0.5	10.5	10.5	32.8
2032	0.0	0.0	0.0	0.0	0.0	1.6	8.1	0.6	0.6	10.8	10.8	34.0
PV @ Discount Rate												
4%	-31	0	0	1	-30	15	67	5	7	94	64	
7%	-28	0	0	1	-28	9	40	3	5	57	29	
10%	-26	0	0	1	-25	6	25	2	3	37	12	
					% of Benefits	16%	70%	6%	8%	100%		

NPV = ($mill)	29.37
IRR=	14%
NPV/CC=	1.07
BCR=	2.07

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C3 Upgrade Sensitivity Test 50% growth assumed
NPV Calculated from 2000

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(11.0)	0.0	0.0	0.0	(11.0)	0.0	0.0	0.0	0.0	0.0	(11.0)	(9.0)
2003	(11.0)	0.0	0.0	0.0	(11.0)	0.0	0.0	0.0	0.0	0.0	(11.0)	(17.4)
2004	0.0	0.0	0.0	1.2	1.2	0.4	1.0	0.6	0.1	2.1	3.3	2.7
2005	0.0	0.0	0.0	0.0	0.0	(0.2)	3.2	0.3	0.0	3.3	3.3	(8.2)
2006	0.0	0.0	0.0	0.0	0.0	(0.3)	2.7	0.2	0.0	2.6	2.6	(6.5)
2007	0.0	0.0	0.0	0.0	0.0	(0.3)	2.8	0.2	0.0	2.7	2.7	(5.0)
2008	0.0	0.0	0.0	0.0	0.0	(0.3)	2.9	0.2	0.0	2.8	2.8	(3.4)
2009	0.0	0.0	0.0	0.0	0.0	(0.3)	3.0	0.2	0.0	3.0	3.0	(1.9)
2010	0.0	0.0	0.0	0.0	0.0	(0.3)	3.1	0.2	0.0	3.1	3.1	(0.4)
2011	0.0	0.0	0.0	0.0	0.0	(0.3)	3.3	0.2	0.0	3.2	3.2	1.0
2012	0.0	0.0	0.0	0.0	0.0	(0.3)	3.4	0.2	0.0	3.4	3.4	2.4
2013	0.0	0.0	0.0	0.0	0.0	(0.3)	3.5	0.2	0.0	3.5	3.5	3.8
2014	0.0	0.0	0.0	0.0	0.0	(0.3)	3.6	0.3	0.0	3.6	3.6	5.1
2015	0.0	0.0	0.0	0.0	0.0	(0.3)	3.7	0.3	0.0	3.8	3.8	6.4
2016	0.0	0.0	0.0	0.0	0.0	(0.3)	3.9	0.3	0.0	3.9	3.9	7.6
2017	0.0	0.0	0.0	0.0	0.0	(0.2)	4.1	0.3	0.0	4.2	4.2	8.9
2018	0.0	0.0	0.0	0.0	0.0	(0.2)	4.3	0.3	0.0	4.4	4.4	10.1
2019	0.0	0.0	0.0	0.0	0.0	(0.2)	4.5	0.3	0.0	4.7	4.7	11.3
2020	0.0	0.0	0.0	0.0	0.0	(0.1)	4.8	0.3	0.0	5.0	5.0	12.5
2021	0.0	0.0	0.0	0.0	0.0	(0.1)	5.0	0.4	0.0	5.3	5.3	13.7
2022	0.0	0.0	0.0	0.0	0.0	(0.1)	5.2	0.4	0.0	5.5	5.5	14.9
2023	0.0	0.0	0.0	0.0	0.0	(0.1)	5.5	0.4	0.0	5.8	5.8	16.0
2024	0.0	0.0	0.0	0.0	0.0	(0.0)	5.7	0.4	0.0	6.1	6.1	17.1
2025	0.0	0.0	0.0	0.0	0.0	(0.0)	5.9	0.4	0.0	6.4	6.4	18.2
2026	0.0	0.0	0.0	0.0	0.0	0.0	6.2	0.4	0.0	6.6	6.6	19.3
2027	0.0	0.0	0.0	0.0	0.0	0.0	6.4	0.4	0.0	6.9	6.9	20.3
2028	0.0	0.0	0.0	0.0	0.0	0.1	6.6	0.5	0.0	7.2	7.2	21.4
2029	0.0	0.0	0.0	0.0	0.0	0.1	6.9	0.5	0.0	7.5	7.5	22.3
2030	0.0	0.0	0.0	0.0	0.0	0.1	7.1	0.5	0.0	7.7	7.7	23.3
2031	0.0	0.0	0.0	0.0	0.0	0.2	7.3	0.5	0.0	8.0	8.0	24.2
2032	0.0	0.0	0.0	0.0	0.0	0.2	7.5	0.5	0.0	8.3	8.3	25.1
PV @ Discount Rate												
4%	-19	0	0	1	-18	-2	59	5	0	62	44	
7%	-17	0	0	1	-17	-1	35	3	0	37	20	
10%	-16	0	0	1	-15	-1	22	2	0	23	8	
				% of Benefits		-4%	95%	8%	1%	100%		

NPV = ($mill)	20.43
IRR=	14%
NPV/CC=	1.24
BCR=	2.24

ArupTransportationPlanning

VicRoads
Planning Investigations

River Crossing at Echuca-Moama

Further Assessment of Options

ARUP

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Planning Investigations

River Crossing at Echuca-Moama

Further Assessment of Options

April 2001

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Job number 10234/606
_02

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1. INTRODUCTION

Arup Transportation Planning was appointed in February 2001 by VicRoads Planning Investigations to undertake further traffic and economic assessments of options C1, C3 and W1.

Arup have already undertaken a series of preliminary traffic and economic assessments for each of the options, using the EMME/2 model developed by Arup for the region, in the Echuca-Moama study (Arup, December 1998). The focus of this study is to undertake further detailed assessment of the traffic and economic performance of each of the options. Although this study is based on previous analysis, the following revisions were incorporated:

- The inclusion of rehabilitation costs for the existing bridge in the total project cost
- The inclusion of the benefits/ costs of delaying the rehabilitation of the existing bridge in the economic analysis if an additional bridge is constructed
- Revised staging of works for each of the options, as shown in **Appendix A**
- Revised household data for future year scenarios
- Revised bridge capacities
- A long articulated truck ban on the existing bridge in the western option.

This report briefly outlines the traffic performance and economic evaluation undertaken for each of the currently proposed crossings, using cost estimates provided by VicRoads. The analysis is based on the same methodology used in the previous economic evaluation estimates.

2. TASK DESCRIPTIONS

A number of assessments were undertaken, with each one slightly modifying the input parameters. These assessment modifications have been referred to as tasks for reporting purposes.

2.1 Task One

The initial task was an assessment including the revised staging of approach works for the central options. This incorporated the following:

- economic parameters as defined in the VicRoads EVAL4 economic evaluation program (Dec 2000)
- for options C1 & C3 the proposed staging of approach works as outlined in **Appendix A**
- the inclusion of rehabilitation costs for the existing bridge in the total project cost and the revised years for rehabilitation in the base case.

The bridge capacities assumed are shown below. For the central options, each bridge is one way with capacities assumed to be 30,000 vpd in each direction.

Table 1 Existing Bridge Capacities

Option	Existing Bridge	New Bridge
Base	8,000	-
C1	30,000	30,000
C3	30,000	30,000
W1	8,000	8,000

Note: Units are vehicles per day for a single direction

2.2 Task Two

The assessments undertaken for Task Two had the same assumptions as Task One, with revised household data for future years, as provided by the RDP Group. Employment forecasts were assumed to be the same as in the previous modelling work.

RDP Group reviewed the population growth estimates assumed in the 1998 Traffic Study (Arup). The latest available growth forecasts from the Department of Infrastructure suggest lower forecasts than the growth figures originally adopted. A summary of the findings by RDP Group is shown in **Appendix B**.

The revised household growth forecasts suggest a slightly lower rate of growth in future years than previously existed. For example in 2016, there are now assumed to be 2% less households than were previously modelled.

The following assumptions were made to provide the revised household forecasts:

- the overall growth of the two towns would be consistent for the Central and Western scenarios, although the distribution of the development would vary
- the Western option would facilitate more rapid growth in west Moama, while increased scope for commercial development in west Echuca may reduce household capacity

2.3 Task Three

Task Three built on the assessments undertaken in Task Two, with the inclusion of the revised bridge capacities. Task Three includes:

- economic parameters as defined in the VicRoads EVAL4 economic evaluation program (Dec 2000)
- for options C1 & C3 the proposed staging of approach works as outlined in **Appendix A**
- the inclusion of rehabilitation costs for the existing bridge in the total project cost and the revised years for rehabilitation in the base case
- revised household future year forecasts for the central and western options.

In addition, the following bridge capacities were assumed, as provided by VicRoads:

Table 2 Revised Bridge Capacities, Task 3

Option	Existing	New
Base	10,000	-
C1 with rehabilitation	Existing bridge closed	10,000
C1	30,000	30,000
C3 with rehabilitation	Existing bridge closed	10,000
C3	30,000	30,000
W1	10,000	8,000

Note: Units are vehicles per day for a single direction

2.4 Task Four

Additional assessments were undertaken for the Central options, incorporating the revised staging of approach works and the postponement of rehabilitation for the existing bridge. The staging of the approach works and rehabilitation delays are summarised in **Appendix C**.

Task Four assessments incorporated:

- economic parameters as defined in the VicRoads EVAL4 economic evaluation program (Dec 2000)
- the inclusion of rehabilitation costs for the existing bridge in the total project cost and the revised years for rehabilitation in the base case
- revised household future year forecasts for the Central and Western options
- revised bridge capacities
- for options C1 & C3 the proposed staging of approach and rehabilitation works as outlined in **Appendix C.**

2.5 Task Five

A further assessment was undertaken for the Western option assuming a heavy truck ban on the existing bridge. This equated to 25% of commercial vehicles being restricted from using the existing bridge. The assessment incorporated:

- economic parameters as defined in the VicRoads EVAL4 economic evaluation program (Dec 2000)
- the inclusion of rehabilitation costs for the existing bridge in the total project cost and the revised years for rehabilitation in the base case
- revised household future year forecasts for the Western option
- revised bridge capacities.

3. TRAFFIC FLOWS

3.1 2016 Traffic Flows

The estimated total traffic flows on the existing bridge, new bridge and surrounding road network for each of the options, in 2016 are shown on **Figures 1 – 8.**

The proportion of traffic flows on each bridge is summarised in **Table 3.**

Table 3 Proportion of Traffic Flows on Each Bridge

	C1	C3	W1
	Existing (New)	**Existing (New)**	**Existing (New)**
Task 1	50% (50%)	50% (50%)	68% (32%)
Task 2	50% (50%)	50% (50%)	66% (34%)
Task 3	50% (50%)	50% (50%)	68% (32%)
Task 4	50% (50%)	50% (50%)	68% (32%)
Task 5	-	-	67% (33%)

The two central options are one way north and southbound, so carry equal proportions of traffic.

W1 is estimated to carry one third of all vehicles. When a heavy vehicle ban on the existing bridge is enforced (assuming the Western option), traffic reassignment takes place as the total traffic on the new bridge increases only marginally.

AUTO VOLUMES

emme/2

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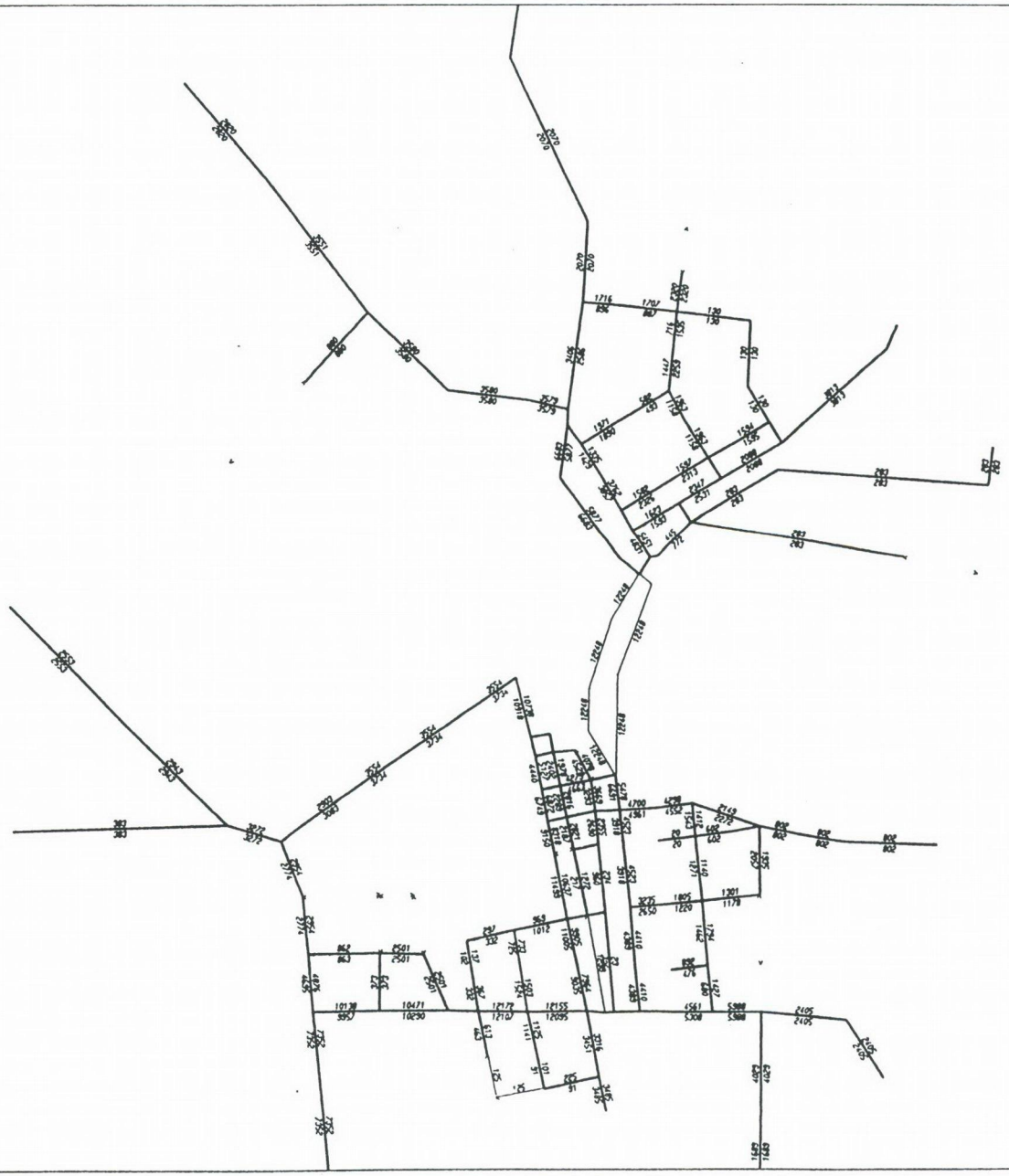

Figure 1

WINDOW:
292153/5996783
302263/6004365

EMME/2 PROJECT: Echuca Moama Traffic Study
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01-03-23 18:06
MODULE: 6
ARUP.....

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emme/2

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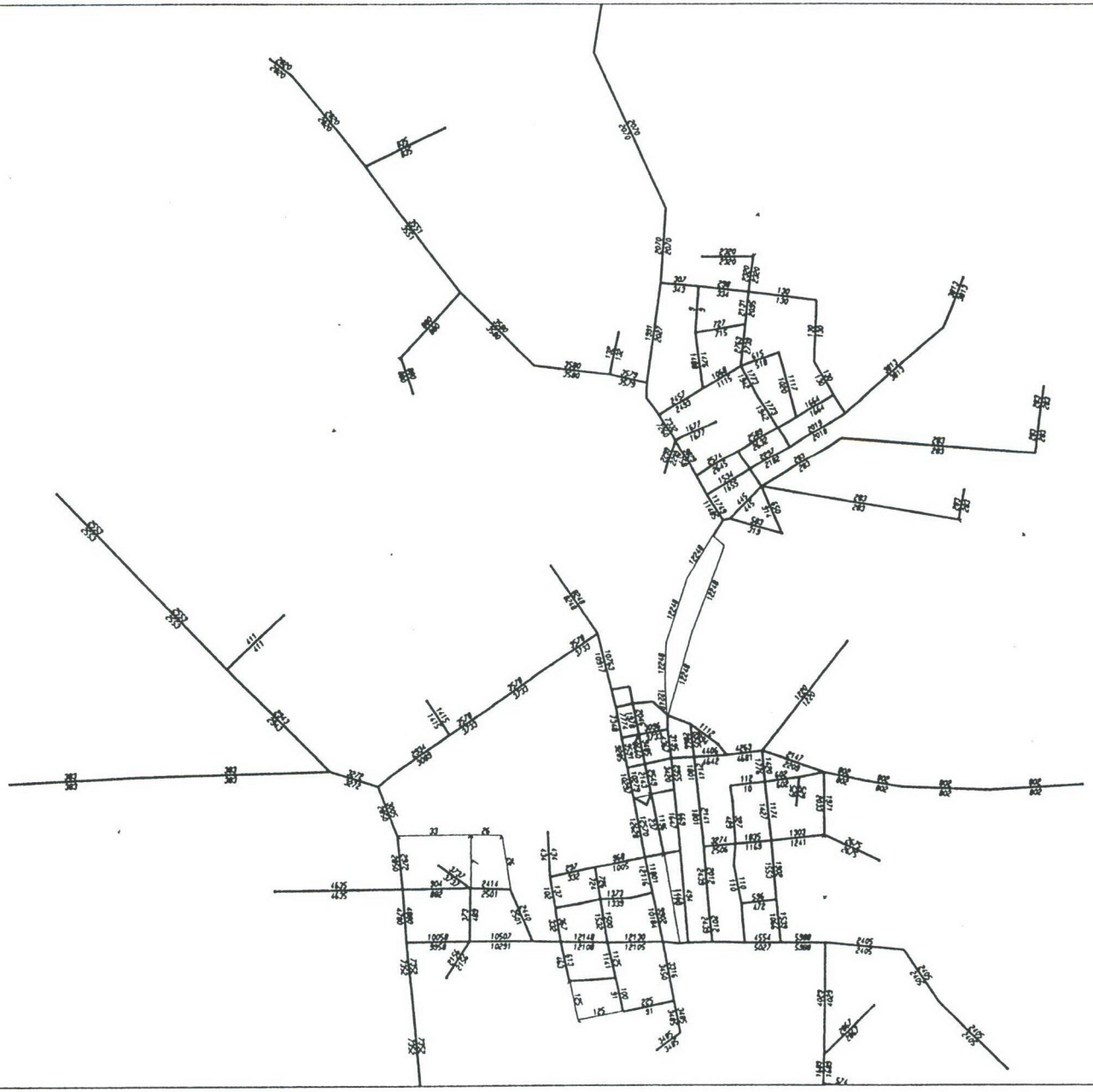

Figure 2

WINDOW:
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302263/6004365

EMME/2 PROJECT: Echuca Moama Traffic Study
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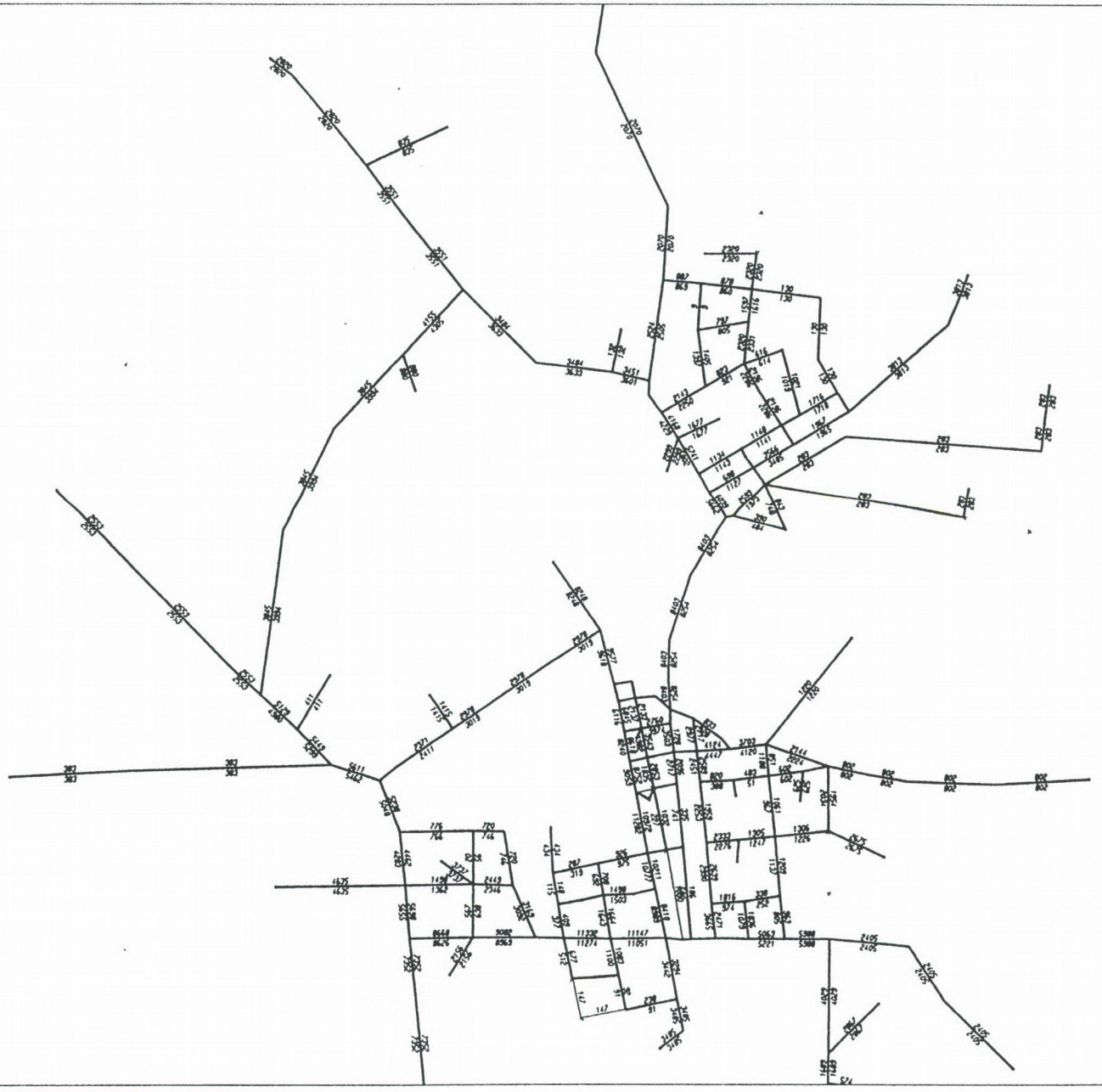

Figure 3

WINDOW:
292153/5996783
302263/6004365

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 510: W1 2016

01-03-23 18:07
MODULE: 6
ARUP.....

AUTO VOLUMES

emme/2

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all

Figure 4

WINDOW:
292153/5996783
302263/6004365

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 28: C1 T2 2016 New & Existing Bridge Open with App Rds

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ARUP.....jf

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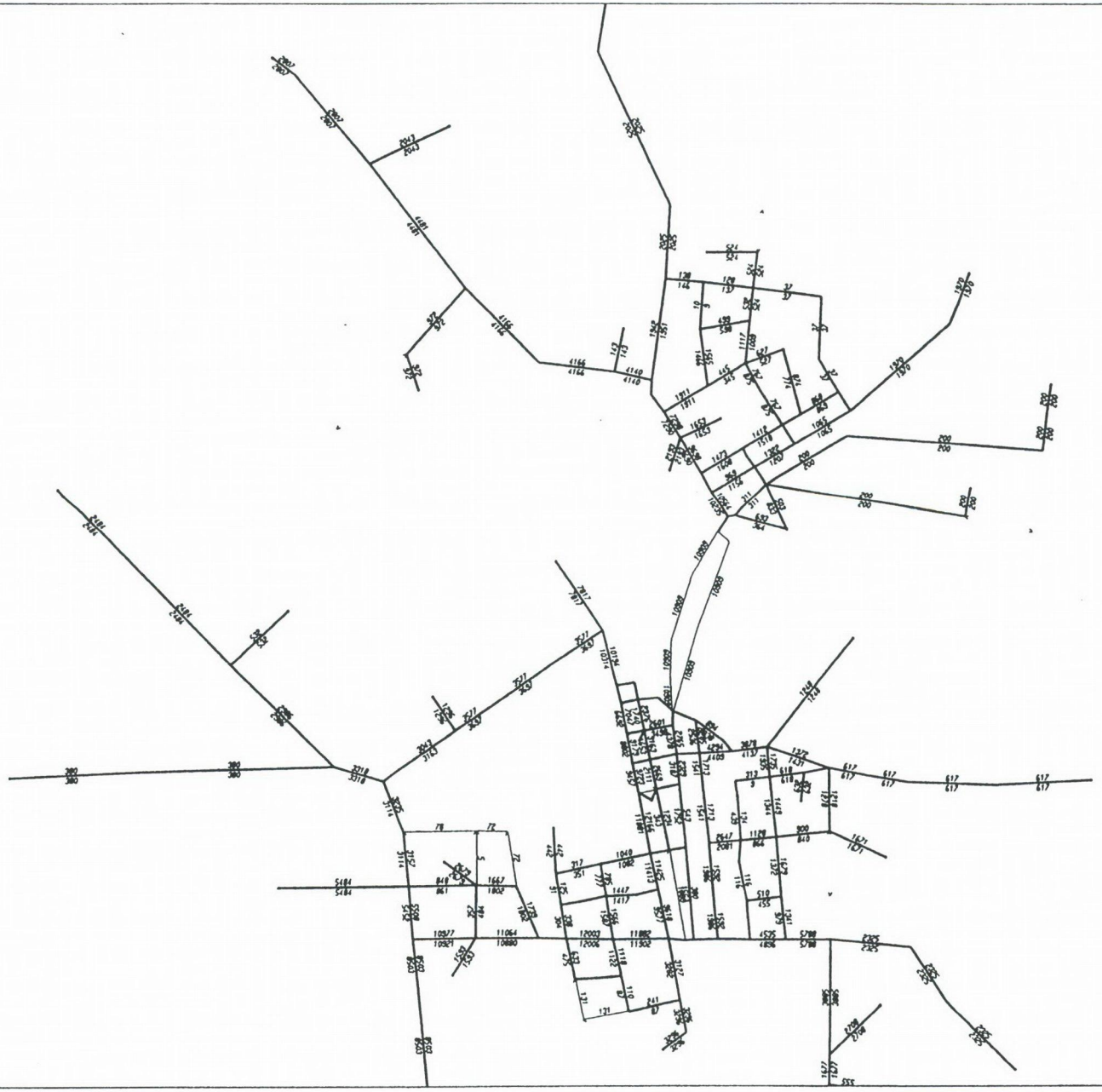

Figure 5

WINDOW:
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302263/6004365

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SCE[redacted]IO 35: C3 T2 2016 New & Existing B[redacted]e Open with App Rds

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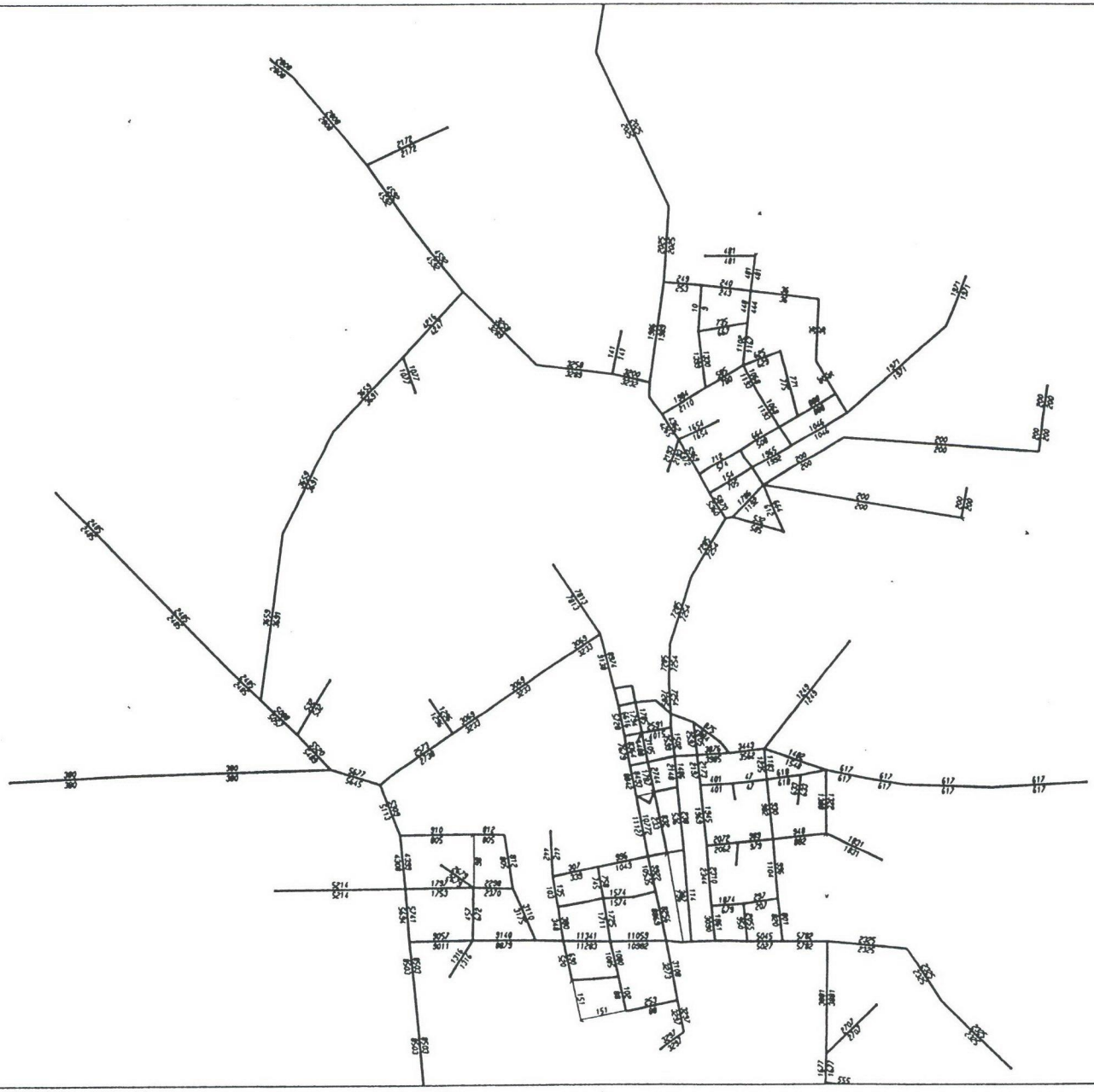

Figure 6

WINDOW:
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302263/6004365

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 41: W1 T2 2016 Existing & New Bridge 2 way

01-03-23 18:09
MODULE: 6.12
ARUP.....jf

AUTO VOLUMES

emme/2

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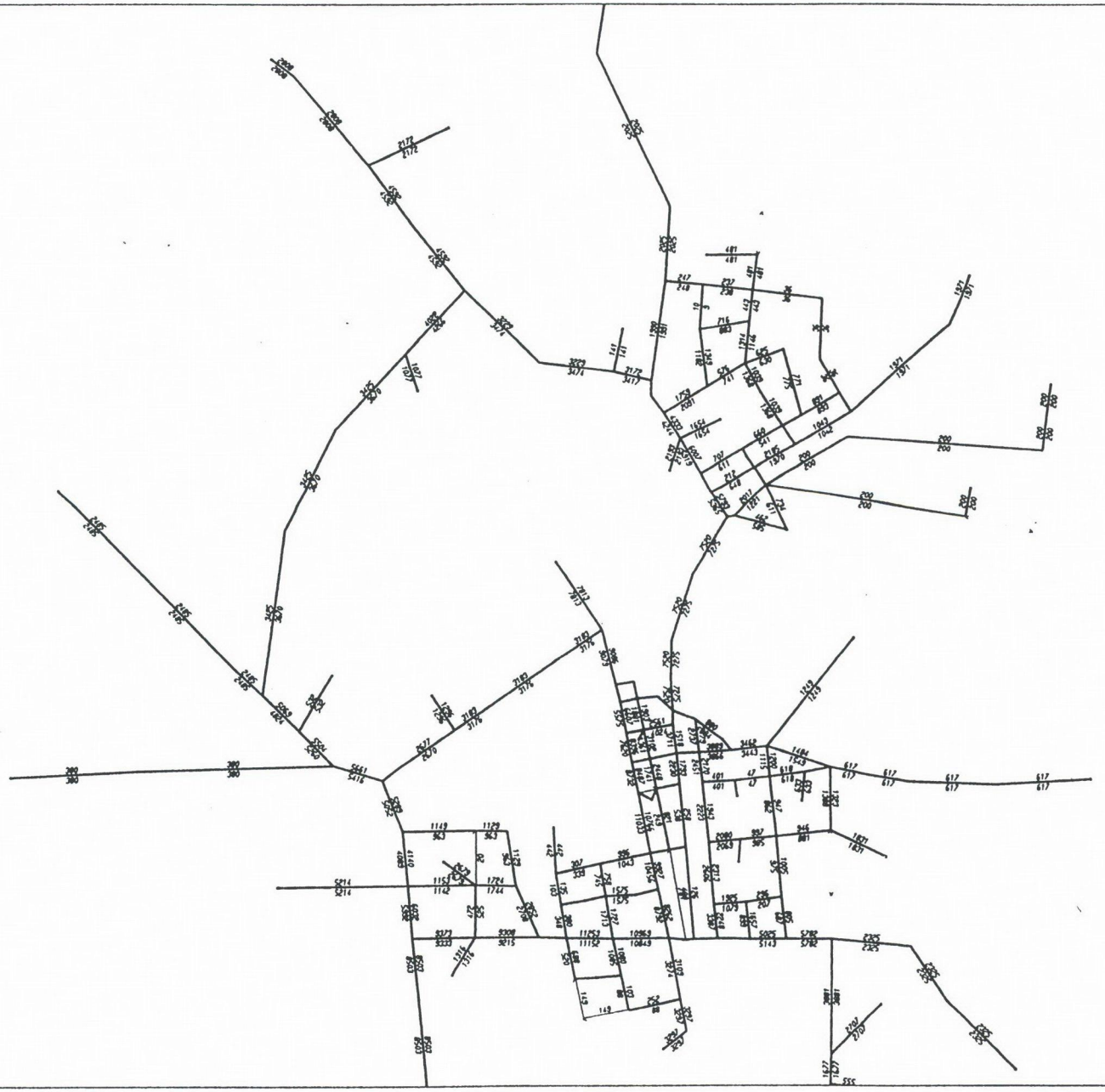

Figure 7

WINDOW:
292153/5996783
302263/6004365

EMME/2 PROJECT: Echuca Moama Traffic Study
SCE[redacted]IO 95: W1 T3 2016 Existing & New Br[redacted]e 2 way

01-03-23 18:09
MODULE: 6[redacted]
ARUP: .....jt

AUTO VOLUMES

emme/2

LINKS:
all

Figure 8

WINDOW:
293423/5996950
301190/6002775

EMME/2 PROJECT: Echuca Moama Traffic Study
SCENARIO 202: W1 2016 both bridges open 25% truck ban on existing

01-03-20 09:31
MODULE: 6.12
ARUP.....jf

4. ECONOMIC EVALUATION

4.1 Option Costing

Estimated costs for each of the alignments were provided by VicRoads Planning Investigations Department, as shown in **Table 4.**

Table 4 Estimated Alignment Costs

Option	Estimated Cost ($M)
Base Case	10.5
C1	45.3
C3	31.3
W1	44.5

These costs include rehabilitation of the existing bridge. For the central options, this amounts to $9.3m. Rehabilitation of the Western option is $10.5m, a higher cost as the works involve a partial closing of the existing bridge and are therefore over a longer period of time.

4.2 Results

A standard approach to economic evaluation of road user benefits has been applied for assessment of the economic performance of projects.

The results of the benefit calculations, including the road user benefit and cost streams are summarised in **Table 5**, and detailed in **Appendix D**. All values assume 2001 resource prices and are based on a discount rate of 7%.

Table 5 Summary of Benefits/ Costs

	Construction Costs 1	Rehabilitation of Existing Bridge	**PV Project Costs**	PV Vehicle Operating Cost Savings	PV Travel Time Savings	PV Freight Time Savings	PV Accident Cost Savings	**PV Road User Benefits**	BCR	NPV
Task One										
C1	36	9.3	**-36**	18	114	4	5	**140**	3.86	104
C3	22	9.3	**-27**	14	114	4	0.3	**133**	5.01	106
W1	34	10.5	**-39**	22	103	3	2	**130**	3.33	91
Task Two										
C1	36	9.3	**-36**	14	70	2	5	**90**	2.5	54
C3	22	9.3	**-27**	11	71	2	0	**85**	3.2	58
W1	34	10.5	**-39**	18	64	2	2	**87**	2.21	47
Task Three										
C1	36	9.3	**-36**	13	50	2	5	**69**	1.89	32
C3	22	9.3	**-27**	11	49	2	0	**61**	2.31	35
W1	34	10.5	**-39**	18	47	1	2	**68**	1.75	29
Task Four										
C1	36	9.3	**-36**	11	52	2	6	**71**	1.98	35
C3	22	9.3	**-25**	10	51	2	1	**64**	2.55	39
Task Five										
W1	34	10.5	**-39**	15	46	1	2	**65**	1.66	26

1) Construction Costs include the upgrading of approach roads for central options.

2) All costs are in $M.

The economic evaluation results consistently show option C3 as having the highest benefit cost ratios (BCR). This is the least expensive option and provides substantial benefits. Option C3 also results in the highest NPV, suggesting this option provides the highest economic benefits over the thirty year assessment period.

The Central options provide the most direct routes between the two town centres and therefore deliver the highest travel time savings. However, the Western option has the highest saving in vehicle operating costs, as this route avoids the town centres and the associated congestion in the surrounding road network.

5. CONCLUSION

Throughout the W1 analysis, one third of traffic is estimated to use the new bridge.

The economic analysis has shown all options perform well economically. The central options show stronger economic performance, with C3 providing slightly higher benefits than C1.

APPENDIX A

Staging Of Options

SECOND MURRAY RIVER CROSSING AT ECHUCA\MOAMA
ECONOMIC ANALYSIS - FUNDING SCENARIOS

	2001	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*Total*
Base Case								
Rehabilitation of Existing Bridge		**$6m**	**$4.5m**					**$10.5m**
Option C1								
New Bridge Construction		**$9m**	**$9m**					**$18m**
Rehabilitation of Existing Bridge				**$4.5m**	**$4.8m**			**$9.3m**
Meninya St Bypass					**$2m**	**$4.5m**	**$4.5m**	**$11m**
Sturt St Upgrade					**$2m**	**$2.5m**	**$2.5m**	**$7m**
								$45.3m
Option C3								
New Bridge Construction		**$9m**	**$9m**					**$18m**
Rehabilitation of Existing Bridge				**$4.5m**	**$4.8m**			**$9.3m**
Meninya St Upgrade					**$1m**	**$3m**		**$4m**
								$31.3m
Option W1								
New Bridge Construction		**$17m**	**$17m**					**$34m**
Rehabilitation of Existing Bridge				**$6m**	**$4.5m**			**$10.5m**
								$44.5m

Additional analysis will be undertaken for Option W1 with truck traffic ban on the existing bridge

APPENDIX B

RDP Group Report

Review of Echuca-Moama Household Data

As a component of the land use planning assessment for the River Murray Bridge study RPD Group has reviewed the household projections as provided in the Traffic Study[1] completed in December 1998.

The review accounts for a range of factors that have the capacity to alter the household projections, including:

- ☐ The Department of Infrastructure (Victoria) small area population projections completed in 2000.
- ☐ Consideration of the different rates of development that may emerge as a result of the current bridge options.
- ☐ Consideration of recent trends in fringe residential and infill housing in Echuca and clustered fringe development in western Moama.

This review involves two components. Firstly it provides a picture of the projected population of the two towns to 2021, accounting for recent population projections. Secondly it provides an indication of the overall household capacity based on the current land availability through zoning and strategy[2].

Reviewing Population and Housing Growth

The population growth estimates provided in the 1998 Traffic Study projected a population of 20,781 for Echuca-Moama in 2016. This was based on compounding historical growth rates for each town. The population projection for Echuca estimated a population of 13,756 in 2016 and 7,025 for Moama in the same year.

These figures are higher than estimated projections from other sources. The Department of Infrastructure projections for Echuca[3] predict a population of 12,378 in 2016 and 12,810 in 2021. This is significantly lower than the projection contained in the traffic study. The Department of Infrastructure Projections also forecast slowing growth in Echuca (from almost 2% per annum to less than 1%).

In the case of Moama, it is possible to conclude that the population calculation for 1996 (based on enumerated population) is an overestimate, as it utilises census collection districts that extend well beyond the boundaries of Moama's urban and rural residential areas. The area included for the estimates extended to Picnic Point and the southern fringes of Mathoura. The growth for Moama is based on a rate of growth that is higher than ABS estimates.

The household projections for both towns are based on trends of decreasing household size (fewer families, more single people and older couples) which are consistent trends across Australia, particularly rural Australia and regional centres such as Echuca-Moama. The trends and estimates in the Traffic Study appear consistent with other estimates of changing household size.

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[1] ARUP (1998) *Echuca-Moama Traffic Study: Final Report*, Roads and Traffic Authority NSW

[2] It is evident that the available land will provide for household growth well in excess of population forecasts to 2021. What this does indicate, however, is the likely future growth in the long term, which should be considered as reliable given the constraints posed to growth in other areas of Echuca and Moama.

[3] Victoria in Future, Department of Infrastructure (2000)

Importantly, however the initial population estimates and projections, and the subsequent projections, indicate a trend for significant population growth coupled with a further increase in housing growth resulting form both overall population growth and decreasing household size. Essentially, the data suggests a continuing trend of growth in Echuca-Moama to beyond 2021. In effect (while the planning period in the Traffic Study was to 2026) the population of Echuca-Moama is likely to continue to grow to a population and household level well in excess of the levels estimated in either the Traffic Study or the DoI Projections. This is particularly evident when it is considered that the land currently available for development (either through zoning or policy intention) as the capacity to house between 24,500 and 32,000 people on 12,865 lots at current lot sizes.

Modelling Household Growth

The following modelling builds on the work undertaken in the 1998 Traffic Study. It provides scenarios for household growth in 2016 and 2026 based on population modelling, changes in household size and the distribution of growth. The transport zones used in the 1998 Traffic Study have been used again to provide consistency. The results of this modelling suggest a slightly lower rate of growth to 2016 than the initial work (8811 houses compared to 8963).

The following assumptions were made to undertake this review:

- ☐ It was assumed that the overall growth of the two towns would be consistent under each bridge scenario (West and Central) although the *distribution* of the development would vary.

- ☐ It was postulated that the western bridge option would facilitate more rapid growth in West Moama, while increased scope for commercial development in West Echuca may reduce household growth capacity there.

- ☐ The household projections developed by the Department of Infrastructure were used to model the overall household growth in Echuca, while a 3.3% housing growth rate was assumed consistently for Moama.

- ☐ Current zoning and planning strategy was assume to continue. As the overall capacity of current zoning and policy allows for 12,865 lots is was recognised that this capacity would not be met during the life of the modelling. (in fact the capacity would not be met until at least 2037 at current growth rates and a low range household size estimate).

The following table provides a review of the household numbers for each zone (as used in the Traffic Study). It provides an estimate at 2016 and 2026 when a Central or Western Bridge is used. It also provides a "maximum" development estimate based on current policy and statutory scenarios.

Housing Estimates 1996-2026 (and Houses at Maximum Capacity for Current Zoning and Strategy Context)

Zones	1996 Houses	Central 2016	West 2016	Central 2026	West 2026	Total Houses (max)
11	114	385	448	473	550	700
12	41	1006	1091	1236	1340	1829
13	357	357	357	357	357	357
14	55	46	46	57	57	85
15	247	247	247	247	247	247
16	120	120	120	120	120	120
17	120	120	120	120	120	120
18	174	174	174	174	174	174
19	137	137	137	137	137	137
42	8	35	35	43	43	63
44	0	165	151	203	185	300
Moama	**1373**	**2793**	**2925**	**3167**	**3330**	**4132**
20	207	207	207	207	207	207
21	89	89	89	89	89	89
22	100	99	99	122	122	180
23	18	165	165	203	203	300
24	590	363	363	446	446	660
25	85	85	85	85	85	85
26	320	320	320	320	320	320
27	196	196	196	196	196	196
28	278	278	278	278	278	278
29	35	746	746	916	916	1355
30	32	1375	1286	1689	1580	2512
31	312	180	100	221	123	409
32	281	281	281	281	281	281
33	382	382	382	382	382	404
34	41	41	41	41	41	41
35	193	193	193	193	193	193
36	247	247	247	247	247	247
37	82	82	82	82	82	82
38	115	115	115	115	115	115
39	181	181	181	181	181	181
40	181	181	181	181	181	181
41	201	171	207	210	254	376
43	41	41	41	41	41	41
Echuca	**4207**	**6018**	**5885**	**6726**	**6563**	**8733**
Total	**5580**	**8811**	**8811**	**9893**	**9893**	**12865**

APPENDIX C

Revised Option Staging (Task 4)

SECOND MURRAY RIVER CROSSING AT ECHUCA\MOAMA
ECONOMIC ANALYSIS - FUNDING SCENARIOS

DELAYED REHABILITATION OF EXISTING BRIDGE FOR OPTIONS C1 & C3

	2001	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*Total*
Option C1										
New Bridge Construction		**$9m**	**$9m**							**$18m**
Rehabilitation of Existing Bridge								**$4.5m**	**$4.8m**	**$9.3m**
Meninya St Bypass				**$2m**	**$9m**					**$11m**
Sturt St Upgrade				**$2m**	**$5m**					**$7m**
										$45.3m
Option C3										
New Bridge Construction		**$9m**	**$9m**							**$18m**
Rehabilitation of Existing Bridge								**$4.5m**	**$4.8m**	**$9.3m**
Meninya St Upgrade				**$4m**						**$4m**
										$31.3m

APPENDIX D

Economic Evaluation
Cost/ Benefit Streams

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - Task 1
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	(4.5)	(4.5)	0.1	1.5	0.0	0.3	1.9	(2.6)	(18.4)
2005	(4.0)	0.0	0.0	(4.8)	(8.8)	0.5	1.6	0.1	0.2	2.4	(6.4)	(23.2)
2006	(7.0)	0.0	0.0	0.0	(7.0)	**0.6**	**2.0**	**0.1**	**0.2**	**2.9**	(4.1)	(26.2)
2007	(7.0)	0.0	0.0	0.0	(7.0)	0.6	2.4	0.1	0.2	3.4	(3.6)	(28.6)
2008	0.0	0.0	0.0	0.0	0.0	1.1	6.0	0.2	0.5	7.7	7.7	(23.8)
2009	0.0	0.0	0.0	0.0	0.0	1.1	6.6	0.2	0.5	8.5	8.5	(18.8)
2010	0.0	0.0	0.0	0.0	0.0	1.2	7.2	0.2	0.5	9.2	9.2	(13.8)
2011	0.0	0.0	0.0	0.0	0.0	1.3	7.9	0.3	0.5	10.0	10.0	(8.7)
2012	0.0	0.0	0.0	0.0	0.0	1.4	8.5	0.3	0.5	10.8	10.8	(3.6)
2013	0.0	0.0	0.0	0.0	0.0	1.5	9.2	0.3	0.5	11.5	11.5	1.5
2014	0.0	0.0	0.0	0.0	0.0	1.6	9.8	0.3	0.5	12.3	12.3	6.6
2015	0.0	0.0	0.0	0.0	0.0	1.7	10.4	0.4	0.6	13.0	13.0	11.6
2016	0.0	0.0	0.0	0.0	0.0	**1.8**	**11.1**	**0.4**	**0.6**	**13.8**	13.8	16.6
2017	0.0	0.0	0.0	0.0	0.0	2.0	12.5	0.4	0.6	15.5	15.5	21.9
2018	0.0	0.0	0.0	0.0	0.0	2.1	13.9	0.5	0.6	17.1	17.1	27.3
2019	0.0	0.0	0.0	0.0	0.0	2.3	15.3	0.5	0.6	18.8	18.8	32.8
2020	0.0	0.0	0.0	0.0	0.0	2.5	16.8	0.5	0.6	20.4	20.4	38.5
2021	0.0	0.0	0.0	0.0	0.0	2.7	18.2	0.6	0.6	22.1	22.1	44.2
2022	0.0	0.0	0.0	0.0	0.0	2.9	19.6	0.6	0.6	23.7	23.7	49.9
2023	0.0	0.0	0.0	0.0	0.0	3.1	21.0	0.7	0.6	25.4	25.4	55.6
2024	0.0	0.0	0.0	0.0	0.0	3.3	22.4	0.7	0.6	27.0	27.0	61.3
2025	0.0	0.0	0.0	0.0	0.0	3.4	23.8	0.8	0.6	28.7	28.7	67.0
2026	0.0	0.0	0.0	0.0	0.0	**3.6**	**25.3**	**0.8**	**0.6**	**30.3**	30.3	72.6
2027	0.0	0.0	0.0	0.0	0.0	3.8	26.7	0.8	0.7	32.0	32.0	78.1
2028	0.0	0.0	0.0	0.0	0.0	4.0	28.1	0.9	0.7	33.6	33.6	83.5
2029	0.0	0.0	0.0	0.0	0.0	4.2	29.5	0.9	0.7	35.3	35.3	88.8
2030	0.0	0.0	0.0	0.0	0.0	4.4	30.9	1.0	0.7	36.9	36.9	94.0
2031	0.0	0.0	0.0	0.0	0.0	4.6	32.3	1.0	0.7	38.6	38.6	99.1
2032	0.0	0.0	0.0	0.0	0.0	4.7	33.8	1.1	0.7	40.3	40.3	104.0
PV @ Discount Rate												
4%	-32	0	0	-8	-40	30	198	6	8	242	202	
7%	-29	0	0	-7	-36	18	114	4	5	140	104	
10%	-27	0	0	-7	-33	11	69	2	3	86	53	
				% of Benefits		13%	81%	3%	4%	100%		

NPV = ($mill)	104.01
IRR=	19%
NPV/CC=	2.86
BCR=	3.86

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C3 - Task 1
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	(4.5)	(4.5)	(0.3)	1.7	0.1	0.3	1.7	(2.8)	(18.5)
2005	(1.0)	0.0	0.0	(4.8)	(5.8)	(0.1)	2.1	0.1	0.2	2.2	(3.6)	(21.3)
2006	(3.0)	0.0	0.0	0.0	(3.0)	**(0.1)**	**2.2**	**0.1**	**0.2**	**2.4**	(0.6)	(21.7)
2007	0.0	0.0	0.0	0.0	0.0	0.7	5.1	0.2	0.0	6.0	6.0	(17.7)
2008	0.0	0.0	0.0	0.0	0.0	0.8	5.7	0.2	0.0	6.7	6.7	(13.6)
2009	0.0	0.0	0.0	0.0	0.0	0.9	6.3	0.2	0.0	7.5	7.5	(9.2)
2010	0.0	0.0	0.0	0.0	0.0	1.0	7.0	0.2	0.0	8.2	8.2	(4.7)
2011	0.0	0.0	0.0	0.0	0.0	1.1	7.6	0.3	0.0	9.0	9.0	(0.2)
2012	0.0	0.0	0.0	0.0	0.0	1.2	8.3	0.3	(0.0)	9.7	9.7	4.4
2013	0.0	0.0	0.0	0.0	0.0	1.2	8.9	0.3	(0.0)	10.4	10.4	9.1
2014	0.0	0.0	0.0	0.0	0.0	1.3	9.6	0.3	(0.0)	11.2	11.2	13.7
2015	0.0	0.0	0.0	0.0	0.0	1.4	10.2	0.3	(0.0)	11.9	11.9	18.3
2016	0.0	0.0	0.0	0.0	0.0	**1.5**	**10.9**	**0.4**	**(0.0)**	**12.7**	12.7	22.9
2017	0.0	0.0	0.0	0.0	0.0	1.7	12.3	0.4	(0.0)	14.3	14.3	27.8
2018	0.0	0.0	0.0	0.0	0.0	1.9	13.7	0.4	(0.0)	16.0	16.0	32.8
2019	0.0	0.0	0.0	0.0	0.0	2.0	15.1	0.5	(0.0)	17.6	17.6	38.0
2020	0.0	0.0	0.0	0.0	0.0	2.2	16.6	0.5	(0.0)	19.3	19.3	43.4
2021	0.0	0.0	0.0	0.0	0.0	2.4	18.0	0.6	(0.1)	20.9	20.9	48.8
2022	0.0	0.0	0.0	0.0	0.0	2.6	19.4	0.6	(0.1)	22.6	22.6	54.2
2023	0.0	0.0	0.0	0.0	0.0	2.8	20.9	0.7	(0.1)	24.2	24.2	59.7
2024	0.0	0.0	0.0	0.0	0.0	3.0	22.3	0.7	(0.1)	25.9	25.9	65.2
2025	0.0	0.0	0.0	0.0	0.0	3.1	23.7	0.7	(0.1)	27.5	27.5	70.6
2026	0.0	0.0	0.0	0.0	0.0	**3.3**	**25.2**	**0.8**	**(0.1)**	**29.2**	29.2	76.0
2027	0.0	0.0	0.0	0.0	0.0	3.5	26.6	0.8	(0.1)	30.8	30.8	81.3
2028	0.0	0.0	0.0	0.0	0.0	3.7	28.0	0.9	(0.1)	32.5	32.5	86.5
2029	0.0	0.0	0.0	0.0	0.0	3.9	29.4	0.9	(0.1)	34.1	34.1	91.6
2030	0.0	0.0	0.0	0.0	0.0	4.0	30.9	1.0	(0.1)	35.8	35.8	96.7
2031	0.0	0.0	0.0	0.0	0.0	4.2	32.3	1.0	(0.1)	37.4	37.4	101.6
2032	0.0	0.0	0.0	0.0	0.0	4.4	33.7	1.0	(0.1)	39.1	39.1	106.4
PV @ Discount Rate												
4%	-20	0	0	-8	-28	25	198	6	0.2	230	201	
7%	-19	0	0	-7	-27	14	114	4	0.3	133	106	
10%	-18	0	0	-7	-25	9	70	2	0	82	57	
						% of Benefits	11%	86%	3%	0%	100%	

NPV = ($mill)	106.39
IRR=	22%
NPV/CC=	4.01
BCR=	5.01

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option W1 - Task 1
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(15.9)
2003	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(30.7)
2004	0.0	0.0	0.0	(6.0)	(6.0)	(0.7)	(0.3)	(0.0)	0.0	(1.0)	(7.0)	(36.5)
2005	0.0	0.0	0.0	(4.5)	(4.5)	1.0	3.4	0.1	0.1	4.6	0.1	(36.4)
2006	0.0	0.0	0.0	0.0	0.0	**1.3**	**4.0**	**0.1**	**0.1**	**5.6**	5.6	(32.4)
2007	0.0	0.0	0.0	0.0	0.0	1.4	4.6	0.2	0.1	6.3	6.3	(28.2)
2008	0.0	0.0	0.0	0.0	0.0	1.5	5.1	0.2	0.1	6.9	6.9	(23.9)
2009	0.0	0.0	0.0	0.0	0.0	1.6	5.7	0.2	0.2	7.6	7.6	(19.5)
2010	0.0	0.0	0.0	0.0	0.0	1.7	6.2	0.2	0.2	8.3	8.3	(15.0)
2011	0.0	0.0	0.0	0.0	0.0	1.8	6.8	0.2	0.2	8.9	8.9	(10.4)
2012	0.0	0.0	0.0	0.0	0.0	1.9	7.3	0.2	0.2	9.6	9.6	(5.9)
2013	0.0	0.0	0.0	0.0	0.0	1.9	7.9	0.3	0.2	10.3	10.3	(1.3)
2014	0.0	0.0	0.0	0.0	0.0	2.0	8.5	0.3	0.2	11.0	11.0	3.2
2015	0.0	0.0	0.0	0.0	0.0	2.1	9.0	0.3	0.2	11.6	11.6	7.8
2016	0.0	0.0	0.0	0.0	0.0	**2.2**	**9.6**	**0.3**	**0.2**	**12.3**	12.3	12.2
2017	0.0	0.0	0.0	0.0	0.0	2.4	10.8	0.3	0.2	13.8	13.8	16.9
2018	0.0	0.0	0.0	0.0	0.0	2.6	12.1	0.4	0.2	15.3	15.3	21.7
2019	0.0	0.0	0.0	0.0	0.0	2.7	13.4	0.4	0.2	16.8	16.8	26.7
2020	0.0	0.0	0.0	0.0	0.0	2.9	14.7	0.5	0.2	18.3	18.3	31.8
2021	0.0	0.0	0.0	0.0	0.0	3.1	16.0	0.5	0.2	19.8	19.8	36.9
2022	0.0	0.0	0.0	0.0	0.0	3.3	17.3	0.5	0.3	21.3	21.3	42.1
2023	0.0	0.0	0.0	0.0	0.0	3.4	18.6	0.6	0.3	22.9	22.9	47.2
2024	0.0	0.0	0.0	0.0	0.0	3.6	19.9	0.6	0.3	24.4	24.4	52.3
2025	0.0	0.0	0.0	0.0	0.0	3.8	21.2	0.7	0.3	25.9	25.9	57.5
2026	0.0	0.0	0.0	0.0	0.0	**4.0**	**22.5**	**0.7**	**0.3**	**27.4**	27.4	62.5
2027	0.0	0.0	0.0	0.0	0.0	4.1	23.7	0.7	0.3	28.9	28.9	67.5
2028	0.0	0.0	0.0	0.0	0.0	4.3	25.0	0.8	0.3	30.4	30.4	72.4
2029	0.0	0.0	0.0	0.0	0.0	4.5	26.3	0.8	0.3	31.9	31.9	77.2
2030	0.0	0.0	0.0	0.0	0.0	4.7	27.6	0.8	0.3	33.4	33.4	81.9
2031	0.0	0.0	0.0	0.0	0.0	4.8	28.9	0.9	0.3	34.9	34.9	86.5
2032	0.0	0.0	0.0	0.0	0.0	5.0	30.2	0.9	0.3	36.4	36.4	90.9
PV @ Discount Rate												
4%	-32	0	0	-9	-41	36	178	6	3	222	181	
7%	-31	0	0	-8	-39	22	103	3	2	130	91	
10%	-30	0	0	-8	-37	14	64	2	1	81	44	
				% of Benefits		17%	79%	2%	1%	100%		

NPV = ($mill)	90.93
IRR=	17%
NPV/CC=	2.33
BCR=	3.33

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - Task 2
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	(4.5)	(4.5)	0.1	1.2	0.0	0.3	1.6	(2.9)	(18.6)
2005	(4.0)	0.0	0.0	(4.8)	(8.8)	0.5	1.3	0.0	0.2	2.1	(6.7)	(23.7)
2006	(7.0)	0.0	0.0	0.0	(7.0)	**0.5**	**1.6**	**0.1**	**0.2**	**2.3**	(4.7)	(27.1)
2007	(7.0)	0.0	0.0	0.0	(7.0)	0.5	1.8	0.1	0.2	2.6	(4.4)	(30.0)
2008	0.0	0.0	0.0	0.0	0.0	0.9	4.7	0.2	0.5	6.2	6.2	(26.2)
2009	0.0	0.0	0.0	0.0	0.0	1.0	5.0	0.2	0.5	6.7	6.7	(22.3)
2010	0.0	0.0	0.0	0.0	0.0	1.1	5.4	0.2	0.5	7.1	7.1	(18.4)
2011	0.0	0.0	0.0	0.0	0.0	1.1	5.8	0.2	0.5	7.6	7.6	(14.5)
2012	0.0	0.0	0.0	0.0	0.0	1.2	6.1	0.2	0.5	8.0	8.0	(10.7)
2013	0.0	0.0	0.0	0.0	0.0	1.3	6.5	0.2	0.5	8.5	8.5	(6.9)
2014	0.0	0.0	0.0	0.0	0.0	1.3	6.9	0.2	0.5	8.9	8.9	(3.2)
2015	0.0	0.0	0.0	0.0	0.0	1.4	7.2	0.2	0.5	9.4	9.4	0.4
2016	0.0	0.0	0.0	0.0	0.0	**1.4**	**7.6**	**0.2**	**0.5**	**9.8**	9.8	4.0
2017	0.0	0.0	0.0	0.0	0.0	1.5	8.1	0.3	0.5	10.5	10.5	7.5
2018	0.0	0.0	0.0	0.0	0.0	1.6	8.7	0.3	0.6	11.2	11.2	11.1
2019	0.0	0.0	0.0	0.0	0.0	1.7	9.3	0.3	0.6	11.9	11.9	14.6
2020	0.0	0.0	0.0	0.0	0.0	1.8	9.8	0.3	0.6	12.5	12.5	18.0
2021	0.0	0.0	0.0	0.0	0.0	1.9	10.4	0.4	0.6	13.2	13.2	21.5
2022	0.0	0.0	0.0	0.0	0.0	2.0	10.9	0.4	0.6	13.9	13.9	24.8
2023	0.0	0.0	0.0	0.0	0.0	2.1	11.5	0.4	0.6	14.6	14.6	28.1
2024	0.0	0.0	0.0	0.0	0.0	2.2	12.1	0.4	0.6	15.3	15.3	31.3
2025	0.0	0.0	0.0	0.0	0.0	2.3	12.6	0.4	0.6	16.0	16.0	34.5
2026	0.0	0.0	0.0	0.0	0.0	**2.4**	**13.2**	**0.5**	**0.6**	**16.6**	16.6	37.5
2027	0.0	0.0	0.0	0.0	0.0	2.5	13.7	0.5	0.6	17.3	17.3	40.5
2028	0.0	0.0	0.0	0.0	0.0	2.6	14.3	0.5	0.6	18.0	18.0	43.4
2029	0.0	0.0	0.0	0.0	0.0	2.7	14.8	0.5	0.6	18.7	18.7	46.2
2030	0.0	0.0	0.0	0.0	0.0	2.8	15.4	0.6	0.6	19.4	19.4	48.9
2031	0.0	0.0	0.0	0.0	0.0	2.9	16.0	0.6	0.6	20.0	20.0	51.6
2032	0.0	0.0	0.0	0.0	0.0	3.0	16.5	0.6	0.6	20.7	20.7	54.1
PV @ Discount Rate												
4%	-32	0	0	-8	-40	22	117	4	8	151	111	
7%	-29	0	0	-7	-36	14	70	2	5	90	54	
10%	-27	0	0	-7	-33	9	44	1	3	57	24	
				% of Benefits		15%	77%	3%	5%	100%		

NPV = ($mill)	54.12
IRR=	15%
NPV/CC=	1.49
BCR=	2.49

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C3 - Task 2
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	(4.5)	(4.5)	(0.3)	1.4	0.0	0.3	1.5	(3.0)	(18.7)
2005	(1.0)	0.0	0.0	(4.8)	(5.8)	0.0	1.6	0.1	0.2	1.9	(3.9)	(21.7)
2006	(3.0)	0.0	0.0	0.0	(3.0)	**0.0**	**1.7**	**0.1**	**0.2**	**2.0**	(1.0)	(22.5)
2007	0.0	0.0	0.0	0.0	0.0	0.8	4.2	0.1	0.0	5.1	5.1	(19.1)
2008	0.0	0.0	0.0	0.0	0.0	0.8	4.5	0.1	0.0	5.5	5.5	(15.6)
2009	0.0	0.0	0.0	0.0	0.0	0.9	4.9	0.2	0.0	5.9	5.9	(12.2)
2010	0.0	0.0	0.0	0.0	0.0	0.9	5.3	0.2	0.0	6.4	6.4	(8.7)
2011	0.0	0.0	0.0	0.0	0.0	1.0	5.6	0.2	0.0	6.8	6.8	(5.2)
2012	0.0	0.0	0.0	0.0	0.0	1.1	6.0	0.2	0.0	7.2	7.2	(1.8)
2013	0.0	0.0	0.0	0.0	0.0	1.1	6.3	0.2	(0.0)	7.7	7.7	1.6
2014	0.0	0.0	0.0	0.0	0.0	1.2	6.7	0.2	(0.0)	8.1	8.1	4.9
2015	0.0	0.0	0.0	0.0	0.0	1.3	7.0	0.2	(0.0)	8.5	8.5	8.2
2016	0.0	0.0	0.0	0.0	0.0	**1.3**	**7.4**	**0.2**	**(0.0)**	**8.9**	8.9	11.5
2017	0.0	0.0	0.0	0.0	0.0	1.4	8.0	0.3	(0.0)	9.6	9.6	14.7
2018	0.0	0.0	0.0	0.0	0.0	1.5	8.5	0.3	(0.0)	10.3	10.3	18.0
2019	0.0	0.0	0.0	0.0	0.0	1.6	9.1	0.3	(0.0)	10.9	10.9	21.2
2020	0.0	0.0	0.0	0.0	0.0	1.7	9.6	0.3	(0.0)	11.6	11.6	24.4
2021	0.0	0.0	0.0	0.0	0.0	1.8	10.2	0.3	(0.0)	12.3	12.3	27.6
2022	0.0	0.0	0.0	0.0	0.0	1.8	10.8	0.4	(0.1)	12.9	12.9	30.7
2023	0.0	0.0	0.0	0.0	0.0	1.9	11.3	0.4	(0.1)	13.6	13.6	33.8
2024	0.0	0.0	0.0	0.0	0.0	2.0	11.9	0.4	(0.1)	14.3	14.3	36.8
2025	0.0	0.0	0.0	0.0	0.0	2.1	12.4	0.4	(0.1)	14.9	14.9	39.7
2026	0.0	0.0	0.0	0.0	0.0	**2.2**	**13.0**	**0.5**	**(0.1)**	**15.6**	15.6	42.6
2027	0.0	0.0	0.0	0.0	0.0	2.3	13.6	0.5	(0.1)	16.3	16.3	45.4
2028	0.0	0.0	0.0	0.0	0.0	2.4	14.1	0.5	(0.1)	16.9	16.9	48.1
2029	0.0	0.0	0.0	0.0	0.0	2.5	14.7	0.5	(0.1)	17.6	17.6	50.8
2030	0.0	0.0	0.0	0.0	0.0	2.6	15.2	0.5	(0.1)	18.2	18.2	53.3
2031	0.0	0.0	0.0	0.0	0.0	2.7	15.8	0.6	(0.1)	18.9	18.9	55.8
2032	0.0	0.0	0.0	0.0	0.0	2.7	16.4	0.6	(0.1)	19.6	19.6	58.2
PV @ Discount Rate												
4%	-20	0	0	-8	-28	19	118	4	0	141	113	
7%	-19	0	0	-7	-27	11	71	2	0	85	58	
10%	-18	0	0	-7	-25	7	45	2	0	34	29	
						% of Benefits	14%	83%	3%	0%	100%	

NPV = ($mill)	58.23
IRR=	18%
NPV/CC=	2.20
BCR=	3.20

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option W1 - Task 2
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(15.9)
2003	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(30.7)
2004	0.0	0.0	0.0	(6.0)	(6.0)	(0.7)	(0.2)	(0.1)	(0.0)	(1.0)	(7.0)	(36.4)
2005	0.0	0.0	0.0	(4.5)	(4.5)	1.0	2.8	0.1	0.1	4.0	(0.5)	(36.8)
2006	0.0	0.0	0.0	0.0	0.0	**1.3**	**3.4**	**0.1**	**0.1**	**4.9**	4.9	(33.3)
2007	0.0	0.0	0.0	0.0	0.0	1.3	3.7	0.1	0.1	5.3	5.3	(29.8)
2008	0.0	0.0	0.0	0.0	0.0	1.4	4.0	0.1	0.2	5.7	5.7	(26.2)
2009	0.0	0.0	0.0	0.0	0.0	1.5	4.3	0.1	0.2	6.1	6.1	(22.7)
2010	0.0	0.0	0.0	0.0	0.0	1.6	4.7	0.1	0.2	6.6	6.6	(19.1)
2011	0.0	0.0	0.0	0.0	0.0	1.6	5.0	0.2	0.2	7.0	7.0	(15.5)
2012	0.0	0.0	0.0	0.0	0.0	1.7	5.3	0.2	0.2	7.4	7.4	(12.0)
2013	0.0	0.0	0.0	0.0	0.0	1.8	5.6	0.2	0.2	7.8	7.8	(8.6)
2014	0.0	0.0	0.0	0.0	0.0	1.9	6.0	0.2	0.2	8.2	8.2	(5.2)
2015	0.0	0.0	0.0	0.0	0.0	1.9	6.3	0.2	0.2	8.6	8.6	(1.8)
2016	0.0	0.0	0.0	0.0	0.0	**2.0**	**6.6**	**0.2**	**0.3**	**9.1**	9.1	1.5
2017	0.0	0.0	0.0	0.0	0.0	2.1	7.1	0.2	0.3	9.7	9.7	4.8
2018	0.0	0.0	0.0	0.0	0.0	2.2	7.6	0.2	0.3	10.3	10.3	8.0
2019	0.0	0.0	0.0	0.0	0.0	2.3	8.1	0.3	0.3	10.9	10.9	11.2
2020	0.0	0.0	0.0	0.0	0.0	2.4	8.6	0.3	0.3	11.5	11.5	14.4
2021	0.0	0.0	0.0	0.0	0.0	2.5	9.1	0.3	0.3	12.1	12.1	17.6
2022	0.0	0.0	0.0	0.0	0.0	2.6	9.6	0.3	0.3	12.8	12.8	20.6
2023	0.0	0.0	0.0	0.0	0.0	2.6	10.1	0.3	0.3	13.4	13.4	23.7
2024	0.0	0.0	0.0	0.0	0.0	2.7	10.6	0.4	0.3	14.0	14.0	26.6
2025	0.0	0.0	0.0	0.0	0.0	2.8	11.1	0.4	0.3	14.6	14.6	29.5
2026	0.0	0.0	0.0	0.0	0.0	**2.9**	**11.6**	**0.4**	**0.3**	**15.2**	15.2	32.3
2027	0.0	0.0	0.0	0.0	0.0	3.0	12.1	0.4	0.3	15.8	15.8	35.0
2028	0.0	0.0	0.0	0.0	0.0	3.1	12.6	0.4	0.3	16.5	16.5	37.7
2029	0.0	0.0	0.0	0.0	0.0	3.2	13.2	0.4	0.3	17.1	17.1	40.2
2030	0.0	0.0	0.0	0.0	0.0	3.3	13.7	0.5	0.3	17.7	17.7	42.7
2031	0.0	0.0	0.0	0.0	0.0	3.4	14.2	0.5	0.3	18.3	18.3	45.1
2032	0.0	0.0	0.0	0.0	0.0	3.5	14.7	0.5	0.3	18.9	18.9	47.5
PV @ Discount Rate												
4%	-32	0	0	-9	-41	30	106	3	3	143	102	
7%	-31	0	0	-8	-39	18	64	2	2	87	47	
10%	-30	0	0	-8	-37	12	41	1	1	56	19	
					% of Benefits	21%	74%	2%	2%	100%		

NPV = ($mill)	47.46
IRR=	14%
NPV/CC=	1.21
BCR=	2.21

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - Task 3
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	(4.5)	(4.5)	0.1	0.8	0.0	0.3	1.2	(3.3)	(19.0)
2005	(4.0)	0.0	0.0	(4.8)	(8.8)	0.5	0.7	0.0	0.2	1.4	(7.4)	(24.6)
2006	(7.0)	0.0	0.0	0.0	(7.0)	**0.5**	**0.8**	**0.0**	**0.2**	**1.5**	(5.5)	(28.5)
2007	(7.0)	0.0	0.0	0.0	(7.0)	0.5	0.9	0.0	0.2	1.7	(5.3)	(32.0)
2008	0.0	0.0	0.0	0.0	0.0	0.9	3.7	0.1	0.5	5.2	5.2	(28.8)
2009	0.0	0.0	0.0	0.0	0.0	1.0	3.9	0.1	0.5	5.5	5.5	(25.6)
2010	0.0	0.0	0.0	0.0	0.0	1.0	4.2	0.1	0.5	5.9	5.9	(22.4)
2011	0.0	0.0	0.0	0.0	0.0	1.1	4.4	0.1	0.5	6.2	6.2	(19.3)
2012	0.0	0.0	0.0	0.0	0.0	1.2	4.7	0.2	0.5	6.5	6.5	(16.2)
2013	0.0	0.0	0.0	0.0	0.0	1.2	4.9	0.2	0.5	6.8	6.8	(13.2)
2014	0.0	0.0	0.0	0.0	0.0	1.3	5.2	0.2	0.5	7.1	7.1	(10.2)
2015	0.0	0.0	0.0	0.0	0.0	1.3	5.4	0.2	0.5	7.4	7.4	(7.3)
2016	0.0	0.0	0.0	0.0	0.0	**1.4**	**5.6**	**0.2**	**0.5**	**7.7**	7.7	(4.5)
2017	0.0	0.0	0.0	0.0	0.0	1.5	6.0	0.2	0.5	8.2	8.2	(1.7)
2018	0.0	0.0	0.0	0.0	0.0	1.5	6.3	0.2	0.6	8.6	8.6	1.0
2019	0.0	0.0	0.0	0.0	0.0	1.6	6.7	0.2	0.6	9.0	9.0	3.7
2020	0.0	0.0	0.0	0.0	0.0	1.7	7.0	0.2	0.6	9.5	9.5	6.3
2021	0.0	0.0	0.0	0.0	0.0	1.7	7.3	0.3	0.6	9.9	9.9	8.8
2022	0.0	0.0	0.0	0.0	0.0	1.8	7.7	0.3	0.6	10.3	10.3	11.3
2023	0.0	0.0	0.0	0.0	0.0	1.9	8.0	0.3	0.6	10.7	10.7	13.7
2024	0.0	0.0	0.0	0.0	0.0	2.0	8.3	0.3	0.6	11.2	11.2	16.1
2025	0.0	0.0	0.0	0.0	0.0	2.0	8.7	0.3	0.6	11.6	11.6	18.4
2026	0.0	0.0	0.0	0.0	0.0	**2.1**	**9.0**	**0.3**	**0.6**	**12.0**	12.0	20.6
2027	0.0	0.0	0.0	0.0	0.0	2.2	9.3	0.3	0.6	12.5	12.5	22.8
2028	0.0	0.0	0.0	0.0	0.0	2.2	9.7	0.3	0.6	12.9	12.9	24.8
2029	0.0	0.0	0.0	0.0	0.0	2.3	10.0	0.4	0.6	13.3	13.3	26.8
2030	0.0	0.0	0.0	0.0	0.0	2.4	10.4	0.4	0.6	13.7	13.7	28.8
3031	0.0	0.0	0.0	0.0	0.0	2.5	10.7	0.4	0.6	14.2	14.2	30.6
2032	0.0	0.0	0.0	0.0	0.0	2.5	11.0	0.4	0.6	14.6	14.6	32.4
PV @ Discount Rate												
4%	-32	0	0	-8	-40	21	83	3	8	114	74	
7%	-29	0	0	-7	-36	13	50	2	5	69	32	
10%	-27	0	0	-7	-33	8	31	1	3	44	11	
				% of Benefits		18%	72%	2%	7%	100%		

NPV = ($mill)	32.42
IRR=	13%
NPV/CC=	0.89
BCR=	1.89

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C3 - Task 3
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	(4.5)	(4.5)	(0.1)	0.9	0.0	0.3	1.10	(3.4)	(19.1)
2005	(1.0)	0.0	0.0	(4.8)	(5.8)	0.1	0.9	0.0	0.2	1.14	(4.7)	(22.6)
2006	(3.0)	0.0	0.0	0.0	(3.0)	**0.1**	**0.9**	**0.0**	**0.2**	**1.2**	(1.8)	(23.9)
2007	0.0	0.0	0.0	0.0	0.0	0.8	3.2	0.1	0.0	4.1	4.1	(21.1)
2008	0.0	0.0	0.0	0.0	0.0	0.8	3.4	0.1	0.0	4.4	4.4	(18.4)
2009	0.0	0.0	0.0	0.0	0.0	0.9	3.7	0.1	0.0	4.7	4.7	(15.7)
2010	0.0	0.0	0.0	0.0	0.0	0.9	3.9	0.1	0.0	4.9	4.9	(13.0)
2011	0.0	0.0	0.0	0.0	0.0	1.0	4.1	0.1	0.0	5.2	5.2	(10.3)
2012	0.0	0.0	0.0	0.0	0.0	1.0	4.3	0.1	(0.0)	5.5	5.5	(7.7)
2013	0.0	0.0	0.0	0.0	0.0	1.1	4.5	0.1	(0.0)	5.8	5.8	(5.2)
2014	0.0	0.0	0.0	0.0	0.0	1.1	4.7	0.2	(0.0)	6.0	6.0	(2.7)
2015	0.0	0.0	0.0	0.0	0.0	1.2	5.0	0.2	(0.0)	6.3	6.3	(0.2)
2016	0.0	0.0	0.0	0.0	0.0	**1.2**	**5.2**	**0.2**	**(0.0)**	**6.6**	6.6	2.2
2017	0.0	0.0	0.0	0.0	0.0	1.3	5.5	0.2	(0.0)	7.0	7.0	4.5
2018	0.0	0.0	0.0	0.0	0.0	1.4	5.9	0.2	(0.0)	7.4	7.4	6.9
2019	0.0	0.0	0.0	0.0	0.0	1.4	6.2	0.2	(0.0)	7.8	7.8	9.2
2020	0.0	0.0	0.0	0.0	0.0	1.5	6.6	0.2	(0.0)	8.2	8.2	11.5
2021	0.0	0.0	0.0	0.0	0.0	1.5	6.9	0.2	(0.0)	8.7	8.7	13.7
2022	0.0	0.0	0.0	0.0	0.0	1.6	7.3	0.2	(0.0)	9.1	9.1	15.9
2023	0.0	0.0	0.0	0.0	0.0	1.7	7.6	0.3	(0.1)	9.5	9.5	18.0
2024	0.0	0.0	0.0	0.0	0.0	1.7	8.0	0.3	(0.1)	9.9	9.9	20.1
2025	0.0	0.0	0.0	0.0	0.0	1.8	8.3	0.3	(0.1)	10.3	10.3	22.2
2026	0.0	0.0	0.0	0.0	0.0	**1.8**	**8.7**	**0.3**	**(0.1)**	**10.8**	10.8	24.1
2027	0.0	0.0	0.0	0.0	0.0	1.9	9.0	0.3	(0.1)	11.2	11.2	26.1
2028	0.0	0.0	0.0	0.0	0.0	2.0	9.4	0.3	(0.1)	11.6	11.6	27.9
2029	0.0	0.0	0.0	0.0	0.0	2.0	9.8	0.3	(0.1)	12.0	12.0	29.7
2030	0.0	0.0	0.0	0.0	0.0	2.1	10.1	0.3	(0.1)	12.4	12.4	31.5
2031	0.0	0.0	0.0	0.0	0.0	2.1	10.5	0.4	(0.1)	12.8	12.8	33.2
2032	0.0	0.0	0.0	0.0	0.0	2.2	10.8	0.4	(0.1)	13.3	13.3	34.8
PV @ Discount Rate												
4%	-20	0	0	-8	-28	18	81	3	0	101	73	
7%	-19	0	0	-7	-27	11	49	2	0	61	35	
10%	-18	0	0	-7	-25	7	31	1	0	39	15	
				% of Benefits		17%	80%	3%	0%	100%		

NPV = ($mill)	34.80
IRR=	14%
NPV/CC=	1.31
BCR=	2.31

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option W1 - Task 3
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(15.9)
2003	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(30.7)
2004	0.0	0.0	0.0	(6.0)	(6.0)	(0.7)	(0.5)	(0.1)	(0.0)	(1.3)	(7.3)	(36.7)
2005	0.0	0.0	0.0	(4.5)	(4.5)	1.0	2.2	0.1	0.1	3.4	(1.1)	(37.5)
2006	0.0	0.0	0.0	0.0	0.0	**1.3**	**2.8**	**0.1**	**0.1**	**4.3**	4.3	(34.5)
2007	0.0	0.0	0.0	0.0	0.0	1.3	3.0	0.1	0.1	4.6	4.6	(31.4)
2008	0.0	0.0	0.0	0.0	0.0	1.4	3.2	0.1	0.2	4.9	4.9	(28.4)
2009	0.0	0.0	0.0	0.0	0.0	1.5	3.4	0.1	0.2	5.2	5.2	(25.4)
2010	0.0	0.0	0.0	0.0	0.0	1.5	3.6	0.1	0.2	5.5	5.5	(22.4)
2011	0.0	0.0	0.0	0.0	0.0	1.6	3.9	0.1	0.2	5.8	5.8	(19.4)
2012	0.0	0.0	0.0	0.0	0.0	1.7	4.1	0.1	0.2	6.1	6.1	(16.6)
2013	0.0	0.0	0.0	0.0	0.0	1.7	4.3	0.1	0.2	6.4	6.4	(13.7)
2014	0.0	0.0	0.0	0.0	0.0	1.8	4.5	0.1	0.2	6.7	6.7	(11.0)
2015	0.0	0.0	0.0	0.0	0.0	1.9	4.7	0.1	0.2	7.0	7.0	(8.2)
2016	0.0	0.0	0.0	0.0	0.0	**1.9**	**4.9**	**0.2**	**0.2**	**7.3**	7.3	(5.6)
2017	0.0	0.0	0.0	0.0	0.0	2.0	5.3	0.2	0.2	7.7	7.7	(3.0)
2018	0.0	0.0	0.0	0.0	0.0	2.1	5.6	0.2	0.3	8.1	8.1	(0.4)
2019	0.0	0.0	0.0	0.0	0.0	2.2	5.9	0.2	0.3	8.5	8.5	2.1
2020	0.0	0.0	0.0	0.0	0.0	2.2	6.2	0.2	0.3	8.9	8.9	4.5
2021	0.0	0.0	0.0	0.0	0.0	2.3	6.5	0.2	0.3	9.3	9.3	6.9
2022	0.0	0.0	0.0	0.0	0.0	2.4	6.8	0.2	0.3	9.7	9.7	9.3
2023	0.0	0.0	0.0	0.0	0.0	2.5	7.2	0.2	0.3	10.1	10.1	11.6
2024	0.0	0.0	0.0	0.0	0.0	2.5	7.5	0.2	0.3	10.5	10.5	13.8
2025	0.0	0.0	0.0	0.0	0.0	2.6	7.8	0.3	0.3	10.9	10.9	15.9
2026	0.0	0.0	0.0	0.0	0.0	**2.7**	**8.1**	**0.3**	**0.3**	**11.3**	11.3	18.0
2027	0.0	0.0	0.0	0.0	0.0	2.8	8.4	0.3	0.3	11.7	11.7	20.0
2028	0.0	0.0	0.0	0.0	0.0	2.8	8.7	0.3	0.3	12.1	12.1	22.0
2029	0.0	0.0	0.0	0.0	0.0	2.9	9.0	0.3	0.3	12.5	12.5	23.9
2030	0.0	0.0	0.0	0.0	0.0	3.0	9.4	0.3	0.3	13.0	13.0	25.7
2031	0.0	0.0	0.0	0.0	0.0	3.1	9.7	0.3	0.3	13.4	13.4	27.5
2032	0.0	0.0	0.0	0.0	0.0	3.1	10.0	0.3	0.3	13.8	13.8	29.1
PV @ Discount Rate												
4%	-32	0	0	-9	-41	28	77	2	3	111	70	
7%	-31	0	0	-8	-39	18	47	1	2	68	29	
10%	-30	0	0	-8	-37	12	31	1	1	44	7	
						% of Benefits	26%	69%	2%	3%	100%	

NPV = ($mill)	29.15
IRR=	12%
NPV/CC=	0.75
BCR=	1.75

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - Task 4
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	(4.0)	0.0	0.0	0.0	(4.0)	(0.1)	0.8	0.0	0.3	1.0	(3.0)	(18.7)
2005	(14.0)	0.0	0.0	0.0	(14.0)	(0.1)	0.8	0.0	0.3	1.1	(12.9)	(28.5)
2006	0.0	0.0	0.0	0.0	0.0	**0.2**	**3.0**	**0.1**	**0.6**	**4.0**	4.0	(25.7)
2007	0.0	0.0	0.0	0.0	0.0	0.3	3.2	0.1	0.6	4.3	4.3	(22.9)
2008	0.0	0.0	0.0	(4.5)	(4.5)	0.3	3.4	0.1	0.7	4.5	0.0	(22.9)
2009	0.0	0.0	0.0	(4.8)	(4.8)	0.3	3.7	0.1	0.7	4.8	(0.0)	(22.9)
2010	0.0	0.0	0.0	0.0	0.0	1.0	4.2	0.1	0.5	5.9	5.9	(19.7)
2011	0.0	0.0	0.0	0.0	0.0	1.1	4.4	0.1	0.5	6.2	6.2	(16.5)
2012	0.0	0.0	0.0	0.0	0.0	1.2	4.7	0.2	0.5	6.5	6.5	(13.5)
2013	0.0	0.0	0.0	0.0	0.0	1.2	4.9	0.2	0.5	6.8	6.8	(10.4)
2014	0.0	0.0	0.0	0.0	0.0	1.3	5.2	0.2	0.5	7.1	7.1	(7.5)
2015	0.0	0.0	0.0	0.0	0.0	1.3	5.4	0.2	0.5	7.4	7.4	(4.6)
2016	0.0	0.0	0.0	0.0	0.0	**1.4**	**5.6**	**0.2**	**0.5**	**7.7**	7.7	(1.8)
2017	0.0	0.0	0.0	0.0	0.0	1.5	6.0	0.2	0.5	8.2	8.2	1.0
2018	0.0	0.0	0.0	0.0	0.0	1.5	6.3	0.2	0.6	8.6	8.6	3.7
2019	0.0	0.0	0.0	0.0	0.0	1.6	6.7	0.2	0.6	9.0	9.0	6.4
2020	0.0	0.0	0.0	0.0	0.0	1.7	7.0	0.2	0.6	9.5	9.5	9.0
2021	0.0	0.0	0.0	0.0	0.0	1.7	7.3	0.3	0.6	9.9	9.9	11.5
2022	0.0	0.0	0.0	0.0	0.0	1.8	7.7	0.3	0.6	10.3	10.3	14.0
2023	0.0	0.0	0.0	0.0	0.0	1.9	8.0	0.3	0.6	10.7	10.7	16.5
2024	0.0	0.0	0.0	0.0	0.0	2.0	8.3	0.3	0.6	11.2	11.2	18.8
2025	0.0	0.0	0.0	0.0	0.0	2.0	8.7	0.3	0.6	11.6	11.6	21.1
2026	0.0	0.0	0.0	0.0	0.0	**2.1**	**9.0**	**0.3**	**0.6**	**12.0**	12.0	23.3
2027	0.0	0.0	0.0	0.0	0.0	2.2	9.3	0.3	0.6	12.5	12.5	25.5
2028	0.0	0.0	0.0	0.0	0.0	2.2	9.7	0.3	0.6	12.9	12.9	27.5
2029	0.0	0.0	0.0	0.0	0.0	2.3	10.0	0.4	0.6	13.3	13.3	29.5
2030	0.0	0.0	0.0	0.0	0.0	2.4	10.4	0.4	0.6	13.7	13.7	31.5
2031	0.0	0.0	0.0	0.0	0.0	2.5	10.7	0.4	0.6	14.2	14.2	33.3
2032	0.0	0.0	0.0	0.0	0.0	2.5	11.0	0.4	0.6	14.6	14.6	35.1
PV @ Discount Rate												
4%	-32	0	0	-7	-39	19	86	3	9	116	77	
7%	-30	0	0	-6	-36	11	52	2	6	71	35	
10%	-28	0	0	-5	-33	7	34	1	4	46	13	
				% of Benefits		15%	74%	2%	8%	100%		

NPV = ($mill)	35.12
IRR=	13%
NPV/CC=	0.98
BCR=	1.98

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C3 - Task 4
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	(4.0)	0.0	0.0	0.0	(4.0)	(0.2)	0.9	0.0	0.3	1.1	(2.9)	(18.6)
2005	0.0	0.0	0.0	0.0	0.0	0.4	2.9	0.1	0.2	3.5	3.5	(16.0)
2006	0.0	0.0	0.0	0.0	0.0	**0.4**	**3.0**	**0.1**	**0.2**	**3.6**	3.6	(13.4)
2007	0.0	0.0	0.0	0.0	0.0	0.4	3.1	0.1	0.2	3.8	3.8	(10.9)
2008	0.0	0.0	0.0	(4.5)	(4.5)	0.5	3.3	0.1	0.2	4.0	(0.5)	(11.1)
2009	0.0	0.0	0.0	(4.8)	(4.8)	0.5	3.5	0.1	0.2	4.3	(0.5)	(11.5)
2010	0.0	0.0	0.0	0.0	0.0	0.9	3.9	0.1	0.0	4.9	4.9	(8.8)
2011	0.0	0.0	0.0	0.0	0.0	1.0	4.1	0.1	0.0	5.2	5.2	(6.1)
2012	0.0	0.0	0.0	0.0	0.0	1.0	4.3	0.1	0.0	5.5	5.5	(3.5)
2013	0.0	0.0	0.0	0.0	0.0	1.1	4.5	0.1	0.0	5.8	5.8	(1.0)
2014	0.0	0.0	0.0	0.0	0.0	1.1	4.7	0.2	0.0	6.0	6.0	1.5
2015	0.0	0.0	0.0	0.0	0.0	1.2	5.0	0.2	0.0	6.3	6.3	4.0
2016	0.0	0.0	0.0	0.0	0.0	**1.2**	**5.2**	**0.2**	**0.0**	**6.6**	6.6	6.4
2017	0.0	0.0	0.0	0.0	0.0	1.3	5.5	0.2	0.0	7.0	7.0	8.7
2018	0.0	0.0	0.0	0.0	0.0	1.4	5.9	0.2	0.0	7.4	7.4	11.1
2019	0.0	0.0	0.0	0.0	0.0	1.4	6.2	0.2	0.0	7.8	7.8	13.4
2020	0.0	0.0	0.0	0.0	0.0	1.5	6.6	0.2	0.0	8.2	8.2	15.7
2021	0.0	0.0	0.0	0.0	0.0	1.5	6.9	0.2	0.0	8.7	8.7	17.9
2022	0.0	0.0	0.0	0.0	0.0	1.6	7.3	0.2	0.0	9.1	9.1	20.1
2023	0.0	0.0	0.0	0.0	0.0	1.7	7.6	0.3	(0.1)	9.5	9.5	22.2
2024	0.0	0.0	0.0	0.0	0.0	1.7	8.0	0.3	(0.1)	9.9	9.9	24.3
2025	0.0	0.0	0.0	0.0	0.0	1.8	8.3	0.3	(0.1)	10.3	10.3	26.4
2026	0.0	0.0	0.0	0.0	0.0	**1.8**	**8.7**	**0.3**	**(0.1)**	**10.8**	10.8	28.4
2027	0.0	0.0	0.0	0.0	0.0	1.9	9.0	0.3	(0.1)	11.2	11.2	30.3
2028	0.0	0.0	0.0	0.0	0.0	2.0	9.4	0.3	(0.1)	11.6	11.6	32.1
2029	0.0	0.0	0.0	0.0	0.0	2.0	9.8	0.3	(0.1)	12.0	12.0	34.0
2030	0.0	0.0	0.0	0.0	0.0	2.1	10.1	0.3	(0.1)	12.4	12.4	35.7
2031	0.0	0.0	0.0	0.0	0.0	2.1	10.5	0.4	(0.1)	12.8	12.8	37.4
2032	0.0	0.0	0.0	0.0	0.0	2.2	10.8	0.4	(0.1)	13.3	13.3	39.0
PV @ Discount Rate												
4%	-21	0	0	-7	-27	17	84	3	1	104	77	
7%	-20	0	0	-6	-25	10	51	2	1	64	39	
10%	-19	0	0	-5	-23	7	34	1	1	42	19	
						% of Benefits	16%	80%	3%	1%	100%	

NPV = ($mill)	39.01
IRR=	17%
NPV/CC=	1.55
BCR=	2.55

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option W1 - Task 5
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(15.9)
2003	(17.0)	0.0	0.0	0.0	(17.0)	0.0	0.0	0.0	0.0	0.0	(17.0)	(30.7)
2004	0.0	0.0	0.0	(6.0)	(6.0)	(0.8)	(0.5)	(0.1)	(0.0)	(1.4)	(7.4)	(36.8)
2005	0.0	0.0	0.0	(4.5)	(4.5)	0.8	2.3	0.1	0.1	3.3	(1.2)	(37.7)
2006	0.0	0.0	0.0	0.0	0.0	**1.1**	**2.7**	**0.1**	**0.1**	**4.0**	4.0	(34.8)
2007	0.0	0.0	0.0	0.0	0.0	1.2	2.9	0.1	0.1	4.3	4.3	(31.9)
2008	0.0	0.0	0.0	0.0	0.0	1.2	3.1	0.1	0.2	4.6	4.6	(29.0)
2009	0.0	0.0	0.0	0.0	0.0	1.3	3.4	0.1	0.2	4.9	4.9	(26.2)
2010	0.0	0.0	0.0	0.0	0.0	1.4	3.6	0.1	0.2	5.2	5.2	(23.3)
2011	0.0	0.0	0.0	0.0	0.0	1.4	3.8	0.1	0.2	5.5	5.5	(20.5)
2012	0.0	0.0	0.0	0.0	0.0	1.5	4.0	0.1	0.2	5.8	5.8	(17.8)
2013	0.0	0.0	0.0	0.0	0.0	1.6	4.2	0.1	0.2	6.1	6.1	(15.1)
2014	0.0	0.0	0.0	0.0	0.0	1.6	4.4	0.1	0.2	6.4	6.4	(12.4)
2015	0.0	0.0	0.0	0.0	0.0	1.7	4.6	0.1	0.2	6.7	6.7	(9.9)
2016	0.0	0.0	0.0	0.0	0.0	**1.7**	**4.8**	**0.1**	**0.2**	**7.0**	7.0	(7.3)
2017	0.0	0.0	0.0	0.0	0.0	1.8	5.2	0.1	0.2	7.3	7.3	(4.8)
2018	0.0	0.0	0.0	0.0	0.0	1.9	5.5	0.1	0.2	7.7	7.7	(2.4)
2019	0.0	0.0	0.0	0.0	0.0	1.9	5.8	0.2	0.2	8.1	8.1	(0.0)
2020	0.0	0.0	0.0	0.0	0.0	2.0	6.1	0.2	0.2	8.5	8.5	2.3
2021	0.0	0.0	0.0	0.0	0.0	2.0	6.4	0.2	0.3	8.8	8.8	4.6
2022	0.0	0.0	0.0	0.0	0.0	2.1	6.7	0.2	0.3	9.2	9.2	6.8
2023	0.0	0.0	0.0	0.0	0.0	2.1	7.0	0.2	0.3	9.6	9.6	9.0
2024	0.0	0.0	0.0	0.0	0.0	2.2	7.3	0.2	0.3	10.0	10.0	11.1
2025	0.0	0.0	0.0	0.0	0.0	2.2	7.6	0.2	0.3	10.3	10.3	13.1
2026	0.0	0.0	0.0	0.0	0.0	**2.3**	**8.0**	**0.2**	**0.3**	**10.7**	10.7	15.1
2027	0.0	0.0	0.0	0.0	0.0	2.3	8.3	0.2	0.3	11.1	11.1	17.0
2028	0.0	0.0	0.0	0.0	0.0	2.4	8.6	0.2	0.3	11.5	11.5	18.9
2029	0.0	0.0	0.0	0.0	0.0	2.4	8.9	0.2	0.3	11.8	11.8	20.7
2030	0.0	0.0	0.0	0.0	0.0	2.5	9.2	0.3	0.3	12.2	12.2	22.4
2031	0.0	0.0	0.0	0.0	0.0	2.6	9.5	0.3	0.3	12.6	12.6	24.0
2032	0.0	0.0	0.0	0.0	0.0	2.6	9.8	0.3	0.3	13.0	13.0	25.6
PV @ Discount Rate												
4%	-32	0	0	-9	-41	24	76	2	3	106	64	
7%	-31	0	0	-8	-39	15	46	1	2	65	26	
10%	-30	0	0	-8	-37	10	30	1	1	42	5	
					% of Benefits	24%	72%	2%	3%	100%		

NPV = ($mill)	25.63
IRR=	11%
NPV/CC=	0.66
BCR=	1.66

VicRoads
Planning Investigations

River Crossing at Echuca-Moama

C1 – Staging Assessments

ARUP

VicRoads
Planning Investigations

River Crossing at Echuca Moama

C1 - Staging Assessments

May 2001

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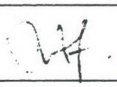
		Signature			
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A Staging of Option C1
B Economic Evaluation

1. INTRODUCTION

Arup Transportation Planning was appointed in April 2001 by VicRoads Planning Investigations to undertake detailed staging assessments of option C1.

This work builds on the previous assessments undertaken by Arup, using the EMME/2 model developed for the region in the Echuca-Moama study (Arup, December 1998). The focus of this study is to undertake detailed staging assessments of option C1. This study builds upon the previous analysis undertaken in March 2001, with the following staging of assessments incorporated into option C1:

- Construction of the new bridge, with rehabilitation of the existing bridge.
- Construction of the new bridge, with the upgrading of the Echuca approach works but no rehabilitation of the existing bridge.
- Construction of the new bridge, with the upgrading of the Moama approach works but no rehabilitation of the existing bridge.
- Construction of the new bridge, with the upgrading of the Echuca & Moama approach works and rehabilitation of the existing bridge.

This report briefly outlines the economic evaluation undertaken for each of the staging assessments of option C1, using cost estimates provided by VicRoads. The analysis is based on the same methodology used in the previous economic evaluation estimates.

2. STAGING OF OPTION C1

Eleven initial staging assessments were undertaken in order to determine the optimal time for each of the staging works. These are described in detail below, and summarised in **Appendix A.** This was followed by a further three assessments, which tested a variation in timing for the staging works.

- **B1** - New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would operate as two lane northbound and the new bridge as two land southbound.
- **R1** - New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge is closed to traffic in 2004.
- **R2** - New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge is closed to traffic for 9 months, due to rehabilitation in 2004. Following rehabilitation, the existing bridge would operate as two lane northbound and the new bridge as two lane southbound.
- **R3** - New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. Until rehabilitation of the existing bridge, this bridge operates as one lane northbound, and the new bridge as two lanes southbound. The existing bridge is closed to traffic for 9 months, due to rehabilitation in 2009. Following rehabilitation, the existing bridge would operate as two lane northbound and the new bridge as two land southbound.
- **R4**- New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would operate as two lane northbound and the new bridge as two lane southbound. In 2009, the existing bridge is closed to traffic for 9 months, due to rehabilitation. Following rehabilitation, the existing bridge would operate as two lane northbound and the new bridge as two land southbound.
- **E1** New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would operate as 2 lane northbound and new bridge as 2 lane southbound. The Echuca approach works are carried out in 2004/05 and opened to traffic in 2006. This includes the upgrading of Sturt St and new signalised intersections as proposed for Option C1. This scenario assumes no rehabilitation of existing bridge and no upgrading of Moama approach.
- **E2** – New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would operate as two lane northbound and the new bridge as two land southbound. The Echuca approach works are carried out in 2013/14, and opened to traffic in 2015. This includes the upgrading of Sturt Street, and new signalised intersections as proposed for option C1. This scenario assumes no rehabilitation of the existing bridge and no upgrading of the Moama approach.
- **E3** – New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would operate as two lane northbound and the new bridge as two lane southbound. The Echuca approach works are carried out in 2023/24 and opened to traffic in 2025. This includes the upgrading of Sturt Street and new signalised intersections as proposed for option C1. This scenario assumes no rehabilitation of the existing bridge and no upgrading of Moama approach.
- **M1** – New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would operate as two lane northbound and the new bridge as two lane southbound. The Moama approach works are carried out in 2004/05 and opened to traffic in 2006. This includes the bypass of Meninya Street and new signalised

intersection as proposed in option C1. This scenario assumes no rehabilitation of the existing bridge and no upgrading of Echuca approach.

- **M2** – New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would operate as two lane northbound and the new bridge as two lane southbound. The Moama approach works are carried out in 2013/04 and opened to traffic in 2015. This includes the bypass of Meninya Street and new signalised intersection as proposed for option C1. This scenario assumes no rehabilitation of the existing bridge and no upgrading of Echuca approach.
- **M3** – New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would operate as two lane northbound and new bridge as two lane southbound. The Moama approach works are carried out in 2023/04 and opened to traffic in 2025. This includes the bypass of Meninya Street and new signalised intersection as proposed for option C1. This scenario assumes no rehabilitation of existing bridge and no upgrading of Echuca approach.

Assessments T1-T3 combined all the staging works, varying the timings of the works.

- **T1** - New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would operate as two lane northbound and new bridge as two lane southbound. The Moama approach works are carried out in 2004/05 and opened to traffic in 2006. This includes the bypass of Meninya Street and new signalised intersection as proposed in option C1. The existing bridge would be closed for rehabilitation works in 2009, for 9 months, with the new bridge operating as two way during this period. The Echuca approach works are carried out in 2023/24 and opened to traffic in 2025. This includes the upgrading of Sturt Street and new signalised intersections as proposed for option C1.
- **T2** - New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would be closed for 9 months in 2004 for rehabilitation works, with the new bridge operating as two way during this period. Following rehabilitation, the existing bridge would re-open, operating as two lane northbound and new bridge as two lane southbound. The Moama approach works are carried out in 2006/07 and opened to traffic in 2008. This includes the bypass of Meninya Street and new signalised intersection as proposed in option C1. The Echuca approach works are carried out in 2023/24 and opened to traffic in 2025. This includes the upgrading of Sturt Street and new signalised intersections as proposed for option C1.
- **T3** - New bridge is built in 2002/03 and opened to traffic in 2004 with tie-ins at either end. The existing bridge would be closed for 9 months in 2004 for rehabilitation works, with the new bridge operating as two way during this period. Following rehabilitation, the existing bridge would re-open, operating as two lane northbound and new bridge as two lane southbound. The Moama approach works are carried out in 2006/07 and opened to traffic in 2008. This includes the bypass of Meninya Street and new signalised intersection as proposed in option C1. The Echuca approach works are carried out in 2008/09 and opened to traffic in 2010. This includes the upgrading of Sturt Street and new signalised intersections as proposed for option C1.

3. ECONOMIC EVALUATION

3.1 Staging Costs for Option C1

The staging costs for option C1 were prepared by VicRoads Planning Investigations, as shown in **Table 1**.

Table 1 Cost of Staging Scenarios

Staging Scenario	Cost ($M)
New Bridge	18
Rehabilitation of Existing Bridge	9.3
Echuca Approach Works	7
Moama Approach Works	11

3.2 Results

A standard approach to economic evaluation of road user benefits has been applied to undertake an assessment of the economic performance for the staging of works for option C1. Parameter values used were drawn from VicRoads EVAL4 December 2000 version.

The results of the benefit calculations, including the road user benefit and cost streams are summarised in **Table 2**, and detailed in **Appendix B**. All values assume 2001 resource prices and are based on a discount rate of 7%.

Table 2 Economic Results of Staging Options

Staging Scenario	PV Cost	PV Benefit	BCR	NPV ($M)
B1 – New Bridge Only	-16.3	26.6	1.6	10.3
R1 – New Bridge & Rehabilitation	-16.3	15.0	0.9	-1.3
R2 – New Bridge & Rehabilitation	-23.6	26.4	1.1	2.8
R3 – New Bridge & Rehabilitation	-21.5	25.3	1.2	3.8
R4 – New Bridge & Rehabilitation	-21.5	26.4	1.2	4.9
E1 – New Bridge & Upgrade Echuca Approach	-21.7	29.7	1.4	8.0
E2 – New Bridge & Upgrade Echuca Approach	-18.9	28.6	1.5	9.7
E3 – New Bridge & Upgrade Echuca Approach	-17.2	27.3	1.6	10.1
M1 – New Bridge & Upgrade Moama Approach	-24.7	70.6	2.9	45.9
M2 – New Bridge & Upgrade Moama Approach	-20.4	53.1	2.6	32.7
M3 – New Bridge & Upgrade Moama Approach	-17.6	36.8	2.1	19.2
T1 – Total Project	-30.8	70.6	2.3	39.8
T2 – Total Project	-31.7	66.4	2.1	34.7
T3 – Total Project	-34.8	68.5	2.0	33.7

Note - Residual benefits for the approach works were included, which take into consideration the later expenditure dates.

A number of assessments were undertaken in order to determine the contribution to benefits for elements of the works provided. The results show the upgrading of approach roads in Moama, provide the greatest benefits. These benefits are principally travel time savings, due to the relative level of congestion on the Moama road network. Moama is currently experiencing a greater congestion level than Echuca, and upgrading the Moama approach roads therefore provide higher benefits levels.

These results were used by VicRoads to develop three 'Total Project' staging assessments, where a combination of upgrading approach roads in Moama and Echuca were assessed, together with the rehabilitation of the existing bridge.

T1 provides the greatest benefit. This suggests the staging of works should be:

- the upgrading work in Moama immediately after the opening of the new bridge
- rehabilitation of the existing bridge in 2009
- delaying the upgrading work in Echuca until 2023.

4. CONCLUSION

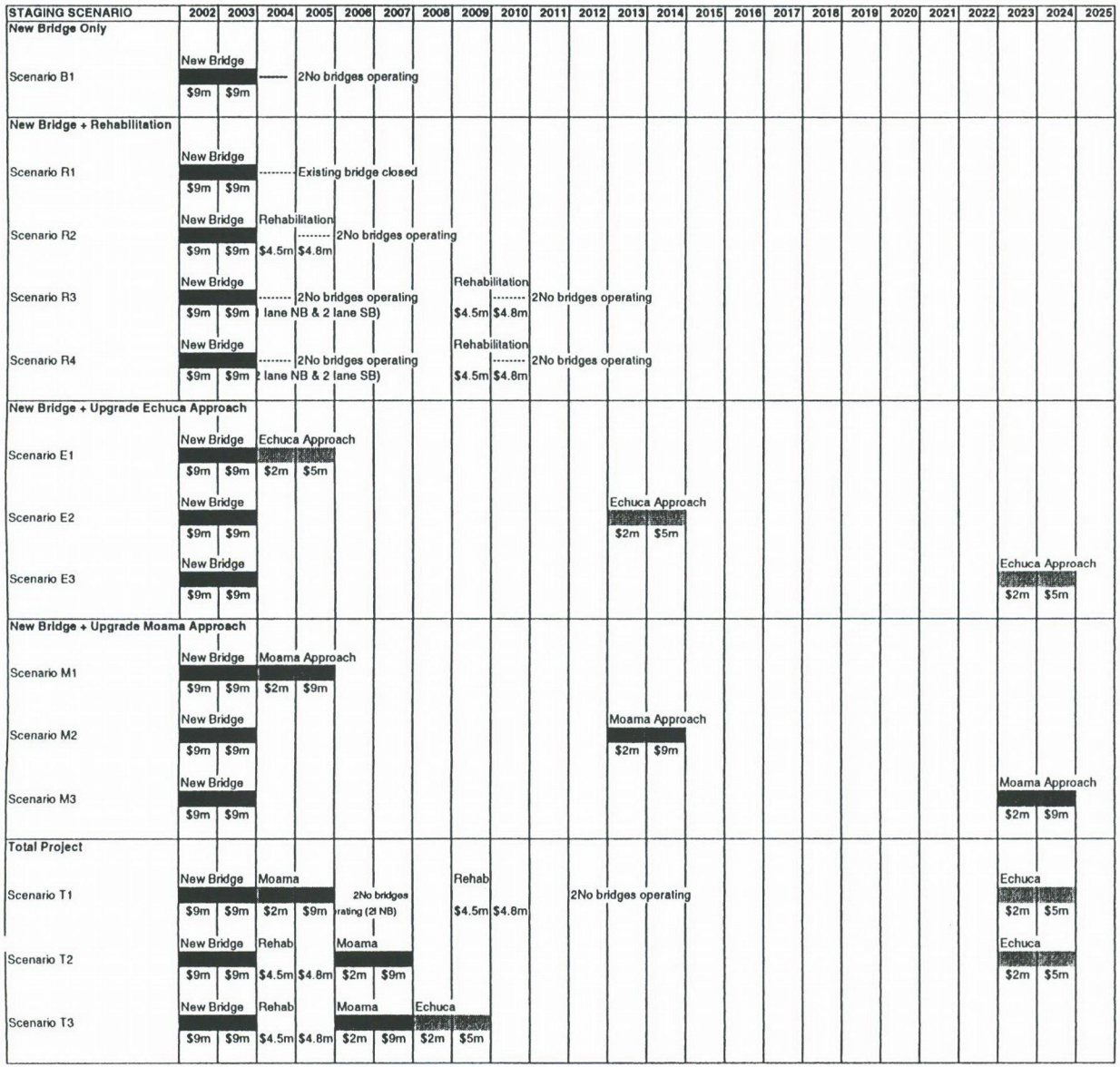
Fourteen assessments have been undertaken in order to determine the optimal timing for rehabilitation of the existing bridge and the staging of approach works. Based on the economic assessment the order of works should be, construct the new bridge, the Moama works, rehabilitation of the existing bridge, and lastly the Echuca approach works.

While this provides the results of the economic analysis of staging, the actual timing of works will also be influenced by other factors.

APPENDIX A

Staging of Option C1

MURRAY RIVER CROSSING AT ECHUCA/MOAMA
ECONOMIC EVALUATION OF STAGING SCENARIOS FOR OPTION C1



Assumptions:
New bridge built in 2002 & 2003
Other works constructed as separate investment decisions

Legend

- Construction of new bridge
- Closure of existing bridge for rehabilitation (9 months)
- Echuca approach works with new signalised intersection & Sturt St upgrade
- Moama approach works with bypass of Meninya St

APPENDIX B

Economic Evaluation

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - B1
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.0	0.2	1.5	1.5	(15.1)
2005	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.2	1.5	1.5	(13.9)
2006	0.0	0.0	0.0	0.0	0.0	**0.5**	**0.8**	**0.0**	**0.2**	**1.5**	1.5	(12.8)
2007	0.0	0.0	0.0	0.0	0.0	0.5	0.9	0.0	0.2	1.7	1.7	(11.7)
2008	0.0	0.0	0.0	0.0	0.0	0.6	1.0	0.0	0.2	1.8	1.8	(10.6)
2009	0.0	0.0	0.0	0.0	0.0	0.6	1.1	0.0	0.2	1.9	1.9	(9.6)
2010	0.0	0.0	0.0	0.0	0.0	0.6	1.2	0.0	0.2	2.0	2.0	(8.5)
2011	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.1	2.1	(7.4)
2012	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.2	2.2	(6.4)
2013	0.0	0.0	0.0	0.0	0.0	0.6	1.4	0.0	0.2	2.3	2.3	(5.3)
2014	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0.0	0.2	2.4	2.4	(4.3)
2015	0.0	0.0	0.0	0.0	0.0	0.6	1.6	0.1	0.2	2.5	2.5	(3.4)
2016	0.0	0.0	0.0	0.0	0.0	**0.7**	**1.7**	**0.1**	**0.2**	**2.6**	2.6	(2.4)
2017	0.0	0.0	0.0	0.0	0.0	0.7	1.8	0.1	0.2	2.8	2.8	(1.5)
2018	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.1	0.2	2.9	2.9	(0.5)
2019	0.0	0.0	0.0	0.0	0.0	0.8	2.0	0.1	0.2	3.1	3.1	0.4
2020	0.0	0.0	0.0	0.0	0.0	0.8	2.1	0.1	0.2	3.2	3.2	1.3
2021	0.0	0.0	0.0	0.0	0.0	0.8	2.3	0.1	0.2	3.4	3.4	2.2
2022	0.0	0.0	0.0	0.0	0.0	0.9	2.4	0.1	0.2	3.5	3.5	3.0
2023	0.0	0.0	0.0	0.0	0.0	0.9	2.5	0.1	0.2	3.7	3.7	3.8
2024	0.0	0.0	0.0	0.0	0.0	0.9	2.6	0.1	0.2	3.8	3.8	4.7
2025	0.0	0.0	0.0	0.0	0.0	1.0	2.7	0.1	0.3	4.0	4.0	5.4
2026	0.0	0.0	0.0	0.0	0.0	**1.0**	**2.8**	**0.1**	**0.3**	**4.1**	4.1	6.2
2027	0.0	0.0	0.0	0.0	0.0	1.0	2.9	0.1	0.3	4.3	4.3	7.0
2028	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.1	0.3	4.4	4.4	7.7
2029	0.0	0.0	0.0	0.0	0.0	1.1	3.1	0.1	0.3	4.6	4.6	8.4
2030	0.0	0.0	0.0	0.0	0.0	1.1	3.2	0.1	0.3	4.7	4.7	9.0
2031	0.0	0.0	0.0	0.0	0.0	1.1	3.3	0.1	0.3	4.9	4.9	9.7
2032	0.0	0.0	0.0	0.0	0.0	1.2	3.5	0.1	0.3	5.0	5.0	10.3
PV @ Discount Rate												
4%	-17	0	0	0	-17	11	27	1	3	42	25.5	
7%	-16	0	0	0	-16	7	17	1	2	27	10.3	
10%	-16	0	0	0	-16	5	11	0	2	18	2.1	
						% of Benefits	27%	62%	2%	9%	100%	

NPV = ($mill)	10.29
IRR=	11%
NPV/CC=	0.63
BCR=	1.63

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - R1
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.3	1.0	1.0	(15.5)
2005	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.3	1.0	1.0	(14.7)
2006	0.0	0.0	0.0	0.0	0.0	**0.2**	**0.4**	**0.0**	**0.3**	**1.0**	1.0	(14.0)
2007	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.0	0.3	1.1	1.1	(13.3)
2008	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.0	0.4	1.1	1.1	(12.6)
2009	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.4	1.2	1.2	(11.9)
2010	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.4	1.2	1.2	(11.3)
2011	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.0	0.4	1.3	1.3	(10.6)
2012	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.0	0.4	1.4	1.4	(9.9)
2013	0.0	0.0	0.0	0.0	0.0	0.2	0.8	0.0	0.4	1.4	1.4	(9.3)
2014	0.0	0.0	0.0	0.0	0.0	0.2	0.9	0.0	0.4	1.5	1.5	(8.7)
2015	0.0	0.0	0.0	0.0	0.0	0.2	0.9	0.0	0.4	1.6	1.6	(8.1)
2016	0.0	0.0	0.0	0.0	0.0	**0.2**	**1.0**	**0.0**	**0.4**	**1.6**	1.6	(7.5)
2017	0.0	0.0	0.0	0.0	0.0	0.2	1.0	0.0	0.4	1.7	1.7	(6.9)
2018	0.0	0.0	0.0	0.0	0.0	0.2	1.0	0.0	0.4	1.7	1.7	(6.4)
2019	0.0	0.0	0.0	0.0	0.0	0.3	1.0	0.0	0.4	1.7	1.7	(5.9)
2020	0.0	0.0	0.0	0.0	0.0	0.3	1.0	0.0	0.4	1.7	1.7	(5.4)
2021	0.0	0.0	0.0	0.0	0.0	0.3	1.0	0.0	0.5	1.8	1.8	(5.0)
2022	0.0	0.0	0.0	0.0	0.0	0.3	1.0	0.0	0.5	1.8	1.8	(4.5)
2023	0.0	0.0	0.0	0.0	0.0	0.3	1.0	0.0	0.5	1.8	1.8	(4.1)
2024	0.0	0.0	0.0	0.0	0.0	0.4	1.0	0.0	0.5	1.8	1.8	(3.7)
2025	0.0	0.0	0.0	0.0	0.0	0.4	1.0	0.0	0.5	1.9	1.9	(3.4)
2026	0.0	0.0	0.0	0.0	0.0	**0.4**	**1.0**	**0.0**	**0.5**	**1.9**	1.9	(3.0)
2027	0.0	0.0	0.0	0.0	0.0	0.4	1.0	0.0	0.5	1.9	1.9	(2.7)
2028	0.0	0.0	0.0	0.0	0.0	0.4	1.0	0.0	0.5	2.0	2.0	(2.4)
2029	0.0	0.0	0.0	0.0	0.0	0.4	1.0	0.0	0.5	2.0	2.0	(2.1)
2030	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.0	0.5	2.0	2.0	(1.8)
2031	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.0	0.5	2.0	2.0	(1.5)
2032	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.0	0.5	2.1	2.1	(1.3)
PV @ Discount Rate												
4%	-17.0	0.0	0.0	0.0	-17.0	4.2	12.1	0.4	6.5	23.2	6.2	
7%	-16.3	0.0	0.0	0.0	-16.3	2.7	7.8	0.2	4.3	15.0	-1.3	
10%	-15.6	0.0	0.0	0.0	-15.6	1.9	5.3	0.2	3.0	10.3	-5.3	
				% of Benefits		18%	52%	2%	28%	100%		

NPV = ($mill)	-1.26
IRR=	6%
NPV/CC=	-0.08
BCR=	0.92

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - R2
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	(4.5)	(4.5)	0.3	0.7	0.0	0.3	1.3	(3.2)	(18.9)
2005	0.0	0.0	0.0	(4.8)	(4.8)	0.5	0.8	0.0	0.2	1.5	(3.3)	(21.4)
2006	0.0	0.0	0.0	0.0	0.0	**0.5**	**0.8**	**0.0**	**0.2**	**1.5**	1.5	(20.3)
2007	0.0	0.0	0.0	0.0	0.0	0.5	0.9	0.0	0.2	1.7	1.7	(19.2)
2008	0.0	0.0	0.0	0.0	0.0	0.6	1.0	0.0	0.2	1.8	1.8	(18.1)
2009	0.0	0.0	0.0	0.0	0.0	0.6	1.1	0.0	0.2	1.9	1.9	(17.0)
2010	0.0	0.0	0.0	0.0	0.0	0.6	1.2	0.0	0.2	2.0	2.0	(16.0)
2011	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.1	2.1	(14.9)
2012	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.2	2.2	(13.8)
2013	0.0	0.0	0.0	0.0	0.0	0.6	1.4	0.0	0.2	2.3	2.3	(12.8)
2014	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0.0	0.2	2.4	2.4	(11.8)
2015	0.0	0.0	0.0	0.0	0.0	0.6	1.6	0.1	0.2	2.5	2.5	(10.8)
2016	0.0	0.0	0.0	0.0	0.0	**0.7**	**1.7**	**0.1**	**0.2**	**2.6**	2.6	(9.9)
2017	0.0	0.0	0.0	0.0	0.0	0.7	1.8	0.1	0.2	2.8	2.8	(8.9)
2018	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.1	0.2	2.9	2.9	(8.0)
2019	0.0	0.0	0.0	0.0	0.0	0.8	2.0	0.1	0.2	3.1	3.1	(7.1)
2020	0.0	0.0	0.0	0.0	0.0	0.8	2.1	0.1	0.2	3.2	3.2	(6.2)
2021	0.0	0.0	0.0	0.0	0.0	0.8	2.3	0.1	0.2	3.4	3.4	(5.3)
2022	0.0	0.0	0.0	0.0	0.0	0.9	2.4	0.1	0.2	3.5	3.5	(4.5)
2023	0.0	0.0	0.0	0.0	0.0	0.9	2.5	0.1	0.2	3.7	3.7	(3.6)
2024	0.0	0.0	0.0	0.0	0.0	0.9	2.6	0.1	0.2	3.8	3.8	(2.8)
2025	0.0	0.0	0.0	0.0	0.0	1.0	2.7	0.1	0.3	4.0	4.0	(2.0)
2026	0.0	0.0	0.0	0.0	0.0	**1.0**	**2.8**	**0.1**	**0.3**	**4.1**	4.1	(1.3)
2027	0.0	0.0	0.0	0.0	0.0	1.0	2.9	0.1	0.3	4.3	4.3	(0.5)
2028	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.1	0.3	4.4	4.4	0.2
2029	0.0	0.0	0.0	0.0	0.0	1.1	3.1	0.1	0.3	4.6	4.6	0.9
2030	0.0	0.0	0.0	0.0	0.0	1.1	3.2	0.1	0.3	4.7	4.7	1.5
2031	0.0	0.0	0.0	0.0	0.0	1.1	3.3	0.1	0.3	4.9	4.9	2.2
2032	0.0	0.0	0.0	0.0	0.0	1.2	3.5	0.1	0.3	5.0	5.0	2.8
PV @ Discount Rate												
4%	-17.0	0.0	0.0	-8.1	-25.1	11.0	26.9	0.9	3.5	42.3	17.2	
7%	-16.3	0.0	0.0	-7.3	-23.6	7.0	16.5	0.6	2.4	26.4	2.8	
10%	-15.6	0.0	0.0	-6.7	-22.3	4.8	10.8	0.4	1.7	17.6	-4.7	
				% of Benefits		26%	62%	2%	9%	100%		

NPV = ($mill)	2.80
IRR=	8%
NPV/CC=	0.12
BCR=	1.12

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - R3
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.2	1.2	1.2	(15.3)
2005	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.2	1.2	1.2	(14.4)
2006	0.0	0.0	0.0	0.0	0.0	**0.5**	**0.5**	**0.0**	**0.2**	**1.2**	1.2	(13.5)
2007	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.0	0.2	1.3	1.3	(12.6)
2008	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.0	0.2	1.4	1.4	(11.8)
2009	0.0	0.0	0.0	(4.5)	(4.5)	0.3	0.9	0.0	0.3	1.6	(2.9)	(13.5)
2010	0.0	0.0	0.0	(4.8)	(4.8)	0.6	1.2	0.0	0.2	2.0	(2.8)	(15.0)
2011	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.1	2.1	(13.9)
2012	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.2	2.2	(12.9)
2013	0.0	0.0	0.0	0.0	0.0	0.6	1.4	0.0	0.2	2.3	2.3	(11.9)
2014	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0.0	0.2	2.4	2.4	(10.9)
2015	0.0	0.0	0.0	0.0	0.0	0.6	1.6	0.1	0.2	2.5	2.5	(9.9)
2016	0.0	0.0	0.0	0.0	0.0	**0.7**	**1.7**	**0.1**	**0.2**	**2.6**	2.6	(8.9)
2017	0.0	0.0	0.0	0.0	0.0	0.7	1.8	0.1	0.2	2.8	2.8	(8.0)
2018	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.1	0.2	2.9	2.9	(7.1)
2019	0.0	0.0	0.0	0.0	0.0	0.8	2.0	0.1	0.2	3.1	3.1	(6.1)
2020	0.0	0.0	0.0	0.0	0.0	0.8	2.1	0.1	0.2	3.2	3.2	(5.3)
2021	0.0	0.0	0.0	0.0	0.0	0.8	2.3	0.1	0.2	3.4	3.4	(4.4)
2022	0.0	0.0	0.0	0.0	0.0	0.9	2.4	0.1	0.2	3.5	3.5	(3.5)
2023	0.0	0.0	0.0	0.0	0.0	0.9	2.5	0.1	0.2	3.7	3.7	(2.7)
2024	0.0	0.0	0.0	0.0	0.0	0.9	2.6	0.1	0.2	3.8	3.8	(1.9)
2025	0.0	0.0	0.0	0.0	0.0	1.0	2.7	0.1	0.3	4.0	4.0	(1.1)
2026	0.0	0.0	0.0	0.0	0.0	**1.0**	**2.8**	**0.1**	**0.3**	**4.1**	4.1	(0.3)
2027	0.0	0.0	0.0	0.0	0.0	1.0	2.9	0.1	0.3	4.3	4.3	0.4
2028	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.1	0.3	4.4	4.4	1.1
2029	0.0	0.0	0.0	0.0	0.0	1.1	3.1	0.1	0.3	4.6	4.6	1.8
2030	0.0	0.0	0.0	0.0	0.0	1.1	3.2	0.1	0.3	4.7	4.7	2.5
2031	0.0	0.0	0.0	0.0	0.0	1.1	3.3	0.1	0.3	4.9	4.9	3.1
2032	0.0	0.0	0.0	0.0	0.0	1.2	3.5	0.1	0.3	5.0	5.0	3.7
PV @ Discount Rate												
4%	-17.0	0.0	0.0	-6.7	-23.6	11.0	25.5	0.9	3.5	40.9	17.3	
7%	-16.3	0.0	0.0	-5.2	-21.5	7.1	15.3	0.5	2.4	25.3	3.7	
10%	-15.6	0.0	0.0	-4.1	-19.8	4.9	9.7	0.3	1.7	16.6	-3.2	
				% of Benefits		28%	61%	2%	9%	100%		

NPV = ($mill)	3.75
IRR=	8%
NPV/CC=	0.17
BCR=	1.17

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - R4
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.0	0.2	1.5	1.5	(15.1)
2005	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.2	1.5	1.5	(13.9)
2006	0.0	0.0	0.0	0.0	0.0	**0.5**	**0.8**	**0.0**	**0.2**	**1.5**	1.5	(12.8)
2007	0.0	0.0	0.0	0.0	0.0	0.5	0.9	0.0	0.2	1.7	1.7	(11.7)
2008	0.0	0.0	0.0	0.0	0.0	0.6	1.0	0.0	0.2	1.8	1.8	(10.6)
2009	0.0	0.0	0.0	(4.5)	(4.5)	0.3	0.9	0.0	0.3	1.6	(2.9)	(12.3)
2010	0.0	0.0	0.0	(4.8)	(4.8)	0.6	1.2	0.0	0.2	2.0	(2.8)	(13.9)
2011	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.1	2.1	(12.8)
2012	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.2	2.2	(11.8)
2013	0.0	0.0	0.0	0.0	0.0	0.6	1.4	0.0	0.2	2.3	2.3	(10.7)
2014	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0.0	0.2	2.4	2.4	(9.7)
2015	0.0	0.0	0.0	0.0	0.0	0.6	1.6	0.1	0.2	2.5	2.5	(8.8)
2016	0.0	0.0	0.0	0.0	0.0	**0.7**	**1.7**	**0.1**	**0.2**	**2.6**	2.6	(7.8)
2017	0.0	0.0	0.0	0.0	0.0	0.7	1.8	0.1	0.2	2.8	2.8	(6.9)
2018	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.1	0.2	2.9	2.9	(5.9)
2019	0.0	0.0	0.0	0.0	0.0	0.8	2.0	0.1	0.2	3.1	3.1	(5.0)
2020	0.0	0.0	0.0	0.0	0.0	0.8	2.1	0.1	0.2	3.2	3.2	(4.1)
2021	0.0	0.0	0.0	0.0	0.0	0.8	2.3	0.1	0.2	3.4	3.4	(3.2)
2022	0.0	0.0	0.0	0.0	0.0	0.9	2.4	0.1	0.2	3.5	3.5	(2.4)
2023	0.0	0.0	0.0	0.0	0.0	0.9	2.5	0.1	0.2	3.7	3.7	(1.6)
2024	0.0	0.0	0.0	0.0	0.0	0.9	2.6	0.1	0.2	3.8	3.8	(0.7)
2025	0.0	0.0	0.0	0.0	0.0	1.0	2.7	0.1	0.3	4.0	4.0	0.0
2026	0.0	0.0	0.0	0.0	0.0	**1.0**	**2.8**	**0.1**	**0.3**	**4.1**	4.1	0.8
2027	0.0	0.0	0.0	0.0	0.0	1.0	2.9	0.1	0.3	4.3	4.3	1.5
2028	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.1	0.3	4.4	4.4	2.3
2029	0.0	0.0	0.0	0.0	0.0	1.1	3.1	0.1	0.3	4.6	4.6	3.0
2030	0.0	0.0	0.0	0.0	0.0	1.1	3.2	0.1	0.3	4.7	4.7	3.6
2031	0.0	0.0	0.0	0.0	0.0	1.1	3.3	0.1	0.3	4.9	4.9	4.3
2032	0.0	0.0	0.0	0.0	0.0	1.2	3.5	0.1	0.3	5.0	5.0	4.9
PV @ Discount Rate												
4%	-17.0	0.0	0.0	-6.7	-23.6	11.0	26.8	0.9	3.5	42.2	18.6	
7%	-16.3	0.0	0.0	-5.2	-21.5	7.0	16.4	0.6	2.4	26.4	4.9	
10%	-15.6	0.0	0.0	-4.1	-19.8	4.8	10.7	0.4	1.7	17.6	-2.2	
				% of Benefits		27%	62%	2%	9%	100%		

NPV = ($mill)	4.88
IRR=	9%
NPV/CC=	0.23
BCR=	1.23

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - E1
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	(2.0)	0.0	0.0	0.0	(2.0)	0.5	0.7	0.0	0.2	1.5	(0.5)	(16.7)
2005	(5.0)	0.0	0.0	0.0	(5.0)	0.5	0.8	0.0	0.2	1.5	(3.5)	(19.4)
2006	0.0	0.0	0.0	0.0	0.0	**0.5**	**0.9**	**0.0**	**0.2**	**1.6**	1.6	(18.2)
2007	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.0	0.2	1.8	1.8	(17.0)
2008	0.0	0.0	0.0	0.0	0.0	0.5	1.1	0.0	0.2	1.9	1.9	(15.8)
2009	0.0	0.0	0.0	0.0	0.0	0.5	1.3	0.0	0.2	2.1	2.1	(14.6)
2010	0.0	0.0	0.0	0.0	0.0	0.6	1.4	0.0	0.2	2.2	2.2	(13.4)
2011	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0.0	0.2	2.3	2.3	(12.2)
2012	0.0	0.0	0.0	0.0	0.0	0.6	1.6	0.1	0.2	2.5	2.5	(11.1)
2013	0.0	0.0	0.0	0.0	0.0	0.6	1.7	0.1	0.2	2.6	2.6	(9.9)
2014	0.0	0.0	0.0	0.0	0.0	0.6	1.9	0.1	0.3	2.8	2.8	(8.7)
2015	0.0	0.0	0.0	0.0	0.0	0.6	2.0	0.1	0.3	2.9	2.9	(7.6)
2016	0.0	0.0	0.0	0.0	0.0	**0.6**	**2.1**	**0.1**	**0.3**	**3.1**	3.1	(6.5)
2017	0.0	0.0	0.0	0.0	0.0	0.7	2.2	0.1	0.3	3.2	3.2	(5.4)
2018	0.0	0.0	0.0	0.0	0.0	0.7	2.4	0.1	0.3	3.4	3.4	(4.3)
2019	0.0	0.0	0.0	0.0	0.0	0.7	2.5	0.1	0.3	3.6	3.6	(3.3)
2020	0.0	0.0	0.0	0.0	0.0	0.7	2.6	0.1	0.3	3.7	3.7	(2.2)
2021	0.0	0.0	0.0	0.0	0.0	0.8	2.7	0.1	0.3	3.9	3.9	(1.2)
2022	0.0	0.0	0.0	0.0	0.0	0.8	2.9	0.1	0.3	4.0	4.0	(0.3)
2023	0.0	0.0	0.0	0.0	0.0	0.8	3.0	0.1	0.3	4.2	4.2	0.7
2024	0.0	0.0	0.0	0.0	0.0	0.9	3.1	0.1	0.3	4.4	4.4	1.6
2025	0.0	0.0	0.0	0.0	0.0	0.9	3.2	0.1	0.3	4.5	4.5	2.5
2026	0.0	0.0	0.0	0.0	0.0	**0.9**	**3.3**	**0.1**	**0.3**	**4.7**	4.7	3.4
2027	0.0	0.0	0.0	0.0	0.0	1.0	3.5	0.1	0.3	4.9	4.9	4.2
2028	0.0	0.0	0.0	0.0	0.0	1.0	3.6	0.1	0.3	5.0	5.0	5.0
2029	0.0	0.0	0.0	0.0	0.0	1.0	3.7	0.1	0.3	5.2	5.2	5.8
2030	0.0	0.0	0.0	0.0	0.0	1.1	3.8	0.1	0.3	5.4	5.4	6.5
2031	0.0	0.0	0.0	0.0	0.0	1.1	4.0	0.1	0.3	5.5	5.5	7.3
2032	0.5	0.0	0.0	0.0	0.5	1.1	4.1	0.1	0.3	5.7	6.2	8.0
PV @ Discount Rate												
4%	-22.9	0.0	0.0	0.0	-22.9	10.7	32.0	1.1	4.0	47.7	24.8	
7%	-21.7	0.0	0.0	0.0	-21.7	6.9	19.5	0.6	2.6	29.7	8.0	
10%	-20.5	0.0	0.0	0.0	-20.5	4.7	12.7	0.4	1.8	19.7	-0.8	
				% of Benefits		23%	66%	2%	9%	100%		

NPV = ($mill)	8.03
IRR=	10%
NPV/CC=	0.37
BCR=	1.37

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - E2
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
Year	Capital Costs	Maintenance Rout	Maintenance Per	Rehab	Total Costs	VOC	TT	Freight	Acc	Total	Cost -Benefit	NPV @ 7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.0	0.2	1.5	1.5	(15.1)
2005	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.2	1.5	1.5	(13.9)
2006	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.2	1.5	1.5	(12.8)
2007	0.0	0.0	0.0	0.0	0.0	0.5	0.9	0.0	0.2	1.7	1.7	(11.7)
2008	0.0	0.0	0.0	0.0	0.0	0.6	1.0	0.0	0.2	1.8	1.8	(10.6)
2009	0.0	0.0	0.0	0.0	0.0	0.6	1.1	0.0	0.2	1.9	1.9	(9.6)
2010	0.0	0.0	0.0	0.0	0.0	0.6	1.2	0.0	0.2	2.0	2.0	(8.5)
2011	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.1	2.1	(7.4)
2012	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.2	2.2	(6.4)
2013	(2.0)	0.0	0.0	0.0	(2.0)	0.6	1.4	0.0	0.2	2.3	0.3	(6.2)
2014	(5.0)	0.0	0.0	0.0	(5.0)	0.6	1.5	0.0	0.2	2.4	(2.6)	(7.3)
2015	0.0	0.0	0.0	0.0	0.0	0.6	2.0	0.1	0.3	2.9	2.9	(6.2)
2016	0.0	0.0	0.0	0.0	0.0	0.6	2.1	0.1	0.3	3.1	3.1	(5.1)
2017	0.0	0.0	0.0	0.0	0.0	0.7	2.2	0.1	0.3	3.2	3.2	(4.0)
2018	0.0	0.0	0.0	0.0	0.0	0.7	2.4	0.1	0.3	3.4	3.4	(2.9)
2019	0.0	0.0	0.0	0.0	0.0	0.7	2.5	0.1	0.3	3.6	3.6	(1.8)
2020	0.0	0.0	0.0	0.0	0.0	0.7	2.6	0.1	0.3	3.7	3.7	(0.8)
2021	0.0	0.0	0.0	0.0	0.0	0.8	2.7	0.1	0.3	3.9	3.9	0.2
2022	0.0	0.0	0.0	0.0	0.0	0.8	2.9	0.1	0.3	4.0	4.0	1.2
2023	0.0	0.0	0.0	0.0	0.0	0.8	3.0	0.1	0.3	4.2	4.2	2.1
2024	0.0	0.0	0.0	0.0	0.0	0.9	3.1	0.1	0.3	4.4	4.4	3.0
2025	0.0	0.0	0.0	0.0	0.0	0.9	3.2	0.1	0.3	4.5	4.5	3.9
2026	0.0	0.0	0.0	0.0	0.0	0.9	3.3	0.1	0.3	4.7	4.7	4.8
2027	0.0	0.0	0.0	0.0	0.0	1.0	3.5	0.1	0.3	4.9	4.9	5.6
2028	0.0	0.0	0.0	0.0	0.0	1.0	3.6	0.1	0.3	5.0	5.0	6.4
2029	0.0	0.0	0.0	0.0	0.0	1.0	3.7	0.1	0.3	5.2	5.2	7.2
2030	0.0	0.0	0.0	0.0	0.0	1.1	3.8	0.1	0.3	5.4	5.4	8.0
2031	0.0	0.0	0.0	0.0	0.0	1.1	4.0	0.1	0.3	5.5	5.5	8.7
2032	2.6	0.0	0.0	0.0	2.6	1.1	4.1	0.1	0.3	5.7	8.3	9.7
PV @ Discount Rate												
4%	-20.5	0.0	0.0	0.0	-20.5	10.8	30.7	1.0	3.8	46.3	25.9	
7%	-18.9	0.0	0.0	0.0	-18.9	7.0	18.5	0.6	2.5	28.6	9.7	
10%	-17.6	0.0	0.0	0.0	-17.6	4.8	11.9	0.4	1.7	18.9	1.3	
				% of Benefits		24%	65%	2%	9%	100%		

NPV = ($mill)	9.72
IRR=	11%
NPV/CC=	0.51
BCR=	1.51

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - E3
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.0	0.2	1.5	1.5	(15.1)
2005	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.2	1.5	1.5	(13.9)
2006	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.2	1.5	1.5	(12.8)
2007	0.0	0.0	0.0	0.0	0.0	0.5	0.9	0.0	0.2	1.7	1.7	(11.7)
2008	0.0	0.0	0.0	0.0	0.0	0.6	1.0	0.0	0.2	1.8	1.8	(10.6)
2009	0.0	0.0	0.0	0.0	0.0	0.6	1.1	0.0	0.2	1.9	1.9	(9.6)
2010	0.0	0.0	0.0	0.0	0.0	0.6	1.2	0.0	0.2	2.0	2.0	(8.5)
2011	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.1	2.1	(7.4)
2012	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.2	2.2	(6.4)
2013	0.0	0.0	0.0	0.0	0.0	0.6	1.4	0.0	0.2	2.3	2.3	(5.3)
2014	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0.0	0.2	2.4	2.4	(4.3)
2015	0.0	0.0	0.0	0.0	0.0	0.6	1.6	0.1	0.2	2.5	2.5	(3.4)
2016	0.0	0.0	0.0	0.0	0.0	0.7	1.7	0.1	0.2	2.6	2.6	(2.4)
2017	0.0	0.0	0.0	0.0	0.0	0.7	1.8	0.1	0.2	2.8	2.8	(1.5)
2018	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.1	0.2	2.9	2.9	(0.5)
2019	0.0	0.0	0.0	0.0	0.0	0.8	2.0	0.1	0.2	3.1	3.1	0.4
2020	0.0	0.0	0.0	0.0	0.0	0.8	2.1	0.1	0.2	3.2	3.2	1.3
2021	0.0	0.0	0.0	0.0	0.0	0.8	2.3	0.1	0.2	3.4	3.4	2.2
2022	0.0	0.0	0.0	0.0	0.0	0.9	2.4	0.1	0.2	3.5	3.5	3.0
2023	(2.0)	0.0	0.0	0.0	(2.0)	0.9	2.5	0.1	0.2	3.7	1.7	3.4
2024	(5.0)	0.0	0.0	0.0	(5.0)	0.9	2.6	0.1	0.2	3.8	(1.2)	3.2
2025	0.0	0.0	0.0	0.0	0.0	0.9	3.2	0.1	0.3	4.5	4.5	4.0
2026	0.0	0.0	0.0	0.0	0.0	0.9	3.3	0.1	0.3	4.7	4.7	4.9
2027	0.0	0.0	0.0	0.0	0.0	1.0	3.5	0.1	0.3	4.9	4.9	5.8
2028	0.0	0.0	0.0	0.0	0.0	1.0	3.6	0.1	0.3	5.0	5.0	6.6
2029	0.0	0.0	0.0	0.0	0.0	1.0	3.7	0.1	0.3	5.2	5.2	7.3
2030	0.0	0.0	0.0	0.0	0.0	1.1	3.8	0.1	0.3	5.4	5.4	8.1
2031	0.0	0.0	0.0	0.0	0.0	1.1	4.0	0.1	0.3	5.5	5.5	8.8
2032	4.9	0.0	0.0	0.0	4.9	1.1	4.1	0.1	0.3	5.7	10.6	10.1
PV @ Discount Rate												
4%	-18.4	0.0	0.0	0.0	-18.4	11.0	28.5	1.0	3.5	44.1	25.7	
7%	-17.2	0.0	0.0	0.0	-17.2	7.1	17.3	0.6	2.3	27.3	10.1	
10%	-16.2	0.0	0.0	0.0	-16.2	4.9	11.2	0.4	1.6	18.1	1.9	
				% of Benefits		26%	63%	2%	9%	100%		

NPV = ($mill)	10.13
IRR=	11%
NPV/CC=	0.59
BCR=	1.59

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - M1
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	(2.0)	0.0	0.0	0.0	(2.0)	0.5	0.7	0.0	0.2	1.5	(0.5)	(16.7)
2005	(9.0)	0.0	0.0	0.0	(9.0)	0.5	0.8	0.0	0.2	1.5	(7.5)	(22.4)
2006	0.0	0.0	0.0	0.0	0.0	0.8	3.0	0.1	0.4	4.4	4.4	(19.3)
2007	0.0	0.0	0.0	0.0	0.0	0.9	3.2	0.1	0.5	4.7	4.7	(16.2)
2008	0.0	0.0	0.0	0.0	0.0	0.9	3.5	0.1	0.5	5.0	5.0	(13.1)
2009	0.0	0.0	0.0	0.0	0.0	1.0	3.7	0.1	0.5	5.3	5.3	(10.1)
2010	0.0	0.0	0.0	0.0	0.0	1.0	4.0	0.1	0.5	5.6	5.6	(7.0)
2011	0.0	0.0	0.0	0.0	0.0	1.1	4.2	0.1	0.5	5.9	5.9	(4.0)
2012	0.0	0.0	0.0	0.0	0.0	1.1	4.4	0.1	0.5	6.2	6.2	(1.1)
2013	0.0	0.0	0.0	0.0	0.0	1.2	4.7	0.2	0.5	6.5	6.5	1.8
2014	0.0	0.0	0.0	0.0	0.0	1.2	4.9	0.2	0.5	6.8	6.8	4.6
2015	0.0	0.0	0.0	0.0	0.0	1.3	5.2	0.2	0.5	7.1	7.1	7.4
2016	0.0	0.0	0.0	0.0	0.0	1.3	5.4	0.2	0.5	7.4	7.4	10.1
2017	0.0	0.0	0.0	0.0	0.0	1.4	5.7	0.2	0.5	7.8	7.8	12.7
2018	0.0	0.0	0.0	0.0	0.0	1.5	6.1	0.2	0.5	8.3	8.3	15.3
2019	0.0	0.0	0.0	0.0	0.0	1.6	6.4	0.2	0.5	8.7	8.7	17.9
2020	0.0	0.0	0.0	0.0	0.0	1.6	6.7	0.2	0.5	9.1	9.1	20.4
2021	0.0	0.0	0.0	0.0	0.0	1.7	7.1	0.2	0.5	9.6	9.6	22.9
2022	0.0	0.0	0.0	0.0	0.0	1.8	7.4	0.3	0.5	10.0	10.0	25.3
2023	0.0	0.0	0.0	0.0	0.0	1.9	7.7	0.3	0.5	10.4	10.4	27.7
2024	0.0	0.0	0.0	0.0	0.0	2.0	8.0	0.3	0.6	10.8	10.8	29.9
2025	0.0	0.0	0.0	0.0	0.0	2.0	8.4	0.3	0.6	11.3	11.3	32.2
2026	0.0	0.0	0.0	0.0	0.0	2.1	8.7	0.3	0.6	11.7	11.7	34.3
2027	0.0	0.0	0.0	0.0	0.0	2.2	9.0	0.3	0.6	12.1	12.1	36.4
2028	0.0	0.0	0.0	0.0	0.0	2.3	9.4	0.3	0.6	12.5	12.5	38.4
2029	0.0	0.0	0.0	0.0	0.0	2.3	9.7	0.3	0.6	13.0	13.0	40.4
2030	0.0	0.0	0.0	0.0	0.0	2.4	10.0	0.4	0.6	13.4	13.4	42.3
2031	0.0	0.0	0.0	0.0	0.0	2.5	10.4	0.4	0.6	13.8	13.8	44.1
2032	0.7	0.0	0.0	0.0	0.7	2.6	10.7	0.4	0.6	14.3	15.0	45.9
PV @ Discount Rate												
4%	-26.2	0.0	0.0	0.0	-26.2	21.3	83.4	2.9	7.4	115.0	88.7	
7%	-24.7	0.0	0.0	0.0	-24.7	13.2	50.8	1.7	4.8	70.6	45.9	
10%	-23.2	0.0	0.0	0.0	-23.2	8.7	32.9	1.1	3.3	46.1	22.9	
				% of Benefits		19%	72%	2%	7%	100%		

NPV = ($mill)	45.91
IRR=	17%
NPV/CC=	1.86
BCR=	2.86

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - M2
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.0	0.2	1.5	1.5	(15.1)
2005	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.2	1.5	1.5	(13.9)
2006	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.2	1.5	1.5	(12.8)
2007	0.0	0.0	0.0	0.0	0.0	0.5	0.9	0.0	0.2	1.7	1.7	(11.7)
2008	0.0	0.0	0.0	0.0	0.0	0.6	1.0	0.0	0.2	1.8	1.8	(10.6)
2009	0.0	0.0	0.0	0.0	0.0	0.6	1.1	0.0	0.2	1.9	1.9	(9.6)
2010	0.0	0.0	0.0	0.0	0.0	0.6	1.2	0.0	0.2	2.0	2.0	(8.5)
2011	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.1	2.1	(7.4)
2012	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.2	2.2	(6.4)
2013	(2.0)	0.0	0.0	0.0	(2.0)	0.6	1.4	0.0	0.2	2.3	0.3	(6.2)
2014	(9.0)	0.0	0.0	0.0	(9.0)	0.6	1.5	0.0	0.2	2.4	(6.6)	(9.0)
2015	0.0	0.0	0.0	0.0	0.0	1.3	5.2	0.2	0.5	7.1	7.1	(6.2)
2016	0.0	0.0	0.0	0.0	0.0	1.3	5.4	0.2	0.5	7.4	7.4	(3.5)
2017	0.0	0.0	0.0	0.0	0.0	1.4	5.7	0.2	0.5	7.8	7.8	(0.9)
2018	0.0	0.0	0.0	0.0	0.0	1.5	6.1	0.2	0.5	8.3	8.3	1.8
2019	0.0	0.0	0.0	0.0	0.0	1.6	6.4	0.2	0.5	8.7	8.7	4.3
2020	0.0	0.0	0.0	0.0	0.0	1.6	6.7	0.2	0.5	9.1	9.1	6.9
2021	0.0	0.0	0.0	0.0	0.0	1.7	7.1	0.2	0.5	9.6	9.6	9.3
2022	0.0	0.0	0.0	0.0	0.0	1.8	7.4	0.3	0.5	10.0	10.0	11.7
2023	0.0	0.0	0.0	0.0	0.0	1.9	7.7	0.3	0.5	10.4	10.4	14.1
2024	0.0	0.0	0.0	0.0	0.0	2.0	8.0	0.3	0.6	10.8	10.8	16.4
2025	0.0	0.0	0.0	0.0	0.0	2.0	8.4	0.3	0.6	11.3	11.3	18.6
2026	0.0	0.0	0.0	0.0	0.0	2.1	8.7	0.3	0.6	11.7	11.7	20.7
2027	0.0	0.0	0.0	0.0	0.0	2.2	9.0	0.3	0.6	12.1	12.1	22.8
2028	0.0	0.0	0.0	0.0	0.0	2.3	9.4	0.3	0.6	12.5	12.5	24.8
2029	0.0	0.0	0.0	0.0	0.0	2.3	9.7	0.3	0.6	13.0	13.0	26.8
2030	0.0	0.0	0.0	0.0	0.0	2.4	10.0	0.4	0.6	13.4	13.4	28.7
2031	0.0	0.0	0.0	0.0	0.0	2.5	10.4	0.4	0.6	13.8	13.8	30.5
2032	4.0	0.0	0.0	0.0	4.0	2.6	10.7	0.4	0.6	14.3	18.3	32.7
PV @ Discount Rate												
4%	-22.4	0.0	0.0	0.0	-22.4	18.5	65.9	2.3	5.7	92.4	70.0	
7%	-20.4	0.0	0.0	0.0	-20.4	11.1	37.3	1.3	3.5	53.1	32.7	
10%	-18.7	0.0	0.0	0.0	-18.7	7.1	22.3	0.8	2.3	32.4	13.8	
				% of Benefits		21%	70%	2%	7%	100%		

NPV = ($mill)	32.75
IRR=	15%
NPV/CC=	1.61
BCR=	2.61

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - M3
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.0	0.2	1.5	1.5	(15.1)
2005	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.2	1.5	1.5	(13.9)
2006	0.0	0.0	0.0	0.0	0.0	**0.5**	**0.8**	**0.0**	**0.2**	**1.5**	1.5	(12.8)
2007	0.0	0.0	0.0	0.0	0.0	0.5	0.9	0.0	0.2	1.7	1.7	(11.7)
2008	0.0	0.0	0.0	0.0	0.0	0.6	1.0	0.0	0.2	1.8	1.8	(10.6)
2009	0.0	0.0	0.0	0.0	0.0	0.6	1.1	0.0	0.2	1.9	1.9	(9.6)
2010	0.0	0.0	0.0	0.0	0.0	0.6	1.2	0.0	0.2	2.0	2.0	(8.5)
2011	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.1	2.1	(7.4)
2012	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.2	2.2	2.2	(6.4)
2013	0.0	0.0	0.0	0.0	0.0	0.6	1.4	0.0	0.2	2.3	2.3	(5.3)
2014	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0.0	0.2	2.4	2.4	(4.3)
2015	0.0	0.0	0.0	0.0	0.0	0.6	1.6	0.1	0.2	2.5	2.5	(3.4)
2016	0.0	0.0	0.0	0.0	0.0	**0.7**	**1.7**	**0.1**	**0.2**	**2.6**	2.6	(2.4)
2017	0.0	0.0	0.0	0.0	0.0	0.7	1.8	0.1	0.2	2.8	2.8	(1.5)
2018	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.1	0.2	2.9	2.9	(0.5)
2019	0.0	0.0	0.0	0.0	0.0	0.8	2.0	0.1	0.2	3.1	3.1	0.4
2020	0.0	0.0	0.0	0.0	0.0	0.8	2.1	0.1	0.2	3.2	3.2	1.3
2021	0.0	0.0	0.0	0.0	0.0	0.8	2.3	0.1	0.2	3.4	3.4	2.2
2022	0.0	0.0	0.0	0.0	0.0	0.9	2.4	0.1	0.2	3.5	3.5	3.0
2023	(2.0)	0.0	0.0	0.0	(2.0)	0.9	2.5	0.1	0.2	3.7	1.7	3.4
2024	(9.0)	0.0	0.0	0.0	(9.0)	0.9	2.6	0.1	0.2	3.8	(5.2)	2.3
2025	0.0	0.0	0.0	0.0	0.0	2.0	8.4	0.3	0.6	11.3	11.3	4.5
2026	0.0	0.0	0.0	0.0	0.0	**2.1**	**8.7**	**0.3**	**0.6**	**11.7**	11.7	6.7
2027	0.0	0.0	0.0	0.0	0.0	2.2	9.0	0.3	0.6	12.1	12.1	8.8
2028	0.0	0.0	0.0	0.0	0.0	2.3	9.4	0.3	0.6	12.5	12.5	10.8
2029	0.0	0.0	0.0	0.0	0.0	2.3	9.7	0.3	0.6	13.0	13.0	12.7
2030	0.0	0.0	0.0	0.0	0.0	2.4	10.0	0.4	0.6	13.4	13.4	14.6
2031	0.0	0.0	0.0	0.0	0.0	2.5	10.4	0.4	0.6	13.8	13.8	16.4
2032	8.1	0.0	0.0	0.0	8.1	2.6	10.7	0.4	0.6	14.3	22.3	19.2
PV @ Discount Rate												
4%	-19.1	0.0	0.0	0.0	-19.1	14.5	44.5	1.5	4.3	64.8	45.7	
7%	-17.6	0.0	0.0	0.0	-17.6	8.7	24.6	0.8	2.7	36.8	19.2	
10%	-16.5	0.0	0.0	0.0	-16.5	5.7	14.6	0.5	1.8	22.6	6.1	
				% of Benefits		24%	67%	2%	7%	100%		

NPV = ($mill)	19.18
IRR=	13%
NPV/CC=	1.09
BCR=	2.09

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - T1
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	(2.0)	0.0	0.0	0.0	(2.0)	0.5	0.7	0.0	0.2	1.5	(0.5)	(15.1)
2005	(9.0)	0.0	0.0	0.0	(9.0)	0.5	0.8	0.0	0.2	1.5	(7.5)	(13.9)
2006	0.0	0.0	0.0	0.0	0.0	**0.8**	**3.0**	**0.1**	**0.4**	**4.4**	4.4	(12.8)
2007	0.0	0.0	0.0	0.0	0.0	0.9	3.2	0.1	0.5	4.7	4.7	(11.7)
2008	0.0	0.0	0.0	0.0	0.0	0.9	3.5	0.1	0.5	5.0	5.0	(10.6)
2009	0.0	0.0	0.0	(4.5)	(4.5)	0.9	3.7	0.1	0.6	5.3	0.8	(12.3)
2010	0.0	0.0	0.0	(4.8)	(4.8)	1.0	4.0	0.1	0.5	5.6	0.8	(13.9)
2011	0.0	0.0	0.0	0.0	0.0	1.1	4.2	0.1	0.5	5.9	5.9	(12.8)
2012	0.0	0.0	0.0	0.0	0.0	1.1	4.4	0.1	0.5	6.2	6.2	(11.8)
2013	0.0	0.0	0.0	0.0	0.0	1.2	4.7	0.2	0.5	6.5	6.5	(10.7)
2014	0.0	0.0	0.0	0.0	0.0	1.2	4.9	0.2	0.5	6.8	6.8	(9.7)
2015	0.0	0.0	0.0	0.0	0.0	1.3	5.2	0.2	0.5	7.1	7.1	(8.8)
2016	0.0	0.0	0.0	0.0	0.0	**1.3**	**5.4**	**0.2**	**0.5**	**7.4**	7.4	(7.8)
2017	0.0	0.0	0.0	0.0	0.0	1.4	5.7	0.2	0.5	7.8	7.8	(6.9)
2018	0.0	0.0	0.0	0.0	0.0	1.5	6.1	0.2	0.5	8.3	8.3	(5.9)
2019	0.0	0.0	0.0	0.0	0.0	1.6	6.4	0.2	0.5	8.7	8.7	(5.0)
2020	0.0	0.0	0.0	0.0	0.0	1.6	6.7	0.2	0.5	9.1	9.1	(4.1)
2021	0.0	0.0	0.0	0.0	0.0	1.7	7.1	0.2	0.5	9.6	9.6	(3.2)
2022	0.0	0.0	0.0	0.0	0.0	1.8	7.4	0.3	0.5	10.0	10.0	(2.4)
2023	(2.0)	0.0	0.0	0.0	(2.0)	1.9	7.7	0.3	0.5	10.4	8.4	(1.6)
2024	(5.0)	0.0	0.0	0.0	(5.0)	2.0	8.0	0.3	0.6	10.8	5.8	(0.7)
2025	0.0	0.0	0.0	0.0	0.0	2.0	8.7	0.3	0.6	11.3	11.3	0.0
2026	0.0	0.0	0.0	0.0	0.0	**2.1**	**9.0**	**0.3**	**0.6**	**11.7**	11.7	0.8
2027	0.0	0.0	0.0	0.0	0.0	2.2	9.3	0.3	0.6	12.1	12.1	1.5
2028	0.0	0.0	0.0	0.0	0.0	2.2	9.7	0.3	0.6	12.5	12.5	2.3
2029	0.0	0.0	0.0	0.0	0.0	2.3	10.0	0.4	0.6	13.0	13.0	3.0
2030	0.0	0.0	0.0	0.0	0.0	2.4	10.4	0.4	0.6	13.4	13.4	3.6
2031	0.0	0.0	0.0	0.0	0.0	2.5	10.7	0.4	0.6	13.8	13.8	4.3
2032	5.9	0.0	0.0	0.0	5.9	2.5	11.0	0.4	0.6	14.3	20.1	4.9
PV @ Discount Rate												
4%	-27.6	0.0	0.0	-6.7	-34.2	21.2	84.2	2.9	7.6	114.9	80.7	
7%	-25.6	0.0	0.0	-5.2	-30.8	13.2	51.2	1.8	4.9	70.6	39.8	
10%	-23.8	0.0	0.0	-4.1	-27.9	8.7	33.0	1.1	3.4	46.1	18.2	
				% of Benefits		19%	72%	2%	7%	100%		

NPV = ($mill)	39.80
IRR=	16%
NPV/CC=	1.29
BCR=	2.29

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - T2
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	(4.5)	(4.5)	0.3	0.7	0.0	0.3	1.3	(3.2)	(15.1)
2005	0.0	0.0	0.0	(4.8)	(4.8)	0.5	0.8	0.0	0.2	1.5	(3.3)	(13.9)
2006	(2.0)	0.0	0.0	0.0	(2.0)	**0.5**	**0.8**	**0.0**	**0.2**	**1.5**	(0.5)	(12.8)
2007	(9.0)	0.0	0.0	0.0	(9.0)	0.5	0.9	0.0	0.2	1.7	(7.3)	(11.7)
2008	0.0	0.0	0.0	0.0	0.0	0.9	3.5	0.1	0.5	5.0	5.0	(10.6)
2009	0.0	0.0	0.0	0.0	0.0	1.0	3.7	0.1	0.5	5.3	5.3	(12.3)
2010	0.0	0.0	0.0	0.0	0.0	1.0	4.0	0.1	0.5	5.6	5.6	(13.9)
2011	0.0	0.0	0.0	0.0	0.0	1.1	4.2	0.1	0.5	5.9	5.9	(12.8)
2012	0.0	0.0	0.0	0.0	0.0	1.1	4.4	0.1	0.5	6.2	6.2	(11.8)
2013	0.0	0.0	0.0	0.0	0.0	1.2	4.7	0.2	0.5	6.5	6.5	(10.7)
2014	0.0	0.0	0.0	0.0	0.0	1.2	4.9	0.2	0.5	6.8	6.8	(9.7)
2015	0.0	0.0	0.0	0.0	0.0	1.3	5.2	0.2	0.5	7.1	7.1	(8.8)
2016	0.0	0.0	0.0	0.0	0.0	**1.3**	**5.4**	**0.2**	**0.5**	**7.4**	7.4	(7.8)
2017	0.0	0.0	0.0	0.0	0.0	1.4	5.7	0.2	0.5	7.8	7.8	(6.9)
2018	0.0	0.0	0.0	0.0	0.0	1.5	6.1	0.2	0.5	8.3	8.3	(5.9)
2019	0.0	0.0	0.0	0.0	0.0	1.6	6.4	0.2	0.5	8.7	8.7	(5.0)
2020	0.0	0.0	0.0	0.0	0.0	1.6	6.7	0.2	0.5	9.1	9.1	(4.1)
2021	0.0	0.0	0.0	0.0	0.0	1.7	7.1	0.2	0.5	9.6	9.6	(3.2)
2022	0.0	0.0	0.0	0.0	0.0	1.8	7.4	0.3	0.5	10.0	10.0	(2.4)
2023	(2.0)	0.0	0.0	0.0	(2.0)	1.9	7.7	0.3	0.5	10.4	8.4	(1.6)
2024	(5.0)	0.0	0.0	0.0	(5.0)	2.0	8.0	0.3	0.6	10.8	5.8	(0.7)
2025	0.0	0.0	0.0	0.0	0.0	2.0	8.7	0.3	0.6	11.3	11.3	0.0
2026	0.0	0.0	0.0	0.0	0.0	**2.1**	**9.0**	**0.3**	**0.6**	**11.7**	11.7	0.8
2027	0.0	0.0	0.0	0.0	0.0	2.2	9.3	0.3	0.6	12.1	12.1	1.5
2028	0.0	0.0	0.0	0.0	0.0	2.2	9.7	0.3	0.6	12.5	12.5	2.3
2029	0.0	0.0	0.0	0.0	0.0	2.3	10.0	0.4	0.6	13.0	13.0	3.0
2030	0.0	0.0	0.0	0.0	0.0	2.4	10.4	0.4	0.6	13.4	13.4	3.6
2031	0.0	0.0	0.0	0.0	0.0	2.5	10.7	0.4	0.6	13.8	13.8	4.3
2032	6.6	0.0	0.0	0.0	6.6	2.5	11.0	0.4	0.6	14.3	20.9	4.9
PV @ Discount Rate												
4%	-26.6	0.0	0.0	-8.1	-34.8	20.5	80.6	2.8	7.2	110.1	75.3	
7%	-24.4	0.0	0.0	-7.3	-31.7	12.6	48.0	1.6	4.6	66.4	34.7	
10%	-22.4	0.0	0.0	-6.7	-29.1	8.2	30.3	1.0	3.1	42.5	13.4	
				% of Benefits		19%	72%	2%	7%	100%		

NPV = ($mill)	34.71
IRR=	14%
NPV/CC=	1.09
BCR=	2.09

Murray River Crossing at Echuca-Moama
Economic Evaluation - Option C1 - T3
NPV Calculated from 2002 for 30 years

	Costs ($millions)					Benefits ($millions)						
	Capital	Maintenance			Total						Cost	NPV @
Year	Costs	Rout	Per	Rehab	Costs	VOC	TT	Freight	Acc	Total	-Benefit	7%
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(8.4)
2003	(9.0)	0.0	0.0	0.0	(9.0)	0.0	0.0	0.0	0.0	0.0	(9.0)	(16.3)
2004	0.0	0.0	0.0	(4.5)	(4.5)	0.3	0.7	0.0	0.3	1.3	(3.2)	(15.1)
2005	0.0	0.0	0.0	(4.8)	(4.8)	0.5	0.8	0.0	0.2	1.5	(3.3)	(13.9)
2006	(2.0)	0.0	0.0	0.0	(2.0)	**0.5**	**0.8**	**0.0**	**0.2**	**1.5**	(0.5)	(12.8)
2007	(9.0)	0.0	0.0	0.0	(9.0)	0.5	0.9	0.0	0.2	1.7	(7.3)	(11.7)
2008	(2.0)	0.0	0.0	0.0	(2.0)	0.9	3.5	0.1	0.5	5.0	3.0	(10.6)
2009	(5.0)	0.0	0.0	0.0	(5.0)	1.0	3.7	0.1	0.5	5.3	0.3	(12.3)
2010	0.0	0.0	0.0	0.0	0.0	1.0	4.2	0.1	0.5	5.9	5.9	(13.9)
2011	0.0	0.0	0.0	0.0	0.0	1.1	4.4	0.1	0.5	6.2	6.2	(12.8)
2012	0.0	0.0	0.0	0.0	0.0	1.2	4.7	0.2	0.5	6.5	6.5	(11.8)
2013	0.0	0.0	0.0	0.0	0.0	1.2	4.9	0.2	0.5	6.8	6.8	(10.7)
2014	0.0	0.0	0.0	0.0	0.0	1.3	5.2	0.2	0.5	7.1	7.1	(9.7)
2015	0.0	0.0	0.0	0.0	0.0	1.3	5.4	0.2	0.5	7.4	7.4	(8.8)
2016	0.0	0.0	0.0	0.0	0.0	**1.4**	**5.6**	**0.2**	**0.5**	**7.7**	7.7	(7.8)
2017	0.0	0.0	0.0	0.0	0.0	1.5	6.0	0.2	0.5	8.2	8.2	(6.9)
2018	0.0	0.0	0.0	0.0	0.0	1.5	6.3	0.2	0.6	8.6	8.6	(5.9)
2019	0.0	0.0	0.0	0.0	0.0	1.6	6.7	0.2	0.6	9.0	9.0	(5.0)
2020	0.0	0.0	0.0	0.0	0.0	1.7	7.0	0.2	0.6	9.5	9.5	(4.1)
2021	0.0	0.0	0.0	0.0	0.0	1.7	7.3	0.3	0.6	9.9	9.9	(3.2)
2022	0.0	0.0	0.0	0.0	0.0	1.8	7.7	0.3	0.6	10.3	10.3	(2.4)
2023	0.0	0.0	0.0	0.0	0.0	1.9	8.0	0.3	0.6	10.7	10.7	(1.6)
2024	0.0	0.0	0.0	0.0	0.0	2.0	8.3	0.3	0.6	11.2	11.2	(0.7)
2025	0.0	0.0	0.0	0.0	0.0	2.0	8.7	0.3	0.6	11.6	11.6	0.0
2026	0.0	0.0	0.0	0.0	0.0	**2.1**	**9.0**	**0.3**	**0.6**	**12.0**	12.0	0.8
2027	0.0	0.0	0.0	0.0	0.0	2.2	9.3	0.3	0.6	12.5	12.5	1.5
2028	0.0	0.0	0.0	0.0	0.0	2.2	9.7	0.3	0.6	12.9	12.9	2.3
2029	0.0	0.0	0.0	0.0	0.0	2.3	10.0	0.4	0.6	13.3	13.3	3.0
2030	0.0	0.0	0.0	0.0	0.0	2.4	10.4	0.4	0.6	13.7	13.7	3.6
2031	0.0	0.0	0.0	0.0	0.0	2.5	10.7	0.4	0.6	14.2	14.2	4.3
2032	2.9	0.0	0.0	0.0	2.9	2.5	11.0	0.4	0.6	14.6	17.5	4.9
PV @ Discount Rate												
4%	-30.1	0.0	0.0	-8.1	-38.2	20.7	82.6	2.8	7.5	113.6	75.5	
7%	-27.5	0.0	0.0	-7.3	-34.8	12.7	49.3	1.7	4.8	68.5	33.7	
10%	-25.2	0.0	0.0	-6.7	-31.8	8.3	31.2	1.1	3.3	43.8	12.0	
					% of Benefits	19%	72%	2%	7%	100%		

NPV = ($mill)	33.71
IRR=	13%
NPV/CC=	0.97
BCR=	1.97

vicroads design
ENGINEERING & TECHNOLOGY CONSULTANTS

INTER-OFFICE MEMO

TO	:	Principal Road Design Engineer Manager – Planning & Investigation **Attn: Mr Tony Hillman**	**DATE**	: 14 May 2001
FROM	:	Matthew Pascoe Traffic Design Engineer	**OUR REF**	: 1112
BUSINESS AREA	:	VicRoads – Design	**FILE NO**	: NOR 0.1
CONTACT NAME	:	Matthew Pascoe	**EXT**	: 8202
SUBJECT	:	**NORTHERN HIGHWAY** **MURRAY RIVER BRIDGE AT ECHUCA**		

1.0 INTRODUCTION

1.1 Planning Investigations Department requested that additional advice be provided regarding the capacity of the existing crossing of the Murray River at Echuca/Moama, and also the capacity of Option C1 with the existing bridge decommissioned. The advice requested includes:

a) an estimate of existing theoretical capacity of the bridge and the roundabouts in Echuca and Moama,
b) an estimate of when each Level of Service (LoS) will be reached, and
c) an estimate of the theoretical capacity of the new bridge proposed in Option C1 operating as a two lane two way bridge with new signalised intersections at each end, and with the existing bridge decommissioned.

1.2 For analysis purposes it was decided that the two roundabouts and the bridge should be considered as a 'system' and the system would "break" down when one of its components failed.

1.3 Reference should be made to:

- the "Murray River Crossing at Echuca - Moama" – Detailed traffic and economic evaluation of Options prepared for VicRoads Planning Investigations Department, by ARUP Transportation Planning and dated December 1998.

2.0 EXISTING TRAFFIC VOLUMES

2.1 Traffic counts from February 2000 show that the Echuca bridge carries volumes in the order of 16,500 vpd with a typical commercial vehicle content of 10% on an average weekday.

3.0 FORECAST TRAFFIC VOLUMES

3.1 Previous predicted work contained in the ARUP report, dated February 2000, has been manually adjusted so that the traffic volumes in Sturt St are a better representation of what could be expected, after actions are taken to divert traffic from High Street into Sturt Street. See Appendix A1 and A2 for forecast volumes used for analysis.

4.0 OUTCOME OF ANALYSIS

4.1 The analysis has found that the capacity of the river crossing is determined by the capacity of the intersections. The capacity of the systems were based on the point where the degree of saturation (DoS) for any movement reached 0.8 for roundabouts, where queuing and delays are considered to be excessive and 0.9 for signalised intersections, where delays may exceed one cycle. Levels of Service calculations performed by SIDRA are based on both delay and degree of saturation. Summary tables of results are shown in Appendix B.

Existing System

4.2 The theoretical capacity of the existing system is estimated to be reached when the Echuca roundabout reaches a DoS of 0.8. At this time the traffic volume on the bridge is expected to be 25,000 vpd.

4.3 The existing system would be expected to operate at LoS C until the bridge volume reaches 23,500 vpd when it would drop to LOS D. Any further decrease in LoS is irrelevant due to unstable and unpredictable flows occurring when the bridge volumes are about 25,000 vpd.

4.4 The ARUP model assigns a large amount of traffic along Shaw St and Francis St but in reality it would be expected that this traffic would use the Cobb Hwy and Blair St. Reanalysis of the Moama roundabout with the majority of the traffic on Shaw St reassigned to Blair St found that the theoretical capacity of the Moama roundabout is estimated to be reached when the bridge volume reaches 25,000 vpd.

Option C1 with new bridge only

4.5 The theoretical capacity of Option C1 with only the new bridge operating is estimated to be reached at a bridge volume of 29,500 vpd. However the system is expected to exhibit unacceptable operating characteristics earlier due to the right turning queue into Heygarth St, Echuca extending onto the bridge and blocking through traffic. At this time the volume on the bridge is expected to be about 24,500 vpd.

4.6 Option C1 with only the new bridge operating would be expected to operate at LoS C until the bridge volume reaches 24,500 vpd and then drop to LoS E/F due to the through movement being blocked, as mentioned in 4.5.

Option C1 with both existing and new bridges operating

4.7 The theoretical capacity of Option C1 with both the existing and the new bridge operating is estimated to be reached when the volume on the bridge is expected to be about 31,800 vpd.

5.0 DISCUSSION

5.1 The existing system has two constraints that could cause intermittent operational problems. These are the north bound merge at the Echuca end prior to the bridge and the shops in Meninya Street, Moama. The merge prior to the bridge immediately follows the roundabout, north bound, and is not well marked therefore vehicles sometimes have trouble merging due to the poor delineation creating uncertainty where the merge is supposed to take place. Improved delineation could minimise this effect. The Meninya Street shops, parking/unparking manoeuvres and also a pedestrian crossing beyond the Moama roundabout sometimes cause delays to the through traffic with queues backing up into the roundabout. These intermittent effects cannot be satisfactorily analysed.

5.2 The limiting constraint on the Option C1 system with the new bridge only is the lack of storage space for the right turn into Heygarth St, Echuca. Unfortunately this cannot be improved as the intersection is situated in close proximity to the bridge. This causes the system to break down, before the theoretical capacity of the intersection is reached, when right turn queues overflow into the through lane blocking the bridge. Option C1 with new bridge only does not significantly improve the capacity of the crossing, however it does provide the flexibility to manage larger vehicles, relative queue lengths and is better suited to major events and/or changes in traffic patterns.

6.0 CONCLUSION

It is concluded that:

6.1 Both the existing system and Option C1 system with the new bridge only would reach theoretical capacity at approximately the same time when the bridge volume reaches about 25,000 vpd. However, actual capacity could be reached earlier due to the operational problems discussed in 5.1.

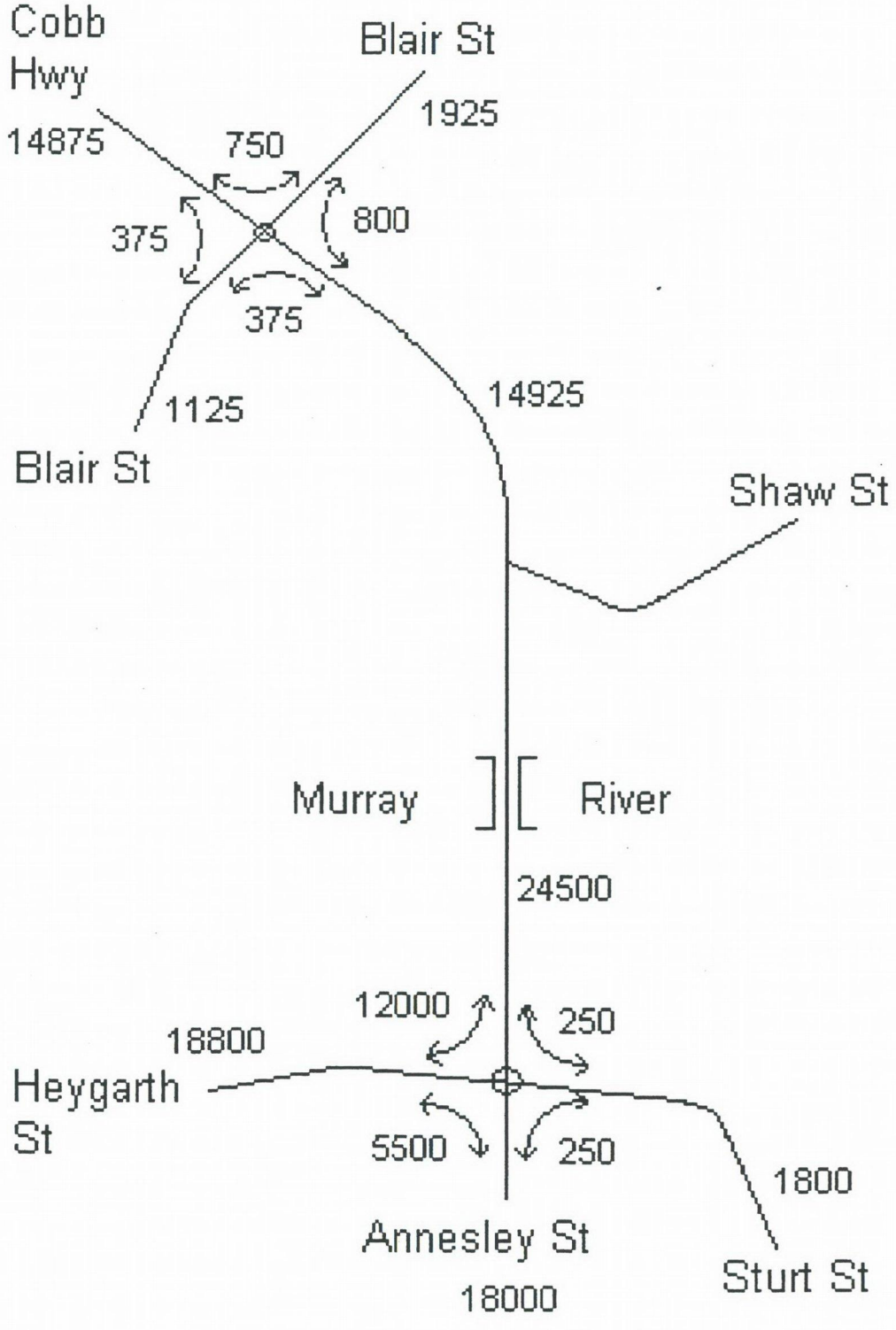
6.2 The limiting factor for Option C1 system with the new bridge only is not the degree of saturation but the through traffic from the bridge being blocked by turning traffic into Heygarth St, Echuca.

6.3 Option C1 system with the new bridge only does not significantly improve the capacity of the system, however it does improve the operation by providing more flexibility and the ability to manage queue lengths and delays.

Matthew Pascoe
Traffic Design Engineer

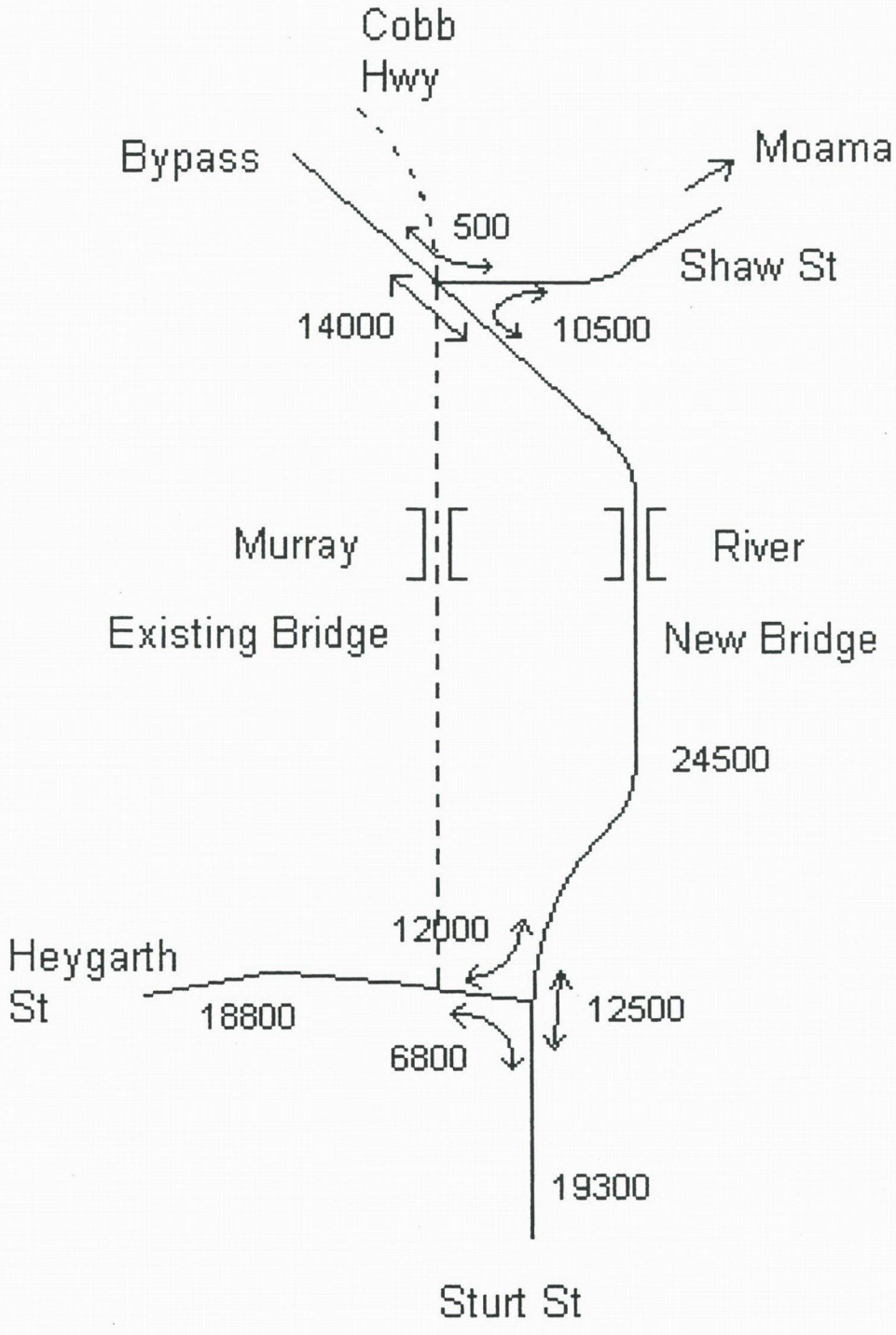
Copies to: GM – TRUM – Attn: Mr Gary Veith
TE FILE – NOR 0.1

APPENDIX A1 – Forecast Daily volumes in year 2016 for the existing situation
Source: 1998 ARUP Report "Murray River Crossing at Echuca – Moama"



APPENDIX A2 – Forecast Daily volumes in year 2016 for Option C1 with new bridge operating as a 2-lane, 2-way bridge.

Source: 1998 ARUP Report "Murray River Crossing at Echuca – Moama"



APPENDIX B - Summary of Results

Volume at which theoretical capacity is reached

		Volume over Bridge (vpd)
Existing	DoS = 0.8	25000
Option C1 *One Bridge	DoS = 0.9	29500
	Through traffic blocked	24500
Option C1 *Two Bridges	DoS = 0.9	31800

System includes the bridge over the Murray River and the roundabouts in both Echuca and Moama

Volume when each LoS is reached

	LoS	Volume over Bridge (vpd)
Existing	A	-
(LoS on worst leg)	B	10000
	C	12500
	D	23500
	E	28000
	F	29500
Option C1 *One Bridge	A	-
(LoS of intersection)	B	-
	C	7000
	Queues block through traffic	24500
	D	NA
	E	NA
	F	NA

Reply

To: Tony Hillman
cc:
From: Matthew Pascoe
Date: 02/07/2001 16:29:05

Ext:

8202

Fax:

(03) 9811 8329

RECEIVED
PLANNING INVESTIGATIONS
DEPARTMENT

Subject: Single lane merge prior to the bridge at Echuca

Project File Name
MURRAY RIVER BRIDGE AT ECHUCA
Section
PID Correspondence
Category
Traffic Analysis

Job No. 1174

Planning investigations Department requested that a proposed northbound single lane entry merge from Annesley St to Sturt St just prior to the Murray River bridge at Echuca be analysed and commented on.

From a strategic view point we would question the wisdom of such a layout which encourages northbound traffic to access Sturt St on the western side of the railway line. This seems contradictory to the strategic aim of moving traffic from Annesley St to Sturt St.

The proposed single lane is not supported because:

- there is insufficient length before the bridge to provide adequate merge length for it to operate safely
- a shorter than required merge length can cause severe operational problems and from previous experience can cause a number of accidents including rear end collisions. The taper area would be traversed by platoons of vehicles and whilst the merge would operate satisfactory during periods of low traffic volumes, it would not operate satisfactory during platoons of vehicles due to the small number of gaps and not enough manouvre length.

A fully controlled, two lane connection was investigated as an alternative. This included the removal of the northbound access to Sturt St on the eastern side of the railway line. Refer to the diagram attached to the hand copy of this note. Our preliminary investigations revealed the following:

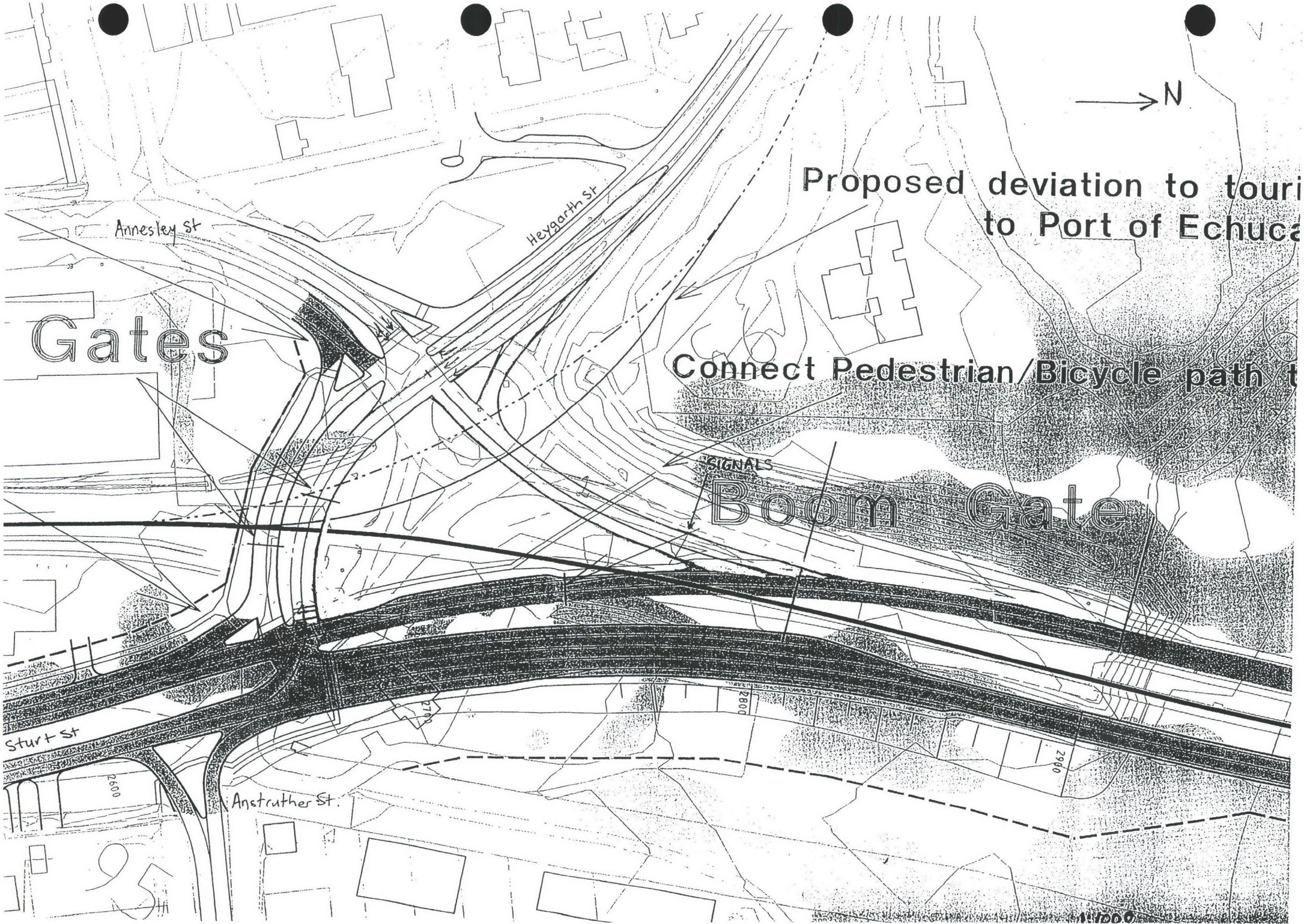
- analysis of the intersection (without the proposed two lane connection) as separate sites indicated Degrees of Saturation (DoS's) of less than 0.52. We would conclude that once

detail phasing and linking has been resolved the site would work satisfactory but at a higher DoS than for the individual sites.

- this site as a whole is complex in terms of signal operation due to the effect of the railway crossing.
- inclusion of the two lane connection introduces two further sets of signals adjacent to the northern railway crossing point. This further complicates an already complex site.
- to satisfactorily analyse this site full phasing diagrams would need to be developed and based on appropriate linking strategies for the major movements. The possible Tourist Railway would have to be included in this analysis, further complicating operation.
- it would be expected that the Tourist Railway would operate more frequently than the commercial line and further the peak Tourist Railway movements would be expected to coincide with high holiday traffic flows.
- discussions with Frank Woollard from Signal Operations have indicated that resolution of the phasing would be highly complex and may take a couple of months to satisfactorily resolve.
- Frank Woollard also indicated that the complex nature of the site is such that a long cycle time would be required which could lead to unnecessary delays and queues.

In summary, addition of the two lane connection further complicates an already complex site. This raises the issue of whether it is necessary or appropriate to consider such a complex solution for installation in a rural township.

Matthew Pascoe


N
Proposed deviation to touri
to Port of Echuca
Connect Pedestrian/Bicycle path t
Gates
Annesley St
Heygarth St
SIGNALS
Boom Gate
Sturt St
Anstruther St.
2600
2800
2790
1:1000

vicroads design
ENGINEERING & TECHNOLOGY CONSULTANTS

INTER-OFFICE MEMO

TO : Principal Road Design Engineer
Manager – Planning & Investigations
Attn: Mr Tony Hillman

DATE : 20 July 2001

FROM : Jose Leong
Traffic Design Engineer

OUR REF : 1174

BUSINESS AREA : VicRoads – Design

FILE NO : NOR 0.1

CONTACT NAME : Jose Leong

EXT : 8206

SUBJECT : **NORTHERN HIGHWAY**
ECHUCA – MOAMA – MURRAY RIVER BRIDGE
FRANCIS STREET EXTENSION TO COBB HIGHWAY

1.0 INTRODUCTION

1.1 Tony Hillman from the Planning and Investigations Department has requested the Traffic Design team to carry out a SIDRA analysis on the proposed Cobb Highway / Perricoota Road / Francis Street intersection and Cobb Highway / Meninya Street intersection.

1.2 The lotus note from Tony Hillman dated 21 June 2001 states that the Shire of Murray estimates that if Francis Street is reopened it would take about 50% to 75% of the traffic off Regent Street.

1.3 For analysis purposes, it was assumed that,

- Cobb Highway / Perricoota Road / Francis Street is a four leg roundabout.
- Cobb Highway / Meninya Street is a three leg intersection, being either a roundabout or a signalised or unsignalised T-Junction.

1.4 Reference should be made to:

- "Murray River Crossing at Echuca - Moama" – Detailed traffic and economic evaluation of Options prepared for VicRoads Planning Investigations Department, by ARUP Transportation Planning and dated December 1998.
- The locality plan attached as appendix A.

2.0 EXISTING TRAFFIC VOLUMES

2.1 Tony Hillman's lotus note of 21 June 2001, see copy attached as Appendix B, indicates that Regent Street carried about 2000vpd in the early 90's

3.0 FORECAST TRAFFIC VOLUMES

3.1 According to the latest ARUP modelling, Regent Street is expected to carry about 4000vpd in the year 2016. Refer to Appendix B for Tony Hillman's lotus note dated 21 June 2001.

3.2 Traffic volumes modelled by ARUP for year 2016, are attached as Appendix C. These volumes have been manually adjusted to provide forecast volumes if Francis Street is to be reopened. These adjusted traffic volumes are shown in Appendix D.

4.0 OUTCOME OF ANALYSIS

4.1 Cobb Highway / Perricoota Road / Francis Street crossroad intersection was analysed as a four leg roundabout. The SIDRA analysis results are as shown in the table 1.0 below.

4.2 Cobb Highway / Meninya Street T- Junction intersection was analysed as an unsignalised intersection, a signalised intersection and a roundabout. The SIDRA analysis results are as shown in the table 1.0 below.

4.3 Table 1.0 – Summary of SIDRA analysis results.

INTERSECTION NAME	INTERSECTION TYPE	DoS		Average Delay (s)		Queue Length (m)	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Cobb Highway, Perricoota Road and Francis Street	Roundabout	0.3	0.4	15	16	13	19
Cobb Highway and Meninya Street	Unsignalised	0.8	1.5	147	928	48	357
Cobb Highway and Meninya Street	Signalised With 60s Cycle Time	0.7	0.5	38	38	61	67
Cobb Highway and Meninya Street	Signalised With 90s Cycle Time	0.6	0.5	56	49	60	81
Cobb Highway and Meninya Street	Roundabout	0.5	0.4	18	13	28	24

4.4 Cobb Highway / Perricoota Road / Francis Street roundabout.

Table 1.0 shows that if this intersection is constructed as a roundabout, it would yield low DoS's, low average delays and short queues in both peaks. These conditions are indicative of a roundabout operating well below capacity with room for future traffic growth and/or changes in traffic patterns.

4.5 Cobb Highway and Meninya Street.

4.5.1 Unsignalised Intersection.

If the T-Junction is to be constructed as an unsignalised intersection, it would yield high DoS's, very high average delays and very long queues. The highest maximum average delay of 928 seconds in the PM peak for traffic turning right from Meninya Street heading north to Cobb Highway is unacceptable. From an operational point of view, this treatment is not acceptable.

4.5.2 Signalised Intersection.

If the T-Junction is to be constructed as a signalised intersection, it would yield acceptable DoS's, delays and queue lengths in both peaks. These conditions are indicative of a signalised intersection, which has room for future traffic growth and/or changes in traffic patterns.

4.5.3 Roundabout

If the T-Junction is to be constructed as a roundabout intersection, it would yield low DoS's, low average delays and short queue lengths. These conditions are indicative of a roundabout operating well below capacity with room for future traffic growth and/or changes in traffic patterns.

5.0 DISCUSSION / SUMMARY

5.1 The proposal to reopen Francis Street creates a crossroad intersection at the location of the existing Cobb Highway / Perricoota Road "T" intersection.

5.2 SIDRA analysis indicates that the proposed roundabout, as modified per the attached sketch, would be expected to operate at DoS's of around 0.3 to 0.4 in both peaks. This is well below the maximum desirable DoS of 0.8 for a roundabout. The expected queue length and delays are also minimal. These figures indicate a roundabout operating well with room for changes in traffic patterns and growth in traffic volumes.

5.3 For the Cobb Highway / Meninya Street T-Junction intersection, the SIDRA analysis indicates that a roundabout or a signalised intersection is required in order to achieve acceptable DoS's, delays and queue lengths. As an unsignalised intersection, traffic turning right from Meninya Street heading north to Cobb Highway would have very limited opportunity to carry out this movement. From an operational point of view, this should be avoided.

5.4 The SIDRA analysis results as shown in the table 1.0 indicates that there are no significant differences in DoS's and Queues, between 60 and 90 seconds cycle time. The delays however are lower for a 60 seconds cycle time.

5.5 Roundabouts and signalised intersections tend to exhibit operational difficulties when constructed in close proximity to each other, due to the traffic platoons from the signals entering the roundabout. This highly platooned traffic limits the availability of gaps for Perricoota Road and Francis Street traffic, leading to longer delays and queues on the smaller side roads.

5.6 If Cobb Highway / Perricoota Road / Francis Street is constructed as a roundabout, then the Cobb Highway / Meninya Street intersection should also be constructed as a roundabout.

5.7 The desirable radius for the central island of these roundabouts is 20 metres. The radii of the central islands shown on the sketch attached as Appendix E are only 15 metres. The diameter of these central islands should be increased if possible during future design development.

5.8 The down side of a two roundabout treatment is the impact on the manoeuvrability of commercial vehicles. In general, commercial vehicles tend to prefer signalised intersections to roundabouts, because signalised intersections have straighter alignments and less geometric delays. However, it is considered that the significantly lower overall delays associated with the roundabout, and in particular during off peak periods, far out weigh the geometric delay and thus a roundabout is the best option.

6.0 CONCLUSION

It is concluded that:

6.1 Based on the Shire of Murray's traffic distribution, the roundabout proposed for the Cobb Highway / Perricoota Road / Francis Street intersection as per Appendix E is a suitable treatment.

6.2 For the Cobb Highway / Meninya Street T-Junction intersection, the SIDRA analysis indicates that,

i) An unsignalised intersection does not have sufficient capacity and is therefore not suitable.
ii) A signalised intersection does have sufficient capacity, but is not supported due to the close proximity of the roundabout and the ensuing operational problems.
iii) A roundabout does have sufficient capacity, is compatible with the adjacent roundabout, has lower delays and shorter queues than the signalised option, and is therefore the preferred treatment at this intersection.

Jose Leong
Traffic Design Engineer

Copies to: GM – TRUM – Attn: Mr Gary Veith
TE FILE – NOR 0.1

APPENDIX A
LOCALITY PLAN

Richard Yeoman
21/06/01 16:50

vicroads design

To: Jose Leong/VicRoads@VICROADS, Douglas Harley/VicRoads@VICROADS
cc:
Fax to:
Subject: Estimated Volume in Francis St Moama

Ext: 8226 **Business Area:** Vicroads Design
Fax: 98118329 **Internet:** richard.yeoman@roads.vic.gov.au

Richard Yeoman
Traffic Design Team Leader
VicRoads Design
Phone 03 9811 8226, Fax 03 9811 8329
email: richard.yeoman@roads.vic.gov.au
----- Forwarded by Richard Yeoman/VicRoads on 21/06/01 04:53 PM -----

Tony Hillman
21/06/01 04:03 PM

To: Richard Yeoman/VicRoads@VICROADS
cc: Bruno Aleksic, Mustafa Uzunoglu/VicRoads@VICROADS, Peter Atamian/VicRoads@VICROADS
Fax to:
Subject: Estimated Volume in Francis St Moama

Ext: 2745 **Business Area:** Planning and Investigation
Fax: 98542230 **Internet:** tony.hillman@roads.vic.gov.au

Richard,

The Shire of Murray rang with an estimate of the traffic volume that would use Francis St if it was reopened to join the Cobb Hwy at Pericoota Rd.

If Francis St is reopened to the Cobb Hwy, it would take traffic generated by the residential area to the north of Meninya St. It is considered that this would result in a shift of some traffic from Regent St to Francis St. Regent St is the last street intersecting with Meninya St at the north end. A recorded volume in Regent St in 1993 was about 2000vpd. The Arup model for te 1997 base case indicates a similar volume using this street.

The latest Arup 2016 predictions for Option C1 indicate that Regent St would carry about 4000vpd. The Shire estimates that Francis St would take 50% to 75% of this traffic from Regent St. This means that for 2016 predictions about 2000vpd to 3000vpd would enter the Cobb Hwy/Perricoota Rd intersection from Francis St.

The reduction in traffic in Regent St would also mean that there would be less traffic entering the Cobb Hwy from Meninya St. The Shire estimates that 90% of this traffic would turn left at the Cobb Hwy to travel across the bridge to Echuca. Hence the shift in traffic to Francis St would have only a minor effect on the traffic volume entering the Cobb Hwy/Perricoota Rd intersection from the south.

Regards

Tony Hillman

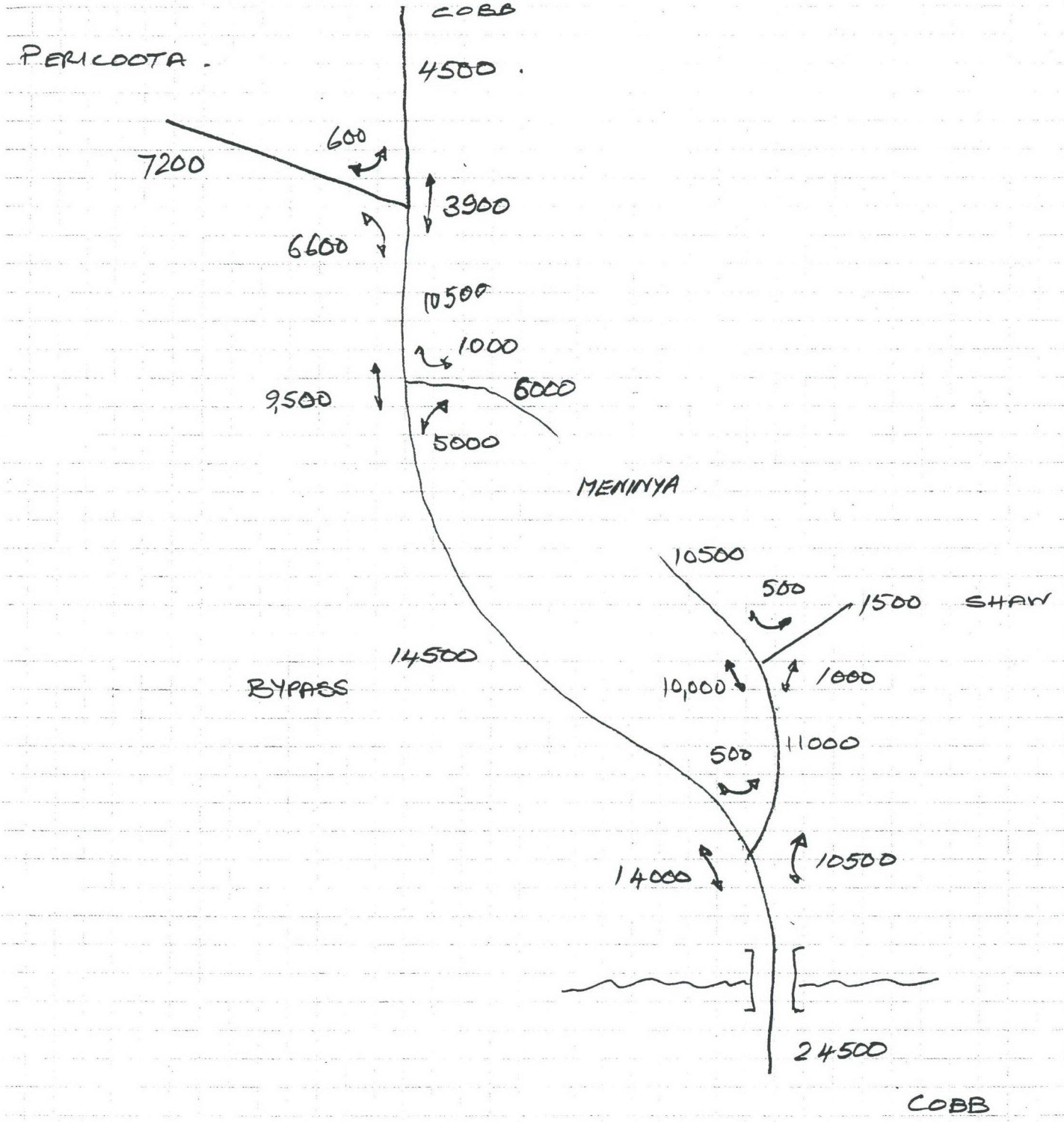
APPENDIX B
LOTUS NOTE FROM TONY HILLMAN

Date: 2 III 2000 RJ File Ref No.: LD175

Job Name: ECHUCA BRIDGE

Description Y2016 ~ OPTION C1 SHEET 2

vic roads design
ENGINEERING & TECHNOLOGY CONSULTANTS



APPENDIX C
OPTION C1 Y2016

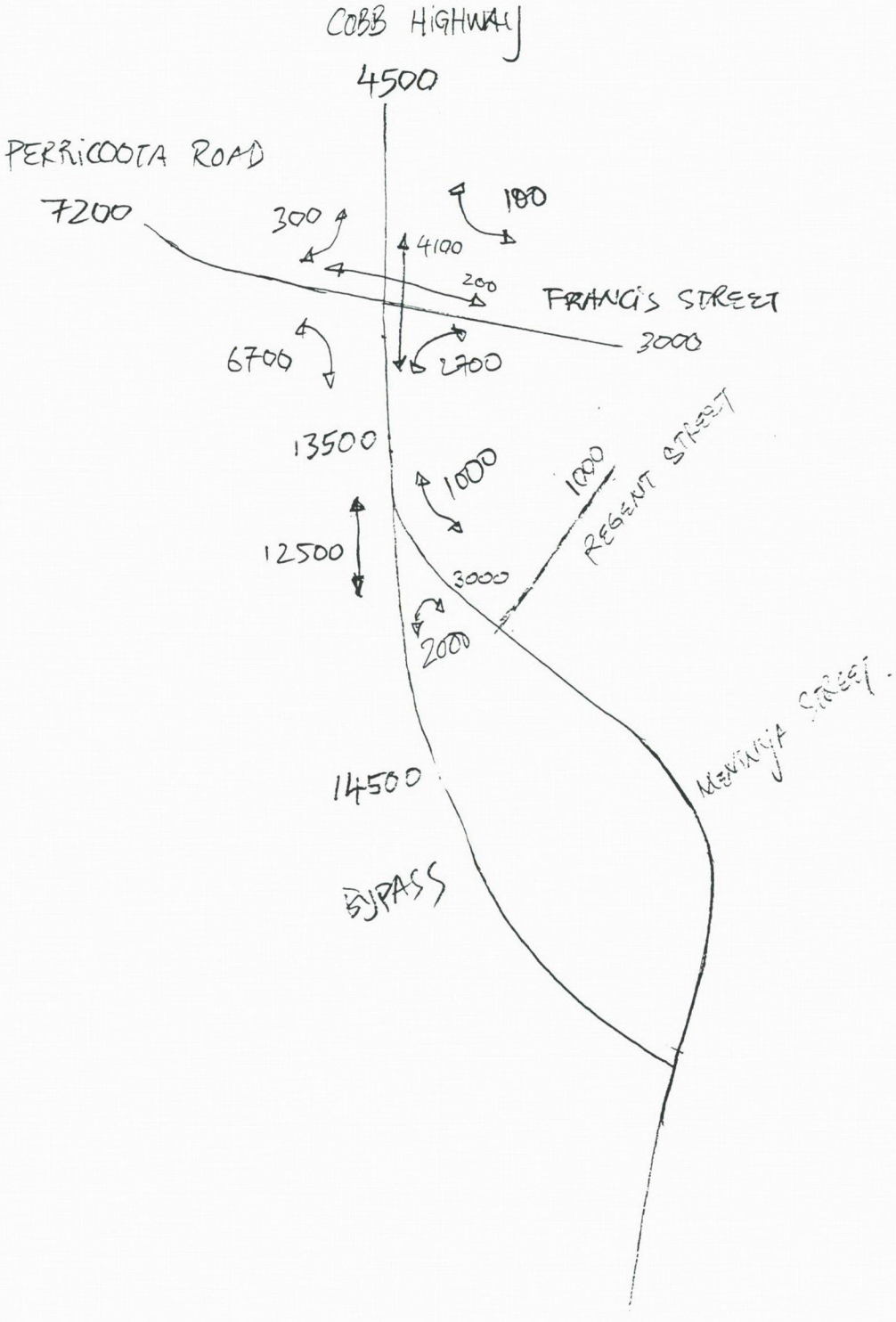
Date:..... File Ref No.: .....

Job Name:.....

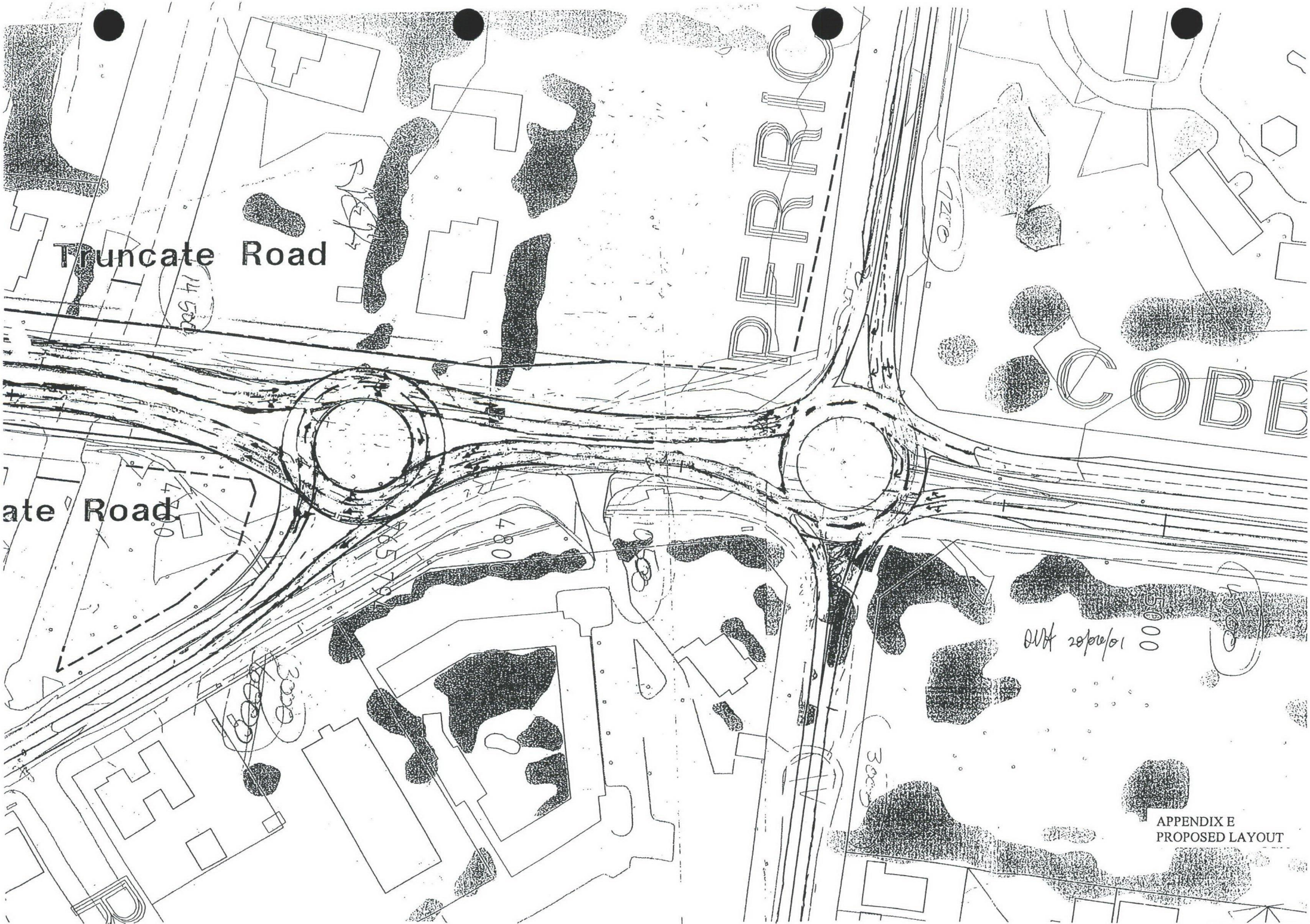
Description .....

vicroads design
ENGINEERING & TECHNOLOGY CONSULTANTS

FORECAST TRAFFIC VOLUMES FOR Y2016



APPENDIX D
FORECAST TRAFFIC VOLUMES FOR Y2016



APPENDIX E
PROPOSED LAYOUT

Business and Tourism

- **Murray River Crossing at Echuca/Moama, Business and Tourism Study, Final Report,** *Saturn Corporate Resources Pty Ltd, December 1999*

SATURN CORPORATE RESOURCES PTY. LTD.
ACN 075 607 751
Regional and Industry Economics, Strategic Management, Transport Planning, Market Research

Murray River Crossing at Echuca/Moama

Business and Tourism Study

Final Report

Prepared VicRoads
December 1999

Prepared by Bill Unkles
Saturn Corporate Resources Pty Ltd

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Executive Summary

Echuca and Moama have become major tourism destinations within the domestic tourist market. Tourism Victoria considers the tourist potential of these towns can be significantly enhanced by the well planned development of the Port of Echuca precinct. Echuca also has strong growing food processing sector, with the new Cedenco plant planning an expansion of capacity and Heinz announcing plans for a new food processing plant in the town.

The influence of tourism is clearly evident in the employment structure of the towns with employment in the Accommodation, Cafes and Restaurants sector accounting for 11.6 per cent of employed local residents and the Wholesale and Retail sectors, which when combined account for 25.2 per cent of local employment. Within all of Rural Victoria these industries respectively account for only 4.7 per cent and 19.7 per cent of employed residents.

The strength of tourism relies on both the attraction of the Port of Echuca, the quality of the sporting clubs in Moama and the natural attraction of the riverside environment. The towns also attract a small but significant retirement industry, as evidenced by the local age profile.

The business and tourism impacts study is primarily based on information gained from a survey of local businesses. Some 106 businesses were interviewed with almost a quarter of these being in Moama. Most respondents (86.8 per cent) believe there was a strong need for a new bridge and there is a slight preference for it to be located in the Western corridor, closely followed the Central corridor.

The importance of the tourism industry appears to influence the support for the bridge options by the local business and tourism sector. The respondents identifying a likely gain in total turnover for their businesses of around $500,000 if the Central Corridor was adopted, yet they tended slightly to favour construction in the Western corridor. This possibly reflects an acceptance of the need to remove heavy traffic from the centre of the towns, in order to support long-term tourism growth.

The estimated value of the tourism impact on the local economy varied from an increase in sales of $2.1 million for construction of the bridge within the Central corridor to a loss of turnover of $7.6 million if the Eastern corridor was adopted. However there was strong potential for some cost savings for local businesses ranging from $6.6 million to $8.7 million from the provision of a new bridge. However, much of these savings reflect potential transport cost reductions for the major food processors and rely on the approval for the use of road train configurations to their sites. This has not been approved and lies outside the scope of this study. The cost savings for local businesses are likely to be less than $1 million if a new bridge is constructed. Many of these savings would be in response to a fall in turnover.

Moama based businesses considered themselves to be most adversely affected by the construction of a new bridge. Responses from these businesses accounted for more than the total expected reductions in turnover, with Echuca based businesses expecting a small but overall positive impact on their turnover. These businesses would also be most adversely affected by the refurbishment of the existing bridge should it be closed. The respondents suggested sales could fall by some $3.7 million over a possible six month closure period, 61 per cent of this would be due to a fall in sales win Moama businesses. Most Moama businesses welcomed the news that any bridge closure would be partial, however when asked to assess the impact they felt the impacts over a given 6 month period would fall typically by between a half to a third of the impact of a full closure. While the Moama businesses that previously expected to gain from a bridge closure now expected no impact. Given that a temporary closure may be for 14 months, as opposed to 6 months for full closure, the net estimated impact based on industry responses was a fall in turnover totalling $4.7 million.

1. Introduction

Vicroads and the Roads and Traffic Authority of New South Wales are the joint proponents of a proposal to build a new bridge across the Murray River at Echuca/Moama. The bridge is to be partly financed from the Commonwealth Government Centenary of Federation Building program with the proponent states providing the balance of funds. VicRoads has been nominated as the Project Manager and as a result is undertaking a planing study to investigate options for upgrading the river crossing.

The current bridge at Echuca/Moama was built in 1879 and is the oldest Murray bridge. The bridge has a heritage classification and is ranked in the top ten of early steel bridges in Australia. The heritage classification underlines the importance of the bridge as part of the Echuca tourism complex. The Port of Echuca is not a museum but rather a living and working example of steam powered boats, working wharves and other steam applications. The attraction of the Port is heavily dependent upon the maintenance of the precinct as an attractive and historically believable landscape. The current bridge forms a key part of this landscape.

The current bridge provides a vital link between Echuca and Moama with the nearest alternative bridges requiring either a 101 kilometre or a 195 kilometre round trip. The current bridge is not subject to load restrictions but is relatively narrow with only one lane each way. The bridge becomes highly congested at times during the summer holiday and fruit picking seasons, occasionally the movement of wide loads across the bridge can delay traffic each way for more than half an hour.

The development of a new crossing will directly impact the local business and tourism interests of Echuca Moama. Vicroads have commissioned Saturn Corporate Resources to investigate these impacts, with particular emphasis on the issues of differential impacts between alternative crossing sites.

1.1 Approach

The approach used by Saturn Corporate Resources was based upon a combination of field surveys of business and tourism interests in the Echuca/Moama region, a review of major reports and information published including statistical information drawn from the 1996 census and other published statistics.

The published data and information provides background information on the structure and health of the local economy. This information was collected for the townships of Echuca and Moama as well as the surrounding region as given by the relevant local government areas of Campaspe and Murray. In order to provide some perspective on these results, they are compared to the equivalent ratios for Victoria and the Rural Victoria.

The survey of businesses and tourism operators was primarily a questionnaire supplemented by additional discussion of major issues with significant employers, transport operators, leaders of community business groups and the Port of Echuca management. A total of 106 completed surveys were received by Saturn, while some 120 respondents were approached. A preliminary survey was undertaken and then the survey form was refined prior to interviewing most of the respondents. Results of the preliminary survey were incorporated in the total responses, after some minor adjustments to the collected data,. These adjustments reflected discussions held with respondents.

The survey questions sought responses detailing the likely impacts of each bridge option upon the respective business in both quantitative and qualitative terms. In addition, respondents were asked to identify the approximate level of turnover for their business as well as, information on staff numbers, recent and expected turnover growth, information on markets and marketing strategies they have adopted. The respondent's assessments of the impacts of the various bridge impacts has been combined with turnover figures, where given, in order to provide an estimate of the financial impact of the various options.

As the survey was undertaken after the Moama Traders raised their concerns regarding the possible closure of the current bridge for refurbishment, the survey included questions aimed at estimating the impact such a closure may have on the affected traders.

The survey responses differed in overall quality with many firms unable to provide a clear picture of where their customers were sourced from or how much of their business was based on passing trade. In addition, there was some confusion about the nature of passing trade with some respondents apparently including all non local residents as passing trade despite the fact that these people had made the town a specific destination and were staying for one or more nights.

The survey results provided an approximate value of turnover per employed person for the firms surveyed. This data was then combined with information from the 1996 census to provide an estimate of the total turnover in the area based upon the total number of employed persons including part time employed.

Many firms were unsure of the impact that the options would have on their sales and costs with data on costs being the least reliable. In estimating the cost impact, the expected impact has been multiplied by the turnover figure and then by the national average ratio of cost inputs to total turnover as provided by the ABS national Input-Output tables. This provides a useful indicative estimate of impacts.

2. Echuca Moama socio-economic features

2.1 The economy

2.1.1 Introduction

Echuca and Moama like many twin towns along the Murray River have a high degree of interdependency. Echuca (population 10,014) and Moama (population 2469, ABS 1996 census) have become a major tourism destination along the Murray River, boasting a range of Sporting clubs, and the Port of Echuca as the prime attractions.

Echuca and Moama are part of the Local Government areas of Campaspe and Murray respectively and are the major growth centres within these shires. Population growth has been strong in both towns with annual growth between 1991 and 1996 averaging 1.2 per cent for Echuca and 1.8 per cent for Moama. The Murray Shire has enjoyed strong growth of 2.0 per cent over the 5 years to 1998 compared to a state average of only 1.1 per cent and the Sydney average of 1.3 per cent. The Campaspe shire grew by 0.6 per cent over a similar period compared to a Victorian average of 0.8 per cent per annum and the Melbourne average of 1.1 per cent. This growth was stronger than most Victorian rural municipalities.

2.1.2 Agriculture and related production

Apart from being a major tourism destination, the towns are service centres for the surrounding agricultural communities. Agricultural commodity handling and food processing are major enterprises in Echuca. The enterprises include the Ricegrowers Co-operative Mill and packaging plant, Cedenco, a producer of packaged and bulk tomato products, Nestlé dairy products and Simplot's Leggos plant, which produces tomato products and packaged meals for the retail market. Cedenco plan to considerably expand the production capacity of the existing plant and Heinz have recently announced plans to establish a major food processing plant in Echuca.

The value of agricultural production in the Shires of Murray and Campaspe was $380 million in 1995-96, milk production accounted for $191.8 million (50.4 per cent of the total) and $106 million (27.8 per cent) was due to production of crops (other than fodder). Most of the milk $188.5 million was produced in the Campaspe area. Total milk production in the region accounted for 37.2 per cent of total Murray Valley milk production in 1995-96. In that year, some 93,000 tonnes were grown in the Campaspe Shire and some 48,000 tonnes of rice was grown in the Murray Shire. A high proportion of this product is transported to Echuca.

The Campaspe Shire Economic Development Manager indicated that the food processing sector located in the South East of Echuca and further south along McKenzies Road may experience significant expansion in the next few years. Part of this expansion includes Cedenco's and Heinz's plans but other major processors have expressed strong interest in developments in this area (Phillips,1999).

2.1.3 Transport services

While the manufacturing plants tend to be on the Victorian side of the border, the transport providers tend to be in New South Wales. This reflects the previous road transport registration cost regime, which provided significant cost savings to interstate operators. While this anomaly has been removed, the incentive for depots to be located within New South Wales remains, as

road trains can operate in the West of Great Divide in this state and Queensland. These provide significant cost savings over conventional pantechnicons and B/doubles. Many of these vehicles cart to Moama, then split the load into two trips for the run to Melbourne or across to Echuca.

A high proportion of the commercial traffic using the Echuca Moama bridge is related to the delivery of stock to and from these plants. Both Neil's and Boylan Transport provide warehousing and distribution services for Simplot and Cedenco out of their Moama bases. A high proportion of product is shipped across the border for storage or reloading and subsequent delivery to Melbourne, Sydney and Brisbane. This operation generates substantial cross border traffic.

2.1.4 Tourism

The Tourism industry is a major strength of the Echuca-Moama economy. The industry is primarily built upon the Port of Echuca which since its initial development in the 1970s has become one of Victoria's more significant historic attractions. The attractions of the Port as a an operating steam port with associated facilities has grown strongly in the past decade and it now recognised by Tourism Victoria as key investment opportunity.

Tourism accommodation in the Campaspe Shire generated a turnover of around $5.4 million in 1998 (ABS Cat 8635.2 special) with 123,000 visitor nights spent in hotels motels and serviced apartments. Details of caravan park stays are no longer available. Most of the accommodation in the Shire is based in Echuca, it is estimated by Saturn that a further $2 to $3 million per annum may be turned over in Moama accommodation establishments. Estimates made in the Meeting of the Whistles Report (Datab. 1999) suggest the study region encompassing Maldon, Bendigo, Echuca and Deniliquin generates tourism expenditure in excess of $400 million per annum.

The Murray Region Tourism Plan (Urban, 1997) identifies 7 key themes for the development of tourism along the Murray, two of these themes are Murray History and Murray Sports both strengths of the Echuca Moama tourism industry. The strategy calls for greater integration of Murray attractions and promotions, with a particular focus on developing the East West travel market.

The historic precinct of Echuca, which includes the Port of Echuca, Port Esplanade and the northern sections of Hare Street and High Street, has been identified as an area of national tourism significance by the Tourism Victoria (P Keage, Pers. Comm.). Tourism Victoria considers this area to have the same historic significance as Williamstown, Ballarat, Queenscliff and Beechworth. It has funded a major tourism development strategy for this area and is actively supporting efforts to raise funds for development of the assets in the area.

The Victorian Government has announced a $300,000 thousand grant for the refurbishment of the locomotive shed at Echuca. The Port Development Strategy calls for the full integration of the Port area with the rail yards, with the rail line running into the Port itself. A critical factor for the success of such a project is the reduction of traffic within the existing bridge corridor. Thus Tourism Victoria would not favour the construction of a bridge in the Central corridor.

The potential for the rail line has been enhanced by the recently completed strategy for the development of a Maldon, Castlemaine, Bendigo, Echuca, Wakool, Deniliquin rail trip. A recent report prepared by Datab Pty Ltd for the local Area Consultative Committees has identified the potential for development of such a trip. The success of such a venture depends upon the development of the rail infrastructure and would be enhanced by implementation of the Port

Strategy Plan. Already Great Northern Rail and Great Western Rail have indicated their interest in operating trains on this rail loop.

A major part of the attraction of the Port of Echuca is the paddlesteamer fleet. This fleet is the oldest in the world and includes the oldest operating Paddlesteamer the P.S. Pevensey, which is 95 years old. The paddlesteamers provide a reason for travellers to plan an extended stay in Echuca. This is critical, as length of stay is a key factor in generating local tourist expenditure.

2.2 Socio-Economic Characteristics of Echuca and Moama

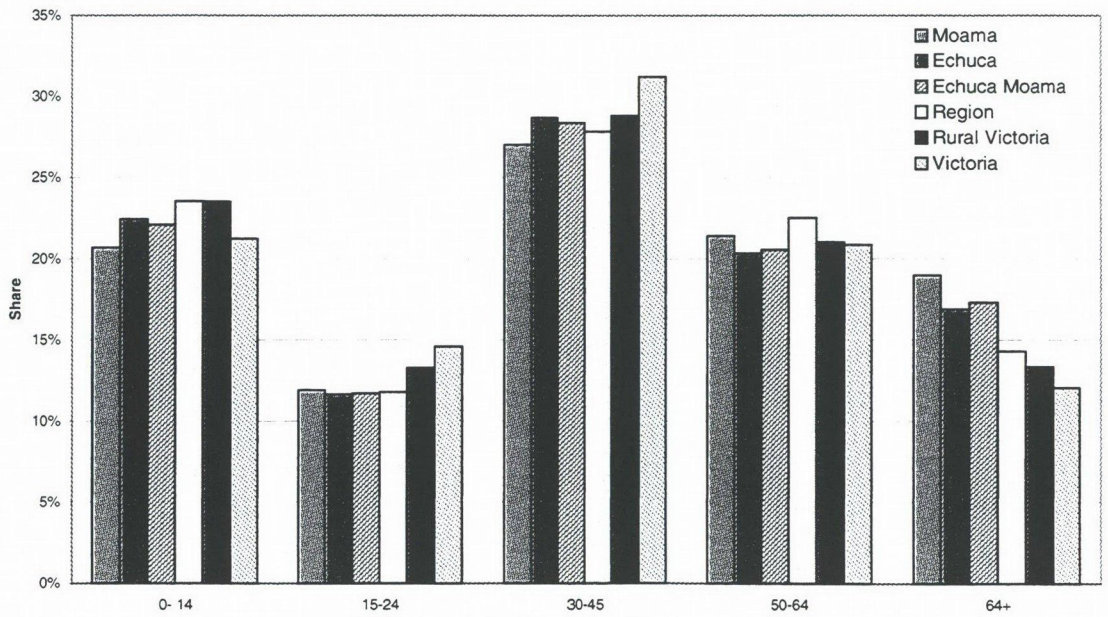
2.2.1 Population

The 1996 Census of Population and Housing provides the most detailed available information on small areas. At the time of the Census there were 12,483 person living in Echuca Moama, 6425 of these were female. In the five years from 1991 the population of Echuca grew at an annual rate of 1.2 per cent and Moama 1.8 per cent. For the combined towns the growth rate averaged 1.3 per cent per annum.

The total resident population count includes all persons resident in the town on the night of the Census and included 869 visitors to the area, 76 per cent of whom were staying in Echuca on the census night. Visitors comprised 7.0 per cent of the total population of the towns, and 8.8 per cent of the population of the region (Shires of Murray and Campaspe). This compares to a visitor share of only 3.4 per cent for Victoria and 5.0 per cent for Regional Victoria. As the Census is taken in August during school term, visitor numbers are well below peak levels.

The age structure of the population is illustrated on Figure 2.1.

Figure 2.1 Age structure Echuca Moama and selected areas



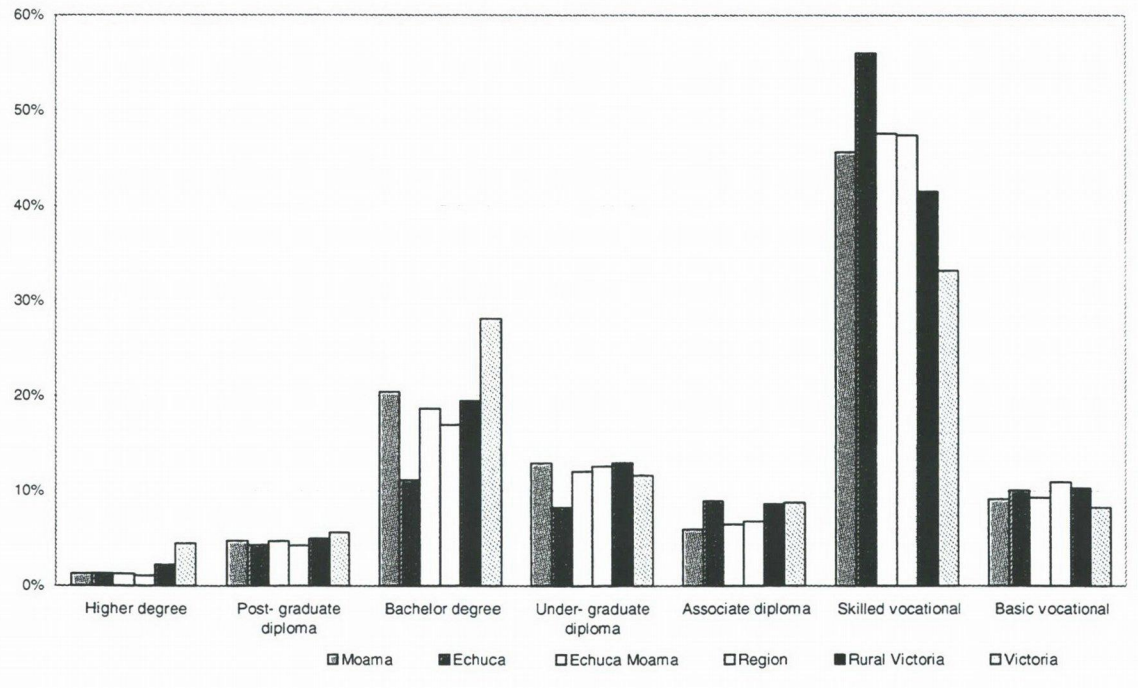
The towns have a relatively high proportion (17 per cent) of older persons compared to Rural Victorian and Victoria, the share of older persons in Moama was higher than in Echuca. This share reflects the importance of the retirement industry to the towns. The over proportional representation of over 64 year olds was balanced by significantly lower proportions of children

(0-14 years) and youth 15-24 years) compared to Rural Victoria and 15 to 45 year olds when compared to the Victorian average. Significantly, the townships have a much lower proportion of children than the surrounding region, but a higher proportion of 30-45 year olds and over 64 year olds.

2.2.2 Education

The townships have a relatively high proportion of persons with skilled vocational (trades) training (48 per cent of residents over 15 years of age), this is particularly so for Echuca where the ratio is a high 56 per cent. This compares to ratios of 41 per cent for Rural Victoria and 33 per cent for all Victoria. For the combined townships, the ratios of persons with basic vocational training and undergraduate and postgraduate diplomas are similar to the Region and all Victoria. There is a clear difference in the educational attainment of residents of Echuca and Moama. Echuca residents have a significantly lower ratio of undergraduate diplomas (8 per cent) and bachelor degrees (11 per cent) when compared to Moama (13 per cent and 20 per cent, respectively). The ratio of higher degree holders for the townships (1 per cent) was lower than the Rural Victoria (2 percent) and all of Victoria (4 per cent). The educational attainment ratios are illustrated on Figure 2.2.

Figure 2.2 Educational attainment Echuca Moama and selected areas



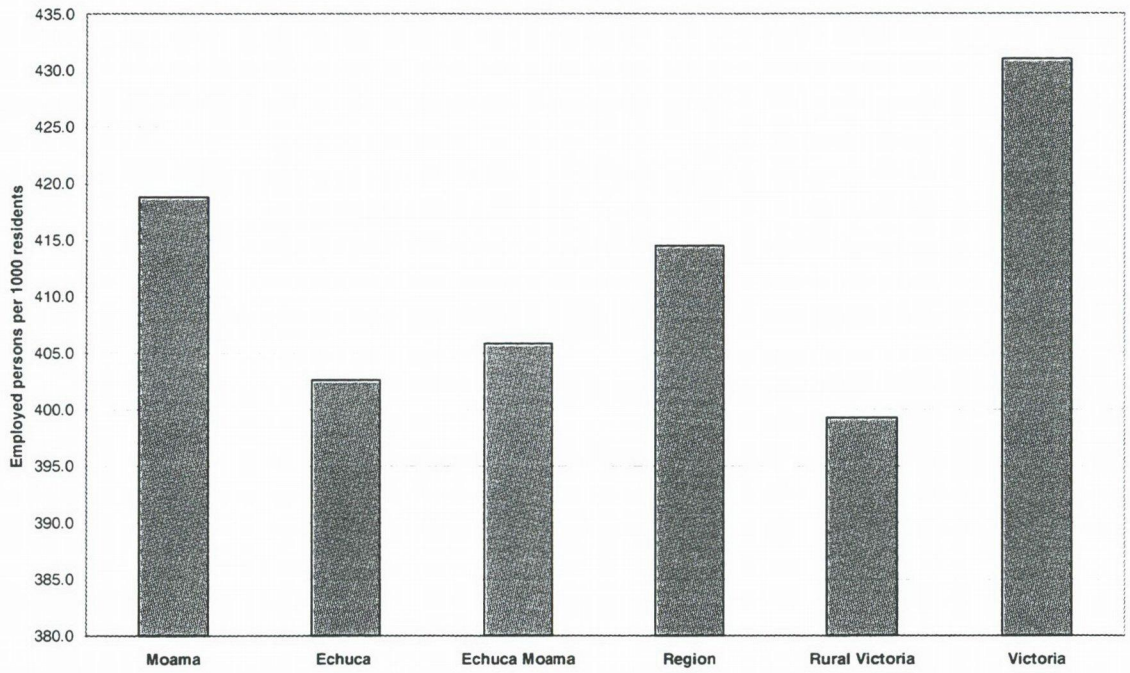
The qualification structure is consistent with the broad patterns of employment in the towns with the strong dependence upon tourism, food processing and agricultural support activities.

2.2.3 Employment

The townships have a similar level of employed persons per 1000 residents (405.8) to the rural Victorian average (399.5), though lower than the regional average (414.5) and significantly below the Victorian average (431.0). The discrepancy between the Moama ratio (418.8) and Echuca (405.8) most likely refects the high level of commuting from Moama to Echuca for employment. These employment ratios are shown on Figure 2.3.

The unemployment level in the townships at the time of the Census was a relatively low 7.2 per cent compared to 10.3 per cent for Rural Victoria and 9.4 per cent for all Victoria. The unemployment rate was also lower than the Melbourne Statistical Division average of 9.1 per cent. The low level of unemployment is offset slightly by a lower workforce participation rate in the townships (57.1 percent) compared to Rural Victoria (59.6 per cent).

Figure 2.3 Employment per 1000 residents Echuca Moama and selected areas

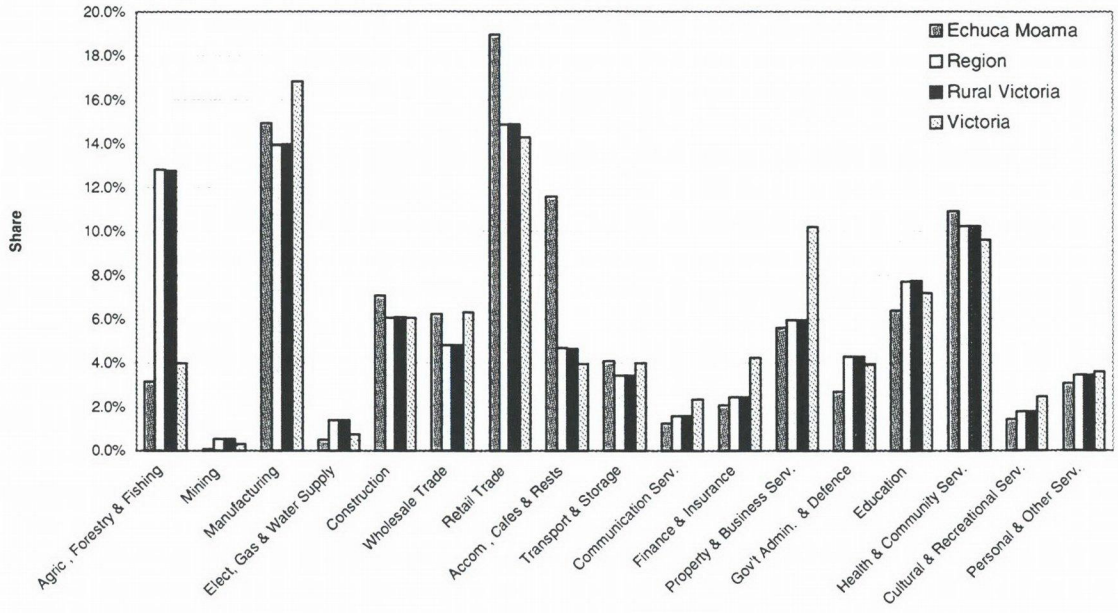


2.2.4 Industry structure

The industry structure of the region can be determined by looking at the employment of local residents by the industry of employment. Figure 2.4 illustrates the employment structure of the townships and region.

Within Echuca Moama, the share of employment in the accommodation, cafes and restaurants (11.6 per cent) and retail (19.0 per cent) and wholesale trades sectors (6.2 per cent) is very high when compared to Rural Victoria (4.7 per cent, 14.9 per cent and 4.8 per cent respectively). This structure reflects importance of the tourism sector within the local economy. These three sectors account for 36.8 per cent of local employment. The share of manufacturing employment (14.1 per cent) is higher than for Rural Victoria (14.0 per cent) but lower than the Victorian average(16.8 per cent). As befits a town with relatively strong population growth, there is a relatively high level of construction sector employment (7.1 per cent). The transport sector is also a significant employer (4.1 per cent), when compared to Rural Victoria (3.4 per cent) and Victoria (4.0 per cent).

Figure 2.4 Share of employment by industry Echuca Moama and selected areas



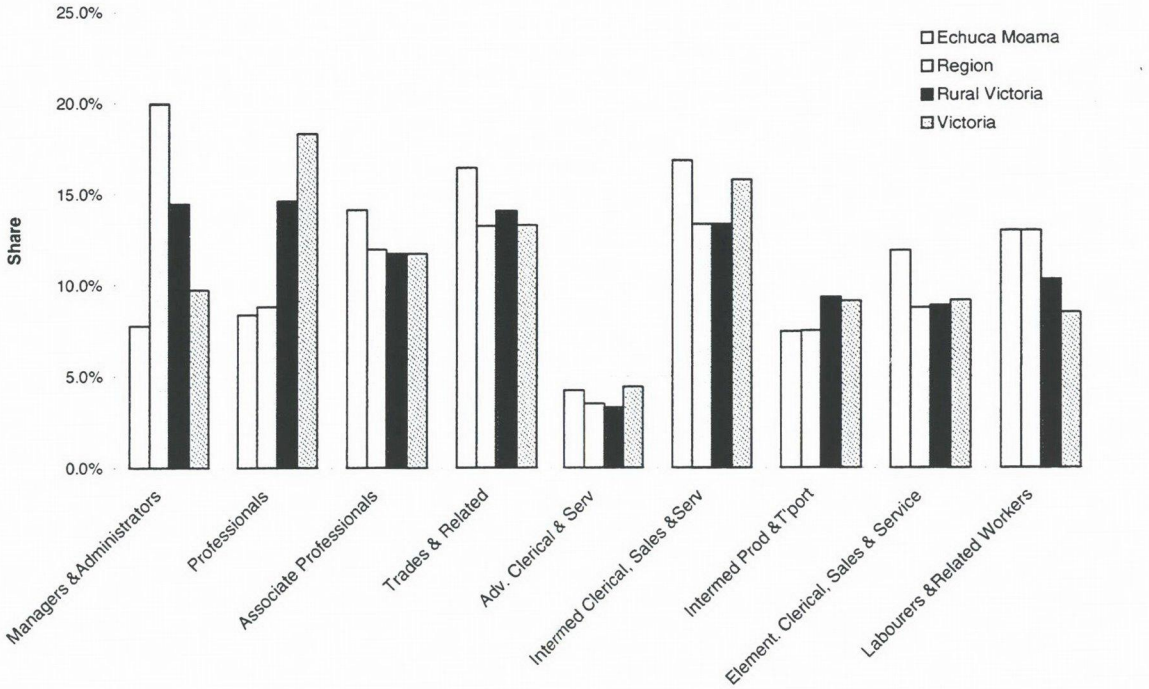
However there is a relatively low level of employment in the service industries when compared to Rural Victoria. In particular, Education (6.4 per cent cf. 7.7 per cent), Cultural and Recreational Services (1.4 per cent cf. 1.8 per cent), Government administration and Defence (2.7 per cent cf. 4.3 per cent) and Electricity Gas and Water Supply (0.5 per cent cf. 1.4 per cent). The combined share of employment in Finance and Insurance and Property and Business Services (7.7 per cent) is lower than that for Rural Victoria (8.5 per cent), and well below the Victorian average (14.4 per cent).

2.2.5 Occupation

The occupation structure of Echuca Moama is reflective of the industry structure. As illustrated on Figure 2.5 (overleaf)

There are relatively high proportions of persons employed in Clerical Sales and Service jobs (16.8 per cent) and the trades and related occupations (16.4 per cent), elementary clerical, sales and service (11.9 per cent) and labourers and related workers (13.0 per cent). The share of local residents employed in these occupations is significantly higher than for the region and the rest of Victoria. Within the region, there is a high proportion of managers and administrators this reflects the importance of farming in the area as farmers are classified as managers.

Figure 2.5 Share of employment by occupation Echuca Moama and selected areas



3 Impacts of the bridges

3.1 Characteristics of survey respondents

A total of 106 business and tourist enterprises within Echuca Moama have responded to the business and tourism survey. The respondents were drawn from the following industries:

Table 3.1 Survey responses by industry sector

Industry Sector	No of respondents	Share of total respondents
Manufacturing	4	3.8%
Construction	2	1.9%
Wholesale Trade	3	2.8%
Retail Trade	59	55.7%
Accommodation, Cafes & Rests	10	9.4%
Transport & Storage	5	4.7%
Finance & Insurance	4	3.8%
Property & Business Serv.	5	4.7%
Health & Community Serv.	2	1.9%
Cultural & Recreational Serv.	11	10.4%
Personal & Other Serv.	1	0.9%

Reflecting the general concentration of industry in Echuca the majority of firms interviewed were based there, with 24 businesses from Moama interviewed, reflecting the proportional share of population. Most of the businesses interviewed were located within or adjacent to the Central Corridor. This also reflects the general concentration of enterprises within the two towns.

3.2 Survey results

3.2.1 Employment and turnover

The total value of production reported by the respondents was $150 million. The total number of fulltime employees and owners in responding firms was 898 and part-timers totalled 352. This was then converted to an effective full time employee (EFTE) number of 994. Based on the average turnover by EFTE for firms providing information on turnover (excluding the large food processors) multiplying this figure by EFTE and adding back food processing turnover, the value of turnover/sales for interviewed firms was estimated at $217 million. Using the average turnover for effective fulltime employees for all industries and multiplying by the number of employed residents, the total turnover for the Echuca Moama economy was estimated to be approximately $910 million to $950 million per annum. The value of turnover in surveyed firms was approximately 24 per cent of annual turnover.

3.2.2 Length of operation and growth

The respondents had been operating their enterprises at their current site for an average of 11.5 years, this included 22 respondents who had been operating for only and average of 7.4 months. The average turnover growth for the past 2 years was 10.0 per cent when weighted by reported turnover and 8.0 per cent if weighted by EFTE. The expected average weighted growth for the next 2 years was 19.1 per cent by turnover and 15.0 per cent weighted by EFTE. This difference partially reflects the strong growth expected by the major food processors.

Most respondents cited the strength of the tourism industry (57.6 per cent) and the strong growth of the local economy (54.5 per cent) as the reason for the expected growth. The next most popular factor was the growth of the national economy. The results of this question are detailed in the Table 3.2, note respondents provided multiple answers to this question.

Table 3.2 Factors determining expected change in turnover

Factor	Share of responses
Growth of the national economy	38.4%
Growth of the Local Economy	54.5%
Growth of Local Tourism	57.6%
New Markets	24.2%
Loss of markets	16.2%
Change in traffic flows	17.2%
Advertising	27.3%
Other marketing efforts	12.1%

3.2.3 Customer details

While many respondents were unsure of where their customers came from, many respondents were able to exercise either clear judgements or provide information gleaned from sales or customer data. These responses have been weighed by both turnover and EFTE to obtain an estimate of the source of customers for local business. These results are detailed in Table 3.3. The highest proportion of customers was from Echuca followed by Melbourne and Moama when weighted by EFTE, however, if weighted by turnover the rest of NSW replaced Moama in the third spot.

Table 3.3 Source of customers for Echuca Moama businesses

Source	Weighted Average by EFTS nos	Weighted Average by turnover
Echuca	31.0%	20.9%
Moama	13.2%	9.2%
Region NSW	6.5%	7.8%
Region Vic	6.4%	7.9%
Melbourne	19.1%	22.8%
Rest of Vic	3.9%	3.7%
NSW	7.9%	20.8%
Other states	2.6%	4.1%
International	1.5%	3.2%

While some respondents attributed visitors residing in the area to passing trade the weighted average of turnover due to passing trade was either 13.5 per cent when weighted by EFTE or 4.5 per cent weighted by turnover. The EFTE weighted average is most likely a better estimate of the importance of this type of trade to the retail sector. For the Moama respondents who were drawn predominantly from the retail sector but included the golf and bowling clubs the value of passing trade was estimated at an EFTE weighted average of 7.4 per cent and a turnover weighted average of 5.5 per cent.

Respondents were asked to identify how they had developed the loyalty of their regular customers. The most important factor cited was word of mouth (69 per cent) and then the correct advertising (51 per cent), physical location (50 per cent) and quality of service (50 per cent). These results are detailed in Table 3.4.

Table 3.4 Factors maintaining regular customer loyalty

Factor	No of times cited	Share of total respondents
Established business relationships	35	37.2%
Advertising	48	51.1%
Word of mouth	65	69.1%
Head office	5	5.3%
Physical location	47	50.0%
Quality of service	47	50.0%
Other	7	7.4%
No response	12	12.8%

3.2.4 Impacts of the bridge options

The local impacts of the bridges were estimated by asking respondents to estimate the impact of a diversion option on their turnover and on their costs. These figures were then combined with the reported details on turnover where these had been provided. The local impacts would be more adverse in terms of turnover if construction was in the Eastern or Western Corridors.

Based purely on the impact on turnover of respondent enterprises, the local business impacts of the Eastern Corridor were estimated to be a fall in sales of around $1.8 million with costs falling by $1.5 million. Most of these cost savings are attributable to the food processing industry in the industrial area to the south east and are dependant upon the approval of the use of road trains, by licence, to the factory gate from New South Wales. (The introduction of cross border operation of road trains may not be approved, this issue is outside the scope of the current study). The $1.8 million fall in turnover represents only 1.2 per cent of total reported turnover.

The Western Corridor is likely to reduce turnover by Echuca Moama traders, falling by $0.97 million or 0.6 per cent of reported turnover. This lower impact partially reflects increase trade captured by retailers along the Murray Valley Highway north of Ogilvie Avenue in Echuca and the closer proximity of the road to the Rich River Golf Club. The Western Corridor would reduce costs of local businesses by approximately $2.1 million per annum.

The Central Corridor is seen as increasing likely turnover by $0.5 million and reducing costs by approximately $1.96 million. It is difficult to see why the Central corridor would increase sales to this extent as the traffic will be moved out of the central business areas of both Echuca and Moama. However the Echuca traders feel they can capture more passing trade from travellers along this route.

The total impact of each option on the Echuca Moama economy was estimated by extrapolating the industry responses on the basis of the total EFTE surveyed and total employed in the Echuca Moama area. On this basis the estimated impacts are; a loss in sales of approximately $7.7 million from the Eastern Corridor, the Western Corridor will generate fall in sales of $4.0 million and the Central Corridor may increase sales by up to $2.1 million. Each corridor is expected to lead to a fall in costs for local business thus offsetting the decline is turnover. The net effect on an economy wide basis are for a net loss of $1.2 million on the Eastern Corridor, a net improvement in trading position on the Western Corridor of $4.7 million and a net improvement from the Central Corridor of $10.3 million. The cost improvements are however predicated on the approval of the use of road trains from Moama to the food processing industries of Echuca, which is currently not approved and is not the subject of this study.

The impacts on turnover of respondent forms and for the Echuca Moama economies are detailed in Table 3.6.

Table 3.6 Financial impacts of the bridge options

Corridor	Impact on respondents			Impact on the Echuca Moama Economy		
	Turnover $ m	Costs $ m	Net impact $ m	Turnover $ m	Costs $ m	Net impact $ m
Eastern Corridor	-1.84	-1.55	-0.29	-7.68	-6.46	-1.22
Central Corridor	0.50	-1.97	2.47	2.09	-8.21	10.30
Western Corridor	-0.97	-2.09	1.12	-4.03	-8.76	4.73

3.2.5 Impact on Moama businesses

The simple extrapolation of results may not be valid as a high proportion of the expected negative impacts were due to the impacts expected by the Moama businesses. This group accounted for $1.4 million of the $1.8 million decline in respondent's turnover on the Eastern Corridor, to lose turnover worth $0.99 million compared to a total of only $0.96 million for the combined towns, if the Western Corridor was selected. Moama businesses also expected a slight loss of trade of $0.03 million if the Central Corridor was selected; yet the combined impact was reported as a gain of $0.50 million. This group also expected costs to increase if the Eastern Corridor was adopted and sales to fall slightly if the Central Corridor was adopted. Clearly, the different impacts make for a tale of two cities.

3.2.6 Rehabilitation of the old bridge

Respondents were asked to estimate the impact of potential temporary closure of the existing bridge following the completion of the new crossing. The question assumed a full closure, though respondents were assured that no decision on the nature of the closure had been made.

Moama traders were particularly concerned about this development, as they believe they would lose a large proportion of trade to Echuca, in the event of a hypothetical 6-month closure. After completion of the initial survey, it was announced that a full closure would not be implemented but that a 14-month closure with one lane operating under traffic lights would be undertaken to enable bridge refurbishments. A subsequent approach was made to all the Moama survey respondents to assess the likely impact of the partial bridge closure. The results of both these surveys are provided in Table 3.7.

Table 3.7 Impact full and partial bridge closures on turnover and costs of Moama based respondents

	Full closure for 6 months		Partial Closure for 14 months	
	Turnover $ m	Costs $ m	Turnover $ m	Costs $ m
During closure	-3.64	+2.11	4.73	-0.15
For following 12 months	-1.72	+0.32	1.23	0.00

The aggregate survey results suggest this would lead to a fall in sales of some $2.1 million. This partly reflects the strong perceived impact of a loss of sales to Echuca not being seen as a business opportunity by the Echuca traders. Nevertheless, there is still likely to be net loss of trade. Respondents were asked to consider the longer-term impact of the closure and it was estimated the fall in sales for the 12 months following the re-opening closure could be around

$1.3 million. The turnover falls would be accompanied by appropriate falls in costs though these were not provided with sufficient clarity.

3.2.7 Support for the new bridge

Most of the respondents clearly supported the construction of a new bridge. 92 respondents of the 106 supported the new bridge idea, while only 10 opposed the idea. Of the 24 Moama respondents 17 supported the construction of a new bridge, 4 opposed it and 3 were undecided. These results are detailed in Table 3.8.

Table 3.8 Support for the bridge options by location of business

	Echuca respondents	Moama respondents	Total
Support new bridge	75 (91.4%)	17 (70.8%)	92 (86.8%)
Do not support new bridge	6 (7.3%)	4 (16.7%)	10 (9.4%)
No Opinion	1 (1.2%)	3 (12.5%)	4 (3.8%)
Total	**82 (100.0%)**	**24 (100.0%)**	**106 (100.0%)**
Preferred Option			Total including shared responses
Favour Eastern Corridor	14 +(3)	1 +(3)	21
Favour Central Corridor	28	7+ (1)	36
Favour Western Corridor	29 +(3)	6 +(3+1)	42
No preference	8	6	14
Total respondents	79 + 3 = 82	20 + 4 =24	113

(Note numbers in brackets indicate a shared preference)

In terms of the location the most preferred location by respondents was the Western Corridor with 35 respondents citing this and 6 citing this option or the Eastern Corridor. 35 responses supported the Central Corridor with one supporting either this or the Eastern Corridor, only 15 responses called for the Eastern Corridor alone and 14 respondents were unable to cite a preference.

3.3 Tourism issues

The Port of Echuca and its associated paddlesteamers is a the key tourism attraction of the towns. The value of the paddlesteamers as an attraction could be significantly harmed by the construction of a design, which either hampers navigation or threatens the historic atmosphere of the paddlesteamer experience. Navigation issues are particularly important for the Western Corridor as the paddlesteamers require high flow clearance of approximately 9 metres. If this is not provided the viability of paddlesteamer trips may be threatened.

If the proposed rail developments flagged in both the Meeting of the Whistles report and the Port Development Strategy are implemented the integrity of this historic precinct could be further threatened by construction of the bridge in the Central Corridor as traffic flows and required road works may not be compatible with development of steam rail services and the requisite historic ambience.

The long-term development of the Echuca Moama economy depends upon the successful development of the tourism product. This success will in turn require sound infrastructure planning and town planning strategies from both Local and State Governments.

4. Conclusions and recommendations

The construction of a new bridge is overwhelmingly supported by the business and tourism industries of Echuca and Moama, with many survey respondents keen to see construction commence but sceptical about its likelihood given past history.

The economic impact evaluation would suggest the construction of the bridge within the Central Corridor would provide a boost to the sales and turnover. Nevertheless, a slight majority of respondents favoured construction of the new bridge within the Western corridor. This appeared to reflect a capacity of respondents to think about the bridges longer term impacts and perhaps to consider longer term strategic factors rather than direct economic interests when thinking about major road siting and infrastructure development.

The issue of a potential closure of the current bridge for refurbishment once the new bridge is completed was of particular concern to Moama business operators. All of these respondents were pleased with the announced intention to only partially close the bridge for this purpose. Despite their concern about a bridge closure being allayed, the aggregated impact of the partial bridge closure on Moama businesses is worse than a full closure. This is primarily due to the increased period of closure. It is likely that many Moama businesses have underestimated their capacity to retain the loyalty of their existing customers and the impacts of a bridge closure may be overestimated. It would be helpful of the construction authorities to work with these traders to develop business skills and strategies to improve their competitiveness.

The potential development and growth of the Port, the redevelopment of the Echuca rail locomotive shed and the possibility of integrating these facilities in the long term with a tourist rail service linking Maldon and Deniliquin, tends to favour the removal of the heavy transport traffic from the Central corridor. In addition, the construction of a new bridge within the Central Corridor may severely impact the visual attraction of the Port and the of visitors riding the paddlesteamers. As the tourism industry now is a key driver of local growth, long term infrastructure development in the area must not threaten the integrity of the historic precinct.

If the development mooted for the industrial estates to the South East of Echuca is realised and these industries are reliant on agricultural produce from Southern New South Wales, there is a strong local case for construction of the new bridge within the Eastern corridor. However, this will not ease the heavy vehicle pressure on Ogilvie Avenue. The construction of the Western option would remove through traffic from Echuca Moama and service the new estates being developed to the west, but heavy vehicles with produce for processing would continue to be routed along Ogilvie Avenue, this traffic could be highly significant in the March quarter of each year.

On the basis of the current study it is not possible to clearly favour either the Eastern or Western corridor for the construction of the new bridge. While the Central bridge option presents some difficulties for the development of the historic precinct this bridge is likely to be the most beneficial for the current business and tourism interests. This reflects the current use of the bridge which is dominated by local traffic.

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Appendix - Glossary of comments

Comments in relation to impact on turnover

Corridor	Impact	Reason
All	Nil impact	Customers are all business houses
All	Nil impact	Impact due to signage / ease of travel
All	Nil impact	Business doesn't rely on passing traffic
All	Nil impact	Customers won't change habits because of bridge
All	Nil impact	Existing market won't change because of bridge
All	Nil impact	Echuca is a destination - not a through town
All	Nil impact	Customers come specifically to Echuca - they are not through traffic
All	Nil impact	If customers want to come to Echuca, they will
All	Nil impact	Customers all live locally
All	Nil impact	Most customers are regulars, tourists come into the town anyway
All	Nil impact	Because office/ main trade elsewhere
All	Nil impact	Customers will come no matter which bridge they use
All	Nil impact	Not tourists that buy
All	Nil impact	People will come no matter what the bridge
All	Nil impact	Customers come for the service & will continue to come
All	Nil impact	No product comes from Melbourne. Clients are established - customers will come when they come to Echuca
All	Nil impact	Tourism will find us because we are an attraction
All	Nil impact	Customers will have a look around if they want but bridge wont have great effect
All	Nil impact	If people are coming to Echuca it will make no real difference - only passing trade may be missed but this is not very significant
All	Nil impact	People come to Echuca anyway
All	Nil impact	Bridges won't bring more customers. More comfortable for tourists if a new route/ traffic restrictions
All	Nil impact	Echuca is a destination not reliant on passing trade
All	Nil impact	No impact solely because of bridge location
All	Nil impact	Customers come regardless of bridge
Central	Decrease	Noise and visual impact
Central	Decrease	Would take trade just off the road
Central	Increase	Increased visibility and some passing trade
Central	Increase	Passing traffic brings customers along central route
Central	Increase	Passing trade would increase if kept in centre
Central	Increase	Flow through traffic
Central	Decrease	Navigation costs could increase dramatically
Central	Decrease	Traffic congestion would increase
East	Decrease	Competition at this location
East	Increase	Increased visibility of location. Council ay improve the road
East central	Decrease	Passing trade impacts
East West	Decrease	Less traffic
East West	Decrease	Flow decrease
East West	Decrease	Less traffic flow
East West	Decrease	Traffic flow
East West	Decrease	Less traffic
East West	Decrease	Less people
East West	Decrease	Loss of flow traffic
East West	Decrease	Less traffic
East West	Decrease	Less traffic
East West	Decrease	Traffic flow reduced
East West	Decrease	Less customers
East West	Decrease	Half of the growth is expected growth in customers is expected from NSW

			in Moama
East	West	Decrease	Town bypassed - customers from NSW will go elsewhere (eg. Bendigo or Shepparton)
East	West	Decrease	Bypassed towns don't succeed, wouldn't get passing traffic, easy for customers to go elsewhere
East	West	Decrease	Loss of customers
East	West	Decrease	Changes in passing traffic and exposure, if eastern route
East	West	Decrease	There is some passing traffic that might lose customers if E & W bridge is built.
East	West	Decrease	Flow though
East	West	Decrease	Road goes past shop - would lose customers
East	West	Decrease	Loss of passing trade
East	West	Decrease	Loss of passing trade
East	West	Decrease	Loss passing trade
East	West	Decrease	Lose passing trade
East	West	Decrease	Town bypassed
East	West	Decrease	Loss of passing trade
East	West	Decrease	Loss of passing trade
East	West	Decrease	Lose local trade if they don't use roundabout
East	West	Decrease	People likely to forget about Moama
West		Increase	Increased Passing trade
West		Increase	Passing traffic
West		Increase	Increased visibility for passing trade

Comments specifically in relation to impact on costs

Corridor	Impact	Reason
All	Decrease	Only if able to use road trains
West	Decrease	More direct to Mellbourne
East	Decrease	Travel time savings
E W	Increase	Cost of developing access roads

Social Impacts

- **Social Impact Study of Second Murray River Crossing at Echuca-Moama, Stage 1 Report,** *Woodward-Clyde, 4 February 2000*
- **Social Impact Study of Second Murray River Crossing at Echuca-Moama, Stage 2 Report,** *Woodward-Clyde Pty Ltd, July 2000*

REPORT

SOCIAL IMPACT STUDY OF SECOND MURRAY RIVER CROSSING AT ECHUCA-MOAMA
STAGE 1 REPORT

Prepared for
VicRoads

4 February 2000

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Executive Summary

AGC Woodward-Clyde was appointed by VicRoads in September 1999 to undertake an evaluation of the potential social impacts and effects of a new crossing of the Murray River between Echuca and Moama.

Several other studies are being carried out concurrently in the areas of cultural heritage, business and tourism, traffic, noise, and flora and fauna.

The project is a joint initiative of VicRoads and the Roads and Traffic Authority (RTA), with VicRoads as project manager.

• *Background*

The existing steel bridge linking Echuca and Moama was built as a rail bridge in 1873 and converted for dual road and rail use soon afterwards in 1879. In 1988 a separate rail bridge was constructed, and the steel bridge rehabilitated for road traffic only. It is the only crossing of the Murray in the region, with the closest bridge being upstream at Barmah which is a round trip of 67km.

With road traffic levels increasing, a second crossing of the Murray River is required to cater for the longer term traffic needs of the local community and the region as a whole.

Three corridors have been selected by Government and representatives of the local community as possible locations for the second river crossing. They are:

- a western (downstream) crossing in the vicinity of Wharparilla Drive, Echuca and Merool Road, Moama;
- a central crossing adjacent to or in the vicinity of the existing bridge involving an upgrade of Sturt Street, Echuca and bypassing to the south of Meninya Street, Moama; and
- an eastern (upstream) crossing in the vicinity of Mary Ann Road, Echuca and Old Deniliquin Road, Moama.

• *Objectives of Social Impact Assessment (SIA)*

The key purpose, as outlined in the project brief, was to: *provide an evaluation of the social impact of the three corridors and a detailed assessment of up to six route alignments for the second Murray River Crossing in the Echuca-Moama Planning Study.*

• *Method*

In order to prepare the social impact assessment, activities have been undertaken in two stages.

Stage one of the study has involved an assessment of each of the three corridors – western, central and eastern - and the likely social impacts and effects that could eventuate.

Stage two will be the analysis of the individual route alignments.

A social profile of the study area has been prepared which describes the existing social environment. The issues facing the communities of Echuca-Moama have been examined. Based on this information and that from previous studies, the potential social impacts and the effects of each of the three corridors have been identified.

- ***Social Profile***

A social profile of the area has been developed based on:

- analysis of the demographic characteristics of the Study area;
- identification of the existing recreational, cultural and tourism opportunities;
- description of the employment patterns of the resident labour-force;
- existing studies;
- identification of community networks and social linkages via face-to-face and telephone discussions with a sample of local community groups, recreational facilities, emergency services and residents:
- discussions with representatives – principals, teachers, etc – of preschools and kindergartens, primary schools, secondary schools and tertiary institutions;

  Information was sought on enrolments, projected enrolments, residential origin of students, modes of transportation to and from school, traffic concerns, potential positive and negative impacts of the western, central and/or eastern corridor, and preferred corridor option.
- discussions with officers of the Shire of Campaspe and the Shire of Murray with regard to recreation, community services, older persons and people with disabilities.

  Information was sought on local community issues, including access and the usage of facilities and services across the municipalities, the traffic concerns of older people and people with disabilities, and the future direction of the Shires in terms of residential growth and service provision.
- discussions with representatives of:

  – Church of Christ, Echuca;
  – Echuca Hospital;
  – Echuca High School Bus Coordinator;
  – Moama Bowling Club;
  – Moama Sports Club;
  – Moama Recreation Reserve;
  – RSL & Citizens Club; and
  – Port of Echuca.

  Information was sought on the use of facilities and services and the perceived advantages and disadvantages of each of the corridor options to the various user groups

- Information was sought on the views of traders and the profile of shoppers via:

– discussions with representatives of Echuca and Moama businesses and members of the Business and Traders Association;

– discussions with representatives of Misty Gum Cottages, Port of Echuca Motel, Madison Spa Motel, Sundowner Motel, Merool Riverside Holiday Park, Shady River Holiday Park, Moama Riverside Holiday Park, Brimbank Holiday park, nursery on Meninya Street Moama, Chanters Winery and business in Sturt Street.

– interviews with 106 business and tourist enterprises carried out by Saturn Corporate Resources Pty Ltd in undertaking the Business and Tourism Assessment component of the Second River Crossing study.

- ***Community Values and Attitudes***

Community values and attitudes have been elicited via face-to-face interviews with residents living within the three corridors and environs, members of the Community Consultative Committee and a number of group discussions.

The underlying aim of this research was to understand the logic behind different individuals' thoughts and attitudes which may underpin behaviour and which may underline the perceptions of the positive and negative features of living in Echuca-Moama and the proposed river crossing. The aim of the interviews was not to reach numerically based measurements of opinion from a representative sample of households living within each corridor and beyond. The aim was more to find out how dominant the thoughts and attitudes among different community members appear to be.

(Administering a survey to a statistically reliable sample of households across Echuca-Moama was beyond the scope of this exercise).

Face-to-face interviews (44) were undertaken with residents representing:

- 19 households in the Western Corridor and environs;
- 20 households in the Central Corridor and environs; and
- five households in the Eastern Corridor and environs;

A number of less structured discussions (6) and group discussions with residents were also conducted to explore community issues and views on the Proposal:

- group one comprised 17 residents (10 households) of Maiden Smith Drive, Moama;
- group two comprised five residents (four households) of Hume and Hovell Streets, Echuca; and
- group three comprised five residents (three households) in Wharparilla Drive, Echuca.

An unsuccessful attempt was made to form a focus group of Moama residents.

- ***Analysis and Preparation of Report***

The findings from all of the above tasks have been analysed and discussed in the body of this report under the following headings:

- Study Area;
- Demographic Characteristics;
- Social Patterns and Linkages;
- Community Attitudes and Values;
- Community Attitudes to the Proposed Second Murray River Crossing; and

- Preliminary Social Impact Analysis.

- ***Summary of Stage One Findings***

Community Opinion

The majority of all residents, community groups, service providers, traders and business associations interviewed believe that a second crossing of the Murray River is required. Those few who do not believe that a second crossing is warranted believe that the capacity of the existing bridge needs to be improved.

In terms of where this second river crossing should be located, a variety of views were expressed.

Residents

- 19 of the 44 households interviewed in face-to-face interviews gave the proposed Western Corridor as their preferred option. The proposed Eastern Corridor is preferred next, followed by the Central Corridor option.
- Of the 17 residents (10 households) interviewed in the Maiden Smith Drive group discussion, the majority preferred the proposed Eastern Corridor Option, followed by a preference for a Western Corridor that is located further west of the existing corridor.
- The five residents (four households) involved in the Hume and Hovell Street group discussion prefer the proposed Western Corridor Option as it is the straightest run and would be better for trucks.

Community Groups and Service Providers

- Community groups and service providers generally desire a route that bypasses the centres of town. Whilst many of the representatives could not provide an official statement as to the overall preferred option of the organisation they represent, they tended to lean in favour of the proposed Western Corridor Option.

Traders and Business Operators

- While the Echuca and Moama Business and Traders Association generally supported the proposed Western Corridor Option, there is some dissension from this view. Some traders are concerned that traffic is not diverted away from their premises, and thus some favoured the proposed Central Corridor Option.
- The survey of businesses conducted by Saturn Corporate Resources substantiated these views with 35 businesses supporting the Western Corridor option and an additional six supporting either the Western or Eastern Corridor option. The next most popular option was the Central Corridor Option with 35 businesses in favour of this option. Only 15 businesses preferred the Eastern Corridor option and 14 did not have a preference.

Overall

Overall, there is general agreement that it is important that heavy vehicles and passing traffic be taken out of the centres of Echuca and Moama. Either the proposed Western Corridor or the proposed Eastern Corridor option would satisfy this criterion. On the other hand a number of businesses, particularly those located in the environs of Meninya Street, feel that this traffic is essential to keep the businesses of Meninya Street viable.

In terms of taking into consideration other criteria, for example:

- the growing population of Echuca and Moama with areas developing to the west of both towns; and
- alleviating the general heavy vehicle traffic flow between the Northern Highway and the Cobb Highway,

the overall consensus was that it would 'make sense' to locate the river crossing within the Western Corridor even though some of the residents of Wharparilla Drive, and all residents interviewed along Merool Lane and Maiden Smith Drive would disagree with this view. They also believed that this option would have considerable impact on the environmental values of this area.

Preliminary Analysis of Social Impacts

Number of People Affected

The Central Corridor option would affect the most people, that is, more households would be subjected directly to changed conditions in their living environment.

Social Patterns and Linkages

Positive Effects:

The proposed Western Corridor Option would facilitate social interaction patterns and linkages for many of the existing residents and those who live in the areas zoned as future residential, particularly if Warren Street is upgraded.

Negative Effects:

Social interaction patterns and linkages in some of the existing residential areas, particularly in the vicinity of Sturt Street and Echuca east, may not be facilitated and the Moama Town Centre could be dislocated with the Central Corridor Option.

Impact on Existing Access and Safety

Positive Effects:

The proposed Western Corridor Option and to a lesser extent the Eastern and Central Corridor Options could alleviate some of the access issues.

Negative Effects:

The proposed Eastern Corridor option could exacerbate some of the access issues.

Impact on General Amenity

Positive Effects:

This will depend on any ameliorative measures that are put in place to address the negative effects.

Negative Effects:

In terms of the impact on general amenity and any change in the physical conditions that affect the general quality of the residential environment, all corridor options have potential negative impacts. However, the Western Corridor Option is the most affected, followed by the Eastern and Central Corridor Options.

AGC Woodward-Clyde was appointed by VicRoads in September 1999 to undertake an evaluation of the potential social impacts and effects of a new crossing of the Murray River between Echuca and Moama.

Several other studies are being carried out concurrently in a number of areas including cultural heritage, business and tourism, traffic, noise, and flora and fauna.

The project is a joint initiative of VicRoads and the N.S.W. Roads and Traffic Authority (RTA), with VicRoads as project manager.

1.1 BACKGROUND

The existing steel bridge linking Echuca and Moama was built as a rail bridge in 1873 and converted for dual road and rail use soon afterwards in 1879. In 1988 a separate rail bridge was constructed, and the steel bridge rehabilitated for road traffic only. It is the only crossing of the Murray River in the region, with the closest bridge being upstream at Barmah which is a round trip of 67km.

With road traffic levels increasing, a second crossing of the Murray River is required to cater for the longer term traffic needs of the local community and the region as a whole.

Three corridors have been selected by Government and representatives of the local community as possible locations for the second river crossing. They are:

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- an eastern (upstream) crossing in the vicinity of Mary Ann Road, Echuca and Old Deniliquin Road, Moama.

Figure 1 depicts these corridors and more detail is provided in Section 2.1.

1.2 OBJECTIVES OF SOCIAL IMPACT ASSESSMENT (SIA)

The key purpose, as outlined in the project brief, was to: *provide an evaluation of the social impact of the three corridors and a detailed assessment of up to six route alignments for the second Murray River Crossing in the Echuca-Moama Planning Study.*

1.3 METHOD

In order to prepare the social impact assessment, activities have been undertaken in two stages.

Stage one has been a study of the three corridors and **Stage two** will be the analysis of the individual route alignments.

The methodology undertaken to carry out Stage one, the subject of this report, is detailed below.

- ***Stage 1 – Study of the three corridors***

Stage one of the study has involved an assessment of each of the three corridors – western, central and eastern - and the likely social impacts and effects that could eventuate.

A social profile of the study area has been prepared which describes the existing social environment. The issues facing the communities of Echuca-Moama have been examined. Based on this information and that from previous studies, the potential social impacts and the effects of each of the three corridors have been identified.

1.3.1 Social Profile

A social profile of the area has been developed based on:

- analysis of the demographic characteristics of the Study area using Australian Bureau of Statistics (ABS) Census data (refer Appendix 1: Tables – Demographic Characteristics);
- identification of the existing recreational, cultural and tourism opportunities;
- description of the employment patterns of the resident labour-force;
- existing studies including:
  - Shire of Campaspe:
    - *Integrated Strategy Plan, 1996;*
    - *Planning Scheme Amendment C3 Echuca West Development Report, 1999;*
    - *Community Groups and Organisations Directory; and*
    - *Local Planning Policy Framework.*
  - Shire of Murray:
    - *Cultural Plan 1999 – 2001;*
    - *Council Annual Report 1998/1999;*
    - *A Socio-Economic Profile of the Shire of Murray;*
    - *Social and Community Plan 1999 – 2004; and*
    - *Community Services Directory, 1999.*
  - studies from the previous EES process;
  - VicRoads commissioned a number of studies to be undertaken concurrently with this social impact assessment, including:
    - Saturn Corporate Services, *Murray River Crossing at Echuca/Moama Business and Tourism Study – Final Report*, December 1999.
    - Marshall Day Associates, *Murray River Crossing at Echuca/Moama Ambient Noise Survey*, December 1999.
    - Biosis Research, *Stage One Overview Report – Flora and Fauna Assessment of proposed Second Murray River Crossing at Echuca/Moama Victoria and New South Wales*, December 1999.
    - Austral Heritage Consultants, *Murray River Crossing at Echuca/Moama Planning Study, Background report*, January 2000.
    - Phillip Liston and Associates, *Murray River Crossing at Echuca/Moama Planning Study Landscape Assessment*, December 1999.

- other published studies including the *Echuca-Moama Accommodation Visitor Survey (March – April 1999).*

- identification of community networks and social linkages via face-to-face and telephone discussions with a sample of local community groups, recreational facilities, emergency services and residents:
  - discussions were held with representatives – principals, teachers, etc – of the following schools:
    - Bendigo College of TAFE;
    - Echuca Secondary College;
    - Echuca High School;
    - Rich River Christian College;
    - Moama Primary School;
    - Echuca West Primary School;
    - Echuca East Primary School;
    - St Mary's Primary School;
    - Moama Pre School;
    - Echuca Central Kindergarten;
    - Echuca East Pre School; and
    - Echuca South Pre School.

    Information was sought on enrolments, projected enrolments, residential origin of students, modes of transportation to and from school, traffic concerns, potential positive and negative impacts of the western, central and/or eastern corridor, and preferred corridor option.

  - discussions were held with officers of the Shire of Campaspe and the Shire of Murray with regard to:
    - recreation;
    - community services;
    - older persons; and
    - persons with disabilities.

    Information was sought on local community issues, including access and the usage of facilities and services across the municipalities, the traffic concerns of older people and people with disabilities, and the future direction of the Shires in terms of residential growth and service provision.

  - discussions were held with representatives of:
    - Church of Christ, Echuca;
    - Echuca Hospital;
    - Echuca High School Bus Coordinator;

- Moama Bowling Club;
- Moama Sports Club;
- Moama Recreation Reserve;
- RSL & Citizens Club; and
- Port of Echuca.

Information was sought on the use of facilities and services and the perceived advantages and disadvantages of each of the corridor options to the various user groups.

- Information was sought on the views of traders and the profile of shoppers via:
- discussions with representatives of Echuca and Moama businesses and members of the Business and Traders Association;
- discussions with representatives of Misty Gum Cottages, Port of Echuca Motel, Madison Spa Motel, Sundowner Motel, Merool Riverside Holiday Park, Shady River Holiday Park, Moama Riverside Holiday Park, Brimbank Holiday park, nursery on Meninya Street Moama, Chanters Winery and business in Sturt Street.
- interviews with 106 business and tourist enterprises carried out by Saturn Corporate Resources Pty Ltd in undertaking the Economic Impact Assessment component of the Second River Crossing study.

Information on all community services was mapped (refer Figure 1).

1.3.2 Community Values and Attitudes

Apart from the above discussions, community values and attitudes have been elicited via face-to-face interviews with residents living within the three corridors and environs, members of the Community Consultative Committee and a number of group discussions.

The underlying aim of this research was to understand the logic behind different individuals' thoughts and attitudes which may underpin behaviour and which may underline the perceptions of the positive and negative features of living in Echuca-Moama and the proposed river crossing. The aim of the interviews was not to reach numerically based measurements of opinion from a representative sample of households living within each corridor and beyond. The aim was more to find out how dominant the thoughts and attitudes among different community members appear to be.

(Administering a survey to a statistically reliable sample of households across Echuca-Moama was beyond the scope of this exercise).

Face-to-face interviews were undertaken with residents representing:

- 19 households in the Western Corridor and Environs, including:
  - 16 households in Wharparilla Drive, Echuca;
  - two households in Merool Lane, Moama; and
  - one household in Layfield Downs Estate, Moama.
- 20 households in the Central Corridor and Environs, including:
  - 13 households in Sturt Street, Echuca and environs;

- three permanent caravan park residents, Moama;
- one household in Porter Street, Moama;
- one household in McLaren Street, Moama;
- one household in Boundary Road, Moama; and
- one household in Berry Street, Moama.

- Five households in the Eastern Corridor and Environs, including:
  - one household/farm on Old Deniliquin Road; and
  - four households on Ogilvie Avenue/Murray Valley Highway.

During the face-to-face interviews (44) residents were questioned on:

- length of residence;
- reasons for living in the area;
- likes and dislikes of the Echuca-Moama area and street in particular;
- areas of special interest or attraction in the area;
- travel patterns;
- frequency of crossing the existing bridge;
- awareness and understanding of the proposal;
- need for a second river crossing;
- local community reactions to the proposal;
- standard and suitability of the existing bridge;
- positive and negative consequences of the proposed river crossing should it be constructed in the western, central or eastern corridor;
- the most important considerations in deciding where to place the new crossing; and
- the preferred option.

The results were processed in tabular form (refer Appendix 2: Summary Tables of Community Attitudes)

A number of telephone or less structured discussions (6) and group discussions with residents were also conducted to explore the above questions, community issues and the Proposal:

- group one comprised 17 residents (10 households) of Maiden Smith Drive, Moama;
- group two comprised five residents (four households) of Hume and Hovell Streets, Echuca; and
- group three comprised five residents (three households) in Wharparilla Drive, Echuca.

An unsuccessful attempt was made to form a focus group of Moama residents.

The table below and Figure 2 highlight for each corridor and environs:

- actual number of households or dwellings;
- total number of households contacted via telephone or doorknocking to seek interview but not attained because household 'out', did not want to participate etc.; and
- total number of households interviewed (67) including, face-to-face interviews, telephone and/or less structured discussions or by group discussion.

	Total No. households	Total No. households contacted (interview not attained)	No. effective interviews held with households
WESTERN CORRIDOR			
Wharparilla Dve	61	49	16 face-to-face 1 by telephone 3 (group discussion)
Merool Lane	5	4	2 face-to-face 1 general discussion
Maiden Smith Drive	22	22	10 households (17 residents) via group discussion 1 by telephone
Layfield Downs Estate	25	3	1 face to face 2 general discussion
CENTRAL CORRIDOR			
Sturt Street	51	37	11 face-to-face
Hume Street	64	1	1 face-to-face 2 group discussion
Boundary Road	3	3	1 face-to-face
Berry Street	6	3	1 face-to-face 1 general discussion
Other	5	5	3 face-to-face
Moama Caravan Park permanent residents	4	3	3 face-to-face
EASTERN CORRIDOR			
Old Deniliquin Road /Edward Street	4	2	1 face-to-face 1 general discussion
Mitchell Road/Murray Valley Highway	6	6	4 face-to-face

Note: the shaded areas highlight the streets that are within the actual corridors. Other streets are those in the immediate environs of corridor boundaries.

Administering a survey to a statistically reliable sample of households across Echuca-Moama was beyond the scope of this exercise. Notwithstanding, the 67 households interviewed do provide an indication of how dominant the thoughts and attitudes of the community members appear to be.

Interview locations are provided in Figure 2.

1.3.3 Analysis and Preparation of Report

The findings from all of the above tasks have been analysed and discussed in the subsequent chapters of this report under the following headings:

- Study Area;
- Demographic Characteristics;
- Social Patterns and Linkages;
- Community Attitudes and Values;
- Community Attitudes to the Proposed Second Murray River Crossing; and
- Preliminary Social Impact Analysis.

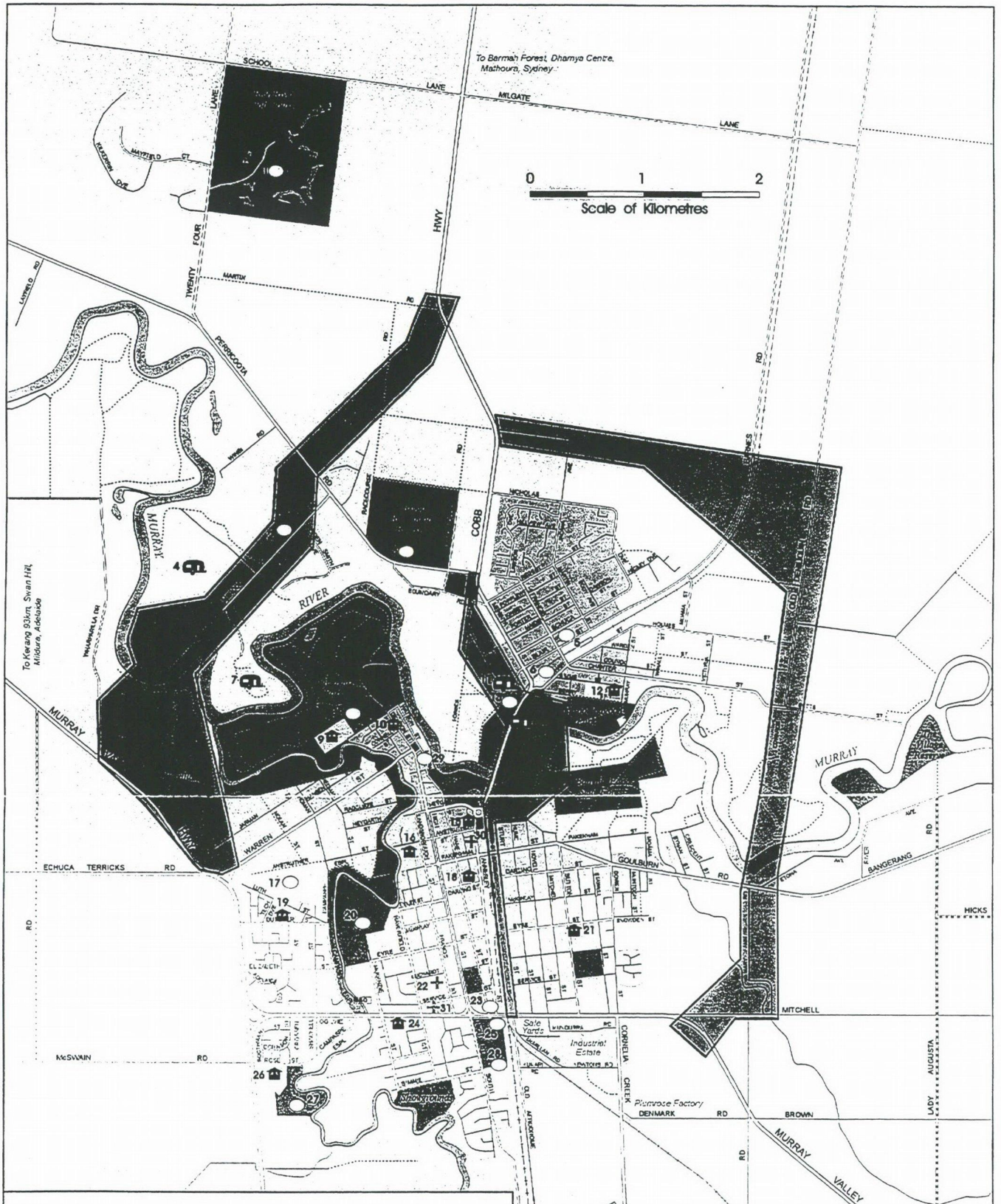
1.3.4 Acknowledgments

Woodward-Clyde would like to acknowledge the assistance and valuable input of local residents, community groups, traders, and business operators in the preparation of this report.

Figures 1 and 2

- Study Area and Key Community Facilities

- Indicative Interview Locations



HEALTH FACILITIES
- 22 Hospital
- 30 Nish Street Medical Practice
- 31 Ogilvie Avenue Medical Practice

EDUCATION FACILITIES
- 9 Echuca High School
- 10 RC College
- 12 Moama Primary School
- 15 St Mary's Primary School
- 16 Echuca Primary School
- 18 Campaspe College
- 19 Echuca Secondary College
- 21 Echuca East Primary School
- 24 Echuca South Primary School
- 26 Rich River Christian College

RECREATION AND LEISURE FACILITIES
- 1 Rich River Golf Club
- 2 RSL Club
- 3 Sportsman's Club
- 5 Moama Swimming Pool
- 6 Moama Bowling Club
- 8 Oval and Tennis Facilities
- 13 Skate Park / Playground
- 17 Sporting Complex
- 20 Echuca Golf Course
- 23 Echuca Swimming Pool
- 25 Echuca Bowling Club
- 27 Rotary Park
- 28 Tennis Netball Facilities
- 29 Port of Echuca

ACCOMMODATION
- 4 Shady Park Holiday Park
- 7 Merool Riverside Holiday Park
- 11 Riverbank Holiday Park
- 14 Moama Riverside Holiday Park

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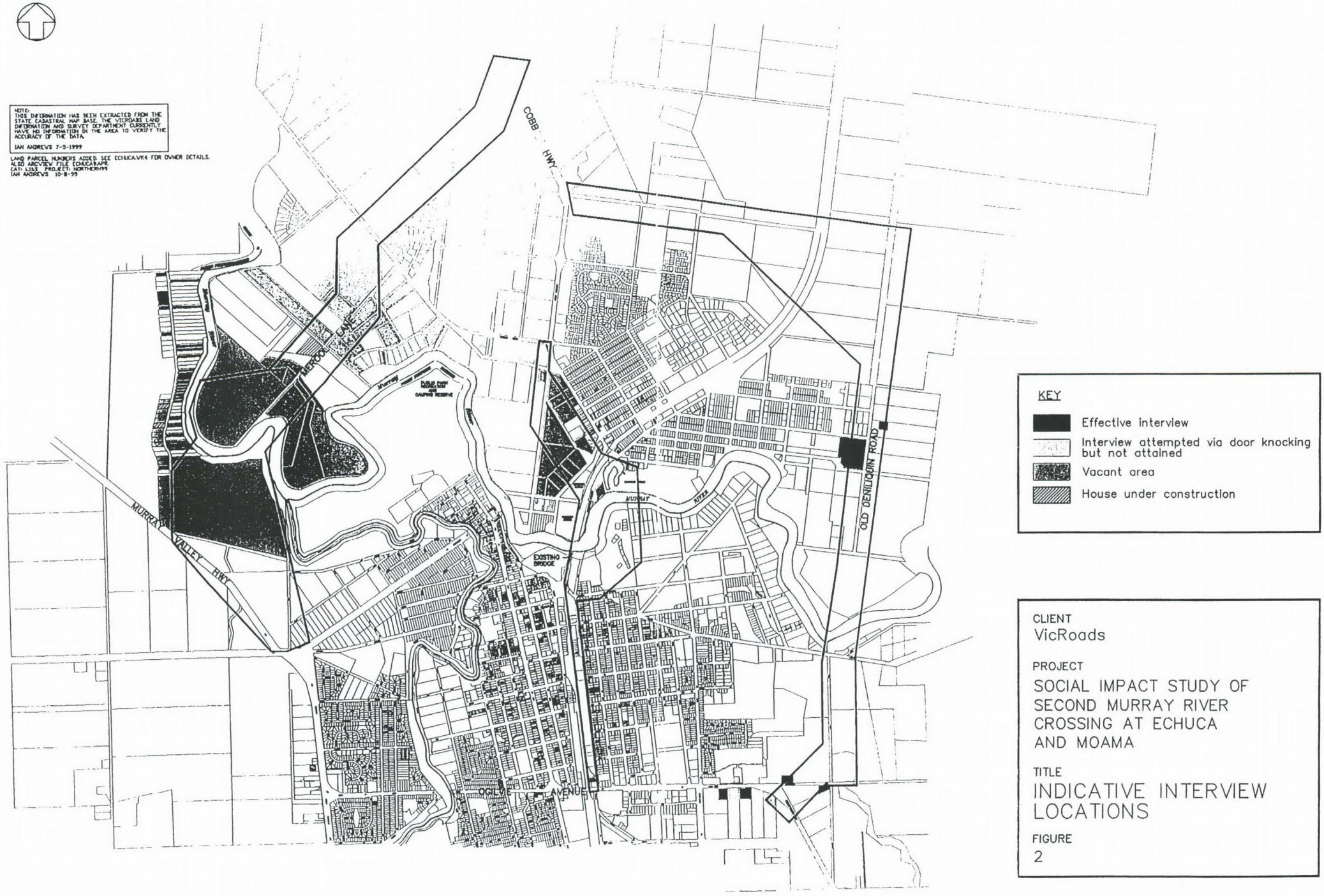
CLIENT
VicRoads

PROJECT
SOCIAL IMPACT STUDY OF SECOND MURRAY RIVER CROSSING AT ECHUCA AND MOAMA

TITLE
KEY COMMUNITY FACILITIES

FIGURE
1


NOTE:
THIS INFORMATION HAS BEEN EXTRACTED FROM THE STATE CADASTRAL MAP BASE. THE VICROADS LAND INFORMATION AND SURVEY DEPARTMENT CURRENTLY HAVE NO INFORMATION IN THE AREA TO VERIFY THE ACCURACY OF THE DATA.
IAN ANDREWS 7-5-1999
LAND PARCEL NUMBERS ADDED. SEE ECHUCA.VK4 FOR OWNER DETAILS.
MGD5 ARCVIEW FILE ECHUCA.APR
CAT: LIAS PROJECT: NORTHERN99
IAN ANDREWS 10-8-99
COBB HWY
MEROOL GATE
MURRAY VALLEY HWY
EXISTING BRIDGE
OGILVIE AVENUE
OLD DENILIQUIN ROAD
MURRAY RIVER
KEY
Effective interview
Interview attempted via door knocking but not attained
Vacant area
House under construction
CLIENT
VicRoads
PROJECT
SOCIAL IMPACT STUDY OF SECOND MURRAY RIVER CROSSING AT ECHUCA AND MOAMA
TITLE
INDICATIVE INTERVIEW LOCATIONS
FIGURE
2
Woodward Clyde

2.1 GEOGRAPHIC DESCRIPTION

2.1.1 Study Area

Echuca in the Campaspe Shire of Victoria, and Moama in the Murray Shire of NSW are found on opposite sides of the Murray River. Functionally Echuca and Moama operate as twin towns (Echuca-Moama) and they are located on the closest point of the Murray River to Melbourne.

The Shire of Campaspe is located in north central Victoria, 205km directly north of Melbourne. Its northern border is the Murray River. Campaspe Shire is 4,529km^2 in size and Echuca is the largest settlement. Other settlements in the Shire include Kyabram, Rochester, Tongala, Rushworth, Stanhope, Lockington, Gunbower and Girgarre.

The Murray Shire is located in the southern Riverina of NSW, 800kms from Sydney and 205kms from Melbourne. Murray Shire is 4,328km^2 in size. Moama is the largest settlement within the Shire. Other settlements include Mathoura, Bunnaloo and Womboota. The main service towns for Moama are Echuca, Deniliquin 75kms to the north, Shepparton 75kms south east and Bendigo 90kms to the south west. Victoria directly influences the Murray Shire due to its proximity to Echuca-Moama.

2.1.2 Western Corridor

The Western Corridor would involve a western bypass of the centre of Echuca-Moama, joining the Murray Valley Highway in Victoria with the Cobb Highway in NSW.

The populations of both Echuca and Moama are currently expanding, and as such residential development is required. Most of this development is taking place to the west of the traditional townships of Echuca and Moama, as expansion in other directions is largely inhibited by the prevalence of flood prone land. Wharparilla Drive and Merool Lane are new residential areas with most houses having been constructed within the last eight years. The proposed western corridor is situated near much of this existing and planned residential development.

In NSW, new housing estates are currently under construction and more are planned to the west of Merool Lane and along Pericoota Road. This area is zoned for *future residential development.* Existing residential properties that are located within the actual corridor are all at least one to two acres in size. The RSL & Citizens Club, a winery and two caravan parks also own land within the corridor. Land to the north of Pericoota Road in the environs of the corridor is currently broad acre farming land, with some viticulture, much of which is zoned for *future residential development.* The area adjacent to where the corridor joins Cobb Highway is zoned for future industrial development.

On the Victorian side of the border, the 1000 hectares of land west of the Murray Valley Highway is zoned for *future residential* land as part of the *Echuca West Strategic Plan.* Under this plan, 160 hectares of the land closest to the Murray Valley Highway will be developed first as Stage one. 1.5 hectares of this 160 hectares is zoned for a local neighbourhood shopping centre, 3.4 acres for a primary school and general open space, and 3.3 hectares is zoned for highway business commercial uses along the highway. Access to this area will be provided at four points. These points will be at the Echuca-Serpentine Road, the Murray Valley Highway opposite Butcher Street, and at two points on McSwains Road which in turn provides access to

the existing roundabout at the intersection of the Northern and Murray Valley Highways. The Strategic Plan indicated that "Stage 1 will provide around 1200 lots which represent(s) 15 years supply for the Echuca area based on estimated growth rates. In combination with the existing in-fill development, Stage 1 is estimated to provide for 25 years of residential development."

There is also bushland on both sides of the actual river, the majority of which is privately owned, with the exception of the Wharparilla Flora Reserve (refer Biosis Research Report).

2.1.3 Central Corridor

The Central Corridor would involve the re-routing of the highway through Echuca, and then behind Meninya Street, joining the Murray Valley Highway with the Cobb Highway close to the township of Moama.

This corridor runs through an established residential and light industrial and transport area of Echuca in Victoria, with Sturt Street located parallel to the railway line. Light industry along Sturt Street includes the Rice Mill. The land immediately south of the river is flood prone bush land.

In NSW, the area south of Meninya Street (with the exception of Boundary Road) is flood prone and as such is not zoned for any residential, business or industrial development, although an eco-tourism development that is sympathetic to the flood regime has been proposed for the area. This is currently bushland with multiple access tracks leading to various Moama beaches on the Murray River. In this area, the corridor backs onto a caravan park and two motels; and encompasses children's playground and skate ramp. The land to the north of the river, east of the existing bridge, is predominantly a recreation reserve. Horseshoe Lagoon is located here, and a series of boardwalks have been constructed through the area (refer Biosis Research Report). The Moama Jetty and a caravan park are located within the corridor on this side of the existing bridge.

2.1.4 Eastern Corridor

The Eastern Corridor would involve an eastern bypass of the centre of Echuca joining the Murray Valley Highway in Victoria with the Cobb Highway in NSW.

This corridor contains predominantly broad acre farming land on both sides of the river that is largely flood prone. A levee bank has been proposed by the Shire of Murray that would be located closer to the township of Moama than the corridor. No residential or industrial development is zoned for this area, although there are viticulture ventures. A number of residences are situated where the corridor joins the Murray Valley Highway, and there are a number of farm residences within the corridor or environs.

A strip of bushland exists on the NSW side of the river and there is a public boat ramp on the Victorian side.

2.2 HISTORICAL CONTEXT

As described in Coulson 1995, both Echuca and Moama originated in their present locations because the banks of the Murray River sloped gently down to the water and provided suitable crossing places for stock. Settlements grew around these locations. The areas' early reputation

as a crossing place was further advanced when two men, James Maiden (in 1845) and Henry Hopwood (in 1853) each put in a punt. Hopwood also built a pontoon bridge across the Murray River and in 1857 placed a bridge across the Campaspe River thus giving him a monopoly over the river crossings in the area. During the 1850s, Echuca became a main hub in the supply of goods to the Victorian goldfields and by 1864 had become linked to Melbourne by railway (refer to Austral Heritage Consultants Report).

Echuca's river trade flourished in the 1870s and early 1880s. For more than a generation, until the train took over, Echuca, as a Victorian port, ranked second only to Melbourne in the volume of merchandise handled on its wharves. Moama, being located so far from Sydney amongst other reasons, could not keep pace with Echuca.

In 1873 the existing Iron Bridge was opened as a rail crossing and in 1879 it was converted to cater for both road and rail traffic between Echuca and Moama. In 1988 a separate rail bridge was constructed, and the steel bridge rehabilitated for road traffic only. Apart from being the oldest bridge over the Murray, it is the only crossing of the Murray in the region, with the closest bridge being upstream at Barmah that is a round trip of 67 kilometres.

It is also notable that the current bridge has a heritage classification railway (refer to Austral Heritage Consultants Report). This emphasises the importance of the bridge as part of the historic Port of Echuca, an important tourist destination for paddlesteamer rides and other port related activities. The attraction of the Port is dependent on these activities and the maintenance of the historic precinct that includes the bridge.

In more recent times, Moama flourished as a result of Victorian gaming laws forbidding casinos and poker machines in Victoria. As the closest NSW town to Melbourne, Moama was a "pokie" destination. Since the Victorian gaming laws changed in 1994, the number of visitors to Moama for the express purpose of gambling has declined. Notwithstanding, Echuca-Moama as a tourist destination is becoming even more popular.

2.3 SOCIAL IMPLICATIONS

- The proposed Western Corridor Option is situated within and in proximity to the existing and proposed residential growth areas within Echuca and Moama. The RSL & Citizens Club, winery and two caravan parks also own land within the corridor.
- The proposed Central Corridor Option is situated within an established residential area. It also backs onto two caravan parks and two motels; and encompasses a children's playground and skate ramp and is adjacent to part of the Echuca-Moama historic precinct, including the Port of Echuca.
- The proposed Eastern Corridor Option is situated in an area that is mainly broad acre farming. Notwithstanding, there are some residences where the corridor joins the Murray Valley Highway.

3.1 INTRODUCTION

The following information describes the key demographic characteristics of the Echuca and Moama populations as well as the Shires of Campaspe and Murray and Country Victoria and N.S.W. (excluding Melbourne and Sydney Statistical Divisions), as indicated in the ABS 1991 and 1996 Census data (refer Appendix 2: Tables - Demographic Characteristics).

3.2 POPULATION SIZE AND CHANGE

The overall population in the Campaspe Shire grew from 32,772 to 33,320 persons, that is, by 548 persons or 1.7% in the intercensal period 1991 to 1996. In that same period in the Murray Shire, there was a population change from 5,007 to 5,319, an increase of 312 or 6.2%.

It is notable that the 1998 ABS Estimated Resident Population placed the Murray Shire as the fifth fastest growing Local Government Area (LGA) in NSW and the fastest outside the Sydney Metropolitan area, at 4.2%.

The twin towns of Echuca and Moama have contributed to the Shires' growth patterns. Between 1991 and 1996 Echuca grew from 9,450 to 10,014, that is, by 564 persons or 6.0%. In Moama the population changed from 2,258 to 2,469, a growth of 211 persons or 9.3%. By the time of the 1996 Census, the population of Echuca made up 30% of the Campaspe Shire's population and that of Moama comprised 46.4% of the Murray Shire's population.

In terms of households, the number of households increased between 1991 and 1996 in both Echuca and Moama, by 374 households or 11.1% in Echuca and by 127 or 16% in Moama to reach 3,742 and 922 households respectively. The increase in Echuca represented 49.0% of the overall growth in households across the Campaspe Shire (763 or 6.8%) and in Moama it represented 72.6% of the growth across the Murray Shire (175 or 10.3%). Moreover, while the household growth patterns in the respective Shires were similar to the growth achieved in Country Victoria (6.7%) and Country NSW (10.7%) the towns' household growth demonstrated increases well above the country averages.

Average household size (the average number of persons per occupied private dwelling) in Echuca and Moama was 2.67 and 2.68 respectively. In both cases these figures were smaller than in the municipalities of Campaspe (2.90) and Murray (2.78) and across Country Victoria (2.87) and Country NSW (2.84) at the time of the 1996 census.

3.3 SOCIO-ECONOMIC CHARACTERISTICS

Based on the ABS 1996 Census data, key socio-economic characteristics of the Echuca and Moama populations (refer Table 3.1) were as follows.

3.3.1 Age Structure

- The under 14 age group represented 22.4% and 20.6% of the population in Echuca and Moama respectively. In the Shires of Campaspe and Murray this age group made up 23.8% and 21.6% of the population respectively. Moreover, their presence was not that dissimilar to elsewhere in Country Victoria (23.5%) and Country NSW (22.8%).

Table 3.1- Key Demographic Characteristics

	Echuca	Shire of Campaspe	Country Victoria	Moama	Shire of Murray	Country NSW
Population						
1991 no.	9,450	32,772	1,221,749	2,258	5,007	2,193,458
1996 no.	10,014	33,320	1,235,373	2,469	5,319	2,297,406
Households						
1991 no.	3368	11,267	444,158	795	1,702	739,887
1996 no.	3,742	12,030	416,078	922	7,877	819,043
Av. Household Size (1996)	2.67	2.90	2.87	2.68	2.78	2.84
Age Structure (1996)						
Under 14 yrs %	22.4	23.8	23.5	20.6	21.6	22.8
Over 60 yrs %	21.5	18.6	17.4	23.0	20.7	18.6
Birthplace (1996)						
Australian Born %	91.2	91.7	87.1	91.8	92.0	86.9
Occupational Structure (1996)						
Managers and Administrators %	6.4	22.5	14.0	7.4	24.2	14.5
Professionals and para-professionals %	28.6	21.1	25.6	21.6	19.0	10.9
Clerical Sales and Service workers %	28.1	21.2	24.8	31.7	21.2	27.0
Labourers and Related Workers %	20.6	19.8	19.1	19.7	19.6	20.0
Income Levels (1996)						
Median individual annual income	$13,900	$13,400	$13,100	$13,200	$12,600	$12,900
Median household annual income	$26,200	$26,900	$26,900	$25,800	$25,200	$26,900
Education Attainment (1996)						
Not qualified %	62.6	65.3	62.3	64.5	65.3	60.0
Diploma, degree, high qualification %	11.4	9.8	12.7	7.9	8.8	12.7
Tenure Status (1996)						
Owned/being purchased %	74.0	71.2	72.5	65.7	68.3	67.5
Car ownership (average)	1.46	1.79	1.70	1.53	1.71	1.46

Source: ABS Census Data, 1991 and 1996

- Echuca-Moama has become a popular place to retire to. In 1996, the over 60s population made up 21.5% of the Echuca population and 23% of the Moama population. This was higher than the 18.6% and 20.7% this age group represented within the Shires of Campaspe and Murray respectively, and was significantly higher than Country Victoria (17.4%).

3.3.2 Birthplace

- 91.2% of the Echuca population and 91.8% of the Moama residents were born in Australia. These figures were similar to the Shire figures but were higher than the average for Country Victoria (87.1%) and NSW (86.9%).
- The number of Aboriginal and Torres Strait Islanders increased in Echuca from 255 to 273 between 1991 and 1996. In Moama the number increased from 33 to 84. It is notable that this group represents 2.7% of the population in Echuca and 3.4% in Moama, figures marginally less than for the Shires as a whole (3.7%). In Country Victoria and NSW Aboriginal and Torres Strait Islanders made up 0.8% and 2.9% of the population respectively.

3.3.3 Occupational Structure

- The total number of employed persons increased by 6.8% in Echuca and 11.4% in Moama during 1991 and 1996. Reflecting the growth in development, tourism and service industries across these towns, managers and administrators declined in absolute terms between 1991 and 1996 in both towns but professionals and para-professionals increased along with clerical sales and service workers and labourers and related workers. In Echuca these four occupational groups represented 6.4%, 28.6%, 28.1% and 20.6% of the employed population respectively at the time of the 1996 census. In Moama they made up 7.4%, 21.6%, 31.7% and 19.7% of the employed population respectively.

  In the Shires of Campaspe and Murray and in all Country Victoria and Country NSW, it is notable that managers and administrators also declined in absolute terms between 1991 and 1996 but remained a more dominant occupational group than in Echuca and Moama. This is not surprising as farmers and other agricultural landowners generally record their occupation as managers and administrators. While this group is declining overall, their presence would be greater in other parts of the municipalities under study and in rural Victoria and NSW than in the more urban area of Echuca-Moama. Professionals and para-professionals, clerical sales and service workers and labourers and related workers also increased in absolute terms but were not as well represented, particularly the clerical sales and service workers. These occupational groups made up 22.5%, 21.1%, 21.2%, 19.8% of the employed population respectively in the Shire of Campaspe and 24.2%, 19.0%, 21.2% and 19.6% respectively in the Shire of Murray. In Country Victoria these groups represented 14.0%, 25.6%, 24.8% and 19.1% of the employed population respectively and 14.5%, 10.9%, 27.0% and 20.0% respectively.

3.3.4 Education Attainment

- The level of persons over 15 years of age in Echuca and Moama who were *not qualified*(no further education including a trade) was 65% in both Echuca and Moama. Similar figures

were recorded for the Shires of Campaspe and Murray. This representation (65%) was higher than the 60% *not qualified* in Country Victoria and 62.2% in Country NSW.

- In Echuca, 7% of the population had a diploma, degree or higher qualification and in Moama 10.4% had these qualifications. In the municipalities of Campaspe and Murray they represented 9.8% and 8.7% of the population respectively. However, compared with Country Victoria (12.7%) and NSW (12.6%), these figures were quite low.

3.3.5 Income Levels

- Median individual annual incomes were higher in Echuca ($13,900) than in the Shire of Campaspe ($13,400) and in Country Victoria ($13,100). They were also higher in Moama ($13,200) than in Shire of Murray ($12,600) or Country NSW ($12,900) but lower than Echuca.
- Median household annual incomes were not as high in Echuca ($26,200) as the Shire of Campaspe ($26,900) or Country Victoria ($26,900). In Moama the median household annual income was even less ($25,800) but marginally greater than for the Shire of Murray ($25,200) but less than for all Country NSW ($26,900).

3.3.6 Tenure Status

- 72.5% and 67.5% of occupied dwellings were either owned or being purchased in Country Victoria and NSW respectively compared with 68.3% in the Murray Shire and 71.2% in the Campaspe Shire. In Echuca and Moama 74% and 65.7% of occupied dwellings respectively fitted into this tenure category.

3.3.7 Dwelling Type

- 1.2% of occupied private dwellings in Country Victoria were caravans, cabins and houseboats. Echuca had nearly three times the state percentage of "alternative dwellings" at 3.2%. Moama actually had a marginally lower percentage of caravans, cabins and houseboats, 2.1% compared with 2.5% in Country NSW. These percentages are a further indication of the Echuca-Moama area being an important holiday destination.

3.3.8 Vehicle Access

- Reflecting the area's older population, the average number of vehicles per household was 1.46 for Echuca and 1.53 for Moama. These figures were marginally less than the Campaspe (1.79) and Murray Shire (1.71) averages and those reported for Country Victoria (1.70) and not that dissimilar to Country NSW (1.46).

3.4 CORRIDOR OPTIONS – AFFECTED RESIDENTS

3.4.1 Western Corridor

The proposed Western Corridor stretches on both sides of the Murray River and takes in an area with predominantly large houses and large blocks of land along Merool Lane. It also abuts, but

does not encompass Wharparilla Drive, Maiden Smith Drive and Layfield Downs Estate. The number of dwellings – including permanent residences and holiday homes – that are within the environs of this corridor are as follows:

- Merool Lane - 5
- Wharparilla Drive - 61
- Layfield Downs Estate - 25
- Maiden Smith Drive - 22

Not all households within the Western Corridor and environs were interviewed but the Summary Table (refer Appendix 2) does give some indication of the socio-economic characteristics of this population. They tend to:

- be newcomers as well as those who have lived in the Echuca-Moama area for more than ten years;
- be at the more mature or late stage of the life cycle with children living at home or older couple, retired with no children living at home;
- have completed secondary school or carried out a trade(s) course as their highest level of education attained;
- be working full time or retired;
- be self-employed and working in skilled trades occupations; and
- be Australian born.

3.4.2 Central Corridor

Some 51 dwellings located on the eastern side of Sturt Street opposite the railway line and near light industry (for example, rice mill, petrol stations, etc) are within the proposed corridor. Houses tend to be old brick or weatherboard, with the exception of a number of units half way up Sturt Street, and the houses near Ogilvie Avenue which are new.

In Moama, only two dwellings are located within the corridor and these are found near the junction of Boundary Road and Meninya Street.

All other potentially affected residents live in caravan parks. There are four permanent residents and 52 annuals at Moama Riverside Holiday Park and no permanent residents at Riverbank Holiday Park. As indicated in the Summary Table (refer Appendix 2) the socio-economic characteristics of this population can be described as:

- being more established with more households who have lived in the Echuca-Moama area for at least ten years and many for more than 20 years;
- at the late stage of the life cycle, retired with no children living at home;
- having completed secondary school and/or at least Year Nine with very few having undertaken a formal apprenticeship or tertiary education; and
- mainly Australian born.

3.4.3 Eastern Corridor

The eastern corridor is predominantly broad acre farming land. Properties tend to be large (one acre to over 100 acres). There are approximately nine homes located within the corridor itself, although some of these are well set back from Old Deniliquin Road.

Respondents included:

- a semi-retired farmer, a caravan park and winery owner/operator, a stud owner/manager, a plumber and two persons involved in the transport or trucking industry;
- at the mature stage of the life cycle with older children living at home;
- persons having completed secondary school and/or skill trades course;
- with the exception of one interviewee, Australian born.

3.5 PROJECTED POPULATION

According to the *Shire of Campaspe Integrated Strategy Plan, 1996:* "When the combined population potential of Echuca and Moama is considered, the 2011 population potential could be in the order of 16,000" (p.22). However, this is likely to be an under-estimation. In 1996 the combined population was 15,333. Moreover, there is substantial growth to the west (refer Section Two). On the Victorian side of the border alone there is 1000 hectares of land west of the Murray Valley Highway zoned for *future residential.* Some 160 hectares of this land or 1200 lots will be developed as Stage 1. This stage is expected to commence development in the year 2000. If the current household occupancy rate of 2.67 is applied then this area will contribute some 3,204 persons to the overall population growth over the next fifteen years. In addition to this growth will be infill development in the order of 400 lots which would cater for around 1,000 to 1,200 persons.

If the Moama population growth pattern of 9.3% increase between 1991 and 1996 is maintained and if the proposed residential development occurs to the west of the Moama township then the combined Echuca-Moama population is more likely to be in the order of 20,000.

3.6 SOCIAL IMPLICATIONS

The actual number and characteristics of people or households potentially affected – directly or indirectly – will be determined in the second stage of the assessment when the alignment options are considered. However, if the information gleaned from the investigation and consultation processes to date are considered then it is likely that the proposed Central Corridor Option will affect the greatest number of households indirectly and directly. Moreover, they are likely to be in the more *vulnerable* category, older and of lower socio-economic status.

4.1 INTRODUCTION

Social patterns and linkages relate to the degree an area functions as a community. That is, the amount of social interaction and cohesion indicated by residents, including their use of local facilities; participation in organisations, community groups and club activities; personal relationships within an area; a feeling of belonging. Areas of exclusive interaction and strong community cohesion are more easily threatened by any major change.

Echuca is the principal town in the Shire of Campaspe and Moama the largest town in the Shire of Murray. As twin towns, Echuca-Moama share much of their community infrastructure, despite the fact that they are located in different states, and on opposite sides of the Murray River.

Echuca is the larger centre, and is the regional focus for higher order services in health, education and shopping, as well as a range of other community facilities and services. As such, access to Echuca is very important to the residents of Moama in particular, who rely on Echuca in the course of their day to day living. Most shopping is undertaken in Echuca due to the wider variety of specialty stores and the major supermarkets available there to fulfil not only the main weekly shopping trip for fresh food, groceries and small household goods, but also comparison shopping for clothing and larger household goods. In addition, many Moama residents work in Echuca. The only access to Echuca is via the existing bridge.

Moama, on the other hand, performs a different role. It has a stronger recreational focus and contains more recreational facilities than does Echuca. The Moama Bowls Club is located in the heart of Moama, and the RSL & Citizens Club, Rich River Golf Club, Moama Sports Club and the Moama Recreation Reserve are all located to the west of Moama along or just off Pericoota Road. In terms of shopping, Meninya Street, Moama only performs a local convenience function serving the needs of Moama residents and visitors, the post office being one of the most important of the services offered.

Figure 1 highlights the distribution of key community infrastructure according to:

- health services;
- education facilities; and
- sporting and leisure facilities.

With the exception of two caravan parks, the Moama Riverside Holiday Park and the Riverbank Holiday Park, skate park and playground, Church of Christ, and the RSL & Citizens Club, there are no facilities located within the corridor boundaries.

Notwithstanding, a key determinant of the nature and extent of effects on social patterns and linkages will be the extent of any severance to or change of local road based access patterns to the facilities and services.

Section 4.2 lists the various facilities and services, their catchments, and discusses any issues pertaining to access, traffic, and safety gleaned from discussions with a sample of service providers. Section 4.3 further describes the social interaction patterns and linkages and how the community functions. The qualitative information gleaned thus far from interviews with residents, community groups, and group discussions has been drawn upon.

4.2 COMMUNITY INFRASTRUCTURE

4.2.1 Health

- ***Echuca***
- Echuca Regional Health Hospital – Located in central Echuca, comprises 66 acute beds, 69 nursing home beds and 34 hostel beds. The average length of stay is 2-3 days. The hospital employs approximately 400 staff and has an accident and emergency department, an oncology clinic, surgical facilities etc. Patients are transferred to Bendigo or Melbourne for treatment on an as needs basis.
- Doctors – There are two large doctors surgeries in Echuca, the Murray River Medical Centre in Ogilvie Avenue with six doctors, and the Nish Street Medical Practice with eight doctors. There are also smaller medical centres in Martin Street and in Francis Street, and there is a diabetic clinic in Hare Street and a pathology clinic in Percy Street.

- ***Moama***
- Moama relies largely on the Echuca Hospital and Echuca based doctors for medical issues.
- A new doctor has recently settled in Moama and is in the process of getting a partner and advertising the fact that a doctors surgery is now located in Moama.

- Health and medical representatives commented on the bridge delays and closure that can reduce access for emergency vehicles travelling between Echuca and Moama. This is particularly significant in terms of ambulance travel as there is no hospital in Moama. The nearest hospital is in Deniliquin, a considerable distance away.

4.2.2 Tertiary Education

- Campaspe College of Adult Education – (November 1999 enrolments 802 – expected increase of 10% per annum). Previously called the Echuca campus of the Bendigo Regional Institute of TAFE, the Campaspe College is located in the centre of Echuca on Hare Street. It provides a wide range of quality training products and services as well as courses in hospitality, viticulture, business, information technology, arts, and agriculture.

  The College is currently looking for a larger site to expand to. A site that is central to the centres of Echuca and Moama is preferable to allow easy access for students, particularly those travelling to and from work.

4.2.3 Secondary Education

Echuca has four secondary schools. Two are state schools and two private. These schools serve both Victorian and NSW students. Moama does not have a secondary school.

- Echuca Secondary College – Years 7 to 12 (1999 enrolments 500). Located in West Echuca between the Campaspe River and the Murray Valley Highway on Butcher Street, Echuca

Secondary College is the largest public school site in Victoria. The catchment area encompasses Echuca, Moama, Deniliquin, Mathoura and Lockington, with approximately 25% of students travelling from NSW and 75% from Victoria.

The school representative is concerned with existing traffic along the Murray Valley Highway and Warren Street that have 100km/hr speed limits. He feels that this speed limit should be dropped to 70km/hr, and that the intersection of Murray Valley Highway with Warren Street should be upgraded as it is particularly dangerous.

The school principal would like to see the school site and adjoining land turned into an educational precinct with the TAFE and perhaps an amalgamated secondary school next to each other.

- Echuca High School – Years 7 to 12 (1999 enrolments 610). Located between the Campaspe River and the Murray River on Croften Street, Echuca High students come from Echuca, Moama and as far away as Bunnallo, Wamboota, Mathoura, Tongala, Barmah, Kotta, Lockington and Nannealla.

The school representative is concerned about the existing condition of Warren Street with regard to student safety and feels that there is a need for a cycle path to be constructed along this street which is separate from the traffic.

- St Joseph's College – Years 7 to 12
- Rich River Christian College – Prep to Year 10 (1999 enrolments 65). Located to the south of Echuca on Rose Street between the Northern Highway and the Campaspe River, Rich River Christian College is a small private school.

– Transport to and from the school used to be a problem in terms of country student access, so Rich River Christian College established their own school bus system to pick students up from Kyabrum and Cohuna. Students also reside in Bamawn, Lockington, Picola, Tongala, Koyuga and Echuca.

4.2.4 Primary Education

- ***Echuca***

Echuca has five primary schools, three of which are public and two private.

- Echuca Central Primary School.
- Echuca East Primary School (1999 enrolments 400 – expected increase of 10 students per annum). Located on the corner of Eyre and Sutton Streets in East Echuca, the catchment area generally extends west to the railway line and on both sides of Ogilvie Avenue. Eighty percent of students come from Echuca, 10% from Moama and 10% from rural Victoria to the east of Echuca.

The school representative believes that the roundabout near the bridge can be dangerous for children to navigate. General traffic concerns also include the need for safe bus drop off points at the school and along bus routes, and the need for safe car drop off points at the school.

- Echuca South Primary School.
- Rich River Christian College (1999 enrolments 65) – as discussed above.
- St Mary's Primary School (1999 enrolments 325 and expects 350 in 2002 and 370 in 2005). Located on Anstruther Street near the roundabout leading to the bridge, students are catholic and do not come from within any defined catchment area. Sixty-five percent of students live in Echuca, 25% come from Moama and 10% are from rural areas.

General traffic concerns revolve around traffic flow at the school site. There is a lack of parking for parents to pick up and drop off children. The school representative's "biggest fear is that a chemical spill will occur at the roundabout" leading to the bridge that is located next to the school.

St Mary's is currently considering acquiring a second site in West Echuca, to the west of the Murray Valley Highway. It is felt that they could accept more students if they had more space, and realise that West Echuca is the direction that the town is expanding in.

- ***Moama***

Moama has only one primary school, although land has been reserved to the west of Moama for a future educational site, be it a primary school or a secondary school.

- Moama Primary School (1999 enrolments 802 – expect 10% increase per annum). Located on Simms Street in the eastern area of Moama, Moama Primary School has a wide catchment area which extends 31km to Barmah and Cummeragunja (Aboriginal community), 25km up the Cobb Highway, 25km towards Burnaloo; and the township of Moama.

4.2.5 Children's Services

Echuca has four kindergartens and Moama has one. All kindergartens were made aware of the study, and discussions were held with Echuca South Community Pre School, Echuca Central Kindergarten and Moama Pre-School.

- ***Echuca***

- Echuca Central Kindergarten (1999 enrolments 87 children between the ages of three and six, with a capacity for 96 children). Located on Anstruther Street, two blocks east of High Street, their main catchment area extends west of the railway line and north of Ogilvie Avenue.

The kindergarten representative would like to see the intersections at High and Anstruther Streets, and High and Pakenham Streets improved.

- Echuca Day Nursery.
- Echuca East Kindergarten.
- Echuca South Community Pre-School (1999 enrolments 72 children between the ages of three and six – expect this number to remain constant). Located in High Street, the catchment area extends south from Warren Street, west of the railway line and to the south of Ogilvie Avenue.

The pre-school representative would like the road surface in front of the centre to be totally sealed for safety reasons.

- ***Moama***
- Moama and District Pre-School Centre (1999 enrolment 108 three to six year olds – expect approximately 100 in 2002 and 2005). Located in Regent Street in the town of Moama, 34% of children come from the area west of the Cobb Highway out as far as the Rich River Golf Club, 52% come from the Moama town area east of the Cobb Highway and 15% come from Echuca.

The pre-school representative is concerned that the pedestrian crossing in Meninya Street is not safe. It is located very close to a roundabout. She believes that truck drivers do not expect the crossing and often travel along Meninya Street quite fast. Moreover, they do not always see the warning signs or children waiting to cross the road because of parked cars.

4.2.6 Older Person's Services

Echuca-Moama is a popular retirement destination, due largely to its proximity to Melbourne, the wonderful climate, and excellent entertainment facilities such as the bowling clubs, the golf clubs and the RSL.

- ***Echuca***

The key older person's and aged care facilities located in Echuca include:

- Echuca Senior Citizens Club;
- Echuca Hospital Nursing Home (60 beds);
- Glanville Village (34 bed hostel); and
- Englebert Lodge (61 bed hostel).

- ***Moama***

There are many older persons and aged care facilities in Moama including:

- Moama Senior Citizens Community Centre;
- Allen Court Retirement Village (79 self contained strata units);

- Moama Community Lions Village (20 retirement units);
- Jacana Green Retirement Village (33 retirement units with a further 39 units proposed); and
- Sedberg Retirement Complex (10 self-contained units).

One community facility representative expressed concern regarding older persons ability and perceived ability to back out of angle parks along Meninya Street. "Trucks often travel quite quickly through the roundabout, to minimise gear changes. It can be quite a nerve racking experience to back out of your car park with trucks bearing down on you."

4.2.7 Sporting and Leisure Facilities

- ***Echuca***

While Moama is renowned as having excellent sporting and leisure facilities, Echuca also has an extensive array of facilities including:

- Echuca Bowling Club (located on Ogilvie Avenue);
- Workers and Sports Club (centre of town);
- YMCA (centre of town);
- Echuca Swimming Pool and Gymnasium (top end of High Street);
- Echuca Golf Course (along the Campaspe River near the centre of town);
- Echuca Racecourse (out of town);
- the Murray and Campaspe Rivers (water skiing, houseboats; fishing and swimming etc); and
- various facilities for athletics, tennis, football, ballet, and water skiing etc.

- ***Moama***

The key facilities located in Moama include:

- Moama Bowling Club - Currently (November 1999) has 7877 members, and in 1998 had 208,082 visitors to the club that were not members from outside of the Echuca-Moama area. Nearly half of these were from Melbourne, and the majority of the rest from regional Victoria. Located in central Moama, near the existing bridge, the Moama Bowling Club has 216 gaming machines and five bowling greens. It also has a number of meeting rooms which are utilised almost daily for conferences and functions, and also by smaller clubs such as bridge, Rotary, football, etc for their monthly meetings.
- RSL & Citizens Club - Currently (November 1999) has 6000 members. 1,112 are from Moama, 2,504 from Echuca, 884 from the local rural area and 1,500 are from the Melbourne area. The RSL gets 100 new members a month and it welcomes many visitors every day. Located in Merool Lane to the west of Moama, the RSL has 125 gaming machines. Many other clubs use their premises for their monthly meetings, for example: Lions Club, Rotary, Echuca Football Club etc.

- Rich River Golf Club - Has 10 to 12 tennis courts and two bowling greens in addition to the 18 hole golf course.
- Moama Sports Club – As part of the Rich River Golf Club, the Moama Sports Club shares their membership base. With approximately 90 gaming machines and situated in the middle of the Moama Recreation Reserve on Pericoota Road, the Sports Club has a predominantly local trade. Friday evenings are the busiest with people dropping in after work. The seniors' sporting groups that play at the recreation reserve sometimes utilise the Club's facilities after games in the evenings and on weekends.
- Moama Recreation Reserve – Has facilities for football, netball, tennis, junior soccer (220 members – set to rise), touch football (20 teams, 250 members), cycling (50-60 members), and baseball, etc. Teams generally play once a week while in season. The reserve has:
  - three main ovals (two can double as cricket fields);
  - two netball courts which convert to tennis courts – can also convert the Sports Club car park to netball courts when needed;
  - a velodrome;
  - a trotting track; and
  - an Adventure Playground.
- Moama also has:
  - Skate park (between Meninya Street and the Murray River);
  - Gun Club (out of town);
  - Basketball Stadium (in the centre of town);
  - Semoz Paint Ball (out of town);
  - parks, gardens and playgrounds;
  - the Murray River (water skiing, houseboats, fishing and swimming, etc); and
  - a proposed motorcycle track on Millgate Road (out of town).

4.2.8 Tourist Attractions

- The Port of Echuca is an authentic working steam port. It attracts many visitors to the area (on average approximately1000 paddlesteamer rides are taken every day) and is hoping to become recognised as an international tourism area. Nowhere else in the world can tourists travel by rail from a major city to a wharf, and then on a paddlesteamer. The Port is also home to a number of fine restaurants that the residents of Echuca and Moama, and visitors alike enjoy.

A Port representative stated that whatever happens, trucks have to be taken out of the historic precinct. They hope that the historic precinct will soon be recognised as including the railway line up to the old locomotive shed in addition to the Port area.

- The Murray River – the river is the reason for the success of Echuca-Moama as a tourist destination. Without the Murray River, there would be no historic port, no paddlesteamers, no water skiing or houseboats.
- Accommodation - as a popular tourist destination, both Echuca and Moama have extensive visitor accommodation, varying from houseboats on the Murray to B&Bs, caravan parks, serviced apartments and motels. It can be clearly seen that visitors stay on both sides of the river.

Motels located along the current highway route on High Street, Echuca and Meninya Street, Moama (with the exception of Madison Spa Motel) are currently disrupted by traffic noise, although they accept that this is a consequence of being located on a busy thoroughfare, which in turn provides passing trade.

4.3 USAGE OF LOCAL FACILITIES

As noted in Section 4.2 Echuca-Moama has a range of facilities in health, education, children's services and recreation and leisure. During the face-to-face interviews with residents, residents were asked about their travel patterns and usage of a range of facilities and services. The summary tables (refer Appendix 3) indicate quite clearly that High Street, Echuca and Meninya Street, Moama are important destinations, along with the local schools and the Port of Echuca Precinct, and are frequented on a regular basis.

4.4 USE OF CLUBS, RECREATION AND SPORTING FACILITIES

While membership of the clubs, for example, RSL & Citizens Club, Moama Bowling Club, Rich River Golf Club, Workers Club, etc. does not appear extensive among the residents surveyed (see Appendix 2), according to the club managers they do have healthy memberships and patronage on a regular basis is quite common.

It is also notable that the river is an important recreational resource for the residents, particularly those living along Wharparilla Drive.

4.5 FRIENDSHIPS AND FAMILY TIES

While some residents were relatively new to the area, there were many particularly those living in the environs of the Central Corridor, who had lived in the Echuca-Moama area for a long time and enjoyed their friends and relatives and the "small town" atmosphere.

4.6 SOCIAL IMPLICATIONS

Travel patterns, access to and usage of local facilities have been affected adversely by vehicular traffic within the Echuca-Moama area for at least ten years. These issues were highlighted in the 1987 report: *Road Crossing Over the Murray River Echuca-Moama, Environmental Impact Statement, Environment Effects Statement* for Road Construction Authority and Department of Main Roads by Dames & Moore. They were raised again in this study. Discussions with the sample of community infrastructure managers and service providers revealed a number of issues

and concerns with the existing traffic situation and in turn access and safety for pedestrians and cyclists to a number of community facilities in Echuca and Moama. To summarise:

- unnecessary heavy vehicles passing through the centre of Echuca and Moama;
- traffic congestion and delays leading up to and on the existing bridge;
- conflict between pedestrians and vehicles at the roundabouts on either side of the bridge;
- existing traffic conditions impede access – on foot or bicycle in particular - to community facilities;
- bridge delays or closures due to an accident or repair work can hamper employee, student and visitor ability to access various community facilities as well as reduce access for emergency vehicles travelling between Echuca and Moama;
- unsafe intersections, for example, Warren Street/Murray Valley Highway, Sturt Street/Ogilvie Avenue, Hume Street/Ogilvie Avenue, Sturt Street/Pakenham Street/railway crossing, High Street, particularly for students travelling to and from school on foot and by bicycle, older people, people with young children and people with mobility problems;
- potential for a chemical spill in the centre of Echuca or Moama or on the existing bridge;
- pedestrian movement is impeded across Meninya Street - even at the pedestrian crossing -by fast travelling trucks; and
- vehicular movement in Meninya Street in terms of parking and reversing out of car parks is very difficult as a result of the fast travelling traffic.

- The proposed Western Corridor Option could alleviate some of these access issues. However, careful consideration would need to be given to the upgrading of Warren Street, an important access route to key facilities, including secondary and primary schools, for example, Echuca High School, Roman Catholic College, Echuca Primary School, etc.
- The proposed Central Corridor Option could exacerbate some of these access issues. In fact, while it may alleviate the existing traffic conditions on Meninya Street, the upgrading of Sturt Street could dislocate the community and create a division or psychological barrier between the east and west of Echuca. It would also be important that the existing bridge is not totally closed at any time as this could dislocate the community of Moama and impede access to Echuca.
- The proposed Eastern Corridor Option could also alleviate some of these access issues but not to the level of the Western Corridor option. This is not where the residential growth is occurring. Moreover, the main facilities and services are located in that part of Echuca west of Sturt street, Echuca. Ogilvie Avenue may also need upgrading. It is also noteworthy that key recreational and medical facilities, for example, Echuca Bowling Club, Hospital and Ogilvie Avenue Medical Practice are located on this road.

5.1 INTRODUCTION

Understanding community values and attitudes to their living environment is important in any social impact assessment. These factors provide important background information that can influence people's perceptions of risk. In this instance the perceived risk is that associated with living in the environs of a newly constructed road which will bypass the centres of Echuca and Moama, and the development of a second crossing of the Murray River.

The following highlights residents' and other stakeholders' perceptions and attitudes to living in Echuca-Moama and their local area. Residents (44) and other community members during the group discussions and less structured discussions were asked about:

- the reasons for choosing to live at their current address;
- the things they liked and disliked most about living in the general area of Echuca-Moama;
- the things they liked and disliked most about living in their street; and
- the things they value and the areas of special interest or attraction in the region.

5.2 ATTITUDES TO LIVING IN ECHUCA-MOAMA

5.2.1 Reasons for Choosing to Live at their Current Address

Those residents who participated in the group discussions including Maiden Smith Drive (10 households; and Hume and Hovell Streets (four households) and in the face-to-face interviews (44) had moved into the area for a range of different reasons.

- ***Residents of Western Corridor and environs***

Reflecting a newly developing residential area, only ten of the 19 interviewees living within the environs of the western corridor had lived in the Echuca-Moama area for ten years or more and five at their current address. Moreover, those living within this part of the study area along Wharparilla Drive and Merool Lane, had moved here for the more relaxed lifestyle, the quietness and the river environment.

Likewise Maiden Smith Drive residents had moved to their current addresses for lifestyle reasons, including the natural beauty of the area, the large blocks of land, and having plenty of privacy. The climate was also an attraction for those that moved to Moama from outside of the region. All of these residents agreed that they are fortunate to "live in town, but just out of town – the best of both worlds!"

- ***Residents of Central Corridor and environs***

Those residents living in the environs of the central corridor in Moama and along Sturt Street and nearby Hume Street and Ogilvie Avenue – a much older part of the Echuca-Moama area - tended to be more established residents of many more years residency than the western corridor residents. Fifteen of the 20 interviewees had lived in the area for more than ten years and ten had

lived at their current address for more than ten years. Moreover, the key reasons given for living in this part of the study area related to family reasons and employment opportunities.

- ***Residents of Eastern Corridor and environs***

Five face-to-face interviews (and one general discussion) were conducted with the residents living in the environs of the eastern corridor option. Four of the residents had lived in the area for more than twenty years and only two for more than ten years at their current address. Furthermore the key reasons related to proximity to their work, in this instance close to industry and their related trade or transport business. As noted previously, industry and transport companies are located in this part of Echuca along Ogilvie Avenue and the adjacent industrial estate.

5.2.2 Things Liked Most About Living in the General Area of Echuca-Moama and at their Current Address

- ***Residents of Western Corridor and environs***

The Wharparilla Drive residents in particular highlighted living near the river, their outlook and the landscape quality of their *natural* living environment, that is, the trees, bushland, and bird life. These features were mentioned more frequently than their proximity to the clubs, community facilities and employment opportunities.

Predicably the river/views/outlook and the natural bushland of their surroundings and the quietness of the area were highlighted as being the key things they liked about their street.

Maiden Smith Drive residents mentioned their appreciation of the "space" that they are surrounded by. The peacefulness, outlook, birdlife and natural beauty of the area are very important to them, as is the perceived sense of home security that they enjoy - "you can leave the back door open." Proximity to the clubs is also perceived as a benefit of the area, as is the proximity to Melbourne.

- ***Residents of the Central Corridor and environs***

Similar to the residents living in the environs of the western corridor option, these residents also focussed on proximity to the river and its environs as being a thing they liked about their area. However, they also liked the country town or small town atmosphere that Echuca-Moama offers, their proximity to shops, and the climate.

Regarding the things they liked about living in their street 11 of the 20 residents interviewed highlighted their close proximity to everything, for example, shops, work, town, etc.

Residents in Hume and Hovell Streets enjoy their proximity to the river, and to anywhere they might want to travel to in Echuca or Moama. They liked being able to walk to the shops, and as mentioned by one resident who used to live in Melbourne, "commuting to work takes a maximum of five minutes!" The fact that there are few traffic lights, the proximity to Bendigo and Shepparton, and the climate were also seen as benefits of living in the area.

- ***Residents of the Eastern Corridor and environs***

Comments made by these residents were quite varied but being close to family was mentioned by two of the five respondents from this part of the study area. Two of the five residents also liked their proximity to the river, their space, and privacy with no close neighbours.

5.2.3 Things Disliked Most About Living in General Area of Echuca-Moama and at their Current Address

- ***Residents of the Western Corridor and environs***

Seven of the 19 respondents stated there was *nothing* they disliked in the Echuca-Moama area and nine of the 20 respondents stated there was nothing they disliked in their street. Five commented on the lack of facilities for young people and/or medical facilities in the area. Moreover, three residents of Wharparilla Drive disliked the proximity to their neighbours and two Merool Lane residents, the unsealed road outside their properties.

While Maiden Smith Drive residents generally believe Echuca-Moama is a "beaut place to live," there was consensus that a better road between Echuca and Melbourne would be a bonus. They commented also that shopping in Echuca tends to be expensive – "shops focus on tourists too much."

- ***Residents of the Central Corridor and environs***

Twelve of the 20 residents interviewed from this area stated they disliked *nothing* in the general area and eight stated that they disliked *nothing* in their street. There were ten residents of Sturt Street who stated they disliked the dust and/or noise pollution from traffic, trains and nearby mill and railyards.

Hume and Hovell Street residents commented on their dislike of tourists, particularly the rubbish they leave behind, during the Christmas, Easter and Southern 80 periods. They also felt that there is a lack of shopping variety in Echuca. Other key dislikes named were the times when the heavy vehicles travelled down Hume and Hovell Streets rather than using Sturt Street.

- ***Residents of the Eastern Corridor and environs***

These residents only expressed dislikes of their street which included, the noise, dust and air pollution from the passing traffic.

5.3 ATTRACTIONS AND AREAS OF SPECIAL INTEREST

The river and beaches, the Port of Echuca, clubs and recreation facilities were key attractions named by the majority of residents who participated in the survey. Of special interest to the Western Corridor residents were the use of the river for boating and the bushland for walking and in particular the Murray River's intrinsic value.

5.4 SOCIAL IMPLICATIONS

Based on the above, it will be important that the selected corridor option has minimal impact on the river and environs. The proximity to the river and the natural bushland were important to all residents who participated in the survey, in particular, those residing in the Western Corridor and environs. The Port of Echuca is of special interest to all residents. The Central Corridor residents also enjoy their easy access to work, shops, facilities and services.

The proposed Central Corridor Option could exacerbate travel patterns and access to facilities and services including the Port of Echuca and its activities, while the proposed Western Corridor Option and to a less degree, the proposed Eastern Corridor Option, could alleviate these access issues (see Section 4.6).

SECTION SIX Community Attitudes to the Proposed Second Murray River Crossing

6.1 GENERAL ATTITUDES

6.1.1 Residents

In order to gain some measure of the residents' level of concern over the proposed second river crossing, first a general question was asked of the residents who live within the environs of the corridor options about the key issues facing the Echuca-Moama community. This question sought a spontaneous response and tested whether the Proposal was in the forefront of residents' minds.

The main issue raised, without any prompting, related to the second Murray River crossing proposal. However, this was only raised by 14 of the 44 residents interviewed. Moreover, it was the Wharparilla Drive residents who were more inclined to raise this as an issue. Other issues raised during the face-to-face interviews, such as, inadequate medical facilities, lack of employment opportunities, youth unemployment, use of illicit drugs, etc. were only raised by one or two people.

When asked about key issues, there was an overwhelming response by Maiden Smith Drive residents that other community issues have paled into insignificance when compared with "the threat of having Merool Lane turned into a four-lane highway."

Hume and Hovell Street residents mentioned health and employment as being two key issues facing the community of Echuca. It was felt that "you have to wait too long to get an appointment with your doctor, and that most employment in the area focuses on those 35 years and younger, which is difficult for everyone else."

6.1.2 Community Groups and Service Providers

The majority of the community group and service provider representatives interviewed did not regard the proposed second river crossing as an issue of direct concern to them. Those representatives who were concerned over the Proposal tended to be the groups located in the environs of one of the corridors. Such groups included the RSL & Citizens Club, Moama Bowling Club, Moama Riverside Holiday Park, Riverbank Holiday Park, A Shady River Holiday Park, Madison Spa Motel, Sundowner Motor Inn and the Port of Echuca.

Most representatives of schools, the hospital, and other recreational facilities did not tend to view the Proposal as being of major concern. Instead, such issues tended to focus around their area of business. For example, the schools and pre-schools focused on issues relating to children, teenagers and education. Such issues included the need for the provision of safe pedestrian and cyclist access and facilities, the need for funding to allow for capital works projects and specialist teachers, the possibility of amalgamating the secondary college with the high school and the lack of entertainment for teenagers.

Other issues raised related to employment levels, the importance of tourism to the township of Echuca-Moama, and the services provided (or lack of) by Council.

6.2 AWARENESS OF AND NEED FOR THE PROPOSAL

6.2.1 Residents

All residents interviewed were familiar with the Proposal. Moreover, with the exception of four Wharparilla Drive residents, all believed there was a need for the second river crossing. The main reasons given for needing the crossing included:

- increased traffic congestion on the existing bridge and access roads in times of an accident or maintenance of the bridge;
- to get the traffic, in particular heavy vehicles, out of Echuca and Meninya Street Moama; and
- traffic *overload* created by the existing amount of traffic travelling over the bridge.

Nineteen of the 44 residents interviewed use the existing bridge daily or more frequently. Some nine use the bridge three to five times per week, 11 up to three times a week, eight less often and six never. In other words, residents were generally quite used to travelling back and forth over the existing bridge and so were familiar with any traffic problems associated with the bridge.

The existing bridge was not only seen as being prone to delays (refer Section 4.2) but also too narrow to take the existing amount of traffic. Furthermore, the delays were also exacerbated by the narrowness of the bridge when agricultural machinery and/or a wide load of some sort were being transported across the bridge.

Maiden Smith Drive group discussion participants also felt that a second river crossing is required, for similar reasons as those detailed above.

Hume and Hovell Street group discussion participants were less certain that a second crossing is required, although they agreed that the capacity of the existing bridge can at times be insufficient, particularly with regard to its width. These residents rarely use the existing bridge.

6.2.2 Community Groups and Service Providers

All community group and service provider representatives were familiar with the Proposal, and all agreed that a second river crossing is needed. The reasons were not that dissimilar to those of the residents. The different reasons included:

- Schools
  - to get the traffic, in particular heavy vehicles, out of the centres of Echuca and Moama and away from the roundabouts leading up to the existing bridge, to improve pedestrian safety;
  - to ensure that trucks carrying chemicals do not have to travel through the centres of Echuca and Moama, and thus do not have to negotiate the tight turns that town streets entail, and thus the fear of chemical spills will be negated;
  - to improve access across the existing bridge by easing congestion; and
  - to ensure alternative access (particularly for emergency vehicles) in case of the closure of the existing bridge.

- Sporting and Leisure Facilities
  - to ensure alternative access in case of significant congestion on the existing bridge, or more importantly, in case of the closure of the existing bridge. This is important in terms of patrons accessing facilities, and also in terms of staff arriving at work on time; and
  - to take heavy vehicles and congestion out of the centres of Echuca and Moama.
- Medical Facilities
  - to ensure there is quick access across the river in case of medical emergency.

6.2.3 Traders and Business Operators

As discussed in the Saturn Corporate Resources Report (December 1999):

"Most respondents (86.6%) believe there is a strong need for a new bridge."

Most (92% of 106) of the traders/businesses interviewed in the Business and Tourism Study support the construction of a second river crossing. Of these 75, were Echuca based and 17, Moama based. Ninety one percent of the Echuca respondents and 71% of the Moama residents were in favour.

6.3 KEY CONSIDERATIONS WHEN DECIDING ON THE LOCATION OF THE BRIDGE

The key criteria that should be considered when deciding the location of the bridge mentioned by the residents interviewed related to:

- heavy vehicles out of the town centre;
- least disruption to people; and
- preservation of trees and natural bushland and effect on the environment.

Predicably, the first factor listed above was more likely to be mentioned by the Sturt Street residents, and the second and third by the Wharparilla Drive residents.

Key considerations mentioned by the residents participating in the Hume and Hovell Street group discussion substantiated the above. To illustrate:

- making it easy for trucks to get where they are going to; and
- causing the least disruption to people (they would like to keep the trucks out of town and out of residential areas, but do not want to move the problem to another person's front yard).

It is notable that the preservation of bushland was not thought to be a real consideration to take into account as they believed the bridge would only take a "strip" and "you could look at the surrounding bushland as you drove by."

Maiden Smith Drive residents, participating in the group discussion, emphasised the following as key considerations:

- the proximity of homes; and

- the preservation of bushland.

6.4 PERCEIVED ADVANTAGES AND DISADVANTAGES OF THE THREE CORRIDOR OPTIONS

Representatives of community groups, traders, business operators and residents were asked an open-ended question about the advantages and disadvantages of each corridor option. While awareness of the proposal is high, it is notable that the communities' level of understanding of the options was not extensive. In fact, it was quite difficult at times to stimulate comments. As noted above, there is strong support for the proposal. People have known about it for years. Perhaps people now just want the bridge to be built without any more discussion. When residents were asked to give their opinion on the reactions of the local community to the proposal some residents stated: "People just wish it would get done/it should've been done years ago." It is also interesting to cite the words in the Saturn Corporate Resources report about the opinion of the local businesses. They also support its construction but are sceptical because it has been talked about for such a long time:

> *"The construction of a new bridge is overwhelmingly supported by businesses and tourism industries of Echuca and Moama, with many survey respondents keen to see construction commerce, but sceptical about the likelihood given past history."*

6.4.1 Western Corridor

ADVANTAGES

- ***Residents***

Some seven of the residents who participated in the face-to-face interviews stated that there were no advantages with this option. In the main these residents live in the environs of the Western Corridor. However, even though there was some opposition to this option particularly among the residents living along Wharparilla Drive near the river and along Merool Lane, there were some residents who cited improved access to Moama Town Centre as a key advantage of this option. These residents were from Wharparilla Drive but in the houses furthest away from the river.

Residents living in the environs of the Central and Eastern Corridor, in particular along Sturt Street, saw the advantages as being:

- takes the traffic out of town; and
- decreases passing traffic.

As noted in Section Five, these residents already endured the noise from the passing traffic hence it was not surprising that they focussed on these advantages for the Western Corridor option. They believed this option would make their living environment quieter with less traffic passing their front door. It is also notable that this option meets one of their key considerations in deciding where to place the second river crossing, it takes the heavy vehicles out of the town centre.

- ***Community Groups and Service Providers***

Almost without exception, the community groups and service provider representatives interviewed believe that the second river crossing should be located out of the centre of town. Some of these groups do not have an opinion on whether it should be located to the east or to the west, just that it is important to take heavy traffic out of the town centres, and to provide guaranteed emergency access. Such groups included the Echuca Hospital, many of the schools and preschools, the Moama Riverside Holiday Park, Moama Sports Club, and the Port of Echuca.

Although the Echuca Hospital does not have an official position on the issue, the representative interviewed can see that there are advantages in providing guaranteed access between Echuca and Moama by providing an alternative route.

All school and pre-school representatives believed that it is important to divert passing traffic and heavy vehicles out of the centres of Echuca and Moama, and to allow for guaranteed emergency services access between Echuca and Moama. This would result in a safer pedestrian environment for children and students in Meninya Street, Moama which is felt to be quite dangerous at present, as well as High, Heygarth, and Sturt Streets in Echuca.

The representatives of the schools located to the west of the railway line tended to prefer this corridor to the Eastern Corridor. A common theme was that Echuca and Moama are expanding to the west, and that it makes sense to provide convenient access for this future population. St Mary's Primary School and Moama Primary School even have plans to open a second campus in this new western area in the medium and longer term respectively. Campaspe College is also looking for a new campus, and Echuca Secondary College hopes that an "education precinct" can be developed on and next to their existing site in West Echuca.

Another advantage expressed with regard to the Western Corridor was that it would provide improved access to those recreation and leisure facilities located along Merool Lane and off Pericoota Road, Moama. The RSL & Citizens Club in particular sees the Western Corridor as being very advantageous as "it would improve access to the club and therefore business." The Merool Riverside Holiday Park also sees improved access for patrons from their camping ground to Echuca and vice-versa as being an advantage of this option, although they would be concerned should the bend of the river closest to the holiday park be utilised.

DISADVANTAGES

- ***Residents***

Predicably, the disadvantages were more likely to be raised by the residents living within the environs of the Western Corridor, especially those living along Merool Lane and Wharparilla Drive and Layfield Downs Estate. The key concerns – in descending order - related to:

- increase in noise;
- environmental degradation;
- increase in air pollution from dust and car fumes;
- reduction in property values; and

- increase in traffic delays along upgraded roads, for example, along Warren Street.

- ***Community Groups and Service Providers***

Among these stakeholders, the major disadvantage expressed with regard to the Western Corridor centred on the loss of business to traders and service providers in Meninya Street. This view was expressed more by those service providers located in the environs of the Central Corridor, not within the designated corridor boundaries. The Moama Bowling Club and the Riverbank Holiday Park are two such service providers who believe business would suffer. The Moama Bowling Club representative believes that the Western Corridor would take 30% of traffic and approximately 10% of their trade.

The manager of one of the holiday parks does not want the Western Corridor option to be constructed. Patrons stay in this holiday park to experience the "peace and quiet" of the area. Another comment was that "passing truck drivers would not stop here – this option would not improve business."

6.4.2 Central Corridor

ADVANTAGES

- ***Residents***

Nine residents who participated in the face-to-face interviews did not believe there were any advantages with this option. They believed it would not take the traffic out of Sturt Street, would not change travel patterns and would not alleviate the "bottleneck in Moama."

On the other hand, comments were made by a number of residents living in Hume and Hovell Streets in East Echuca that an upgrade of Sturt Street is necessary. According to these residents, many heavy vehicles including "B Doubles" and farm machinery such as tractors currently use Hume and Hovell Streets, rather than Sturt Street, in order to avoid the roundabout and narrow turning into Sturt Street. Sturt Street is also considerably narrower than Hume and Hovell Streets. If constructing the central option meant that these residents would no longer be subject to having trucks and the like travelling down their own streets (which are only half sealed), this would be considered a great advantage.

- ***Community Groups and Service Providers***

As already mentioned, there are few community groups or service providers that are in favour of the Central Corridor. Those that can see its advantages include the Moama Bowling Club and Riverbank Holiday Park. They believe they could be disadvantaged if all traffic travelling between Echuca and Moama no longer has to pass their premises.

DISADVANTAGES

- ***Residents***

One of the key concerns raised with this option was the potential for it to exacerbate the traffic conditions along Ogilvie Avenue and at the railway crossings along Sturt Street. Ogilvie Avenue is already felt to be congested, and is considered difficult to make a right hand turn into Ogilvie Avenue from Sturt Street and Hume Street. There are already queues across Sturt Street when the boom gates are down. Sturt Street residents also complained about the current noise level from traffic, the rice mill and the railway yards.

Some of Moama residents also expressed concern over a likely increase in noise with this option and their outlook being affected if another bridge were built beside the existing bridge and a road constructed behind Meninya Street.

- ***Community Groups and Service Providers***

The predominant disadvantage expressed with regard to the Central Corridor was the fact that the heavy vehicle traffic and its associated impacts such as congestion, noise, and pedestrian, cyclist and vehicular safety, would not be removed from the centres of Echuca and Moama.

Schools and pre-schools also believed that this option would not alleviate the traffic issues within the town centres. Children and students travel on foot and by bicycle throughout Echuca and Moama. The volume and speed of traffic travelling through the Meninya Street shopping centre and around the roundabouts on either side of the existing bridge in particular, is already of concern to those schools and pre-schools who have children in those areas. Children and teenagers can be unpredictable, and trucks often travel too fast and are slow to stop. To make a decision to continue to funnel traffic through such areas seems like 'madness' to these groups.

The principal of Echuca High School was also concerned that an additional intersection would have to be constructed on the Moama side of the existing bridge which would be yet another obstacle for students to have to negotiate. In addition, he was concerned that the new approach road to the second river crossing, which would be constructed between Meninya Street and the Murray River, would create a dangerous island of the existing children's playground and skate ramp.

The Minister of the Church of Christ, located on Sturt Street, is concerned about any impacts the upgrade of Sturt Street and the associated increase in traffic volumes would have on noise during sermons, on car parking availability, and on the safety of congregation members crossing Sturt Street. He was also concerned that members of his congregation and other users of the Church facilities, many of whom live in East Echuca, (including Sturt Street), would be affected by an increase in traffic along Sturt Street.

The Port of Echuca representative has concerns regarding the Central Corridor for a number of reasons. First, about any impact that a second river crossing in the vicinity of the Port would have on the views that are currently enjoyed toward the existing 'historic' bridge which is part of the "Port experience." Secondly, concerns that any increase in traffic in the historic precinct would detract from the experience of visiting the area as a tourist, and thirdly is concerned about the impact of increased traffic on the capacity to develop a national heritage transport centre

linking the Port of Echuca and the Echuca Rail Centre Complex. The Port representative is also concerned about any impact that new bridge pylons would have on river currents. It is essential that paddlesteamers be able to continue to safely navigate the river.

- ***Traders and Business Operators***

The owner/manager of Madison Spa Motel is very concerned that the Central Corridor option would diminish the quality of stay that visitors have to the motel, and thus affect business. The motel, which is very new, was designed such that it is buffered from existing Meninya Street traffic noise, and so that every room enjoys bushland views.

The Moama Riverside Holiday Park manager feels that as they are located between the river/lagoon and the existing vehicle and road bridges, the Park would be destroyed should this corridor option be constructed. The manager is concerned about how they would be compensated financially, and about what would happen to the four permanent residents living there. Three of them are elderly, have lived there for years, and have emotional ties to the Park.

The comments made by the manager of the Sundowner Motel, also on Meninya Street, were consistent with the opinions expressed by the other motel operator.

6.4.2 Eastern Corridor

ADVANTAGES

- ***Residents***

This option meets the second consideration for the location of the second crossing, "to be the least disruptive to people" (Section 6.3). There are likely to be fewer people affected by this option. Moreover, it was seen as advantageous for the trucking companies and industry located in that area. It would enable them to take goods directly to and from the Cobb Highway to the Murray Valley Highway, to the saleyards and other industrial plants in Echuca and the trucking depots and industry in Moama.

- ***Community Groups and Service Providers***

Generally speaking, the Eastern Corridor generated a lot less discussion than did the Western and Central Corridors. To a certain degree this was because a lot of the representatives interviewed were not familiar with the area and so had little to say about it.

As already discussed, a number of the community groups and service providers do not have an official position on where they would prefer the second river crossing to be located. However, they did say that they would prefer it to be out of town to improve the traffic conditions and therefore access and safety within and between the two town centres. In terms of meeting these criteria, the Eastern Corridor has advantages.

- ***Traders and Business Operators***

The manager of the Port of Echuca Motel felt that this corridor would be preferable to the Western Corridor as passing traffic travelling north from Melbourne would not completely bypass the centre of Echuca. Traffic would have to travel along Ogilvie Avenue. It would therefore, be more likely to visit Echuca, than bypass the town to the west.

Chanter's Winery located on the corner of Edward Street and Bett Street to the east of Moama would likely benefit from improved access and increased passing trade at their cellar door.

DISADVANTAGES

- ***Residents***

Similarly to the Central Corridor option, this option was not seen as alleviating the local traffic conditions along Ogilvie Avenue.

- ***Community Groups and Service Providers***

Very few comments were made on the disadvantages of this corridor, other than the fact that as it passes through a lot of flood prone land and is longer than the other two corridors, that it would seem to be the most expensive option. This expense factor was seen as a disadvantage by a number of the community groups and service providers, particularly those who rely on government funding.

Echuca and Moama are expanding to the west, yet this corridor is on the opposite side of town and thus not very convenient, was commented on by a small number of service providers, such as the Echuca High School bus coordinator. On the other hand, some groups, and certainly many of the residents interviewed, saw this as being one of the key advantages of the Eastern Corridor.

6.5 PREFERRED CORRIDOR OPTION

The majority of all residents, community groups, service providers, traders, and business associations interviewed believe that a second crossing of the Murray River is required. Those few who do not believe a second crossing is warranted believe that the capacity of the existing bridge needs to be improved.

In terms of where this second river crossing should be located, a variety of views were expressed. These are summarised below.

6.5.1 Residents

- Of the 44 households interviewed face-to-face, some 19 gave the proposed Western Corridor as their preferred option. It is notable that five of the 16 households interviewed along Wharparilla Drive (in houses numbered 118 or more) preferred this western option. However, any acceptable alignment in this Western Corridor would have to be designed to avoid the intersection of Wharparilla Drive and Murray Valley Highway, and would need to be closer to Warren Street. It was also though that Warren Street would need to be upgraded to overcome the existing traffic problems discussed in Section Four.

The Proposed Eastern Corridor Option is preferred next, followed by the proposed Central Corridor Option.

- Of the 17 residents (10 households) interviewed in the Maiden Smith Drive group discussion, the majority preferred the proposed Eastern Corridor Option, followed by a preference for a Western Corridor that is located further west of the existing corridor. They can see the importance of getting heavy vehicle traffic out of the centres of Echuca and Moama, but feel that disruption of one residential area should not be replaced with the disruption of another residential area.
- The five residents (4 households) involved in the Hume and Hovell Street group discussion prefer the proposed Western Corridor Option as it is the straightest run and would be better for trucks.

6.5.2 Community Groups and Service Providers

- Community groups and service providers generally desire a route that bypasses the centres of town. Whilst many of the representatives could not provide an official statement as to the overall preferred option of the organisation they represent, they tended to lean in favour of the proposed Western Corridor Option.

6.5.3 Traders and Business Operators

- While the Echuca and Moama Business and Traders Association generally supported the proposed Western Corridor Option, there is some dissension from this view. Some traders are concerned that traffic is not diverted away from their premises, and thus some favoured the proposed Central Corridor Option.
- The survey of businesses conducted by Saturn Corporate Resources (1999) substantiated these views with 35 businesses supporting the Western Corridor option and an additional six supporting either the Western or Eastern Corridor option. The next most popular option was the Central Corridor Option with 35 businesses in favour of this option. Only 15 businesses preferred the Eastern Corridor option and 14 did not have a preference.

6.5.4 Overall

Overall, there is general agreement that it is important that heavy vehicles and passing traffic be taken out of the centres of Echuca and Moama. Either the proposed Western Corridor or the proposed Eastern Corridor option would satisfy this criterion. On the other hand a number of businesses, particularly those located in the environs of Meninya Street, feel that this traffic is essential to keep the businesses of Meninya Street viable.

In terms of taking into consideration other criteria, for example:

- the growing population of Echuca and Moama with areas developing to the west of both towns; and
- alleviating the general heavy vehicle traffic flow between the Northern Highway and the Cobb Highway,

the overall consensus was that it would 'make sense' to locate the river crossing within the Western Corridor even though some of the residents of Wharparilla Drive, and all residents interviewed along Merool Lane and Maiden Smith Drive would disagree with this view. They also believed that this option would have considerable impact on the environmental values of this area.

7.1 INTRODUCTION

Impact prediction may be defined as the identification and measurement of the various consequences of implementing a particular course of action. The social changes are likely to be caused by changes – direct and indirect – to the environment in the study area. The assessment of the social impacts and effects expected to be generated is based on the findings of the research discussed in the previous sections of this report and the findings from other specialist studies carried out to date, that is:

- Qualitative data: the subjective measurement of the communities' awareness, knowledge and understanding of the proposed Second Murray River Crossing as well as their attitudes, beliefs and values with regard to each corridor option and their effects on the existing social environment.
- Quantitative data: demographic characteristics, usage patterns of facilities and services, technical information from other specialist studies:
  - Saturn Corporate Resources, *Murray River Crossing at Echuca/Moama Business and Tourism Study Final Report, December 1999*;
  - Marshall Day Associates, *Murray River Crossing at Echuca/Moama Ambient Noise Survey, December 1999;*
  - Biosis Research, *Stage One Overview Report – Flora and fauna assessment of proposed second river crossing at Echuca/Moama Victoria and New South Wales, December 1999;*
  - Austral Heritage Consultants, *Murray River Crossing at Echuca/Moama Planning Study: Cultural Heritage Study Background Report*, January 2000; and
  - Phillip Liston and Associates, *Murray River Crossing at Echuca/Moama Planning Study Landscape Assessment,* December 1999.

The impact categories and some of the possible measures of effect that have been considered in the preliminary Stage One analysis of the three corridor options are as follows:

- Number and characteristics of people affected: the change in population size and socio-economic profile of the area by:
  - change processes, that is, the number of people affected or subjected directly to changed conditions and living environment.
- Social patterns and linkages: likely change in how an area functions as a community, that is:
  - the amount of social interaction;
  - personal relationships within an area; and
  - feeling of belonging or identifying with an area.
- Access: change in movement patterns and conditions on local roads – perceived and actual – which affect access and usage of facilities.

- Safety (actual and perceived):
  - change in physical conditions that affect safety or perceptions of safety when moving about the area.
- General amenity (perceived and actual): change in the physical conditions that affect:
  - the quality of the environment and residential amenity, for example, change in views and/or outlook, noise level, privacy.
  - change in recreation development and opportunities.
  - communities' level of satisfaction with the environment with any:
  - change to the area's attractiveness and recreational opportunities;
  - change in the Aboriginal archaeological resources and other cultural resources and its effect on the heritage value to the community; and
  - change in the flora and fauna and its effect on the environment.
  - reduction in the overall value of the area for future generations.

7.2 NUMBER AND CHARACTERISTICS OF PEOPLE AFFECTED

7.2.1 Western Corridor

The proposed Western Corridor stretches on both sides of the Murray River and takes in an area with predominantly large houses and large blocks of land along Merool Lane. It also abuts, but does not encompass Wharparilla Drive, Maiden Smith Drive and Layfield Downs Estate. The number of dwellings – including permanent residences and holiday homes – that are within the immediate environs of the corridor boundary and households who could be affected – directly or indirectly – or subjected to changed conditions in their living environment are as follows:

- Merool Lane - 5
- Wharparilla Drive - 61
- Layfield Downs Estate - 25
- Maiden Smith Drive – 22.

According to the survey results the socio-economic characteristics of this population tend to:

- be newcomers as well as those who have lived in the Echuca-Moama area for more than ten years;
- be at the more mature or late stage of the life cycle with children living at home or older couple, retired with no children living at home;
- have completed secondary school or carried out a trade(s) course as their highest level of education attained;
- be working full time or retired;
- be self-employed and working in skilled trades occupations; and

- be Australian born.

Also found within the environs of the Western Corridor is 1000 hectares of land west of Echuca, west of the Murray Valley Highway zoned for *future residential.* Some 160 hectares of this land or 1200 lots will be developed as Stage 1. This stage is expected to commence development in the year 2000 and is likely to contribute some 3,200 persons to the overall population growth over the next fifteen years.

There is also residential development proposed west of the Moama township.

7.2.2 Central Corridor

The number of dwellings or households who could be affected – directly or indirectly – or subjected to changed conditions in their living environment within the proposed boundary of the Central Corridor option and immediate environs are as follows:

- Sturt Street - 51
- Junction of Boundary Road and Meninya Street, Moama – 3
- Moama Riverside Holiday Park – 4 permanent residents and 52 annuals
- Riverbank Holiday Park – no permanent residents.

According to the survey results socio-economic characteristics of this population can be described as:

- being more established with more households who have lived in the Echuca-Moama area for at least ten years and many for more than 20 years;
- at the late stage of the life cycle, retired with no children living at home;
- having completed secondary school and/or at least Year Nine with very few having undertaken a formal apprenticeship or tertiary education; and
- mainly Australian born.

7.2.3 Eastern Corridor

The number of dwellings or households who could be affected – directly or indirectly - or subjected to changed conditions in their living environment is ten.

Survey respondents included:

- a semi-retired farmer, a caravan park and winery owner/operator, a stud owner/manager, a plumber and two persons involved in the transport or trucking industry;
- at the mature stage of the life cycle with older children living at home;
- persons having completed secondary school and/or skill trades course;
- with the exception of one interviewee, Australian born.

In summary, the actual number and characteristics of people or households potentially affected – directly or indirectly – will be determined in the second stage of the assessment when the alignment options are considered. The most important information gleaned from the investigation and consultation processes undertaken to date, and which needs to be further considered in the second stage is:

- the proposed Western Corridor Option and environs contains those areas zoned for future residential growth;
- the proposed Central Corridor Option and environs will affect the greatest number of households indirectly and directly. Moreover, they are likely to be in the more *vulnerable* category, older and of lower socio-economic status; and
- the proposed Eastern Corridor Option and environs will affect the least number of households, indirectly and directly.

7.3 SOCIAL PATTERNS AND LINKAGES

A key determinant of the nature and extent of effects on social patterns and linkages will be the extent of any severance to or change in local based road patterns to the facilities and services.

7.3.1 Western Corridor

The proposed Western Corridor Option is situated within and in proximity to the existing and proposed residential growth areas within Echuca and Moama. The RSL & Citizens Club, winery and two caravan parks also own land within the corridor. An alternative river crossing in this location would facilitate social interaction patterns and linkages for many of the existing residents and those who will live in areas zoned as future residential, particularly if Warren Street is upgraded.

7.3.2 Central Corridor

The proposed Central Corridor Option is situated within an established residential area. It also backs onto two caravan parks and two motels; and encompasses a children's playground and skate ramp and part of the Echuca-Moama historic precinct, including the Port of Echuca. While access would not be severed, the upgraded road along Sturt Street and the newly constructed road behind Meninya Street could act as a psychological barrier to movement patterns and in turn social interaction and community linkages. In other words, social interaction patterns and linkages for some of the existing residents, particularly those living in Sturt Street and Echuca east, may not be facilitated and the Moama Town Centre would be dislocated from the river.

7.3.3 Eastern Corridor

The proposed Eastern Corridor Option is situated in an area that is mainly broad acre farming. Notwithstanding, there are some residences where the corridor joins the Murray Valley Highway. Social interaction patterns and linkages would not be facilitated to any great degree for the Echuca-Moama residents with this option.

7.4 IMPACT ON EXISTING ACCESS AND SAFETY

Impact on access relates to existing movement patterns about an area, to and from local facilities and regional facilities, including tourism attractions and facilities in the Echuca-Moama area.

Travel patterns, access to and usage of local facilities are already affected by vehicular traffic within the Echuca-Moama area. To reiterate:

- unnecessary heavy vehicles passing through the centre of Echuca and Moama;
- traffic congestion and delays leading up to and on the existing bridge;
- conflict between pedestrians and vehicles at the roundabouts on either side of the bridge;
- existing traffic conditions impede access – on foot or bicycle in particular – to community facilities;
- bridge delays or closures due to an accident or repair work can hamper employee, student and visitor ability to access various community facilities. Bridge delays or closures can reduce access for emergency vehicles travelling between Echuca and Moama;
- unsafe intersections, for example, Warren Street/Murray Valley Highway, Sturt Street/Ogilvie Avenue, Hume Street/Ogilvie Avenue, Sturt Street/Pakenham Street/railway crossing, High Street, particularly for students travelling to and from school on foot and by bicycle, older people, people with young children and people with mobility problems;
- potential for a chemical spill in the centre of Echuca or Moama or on the existing bridge.
- pedestrian movement is impeded across Meninya Street – even at the pedestrian crossing –by fast travelling trucks; and
- vehicular movement in Meninya Street in terms of parking and reversing out of car parks is very difficult as a result of the fast travelling traffic.

7.4.1 Western Corridor

The proposed Western Corridor Option could alleviate some of these access issues. Moreover, consistent with the communities' most important criterion that should be considered when deciding on the location of the bridge, 'getting the heavy vehicles out of the town centre,' it would be the preferred option, except for some residents living in the Western Corridor and environs and some business operators. However, careful consideration would need to be given to the upgrading of Warren Street, an important access route to key facilities, including secondary and primary schools, for example, Echuca High School, Roman Catholic College, Echuca Primary School, etc.

7.4.2 Central Corridor

The proposed Central Corridor Option could exacerbate some of these issues. In fact, while it may alleviate the existing traffic conditions on Meninya Street, the upgrading of Sturt Street could dislocate the community and create a division or psychological barrier between the east and west of Echuca. (It will also be important that the existing bridge is not totally closed at any time as this could dislocate the community of Moama and impede access to Echuca.)

7.4.3 Eastern Corridor

The proposed Eastern Corridor Option could also alleviate some of these access issues but not to the level of the Western Corridor Option. This is not where the residential growth is occurring. Moreover, the main facilities and services are located in the western part of Echuca, that is, west of Sturt Street. Ogilvie Avenue will also need upgrading. It is also noteworthy that key recreational and medical facilities, for example, Echuca Bowling Club, Hospital and Ogilvie Avenue Medical Practice are located on this road.

7.5 IMPACT ON GENERAL AMENITY

General amenity is the perceived value of an area to a community in terms of its residential, landscape, conservation and recreational value. The second river crossing must therefore endeavour to minimise disturbance – noise, air quality, visual intrusion, etc. – in areas of high value to the community.

7.5.1 Residential Value

- ***Western Corridor***

Residents living within the western corridor and environs valued the peace and quiet of their living environment. Existing ambient noise monitoring conducted by Marshall Day Associates, *Murray River Crossing at Echuca/Moama Ambient Noise Survey, December 1999,* in Wharparilla Drive and Merool Lane indicated that the L_{10} 18hr or average intrusive noise level between 0600 and 2400hrs was 49 and 43 respectively. Without knowing the projected traffic flow and associated noise levels with the new road and the number of houses within a particular distance of the route alignment, it is difficult to say what the impact on residential amenity will be at this stage. However, if the existing ambient noise levels are taken into account, impact on residential amenity in this corridor could be greater than in the other two corridors. That is more households could be subjected to changed conditions associated with noise but this would depend on the location of the residences and their proximity to the route alignment. If the route alignment were too close to houses, particularly along Merool Lane and the Layfield Downs Estate, it could also affect the area's attractiveness for residential development.

- ***Central Corridor***

Generally the Central Corridor residents currently experience higher ambient noise levels than the Western Corridor residents. The noise monitoring indicated that the L10 18hr or average intrusive noise level between 0600 and 2400hrs was 64 at 86 Sturt Street, 54 at Riverside Caravan Park and 49 at Madison Spa. Again, without knowing the projected traffic flow and associated noise levels with the new road and the number of houses within a particular distance of the route alignment, it is difficult to say what the impact on residential amenity will be at this stage. However, if the existing ambient noise levels are taken into account, the change in the ambient noise level is unlikely to be as marked for the greater part of this corridor option, in particular along Sturt Street. Residents already endure noise pollution from traffic, industry, trains and railyards (refer Section 5.2.3). Notwithstanding, there would be many more households subjected to the changed conditions associated with the noise as there are likely to be

more houses located within 100 metres of any proposed route alignment. This would certainly affect the area's attractiveness as a place to live.

- ***Eastern Corridor***

Generally the Eastern Corridor residents living along Ogilvie Avenue (35-45 and 305-309) and Mitchell Road (Lot 1) and corner of Mary Anne Road and Goulburn Road currently ~~do not~~ experience higher ambient noise levels than the Western Corridor residents. The noise monitoring indicated that the L10 18hr or average intrusive noise level between 0600 and 2400hrs was 61, 71, 58 and 53 at these three locations. Again, without knowing the projected traffic flow and associated noise levels with the new road and the number of houses within a particular distance of the route alignment, it is difficult to say what the impact on residential amenity will be at this stage. However, if the existing ambient noise levels are taken into account, the change in the ambient noise level is unlikely to be as marked for the greater part of this corridor option as for the Western Corridor. Notwithstanding, there would be many households along Ogilvie Avenue/Mitchell Road subjected to the changed conditions associated with the noise. Moreover, these households would be located within 100 metres of any proposed route alignment.

7.5.2 Landscape Value

- ***Western Corridor***

The proximity to the river and the natural bushland were especially important to residents living within the Western Corridor and environs who participated in the survey. It is also notable that the landscape assessment prepared by Phillip Liston and Associates is consistent with the residents' opinions. The assessment indicated that the areas surrounding the Murray River in this corridor are of high landscape value. In fact, the report states:

> *"The visual and physical impacts on areas of high landscape value surrounding the Murray River will be significant compared with the other corridor option* (p.71)."

It is also significant that the report highlights:

> *"The majority of the Western Corridor has little physical or visual relationship to existing road reserves and land use patterns with the exception of Merool Lane – resulting in the creation of a potential "barrier" across the landscape* (p.71)."

In other words, the Western Corridor Option could potentially affect the landscape value of not only the Murray River and environs but also Wharparilla Flora Reserve, the views and natural environment of the Wharparilla Drive residents and the existing and future residential areas both north and south of the river crossing.

- ***Central Corridor***

Residents living north of the Murray River in particular certainly appreciated the river environs. However, unlike the Western Corridor, a large part of the possible road development would be undertaken utilising the existing road network. Moreover, there are less visual impacts associated with a second river crossing further upstream or downstream as this part of the river

environs is highly modified. Notwithstanding, as stated in the landscape assessment report, there would still be the negative implications for residents along the Sturt Street end, and a road developed behind Meninya Street could dislocate the Moama Town Centre, including the two motels and holiday park, from the river. In fact, the road could certainly impact on the existing visual amenity valued by these accommodation options as well as the Moama Riverside Caravan Park.

- ***Eastern Corridor***

As stated in the landscape assessment report:

> *"With the exception of the most western end of the corridor, future holiday development within the corridor will be limited, though the landscape character along the corridor is unlikely to dramatically change in the short to medium future* (p.71)."

In other words, the residential environment from a landscape or visual perspective will not be affected to any great degree especially as there are fewer residents living in the Eastern Corridor compared with the Western or Central corridors.

7.5.3 Environmental and Conservation Value

- ***Western Corridor***

Residents living in the Western Corridor and environs who participated in the survey liked living near the river, the outlook from their properties and the landscape quality of their living environment, that is, trees, bushland and bird life. It is also notable that the investigations carried out by Biosis Research in their *Stage One Overview Report – Flora and fauna assessment of proposed second river crossing at Echuca/Moama Victoria and New South Wales, December 1999,* indicated:

> *"The Western Corridor is the most environmentally significant, even without taking into account the Wharparilla Flora Reserve. The Flora Reserve, which supports rare native plants in an extensively and altered landscape, is irreplaceable for conservation. It is noted that the Western Corridor is the widest corridor and thus could contain more species and environmental values due to this alone (p.27)."*

The Western Corridor also "contains areas of natural value on both sides of the Murray River associated with the Murray River flood plain riverine environment...and also contains values away from the flood plain (Riverina Plains Grassland, Grey Box Woodland respectively) (p27)."

Residents did not raise any issues relating to cultural heritage sites and places and the perceived value. However, it is significant that Austral Heritage Consultants in their background report, *Murray River Crossing at Echuca/Moama Planning Study: Cultural Heritage Study,* January 2000, indicated that the Western Corridor contains most of the Aboriginal sites (11) and also a number of post contact places (3).

- ***Central Corridor***

Similar to the residents of the Western Corridor, residents of the Central Corridor and environs also focussed on their proximity to the river and its environs. However, other features raised as things they liked about the area, for example, access to work, shops, etc. were probably perceived as equally as important or more important. The investigations carried out by Biosis Research indicated that this area is not as environmentally significant in terms of habitat corridor, flora and fauna values, as either the Western or Eastern Corridors.

Residents of this corridor also did not raise any issues of archaeological and heritage interest. Notwithstanding, Austral Heritage Consultants stated the Central Corridor contains most of the post-contact places (10) but the least number of Aboriginal sites (2).

- ***Eastern Corridor***

Residents of this area did not place as much emphasis on the river and environs as being important features of their living environment. However, in terms of both flora and fauna values and therefore natural heritage value this corridor was ranked 'intermediate' by Biosis Research.

In terms of archaeological and heritage interest, Austral Heritage Consultants indicated that this corridor option contained two Aboriginal sites and two post contact places.

7.5.4 Recreational Value

- ***Western Corridor***

Key recreational facilities are located within or adjacent to this corridor, for example, RSL & Citizens Club, Moama Sports Club. Access to these facilities and development of other recreational opportunities, particularly within the Echuca-Moama historic precinct, would be facilitated by an alternative river crossing in this corridor. At the same time the perceived attractiveness and recreational value of the river and environs could be reduced.

- ***Central Corridor***

The Port of Echuca is of special interest to all residents. The proposed Central Corridor option could exacerbate travel patterns and access to facilities and services including the Port of Echuca and its activities, children's playground and skate ramp. This option would therefore reduce the further development of planned recreational and tourism opportunities within the historic Echuca-Moama precinct as well as the perceived attractiveness and recreational value of the river and environs, including the Moama Jetty. The existing views from the Port would also be interrupted. As stated in the landscape assessment report:

> *"Replacing existing trees (on the eastern side of the existing rail bridge) with a main bridge abutment on the north bank will have severe visual impacts on the immediate river environs (p.37)."*

- ***Eastern Corridor***

The proposed Eastern Corridor Option could reduce the attractiveness and recreational value of the river and environs.

7.6 SUMMARY

In terms of where the second river crossing should be located and community opinion, there was generally a greater preference for the Western Corridor option among residents, community groups and service providers, traders and business operators. Only some of the Wharparilla Drive residents, Merool Lane and Maiden Smith Drive residents and some business operators opposed this option.

When the social (positive and negative) effects are assessed in the context of the impact categories:

- number and characteristics of people affected;
- social patterns and linkages;
- access and safety; and
- general amenity,

the findings can be summarised as follows:

- ***Number of People Affected***

The Central Corridor option would affect the most people, that is, more households would be subjected directly to changed conditions in their living environment.

- ***Social Patterns and Linkages***

Positive Effects:

The proposed Western Corridor Option would facilitate social interaction patterns and linkages for many of the existing residents and those who live in the areas zoned as future residential, particularly if Warren Street is upgraded.

Negative Effects:

Social interaction patterns and linkages in some of the existing residential areas, particularly in the vicinity of Sturt Street and Echuca east, may not be facilitated and the Moama Town Centre could be dislocated with the Central Corridor Option.

- ***Impact on Existing Access and Safety***

Positive Effects:

The proposed Western Corridor Option and to a lesser extent the Eastern and Central Corridor Options could alleviate some of the access issues.

Negative Effects:

The proposed Eastern Corridor option could exacerbate some of the access issues.

- ***Impact on General Amenity***

Positive Effects:

This will depend on any ameliorative measures that are put in place to address the negative effects.

Negative Effects:

In terms of the impact on general amenity and any change in the physical conditions that affect the general quality of the residential environment, all corridor options have potential negative impacts. However, the Western Corridor Option is the most affected, followed by the Eastern and Central Corridor Options.

Until more detailed analysis is carried out for a number of route alignments within each corridor in Stage Two, it is difficult to be more conclusive as to the preferred corridor option at this stage.

Stage Two of the Social Impact Assessment will comprise:

1. Conduct of assessment of a number of Route Alignments within each Corridor

The assessment will include the development of a quantified catalogue of social benefits and costs of the proposal within the context of each route alignment (in the short and longer term) or development of an evaluation matrix comprising:

- summation and quantification (where possible) of benefits and costs
- identification of relative importance of benefits and costs measured
- identification of the 'winners' and 'losers' in the short and longer term, that is, those adversely and beneficially affected by the proposal and where possible, the value of the impacts on them.

2. Development of strategy for mitigating potentially adverse social effects

- identification of possible mitigating measures
- assessment of likely relevance/application of mitigating measures
- development of strategy for mitigation measures.

Preparation of a report encompassing the three corridors and detailed assessments of a number of route alignment options will be completed.

Appendix 1

Tables – Demographic Characteristics

Murray River Crossing Social Impact Assessment - Demographic Characteristics												
	Echuca				Campaspe LGA				Country Victoria			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Population												
Males	4,612	4,845	233	5.1%	16,471	16,725	254	1.5%	607,304	612,411	5,107	0.8%
Females	4,838	5,169	331	6.8%	16,301	16,595	294	1.8%	614,445	622,962	8,517	1.4%
Persons	9,450	10,014	564	6.0%	32,772	33,320	548	1.7%	1,221,749	1,235,373	13,624	1.1%
Households	3,368	3,742	374	11.1%	11,267	12,030	763	6.8%	416,078	444,158	28,080	6.7%
Age - Males												
0-4	394	370	(24)	-6.1%	1,351	1,340	(11)	-0.8%	50,381	46,978	(3,403)	-6.8%
5-9	417	375	(42)	-10.1%	1,480	1,336	(144)	-9.7%	51,203	50,145	(1,058)	-2.1%
10-14	338	414	76	22.5%	1,398	1,468	70	5.0%	51,118	51,348	230	0.4%
15-19	332	292	(40)	-12.0%	1,254	1,136	(118)	-9.4%	49,284	45,767	(3,517)	-7.1%
20-24	274	282	8	2.9%	1,062	928	(134)	-12.6%	42,131	38,606	(3,525)	-8.4%
25-29	332	349	17	5.1%	1,094	1,070	(24)	-2.2%	42,446	38,707	(3,739)	-8.8%
30-34	401	340	(61)	-15.2%	1,231	1,159	(72)	-5.8%	47,560	42,757	(4,803)	-10.1%
35-39	315	388	73	23.2%	1,143	1,237	94	8.2%	46,661	47,063	402	0.9%
40-44	298	321	23	7.7%	1,166	1,176	10	0.9%	44,935	46,412	1,477	3.3%
45-49	243	320	77	31.7%	994	1,175	181	18.2%	34,586	43,826	9,240	26.7%
50-54	211	251	40	19.0%	895	1,011	116	13.0%	29,334	33,783	4,449	15.2%
55-59	177	215	38	21.5%	715	856	141	19.7%	26,066	28,705	2,639	10.1%
60-64	207	208	1	0.5%	781	725	(56)	-7.2%	27,005	25,113	(1,892)	-7.0%
65-69	220	218	(2)	-0.9%	709	697	(12)	-1.7%	23,636	24,656	1,020	4.3%
70-74	195	221	26	13.3%	528	601	73	13.8%	16,946	20,360	3,414	20.1%
75+	239	260	21	8.8%	690	775	85	12.3%	23,322	26,528	3,206	13.7%
Total Males	4,593	4,824	231	5.0%	16,491	16,690	199	1.2%	606,614	610,754	4,140	0.7%

Data Source: ABS 1991 and 1996 Census

Murray River Crossing Social Impact Assessment - Demographic Characteristics												
	Echuca				Campaspe LGA				Country Victoria			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Age - Females												
0-4	351	352	1	0.3%	1,213	1,223	10	0.8%	47,891	44,748	(3,143)	-6.6%
5-9	342	353	11	3.2%	1,318	1,240	(78)	-5.9%	48,967	47,818	(1,149)	-2.3%
10-14	323	376	53	16.4%	1,323	1,332	9	0.7%	48,660	48,790	130	0.3%
15-19	308	310	2	0.6%	1,097	1,077	(20)	-1.8%	46,214	42,700	(3,514)	-7.6%
20-24	322	278	(44)	-13.7%	968	805	(163)	-16.8%	40,506	36,302	(4,204)	-10.4%
25-29	346	339	(7)	-2.0%	1,098	1,016	(82)	-7.5%	43,905	39,118	(4,787)	-10.9%
30-34	393	363	(30)	-7.6%	1,197	1,160	(37)	-3.1%	49,380	45,278	(4,102)	-8.3%
35-39	329	394	65	19.8%	1,218	1,218	-	0.0%	46,874	49,208	2,334	5.0%
40-44	298	371	73	24.5%	1,090	1,255	165	15.1%	43,238	46,408	3,170	7.3%
45-49	247	307	60	24.3%	985	1,085	100	10.2%	33,250	42,028	8,778	26.4%
50-54	229	255	26	11.4%	873	942	69	7.9%	28,383	32,724	4,341	15.3%
55-59	223	220	(3)	-1.3%	781	810	29	3.7%	25,639	27,938	2,299	9.0%
60-64	208	254	46	22.1%	749	765	16	2.1%	26,811	25,086	(1,725)	-6.4%
65-69	277	248	(29)	-10.5%	711	697	(14)	-2.0%	25,783	25,639	(144)	-0.6%
70-74	207	258	51	24.6%	609	654	45	7.4%	20,899	24,109	3,210	15.4%
75+	423	480	57	13.5%	1,092	1,284	192	17.6%	37,608	43,235	5,627	15.0%
Total Females	4,826	5,158	332	6.9%	16,322	16,563	241	1.5%	614,008	621,129	7,121	1.2%

Data Source: ABS 1991 and 1996 Census

Murray River Crossing Social Impact Assessment - Demographic Characteristics												
	Echuca				Campaspe LGA				Country Victoria			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Age - Persons												
0-4	745	722	(23)	-3.1%	2,564	2,563	(1)	0.0%	98,272	91,726	(6,546)	-6.7%
5-9	759	728	(31)	-4.1%	2,798	2,576	(222)	-7.9%	100,170	97,963	(2,207)	-2.2%
10-14	661	790	129	19.5%	2,721	2,800	79	2.9%	99,778	100,138	360	0.4%
15-19	640	602	(38)	-5.9%	2,351	2,213	(138)	-5.9%	95,498	88,467	(7,031)	-7.4%
20-24	596	560	(36)	-6.0%	2,030	1,733	(297)	-14.6%	82,637	74,908	(7,729)	-9.4%
25-29	678	688	10	1.5%	2,192	2,086	(106)	-4.8%	86,351	77,825	(8,526)	-9.9%
30-34	794	703	(91)	-11.5%	2,428	2,319	(109)	-4.5%	96,940	88,035	(8,905)	-9.2%
35-39	644	782	138	21.4%	2,361	2,455	94	4.0%	93,535	96,271	2,736	2.9%
40-44	596	692	96	16.1%	2,256	2,431	175	7.8%	88,173	92,820	4,647	5.3%
45-49	490	627	137	28.0%	1,979	2,260	281	14.2%	67,836	85,854	18,018	26.6%
50-54	440	506	66	15.0%	1,768	1,953	185	10.5%	57,717	66,507	8,790	15.2%
55-59	400	435	35	8.8%	1,496	1,666	170	11.4%	51,705	56,643	4,938	9.6%
60-64	415	462	47	11.3%	1,530	1,490	(40)	-2.6%	53,816	50,199	(3,617)	-6.7%
65-69	497	466	(31)	-6.2%	1,420	1,394	(26)	-1.8%	49,419	50,295	876	1.8%
70-74	402	479	77	19.2%	1,137	1,255	118	10.4%	37,845	44,469	6,624	17.5%
75+	662	740	78	11.8%	1,782	2,059	277	15.5%	60,930	69,763	8,833	14.5%
Total Persons	9,419	9,982	563	6.0%	32,813	33,253	440	1.3%	1,220,622	1,231,883	11,261	0.9%
Motor Vehicles												
None	436	426	(10)	-2.3%	938	956	18	1.9%	39,484	39,711	227	0.6%
1	1,439	1,593	154	10.7%	4,170	4,302	132	3.2%	159,602	167,929	8,327	5.2%
2	1,201	1,324	123	10.2%	4,237	4,600	363	8.6%	153,878	163,823	9,945	6.5%
3 or more	296	305	9	3.0%	1,893	1,875	(18)	-1.0%	63,798	61,734	(2,064)	-3.2%
Not Stated	65	195	130	200.0%	191	545	354	185.3%	9,587	21,124	11,537	120.3%
Total households	3,437	3,843	406	11.8%	11,429	12,278	849	7.4%	426,349	454,321	27,972	6.6%
Average (mean)	1.51	1.46	-0.05	-3.3%	1.85	1.79	-0.06	-3.2%	1.77	1.70	-0.07	-4.0%
Value for 3+ set at 4.5												

Murray River Crossing Social Impact Assessment - Demographic Characteristics												
	Echuca				Campaspe LGA				Country Victoria			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Occupation												
Managers/Administrators	439	258	(181)	-41.2%	3,860	3,103	(757)	-19.6%	86,470	69,224	(17,246)	-19.9%
Professionals	381	574	193	50.7%	1,074	1,519	445	41.4%	49,971	69,866	19,895	39.8%
Para-professionals	206	582	376	182.5%	647	1,386	739	114.2%	32,100	56,212	24,112	75.1%
Trades, Plant & machine operators & drive	918	569	(349)	-38.0%	2,831	1,727	(1,104)	-39.0%	107,003	67,421	(39,582)	-37.0%
Clerical, sales & service workers	1,080	1,135	55	5.1%	2,736	2,916	180	6.6%	116,874	122,405	5,531	4.7%
Labourers & related workers	523	832	309	59.1%	1,601	2,721	1,120	70.0%	60,431	94,219	33,788	55.9%
Inadequately Described	33	27	(6)	-18.2%	69	85	16	23.2%	6,151	4,470	(1,681)	-27.3%
Not Stated	197	58	(139)	-70.6%	770	286	(484)	-62.9%	26,511	9,426	(17,085)	-64.4%
Total Employed	3,777	4,035	258	6.8%	13,588	13,743	155	1.1%	485,511	493,243	7,732	1.6%
Birthplace												
Australian Born	8665	9012	347	4.0%	30172	30252	80	0.3%	1073733	1067373	-6360	-0.6%
OSB-English Speaking Country	379	385	6	1.6%	1178	1078	-100	-8.5%	64417	61248	-3169	-4.9%
OSB- Not English Speaking Country	220	250	30	13.6%	969	922	-47	-4.9%	65292	63389	-1903	-2.9%
Not stated BPL	164	236	72	43.9%	415	740	325	78.3%	20253	32829	12576	62.1%
Total	9428	9883	455	4.8%	32734	32992	258	0.8%	1223695	1224839	1144	0.1%
Ancestry												
Aboriginal & Torres Strait Islanders	255	273	18	7.1%	378	449	71	18.8%	8770	10749	1979	22.6%
Employment Status												
Employed	3735	4032	297	8.0%	13577	13743	166	1.2%	485797	493243	7446	1.5%
Unemployed	485	316	-169	-34.8%	1560	1060	-500	-32.1%	66682	56564	-10118	-15.2%
Not in the Labour Force	2957	3293	336	11.4%	9182	10148	966	10.5%	352553	372882	20329	5.8%
Unemployment Rate	11.5	7.3	-4.2	-36.8%	10.3	7.2	-3.1	-30.5%	12.1	10.3	-1.8	-14.8%
Participation Rate	58.3	56.2	-2.2	-3.7%	61.3	58.5	-2.8	-4.6%	59.8	58.4	-1.5	-2.4%

Data Source: ABS 1991 and 1996 Census

Census Applications Pty Ltd 1999

	Murray River Crossing Social Impact Assessment - Demographic Characteristics											
	Echuca				Campaspe LGA				Country Victoria			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Educational Attainment												
MALES												
Degree or higher	185	248	63	34.1%	460	587	127	27.6%	24938	30558	5620	22.5%
Diploma	120	137	17	14.2%	320	403	83	25.9%	16317	21288	4971	30.5%
Skilled Vocational	691	785	94	13.6%	2191	2422	231	10.5%	87175	90839	3664	4.2%
Other	51	57	6	11.8%	233	223	-10	-4.3%	10716	9034	-1682	-15.7%
Not Qualified	2039	2056	17	0.8%	7940	7646	-294	-3.7%	269348	262894	-6454	-2.4%
Inad Described/Not Stated	376	402	26	6.9%	1134	1297	163	14.4%	46234	49171	2937	6.4%
Total	3462	3685	223	6.4%	12278	12578	300	2.4%	454728	463784	9056	2.0%
FEMALES												
Degree or higher	165	273	108	65.5%	527	767	240	45.5%	24461	35761	11300	46.2%
Diploma	233	234	1	0.4%	766	741	-25	-3.3%	32848	32352	-496	-1.5%
Skilled Vocational	99	116	17	17.2%	268	345	77	28.7%	9722	12416	2694	27.7%
Other	114	123	9	7.9%	401	412	11	2.7%	16955	16636	-319	-1.9%
Not Qualified	2716	2815	99	3.6%	8995	8932	-63	-0.7%	331475	325530	-5945	-1.8%
Inad Described/Not Stated	500	527	27	5.4%	1445	1599	154	10.7%	53508	58724	5216	9.7%
Total	3827	4088	261	6.8%	12402	12796	394	3.2%	468969	481419	12450	2.7%
PERSONS												
Degree or higher	350	521	171	48.9%	987	1354	367	37.2%	49399	66319	16920	34.3%
Diploma	353	371	18	5.1%	1086	1144	58	5.3%	49165	53640	4475	9.1%
Skilled Vocational	790	901	111	14.1%	2459	2767	308	12.5%	96897	103255	6358	6.6%
Other	165	180	15	9.1%	634	635	1	0.2%	27671	25670	-2001	-7.2%
Not Qualified	4755	4871	116	2.4%	16935	16578	-357	-2.1%	600823	588424	-12399	-2.1%
Inad Described/Not Stated	876	929	53	6.1%	2579	2896	317	12.3%	99742	107895	8153	8.2%
Total	7289	7773	484	6.6%	24680	25374	694	2.8%	923697	945203	21506	2.3%

Data Source: ABS 1991 and 1996 Census

Murray River Crossing Social Impact Assessment - Demographic Characteristics

	Echuca				Campaspe LGA				Country Victoria			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Tenure Status												
Owned	1,425	1,592	167	11.7%	5,397	5,787	390	7.2%	193,788	211,938	18,150	9.4%
Being purchased	828	902	74	8.9%	2,779	2,989	210	7.6%	113,450	115,776	2,326	2.1%
Rented: Govt	396	331	(65)	-16.4%	770	548	(222)	-28.8%	26,307	18,357	(7,950)	-30.2%
Rented: Other & Not stated	632	805	173	27.4%	1,741	2,046	305	17.5%	66,761	77,761	11,000	16.5%
Total Rented	1,028	1,136	108	10.5%	2,511	2,594	83	3.3%	93,068	96,118	3,050	3.3%
Other & Not stated	148	194	46	31.1%	767	862	95	12.4%	26,076	28,206	2,130	8.2%
Total Occupied Private Dwellings	3,429	3,824	395	11.5%	11,454	12,232	778	6.8%	426,382	452,038	25,656	6.0%
Type of Dwelling												
Separate house*	2,781	3,085	304	10.9%	10,138	10,663	525	5.2%	379,248	400,151	20,903	5.5%
Semi-det, Row/Terrace, etc	332	56	(276)	-83.1%	508	107	(401)	-78.9%	16,618	12,553	(4,065)	-24.5%
Flats - 1 to 2 storey	135	505	370	274.1%	346	954	608	175.7%	17,247	26,114	8,867	51.4%
Flats - 3 storey	-	-	-		-	-	-		248	267	19	7.7%
Medium density dwellings **	467	561	94	20.1%	854	1,061	207	24.2%	34,113	38,934	4,821	14.1%
Flats - 4 or more storeys	-	-	-		-	-	-		104	223	119	114.4%
Caravan, cabin, houseboat	117	123	6	5.1%	269	266	(3)	-1.1%	7,130	5,900	(1,230)	-17.3%
Improvised home/campers	3	-	(3)	-100.0%	16	12	(4)	-25.0%	476	476	-	0.0%
House/flat attach to shop/office	53	65	12	22.6%	130	107	(23)	-17.7%	2,908	2,754	(154)	-5.3%
Not stated	6	21	15	250.0%	46	170	124	269.6%	2,263	5,883	3,620	160.0%
Total Occupied Private Dwellings	3,427	3,855	428	12.5%	11,453	12,279	826	7.2%	426,242	454,321	28,079	6.6%
Family Type/Composition												
Parent & dep child(ren) only	189	216	27	14.3%	462	513	51	11.0%	21,211	22,303	1,092	5.1%
Parent, child(ren), Other	54	202	148	274.1%	115	563	448	389.6%	4,488	22,239	17,751	395.5%
Couple & dep child(ren) only	905	699	(206)	-22.8%	3,354	2,496	(858)	-25.6%	123,057	90,557	(32,500)	-26.4%
Couple, child(ren), Other	120	419	299	249.2%	591	1,952	1,361	230.3%	20,916	70,320	49,404	236.2%
Couple only	889	1,092	203	22.8%	2,972	3,454	482	16.2%	101,822	117,341	15,519	15.2%
Other family	345	34	(311)	-90.1%	1,290	116	(1,174)	-91.0%	46,375	4,264	(42,111)	-90.8%
Total	2,502	2,662	160	6.4%	8,784	9,094	310	3.5%	317,869	327,024	9,155	2.9%

Data Source: ABS 1991 and 1996 Census

Census Applications Pty Ltd 1999

Murray River Crossing Social Impact Assessment - Demographic Characteristics												
	Echuca				Campaspe LGA				Country Victoria			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Household Type												
One Family Household	2,469	2,622	153	6.2%	8,726	8,944	218	2.5%	315,001	322,102	7,101	2.3%
Two Family Household	9	14	5	55.6%	27	69	42	155.6%	1,324	2,425	1,101	83.2%
Three Family Household	-	-	-		-	-	-		21	23	2	9.5%
Group Household	119	156	37	31.1%	283	320	37	13.1%	13,092	14,026	934	7.1%
Lone Person Household	771	950	179	23.2%	2,231	2,697	466	20.9%	86,640	105,582	18,942	21.9%
Total Households	3,368	3,742	374	11.1%	11,267	12,030	763	6.8%	416,078	444,158	28,080	6.7%
Household Size												
1 or 2	1,887	2,329	442	23.4%	5,864	6,848	984	16.8%	217,521	253,283	35,762	16.4%
3 or 4	1,108	1,081	(27)	-2.4%	3,754	3,646	(108)	-2.9%	140,271	137,828	(2,443)	-1.7%
5 or more	368	341	(27)	-7.3%	1,702	1,544	(158)	-9.3%	58,596	53,048	(5,548)	-9.5%
Total households	3,363	3,751	388	11.5%	11,320	12,038	718	6.3%	416,388	444,159	27,771	6.7%
Average household size	2.85	2.67	-0.18	-6.3%	3.08	2.90	-0.18	-5.8%	3.03	2.87	-0.16	-5.3%
Value for 5+ set at 7												
Medians*												
Median Individual Annual Income	$13,500	$13,900	$400	3.0%	$13,300	$13,400	$100	0.8%	$13,500	$13,100	($400)	-3.0%
Median Family Annual Income	$31,900	$30,800	($1,100)	-3.4%	$31,800	$31,600	($200)	-0.6%	$32,900	$31,800	($1,100)	-3.3%
Median Household Annual Income	$25,800	$26,200	$400	1.6%	$26,700	$26,900	$200	0.7%	$27,800	$26,900	($900)	-3.2%
Median Monthly Mortgage	$505	$650	$145	28.7%	$542	$642	$100	18.5%	$536	$617	$81	15.1%
Median Weekly Rent	$105	$116	$11	10.5%	$83	$100	$17	20.5%	$95	$100	$5	5.3%
**1991 converted to $1996*												

Data Source: ABS 1991 and 1996 Census

Census Applications Pty Ltd 1999

Murray River Crossing Social Impact Assessment - Demographic Characteristics												
	Moama				Murray LGA				Country NSW			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Population												
Males	1,129	1,213	84	7.4%	2,586	2,703	117	4.5%	1,096,841	1,144,440	47,599	4.3%
Females	1,129	1,256	127	11.2%	2,421	2,616	195	8.1%	1,096,617	1,152,966	56,349	5.1%
Persons	2,258	2,469	211	9.3%	5,007	5,319	312	6.2%	2,193,458	2,297,406	103,948	4.7%
Households	795	922	127	16.0%	1,702	1,877	175	10.3%	739,887	819,043	79,156	10.7%
Age - Males												
0-4	78	94	16	20.5%	192	177	(15)	-7.8%	89,138	85,897	(3,241)	-3.6%
5-9	90	77	(13)	-14.4%	201	212	11	5.5%	89,660	90,769	1,109	1.2%
10-14	65	97	32	49.2%	170	199	29	17.1%	86,383	90,794	4,411	5.1%
15-19	63	62	(1)	-1.6%	162	148	(14)	-8.6%	84,083	80,529	(3,554)	-4.2%
20-24	73	79	6	8.2%	165	155	(10)	-6.1%	75,452	73,887	(1,565)	-2.1%
25-29	83	73	(10)	-12.0%	184	149	(35)	-19.0%	77,539	72,348	(5,191)	-6.7%
30-34	101	87	(14)	-13.9%	208	186	(22)	-10.6%	85,895	80,133	(5,762)	-6.7%
35-39	83	107	24	28.9%	190	216	26	13.7%	82,085	87,583	5,498	6.7%
40-44	87	69	(18)	-20.7%	170	188	18	10.6%	78,967	83,773	4,806	6.1%
45-49	69	71	2	2.9%	185	167	(18)	-9.7%	64,022	79,627	15,605	24.4%
50-54	50	70	20	40.0%	153	193	40	26.1%	54,801	64,062	9,261	16.9%
55-59	57	57	-	0.0%	149	156	7	4.7%	49,791	55,723	5,932	11.9%
60-64	55	57	2	3.6%	147	158	11	7.5%	53,827	50,554	(3,273)	-6.1%
65-69	57	63	6	10.5%	112	150	38	33.9%	48,441	51,887	3,446	7.1%
70-74	49	65	16	32.7%	89	120	31	34.8%	35,067	42,906	7,839	22.4%
75+	58	82	24	41.4%	108	126	18	16.7%	41,285	50,503	9,218	22.3%
Total Males	1,118	1,210	92	8.2%	2,585	2,700	115	4.4%	1,096,436	1,140,975	44,539	4.1%

Data Source: ABS 1991 and 1996 Census

Census Applications Pty Ltd 1999

0-4	83	92	9	10.8%	168	201	33	19.6%	84,228	82,232	(1,996)	
5-9	72	81	9	12.5%	166	181	15	9.0%	85,466	86,586	1,120	1.3%
10-14	79	69	(10)	-12.7%	202	177	(25)	-12.4%	81,817	86,170	4,353	5.3%
15-19	70	63	(7)	-10.0%	157	153	(4)	-2.5%	79,089	75,719	(3,370)	-4.3%
20-24	64	89	25	39.1%	140	141	1	0.7%	71,144	69,474	(1,670)	-2.3%
25-29	82	83	1	1.2%	152	163	11	7.2%	77,346	72,228	(5,118)	-6.6%
30-34	93	88	(5)	-5.4%	208	179	(29)	-13.9%	86,836	81,900	(4,936)	-5.7%
35-39	71	95	24	33.8%	156	207	51	32.7%	81,113	89,584	8,471	10.4%
40-44	83	64	(19)	-22.9%	176	155	(21)	-11.9%	75,374	82,324	6,950	9.2%
45-49	54	85	31	57.4%	153	177	24	15.7%	61,371	75,416	14,045	22.9%
50-54	52	65	13	25.0%	118	171	53	44.9%	53,572	61,903	8,331	15.6%
55-59	60	68	8	13.3%	136	161	25	18.4%	50,162	55,199	5,037	10.0%
60-64	68	54	(14)	-20.6%	151	131	(20)	-13.2%	53,746	51,609	(2,137)	-4.0%
65-69	68	90	22	32.4%	115	147	32	27.8%	50,687	52,993	2,306	4.5%
70-74	61	68	7	11.5%	101	111	10	9.9%	40,604	47,564	6,960	17.1%
75+	84	100	16	19.0%	129	156	27	20.9%	64,048	78,136	14,088	22.0%
Total Females	1,144	1,254	110	9.6%	2,428	2,611	183	7.5%	1,096,603	1,149,037	52,434	4.8%

Data Source: ABS 1991 and 1996 Census

Census Applications Pty Ltd 1999

Value for 3+ set at 4.5			

Data Source: ABS 1991 and 1996 Census

Census Applications Pty Ltd 1999

Murray River Crossing Social Impact Assessment - Demographic Characteristics

	Moama				Murray LGA				Country NSW			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Occupation												
Managers/Administrators	142	77	(65)	-45.8%	631	554	(77)	-12.2%	121,870	94,170	(27,700)	-22.7%
Professionals	63	83	20	31.7%	136	197	61	44.9%	85,232	128,338	43,106	50.6%
Para-professionals	47	140	93	197.9%	89	239	150	168.5%	53,602	97,157	43,555	81.3%
Trades, Plant & machine operators & drive	220	163	(57)	-25.9%	386	257	(129)	-33.4%	191,672	124,725	(66,947)	-34.9%
Clerical, sales & service workers	279	327	48	17.2%	473	485	12	2.5%	217,150	238,530	21,380	9.8%
Labourers & related workers	111	203	92	82.9%	272	447	175	64.3%	120,801	176,689	55,888	46.3%
Inadequately Described	24	14	(10)	-41.7%	33	34	1	3.0%	9,012	7,670	(1,342)	-14.9%
Not Stated	39	23	(16)	-41.0%	96	72	(24)	-25.0%	43,940	16,135	(27,805)	-63.3%
Total Employed	925	1,030	105	11.4%	2,116	2,285	169	8.0%	843,279	883,414	40,135	4.8%
Birthplace												
Australian Born	2071	2242	171	8.3%	4650	4829	179	3.8%	1919958	1973675	53717	2.8%
OSB-English Speaking Country	96	90	-6	-6.3%	176	185	9	5.1%	125653	126332	679	0.5%
OSB- Not English Speaking Country	49	54	5	10.2%	92	102	10	10.9%	110412	113756	3344	3.0%
Not stated BPL	46	55	9	19.6%	114	135	21	18.4%	39735	57384	17649	44.4%
Total	2262	2441	179	7.9%	5032	5251	219	4.4%	2195758	2271147	75389	3.4%
Ancestry												
Aboriginal & Torres Strait Islanders	33	84	51	154.5%	152	200	48	31.6%	47415	67047	19632	41.4%
Employment Status												
Employed	907	1034	127	14.0%	2093	2273	180	8.6%	843433	883414	39981	4.7%
Unemployed	109	75	-34	-31.2%	243	180	-63	-25.9%	124007	112835	-11172	-9.0%
Not in the Labour Force	716	806	90	12.6%	1404	1609	205	14.6%	670091	733747	63656	9.5%
Unemployment Rate	10.7	6.8	-4.0	-37.0%	10.4	7.3	-3.1	-29.5%	12.8	11.3	-1.5	-11.6%
Participation Rate	56.8	56.8	0.0	-0.1%	60.0	58.9	-1.1	-1.8%	57.7	56.4	-1.4	-2.3%

Data Source: ABS 1991 and 1996 Census

Census Applications Pty Ltd 1999

	Murray River Crossing Social Impact Assessment - Demographic Characteristics											
	Moama				Murray LGA				Country NSW			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Educational Attainment												
MALES												
Degree or higher	33	34	1	3.0%	58	76	18	31.0%	45729	60273	14544	31.8%
Diploma	20	34	14	70.0%	63	63	0	0.0%	29147	41029	11882	40.8%
Skilled Vocational	178	220	42	23.6%	350	439	89	25.4%	174103	187282	13179	7.6%
Other	24	16	-8	-33.3%	57	35	-22	-38.6%	21420	18844	-2576	-12.0%
Not Qualified	525	542	17	3.2%	1248	1289	41	3.3%	469492	476446	6954	1.5%
Inad Described/Not Stated	108	99	-9	-8.3%	222	212	-10	-4.5%	91402	92676	1274	1.4%
Total	888	945	57	6.4%	1998	2114	116	5.8%	831293	876550	45257	5.4%
FEMALES												
Degree or higher	29	43	14	48.3%	64	101	37	57.8%	39101	60674	21573	55.2%
Diploma	38	45	7	18.4%	127	126	-1	-0.8%	56516	62497	5981	10.6%
Skilled Vocational	17	37	20	117.6%	30	58	28	93.3%	17499	24548	7049	40.3%
Other	29	30	1	3.4%	64	83	19	29.7%	41458	38485	-2973	-7.2%
Not Qualified	661	722	61	9.2%	1335	1438	103	7.7%	574055	588410	14355	2.5%
Inad Described/Not Stated	127	136	9	7.1%	251	250	-1	-0.4%	116363	122948	6585	5.7%
Total	901	1013	112	12.4%	1871	2056	185	9.9%	844992	897562	52570	6.2%
PERSONS												
Degree or higher	62	77	15	24.2%	122	177	55	45.1%	84830	120947	36117	42.6%
Diploma	58	79	21	36.2%	190	189	-1	-0.5%	85663	103526	17863	20.9%
Skilled Vocational	195	257	62	31.8%	380	497	117	30.8%	191602	211830	20228	10.6%
Other	53	46	-7	-13.2%	121	118	-3	-2.5%	62878	57329	-5549	-8.8%
Not Qualified	1186	1264	78	6.6%	2583	2727	144	5.6%	1043547	1064856	21309	2.0%
Inad Described/Not Stated	235	235	0	0.0%	473	462	-11	-2.3%	207765	215624	7859	3.8%
Total	1789	1958	169	9.4%	3869	4170	301	7.8%	1676285	1774112	97827	5.8%

Data Source: ABS 1991 and 1996 Census

Murray River Crossing Social Impact Assessment - Demographic Characteristics

	Moama				Murray LGA				Country NSW			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Tenure Status												
Owned	370	413	43	11.6%	884	959	75	8.5%	353,053	384,548	31,495	8.9%
Being purchased	200	200	-	0.0%	350	376	26	7.4%	167,344	181,943	14,599	8.7%
Rented: Govt	15	12	(3)	-20.0%	30	9	(21)	-70.0%	52,362	43,801	(8,561)	-16.3%
Rented: Other & Not stated	178	230	52	29.2%	332	371	39	11.7%	142,767	173,799	31,032	21.7%
Total Rented	193	242	49	25.4%	362	380	18	5.0%	195,129	217,600	22,471	11.5%
Other & Not stated	48	78	30	62.5%	181	241	60	33.1%	51,899	54,926	3,027	5.8%
Total Occupied Private Dwellings	811	933	122	15.0%	1,777	1,956	179	10.1%	767,425	839,017	71,592	9.3%
Type of Dwelling												
Separate house*	616	699	83	13.5%	1,438	1,579	141	9.8%	640,622	692,038	51,416	8.0%
Semi-det, Row/Terrace, etc	71	18	(53)	-74.6%	74	36	(38)	-51.4%	32,230	45,014	12,784	39.7%
Flats - 1 to 2 storey	103	197	94	91.3%	124	223	99	79.8%	46,196	53,950	7,754	16.8%
Flats - 3 storey	-	-	-		-	-	-		8,690	8,658	(32)	-0.4%
Medium density dwellings **	174	215	41	23.6%	198	259	61	30.8%	87,116	107,622	20,506	23.5%
Flats - 4 or more storeys	-	-	-		3	-	(3)	-100.0%	3,696	4,864	1,168	31.6%
Caravan, cabin, houseboat	20	20	-	0.0%	130	101	(29)	-22.3%	24,205	20,909	(3,296)	-13.6%
Improvised home/campers	-	-	-		8	7	(1)	-12.5%	1,595	2,022	427	26.8%
House/flat attach to shop/office	8	3	(5)	-62.5%	8	7	(1)	-12.5%	6,225	6,021	(204)	-3.3%
Not stated	-	8	8		9	20	11	122.2%	4,201	13,064	8,863	211.0%
Total Occupied Private Dwellings	818	945	127	15.5%	1,794	1,973	179	10.0%	767,660	846,540	78,880	10.3%
Family Type/Composition												
Parent & dep child(ren) only	37	48	11	29.7%	57	87	30	52.6%	41,614	46,535	4,921	11.8%
Parent, child(ren), Other	6	46	40	666.7%	15	83	68	453.3%	9,771	43,652	33,881	346.8%
Couple & dep child(ren) only	200	166	(34)	-17.0%	471	358	(113)	-24.0%	207,224	162,699	(44,525)	-21.5%
Couple, child(ren), Other	33	121	88	266.7%	76	278	202	265.8%	38,041	122,809	84,768	222.8%
Couple only	237	299	62	26.2%	492	615	123	25.0%	186,839	223,730	36,891	19.7%
Other family	67	11	(56)	-83.6%	181	16	(165)	-91.2%	86,587	8,416	(78,171)	-90.3%
Total	580	691	111	19.1%	1,292	1,437	145	11.2%	570,076	607,841	37,765	6.6%

Data Source: ABS 1991 and 1996 Census

Census Applications Pty Ltd 1999

Murray River Crossing Social Impact Assessment - Demographic Characteristics												
	Moama				Murray LGA				Country NSW			
	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change	1991	1996	Change	Per cent Change
Household Type												
One Family Household	575	673	98	17.0%	1,293	1,405	112	8.7%	561,694	593,770	32,076	5.7%
Two Family Household	12	12	-	0.0%	15	17	2	13.3%	4,047	6,852	2,805	69.3%
Three Family Household	-	-	-		-	-	-		43	121	78	181.4%
Group Household	40	34	(6)	-15.0%	56	51	(5)	-8.9%	24,933	27,410	2,477	9.9%
Lone Person Household	168	203	35	20.8%	338	404	66	19.5%	149,170	190,890	41,720	28.0%
Total Households	795	922	127	16.0%	1,702	1,877	175	10.3%	739,887	819,043	79,156	10.7%
Household Size												
1 or 2	471	562	91	19.3%	939	1,119	180	19.2%	390,273	470,853	80,580	20.6%
3 or 4	228	266	38	16.7%	510	558	48	9.4%	251,865	255,467	3,602	1.4%
5 or more	85	83	(2)	-2.4%	239	204	(35)	-14.6%	97,677	92,723	(4,954)	-5.1%
Total households	784	911	127	16.2%	1,688	1,881	193	11.4%	739,815	819,043	79,228	10.7%
Average household size	2.77	2.68	-0.09	-3.2%	2.97	2.78	-0.19	-6.4%	2.99	2.84	-0.15	-5.0%
Value for 5+ set at 7												
Medians*												
Median Individual Annual Income	$13,600	$13,200	($400)	-2.9%	$13,000	$12,600	($400)	-3.1%	$13,300	$12,900	($400)	-3.0%
Median Family Annual Income	$32,000	$30,400	($1,600)	-5.0%	$28,700	$28,400	($300)	-1.0%	$32,800	$31,600	($1,200)	-3.7%
Median Household Annual Income	$27,000	$25,800	($1,200)	-4.4%	$24,400	$25,200	$800	3.3%	$27,700	$26,900	($800)	-2.9%
Median Monthly Mortgage	$578	$726	$148	25.6%	$606	$741	$135	22.3%	$596	$755	$159	26.7%
Median Weekly Rent	$114	$141	$27	23.7%	$94	$120	$26	27.7%	$105	$114	$9	8.6%
**1991 converted to $1996*												

Appendix 2

Summary Tables of Community Attitudes

Summary Tables of Community Attitudes: Respondent Details

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Respondent Details						
Sex						
Male	7	9	1	5	3	3
Female	3	4	3	10	4	2
Age Group						
15-19 years						
20-29 years						
30-39 years	5		1	1		
40-49 years	2	4	2	3		2
50-59 years	1	3		3	2	2
60+		5		8	5	1
Not Given		1	1			
Highest Level of Education Obtained						
Post graduate qualifications		1				
Bachelor Degree		2	1	2	1	
Diploma						
Trade/Apprenticeship	6	4	2	1	4	1
Secondary School	2	6	1	10	2	4

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Primary School				1		
Currently studying						
Other				1		
In which of these groups do you fall?						
Working full time	6	3	2	2	2	5
Working part time		1	1	3		
Working casually						
Student				1		
Retired		7		7	5	
Homemaker/unpaid employment	1		1	2		
Pension (disability etc)						
Unemployed						
Other				1		
What is your current occupation?						
Care/Nursing				3		
Sheet metal worker/welder	1		1			
Building Industry	1					
Self Employed	2	2				1
Caravan park owner	1					
Auto engineer/motor mechanic	1					1
Wholesale distribution		2				

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive		Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	<No. 118	>No. 118				
	N=7	N=9	N=3	N=13	N=7	N=5
Boat/Ship Builder		1				
Freight business		1				1
Vet		2				
Plumber			1			
Sales Assistant			1			1
Stud Owner						1
Sports Professional					1	
Station master				1		
Administration					1	
If you are not first or second generation Australian, ethnic background is:						
Asian						
Dutch						
British						
Italian						
Greek						
Other	1 (Yugoslavia)		1 (Maltese)	1 (Spain)	1 (Holland)	

Note: In some cases, responses do not add up to total number of respondents/households interviewed because more than one person in household interviewed.

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Years Lived in Echuca						
0-2 years	1	1	-	-	-	-
More than 2 years and less than 5 years	1	1	-	3	-	-
More than 5 years and less than 10 years	2	3	-	1	1	1
More than 10 years and less than 20 years	2	2	1	2	4	1
20 + years	1	2	2	7	2	4
Years Lived in House						
0-2 years	1	1	2	-	1	-
More than 2 years and less than 5 years	1	2	-	7	-	1
More than 5 years and less than 10 years	2	3	-	-	2	2
More than 10 years and less than 20 years	2	2	-	3	2	2
20 + years	1	1	-	3	2	
Reasons for Living at Current Address						
Property subdivided						1
Quietness	1	3	3		2	1
110 acre property						1
Liked it				1		1
Close to town		1		1		1

Summary Tables of Community Attitudes: Second Crossing of Murray River at Echuca - Moama

Social Impact Assessment (cont'd)

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Close to business/transport						2
Can run business from home						1
10 acres of land						1
Close to Melbourne	1			1		
Went with the job				1		
Easy walk to anything				1		
No other house				1		
Family				4	1	
Handy to School				1		
Handy to work				1		
Affordable/able to pay cash	2	2			1	
Employment opportunities				3		
Bushy/tress/natural environment		2		2	1	
Unmade roads					1	
No traffic					1	
Safe for kids					1	
Secluded					1	

Summary Tables of Community Attitudes: Second Crossing of Murray River at Echuca - Moama

Social Impact Assessment (cont'd)

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
More relaxed lifestyle	3	1	3		1	
River	2	1	2		1	
Coming on holidays here since 1960s					1	
Rural atmosphere		1			1	
Friends		1				
Landscape/environmental attributes			1			
Space			1			
Rural location with unknown facilities		1				

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Things Disliked About Living in General Area of Echuca-Moama						
No dislikes	1	4	2	9	3	2
Proposed second river crossing	1	1				
Lack of employment opportunities				1		
Lack of opportunities for children to do apprenticeships	1					1
Distance from Melbourne		1		1		
Lack of service infrastructure eg. youth, shops, medical facilities, entertainment	2	2	1	2	1	
Too small/isolated	1	1				
Indecision of Compaspe Council				1		
Influx of tourists/increase traffic				1	1	
Aboriginal Content		1				
Vandalism					1	
Air pollution/dust				1		
Poor street lighting					1	

Note: Multiple responses given.

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Things Liked Most About Living in Street						
Central to horse breeding						1
'Country living in city limits'		2				1
Close to everything/shops/work/town				9	2	
Country atmosphere		1				
River/views/outlook onto lagoon, etc	2	6	3	1	2	2
Natural environment/bushland/trees	2	1	1		2	
Quietness/little traffic	4	3	1	1 (Hume St)	2	1
No close neighbours/privacy				1		2
Space/large blocks		1	1	1		
Wider streets				2		
Safe streets					1	
Easy access for trucks to sale yards						1

Note: Multiple responses given.

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Things Disliked Most About Living in Street						
No dislikes	4	5		4	4	3
Dust/air pollution			1	2		1
Noise from traffic				4		1
Noise from boats	1					
Noise from train/railway yard/mill				4		
Noise from neighbours/proximity to neighbours	1	2				
Number of holiday houses/break-ins	1					
Too much development	1					
Climate/wind		1	1			
Drainage		1				
Roads not formed properly/not sealed		1	2			
Turning right into Ogilvie Avenue				1		
No signage/no through road			1			

Note: Multiple responses given.

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Heard About the Proposal						
Yes	7	9	3	13	7	5
No	-	-	-	-	-	-

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Reactions of Local Community to Proposal						
Just want another crossing	-	1	-			1
Emotional (if coming down your street)						
Been talked about since I was in High School/for years		1				
Want the crossing but not in my backyard	-	2	1			1
People just wish it would get done/should've been done years ago				2		1
Haven't we talked about it much	1			2		1
Most people for it				1	1	
Not sure/don't know				8	1	
Need a new bridge but can't agree where	3	2	1		2	
Don't want it	1	1	1			
Most feel eastern option	-	1	-			
Couldn't care less/not interested	-	1	1			

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Areas Special interest or attraction in region						
Port of Echuca	5	3	1	7	2	3
Clubs/recreation facilities		4	1	2	2	2
River-beaches	3	4	1	6	3	4
Boardwalks/walking tracks/bushland	1	2	2	3		
River-watercraft	4	4	1			
Fauna Reserve	1					
Lagoons		1		1		
Restaurants		1				

Note: Multiple responses given.

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive		Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	<No. 118	>No. 118				
	N=7	N=9	N=3	N=13	N=7	N=5
No. of times per day cross the bridge						
Five times a day or more	2	-	1	-	-	1
Less than five times a day but more than once	2	1	2	2	4	-
Daily	2	1	-	1	-	1
Three to five times per week		3		4	1	1
Up to three times per week				2	-	1
Less often		4		2	1	-
Never	1			2	-	1

Note: Multiple responses given.

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Perceptions of Existing Bridge						
Unsafe	1	1	-	4	1	
Prone to delays	2	3	2	7		1
Too narrow	3	7	2	8	4	2
Too narrow for wide load for trucks	2	-	-	1	2	2
Access roads bad	-	2	1	3	1	1
Too many heavy vehicles use the bridge	1	5	2	7	1	5
Insufficient link between Vic and NSW	1	3	-	1	2	3
Of historical importance	1	7	2	11	4	3
Inadequate for pedestrians and cyclists	1	2	1	2	2	1
Bridge adequate for local traffic only	-	-	-			1
Roundabout dangerous	-	-	-	1		
Access roads inappropriate	-	-	-	2		
Too old	-	-	-	2		
Bridge inadequate as is	-	-	-	1		

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Travel Destinations Over Previous Week						
High Street, Echuca	7	9	3	7	4	2
Meninya Street, Moama	3	4	3	9	5	4
Coles or Safeway	3	8	3	9	5	4
Work	4	1	2	1	1	
School	5	1	2	4	2	3
Bank	2	7	1	8	2	3
Doctor	1	2		3		1
Moama Bowling Club	2	3		3	5	
RSL Club			2		2	
Rich River Golf Club	4	2	2	3	1	1
Echuca Golf Club		2		1	1	
Swimming Pool	4	2	2			
River	7	6	1	4	3	1
Beach		2		2		
Port of Echuca Historic precinct	3	4	1	6	2	
Park	1	1				
Friends home(s)	4	5		6	5	2

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive		Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	<No. 118	>No. 118				
	N=7	N=9	N=3	N=13	N=7	N=5
Melbourne	3	2	1	1	2	
Church – Parish of Echuca				1		
Hospital					1	
Workers Club					1	1
Moama Football Ground		1	1			1
YMCA gym	3	1				
Echuca Tennis Club		2				
Echuca Bowling Club		1				
Other						
Not specified			1	2		

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Key Considerations When Deciding Where to Place Bridge						
Safety					1	
Flood prone or not				1		
Volume traffic	1					1
Construction of flood level						1
Preservation of trees/natural bushland	1	1		2		1
Flow of traffic				2	1	2
Cost preservation of land for agricultural production				1		
Heavy vehicles out of town/centre		3		5	2	2
Looking for future long term planning						1
Least disruption to people	1	3	3	2		2
Traffic movements						
Effect on enviornment	2	1				2
Commitment						1
Ease of access in and out of town						1
Access				1		
Must not take trade away from towns				1		
Plenty of room to upgrade in future				1	1	

Note: Multiple responses given.

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Advantages Western Option						
Road already there					1	
Minimal						1
Doesn't go near me						1
Goes straight off highway						
Not dead for Melbourne traffic						1
Trucks would have to do big loop						1
Takes the traffic out of town				5	1	
Links up with Murray Highway/Northern Highway				1		
Decreases passing traffic				3		
Most logical				2		
Takes trucks out of Sturt Street				1		
Would make Ogilvie Avenue safer				1		
Decrease noise				1		
No advantages	2	3	2			
Improved access to Moama town Centre	2	5	2			
Improved access to recreation facilities	-	2	-			
Improved access to Bendigo	-	-	1			

Note: Multiple responses given.

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Advantages Central Option						
People will not drive east or west to get into township	2					1
Will not take passing trade out of town						1
Traffic still goes through Moama	1					1
Traffic still goes through Echuca				1		
None	1	2	1	3	1	1
Does not change traffic patterns at all				1		
Would still get bottleneck in Moama						1
More direct/access for business people	1			1		
Good for traders					1	
Shorter	1				1	
Few houses	1					
Locals would benefit	-	1				

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Advantages Eastern Option						
Minimal/no impact	1	1	1			1
For trucks travelling to industrial area/good for trucking business				1		
Upsets/least number of people					2	1
Finer houses				1		1
Less inconvenience						1
Good for delivery from now to industrial area in Echuca						1
Better than going down Sturt Street				1		
City down gone				1		1
Bypasses town centre				2		
Stops heavy vehicles coming into town				1	2	1
Most practical for Deniliquin traffic						1
Too far out of way				1		
Still have to go along Ogilvie				1		
Decreases passing traffic				1		
Links Echuca-Moama industrial areas	1					

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Disadvantages Western Option						
Does not facilitate local traffic						1
Traffic would no longer need to go through Moama						1
No advantage to Echuca people						1
Difficult to cross Pevicoota Road						1
Pollution for Merool and Wharparilla Drive residents and Layfield Estate (noise and exhuast fumes)	1	4	1			1
Will not help local traffic						1
Effects land owners						1
Goes through too much low country						1
None				4		
Disruption to lifestyle of residents				1		
Goes through less farming land than east					1	
Flood prone					1	
Environmental degradation	3	2	2			
Increase in noise	5	5	2			
Extra traffic	1		1			
Impact on landscape quality	1					
Reduction in property values	2	2	1			
Increase in traffic delays on Warren Street/Upgraded Roads		3	2			

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Disadvantages Central Option						
No disadvantages if upgrade Sturt Street	1					1
Will make Moama an eyesore						1
Would still be completed					1	1
Affects businesses eg. Ozmaze						1
Too congested getting on at Ogilvie Avenue				1		
Too much traffic on Ogilvie/will increase traffic on Ogilvie Avenue		2		1		
Cuts down trees/affects bushlife					2	
Traffic would build up further out railcrossings				2		
Sturt Street noisy and dangerous enough - would make it wise				1		
No disadvantages		1		1		
Can't see any sense in tuying down Sturt Street				1		
Increase in noise				2		
Affects outlook					3	
Would be more chaotic than is now/more traffic				1	1	
Dangerous for kids/Sturt Streeet				1		
Does not take traffic out of town				1		

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Disadvantages Eastern Option						
Does not facilitate local traffic						1
Could reduce farming properties						1
Cost/too expensive				1		
No disadvantages						1
Flood prone				1	2	
(No positive features)				1		
Bypasses Moama completely				1		
Too much traffic on Ogilvie Ave/will increase traffic		2		2		
None				1		
Old Deniliquin Road does not light up as well with highways				1		

Summary Tables of Community Attitudes:

Second Crossing of Murray River at Echuca - Moama: Social Impact Assessment

	Residents Living Within Western Corridor Option and Environs			Residents Living Within Central Corridor Option and Environs		Residents Living Within Eastern Corridor Option and Environs
	Wharparilla Drive <No. 118	Wharparilla Drive >No. 118	Merool Lane/ Layfield Estate	Sturt St and Environs	Moama	
	N=7	N=9	N=3	N=13	N=7	N=5
Preferred Option						
Western	-	5	-	10	2	1
Central	3	2	2	1	1	1
Eastern	2	2	1	1	3	3
East or West	-	-	-	-	-	
Doesn't matter	-	-	-	1	1	-
No response	-	-	-	-	-	-

REPORT

SOCIAL IMPACT STUDY OF SECOND MURRAY RIVER CROSSING AT ECHUCA-MOAMA
STAGE 2 REPORT

Prepared for
VicRoads

12 July 2000

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AGC Woodward-Clyde was appointed by VicRoads in September 1999 to undertake an evaluation of the potential social impacts and effects of a new crossing of the Murray River between Echuca and Moama.

Several other studies are being carried out concurrently in a number of areas including economic evaluation, cultural heritage, business and tourism, traffic, noise, and flora and fauna.

The project is a joint initiative of VicRoads and the N.S.W. Roads and Traffic Authority (RTA), with VicRoads as project manager.

BACKGROUND

The existing steel bridge linking Echuca and Moama was built as a rail bridge in 1879 and converted for dual road and rail use soon afterwards. In 1988 a separate rail bridge was constructed, and the steel bridge rehabilitated for road traffic only. It is the only crossing of the Murray River in the region, with the closest bridge being upstream at Barmah which is a round trip of 67km.

With road traffic levels increasing, a second crossing of the Murray River is required to cater for the longer-term traffic needs of the local community and the region as a whole.

At the commencement of the study three corridors (see Figure 1) were selected as possible locations for the second river crossing by VicRoads, RTA-NSW and the Consultative Committee. They are:

- a western (downstream) crossing in the vicinity of Wharparilla Drive, Echuca and Merool Road, Moama;
- a central crossing adjacent to or in the vicinity of the existing bridge involving an upgrade of Sturt Street, Echuca and bypassing to the south of Meninya Street, Moama; and
- an eastern (upstream) crossing in the vicinity of Mary Ann Road, Echuca and Old Deniliquin Road, Moama.

At the completion of the first Stage of the study, VicRoads and RTA-NSW selected three alignments (see Figure 2) for more detailed assessment. These are an alignment in the western corridor (W1) and two in the central corridor (C1 and C3).

OBJECTIVES OF SOCIAL IMPACT ASSESSMENT (SIA)

The key purpose, as outlined in the Project brief, was:

> *To provide an evaluation of the social impact of the three corridors and a detailed assessment of selected route alignments for the second Murray River Crossing in the Echuca-Moama Planning Study.*

METHOD

In order to prepare the social impact assessment, activities were undertaken in two stages. **Stage one** was the study of the three corridors and **Stage two** was the analysis of the individual route alignments.

Stage 1 – Study of the three corridors

Stage one of the study involved an assessment of each of the three corridors – western, central and eastern - and the potential social impacts and effects.

A social profile of the study area was prepared which described the existing social environment. The issues facing the communities of Echuca-Moama were examined. Based on this information and that from previous studies, the potential social impacts and the effects of each of the three corridors were identified.

Community values and attitudes were also elicited via face-to-face interviews with residents living within the three corridors and environs, members of the Community Consultative Committee and a number of group discussions.

The results from all of the above tasks were analysed and discussed in the Stage One report (January 2000).

SUMMARY OF STAGE TWO FINDINGS

Potential Social Impacts and Effects

People and Property Affected

The environs of the proposed Western Route alignment (W1) contain those areas zoned for future residential growth. This route alignment could therefore be advantageous to a larger number of people in the longer term should the current growth predictions be realised. These residents would have a greater choice in river crossings and easy access to the new bridge as well as the existing bridge.

Conversely, there is a perception that the proposed Central Route alignment (C1) would potentially be disadvantageous to the greatest number of households, directly and indirectly. Moreover, they are likely to be in the more *vulnerable* category, older and of lower socio-economic status.

The proposed Central Route alignment (C3) would affect the least number of dwellings or households and/or properties as this alignment option does not involve total acquisition of any residential properties or commercial businesses. It does not involve the construction or upgrading of any road as is the case with W1 and C1.

While the number of households whose properties will be totally or partially acquired is not considerable for W1 or C1, VicRoads and RTA must recognise each household's unique problems and situation. Already some households are anxious about their situation. Particular issues may need to be carefully and sympathetically handled, even at this point in the study process, hence it is important:

- To develop an ongoing positive program of communication and co-operation with the potentially directly affected households/landowners so that current feelings of uncertainty felt by property owners are allayed.
- To communicate to the potentially affected property owners the implications of property acquisition in terms of the timetable of the acquisition process, their legal limits to both the extent of land to be acquired and the amount of compensation that can be acquired.

When a preferred route is selected it will be important for VicRoads and RTA:

- To compensate the directly affected households for their properties (totally or partially acquired) so that the owners can compete on the open market and have some freedom when trying to purchase elsewhere.
- To consider the individual circumstances of the households who are indirectly affected and subjected to changed conditions and handle problems sympathetically.
- To maintain on-going communication with affected residents.

Community Patterns and Linkages

Overall, the Western Route alignment option (W1) would be more consistent with current community views. There is a perception in the community that the main aim of the second river crossing is to alleviate the truck traffic passing through Moama and Echuca. This perception is not supported by the existing traffic demand. The traffic flow (72000 trips per day) and the resultant issues are mainly created by local traffic patterns, trips around Echuca and Moama (50000pd) or trips that originated outside the area but terminated in Echuca-Moama (18000trips per day). Moreover, some 88% of traffic using the existing bridge is local traffic (that is, through traffic only amounts to 12% of the total 15200vpd). It is also noteworthy that for the Western Route alignment (W1), predicted reduction in traffic flows along High Street, Heygarth Street and Meninya Street would not be as great as for the Central Route alignment option (C1).

In light of the above and local activity patterns (existing usage of the bridge to attain higher order services in Echuca and recreational facilities in Moama) and the predicted traffic flows for each option, the Central Route alignment option (C3) would be the better option in the short term. The construction of the new bridge strengthens the physical and social connection between the towns without affecting the social activity of local residents, including Sturt Street residents, or the trading patterns of local businesses to any great degree, in particular the Meninya Street businesses.

The Western Route alignment option (W1) would facilitate social activity patterns for the existing residents and future residents (and visitors) in the west. It would provide choice. It would provide these residents with an alternate crossing of the river and so relieve traffic on the existing bridge. However, the reduction in traffic on the existing bridge would be less than that provided by the Central Route alignments (C1 and C3).

Existing Access and Safety

Potentially the Central Route alignment (C1) would have the most widespread positive effects on access and safety, particularly in the short term. However, this would only be the case if pedestrian access is facilitated (under controlled conditions) across Sturt Street and traffic management measures are introduced to control the traffic at the access points to the bridge and at the relevant intersections along Sturt Street. If this does not happen there would be the potential for the traffic conditions to reduce safety, particularly for pedestrians.

The Central Route alignment (C3) would not have the same widespread effects. Notwithstanding, the development of this option would improve access and traffic flow over the bridge and to a range of facilities in the short term.

As the population increases, the Western Route alignment (W1) would potentially provide a better alternate access in the longer term but if this option were adopted it would be at the expense of:

- addressing the existing access and safety issues with respect to the existing bridge; and
- relieving the existing traffic congestion and associated problems in Meninya Street and High Street.

General Amenity

While residential amenity for some would be reduced with the development of the road on all alignments, the Western Route alignment (W1) would have the greatest impact and effects on residential amenity. Not as many residences would be subjected to changed conditions as with the Central Route option (C1). However, there would be more residents 'highly annoyed' by the noise levels associated with the changed conditions as they would be more marked than with C1. Noise barriers along a significant length of the route would have to be installed to ameliorate the situation. Residents in the environs of C1 along Sturt Street are already subjected to noise but those who would be living or staying near the proposed alignment at the back of Meninya Street would be exposed to a marked change in noise level. Noise barriers would have to be installed along this part of the route, particularly near Rich River Caravan Park, Madison Spa and Boundary Road to ameliorate the noise and to meet noise attenuation guidelines.

The Western Route alignment (W1) would also have greater impact on the conservation, environmental, cultural heritage and recreational value of the River and environs. As a consequence there would be greater reduction in the overall value of the area for the present community and future generations with this option than with the Central Route alignment options (C1) and (C3).

Rating of the Alignment Options

The following table indicates the overall ratings of the social impacts and effects for the Western Route alignment (W1) and the Central Route alignments (C1) and (C3).

The Table indicates the positive or negative rating (high +/3, medium +/-2 or low +/-1) for each of the impact categories for each alignment option. The ratings recorded relate to an assessment of the technical data in light of community values. In the case of impacts on general amenity, the ratings recorded by the specialist studies have been considered for each area as well as the value the community ascribes to the environment, cultural heritage, landscape and recreation.

Table Rating of Social Impacts and Effects

	(W1)	(C1)	(C3)
People Affected			
Property Acquisition			
Residential	Low (–1)	Low (-1)	0
Commercial	Low (-1)	Moderate (-2)	Low (-1)
Number of properties within 100 metres of reservation subjected to changed or reduced conditions	Low (–1)	Moderate (–2)	0
Number of properties beyond 100 metres of reservation subjected to changed or reduced conditions	Moderate (-2)	Low (-1)	0
SUB-TOTAL	**-5**	**-6**	**-1**
Community Linkages and Patterns			
Positive Effects			
Enhances access and participation in range of activities	Moderate (+2)	High (+3)	Moderate (+2)
Negative Effects			
Breakdown of community cohesion	Low (-1)	Low (-1)	0
Impedes access and further development of activities	0	Low (-1)	0
Affects overall trading patterns and activities	Moderate (-2)	Low (-1)	0
SUB-TOTAL	**-1**	**0**	**+2**
Impacts on Existing Access			
Positive Effects			
Provision of alternative crossing	High (+3)	0	0
Relief of traffic volumes across existing bridge	Moderate (+2)	High (+3)	Moderate (+2)
SUB-TOTAL	**+5**	**+3**	**+2**
Impacts on General Amenity			
Negative Effects			
Residential value	High (-3)	Moderate (-2)	0
Environmental value	Moderate to High (-2.5)	Moderate (-2.)	Low to moderate (-1.5)
Heritage value	Moderate (-2)	Low to Moderate (-1.5)	0
Landscape Value	High (-3)	Moderate to High (-2.5)	Low to moderate (-1.5)

	(W1)	(C1)	(C3)
Recreational value	High (-3)	Moderate (-2)	Low (-1)
SUB-TOTAL	**-13.5**	**-10.5**	**-5**

NOTE: The ratings recorded relate to an assessment of the technical data in light of community values. In the case of Impacts on general amenity, the ratings recorded by the specialist studies have been considered for each area as well as the value the community ascribes to the environment and conservation, landscape and recreation.

Background AGC Woodward-Clyde was appointed by VicRoads in September 1999 to undertake an evaluation of the potential social impacts and effects of a new crossing of the Murray River between Echuca and Moama.

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The key purpose, as outlined in the Project brief, was:

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In order to prepare the social impact assessment, activities were undertaken in two stages. **Stage one** was the study of the three corridors and **Stage two** was the analysis of the individual route alignments.

Stage 1 – Study of the three corridors

Stage one of the study involved an assessment of each of the three corridors – western, central and eastern - and the potential social impacts and effects.

A social profile of the study area was prepared which described the existing social environment. The issues facing the communities of Echuca-Moama were examined. Based on this information and that from previous studies, the potential social impacts and the effects of each of the three corridors were identified. The following outlines the key tasks undertaken. The detailed methodology and findings are discussed in the Stage One report.

1.3.1 Social Profile

A social profile of the area was developed based on:

- analysis of the demographic characteristics of the Study area using Australian Bureau of Statistics (ABS) Census data (refer Stage One Report, Appendix 1: Tables – Demographic Characteristics);
- identification of the existing recreational, cultural and tourism opportunities;
- description of the employment patterns of the resident labour-force;
- studies undertaken by the Shire of Campaspe and the Shire of Murray;
- studies from the previous EES process;
- studies commissioned by VicRoads and undertaken concurrently with the social impact assessment; and
- identification of community networks and social linkages via face-to-face and telephone discussions with:
  - representatives from twelve schools (principals, teachers etc.);
  - officers from the Shire of Campaspe and Shire of Murray;
  - representatives from a range of community facilities.
- Information was sought on the views of traders and the profile of shoppers via:
  - discussions with representatives of Echuca and Moama businesses and members of the Business and Traders Association;
  - discussions with representatives of a range of businesses including accommodation;
  - interviews with 106 business and tourist enterprises carried out by Saturn Corporate as part of the Economic Impact Assessment.

Information on all community services was mapped (refer Figure 3).

1.3.2 Community Values and Attitudes

Apart from the above discussions, community values and attitudes were elicited via face-to-face interviews with residents living within the three corridors and environs, members of the Community Consultative Committee and a number of group discussions.

The underlying aim of this research was to understand the logic behind different individuals' thoughts and attitudes which may underpin behaviour and which may underline the perceptions of the positive and negative features of living in Echuca-Moama and the proposed river crossing. The aim of the interviews was not to reach numerically based measurements of opinion from a representative sample of households living within each corridor and beyond. The aim was more to find out how dominant the thoughts and attitudes among different community members appear to be.

(Administering a survey to a statistically reliable sample of households across Echuca-Moama was beyond the scope of this exercise).

Face-to-face interviews were undertaken with residents representing:

- 19 households in the Western Corridor and Environs.
- 20 households in the Central Corridor and Environs.
- Five households in the Eastern Corridor and Environs.

During the face-to-face interviews (44) residents were questioned on:

- length of residence;
- reasons for living in the area;
- likes and dislikes of the Echuca-Moama area and street in particular;
- areas of special interest or attraction in the area;
- travel patterns;
- frequency of crossing the existing bridge;
- awareness and understanding of the proposal;
- need for a second river crossing;
- local community reactions to the proposal;
- standard and suitability of the existing bridge;
- positive and negative consequences of the proposed river crossing should it be constructed in the western, central or eastern corridor;
- the most important considerations in deciding where to place the new crossing; and
- the preferred option.

The results were processed in tabular form (refer Stage One Report, Appendix 2: Summary Tables of Community Attitudes)

- A number of telephone or less structured discussions (6) and group discussions with residents were also conducted with households from:
  - Maiden Smith Drive, Moama;
  - Hume and Hovell Streets, Echuca; and
  - Wharparilla Drive, Echuca.

The table below highlights for each corridor and environs:

- actual number of households or dwellings;
- total number of households contacted via telephone or doorknocking to seek interview but not attained because household 'out', did not want to participate etc.; and

– total number of households interviewed (67) including, face-to-face interviews, telephone and/or less structured discussions or by group discussion.

	Total No. households	Total No. households contacted (interview not attained)	No. effective interviews held with households
WESTERN CORRIDOR			
Wharparilla Dve	61	49	16 face-to-face 1 by telephone 3 (group discussion)
Merool Lane	5	4	2 face-to-face 1 general discussion
Maiden Smith Drive	22	22	10 households (17 residents) via group discussion 1 by telephone
Layfield Downs Estate	25	3	1 face to face 2 general discussion
CENTRAL CORRIDOR			
Sturt Street	51	37	11 face-to-face
Hume Street	64	1	1 face-to-face 2 group discussion
Boundary Road	3	3	1 face-to-face
Berry Street	6	3	1 face-to-face 1 general discussion
Other	5	5	3 face-to-face
Moama Caravan Park permanent residents	4	3	3 face-to-face
EASTERN CORRIDOR			
Old Deniliquin Road /Edward Street	4	2	1 face-to-face 1 general discussion
Mitchell Road/Murray Valley Highway	6	6	4 face-to-face

Note: the shaded areas highlight the streets that are within the actual corridors. Other streets are those in the immediate environs of corridor boundaries.

Administering a survey to a statistically reliable sample of households across Echuca-Moama was beyond the scope of this exercise. Notwithstanding, the 67 households interviewed does provide an indication of how dominant the thoughts and attitudes of the community members appear to be.

- Analysis and Preparation of Report

The findings from all of the above tasks were analysed and discussed in the Stage One report (January 2000).

Stage Two – Study of the three alignment options

Stage Two of the study involved the assessment of the social impacts and effects of the three selected route alignments Western (W1) and Central (C1 and C3) (refer Figure 2). This was based on:

- findings of the research on the corridor options reported on during Stage One;
- other specialist studies carried out to date;
- additional discussions and analysis pertaining to the specific western (W1), central (C1) and (C3) route alignments.

1.4 ACKNOWLEDGMENTS

Woodward-Clyde would like to acknowledge the assistance and valuable input of local residents, community groups, traders, and business operators in the preparation of the Stage One and Stage Two reports.

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PROJECT
SOCIAL IMPACT STUDY OF SECOND MURRAY RIVER CROSSING AT ECHUCA AND MOAMA

TITLE
ROUTE CORRIDORS

FIGURE
1

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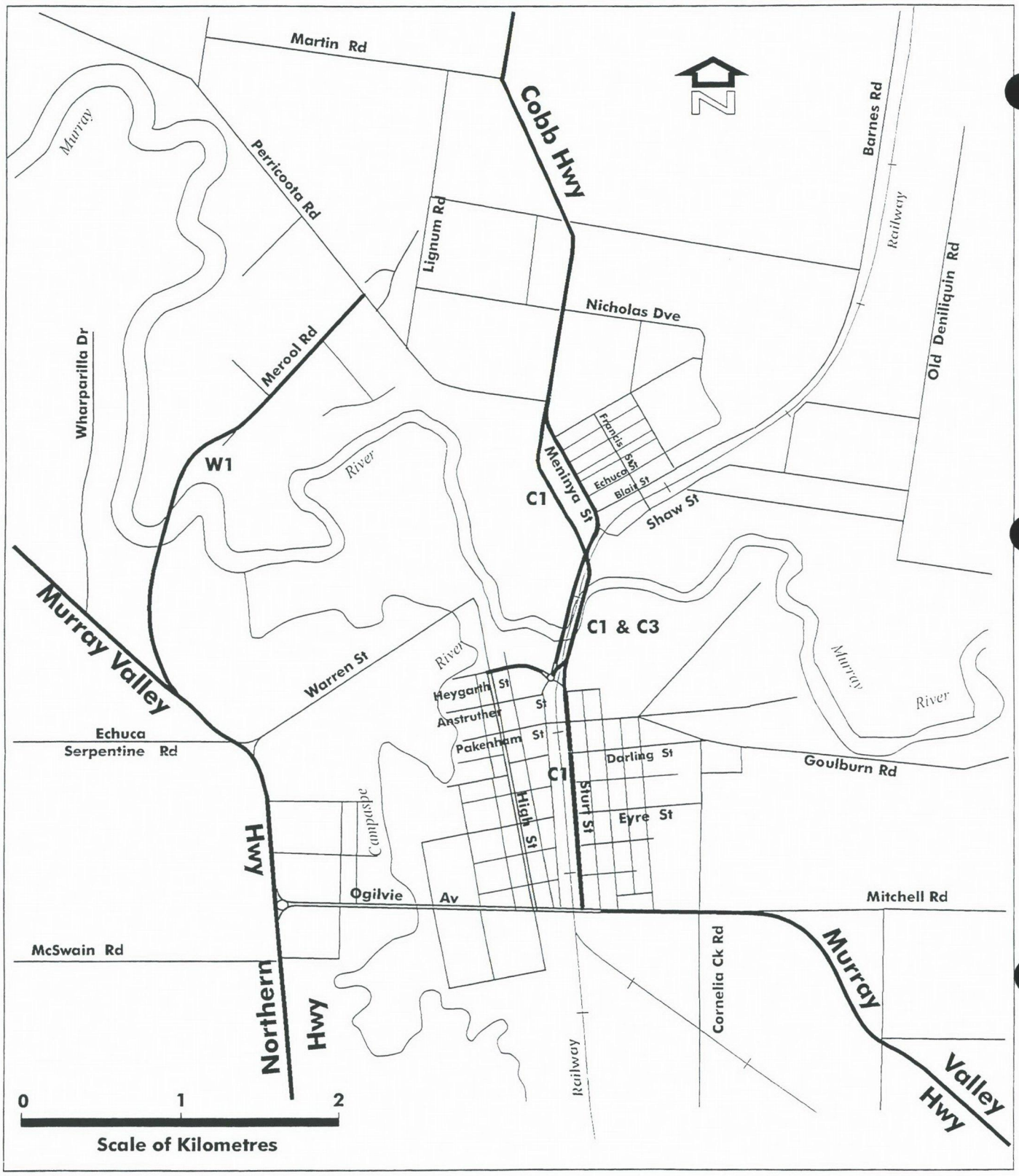

URS

Woodward Clyde

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PROJECT
SOCIAL IMPACT STUDY OF SECOND MURRAY RIVER CROSSING AT ECHUCA AND MOAMA

TITLE
ROUTE OPTIONS

FIGURE
2

2.1 GEOGRAPHIC DESCRIPTION

2.1.1 Study Area

Echuca in the Campaspe Shire of Victoria, and Moama in the Murray Shire of NSW are found on opposite sides of the Murray River. Functionally Echuca and Moama operate as twin towns (Echuca-Moama) and they are located on the closest point of the Murray River to Melbourne.

The Shire of Campaspe is located in north central Victoria, 205km directly north of Melbourne. Its northern border is the Murray River. Campaspe Shire is 4,529km^2 in size and Echuca is the largest settlement. Other settlements in the Shire include Kyabram, Rochester, Tongala, Rushworth, Stanhope, Lockington, Gunbower and Girgarre.

The Murray Shire is located in the southern Riverina of NSW, 800kms from Sydney and 205kms from Melbourne. Murray Shire is 4,328km^2 in size. Moama is the largest settlement within the Shire. Other settlements include Mathoura, Bunnaloo and Womboota. The main service towns for Moama are Echuca, Deniliquin 75kms to the north, Shepparton 75kms south east and Bendigo 90kms to the south west.

2.1.2 Western Route Alignment (W1)

The Western alignment would involve a western bypass of the centre of Echuca-Moama, joining the Murray Valley Highway in Echuca with Perricoota Road, Moama. A future connection from Perricoota Road to Cobb Highway is possible, but is not deemed to be part of the current planning investigation.

The populations of both Echuca and Moama are currently expanding, and as such residential development is required. Most of this development is taking place to the west of the traditional townships of Echuca and Moama, as expansion in other directions is largely inhibited by the prevalence of flood prone land. Wharparilla Drive and Merool Lane are new residential areas with most houses having been constructed within the last ten years or so. The proposed western route alignment is situated near much of this existing and planned residential development.

In Moama NSW, new housing estates are currently under construction and more are planned to the west of Merool Lane and along Pericoota Road. This area is zoned for *future residential development*. Existing residential properties that are located within or adjacent to the route reservation are all at least one to two acres in size. The RSL & Citizens Club, a winery and two caravan parks also own land abutting the alignment.

In Echuca Victoria, the 1000 hectares of land west of the Murray Valley Highway is zoned for *future residential* land as part of the *Echuca West Strategic Plan*. Under this plan, 160 hectares of the land closest to the Murray Valley Highway will be developed first as Stage one. 1.5 hectares of this 160 hectares is zoned for a local neighbourhood shopping centre, 3.4 acres for a primary school and general open space, and 3.3 hectares is zoned for highway business commercial uses along the highway. Access to this area will be provided at four points. These points will be at the Echuca-Serpentine Road, the Murray Valley Highway opposite Butcher Street, and at two points on McSwains Road which in turn provides access to the existing roundabout at the intersection of the Northern and Murray Valley Highways. The Strategic Plan indicated that "Stage 1 will provide around 1200 lots which represent(s) 15 years supply for the Echuca area based on estimated growth rates. In combination with the

existing in-fill development, Stage 1 is estimated to provide for 25 years of residential development."

There is also bushland on both sides of the actual river, the majority of which is privately owned, with the exception of the Wharparilla Flora Reserve (refer Biosis Research Report).

2.1.3 Central Route Alignment (C1)

The Central alignment would involve the re-routing of the highway through Echuca and Moama joining the Murray Valley Highway with the Cobb Highway. The highway route would be re-routed from High Street/Heygarth Street to Sturt Street while in Moama a new bypass would be constructed.

This alignment runs through an established residential and light industrial and transport area of Echuca in Victoria, with Sturt Street located parallel to the railway line. Light industry along Sturt Street includes the Rice Mill. The land immediately south of the river is flood prone bush land.

In Moama, the area south of Meninya Street (with the exception of Boundary Road) is flood prone and as such is not zoned for any residential, business or industrial development, although an eco-tourism development that is sympathetic to the flood regime has been proposed for the area. This is currently bushland with multiple access tracks leading to various Moama beaches on the Murray River. In this area, the proposed reservation backs onto a caravan park and two motels; and encompasses children's playground and skate ramp. It runs through land north of the river and east of the existing bridge, a recreation reserve that includes a caravan park . Horseshoe Lagoon is located nearby, and a series of boardwalks have been constructed through the area (refer Biosis Research Report). The Moama Jetty is also located proximate to the reservation on this side of the existing bridge. It runs through land north of the river and east of the existing bridge, a recreation reserve that includes a caravan park . Horseshoe Lagoon is located nearby, and a series of boardwalks have been constructed through the area (refer Biosis Research Report). The Moama Jetty is also located proximate to the reservation on this side of the existing bridge.

2.1.4 Central Route Alignment (C3)

This alignment involves the construction of a new bridge east of the existing bridge only and some traffic management works on Meninya Street, Moama. The existing roundabout at Blair Street would be removed. Similar to C1 the alignment runs through land north of the river and east of the existing bridge, and a recreation reserve that includes a caravan park. Horseshoe Lagoon is located nearby, and a series of boardwalks have been constructed through the area (refer Biosis Research Report). The Moama Jetty is also located proximate to the reservation on this side of the existing bridge.

2.2 HISTORICAL CONTEXT

As described in Coulson 1995, both Echuca and Moama originated in their present locations because the banks of the Murray River sloped gently down to the water and provided suitable crossing places for stock. Settlements grew around these locations. The area's early reputation as a crossing place was further advanced when two men, James Maiden (in 1845) and Henry Hopwood (in 1853) each put in a punt. Hopwood also built a pontoon bridge across the Murray River and in 1857 placed a bridge across the Campaspe River thus giving him a monopoly over the river crossings in the area. During the 1850s, Echuca became a

main hub in the supply of goods to the Victorian goldfields and by 1864 had become linked to Melbourne by railway (refer to Austral Heritage Consultants Report).

Echuca's river trade flourished in the 1870s and early 1880s. For more than a generation, until the train took over, Echuca, as a Victorian port, ranked second only to Melbourne in the volume of merchandise handled on its wharves. Moama, being located so far from Sydney amongst other reasons, could not keep pace with Echuca.

In 1879 the existing Iron Bridge was opened as a rail crossing and was soon converted to cater for both road and rail traffic between Echuca and Moama. In 1988 a separate rail bridge was constructed, and the steel bridge rehabilitated for road traffic only. Apart from being the oldest bridge over the Murray, it is the only crossing of the Murray in the region, with the closest bridge being upstream at Barmah that is a round trip of 67 kilometres.

It is also notable that the current bridge has a heritage classification (refer to Austral Heritage Consultants Report). This emphasises the importance of the bridge as part of the historic Port of Echuca, an important tourist destination for paddlesteamer rides and other port related activities. The attraction of the Port is dependent on these activities and the maintenance of the historic precinct that includes the bridge.

In more recent times, Moama flourished as a result of Victorian gaming laws forbidding casinos and poker machines in Victoria. As the closest NSW town to Melbourne, Moama was a "pokie" destination. Since the Victorian gaming laws changed in 1994, the number of visitors to Moama for the express purpose of gambling has declined. Notwithstanding, Echuca-Moama as a tourist destination is becoming even more popular.

3.1 INTRODUCTION

This Section describes the key demographic characteristics of the Echuca and Moama populations, the Shires of Campaspe and Murray, Country Victoria and N.S.W. (excluding Melbourne and Sydney Statistical Divisions), as indicated in the ABS 1991 and 1996 Census data (refer Stage One Report, Appendix 1 Tables - Demographic Characteristics). It also summarises the community values and attitudes relating to the Study area and the river crossing proposal, among those residing in the western and central corridor and environs. While this information was sought during Stage One, the further discussions held with a number of key stakeholders during Stage Two indicated that the attitudes expressed previously were still relevant toward the second river crossing. In other words, their views had not changed (refer Stage One Report, Sections Four, Five and Six and Appendix 2: Summary Tables of community Attitudes).

3.2 DEMOGRAPHIC CHARACTERISTICS

3.2.1 Population Size and Change

The overall population in the Campaspe Shire grew from 32,772 to 33,320 persons, that is, by 548 persons or 1.7% in the intercensal period 1991 to 1996. In that same period in the Murray Shire, there was a population change from 5,007 to 5,319, an increase of 312 or 6.2%.

It is notable that the 1998 ABS Estimated Resident Population placed the Murray Shire as the fifth fastest growing Local Government Area (LGA) in NSW and the fastest outside the Sydney Metropolitan area, at 4.2%.

The twin towns of Echuca and Moama have contributed to the Shires' growth patterns. Between 1991 and 1996 Echuca grew from 9,450 to 10,014, that is, by 564 persons or 6.0%. In Moama the population changed from 2,258 to 2,469, a growth of 211 persons or 9.3%. By the time of the 1996 Census, the population of Echuca made up 30% of the Campaspe Shire's population and that of Moama comprised 46.4% of the Murray Shire's population.

In terms of households, the number of households increased between 1991 and 1996 in both Echuca and Moama, by 374 households or 11.1% in Echuca and by 127 or 16% in Moama to reach 3,742 and 922 households respectively. The increase in Echuca represented 49.0% of the overall growth in households across the Campaspe Shire (763 or 6.8%) and in Moama it represented 72.6% of the growth across the Murray Shire (175 or 10.3%). Moreover, while the household growth patterns in the respective Shires were similar to the growth achieved in Country Victoria (6.7%) and Country NSW (10.7%) the towns' household growth demonstrated increases well above the country averages.

Average household size (the average number of persons per occupied private dwelling) in Echuca and Moama was 2.67 and 2.68 respectively. In both cases these figures were smaller than in the municipalities of Campaspe (2.90) and Murray (2.78) and across Country Victoria (2.87) and Country NSW (2.84) at the time of the 1996 census.

3.2.2 Socio-Economic Characteristics

Based on the ABS 1996 Census data, key socio-economic characteristics of the Echuca and Moama populations are described in Table 3.1.

Table 3.1- Key Demographic Characteristics

	Echuca	Shire of Campaspe	Country Victoria	Moama	Shire of Murray	Country NSW
Population						
1991 no.	9,450	32,772	1,221,749	2,258	5,007	2,193,458
1996 no.	10,014	33,320	1,235,373	2,469	5,319	2,297,406
Households						
1991 no.	3368	11,267	444,158	795	1,702	739,887
1996 no.	3,742	12,030	416,078	922	7,877	819,043
Av. Household Size (1996)	2.67	2.90	2.87	2.68	2.78	2.84
Age Structure (1996)						
Under 14 yrs %	22.4	23.8	23.5	20.6	21.6	22.8
Over 60 yrs %	21.5	18.6	17.4	23.0	20.7	18.6
Birthplace (1996)						
Australian Born %	91.2	91.7	87.1	91.8	92.0	86.9
Occupational Structure (1996)						
Managers and Administrators %	6.4	22.5	14.0	7.4	24.2	14.5
Professionals and para-professionals %	28.6	21.1	25.6	21.6	19.0	10.9
Clerical Sales and Service workers %	28.1	21.2	24.8	31.7	21.2	27.0
Labourers and Related Workers %	20.6	19.8	19.1	19.7	19.6	20.0
Income Levels (1996)						
Median individual annual income	$13,900	$13,400	$13,100	$13,200	$12,600	$12,900
Median household annual income	$26,200	$26,900	$26,900	$25,800	$25,200	$26,900
Education Attainment (1996)						
Not qualified %	62.6	65.3	62.3	64.5	65.3	60.0
Diploma, degree, high qualification %	11.4	9.8	12.7	7.9	8.8	12.7
Tenure Status (1996)						
Owned/being purchased %	74.0	71.2	72.5	65.7	68.3	67.5
Car ownership (average)	1.46	1.79	1.70	1.53	1.71	1.46

Source: ABS Census Data, 1991 and 1996

In summary, Echuca and Moama exhibited similar characteristics with respect to household size, percentage Australian and income levels at the 1996 Census. However, Moama exhibited an older population, less educated with fewer professionals and para professionals in the population compared with Echuca. It is also noteworthy, that Moama households were less mobile with a lesser percentage owning or purchasing their home.

3.2.3 Projected Population

According to the *Shire of Campaspe Integrated Strategy Plan, 1996:* "When the combined population potential of Echuca and Moama is considered, the 2011 population potential could be in the order of 16,000" (p.22). However, this is likely to be an under-estimation. In 1996 the combined population was 15,333. Moreover, there is substantial growth to the west (refer Section Two). On the Victorian side of the border alone there is 1000 hectares of land west of the Murray Valley Highway zoned for *future residential.* Some 160 hectares of this land or 1200 lots will be developed as Stage 1. This stage is expected to commence development in the year 2000. If the current household occupancy rate of 2.67 is applied then this area will contribute some 3,204 persons to the overall population growth over the next fifteen years. In addition to this growth will be infill development in the order of 400 lots which would cater for around 1,000 to 1,200 persons.

If the Moama population growth pattern of 9.3% increase between 1991 and 1996 is maintained and if the proposed residential development occurs to the west of the Moama township then the combined Echuca-Moama population is more likely to be in the order of 20,000.

3.3 COMMUNITY VALUES AND ATTITUDES

3.3.1 Attitudes to Living in Echuca-Moama

In the main residents who participated in the survey and who live within the western corridor and environs along Wharparilla Drive, Merool Lane and Maidensmith Drive, moved to their current address for the more relaxed lifestyle, the quietness and the river environment. They currently enjoy these features, their outlook and the landscape quality of their 'natural' living environment, that is, the trees, bushland and bird life.

In the case of the central corridor and environs residents, the key reasons given for living in this part of the Study area were family reasons and employment opportunities. They also focussed on proximity to the river and its environs as being an important feature. They also liked the country town or small town atmosphere that Echuca-Moama offers, their proximity to shops and the climate but unlike the western corridor residents who in the main believed there was 'nothing' they disliked, they commented on the dust and/or noise pollution from traffic, trains and the nearby mill and railyards.

3.3.2 Attractions and Areas of Special Interest

The river and the beaches, the Port of Echuca, clubs and recreation facilities were key attractions named by the majority of residents who participated in the survey. Of special interest to the western corridor residents were the use of the river for boating and the bushland for walking and in particular the Murray River's intrinsic value.

3.3.3 Community Attitudes to the Second Murray River Crossing

Community Opinion

The majority of all residents, community groups, service providers, traders and business associations interviewed believed that a second crossing of the Murray River is required. Notwithstanding, those few who did not believe that a second crossing is warranted believed that the capacity of the existing bridge needs to be improved.

In terms of where this second river crossing should be located, a variety of views were expressed.

Residents

- 19 of the 44 households interviewed in face-to-face interviews gave the Western Corridor as their preferred option. The proposed Eastern Corridor is preferred next, followed by the Central Corridor option.
- Of the 17 residents (10 households) interviewed in the Maiden Smith Drive group discussion, the majority preferred the Eastern Corridor Option, followed by a preference for a Western Corridor that is located further west of the current corridor.
- The five residents (four households) involved in the Hume and Hovell Street group discussion prefer the Western Corridor Option as it is the straightest run and would be better for trucks.

Community Groups and Service Providers

- Community groups and service providers generally desire a route that bypasses the centres of town. While many of the representatives could not provide an official statement as to the overall preferred option of the organisation they represented, they tended to lean in favour of the Western Corridor Option.

Traders and Business Operators

- While the Echuca and Moama Business and Traders Association generally supported the Western Corridor Option, there is some dissension from this view. Some traders are concerned that traffic is not diverted away from their premises, and thus some favoured the Central Corridor Option.
- The survey of businesses (113) conducted by Saturn Corporate Resources substantiated these views with 35 businesses supporting the Western Corridor option and an additional six supporting either the Western or Eastern Corridor option. The next most popular option was the Central Corridor Option with 35 businesses in favour of this option. Only 15 businesses preferred the Eastern Corridor option and 14 did not have a preference.

Overall

According to the traffic surveys through traffic only makes up 4000 trips per day or 5% of all traffic movements (72000 trips per day (pd)) with some 21% of these trips being truck traffic. In terms of bridge traffic, some 1750vpd or 12% of the bridge traffic (15200 vpd) is longer distance interstate traffic passing through the towns. In other words, local traffic is the main contributor to current usage of the existing bridge and to any of the current traffic issues. Notwithstanding, there is strong support that it is important that heavy vehicles and passing traffic be taken out of the centres of Echuca and Moama. The respondents stated that a new

crossing in the Western Corridor (or the Eastern Corridor) would satisfy this criterion. On the other hand a number of businesses, particularly those located in the environs of Meninya Street, felt that this traffic is essential to keep the businesses of Meninya Street viable.

In terms of taking into consideration other criteria, for example:

- the growing population of Echuca and Moama with areas developing to the west of both towns; and
- alleviating the general heavy vehicle traffic flow between the Northern Highway and the Cobb Highway,

the overall consensus was that it would 'make sense' to locate the river crossing within the Western Corridor even though some of the residents of Wharparilla Drive, and all residents interviewed along Merool Lane and Maiden Smith Drive would disagree with this view. They also believed that this option would have considerable impact on the environmental values of this area.

4.1 INTRODUCTION

The results of Stage One of the Echuca-Moama Second Murray River Crossing Study led to the selection of the route alignment options and further analysis of the potential social impacts and effects.

The assessment of the potential social impacts and effects may be defined as the identification and measurement of the various social consequences of implementing a particular action.

The assessment of the social impacts and effects expected to be generated for each route alignment is based on the findings of the research discussed in the Stage One report and the findings from other specialist studies, that is:

- Qualitative data: the subjective measurement of the communities' awareness, knowledge and understanding of the proposed Second Murray River Crossing as well as their attitudes, beliefs and values with regard to each corridor option and their effects on the existing social environment.
- Quantitative data: demographic characteristics, usage patterns of facilities and services, technical information from other specialist studies:
  - Saturn Corporate Resources, *Murray River Crossing at Echuca/Moama Business and Tourism Study Final Report, December 1999*;
  - Marshall Day Associates, *Murray River Crossing at Echuca/Moama Ambient Noise Survey, December 1999;*
  - Marshall Day Associates, *Murray River Crossing Echuca/Moama Preliminary Barrier Design, June 2000;*
  - Biosis Research, *Stage One Overview Report – Flora and fauna assessment of proposed second river crossing at Echuca/Moama Victoria and New South Wales, December 1999;*
  - Biosis Research, *Flora and fauna assessment of proposed second river crossing at Echuca/Moama Victoria and New South Wales, Stage Two: Assessment of Route Options W1, C1 and C3, June 2000;*
  - Austral Heritage Consultants, *Murray River Crossing at Echuca/Moama Planning Study: Cultural Heritage Study Background Report*, January 2000;
  - Phillip Liston and Associates, *Murray River Crossing at Echuca/Moama Planning Study Landscape Assessment,* December 1999; and
  - Arup Transportation Planning, *Murray River Crossing at Echuca Traffic and Economic Evaluation of Options,* June 2000.

The social impacts are likely to be caused by changes – direct and indirect – to the environment in the study area.

4.2 SOCIAL IMPACT CATEGORIES AND EFFECTS

The impact categories and possible measures of effect considered in this evaluation are as follows:

- Number and characteristics of people affected: the change in population size and socio-economic profile of the area by:
  - Property acquisition and relocation of households; and
  - change processes, that is, the number of people affected or subjected directly to changed conditions and living environment.
- Social patterns and linkages: likely change in how an area functions as a community, that is:
  - the amount of social interaction and residents' use of local facilities;
  - personal relationships within an area; and
  - feeling of belonging or identifying with an area.
- Access: change in movement patterns and conditions on local roads – perceived and actual – which affect access and usage of facilities.
- General amenity (perceived and actual): change in the physical conditions that affect:
  - safety or perceptions of safety when moving about the area;
  - the quality of the environment and residential amenity, for example, change in views and/or outlook, noise level, privacy.
  - change in recreation development and opportunities.
  - communities' level of satisfaction with the environment with any:

    change to the area's attractiveness and recreational opportunities;

    change in the Aboriginal archaeological resources and other cultural resources and its effect on the heritage value to the community; and

    change in the flora and fauna and its effect on the environment.

    reduction in the overall value of the area for future generations.

The subsequent sections provide an analysis of each of these potential social impacts and resultant effects.

5.1 INTRODUCTION

While the second Murray River crossing would affect all the existing and projected populations in the Shires of Campaspe and Murray (refer Section Three) the following highlights the more affected residents and/or businesses within the area of influence of the proposed alignment options:

- the number of dwellings or households and/or businesses that will be totally or partially acquired as a result of the second river crossing;
- the number of dwellings or households and /or businesses within 100 metres of the proposed road reservation (outside the area of property acquisition) and where households are likely to be subjected to changed conditions as a result of the second river crossing and the new road alignment;
- the number of dwellings or households and/or businesses beyond 100 metres of the proposed road reservation who could also be subjected to changed conditions as a result of the second river crossing and the new road alignment; and
- zoned or developing residential areas where potential growth in households or a community may be affected.

5.2 WESTERN ROUTE ALIGNMENT (W1)

The proposed Western Route alignment (W1) stretches on both sides of the Murray River and intercepts an area with predominantly large houses and large blocks of land along Merool Lane to Perricoota Road. It is also proximate to a number of residences on Maiden Smith Drive and Layfield Downs Estate on Perricoota Road. It is some 300 metres or more from the residences along Wharparilla Drive.

5.2.1 Property Acquisition

The number of properties that are within the reservation of the route alignment, that is, households who would be directly affected and whose properties would be acquired, totally or partially, would be one household living on a 5.5 acre property (including plumbing business) on Merool Lane. There would also be the consequent displacement of the three residents who make up this household.

These residents have been living in Merool Lane some eight years. They are already feeling the emotional effects and uncertainty of not knowing whether they will have to move for the road proposal, let alone the effects of property acquisition and relocation. With respect to the last matter, they do not believe that they will be able to find an available property in a suitable location in terms of price, quality and size, some four kilometres out of town with all services connected. They also believe that the operating costs will be greater.

In addition to the above, some six rural residential properties in Merool Lane will be partially acquired and a portion of the Jenola Oaks vineyard. The thought of partial acquisition for some of the owners of these residential properties is also posing some emotional disruption. The older residents who have recently built a new home and who have retired there to enjoy the peace and quiet and semi-rural lifestyle are finding it particularly difficult to live with the uncertainty. They do not know if the front of their property will be severed, and how their living environment will change, and what impacts this will have on the value of their investment

5.2.2 Properties Within 100 metres of the Reservation

The number of properties/households that are located less than 100 metres from the road reservation, that is, within an area where households would be subjected to changed or reduced conditions in their living environment with the introduction of the route alignment would be:

- Merool Lane – two rural residential properties
- Corner of Merool Lane and Maiden Smith Drive – two rural residential properties
- Layfield Downs Estate – four residential properties
- Merool Lane - boarding kennels for 30 dogs and six cats
- RSL&Citizens Club.

5.2.3 Properties Beyond 100 metres of the Reservation

The number of properties that are located more than 100 metres from the road reservation, that is, within an area where households and/or businesses are less likely to experience direct changes in their immediate living environment would be:

- Merool Lane – three residential properties (including Grimison Road and winery homestead), Merool Riverside Holiday Park and Shady River Holiday park
- Maiden Smith Drive – 20 residential properties
- Wharparilla Drive – 61 residential properties
- Layfield Downs Estate – 27 residential properties.

It is also noteworthy that the socio-economic characteristics of the population within the area of influence of the Western route alignment, as indicated in the survey reported on in the Stage One report tend to:

- be newcomers as well as those who have lived in the Echuca-Moama area for more than ten years;
- be at the more mature or late stage of the life cycle with children living at home or older couple, retired with no children living at home;
- have completed secondary school or carried out a trade(s) course as their highest level of education attained;
- be working full time or retired;
- be self-employed and working in skilled trades occupations; and
- be Australian born.

5.2.4 Zoned or Developing Residential Areas

Also found within the environs of the Western route alignment are 1000 hectares of land west of Echuca, west of the Murray Valley Highway zoned for *future residential.* Some 160 hectares of this land or 1200 lots will be developed as Stage 1. This stage is expected to commence development in the year 2000 and is likely to contribute some 3,200 persons to the overall population growth over the next fifteen years or so. A second river crossing in this location could potentially provide an alternate access route for these residents.

There is also residential development proposed west of the Moama township, including land on the corner of Merool Lane and Perricoota Road and land zoned residential east of Wharparilla Drive that could be partially acquired.

5.3 CENTRAL ROUTE ALIGNMENT (C1)

The Central Route alignment runs along an existing railway corridor, along Sturt Street, across the Murray River east of the existing bridge and railway line and west of Meninya Street to Perricoota Road behind the commercial properties.

5.3.1 Property Acquisition

The are one residential property within the reservation of the route alignment, that is, one household who would be directly affected and whose property would be totally acquired. This property is adjacent to Madison Spa on Boundary Road. Moreover, the Moama Riverside Holiday Park has 100 sites of which 3 units contain permanent residents and 52 annuals or regular holidaymakers. In addition, Oz Maze and mini golf (corner Anstruther and Sturt Street) would be acquired and there would be partial acquisition of:

- southern end of sturt Street - two commercial businesses (in short term)
- southern end of Sturt Street - four commercial properties (in longer term)
- Sturt Street - proposed TAFE site
- Moama Skate Park and recreation reserve
- vicinity of Boundary Road – one residential property
- part of 56 acres of land owned by Madison Spa and which extends from the motel to the Murray River.

5.3.2 Properties Within 100 metres of the Reservation

The number of properties that are located less than 100 metres from the road reservation, that is, within an area where households would be subjected to changed or reduced conditions in their living environment would be:

- Sturt Street - 51 residential properties
- western side of Hume Street
- Church of Christ (corner of Sturt Street and Pakenham Street)
- approximately 10 commercial businesses along Sturt Street
- the vicinity of Boundary Road and Meninya Street, Moama - 3 residential properties
- units in Rich River Holiday Park - 19 holiday sites
- Sundowner Motel (Meninya Street)
- Madison Spa (Meninya Street).

Conversely, properties or households along Hume Street are likely to experience improved conditions as traffic management measures would be introduced as part of this alignment proposal to discourage traffic to travel along Hume Street.

5.3.3 Properties Beyond 100 metres of the Reservation

There are potentially other properties that will be subjected to changed conditions with the upgrading of Sturt Street. However, the change would not be as noticeable as for W1.

According to the survey results socio-economic characteristics of this population (see Stage One report) can be described as:

- being more established with more households who have lived in the Echuca-Moama area for at least ten years and many for more than 20 years;
- at the late stage of the life cycle, retired with no children living at home;
- having completed secondary school and/or at least Year Nine with very few having undertaken a formal apprenticeship or tertiary eduction;
- mainly Australian born.

5.3.4 Central Route Alignment (C3)

This alignment involves the construction of a new bridge east of the existing bridge only and some traffic management works on Meninya Street, Moama. The existing roundabout at Blair Street would be removed.

This alignment utilises the existing roads. It involves no total acquisition of residential properties but it does involve the partial acquisition of Moama Riverside Holiday Park

5.4 SOCIAL IMPLICATIONS

The environs of the proposed Western Route alignment (W1) contains those areas zoned for future residential growth. This route alignment could therefore be advantageous to a larger number of people in the future. These residents would have a greater choice in river crossings. They would have easy access to the new bridge as well as the existing bridge.

Conversely, the proposed Central Route alignment (C1) would be disadvantageous to the greatest number of households, directly and indirectly. Moreover, they are likely to be in the more *vulnerable* category, older and of lower socio-economic status. However, the proposed Central Route alignment (C3) would affect the least number of dwellings or households and/or properties as this alignment option does not involve total acquisition of any residential properties or commercial businesses. It does not involve the construction or upgrading of any road as is the case with W1 and C1 but it does involve some minor realignment of Meninya Street.

While the number of households whose properties will be totally or partially acquired is not considerable for W1 or C1, VicRoads and RTA must recognise each household's unique problems and situation. Already some households are anxious about their situation. Particular issues may need to be carefully and sympathetically handled, even at this point in the study process, hence it is important:

- To develop an ongoing positive program of communication and co-operation with the potentially directly affected households/landowners so that current feelings of uncertainty felt by property owners are allayed.
- To communicate to the potentially affected property owners the implications of property acquisition in terms of the timetable of the acquisition process, their legal limits to both the extent of land to be acquired and the amount of compensation that can be acquired.

When a preferred route is selected it will be important for VicRoads and RTA:

- To compensate the directly affected households for their properties (totally or partially acquired) so that the owners can compete on the open market and have some freedom when trying to purchase elsewhere.
- To consider the individual circumstances of the households who are indirectly affected and subjected to changed conditions and handle problems sympathetically.
- To maintain on-going communication with affected residents.

6.1 INTRODUCTION

Social patterns and linkages relate to the degree an area functions as a community. That is, the amount of social interaction and cohesion indicated by residents, including their use of local facilities; participation in organisations, community groups and club activities; personal relationships within an area; a feeling of belonging. Areas of exclusive interaction and strong community cohesion are more easily threatened by any major change.

Echuca is the principal town in the Shire of Campaspe and Moama the largest town in the Shire of Murray. As twin towns, Echuca-Moama share much of their community infrastructure, despite the fact that they are located in different states, and on opposite sides of the Murray River.

Echuca is the larger centre, and is the regional focus for higher order services in health, education and shopping, as well as a range of other community facilities and services. As such, access to Echuca is very important to the residents of Moama in particular, who rely on Echuca in the course of their day to day living. Most shopping is undertaken in Echuca due to the wider variety of specialty stores and the major supermarkets available there to fulfil not only the main weekly shopping trip for fresh food, groceries and small household goods, but also comparison shopping for clothing and larger household goods. In addition, many Moama residents work in Echuca. The only access to Echuca is via the existing bridge.

Moama, on the other hand, performs a different role. It has a stronger recreational focus and contains more recreational facilities than does Echuca. The Moama Bowls Club is located in the heart of Moama, and the RSL & Citizens Club, Rich River Golf Club, Moama Sports Club and the Moama Recreation Reserve are all located to the west of Moama along or just off Perricoota Road. In terms of shopping, Meninya Street, Moama only performs a local convenience function serving the needs of Moama residents and visitors, the post office being one of the most important of the services offered.

Figure 3 highlights the distribution of key community infrastructure according to:

- health services;
- education facilities; and
- sporting and leisure facilities.

A key determinant of the nature and extent of effects on social patterns and linkages will be the extent of any severance to or change of local road based access patterns to these facilities and services as well as tourist attractions such as:

- Port of Echuca, an authentic working steam port and home to a number of fine restaurants that residents of Echuca-Moama and visitors alike enjoy.
- The Murray River – an important destination for paddlesteamer rides, water skiing or houseboats.
- Accommodation - varying from houseboats on the Murray to B&Bs, caravan parks, serviced apartments and motels.

As noted in the Stage One report, Echuca-Moama has a range of facilities in health, education, children's services and recreation and leisure. In addition it is a popular tourist destination. The Stage One report describes the social interaction patterns and linkages including the use of facilities, friendship patterns and the social issues raised by the different

sectors of the community. The following highlights the implications of the proposed route alignments with respect to these criteria.

6.2 WESTERN ROUTE ALIGNMENT (W1)

The proposed Western Route alignment is situated within and proximate to the existing and proposed residential growth areas within Echuca and Moama (refer Section 3.2.3).

While access to some facilities is located within the road reservation, there are no community facilities located within the proposed road reservation. However, a number of key facilities are accessed from Merool Lane:

- RSL & Citizens Club
- Jenola winery
- Merool Riverside Holiday Park
- cattery
- Shady River Holiday Park
- Merool Water Sports Club (including boat ramp, river marina, boat lock up, sandy beach, function centre).

Positive Effects

An alternative river crossing in this location would enhance access and in turn facilitate increased participation (by locals and visitors) in:

- RSL & Citizens Club
- Merool Riverside Holiday Park
- Shady River Holiday Park
- Merool Water Sports Club (including boat ramp, river marina, boat lock up, sandy beach, function centre)
- Moama Sports Club
- Rich River Golf Club.

In addition, social interaction patterns and linkages for many of the existing residents who live west of Echuca and who will live in the areas zoned as 'future residential' would be enhanced. It will provide choice, an alternate access route to Echuca or Moama.

Negative Effects

As mentioned in the previous Section, there is one household living in Merool Lane who would be displaced by this option. A number of other households in Merool Lane and Maidensmith Drive would be upset by any partial acquisition of their property and resultant change to the 'peace and quiet' of their rural-residential lifestyle. This alignment option could breakdown the cohesiveness of this newly developing community. Additionally, the road may act as a psychological barrier to promotion of community development in the longer term.

Land currently set aside for more holiday units at the entrance to Merool Holiday Park, the entrance to the Holiday Park and entrance to the cattery are within the reservation. In addition, there could be partial acquisition of the vineyards associated with the winery that is located within the reservation. Unless careful consideration is given to the access to the Park and winery and the other facilities located in Merool Lane, further development could be impeded along with participation in these activities.

This option also has the potential to affect trading patterns, activities and in turn income of a range of businesses dependent on passing trade in Meninya Street. Ten of the 24 businesses located in Meninya Street rely on passing trade. If these businesses are affected there is then the potential for the important local convenience function of the Moama Township to decline. However, this would not be as great as for C1.

6.3 CENTRAL ROUTE ALIGNMENT (C1)

Positive Effects

There would be minimal change to local movement and interaction patterns between residential communities and usage of facilities for those residing in areas west of the proposed alignment. Notwithstanding, the alignment would strengthen the physical and social connection between Echuca and Moama. The existing bridge currently takes 15200vpd and in peak times reaches a level of around 23000vpd. A new bridge and the introduction of traffic management measures on the approaches to the bridge would facilitate movement and ease of access between the townships for the local population who make up some 88% of the traffic crossing the bridge each day. Discussions with local residents in Stage One indicated that the Moama residents, in particular, made up to five trips per day to Echuca. As noted previously, Echuca is the regional centre for higher order services in shopping, health and education but Echuca residents visit Moama for recreation. Moama performs a different role. Besides performing a strong convenience function for the local population, its range of recreation facilities, including the Moama Bowling Club, attract the wider population. This option would therefore facilitate participation in these activities.

Negative Effects

The proposed Central Route alignment (C1) is situated partly within an established residential area, Sturt Street. This street currently attracts some 3400pd. By 2016, if this option were implemented the traffic flow would be around 10500vpd, a level much greater than if nothing were done and if there were a gradual build up of traffic (6100vpd) or if the Western Route alignment (W1) were selected (5500vpd).

While access would not be severed, the upgraded road along Sturt Street (and the newly constructed road behind Meninya Street) could potentially act as a psychological barrier to movement patterns and in turn social interaction and community linkages. For example, access to the Church of Christ and Salvation Army located on Sturt Street could be impeded. In other words, social interaction patterns and linkages for some of the existing residents, particularly those living in Sturt Street and Echuca east, may not be facilitated unless adequate provision is made for pedestrians to cross Sturt Street.

It is also noteworthy that in Echuca, the proposed alignment severs a number of commercial and industrial properties along Sturt Street at the southern end of the alignment. Moreover, it totally encompasses Oz Maze and mini golf on the corner of Anstruther and Sturt Streets.

The alignment also abuts the historic Echuca railway station precinct and the proposed educational precinct. The vision for the historic port precinct and the wharf as outlined in the "Master Plan for the Heritage Precinct of Echuca", March 2000 is:

> *Vision: Echuca's famous port will be the hub of an internationally significant heritage precinct. The visitor experience will extend beyond the wharf to encapsulate the adjacent banks of the Murray and a more integrated relationship between the river, the port, Murray Esplanade and the High Street precinct (p. 24).*

A key element in realising the vision is the reconstructing the rail link "meeting of the whistles". To quote from the Master Plan:

> *A key element of the Port of Echuca Authority capital development planning is the re-establishment of the original rail line that previously extended to the wharf siding. This proposal is fully endorsed by the master plan as a fundamental element of the port precincts long-term consolidation. The re-establishment of the rail line will help to knit together an extended tourist precinct of diverse character that extends from the present port to the Echuca Railway Station via the railway corridor and the Aquatic Reserve (p. 24).*

There is a perception among some community members that the proposed alignment could have implications for the re-development of the precinct. This would be contrary to the aims of the Master Plan for the Heritage Precinct of Echuca. While it narrows the proposed TAFE site sufficiently to render "this development option marginal", traffic along Heygarth Street between the Port, Town Centre and the eastern sector of the Echuca residential area would decrease with this option. Moreover, it directs traffic away from the roundabout hence this option would also reduce any conflict between rail and vehicular traffic and so could facilitate the re-establishment of the original rail line.

In Moama, this alignment directly affects the Moama Riverside Holiday Park, a children's playground, miniature railway and skate ramp. It backs onto the Rich River Holiday Park and a motel, the Sundowner. It intercepts the land owned by the Madison Spa and is located adjacent to their accommodation. In fact the proposed alignment could affect the integrity of their land and their proposal to develop and promote eco-tourism as part of an integrated conference package.

Similar to W1, this option also has the potential to affect trading patterns, activities and in turn income of a range of businesses dependent on passing trade in Meninya Street. To reiterate, ten of the 24 businesses located in Meninya Street rely on passing trade. If these businesses are affected there is then the potential for the important local convenience function of the Moama Township to decline, and as indicated above, this would be greater than for W1. To illustrate, traffic in Meninya Street currently flows at the rate of 12400vpd, if nothing were done it would gradually increase to 14100vod by 2016. If C1 were introduced the flow would be reduced to a level of 6800vpd. If W1 were introduced the traffic flow would be reduced to 11300vpd.

6.4 CENTRAL ROUTE ALIGNMENT (C3)

Positive Effects

With this option any impact created by the build up of traffic would be gradual along Sturt Street, Meninya Street and High Street. Hence there would be minimal change to local traffic

movement and interaction patterns between residential communities and usage of facilities for those residing in areas west of proposed alignment in the short term. However, similar to C1, the physical and social connection between Echuca and Moama would be strengthened with the construction of the new bridge, as some of the existing traffic issues (refer Section Seven) would be addressed. Moreover, it potentially would further enhance access and in turn the viability of Moama Bowling Club and would facilitate participation in the other recreational activities located on this side of the Murray River.

This option does not bypass Meninya Street hence it would not affect trading patterns, activities and in turn income of the businesses more dependent on passing trade in Meninya Street.

Negative Effects

This option does not propose any change to Sturt Street but does remove the existing roundabout in Meninya Street at Blair Street. In the longer term, social activity patterns would more than likely change, as the actual and perceived safety of Sturt Street and Meninya Street is reduced and access is impeded, in particular east-west access to facilities and services west of Sturt Street and the local convenience function of Meninya Street.

The proposed alignment could potentially have implications for the re-development of the historic precinct. It does not reduce traffic along Heygarth Street as is the case with C1 hence it would not reduce conflict between the road and proposed rail traffic. Moreover, it would dislocate the Echuca Town Centre from the eastern residential sector of Echuca and the Murray River.

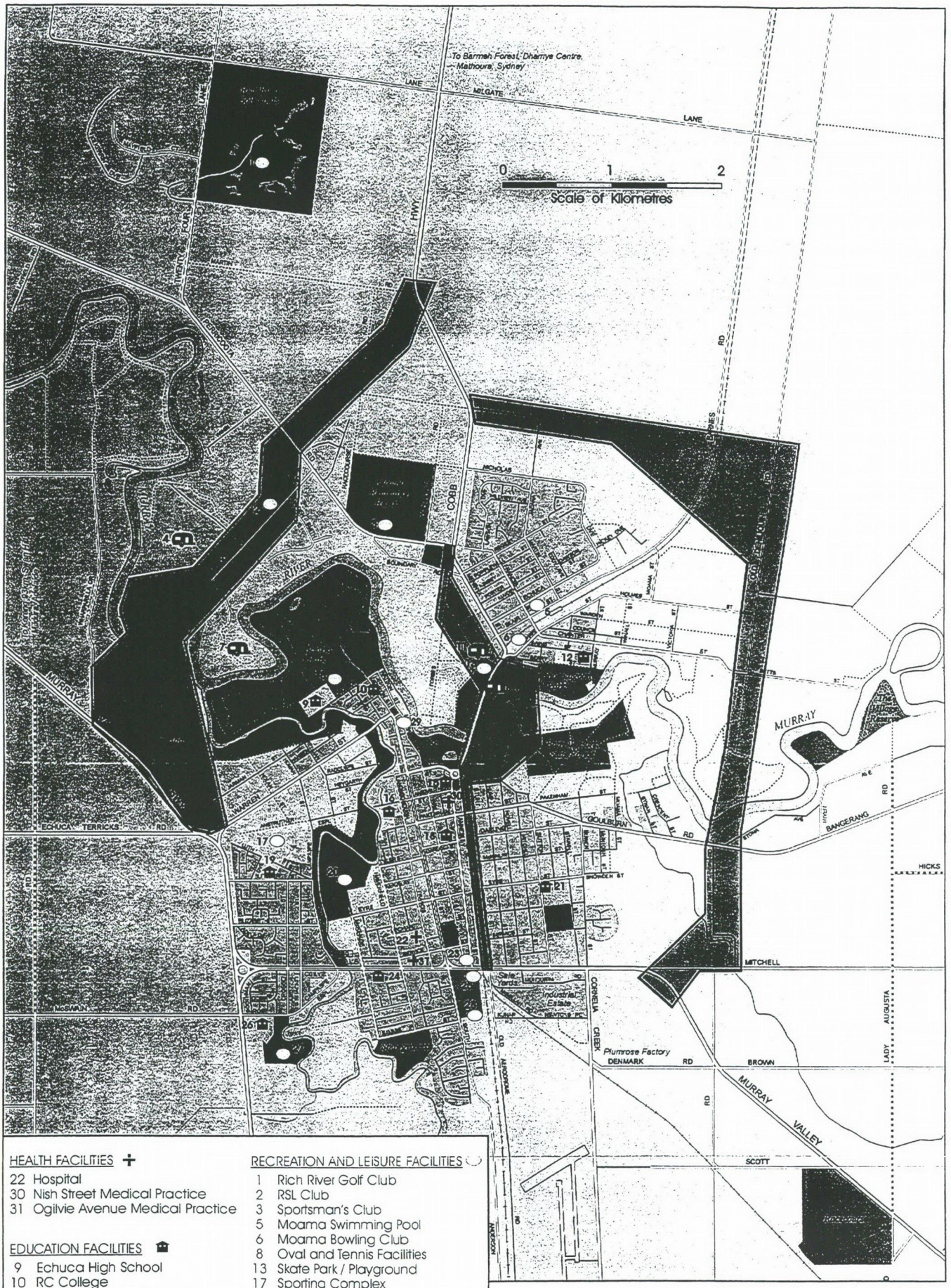
6.5 SOCIAL IMPLICATIONS

Overall, the Western Route alignment option (W1) would be more consistent with community views (refer Section 3.3.3). To reiterate, there is a perception that the main aim of the second river crossing is to alleviate the truck traffic passing through Moama and Echuca even though this perception is not supported by the existing traffic demand. The traffic flow (72000 trips pd) and the resultant issues are mainly created by local traffic patterns, trips around Echuca and Moama (50000 trips pd) or trips that originated outside the area but terminated in Echuca-Moama (18000 trips pd). Moreover, some 88% of traffic using the existing bridge is local traffic (that is, through traffic only amounts to 12% of the total traffic (15200 trips pd) and this is likely to grow at a rate of 3.3% per annum. It is also noteworthy that for the Western Route alignment (W1) the predicted reduction in traffic flows along High Street/Heygarth Street and Meninya Street would not be as great as for the Central Route option (C1

In light of the above and local activity patterns (existing usage of the bridge to attain higher order services in Echuca and recreational facilities in Moama) and the predicted traffic flows for each option, the Central Route alignment option (C3) would be the better option in the short to medium term. The construction of the new bridge strengthens the physical and social connection between the towns without affecting the social activity of local residents, including Sturt Street residents, or the trading patterns of local businesses to any great degree, in particular the Meninya Street businesses.

The Western Route option (W1) would facilitate social activity patterns for the existing and future residents and visitors in the west. It would provide an alternative crossing of the river and so relieve traffic on the existing bridge. However, the reduction in traffic on the existing bridge would be less than that provided by the Central Route options (C1 and C3). In other

words it would not address the local traffic needs and safety issues. Moreover, it would not facilitate truck movement between the existing industrial areas in north east Moama and south east Echuca.



HEALTH FACILITIES +

22 Hospital
30 Nish Street Medical Practice
31 Ogilvie Avenue Medical Practice

EDUCATION FACILITIES

9 Echuca High School
10 RC College
12 Moama Primary School
15 St Mary's Primary School
16 Echuca Primary School
18 Campaspe College
19 Echuca Secondary College
21 Echuca East Primary School
24 Echuca South Primary School
26 Rich River Christian College

RECREATION AND LEISURE FACILITIES

1 Rich River Golf Club
2 RSL Club
3 Sportsman's Club
5 Moama Swimming Pool
6 Moama Bowling Club
8 Oval and Tennis Facilities
13 Skate Park / Playground
17 Sporting Complex
20 Echuca Golf Course
23 Echuca Swimming Pool
25 Echuca Bowling Club
27 Rotary Park
28 Tennis Netball Facilities
29 Port of Echuca

ACCOMMODATION

4 Shady Park Holiday Park
7 Merool Riverside Holiday Park
11 Riverbank Holiday Park
14 Moama Riverside Holiday Park

URS

Woodward Clyde

CLIENT
VicRoads

PROJECT
SOCIAL IMPACT STUDY OF SECOND MURRAY RIVER CROSSING AT ECHUCA AND MOAMA

TITLE
KEY COMMUNITY FACILITIES

FIGURE
3

7.1 INTRODUCTION

Impact on access relates to existing movement patterns about an area, to and from local facilities and regional facilities, including tourism attractions and facilities in the Echuca-Moama area.

As indicated in the previous section, travel patterns, access to and usage of local facilities are already affected by vehicular traffic within the Echuca-Moama area. Currently total vehicle trips in Echuca and Moama amount to 72000 trips pd and some 22% of these trips use the bridge. Moreover, only 4000 trips per day relate to passing traffic and some 21% of these trips or 840 trips per day relate to truck traffic. The issues raised in the Stage One report included:

- unnecessary heavy vehicles passing through the centre of Echuca and Moama;
- traffic congestion and delays leading up to and on the existing bridge;
- conflict between pedestrians and vehicles at the roundabouts on either side of the bridge;
- existing traffic conditions impede access – on foot or bicycle in particular – to community facilities;
- bridge delays or closures due to an accident or repair work can hamper employee, student and visitor ability to access various community facilities. Bridge delays or closures can reduce access for emergency vehicles travelling between Echuca and Moama;
- unsafe intersections, for example, Warren Street/Murray Valley Highway, Sturt Street/Ogilvie Avenue, Hume Street/Ogilvie Avenue, Sturt Street/Pakenham Street/railway crossing, High Street, particularly for students travelling to and from school on foot and by bicycle, older people, people with young children and people with mobility problems;
- potential for a chemical spill in the centre of Echuca or Moama or on the existing bridge.
- pedestrian movement is impeded across Meninya Street – even at the pedestrian crossing – by fast travelling trucks; and
- vehicular movement in Meninya Street in terms of parking and reversing out of car parks is very difficult as a result of the fast travelling traffic.

7.2 WESTERN ROUTE ALIGNMENT (W1)

The proposed Western Route alignment (W1) could alleviate some of these access issues in the longer term as the population grows and holiday makers increase in numbers. This option would provide a second river crossing and alternate access to key facilities such as:

- RSL & Citizens Club
- Merool Riverside Holiday Park
- Shady River Holiday Park
- Merool Water Sports Club (including boat ramp, river marina, boat lock up, sandy beach, function centre)
- Moama Sports Club
- Rich River Golf Club.

- wineries and accommodation (Perricoota Road).

Moreover, the Western Route alignment option (W1) would not be consistent with the communities' most important criterion that should be considered when deciding on the location of the bridge, 'getting the heavy vehicles out of the town centre.' While the community believes this option would relieve the truck traffic this would not be the case. Much of the truck traffic to and from the industrial areas in Moama and to the south east in Echuca would not use the Western Route alignment option (W1). Notwithstanding, this option would be consistent with community's preferred option (excluding some residents living in the environs of the Western Route alignment and some business operators). However, unless careful consideration were given to addressing some of the safety issues along Warren Street, an important access route to key facilities, including secondary and primary schools, for example, Echuca High School, Roman Catholic College, Echuca Primary School, etc. it would not necessarily provide an attractive alternate access route for all local residents.

The development of W1 would mean there would be no attention given to the existing crossing and within 15 years traffic volumes across the existing bridge would be back to current levels. Moreover, the roundabouts at each end of the bridge and commercial activity in Meninya Street would continue to limit traffic –vehicular and pedestrian - flow.

7.3 CENTRAL ROUTE ALIGNMENT (C1)

The proposed Central Route alignment (C1) could have the most positive widespread effects on access and safety. This option could alleviate the existing traffic conditions on Meninya Street and High Street, where much of the accommodation is provided. Conversely, the upgrading of Sturt Street and the resultant increase in traffic along this street with this option could dislocate the community and create a perceived division or psychological barrier between the east and west of Echuca. However, pedestrian access could be facilitated under controlled conditions and the existing intersections would be upgraded, for example, Sturt Street/Ogilvie Avenue and Sturt Street/Pakenham Street/railway crossing with this option. Thus there would be some benefit for the Sturt Street and environs residents who already find these intersections a problem. As noted above, these intersections and the surrounding streets were found difficult for students travelling to and from school on foot and by bicycle, for older people, people with young children and people with mobility problems

It is also important to point out that while this option would relieve traffic in the town centres, it could at times exacerbate some of the existing traffic issues (especially beyond the bridge and access points where traffic measures would be introduced to improve flow of traffic – refer Section 7.1). Moreover, it would not provide a real alternative for local traffic particularly in time of accidents or hold up at access points to the bridge or on the bridge. This would be especially important in the longer term with the increase in local and visitor populations (refer Section Three).

7.4 CENTRAL ROUTE ALIGNMENT (C3)

This would alleviate the current access problems and traffic congestion on the existing bridge. The removal of the roundabout in Meninya Street would improve pedestrian movement as well as traffic flow. However, the Central Route alignment (C3) would not solve the other traffic and pedestrian access issues (refer Section 7.1) to the same degree as C1 or other issues that will be created in the longer term with any population and visitor growth.

7.5 SOCIAL IMPLICATIONS

Potentially, the Central Route alignment (C1) would have the most widespread positive effects on access and safety. However, this would only be the case if pedestrian access is facilitated (under controlled conditions) across Sturt Street and traffic management measures are introduced to control the traffic at the access points to the bridge and at the relevant intersections along Sturt Street. If this does not happen there would be the potential for the traffic conditions to reduce safety, particularly for pedestrians.

The Central Route alignment (C3) would not have the same widespread effects. Notwithstanding, the development of this option would improve access over the bridge and to a range of facilities in the short to medium term.

The Western Route alignment (W1) would provide an alternate access but if this option were adopted it would be at the expense of:

- addressing the existing access and safety issues with respect to the existing bridge; and
- relieving the existing traffic congestion and associated problems in Meninya Street and High Street.

8.1 INTRODUCTION

General amenity is the perceived value of an area to a community in terms of its residential, landscape, conservation and recreational value. The second river crossing must therefore endeavour to minimise disturbance – noise, air quality, visual intrusion, etc. – in areas of high value to the community.

8.2 RESIDENTIAL VALUE

8.2.1 Western Route Alignment (W1)

Residents living within the environs of the Western Route alignment (W1) value the peace and quiet of their living environment. Existing ambient noise monitoring conducted by Marshall Day Associates, *Murray River Crossing at Echuca/Moama Ambient Noise Survey, December 1999*, in Wharparilla Drive and Merool Lane indicated that the L_{10} 18hr or average intrusive noise level between 0600 and 2400hrs was 49 and 43 respectively. With the new road the projected traffic flow is likely to be 7800vpd along Merool Lane and 7100 vpd along Perricoota Road. According to the Marshall Day Associates June 2000 report, *Murray River Crossing Echuca/Moama Preliminary Barrier Design* these traffic volumes and the associated noise level will impact on residential amenity. Moreover, if the existing ambient noise levels were taken into account, impact on residential amenity would be greater than in the environs of the Central Route alignment (C1). That is, more households would be subjected to changed or reduced conditions associated with noise along Merool Lane, Maidensmith Drive and the Layfield Downs Estate. While noise attenuation barriers would be installed along part of the eastern (2-3m in height) and western (3-4 metres in height) sides of Merool Lane and on the northern side of Perricoota Road, 200 metres east and west of Merool Lane, (2-3 metres in height), the area's attractiveness for residential development could still be affected.

8.2.2 Central Route Alignment (C1)

Generally the residents living within the environs of the Central Route alignment (C1) currently experience higher ambient noise levels than those living in the environs of the Western Route alignment (W1). The noise monitoring indicated that the L10 18hr or average intrusive noise level between 0600 and 2400hrs was 64 at 86 Sturt Street, 54 at Riverside Caravan Park and 49 at Madison Spa. The predicted 2016 traffic flow for Sturt Street and Meninya Street is likely to be 10500vpd and 6800vpd respectively. In the case of Sturt Street the associated noise level would increase by approximately by 5dB.

While there would be a gradual build up of traffic along Sturt Street without any upgrading of the road there would still be an impact on residential amenity along Sturt Street but it would not be as marked as along the Western Route alignment. Residents already endure noise pollution from traffic, industry, trains and railyards (refer Section 3.3.1). Notwithstanding, there would be many more households (51) subjected to the changed or reduced conditions associated with the noise as there are likely to be more houses located within 100 metres of the proposed route alignment. Barriers to control the noise would be considered. Notwithstanding, the area's attractiveness as a place to live could still be affected.

While the amenity along Meninya Street is likely to improve with this option, it is still likely to affect the attractiveness of the accommodation options as places to stay, in particular,

Madison Spa. This development would back onto the new road along with two dwellings within the vicinity of Boundary Road. These households would be subjected to changed conditions and reduced amenity associated with the increase in noise. Noise barriers would be installed along this section of the proposed road alignment and along the railway line to shield the Moama Riverside Caravan Park. However, the attractiveness of these accommodation options could still be affected.

The amenity in High Street would marginally improve with this alignment option but the traffic flows would still increase considerably. However, to stay in the existing accommodation would be better with this option than the Western Route alignment (W1).

8.2.3 Central Route Alignment (C3)

This factor does not apply to this alignment as there are no households residing near this alignment

8.3 LANDSCAPE VALUE

8.3.1 Western Route Alignment (W1)

The proximity to the river and the natural bushland were especially important to residents living within the Western Corridor and environs who participated in the survey. It is also notable that the landscape assessment prepared by Phillip Liston and Associates is consistent with the residents' opinions. The assessment indicated that the areas surrounding the Murray River in this corridor are of high landscape value. In fact, the report states:

> *The visual and physical impacts on areas of high landscape value surrounding the Murray River will be significant compared with the other corridor option* (p.71).

It is also significant that the report highlights:

> *The majority of the Western Corridor has little physical or visual relationship to existing road reserves and land use patterns with the exception of Merool Lane – resulting in the creation of a potential "barrier" across the landscape* (p.71).

In other words, the Western Route alignment (W1) could potentially affect the landscape value of not only the Murray River and environs but also Wharparilla Flora Reserve. It could also interrupt the views and natural environment of the Wharparilla Drive residents and the existing and future residential areas both north and south of the river crossing.

8.3.2 Central Route Alignment (C1)

Residents living north of the Murray River in particular certainly appreciated the river environs. However, unlike the Western Route alignment (W1), a large part of the possible road development would be undertaken utilising the existing road network. Moreover, there are less visual impacts associated with a second river crossing further upstream or downstream as this part of the river environs is highly modified. Notwithstanding, as stated in the landscape assessment report, there would still be the negative implications for residents along the Sturt Street end, and a road developed behind Meninya Street could potentially dislocate the Moama Town Centre, including the two motels and holiday park, from the river. In fact, the road could certainly impact on the existing visual amenity valued by these accommodation options as well as the Moama Riverside Caravan Park.

8.3.3 Central Route Alignment (C3)

There would be less visual impact with this option than for W1 or C1. However, there would still be negative implications for residents living along Sturt Street at the northern end, and for those living or staying near the proposed alignment behind Meninya Street.

8.4 ENVIRONMENTAL AND CONSERVATION VALUE

8.4.1 Western Route Alignment (W1)

Residents living in the Western Route alignment (W1) and environs who participated in the survey liked living near the river, the outlook from their properties and the landscape quality of their living environment, that is, trees, bushland and bird life. It is also notable that the investigations carried out by Biosis Research in their *Stage One Overview Report – Flora and fauna assessment of proposed second river crossing at Echuca/Moama Victoria and New South Wales, December 1999,* indicated that the western corridor is *the most environmentally significant.* This was reinforced in their June 2000 report when assessing the options:

> *W1 is the most environmentally sensitive route option, even apart from the Wharparilla Flora Reserve. It passes through some of the best remaining natural riverine vegetation and habitat in Echuca/Moama area. Over twice the amount of native vegetation (22.3ha) would need removal and the vegetation is generally in better condition than in C1...(p.32.*

The Western Route alignment (W1) and environs also "contains areas of natural value on both sides of the Murray River associated with the Murray River flood plain riverine environment...and also contains values away from the flood plain (Riverina Plains Grassland, Grey Box Woodland respectively)."

Residents did not raise any issues relating to cultural heritage sites and places and the perceived value. However, it is significant that Austral Heritage Consultants in their background report, *Murray River Crossing at Echuca/Moama Planning Study: Cultural Heritage Study,* January 2000, indicated that the Western Corridor contains most of the Aboriginal sites (11) and also a number of post contact places (3). Moreover, the Yorta Yorta community emphasised the spiritual value of this area and stated that this option was not viable.

8.4.2 Central Route Alignment (C1)

Similar to the residents of the Western Corridor and environs, residents of the Central Corridor and environs also focussed on their proximity to the river and its environs. However, other features raised as things they liked about the area, for example, access to work, shops, etc. were probably perceived as equally as important or more important. The investigations carried out by Biosis Research indicated that this area is not as environmentally significant in terms of habitat corridor, flora and fauna values, as the Western Route alignment (W1) and environs. Their report states:

> *C1 supports less vegetation and this is in generally poor condition. This route option is located in a relatively disturbed and altered area within or beside the townships. Nonetheless, significant environmental features are present, including 8.7 hectares of native vegetation and a Red Gum Swamp (p33).*

Residents of this corridor also did not raise any issues of archaeological and heritage interest. Notwithstanding, Austral Heritage Consultants stated the Central Corridor contains most of

the post-contact places (10) but the least number of Aboriginal sites (2). Moreover, the Yorta Yorta community support the central river crossing.

8.4.3 Central Route Alignment (C3)

The issues would be similar to the Central route alignment (C1). However, according to Biosis, this option (C3) *contains relatively little native vegetation (2.7 hectares) and would have minimal impact, requiring the removal of some trees but no intact vegetation or habitat (p33).*

8.5 RECREATIONAL VALUE

8.5.1 Western Route Alignment (W1)

Key recreational facilities are located within or adjacent to this alignment, for example, RSL & Citizens Club, Moama Sports Club. Access to these facilities and development of other recreational opportunities would be facilitated by an alternative river crossing in this corridor. At the same time the perceived attractiveness and recreational value of the river and environs in the vicinity of W1 could be reduced.

8.5.2 Central Route Alignment (C1)

The Port of Echuca is of special interest to all residents. The proposed Central Route alignment (C1) would attract traffic away from the Port area past the historic railway precinct. It could potentially exacerbate access to facilities and services, for example, children's playground, skate ramp and miniature railway. This option would reduce the development of the planned recreational and tourism opportunities within the historic Echuca-Moama precinct as well as the perceived attractiveness and recreational value of the river and environs, including the Moama Jetty. Moreover, if the bridge were not constructed to fit in with the existing bridge, views from the Port would also be interrupted.

8.5.3 Central Route Alignment (C3)

The Port of Echuca is of special interest to all residents. Similar to C1, the proposed Central Route alignment (C3) would attract traffic away from the Port area past the historic railway precinct. It could affect the perceived attractiveness and recreational value of the river and environs, including the Moama Jetty. Moreover, if the bridge were not constructed to fit in with the existing bridge, views from the Port would also be interrupted.

8.6 SOCIAL IMPLICATIONS

While residential amenity for some would be reduced with the development of the road on all alignments, the Western Route alignment (W1) would have the greatest effects on residential amenity. Not as many residences would be subjected to changed conditions as with the Central Route option (C1). However, there would be more residents 'highly annoyed' by the noise levels associated with the changed conditions as they would be more marked than with C1. Noise barriers along a significant length of the route would have to be installed to ameliorate the situation. Residents in the environs of C1 along Sturt Street are already subjected to noise but those who would be living or staying near the proposed alignment at the back of Meninya Street would be exposed to a marked change in noise level. Noise

barriers would have to be installed along this part of the route, particularly near Rich River Caravan Park, Madison Spa and Boundary Road to ameliorate the noise and to meet noise attenuation guidelines.

The Western Route alignment (W1) would also have greater impact on the conservation, cultural heritage, environmental and recreational value of the River and environs. As a consequence there would be greater reduction in the overall value of the area for the present community and future generations with this option than with the Central Route alignment options (C1) and (C3).

Tables 9.1 to 9.4 summarise the potential social impacts and effects and mitigating actions for each alignment option. The summary also identifies the flow-on or social effects in light of the assessment prepared by other specialist consultants:

- Saturn Corporate Resources, *Murray River Crossing at Echuca/Moama Business and Tourism Study Final Report, December 1999*;
- Marshall Day Associates, *Murray River Crossing at Echuca/Moama Ambient Noise Survey, December 1999;* Marshall Day Associates, *Murray River Crossing Echuca/Moama Preliminary Barrier Design, June 2000;*
- Biosis Research, *Stage One Overview Report – Flora and fauna assessment of proposed second river crossing at Echuca/Moama Victoria and New South Wales, December 1999;*
- Biosis Research, *Flora and fauna assessment of proposed second river crossing at Echuca/Moama Victoria and New South Wales, Stage Two: Assessment of Route Options W1, C1 and C3, June 2000;*
- Austral Heritage Consultants, *Murray River Crossing at Echuca/Moama Planning Study: Cultural Heritage Study Background Report*, January 2000;
- Phillip Liston and Associates, *Murray River Crossing at Echuca/Moama Planning Study Landscape Assessment,* December 1999; and
- Arup Transportation Planning, *Murray River Crossing at Echuca Traffic and Economic Evaluation of Options,* June 2000.

Table 9.5 – Rating of Social Impacts and Effects, indicates the positive or negative rating (high +/3, medium +/-2 or low +/-1) for each of the impact categories for each alignment option. The ratings recorded relate to an assessment of the technical data in light of community values. In the case of impacts on general amenity, the ratings recorded by the specialist studies have been considered for each area as well as the value the community ascribes to the environment, cultural heritage, landscape and recreation.

Table 9.1- Summary of Social Impacts and Effects – The People and Property Affected

Number and Characteristics of people affected	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment (C3)
Positive effects **No property acquisition**	-	No disruption to rural residential properties.	No disruption or total acquisition of any residential properties or commercial businesses
Properties subjected to changed conditions (less traffic volume)	Residential and commercial properties along Ogilvie Avenue, Sturt Street, High Street and Meninya Street subjected to marginally less traffic volume (2016).	Residential and commercial properties along High Street and Meninya Street subjected to less traffic volume by 2016 than W1.	-
Negative effects **Property acquisition**	Acquisition of: - one 5.5 acre property and consequent displacement of approximately 3 residents. Associated economic and social effects for this household as well as social and emotional disruption associated with acquisition and relocation. (Issues relate to property availability and suitability in terms of quality, size and location (4km from town) compensation; anticipated cost of new property; higher operating costs of residing elsewhere particularly as established at this location some 8 years ago with all utilities connected).	Possible acquisition of: - Moama Riverside Holiday Park (privately run on Council land) 100 caravan sites including sites of 3 permanent residents and 52 holiday makers) - Oz Maze and mini golf (Anstruther and Sturt Streets)	Possible acquisition of: - Moama Riverside Holiday Park 100 caravan sites including sites of 3 permanent residents and 52 holiday makers)

Summary of Potential Social Impacts and Effects

Number and Characteristics of people affected	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment (C3)
Partial acquisition	Partial acquisition of: - 6 rural residential properties (Merool Lane) - Jenola Oaks vineyards (Merool Lane)	Partial acquisition of: - 2 commercial businesses (southern end of Sturt Street) in short term - 4 commercial properties (southern end of Sturt Street) in longer term - proposed TAFE site (Sturt Street) - Moama Skate Park and recreation reserve - 1 residential properties (vicinity of Boundary Road) - part of 56 acres owned by Madison Spa (land extends from motel to river)	-
Properties within 100 metres of reservation subjected to changed or reduced conditions **Properties within 100 metres of reservation subjected to improved conditions**	Potentially 8 residential properties subjected to changed conditions with the introduction of the new road alignment: - 2 Merool Lane - 2 Corner Merool Lane and Maiden Smith Drive - 4 Layfield Downs Estate - RSL & Citizens Club (Merool Lane) - boarding kennels for 30 dogs and 6 cats (Merool Lane)	Changed conditions would not be as great as for W1(see Table 9.4) Potentially 51 residential properties along Sturt Street subjected to changed conditions with the introduction of the new road alignment, and - western side of Hume Street - Church of Christ (corner Sturt Street and Pakenham Street) - Salvation Army (Sturt Street) - approximately 10 commercial businesses (Sturt Street) - 19 caravan sites (Rich River Holiday Park). - Sundowner Motel (Meninya Street) - Madison Spa (Meninya Street) - 3 residential properties (vicinity of Boundary Road) Other Hume Street properties.	-

Number and Characteristics of people affected	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment (C3)
Properties beyond 100 metres of reservation subjected to changed or reduced conditions	Potentially some 111properties likely to be subjected to changed conditions with the introduction of the new alignment: - 61 Wharparilla Drive - 20 Maiden Smith Drive - 3 Grimison Road/Merool Lane - 27 Layfield Downs Estate - Merool Riverside Holiday Park, and - Shady River Holiday Park.	Potentially some properties likely to be subjected to changed conditions (but not as noticeable as for W1) with the upgrading of Sturt Street.	-
Zoned or developing residential areas **Positive Effects** **Negative Effects**	1000 hectares of land zoned 'future residential' west of Murray Valley Highway and in area along Merool Lane and Perricoota Road. Commencing development of approximately 1200 lots in 2000. This will contribute to population growth of approximately 3200. The second river crossing may provide choice for these households in the growth areas. Acquisition of strip of land zoned residential on north-west corner of Merool Lane and Perricoota Road. Acquisition of strip of land zoned residential east of Wharparilla Drive.	- - -	- - -

Number and Characteristics of people affected	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment (C3)
Mitigating actions	Compensation (for properties fully or partially acquired) so that owners can compete on open market and have some freedom of choice when trying to purchase elsewhere. Where properties are indirectly affected, that is, subjected to changed living conditions, consideration should be given as far as possible to individual circumstances by VicRoads and RTA. VicRoads and RTA should recognise household characteristics and each household's unique problems and situation. VicRoads and RTA should handle any problems sympathetically. Ongoing communication with affected residents.	Compensation for Boundary Road residential property and commercial properties fully or partially acquired. Where properties are indirectly affected, that is, subjected to changed living conditions, consideration should be given as far as possible to individual circumstances by VicRoads and RTA. VicRoads and RTA should recognise household characteristics and each household's unique problems and situation. VicRoads and RTA should handle any problems sympathetically. Ongoing communication with affected residents.	Compensation for impact on caravan park..

Table 9.2: Summary of Social Impacts and Effects - Community Patterns and Linkages

Community Patterns and Linkages	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment (C3)
Positive effects	Potentially would enhance access and in turn viability of: - RSL & Citizens Club - Shady River Holiday Park - Merool Riverside Holiday Park - Merool Water Sports Club - Moama Sports Club - Rich River Golf Club Potentially increased participation in social activities with alternative river crossing and enhanced access to Echuca and Moama particularly, for those existing residents living in the west and for those who will live in the areas zoned 'future residential' in longer term More consistent with overall community expectations and perceived need to get truck traffic out of town centres of Echuca and Moama even though 88%. of bridge traffic made up of local traffic.	Minimal change to local movement and interaction patterns between residential communities and usage of facilities for those residing in areas west of proposed alignment. Strengthens the physical and social connection between Echuca and Moama Potentially would further enhance access and in turn viability of Moama Bowling Club. Removes through traffic from High St/Heygarth Street and so improves pedestrian movement between Port precinct and Town Centre. Directs traffic away from roundabout so reduces conflict between rail and vehicular traffic and facilities re-establishment of original rail line.	Minimal change to local movement and interaction patterns between residential communities and usage of facilities for those residing in areas west of proposed alignment. Strengthens the physical and social connection between Echuca and Moama Potentially would further enhance access and in turn viability of Moama Bowling Club Does not affect trading patterns, activities and in turn income of businesses dependent on local and passing trade in Meninya Street hence does not affect local convenience function of centre.
Negative effects	Breakdown of cohesiveness of newly developing communities along Merool Lane with dissection of communities by development of road alignment and/or displacement of household; the road may act as a physical as well as psychological barrier to promotion of community development in the longer term.	Potential for changed behavioural patterns with changed traffic conditions along Sturt Street. Displaces Oz Maze and Mini Golf. Potential to impede access to Church of Christ, Salvation Army (Sturt Street).	No change to roads in Echuca hence social activity patterns would more than likely change as actual and perceived safety of Sturt and Meninya Streets is reduced and access impeded to facilities and services west of Sturt Street and along Meninya Street in longer term..

Community Patterns and Linkages	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment (C3)
	Could impede further development of Merool Holiday Park and development of abutting property on Merool Lane. Potential to affect trading patterns, activities and in turn income of a range of businesses dependent on passing trade in Meninya Street. Could therefore affect local convenience function of centre but not as great as for C1. Does not facilitate truck movement between existing industrial areas in north east Moama and South east Echuca.	New road alignment along Sturt Street could act as physical and/or psychological barrier to movement patterns and could dislocate the eastern residential sector of Echuca from the west unless controlled measures are introduced to facilitate traffic movement. Narrows the proposed TAFE site along Sturt Street and other commercial activities along Sturt Street at southern end. Potential to affect integrity of long term development of historic railway station precinct as traffic flows and required road works may not be compatible with requisite historic ambience. Road alignment behind Meninya Street could act as psychological barrier to movement to river for Moama residents, in particular even though physical access would be provided under the embankment. Potential to affect trading patterns, activities and in turn income of range of businesses dependent on local and passing trade (approx. 10 out of 24) in Meninya Street Could affect local convenience function of centre, use of accommodation offered along Meninya Street, children's playground and skate ramp.	

Community Patterns and Linkages	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment (C3)
<u>Mitigating actions</u>	Careful consideration be given to access of key facilities along Merool Lane.	Consideration be given to Oz Maze being relocated in same area along with children's playground, skate ramp and miniature railway. Ensure provision of controlled measures across Sturt Street to facilitate pedestrian movement. VicRoads and RTA work closely with Councils and Port of Echuca to monitor activities – traffic flow, road works and tourism proposals – to minimise impact on historic Railway Station precinct.	No change to roads in Echuca.

Table 9.3: Summary of Social Impacts and Effects - Impacts on Existing Access

Impact on Existing Access	Western Alignment (W1)	Central Alignment (C1)	Central Alignment (C3)
Positive effects	Potential to alleviate existing access and safety issues with provision of second river crossing and alternative access to key facilities such as: - RSL & Citizens Club - Shady River Holiday Park - Merool Riverside Holiday Park - Merool Water Sports Club - Moama Sports Club - Rich River Golf Club - wineries and accommodation (Perricoota Road) Minimal change to outlying communities as east-west access maintained Potential to provide alternative access route to a range of activities for existing and future populations (1000 hectares of land zoned 'future residential' west of Murray Valley Highway) and in area along Merool Lane and Perricoota Road.	Minimal change to local movement and access routes between residential communities and to and from facilities for those residing in areas west of proposed new alignment. Would alleviate current access and traffic flow problems with existing bridge. May alleviate existing traffic conditions on Meninya Street and so improve local traffic and pedestrian access to Moama. Potentially would further enhance access and in turn viability of Moama Bowling Club Traffic management measures would improve pedestrian movement patterns and safety in residential areas east of Sturt Street.	Minimal change to local movement and access routes between residential communities and to and from facilities for those residing in areas west of proposed new alignment. Potentially would further enhance access and in turn viability of Moama Bowling Club Traffic management measures (removal of the roundabout) would improve pedestrian movement across Meninya Street in short term.
Negative effects	Within 15 years traffic volumes across existing bridge would be at current levels, the narrow existing bridge, roundabouts at each end of bridge and commercial activity in Meninya Street would continue to limit flow across bridge.	Potential to exacerbate existing traffic conditions and safety issues along Sturt Street and impede pedestrian movement to main centre of Echuca unless pedestrian crossings are installed under controlled conditions and traffic management measures are introduced to improve traffic flow.	Would not address existing traffic conditions and access issues along the High Street/Haygarth Street route through Echuca.

Impact on Existing Access	Western Alignment (W1)	Central Alignment (C1)	Central Alignment (C3)
		Potential to exacerbate delays at Ogilvie Avenue and Pakenham Street where road alignment crosses railway line unless intersections upgraded. New railway crossings at either end of the bridge crossing would result in delays.	Would not alleviate existing traffic volume on Meninya Street and so improve local traffic and pedestrian movement to and from Moama in longer term.

Table 9.4: Summary of Social Impacts and Effects - Impacts on General Amenity

Impact on General Amenity	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment C3)
Positive Effects **Residential value**	Potentially removes through truck traffic from both town centres. Reduced impact along Meninya Street W1 will improve the amenity for residential properties and accommodation along Meninya, High and Sturt Streets but in the case of High Street (17700vpd) and Meninya Street (11300vpd) the predicted traffic volumes would not be as low as with C1. In Sturt Street traffic would increase from 2800vpd to 5500vpd with W1 by 2016, but this would be less if 'do nothing' option taken (6100 vpd).	Traffic management measures would improve general amenity in east Echuca. Takes more traffic off Meninya Street and High Street than W1. Predicted volumes would be 6800 vpd, and 15000 vpd respectively.	
Environmental and conservation value **Recreational value**	- -	- -	Does not affect the environmental and conservation value of the land to the same degree as W1 or C1. Does not affect the development of recreational opportunities to the same degree as W1 and C1.
Negative effects **Residential value**	Potentially 8 households within 100m of road reservation and some beyond subjected to changed living conditions or change in character of noise and outlook. While fewer households affected than C1, changed conditions would be more significant than C1.	Potentially 51 households within 100m of road reservation subjected to changed living conditions or change in character of noise and outlook but would not be as noticeable or as significant as for W1 because of existing noise and air pollution generated from existing traffic and industry.	Potentially households along Sturt Street would be subjected to changed living conditions or change in character of noise and outlook but would not be as noticeable or as significant as for W1 or C1 in longer term. Does not take traffic off Meninya Street.

Impact on General Amenity	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment C3)
	Traffic would increase from negligible level to 8100vpd by 2016. This would be contrary to existing 'peace and quiet' valued by residents and reasons for living there on large rural-residential blocks, particularly along Merool Lane and Maidensmith Drive and for some residents in Layfield Downs Estate along Perricoota Road and for some residents further away in Wharparilla Drive. Lower number of households likely to be annoyed by changed noise conditions with W1 but likely to be more annoyed than for C1 because of more significant change	Traffic would increase from 3400vpd along Sturt Street to 10500vpd by 2016 and this would be greater than if no measures taken 6100 vpd. Accommodation options, Rich River Caravan Park, Madison Spa and Boundary Road households subjected to more noise, headlights (at night), etc. Greater number of households within 100 metres of road reservation likely to be annoyed by changed noise conditions but not likely to be as annoyed as those in environs of W1 .	Potentially households and accommodation along Ogilvie Avenue, High Street and Meninya Street would be subjected to increase in traffic volumes and changed conditions by 2016 which would be greater than W1 and C1. .
	High visual impact of river crossing from a number of residences along Wharparilla Drive and for residential areas both north and south of river crossing. Moderate visual impact of road alignment from a number of residences along Merool Lane particularly at southern end. Significant change in area's attractiveness for residential development	High visual impact for Madison Spa and 2 residences (possibly 3) in vicinity of Boundary Road. Change in Sturt Street and environs attractiveness as residential location but not as significant as for W1.	No change to roads near houses.

Summary of Potential Social Impacts and Effects

Impact on General Amenity	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment C3)
Landscape value	High visual impact on areas of high landscape value along Murray River and Wharparilla Flora Reserve.	Impact on Murray River environs but lower significance than WI as river environs already modified.	Impact on Murray River environs but lower than C1.
Environmental and conservation value	22.4 hectares of native vegetation/habitat removed. Splits Wharparilla Flora Reserve in two High impact on flora and fauna without taking into account Wharparilla Flora Reserve. Contains more Aboriginal sites than C1. Has significant spiritual value for Yorta Yorta community.	8.7 hectares of native vegetation/habitat removed. Medium to high impact on flora and fauna.	2.7 hectares of native vegetation/habitat removed. Lowest impact on flora and fauna.
	Impact on areas of Aboriginal cultural and archaeological significance of value to the community and consequent effect on heritage value of the area to community. Highly valued by the community in terms of conservation and environment but less accessible than C1. Reduction in overall value of area for future generations.	Least number of Aboriginal sites affectd and is supported by Yorta Yorta community. Highly valued by the community in terms of conservation and environment and more accessible than environs of W1. Reduction in overall value of area for future generations, but not as great as W1.	

Summary of Potential Social Impacts and Effects

Impact on General Amenity	Western Route Alignment (W1)	Central Route Alignment (C1)	Central Route Alignment C3)
Recreational value	High impact on recreational opportunities with negative effects on river and environs. Significant change in noise environment of river environs.	High impact on recreational opportunities highly valued by the community, the river environs, Moama Jetty, children's playground and skate ramp, Oz Maze. Moderate change in noise environment of river environs. Change in attractiveness of natural asset for recreation. Potential to affect proposed recreational and tourism opportunities within Echuca-Moama historic precinct. Potential to affect proposals of Madison Spa and Murray River PaddleSteamers as will create psychological and physical barrier to access existing and proposed recreational cum tourism development.	No change to road approaches. Marginal change in noise environment of river environs. Marginal change in attractiveness of natural asset for recreation.
Mitigating actions	Installation of extensive noise barriers in highly sensitive areas particularly along Pericoota Road and Merool Lane to meet noise attenuation guidelines. Use of appropriate landscape, plantings and grading to screen road alignment at above locations. Ongoing consultation with residents, and community groups.	Installation of noise barriers at back of Meninya Street to meet noise attenuation guidelines particularly near Rich River Caravan Park and Madison Spa and Boundary Road. Use of appropriate landscape, plantings and grading to screen road alignment at above locations. Introduction of safe access points to recreation reserve and Madison Spa proposed development. Ongoing consultation with Meninya Street traders, local residents, and community groups.	Ongoing consultation with Meninya Street traders, local residents, and community groups.

Table 9.5 Table Rating of Social Impacts and Effects

	(W1)	(C1)	(C3)
People Affected			
Property Acquisition			
Residential	Low (–1)	Low (-1)	0
Commercial	Low (-1)	Moderate (-2)	Low (-1)
Number of properties within 100 metres of reservation subjected to changed or reduced conditions	Low (–1)	Moderate (–2)	0
Number of properties beyond 100 metres of reservation subjected to changed or reduced conditions	Moderate (-2)	Low (-1)	0
SUB-TOTAL	**-5**	**-6**	**-1**
Community Linkages and Patterns			
Positive Effects			
Enhances access and participation in range of activities	Moderate (+2)	High (+3)	Moderate (+2)
Negative Effects			
Breakdown of community cohesion	Low (-1)	Low (-1)	0
Impedes access and further development of activities	0	Low (-1)	0
Affects overall trading patterns and activities	Moderate (-2)	Low (-1)	0
SUB-TOTAL	**-1**	**0**	**+2**
Impacts on Existing Access			
Positive Effects			
Provision of alternative crossing	High (+3)	0	0
Relief of traffic volumes across existing bridge	Moderate (+2)	High (+3)	Moderate (+2)

	(W1)	(C1)	(C3)
SUB-TOTAL	**+5**	**+3**	**+2**
Impacts on General Amenity			
Negative Effects			
Residential value	High (-3)	Moderate (-2)	0
Environmental value	Moderate to High (-2.5)	Moderate (-2.)	Low to moderate (-1.5)
Heritage value	Moderate (-2)	Low to Moderate (-1.5)	0
Landscape Value	High (-3)	Moderate to High (-2.5)	Low to moderate (-1.5)
Recreational value	High (-3)	Moderate (-2)	Low (-1)
SUB-TOTAL	**-13.5**	**-10.5**	**-5**

NOTE: The ratings recorded relate to an assessment of the technical data in light of community values.
In the case of Impacts on general amenity, the ratings recorded by the specialist studies have been considered for each area as well as the value the community ascribes to the environment and conservation, landscape and recreation.

Land Use

- **Murray River Crossing at Echuca-Moama, Evaluation of Land Use Planning Implications,** *Research Planning Design Group, April 2001*

Murray River Crossing at Echuca-Moama

Evaluation of Land Use Planning Implications

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1. Summary of Findings

The purpose of this study is to review relevant land use issues, assess options in relation to land use issues and report with recommendations on planning options. This will provide an evaluation of the interaction of land use planning and the proposed second crossing of the River Murray at Echuca/Moama.

A range of physical and environmental constraints largely determines the existing urban form of Echuca – Moama. Those constraints will continue to direct much of the future urban form of Echuca – Moama. Most future urban growth will occur to the west of Echuca and the north and north west of Moama. Based on likely future growth rates residential development rates are likely to be fairly evenly spread between these two areas.

The specialist studies that have been conducted to date indicate that the direct land use impacts of options for a new river crossing alignment are generally peripheral to the major content of those documents. Although the social impact study indicates that a range of land use impacts resulting from the central alignments particularly on residential areas such as Sturt Street is an important factor to consider, as is the introduction of potential traffic impacts on the semi-rural areas affected by the western alignment.

Both Councils in their future land use planning strategies favour the western alignment. This route option links the two future growth areas on either side of the Murray River and reduces overall traffic pressure on the two town centres and the heritage and tourism precincts. The western alignment will act as a form of central city bypass for movements between the Moama and Echuca communities, and that role will increase in significance as residential development continues.

This study finds that the alternative western and central crossing alignments are likely to have few substantive impacts on the future overall urban form and major land uses in Echuca and Moama. Whether a new bridge was constructed or not (and where it is constructed) the overall future urban form of Echuca/Moama will be fundamentally the same.

However, over time the choice of a western or central alignment will have significant effects on a number of specific land use elements, these include:

- the rate of growth of some specific areas;
- the type of land use likely to occur in certain locations;
- the character and presentation of the traditional town centres of Echuca and Moama; and
- the levels of convenience for certain vehicle movements.

Compared to the central alignment, the western alignment is likely to:

- encourage faster rates of growth in the west Echuca and north west Moama areas
- support the location of new major community infrastructure and facilities and the development of a new stand-alone shopping centre in Echuca West;
- provide scope to better retain the level of amenity and the functioning of the Echuca and Moama town centres (although Option C1 also provides significant scope to remove through traffic from the CBD of each town);

- support the development of Moama's new industrial area to the north of the town along Cobb Highway;

- lessen the demand for a third road crossing of the Campaspe River in Echuca to facilitate east – west movement; and

- impact on some residential areas where expectations of a semi-rural amenity are high.

In terms of overall land use planning issues it appears to matter little in the short term which alignment for a new river crossing is chosen, however, in the longer term a western alignment has some advantages:

- some through traffic is removed from the central road system and the amenity of the two town centres will be improved. Alignment C3 has significant long term land use impacts on the amenity and function of the Meninya Street retail area in Moama;

- the central alignments have distinct land use impacts on the Moama and Echuca town centres and depending on which central option is chosen there are amenity impacts on some commercial and residential areas. The presentation of the Echuca heritage railway, tourist area is improved by not having a major new road crossing in the central corridor, although proposed changes to the rail-road area that accompany redevelopment offer opportunity for improvement to the rail crossing area.

- the western alignment is consistent with and reinforces the urban and residential strategies of both Councils. Given the form of urban development that will occur Echuca and Moama the western alignment will increasingly become an essential element of the overall functioning and operation of both urban areas and will aid their integration as an urban area.

Accordingly it is recommended that the western crossing alignment presents the most appropriate long term option in relation to land use impacts.

2. Background

The purpose of this study is to provide an evaluation of the interaction of land use planning and the proposed second crossing of the River Murray at Echuca/Moama.

This study is designed to ensure that the land use planning issues are adequately considered among the issues relating to the alignment options currently under investigation.

VicRoads and RTA (NSW) have been nominated as co-proponents for the planning study leading to the preparation of an Environment Effects Statement/Environmental Impact Statement (EES/EIS) for the proposed second crossing of the Murray River between Echuca and Moama. Information Bulletins released in August 1999 and September 2000 provide background information on the project.

In Phase 1 of the study a range of alignment options were investigated in three broad corridors – the western corridor to the west of the towns, the central corridor adjacent to the existing bridges and the eastern corridor to the east of the towns. After this initial investigation, three alignment options were investigated in more detail in Phase 2 of the study. These current options under consideration are Option W1 to the west of the town and Options C1 and C3 adjacent to the existing bridges. The Discussion Paper released in September 2000 outlines the results of the planning study to date.

Since Phase 2 of the Study was completed, the Victorian Minister for State and Regional Development has supported the extension of the rail line into the historic port of Echuca. While the use of this spur will not be great, it will put a new constraint on the Central road alignment options that will affect other land use decisions for Echuca.

Chapter 5 of the Discussion Paper discussed land use issues and is based on information supplied by the Shire of Campaspe and the Shire of Murray. The Victorian Department of Infrastructure and the NSW Department of Urban Affairs and Planning have reviewed the Discussion Paper and considered that more work was needed to be undertaken to adequately address the issues relating to land use.

The results of this specialist study of land use issues will be one element assisting VicRoads and RTA (NSW) to adopt a preferred alignment and be used in the preparation of the EES/EIS. The report produced as part of this specialist study will ultimately form part of the technical supplements to the EES/EIS.

The intended outcomes from this specialist study are:

- a review of relevant land use issues;
- an assessment of options in relation to land use issues; and
- a report with recommendations on planning options.

As part of the study the consultants were required to:

- review project documentation and the concept design of current options;
- review other relevant specialist studies which assess options;
- inspect the project area and surrounds including the links to the Cobb Highway north of Moama and the Northern Highway south of Echuca;

- review the Consultative Committee minutes for land use planning issues;
- interview key local government and other agency personnel;
- search Commonwealth, State and local policies as they relate to the project;
- review relevant Council policies, strategies and planning documents including the Campaspe Planning Scheme (including the SPPF, LPPF, zones and overlays) and the Murray Local Environmental Plan 1989 (as amended) in the context of transport/land use issues and development in the vicinity of the project;
- review reports by Councils on the project;
- review future growth rates assumed in traffic modelling;
- consider current and future development patterns in the area;
- assess the impact of each of the route options on land use and planning strategies, including:
  - the potential for local and regional land use change as a result of each of the development options, including the regional linkages beyond Echuca and Moama;
  - how the proposed development options and landuse scenarios meet the objectives of each Councils' planning controls and future development strategies, including the interaction of road and rail traffic in both Echuca and Moama and the operation of the two town centres;
  - the constraints placed on the proposed development by local and regional land use planning strategies, including tourism and heritage studies.

The work has been undertaken in three stages:

(i) Identifying the critical elements of Echuca/Moama's urban form and land uses and how these elements currently function, are likely to function in the future and how they will impact on the future urban form and major land use elements.

(ii) Identifying how the future urban form is likely to develop.

(iii) Identifying the implications of different bridge options, in particular;

- the impacts different bridge options are likely to have on the future urban form
- the impacts different bridge options are likely to have on different land uses in a broad general sense and then on specific land use and development elements and issues.
- the impacts the urban form is likely to have on the traffic using different bridge options.

This approach is designed to enable an assessment to be made about the relative impacts on land use and planning of the different alignments and to make recommendations on the planning options.

3. Review of Relevant Matters

3.1 Urban Form and Land Use

The urban form of Echuca/Moama is distinctive. It is dominated by five major factors:

(i) A uniformly flat topography.

(ii) The physical separation of the two urban areas and communities of Echuca and Moama by the Murray River. Historically Echuca has contained the larger urban area population and commercial and industrial activity. This is likely to continue for the foreseeable future. However, in recent years rates of development in residential land use have been roughly comparable.

(iii) The extensive riverine environment and flood plain areas formed by the Murray River and to a lesser extent the Campaspe River. The floodplain of the Murray River and the extensive riverine environment are a dominant element in the overall presentation, character and form of Echuca-Moama. Large areas, particularly to the east of Echuca-Moama are subject to flooding and this provides a major constraint to urban development. The width, natural and cultural heritage associated with the environs of the Murray River provide a physical barrier to urban settlement and interaction between Echuca and Moama. This area is a major feature of the urban form and establishes a key element in the character of the area that is highly valued in the community.

(iv) The single road link between the two towns which, historically, has formed and influenced urban development and land use issues. The historic single crossing point of the Murray River has influenced the siting and redevelopment of the commercial areas in both Echuca and Moama and has focussed traffic movement between the two centres onto a narrowly defined network of roads. It has placed specific constraints on the development of the road and rail system but has also encouraged a linear development of commercial functions on the roads leading to this crossing point.

(v) The location of Echuca and Moama at the confluence of a number of major highways has provided a framework for much of the urban development. As the urban area has developed the network of major highways connecting with Moama and particularly Echuca have become important elements in the urban form. The fact that the Murray Valley Highway skirts the west and south of Echuca has supported the development of a secondary spine and has acted like a bypass of Echuca.

Each of these factors is a continuing major influence on the likely future urban form and land uses in Echuca and Moama. It can reasonably be expected that this range of factors will continue to be major future influences on urban form. Other influences include:

- The focus of commercial and civic development, which in both Echuca/Moama is located at the existing river crossing place or along the roads that provide immediate access to the crossing. However, this pattern is starting to break down. There is an increasing focus for highway business uses along entrance and peripheral routes like Murray Valley Highway/Northern Highway (MVH/NH) west of Echuca, Ogilvie Ave – MVH east of the railway line and to a lesser extent on some major outlet roads in Moama.

- The role that Echuca has played in providing for the bulk of compact conventional density residential housing will continue with Moama providing for the bulk of lower density and dispersed residential housing demand. Echuca in particular has the capacity to plan future urban and residential development which emphasises linear pathways for walking and cycling

as alternative transport forms and to reduce the overall demands for additional traffic provision. The opportunity may also arise for a pedestrian/bicycle bridge over the River Murray to enhance such a network. The high levels of local traffic across the river reinforce the benefits of a more integrated approach to transport.

- Most future residential development will occur in only two areas – west of MVH in west Echuca and north west / north of Moama. This is likely because of the constraints in other areas such as flooding, road access, location of industrial areas and residential preferences. Both Councils have established their long term strategic land use planning around development in these areas. Only about 500-600 (10%-20%) new residences are likely to be constructed outside these two areas.

- The different forms of tourism development in the area, with a focussed/compact area based on heritage at Echuca and stand alone resort style focus in Moama.

- The industrial areas are primarily focussed in two existing locations (south Echuca and north east Moama) and two future areas, further expansion at south Echuca and a new area north of Moama on the Cobb Highway corridor.

3.2 Specialist Studies

Other specialist studies completed for this project include some issues with specific relevance to the land use planning assessment. The details of these are included within the individual reports, however issues include:

- The social impacts of the development on existing residential areas, including concern at pedestrian safety from the central options and the significant impact on residential amenity that would result from the W1 option being developed in an area that residents value for its tranquil environment.

- The potential for visual impacts on the landscape resulting from option C1 (and its affect on the links between Moama and the river) and W1 (and its more general impacts on a relatively unspoilt riverine area).

- That local traffic movement dominate bridge crossings, suggesting the need to adopt an integrated approach to traffic management.

- The general considerations regarding linkages between the Northern Highway and Murray Valley Highway within urban Echuca.

- The need to mitigate any impacts on flora and fauna though vegetation retention and the development of landscape linkages and corridors.

3.3 Key Stakeholder Organisations and Groups

Discussions were held with various agencies regarding land use planning and development issues associated with the bridge options. Agencies who responded to a request for comment included:

- Department of Urban Affairs and Planning (NSW)
- Department of Infrastructure (Vic)
- Heritage Victoria
- Campaspe Shire Council
- Murray Shire Council
- Port of Echuca

Other agencies were contacted without response.

Each agency or organisation had general points of discussion, with more or less relevance to the specific elements of the land use planning assessment.

DUAP, DoI and the two municipalities had broad interest in the overall form and development of the towns. In general it was recognised that the capacity of the current bridge would not meet future needs, and that the dominant pattern of development was to the west of the existing towns.

Both municipalities saw significant advantages in the development of a western option to create linkages between these growing areas. They also considered that the western option would present advantages to overall traffic movement and traffic planning simply by increasing the overall number of river crossings. These views were strongly expressed in submissions to the Phase Two Report. It was considered that the western bridge option was most consistent with growth trends and the planning strategies of both Councils.

In relation to the central options, the municipalities considered that Option C1 raised two key concerns. In Moama, concern was raised at the potential for the new development to create a barrier between Moama and the river. In Echuca some concern was raised at the impact on Sturt Street residents, although it was recognised that this could be addressed through land purchase and urban design.

Other agencies contacted had specific interest in the heritage and tourism values of the area, particularly the central town areas and the Port of Echuca (and the opposite bank). The Port of Echuca had particular concerns at the visual impact of a new bridge, including the vista to the existing iron bridge from the port area, the view to any structures on the Moama side of the river and the impact of the Sturt Street development. Concern was also expressed at the impact of the bridge entry points on the railway, and the planned railway to the port area (even though use of the railway extension would be infrequent). Heritage Victoria recognised that these visual impacts would have an impact on the experience of visitors, but would be unlikely to effect the heritage significance of the port or railway.

With regard to the port issues, two points appear relevant:

- That the bridge profile and alignment proposed for options C1 and C3 appears to limit visual impact from the port area;

- That the traffic management proposed for option C1 provide the opportunity for a more efficient railway crossing linking the port and the existing railway, although this will depend on appropriate design.

3.4 Consultative Committee

The role of the consultative committee is to include a broad cross section of the local community and involve them in providing review of the EES / EIS, provide advice and assessment and bring forward issues not elsewhere addressed for consideration.

The key points and issues raised by this committee to date in relation to the land use planning and development implications of the bridge development options included the following:

- **Existing bridge status and future of the bridge**: The existing bridge is on the Heritage Register and is considered to be a State Highway, not a national highway bridge.

  VicRoads stated that the intention is to "retain the existing bridge regardless of which of the two options above is proceeded with, and to have it open for traffic". The bridge will have to "be closed for between 6 to 12 months, once the new crossing is finished, to allow these significant and substantial works to be undertaken. These works are necessary to allow the existing bridge to remain open."

The committee raised the issue of restrictions through a truck ban to be placed on the existing bridge, upon completion of new bridge. This was seen to provide scope for the separation of heavy vehicle traffic.

- **Interest in the eastern corridor being included within the study**. The basis for the inclusion of the eastern route was the low impact on residential dwellings and development and that it would better service the industrial area of Echuca and Moama. The committee agreed with the later exclusion of this option.

- **The reliability of the traffic study** was of concern by some of the committee members. Additional traffic analysis is being undertaken.

- **Consideration of the proposed inland port for Echuca**. The issue of the inland port was raised, seeking feedback as to whether it had been suitably considered in the proposal. Council's reply was that the impact of any specific option would be negligible.

- **The issue of flooding** and ensuring that the proposed bridge does not have an adverse impact on flooding affects of the two communities. It would appear that the flooding impacts are to be addressed through specific studies. Constraints presented by floodplains have traditionally played a role in framing the development of both towns.

- **Environmental impacts** were raised as a concern, as was the **amenity of residents** in Wharparilla Drive in regard to the western option. This matter is raised in the Social Impact Assessment. The potential impact on these residents is greater, generally because of expectations and perceptions of their current environment. These impacts will have differential effects on different areas of the towns and on different members of the community.

3.5 Existing Policies Plans and Reports

A number of existing plans, strategies and policies affect the future land use and urban form of Echuca-Moama, and bear relationship to the proposed river crossing. While, from a land use planning perspective, only the Campaspe Municipal Strategic Statement makes explicit reference to a new crossing (and favours a western crossing), other local, state and Commonwealth strategies reflect on these issues.

Local Planning Policy and Strategy

Significant elements of local policy and planning strategy that have a bearing on the bridge options include:

- Direction for urban growth, including residential growth and commercial development;

- Elements of policy and strategy that relate to the use and function of the two town centres;

- Strategy and policy relating to vegetation, landscape and other elements of planning for the riparian environment.

Urban Growth: The Shire of Campaspe Planning Scheme includes specific policy references to the preferred future pattern of urban growth and the constraints posed by transport patterns and landform. The Campaspe MSS recognises the need to encourage infill development in Echuca and to set design standards for development along the river in the Wharparilla Drive area. Overall the MSS identifies the Echuca West area as being the key future growth area. The significance of Echuca West for future growth is reinforced through the current Echuca West Outline Development Plan that provides for significant residential growth and associated community and commercial services.

The Shire of Murray, through the Murray REP and LEP, have a less defined approach to future urban form, although the predominance of growth (at a range of densities) to the west of Moama is an important element of future planning in Murray. Proposals to develop industrial areas to the north of Moama have the potential to generate heavy vehicle traffic.

Commercial Centres: Both planning schemes identify the respective commercial centres as being the core commercial area in each town. The Murray LEP specifically identifies this as a commercial area through zoning. The Campaspe Planning Scheme reinforces the commercial zoning through statements within the Local Planning Policy Framework that reinforce the role of the Echuca CBD as a regional service centre.

Riverine Environments: The Murray Regional Environment Plan provides planning principles that relate to the protection of the riverine environment. It includes scope to include the MDBC on matters relating to certain developments (generally with the potential to effect water quality, flow or banks). The EES/EIS process provides the forum for the objectives of the REP to be met.

The Campaspe Planning Scheme, through the Local Planning Policy Framework, provides specific direction on planning matters affecting the riparian environment. The planning policy framework recognises the significance of the River Murray through a set of policies aimed at maintaining the landscapes and the quality of water and the riparian environment.

State and Commonwealth Policy and Strategy

While no explicit State of Commonwealth policy or strategy exists in relation to the urban form and land use planning issues associated with the crossing of the River Murray at Echuca, a number of consistent principles apply which relate to this issue:

- Integrated project planning principles which have applied through the EES/EIA process
- The principles of sustainable development, in so far as they relate to transport and urban form
- Specific State land use planning policy, in relation to encouraging compact urban form, sustainable transport planning and environmental management.

3.6 Future Growth Rates

As a component of the land use planning assessment the household projections as provided in the Traffic Study[1] completed in December 1998 have been reviewed. The review accounts for a range of factors that have the capacity to alter the household projections, including:

- The Department of Infrastructure (Victoria) small area population projections completed in 2000.
- Consideration of the different rates of development that may emerge as a result of the current bridge options.
- Consideration of recent trends in fringe residential and infill housing in Echuca and clustered fringe development in western Moama.

This review involves two components. Firstly it provides a picture of the projected population of the two towns to 2021, accounting for recent population projections. Secondly it provides an indication of the overall household capacity based on the current land availability through zoning and strategy[2].

Reviewing Population and Housing Growth

Echuca and Moama are both experiencing significant population growth, especially when compared to many other areas in the region. The attraction of the towns as a recreation and retirement location makes a considerable contribution to this growth, with high rates of increase among older age groups and projections for this to continue.

Household growth is anticipated to reflect this comparatively high rate of growth, although housing development rates will also reflect overall trends towards smaller household size creating additional future demand. Currently the bulk of new development in Echuca, and almost all development in Moama, occurs in previously undeveloped areas. Some infill and medium-density housing has occurred recently in Echuca, and while this trend may be expected to continue, it remains a minor component of overall housing growth. A significant proportion of development in Moama occurs in rural residential style estates on larger lots or in clusters centred around recreational focal points such as waterways and golf courses.

The population growth estimates provided in the 1998 Traffic Study projected a population of 20,781 for Echuca-Moama in 2016. This was based on compounding historical growth rates for each town. The population projections in this study estimated a population of 13,756 in 2016 for Echuca, and 7,025 for Moama in the same year[3].

These figures are higher than estimated projections from other sources. The Department of Infrastructure projections for Echuca[4] predict a population of 12,378 in 2016 and 12,810 in 2021. This is significantly lower than the projection contained in the traffic study. The Department of Infrastructure Projections also forecast slowing growth in Echuca (from almost 2% per annum to less than 1%).

In the case of Moama, it is possible to conclude that the population calculation for 1996 (based on enumerated population) is an overestimate, as it utilises census collection districts that extend well

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[1] ARUP (1998) *Echuca-Moama Traffic Study: Final Report*, Roads and Traffic Authority NSW
[2] It is evident that the available land will provide for household growth well in excess of population forecasts to 2021. What this does indicate, however, is the likely future growth in the long term, which should be considered as reliable given the constraints posed to growth in other areas of Echuca and Moama.
3 The current (June 2000) ABS Estimated Residential Population for Campaspe-Echuca is 11,128.
4 Victoria in Future, Department of Infrastructure (2000)

beyond the boundaries of Moama's urban and rural residential areas. The area included for the estimates extended to Picnic Point and the southern fringes of Mathoura. The growth for Moama is based on a rate of growth that is higher than recent and current ABS estimates.

The household projections for both towns are based on trends of decreasing household size (fewer families, more single people and older couples) which are consistent trends across Australia, particularly rural Australia and regional centres such as Echuca-Moama. The trends and estimates in the Traffic Study appear consistent with other estimates of changing household size.

Importantly, however the initial population estimates and projections, and the subsequent projections, indicate a trend for significant population growth coupled with a further increase in housing growth resulting form both overall population growth and decreasing household size. Essentially, the data suggests a continuing trend of growth in Echuca-Moama to beyond 2021. In effect (while the planning period in the Traffic Study was to 2026) the population of Echuca-Moama is likely to continue to grow to a population and household level well in excess of the levels estimated in either the Traffic Study or the DoI Projections. This is particularly evident when it is considered that the land currently available for development (either through zoning or policy intention) has the capacity to house between 24,500 and 32,000 people on 12,865 lots at current lot sizes.

Modelling Household Growth

The following modelling builds on the work undertaken in the 1998 Traffic Study. It provides scenarios for household growth in 2016 and 2026 based on population modelling, changes in household size and the distribution of growth. The transport zones used in the 1998 Traffic Study have been used again to provide consistency. The results of this modelling suggest a slightly lower rate of growth to 2016 than the initial work (8,811 houses compared to 9,378).

In order to develop the small area household forecasting a range of assumptions formed the basis of future growth expectations. These are based on the general findings of this report in relation to housing preference, constraints to growth, future form and distribution of commercial growth, comparative preferences and housing form in Echuca and Moama, and the likely overall population increase.

Trends in household growth and distribution in Echuca-Moama reflect a range of factors including household preferences and the constraints posed by environmental factors and alternative (or competing) land uses.

As discussed within this report, topography and flood patterns constrain growth to the east of both towns and as a result urban growth (and rural residential growth) has generally occurred to the west of each town. The perceived locational advantages of proximity to the river have resulted in less growth occurring to the south of Echuca and the north of Moama.

The potential for growth of commercial areas also presents the possibility of future constraints on residential expansion. Three key trends in this respect are:

(i) the potential expansion of the current Echuca CBD and consequent loss of housing stock (or constraints on infill opportunities);

(ii) the potential growth of a new commercial area on the Northern Highway/Murray Valley Highway (it could be expected that the development of the Western Option would provide for the more rapid development of this area);

(iii) The potential for growth of commercial opportunities in west Moama, but only as a consequence of the development of the Western Option (this is considered less likely than growth in West Echuca).

The following assumptions were made to undertake the review of small area household projections:

- It was assumed that the overall growth of the two towns would be consistent for each year under each bridge scenario (West and Central) although the *distribution* of the development would vary.

- The small areas (generally Census Collection District based) used in the 1998 Traffic Report were used in this review.

- It was postulated that the western bridge option would facilitate more rapid residential growth in West Moama as a result of increased access, while increased scope for commercial development in West Echuca may reduce household growth capacity there.

- The household projections developed by the Department of Infrastructure were used to model the overall household growth in Echuca, while a 3.3% housing growth rate was assumed consistently for Moama.

- Current zoning and planning strategy was assumed to continue. As the overall capacity of current zoning and policy allows for 12,865 lots it was recognised that this capacity would not be met during the life of the modelling (in fact the capacity would not be met until at least 2037 at current growth rates and a low range household size estimate).

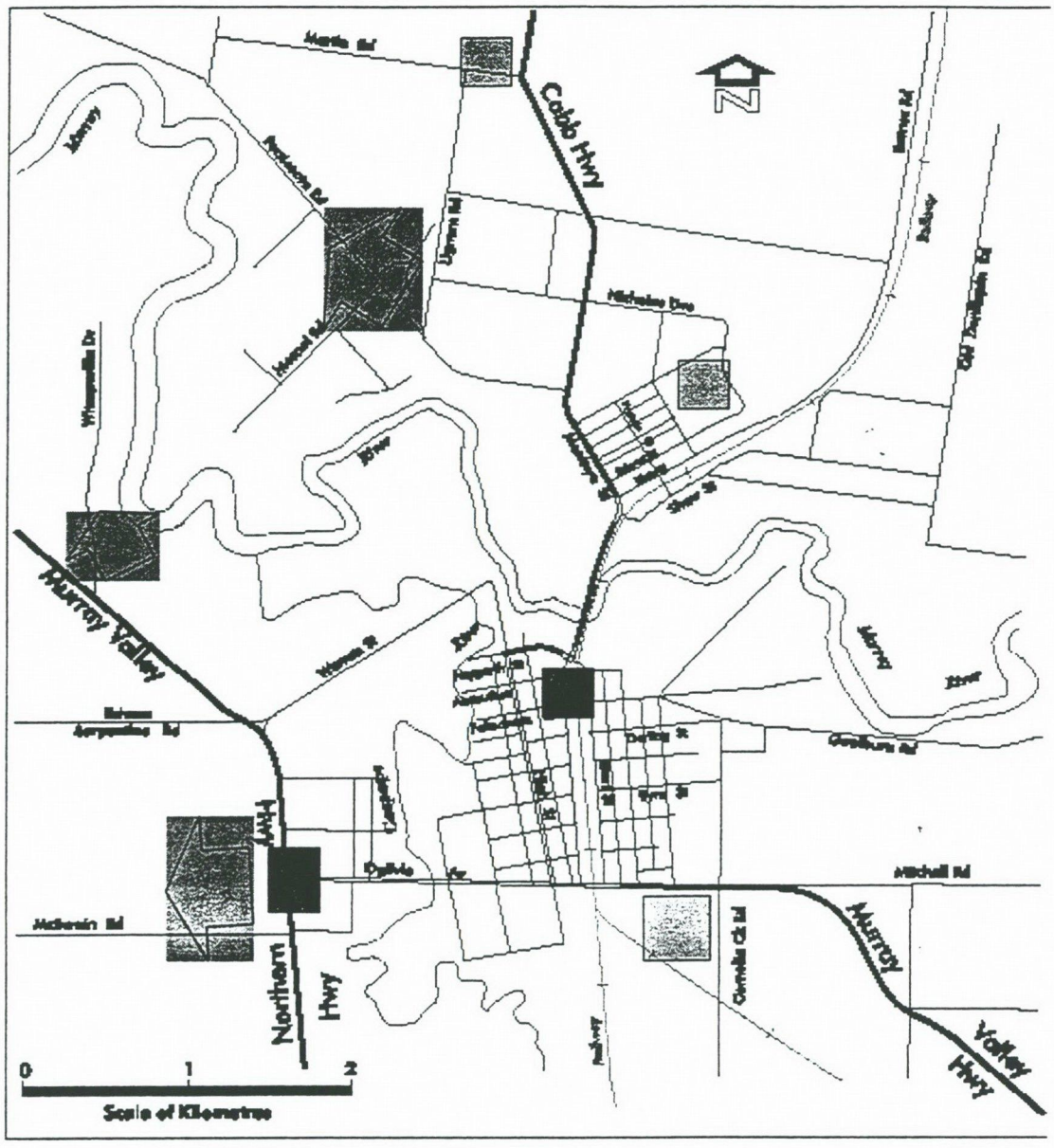
The following table provides a review of the household numbers for each zone (as used in the Traffic Study). It provides an estimate at 2016 and 2026 when a Central or Western Bridge is used. It also provides a "maximum" development estimate based on current policy and statutory scenarios.

Household Estimates 1996-2026 (and Houses at Maximum Capacity within the Current Zoning and Strategy Context)

Zones	1996 Houses	Central 2016	West 2016	Central 2026	West 2026	Total Houses (max)
11	114	385	448	473	550	700
12	41	1,006	1,091	1,236	1,340	1,829
13	357	357	357	357	357	357
14	55	46	46	57	57	85
15	247	247	247	247	247	247
16	120	120	120	120	120	120
17	120	120	120	120	120	120
18	174	174	174	174	174	174
19	137	137	137	137	137	137
42	8	35	35	43	43	63
44	0	165	151	203	185	300
Moama	**1,373**	**2,793**	**2,925**	**3,167**	**3,330**	**4,132**
20	207	207	207	207	207	207
21	89	89	89	89	89	89
22	100	99	99	122	122	180
23	18	165	165	203	203	300
24	590	363	363	446	446	660
25	85	85	85	85	85	85
26	320	320	320	320	320	320
27	196	196	196	196	196	196
28	278	278	278	278	278	278
29	35	746	746	916	916	1,355
30	32	1,375	1,286	1,689	1,580	2,512
31	312	180	100	221	123	409
32	281	281	281	281	281	281
33	382	382	382	382	382	404
34	41	41	41	41	41	41
35	193	193	193	193	193	193
36	247	247	247	247	247	247
37	82	82	82	82	82	82
38	115	115	115	115	115	115
39	181	181	181	181	181	181
40	181	181	181	181	181	181
41	201	207	171	254	210	376
43	41	41	41	41	41	41
Echuca	**4,207**	**6,054**	**5,849**	**6,770**	**6,519**	**8,733**
Total	**5,580**	**8,847**	**8,774**	**9,937**	**9,849**	**12,865**

From the modelling of household growth and a review of policy and planning implications a picture of future development patterns emerges. This is largely consistent with expectations of Council planning strategies. A conceptual description of the trends in residential expansion is provided in the following map.

Conceptual Growth Patterns, Echuca Moama

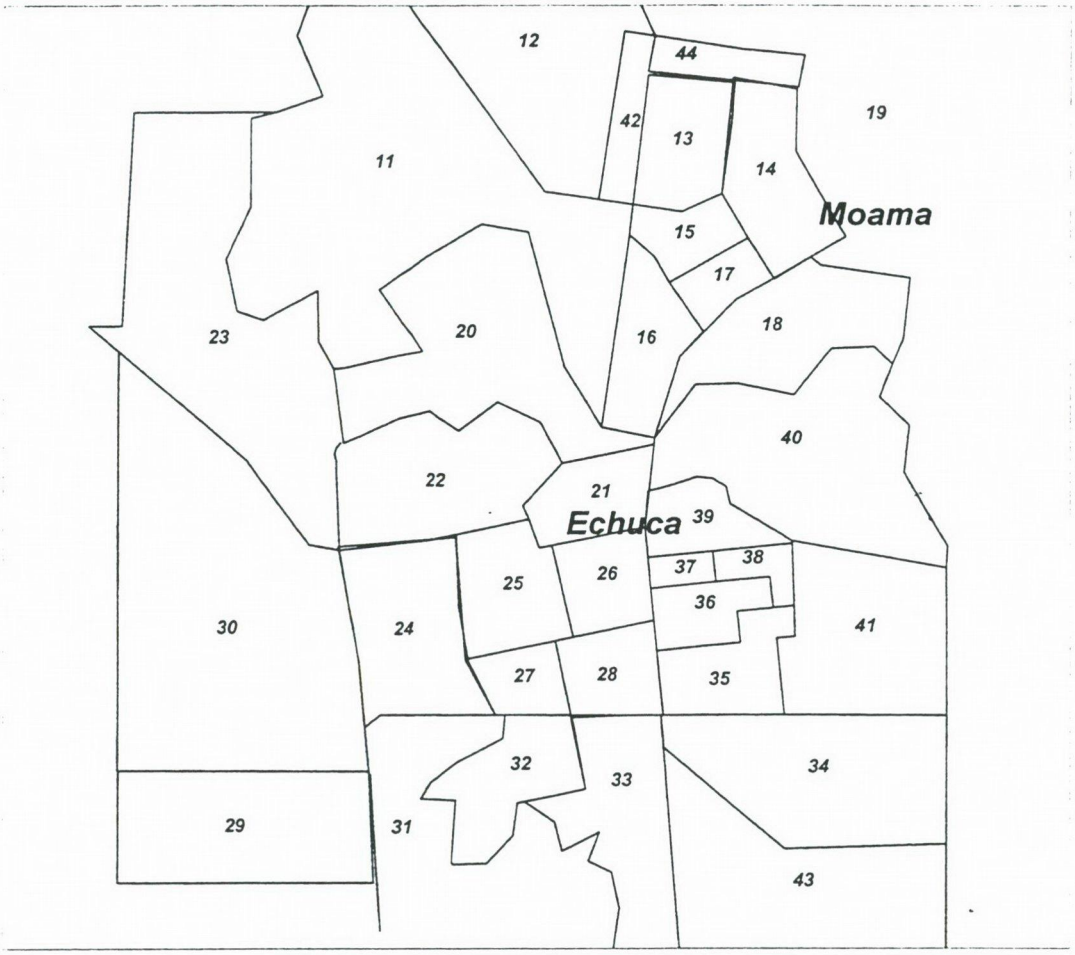


Key Future Residential Growth Areas

Commercial Growth

Industrial Development

Growth Precincts used for Household Estimates



Source: ARUP (1998) *Echuca-Moama Traffic Study: Final Report*, Roads and Traffic Authority NSW. These precincts align with the *Transport Zones used in the ARUP study to model household growth, employment generation and other indicators of change.*

3.7 Land Use Impact of the Route Options

The likely future urban form of Echuca–Moama in a general sense is largely set by physical constraints, transport access and the long term adopted planning strategy of both Councils.

In order to identify future urban form the growth of Echuca/Moama has been extrapolated to the time when there are an additional 7,285 new dwellings, or about twice the current number. While there is some conjecture, based on likely future growth rates, as to when that level of overall development will be achieved, the reality is that the growth of Echuca/Moama is such that it can reasonably be expected that it will be achieved. On current rates of new residential construction it may be achieved by 2037. If a lower growth rate forecast is used it may not be achieved for another 10 or 15 years beyond that date. Alternatively faster growth could see it being achieved a few years earlier.

In many urban centres it would be difficult to forecast the likely urban form for 30 years. However the nature of Echuca/Moama suggests this can be done with some confidence because of the physical constraints that are imposed on where future residential development can occur. If current trends and preferences in migration and housing development continue the split in growth rates between Echuca and Moama remains the only uncertain element.

Within our model, allowance has been made for residential infill of those areas within the existing developed residential areas in Echuca and Moama. This provides for 500-600 dwellings on currently undeveloped land and the prospect of some redevelopment of existing residential development at higher densities than currently exist. Areas to the west of the MVH/NH in Echuca have been set aside on an average of 10 houses/ha. Areas currently zoned in Moama based on zone provisions are estimated to be able to contain 10 lots/ha. Land immediately to the north has been set aside as 10 lots/ha, while other areas to the north-west have provided for 5 lots/ha. We would expect on current trends an approx 50/50 split between Echuca and Moama.

By mapping the urban form at the point where Echuca/Moama has twice the dwelling numbers of the current level the overall urban form has four distinct elements:

(i) About 90% of growth has taken place in only two areas;

(ii) The 'centre of gravity' of Echuca/Moama has shifted considerably west of its current location;

(iii) The level of development in the west and north west of Echuca and Moama respectively is such that there is likely to be strong demands for a range of commercial and community functions to be located in or near these areas;

(iv) There will be a substantially changed road traffic impact on a number of existing routes, in particular east-west routes in Echuca and Pericoota Road in Moama.

Unlike many other urban areas that have a range of possible options for growth, Echuca/Moama has virtually a predetermined overall future urban form (largely as a result of landform and flooding). The only questions being the rate at which development will occur and the proportion of development in each of the two towns, particularly residential development. In many respects the choice of future bridge alignments (west or central) has no overall impact on the major elements of urban form. However, the choice of bridge alignments will have increasing impacts on the detail of urban form, the rate of growth in various parts of the urban area and on important critical elements of land use.

What are the likely consequences of a western bridge?

- Stronger preference and attraction for residential development in the west of Echuca and the north west of Moama. However, the overall urban form is little affected. Some pressure on areas anticipated for rural residential development could be expected.

- Earlier emergence of a likely supplementary commercial area in Moama to serve the north-western residential development and a larger centre than if a new central crossing were constructed.

- Considerably faster growth of the highway business development on the MVH and NH than if the central alignment was built.

- Greater impacts on the amenity and environment of rural residential areas on both sides of the river.

- Hasten the likely development of a neighbourhood shopping centre to serve the area to the west of MVH in Echuca and leading more quickly to pressure to establish a freestanding shopping centre incorporating a discount department store and supermarket. This does present a risk of fragmenting retailing between the CBD locations and any new retail centre, especially if this development occurs prior to the development of a critical population level to sustain further retail floor space.

- Greatly enhance the prospect that investment in facilities like primary/secondary/tertiary education, new community facilities etc would be made on the western side of both Echuca and Moama rather than in more central locations.

- Increased pressure for an alternative Echuca industrial area to be developed.

What are the likely consequences of a central alignment?

- Increased pressure for major east-west road upgrades. While this is not evident through traffic projections it would appear that local pressure for these improvements would emerge over the study period.

- Reinforce the existing town centre of Echuca as the major commercial area.

- Increased pressure on roads like Sturt Street, Ogilvie Avenue and Pericoota Road for highway business uses.

- Reduced passing trade and need for exploration of alternative retailing opportunities in Meninya Street (Option C1 only)

3.8 Impacts on the Operation of the Two Town Centres

Echuca and Moama both support town centres. Echuca's town centre acts as a regional focus for a range of services and has three distinct elements:

- a traditional regional shopping centre based on a core grid layout;
- the heritage-port area which has developed on a strong tourist base; and
- peripheral sales-business areas on the entry roads to the shopping centre area.

The first two elements are continuing to consolidate and build their role and can be expected to continue to do so. The third area, peripheral sales-business is being challenged by developments on the fringe of the Echuca area such as along Ogilvie Avenue-Murray Valley Highway and Northern Highway.

Moama Town Centre is a traditional strip shopping centre servicing local convenience needs. Some peripheral sales-business activity is developing along Meninya Street-Pericoota Road leading into the centre.

Both centres have been supported by a range of civic streetscape works including the development of car parking facilities. Both centres have physical constraints to expansion: the public land areas along the Murray River subject to flooding; the quality and natural values of the riverine environment; adjoining residential areas; traffic circulation; and a need to ensure a reasonably compact area to maintain business viability.

The long term commercial development pressures on both the Echuca and Moama town centres are likely to focus on three elements regardless of which crossing alignment is chosen for development:

- Increasing demand to build the higher order retail/commercial functions to support a growing population. This is likely to be more focused on the larger of the two centres – Echuca.
- Increasing demand to enlarge the heritage-tourist related development including accommodation in and around the Port area and adjoining areas.
- Demand to establish stand alone retail facilities at Echuca west and Moama north west at a local convenience level, as population grows in these areas and provides sufficient households to support this scale of development.

The rate and level at which these changes happen will be dependent on a range of commercial factors and the response of Council planning policies. For instance, when the Echuca west area supports a population commensurate with the area which currently focuses on the Echuca town centre then there will be a strong demand to establish a new sub-regional shopping centre in the area.

Long term impacts on the two town centres are envisaged to be substantially different if either a central or western alignment is chosen. The longer term impacts are summarised in the table below:

Likely Impacts: Central-Western Alignments

	Central Alignment	Western Alignment
Echuca Town Centre	▪ Reinforces role of Echuca town centre as a regional centre for the Moama community. ▪ Greater levels of traffic 'congestion' reached at an earlier date in the town centre. ▪ Greater focus on highway business peripheral sales establishing on lead-in roads to town centre – in particular Sturt Street. ▪ Presentation of tourist-heritage area compromised near river crossing.	▪ Likely to encourage earlier and greater levels of peripheral sales-highway business activity on Murray Valley Highway west and Northern Highway. ▪ Likely to lead to earlier demand of new east-west Echuca transit route (based on community desires if not on traffic volumes) ▪ Establishment of 'stand alone' sub-regional scale shopping centre beyond current CBD ▪ Tourism-heritage area less constrained in scope for presentation. ▪ Reduced demand for traffic access to town centre area.
Moama Town Centre	▪ See impacts under two central options.	▪ Likely to lead to earlier establishment of a new north west 'stand alone' neighbourhood shopping centre.

In summary, the impacts on the two town centres of either the central or western alignments are significant over the longer term. Impacts principally relate to the levels of amenity in the town centre, the likelihood of additional retail-commercial centres developing and the specific impacts on locations such as Meninya Street or Sturt Street. The development of a western alignment reinforces the chances of maintaining the levels of existing amenity in both town centres.

Impacts of Alternative Central Route Options

When the key differences between the two central options are considered, a range of impacts emerge on the form and function of the CBDs and other urban areas.

Central Route Options in Moama

The impact of the option to bypass Meninya Street (Option C1) provides significant impacts and opportunities for central Moama. While the new route will result in the removal of through-traffic, including heavy vehicles from Meninya Street, this will have an impact on the business that relies on passing traffic. The removal of significant volumes of vehicle traffic offers the potential to reposition the Moama CBD, changing the style of current retailing, along with vehicle and pedestrian use.

The location of the proposed C1 alignment (between Meninya Street and the river) will limit opportunities to enhance the river frontage presentation of Moama and limit the connections between Moama CBD and the river.

The C3 option will retain the current Meninya Street route. With the projected increase in traffic volumes over the planning period it would be expected that Meninya Street would be perceived as a comparatively less attractive environment for retail development over time.

Central Route Options in Echuca

In Echuca the proposed option C1 would result in through traffic being redirected along Sturt Street, to the east of the railway. Option C3 would not significantly change through-traffic patterns.

The development of the Sturt Street by-pass has two important impacts:

- Significant levels of traffic, including a high proportion of heavy vehicles, will be removed from central Echuca,
- The Sturt Street alignment will undergo an increase in traffic, changing the nature of this street and presenting challenges to planning for connectivity between east Echuca and the central Echuca area.

The current proposal for Option C1 provides for traffic signals for feeder roads and pedestrians on Sturt Street. By formalising crossing and access points, these (especially if they are aligned with railway station access and railway crossing points) may minimise any disjuncture created by the increased traffic volumes on Sturt Street.

The impact of the increased volumes is likely to have an impact on local amenity for residents on this and nearby streets. Clearly high quality design and noise management techniques should be a part of any planning for this proposal, however this cannot fully mitigate the impacts of this on residents.

The development of a Sturt St alignment for through traffic reduces traffic levels in Heygarth Street and the Echuca CBD in general. This presents significant advantages to vehicle and pedestrian movement in the retail and business centre, advantaging those businesses and precincts not reliant on passing trade, and offering scope for future urban design and development initiatives, and for building links between the retail and tourism nodes in Echuca (which are currently detached).

Likely Impacts – Options C1 / C3

	Option C1	Option C3
Echuca Town Centre	▪ Sturt Street likely to develop into a peripheral sales-highway business area. ▪ Considerable impact on residential amenity values along Sturt Street.	▪ Some town centre business will seek exposure to Annesley Street-Sturt Street area. ▪ Loss of retail-shopper amenity with traffic using Annesley Street.
Moama Town Centre	▪ Likely to be able to retain 'small town' streetscape appearance and values in Meninya Street. ▪ New commercial development likely to focus at corner of Cobb Highway and Perricoota Street. ▪ Reduced 'passing' trade, and increased opportunities for retail development that benefits from lower traffic volumes (especially heavy vehicles). ▪ Loss of potential for 'open space' river presentation of Moama.	▪ Considerable reduction over time in level of retail-shopper amenity in Meninya Street and functioning of town centre. ▪ Earlier pressure for new 'stand alone' retail facility in Moama north-west.

4. Conclusions and Recommendations

The purpose of the study is to review relevant land use issues, assess options in relation to land use issues and report with recommendations on planning options. This will provide an evaluation of the interaction of land use planning and the proposed second crossing of the River Murray at Echuca/Moama.

The two alternative bridge alignments western and central are likely to have no substantive impact on the future overall urban form, that is, the general locations that will develop and the overall distribution of major land uses (particularly commercial or residential) throughout Echuca/Moama. Whether a new bridge was constructed or not and where it is constructed the overall urban form of Echuca/Moama will be fundamentally the same. However, over time the choice of a western or central alignment will have effects on:

- the rate of growth of various areas;
- the type or land use likely to occur in certain locations;
- the character and presentation of the traditional town centres of Echuca and Moama;
- the levels of convenience for certain vehicle movements; and
- the type and volume of traffic on some roads.

The construction of the western alignment in the short term will have little overall impact on the urban form and function. However, its influence on the rates of development in certain areas and the way in which it will influence interaction between Echuca and Moama will become significant.

Because Echuca and Moama will both largely grow to the west and north west respectively, even if a central alignment was chosen, the demand and need for a western alignment will grow. Without a western alignment the total urban area is likely to function at a lesser level, as there is a growing need and requirement for interaction between the communities on either side of the river.

While the overall urban form varies little based on alternative new bridge alignments, there are likely to be important and quite significant medium and long term implications for detailed land use issues such as:

- the rates of development of particular residential land uses in specific areas, in particular:
- a higher growth rate than present in the newer Moama residential areas compared to the current rate in Echuca;
- the central alignment will support higher rates of residential infill in Echuca/Moama, and higher rates of redevelopment and medium housing density.

The western alignment will be likely to encourage faster rates of growth in the west Echuca and north west Moama areas and encourage higher rates of residential leap frogging in Moama and encourage residential development further to the north west of Moama. Other influences of a western alignment are likely to include

- encouragement for the development of new major community infrastructure and facilities and a new stand alone shopping centre in west Echuca, that is west of Murray Valley Highway,

- increased capacity to maintain the current character and amenity levels in the Echuca and Moama town centres

- supporting future possible locations for industrial development centred on north Moama accessed by the Cobb Highway and pressure in Echuca to establish an area to the south west of the urban area.,

- a reduced need for a third road crossing of the Campaspe River to facilitate east – west movement

It is the recommendation of this study that while it matters little in the short term in terms of overall land use planning issues which alignment is chosen, the western alignment has five advantages which support it:

- some through traffic is removed from the central road system and the town centre areas;

- the two central alignments have distinct land use impacts on the Moama and Echuca town centres;

- the presentation of the Echuca heritage railway, tourist area is improved by not having a major new road crossing in the central corridor (however the redevelopment of the central corridor provides an opportunity for the incorporation of appropriate and sympathetic elements of design);

- the western alignment assists both Campaspe and Murray River in strengthening their urban and residential strategies;

- given the future urban form of Echuca – Moama the advantages to overall urban movement of a western alignment route will increase over time. While traffic modelling suggests that the central option(s) would be adequate to deal with traffic volumes over the planning period,

Overall land use considerations are not a major determinant in the choice of alignments. Over time though, the choice of a western or central alignment is likely to have important impacts on some elements of the land use pattern and development of Echuca –Moama. The nature of the impacts are such that the central alignment is more detrimental to the overall functioning of the town centres and increasingly does not relate to the emerging urban form and the growing need for movement between the western areas of Echuca and Moama.

Hydraulics

- **Moama Echuca Bridge Alignment Options, Planning Study for a Bridge Crossing over the Murray River - General Report,** *Sinclair Knight Merz Pty Ltd, January 2000*
- **Moama Echuca Bridge Alignment Options, Planning Study for a Bridge Crossing over the Murray River - Technical Report,** *Sinclair Knight Merz Pty Ltd, January 2000*
- **Hydraulics Study, Echuca-Moama Bridging Alignments, Phase 2,** *Sinclair Knight Merz, May 2000*
- **Murray River Crossing at Echuca/Moama, An Investigation of the Design Floods for the Western Alignment,** *Sinclair Knight Merz, May 2001*
- **Murray River Crossing at Echuca/Moama, A Hydraulic Analysis of the 200 Year ARI Flood for the C1 Alignment,** *Sinclair Knight Merz, July 2001*

Vicroads
January 2000

Moama Echuca Bridge Alignment Options

Planning Study for A Bridge Crossing over the Murray River - General Report

Final

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1. Introduction

Sinclair Knight Merz was commissioned to carry out a hydraulic bridge alignment planning study for a bridge crossing over the Murray River at Moama/Echuca.

The project involved identifying possible bridge/road alignments within three specified corridors, these being:

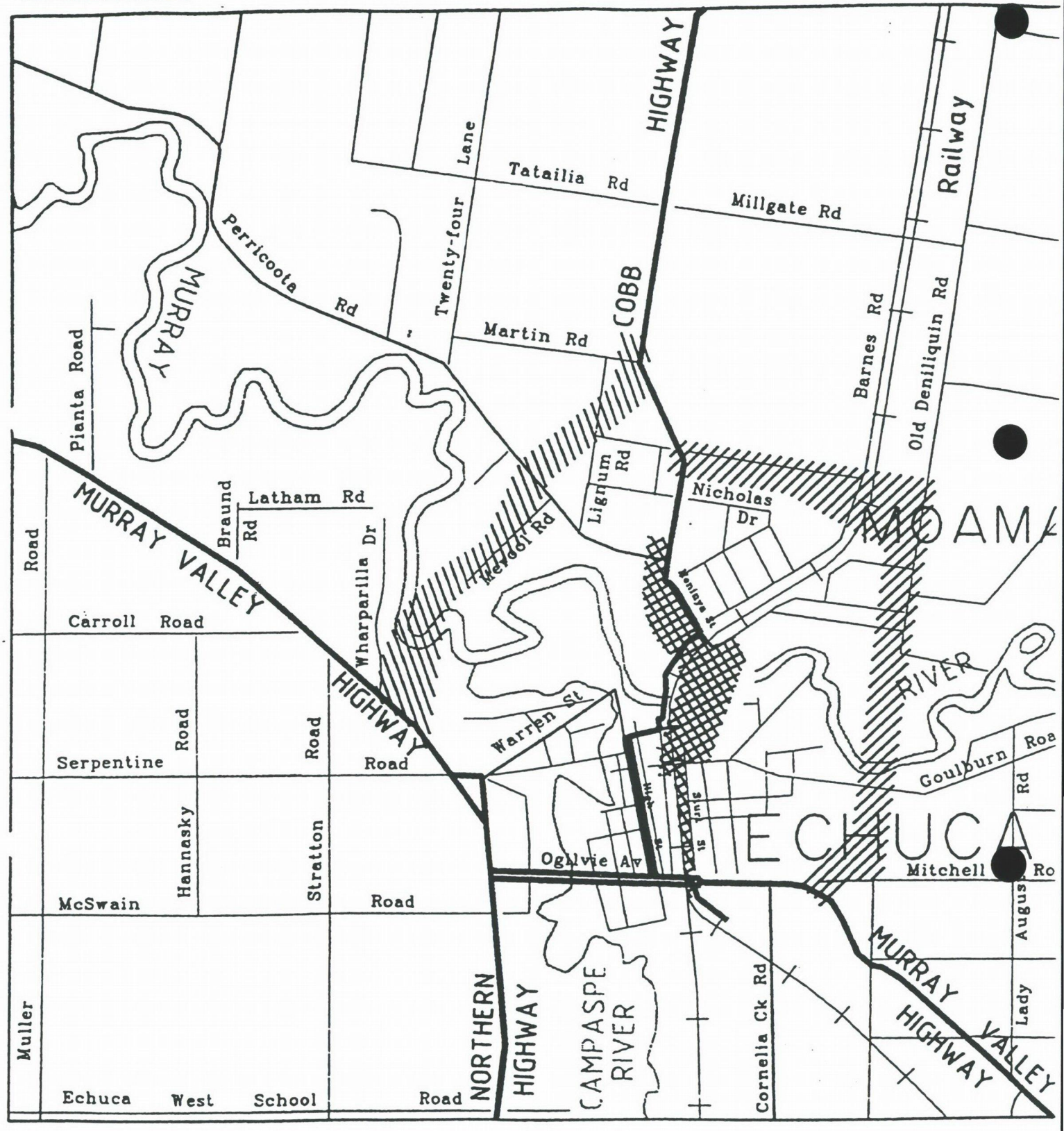
- Eastern Corridor
- Central Corridor
- Western Corridor

Figure 1.1: Locality Plan of the Proposed Bridge Corridors – Moama/Echuca presents the location of each of the corridors.

A total of six (6) alignments within these corridors were identified based on topographical information provided by Vicroads. Advantages and disadvantages for each of the proposed alignments have been documented.

The discussion focuses on the 100 year ARI flood event.

Figure 1.1: Locality Plan of the Proposed Bridge Corridors – Moama/Echuca



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2. Bridge/Road Alignments

2.1 General

Bridge and road alignments for this assessment were based on topographical and existing road infrastructure within the Moama/Echuca study area.

A total of six (6) alignments have been identified within the three corridors, these are:

- Alignment E1 – Eastern Corridor
- Alignment C1 – Central Corridor
- Alignment C2 – Central Corridor
- Alignment W1 – Western Corridor
- Alignment W2 – Western Corridor
- Alignment W3 – Western Corridor.

Advantages and disadvantages of each alignment are discussed on an individual basis in the subsequent sections. This discussion is based on the 100 year ARI flood event.

Please note that all bridge spans and floodway openings in this report should be considered indicative. Due to the complex flow interactions and distributions, further analysis will be required prior to final design(s) of the preferred alignment(s).

2.2 Alignment E1

Alignment E1 extends from the corner of Mitchell Road and the Murray Valley Highway and extends in a northerly direction until connecting to Old Deniliquin Road on the north bank of the Murray River. The alignment continues along Old Deniliquin Road for approximately 3 km where it changes direction to the west. It then connects to the Cobb Highway. **Figure 2.1: Proposed Alignment E1** illustrates the proposed alignment.

This alignment traverses over a distance of approximately 7.5 km. The majority of this alignment spans the floodplain and significant drainage infrastructure would be required should this alignment be adopted. A total bridge span of at least 700 m would be required however this may need to be increased to a maximum of 1200 m given that the northern floodplain is a significant conveyance area when breakout flows occur. The height of embankment fill required over this distance is typically 1.5 m but is up to 5 m in the major flow path area.

If the bridge opening were to be minimised, the velocities through the proposed bridge opening would increase the scour protection required. Given that the proposed bridge opening is located on a bend, the amount of

bank and abutment erosion protection required on the southern bank is also expected to be considerable.

The road embankment for this alignment could also cause a significant restriction to flow and drainage infrastructure and relief bridges will be required along Old Deniliquin Road. If these drainage structures and relief bridges are not included, affluxes upstream of the embankment will be significant. Indicative bridge/culvert opening distances will vary from 150 to 250 m depending on the adopted total bridge span. These openings should be placed at regular intervals at low points along the floodplain. Sizing of the culverts could not be determined due to lack of flow distribution information along the alignment.

A significant reduction of floodplain storage is not expected as relief drainage and backwater flooding will provide a mechanism whereby the floodplain downstream of the proposed embankment will still be available for flood storage.

A number of local drainage issues were identified, these being:

- Deakin Drain – located on the southern bank with a catchment area of approximately 560 km^2.
- Railway Drain – located on the northern floodplain flowing in a southerly direction adjacent to the eastern side of the Railway.

Culverts/bridges through the embankment will have to be provided in both of these locations for floods up to 100 year ARI. The estimated number of culverts in these locations is 10-3000x2700 RCBC and 11-3000x2700 RCBC respectively.

With respect to flooding, the maximum 100 year ARI flood level was estimated to be RL 95.65 m AHD.

2.3 Alignment C1

Proposed Alignment C1 runs adjacent to the existing Cobb Highway/Railway Bridge. The alignment extends from The Murray Valley Highway in a northerly direction until it crosses the Murray River where it changes to a north-westerly direction until it connects with the Cobb Highway. **Figure 2.2: Proposed Alignment C1** illustrates the proposed alignment.

One of the main benefits of this alignment is that if the total bridge span, relief bridges and local drainage structures are kept to approximately the same dimensions of the existing structure, flooding impacts should not increase. Expansion and contraction losses through the bridge opening (proposed plus existing) would be minimised therefore minimising upstream afflux.

The bridge span required for Alignment C1 was estimated to be approximately 500 m which is consistent with the existing structure. The maximum 100 year ARI flood level was estimated to be RL 95.40 m AHD. One of the other things to consider is the manoeuvrability of river vessels and alignment of the proposed new bridge piers with old bridge piers may be an issue.

A relief structure west of the Cobb Highway on the Moama side of the Murray River will be required. This relief structure should be consistent with the relief structure located in the existing embankment (120 m in length). The length of the relief structure in the proposed embankment may have to be increased slightly depending on the skew of the embankment in relation to the direction of flow.

Although this alignment still crosses a significant length of floodplain, the existing structure (Cobb Highway/Rail Bridges) is the current hydraulic control. The construction of the bridge alignment at this location should limit the hydraulic impacts to the current conditions.

2.4 Alignment C2

Proposed Alignment C2 runs adjacent to the Cobb Highway in a northerly direction until it veers in a north-easterly direction before crossing the Murray River. The alignment then sweeps around to a north-westerly direction once across the Murray and connects to the Cobb Highway. **Figure 2.3: Proposed Alignment C2** illustrates the proposed alignment.

Although this alignment is contained within the Central Corridor, the benefits of Alignment C1 are not reflected in this alignment. The Murray River crossing for this alignment crosses some 600 m upstream of the existing structure and therefore the contraction and expansion losses associated with the proposed bridge opening will reflect an individual bridge opening rather than the reduced losses from that of a group of structures (ie. Alignment C1).

Also the proposed bridge opening would be offset from the existing bridge opening by approximately 400 m. This means that additional losses would be introduced via the non-alignment of the proposed and existing bridge openings.

The proposed alignment also crosses the Murray River on a bend and erosion protection may be required on the northern bank. The northern approach embankment may also divert Murray River flows into urban areas on the northern bank.

The bridge opening width of 600 m is required however this will be dependent on the placement of the bridge opening. To reduce the redirection of flows into the township of Moama, the bridge opening should extend to the north at least to the railway. If this is done, the southern bank floodplain will be

significantly restricted and the bridge opening may need to be extended to allow floodwaters to flow over the floodplain and through the existing bridge structure. This would minimise the bridge opening offset between the proposed and existing structures and help to reduce hydraulic impacts. Alternatively, relief bridges/culverts could be placed to allow the passage of floodwaters through the embankment.

Conversely, additional relief bridges/culverts may also have to be introduced into the northern embankment to reduce the effects of; redirection of flow into Moama, scour and afflux should the bridge opening not extend to the railway.

Given the extent of the floodplain (1 km) and the fact that this is a significant conveyance location, the required relief opening (on either bank) would be in the order of 100 to 150 m.

A relief structure west of the Cobb Highway on the Moama side of the Murray River will be required. This relief structure will be consistent with the structure identified for Alignment C1

The maximum 100 year ARI flood level at this location was estimated to be RL 95.40 m AHD.

2.5 Alignment W1

The proposed Alignment W1 extends from the Murray Valley Highway and extends in a north-north westerly direction until it sweeps around to a north-north-easterly direction across the Murray River and connects to Merool Road. A future connection from Merool Rd to the Cobb Highway has also been identified. **Figure 2.4: Proposed Alignment W1** illustrates the proposed alignment. This alignment is also downstream of the Murray/Campaspe junction.

Alignment W1 is downstream of the Murray/Campaspe junction and so the bridge has to span flows from both the Murray and Campaspe Rivers. The percentage increase in flow at this location compared to the flow at the existing bridge structure (upstream of the junction) is approximately 50%.

This alignment will re-direct breakout flows from both the Murray and Campaspe Rivers along the embankment back into the Murray River. Although this embankment will not be as restrictive to the direction of flow as Alignments W2 and W3, relief bridges/culverts and erosion protection will still be required on the southern approach embankment.

Furthermore, the height of the southern approach embankment is 5 m over a distance of approximately 1.5 km.

If a minimum bridge span (700 m) is adopted scour through the bridge opening may become significant unless a large amount of relief bridges are located on both the southern and norhern banks. (100 to 150 m openings)

Adequate drainage would have to be included in the embankment to provide for local drainage. This drainage could be incorporated with relief bridges/culverts and located in a position where they both provide for local drainage and help to reduce bridge and embankment scour.

With respect to flooding, the maximum 100 year ARI flood level was estimated to be RL 95.18 m AHD.

2.6 Alignment W2

The proposed Alignment W2 extends from the Murray Valley Highway and extends in a north-easterly direction across the Murray River and connects to Merool Road to the north of the Murray River. A future connection from Merool Rd to the Cobb Highway has also been identified. **Figure 2.5: Proposed Alignment W2** illustrates the proposed alignment. This alignment is also downstream of the Murray/Campaspe junction.

As for Alignment W1 & W3, Alignment W2 is subject to an increase in flow due to flooding in both the Murray and Campaspe Rivers where the increase is approximately 50%.

This alignment will also redirect Murray and Campaspe Rivers breakout flows along the approach embankment. Approach embankment protection and relief bridges will be required. Alignment W2 will have more of a flooding impact than W1 because it causes a greater restriction to floodplain flows and therefore greater relief openings will be required for this alignment (120 to 160 m).

Adequate drainage would have to be included in the embankment to provide for local drainage. This drainage may be able to be handled by placing the relief bridges/culverts in a position where they both provide local drainage and help to reduce bridge and embankment scour.

The minimum bridge opening is estimated to be 700 m. The average height of embankment fill over the floodplain is approximately 5 m.

The bridge opening for this alignment is also located on a tight bend. If the bridge opening is minimised, velocities on the northern bank may increase considerably. Erosion protection may therefore be required on the northern bank.

With respect to flooding, the maximum 100 year ARI flood level was estimated to be RL 95.19 m AHD.

2.7 Alignment W3

The proposed Alignment W3 extends from the Murray Valley Highway and Cohuna –Echuca Road intersection in a north-north-westerly direction until it crosses the Murray River, downstream of the Murray/Campaspe Junction. Once across the Murray River, the alignment changes to a north-north-easterly direction until it connects to Merool Road. A future connection from Merool Rd to the Cobb Highway has also been identified. **Figure 2.6: Proposed Alignment W3** illustrates the proposed alignment.

Alignment W3 is located downstream of the Murray/Campaspe junction and is also subject to a 50% increase in flow.

The floodplain for this alignment is in the order of 2.5 km in width. A significant amount of fill on both approaches would be required (average height of 4 m). Relief bridges/culverts would be needed on both the northern and southern approach embankments.

The southern approach embankment would form a major restriction to flow, and significant relief drainage infrastructure would be required in addition to the bridge opening. The estimated bridge span for this alignment would be in the order of 700 m with an estimated maximum 100 year ARI flood level of RL 95.18 m AHD.

The southern approach embankment would also redirect breakout flows from the Murray & Campaspe Rivers along the approach embankment. If this were the case, then beaching works along the embankment may be required. The extent of the protection works would be dependent on the amount and placement of relief infrastructure along the embankment.

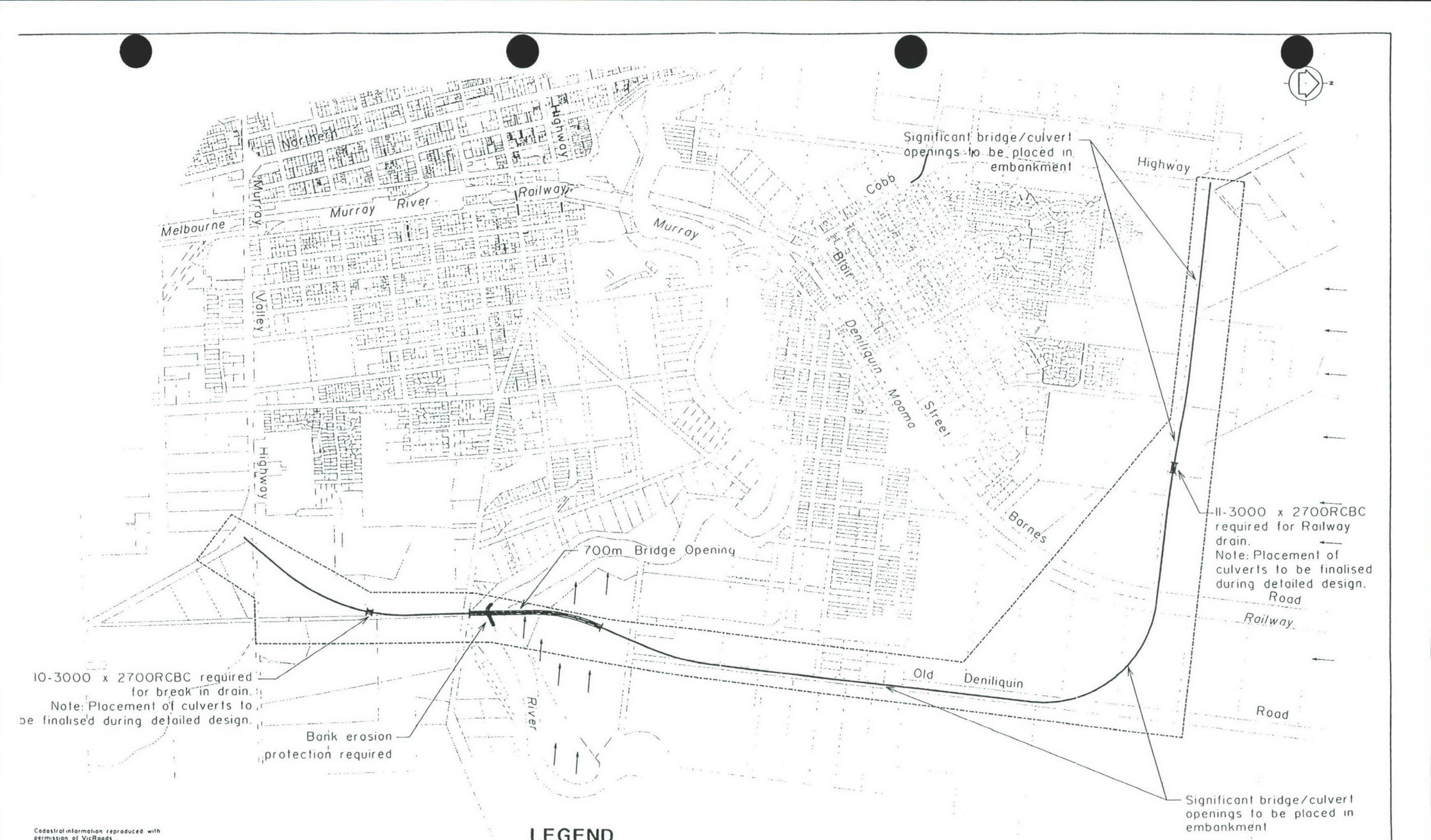
3. Conclusions

A hydraulic planning study has been conducted for the Moama-Echuca Bridge Alignments Project. From this investigation the following conclusion can be drawn.

- **Eastern Corridor** – Alignment E1 is subject to significant flooding and large amounts of embankment fill would be required to have the proposed alignment above the 100 year ARI flood level. In addition, considerable bridge and culvert infrastructure would be required should this alignment be adopted.

- **Central Corridor** – Alignments C1 & C2 are located within this corridor. Alignment C1 is the more hydraulically preferred option as current bridges across the Murray River already cause a restriction and therefore bridge losses due to contraction and expansion will be minimised therefore reducing afflux. Alignment C2 could cause significant affluxes and divert water into urban areas if not carefully considered during detailed design.

- **Western Corridor** – Alignments W1, W2 and W3 are situated in this corridor which are all located downstream of the Murray/Campaspe Junction. The increase in flow from combined river flooding for Western Corridor Alignments are approximately 50% greater than that of the Central and Eastern Corridors. This means that bridge spans in this corridor are likely to be greater than for the other corridors. Significant relief bridge/culvert infrastructure may be required given Murray and Campaspe River breakout flows. Approach embankment protection for each of the alignments is expected to be considerable. The preferred alignment (with respect to hydraulic impacts) in this corridor is Alignment W1 as this introduces the smallest restriction to the floodplain.



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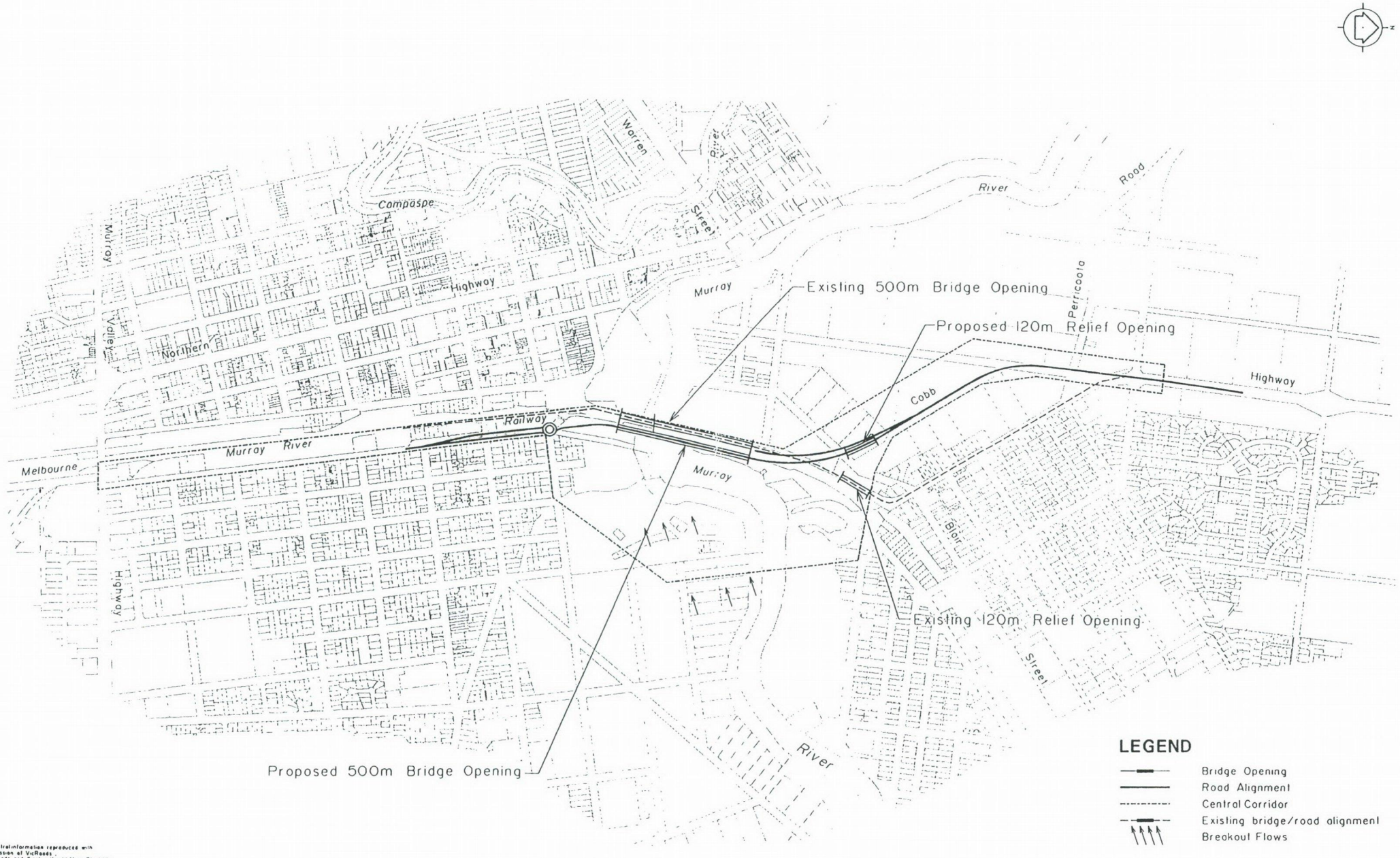
Proposed Alignment E1
FIGURE 2.1



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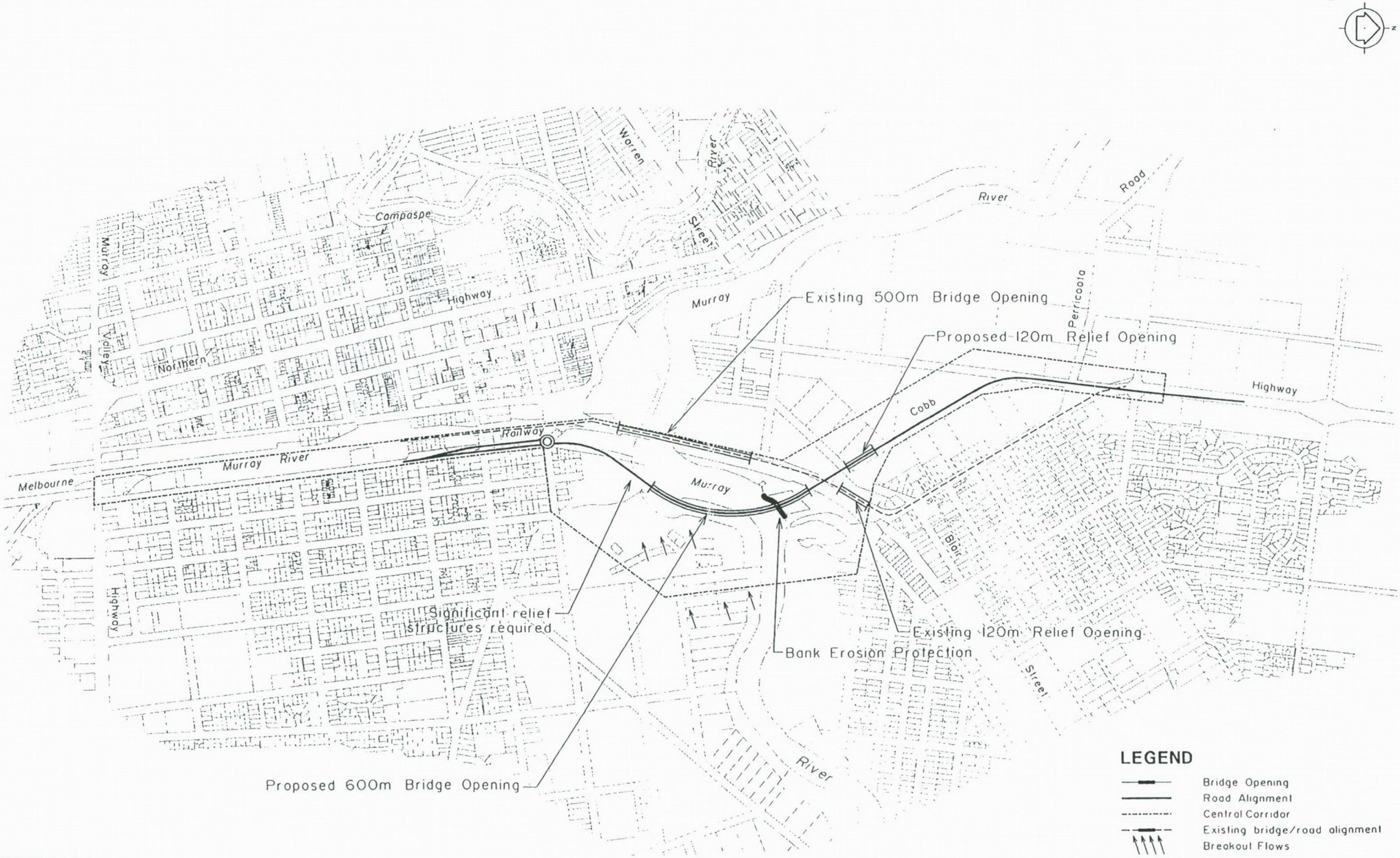
Proposed Alignment C1
FIGURE 2.2



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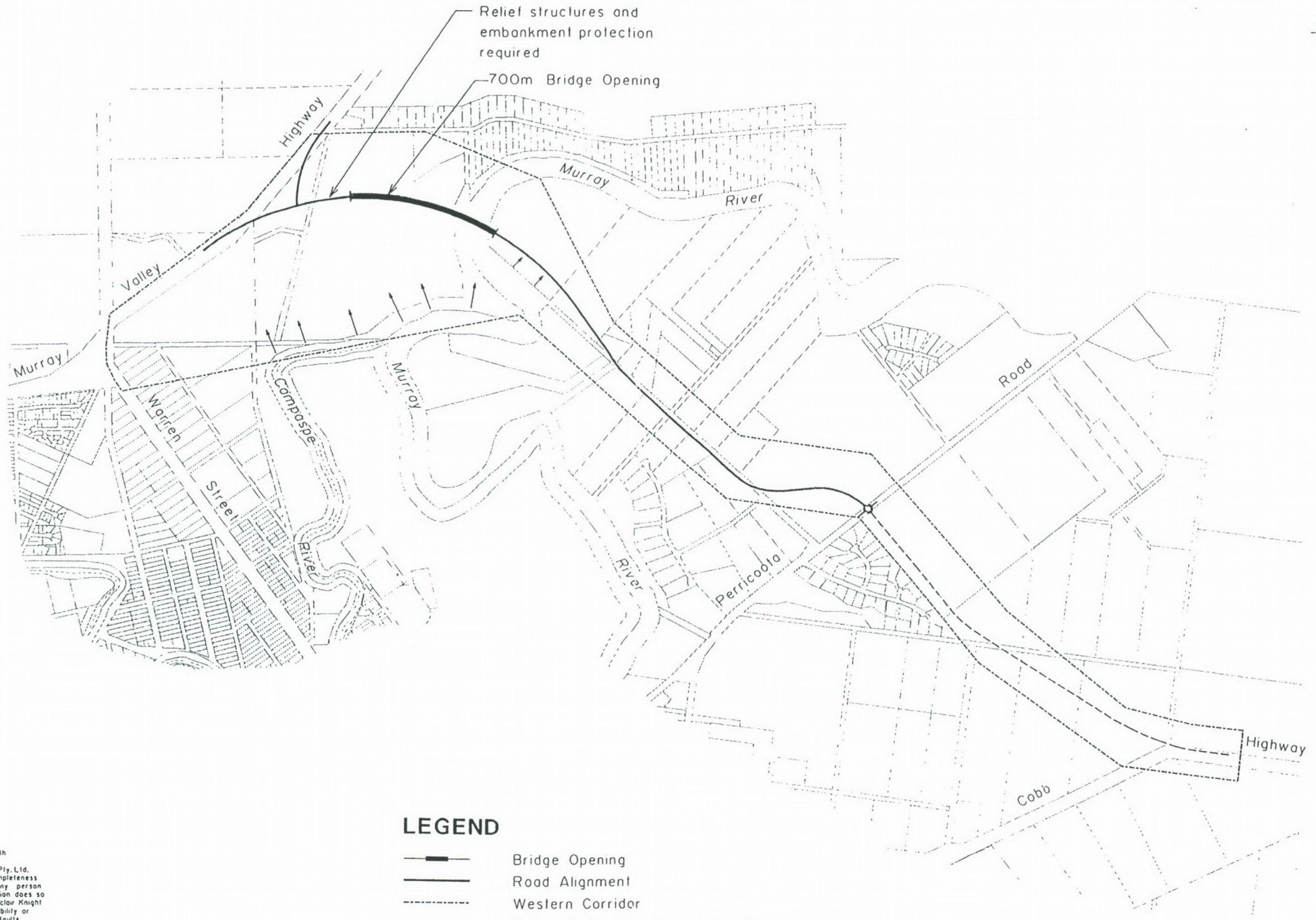
250 125 0 250 500 750

Scale of Metres

Proposed Alignment C2
FIGURE 2.3



LEGEND

- Bridge Opening
- Road Alignment
- Western Corridor
- Future Cobb Hwy. Connection Road
- Breakout Flows

125 0 250 500 750 1000

Scale of Metres

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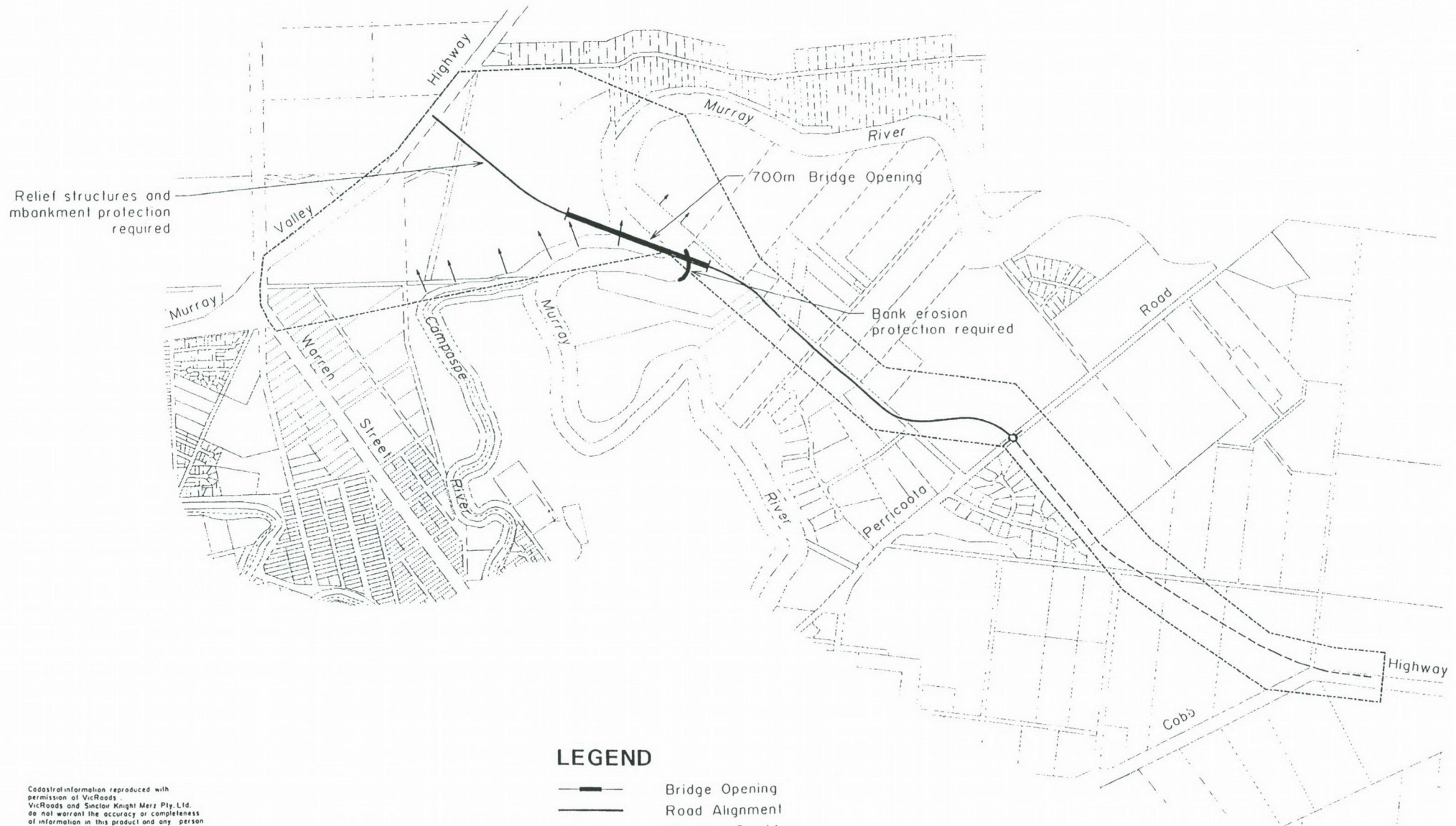
Proposed Alignme[illegible] W1
FIGURE 2.4



LEGEND

- Bridge Opening
- Road Alignment
- Western Corridor
- Future Cobb Hwy. Connection Road
- Breakout Flows

250 125 0 250 500 750 1000

Scale of Metres

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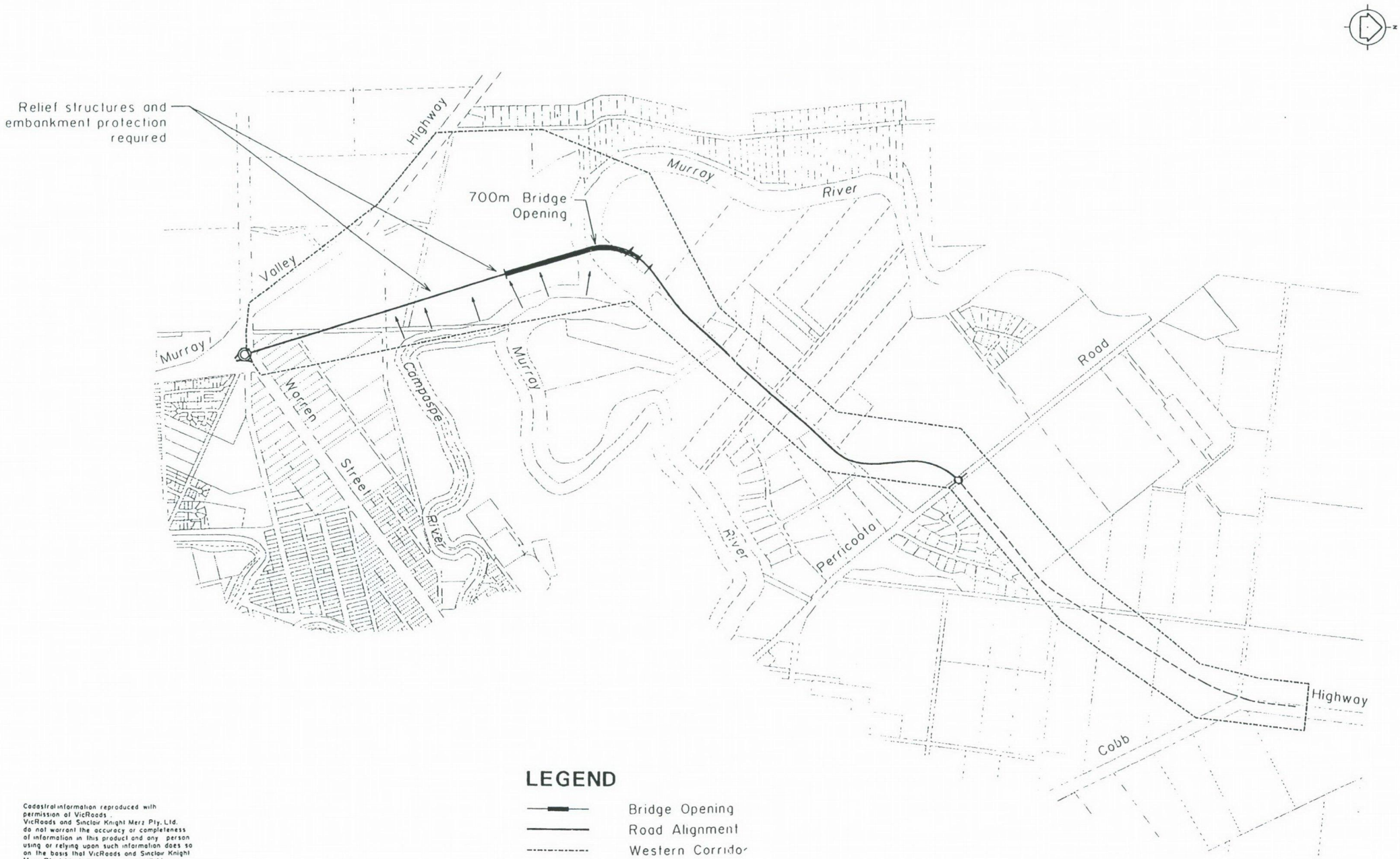
Proposed Alignment W2
FIGURE 2.5



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Proposed Alignment W3
FIGURE 2.6

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Moama Echuca Bridge Alignment Options

Planning Study for A Bridge Crossing over the Murray River - Technical Report

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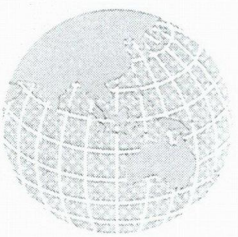

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January 2000

Moama Echuca Bridge Alignment Options

Planning Study for A Bridge Crossing over the Murray River - Technical Report

Final

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1. Introduction

Sinclair Knight Merz was commissioned to carry out a hydraulic bridge alignment planning study for a bridge crossing over the Murray River at Moama/Echuca.

The project involved identifying possible bridge/road alignments within three specified corridors, these being:

- Eastern Corridor
- Central Corridor
- Western Corridor

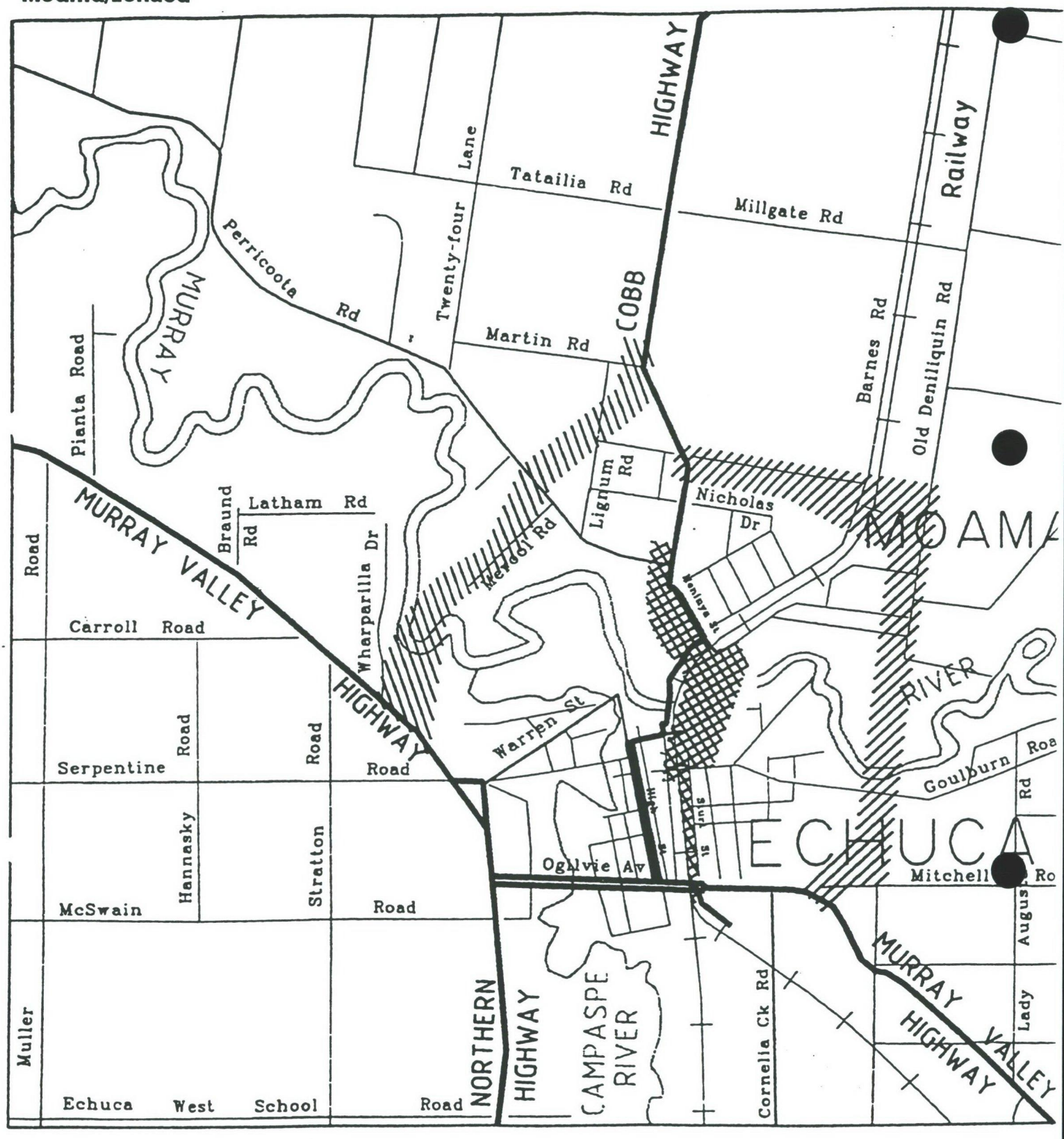
Figure 1.1: Locality Plan of the Proposed Bridge Corridors – Moama/Echuca presents the location of each of the corridors.

A total of six (6) alignments within these corridors were identified based on topographical information provided by Vicroads.

Due to the complex nature of flow distributions across the floodplain for each of the alignment options provided in this report, two (2) dimension hydraulic modelling of the adopted alignment will be required prior to final design. The results presented in this report should be therefore considered indicative.

The results presented in this report relate to the 100 year ARI flood event.

Figure 1.1: Locality Plan of the Proposed Bridge Corridors – Moama/Echuca



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2. Bridge/Road Alignments

2.1 General

Bridge and road alignments for this assessment were based on topographical and existing road infrastructure within the Moama/Echuca study area.

A total of six (6) alignments have been identified over the three corridors, these are:

- Alignment E1 – Eastern Corridor
- Alignment C1 – Central Corridor
- Alignment C2 – Central Corridor
- Alignment W1 – Western Corridor
- Alignment W2 – Western Corridor
- Alignment W3 – Western Corridor.

A preliminary hydraulic investigation has been conducted for each of the proposed alignments. Results presented in this report are for the 100 year ARI flood event and are of a preliminary nature. The results should only be considered indicative and two (2) dimensional hydraulic modelling of the adopted bridge alignment will be required before final design commences.

Analysis of relief bridges/culverts could not be analysed in most cases due to the unknown flow distributions over the floodplain. Opening distances have been provided based on similar cases and should be considered as indicative.

Flow information was extracted from the Moama Floodplain Management Study (SKM, Sept 1999).

The location of relief bridges and culverts will be located such that affluxes and bridge scour are minimised.

2.2 Alignment E1

Figure 2.1: Proposed Alignment E1 illustrates the proposed Alignment E1. This alignment has been modelled in HEC-RAS using a flow of 1070 m^3/s to determine indicative affluxes, total bridge spans and velocities.

Two major local flow paths were identified for this alignment. These were Deakin Drain and Railway Drain. A Rational Method calculation was performed for the Deakin Drain and the 100 year ARI flood was estimated to be 126 m^3/s. The 100 year ARI flow for the Railway Drain was extracted from the Moama Floodplain Management Study (SKM, Sept 1999) and was estimated to be 155 m^3/s.

Table 2.1: Summary of Results for Alignment E1 presents Bridge/Culvert details for the proposed alignment.

Table 2.1: Summary of Results for Alignment E1

Location	Total Bdg Span (m)	Relief Bdg/cul	100 Year ARI Flood Level (m AHD)	Afflux (mm)	Velocity (m/s)
Bridge	700	150 to 250m	95.65	+ 10	0.53
Deakin Drain	NA	10-3000x2700 RCBC	NA	NA	1.5
Railway Drain	NA	11-3000x2700 RCBC	NA	NA	1.8

2.3 Alignment C1

Figure 2.2: Proposed Alignment C1 illustrates the proposed Alignment C1. This alignment has been modelled in HEC-RAS using a flow of 1225 m^3/s to determine indicative affluxes, total bridge spans and velocities.

Table 2.2: Summary of Results for Alignment C1 presents Bridge/Culvert details for the proposed alignment.

Table 2.2: Summary of Results for Alignment C1

Location	Total Bdg Span (m)	Relief Bdg	100 Year ARI Flood Level (m AHD)	Afflux (mm)	Velocity (m/s)
Bridge	500	As per existing	95.40	+ 10	0.56

2.4 Alignment C2

Figure 2.3: Proposed Alignment C2 illustrates the proposed Alignment C2. This alignment has been modelled in HEC-RAS using a flow of 1225 m^3/s to determine indicative affluxes, total bridge spans and velocities.

Table 2.3: Summary of Results for Alignment C2 presents Bridge/Culvert details for the proposed alignment.

Table 2.3: Summary of Results for Alignment C2

Location	Total Bdg Span (m)	Relief Bdg	100 Year ARI Flood Level (m AHD)	Afflux (mm)	Velocity (m/s)
Bridge	700	100 to 150m	95.40	0	0.43

2.5 Alignment W1

Figure 2.4: Proposed Alignment W1 illustrates the proposed Alignment W1. This alignment has been modelled in HEC-RAS using a flow of 1540 m^3/s to determine indicative affluxes, total bridge spans and velocities. This flow represents the composite flows from the Murray and Campaspe Rivers downstream of their junction.

Table 2.4: Summary of Results for Alignment W1 presents Bridge/Culvert details for the proposed alignment.

Table 2.4: Summary of Results for Alignment W1

Location	Total Bdg Span (m)	Relief Bdg	100 Year ARI Flood Level (m AHD)	Afflux (mm)	Velocity (m/s)
Bridge	700	100 to 150m	95.18	+ 30	0.67

2.6 Alignment W2

Figure 2.5: Proposed Alignment W2 illustrates the proposed Alignment W2. Similarly to Alignment W1, this alignment has been modelled in HEC-RAS using a composite Murray/Campaspe flow of 1540 m^3/s. Indicative affluxes, total bridge spans and velocities have been determined.

Table 2.5: Summary of Results for Alignment W2 presents Bridge/Culvert details for the proposed alignment.

Table 2.5: Summary of Results for Alignment W2

Location	Total Bdg Span (m)	Relief Bdg	100 Year ARI Flood Level (m AHD)	Afflux (mm)	Velocity (m/s)
Bridge	700	120 to 160	95.19	+20	0.71

2.7 Alignment W3

Figure 2.6: Proposed Alignment W3 illustrates the proposed Alignment W3. A composite Murray/Campaspe River flow of 1540 m^3/s was used to determine indicative affluxes, total bridge spans and velocities of the alignment.

Table 2.6: Summary of Results for Alignment W3 presents Bridge/Culvert details for the proposed alignment.

Table 2.6: Summary of Results for Alignment W3

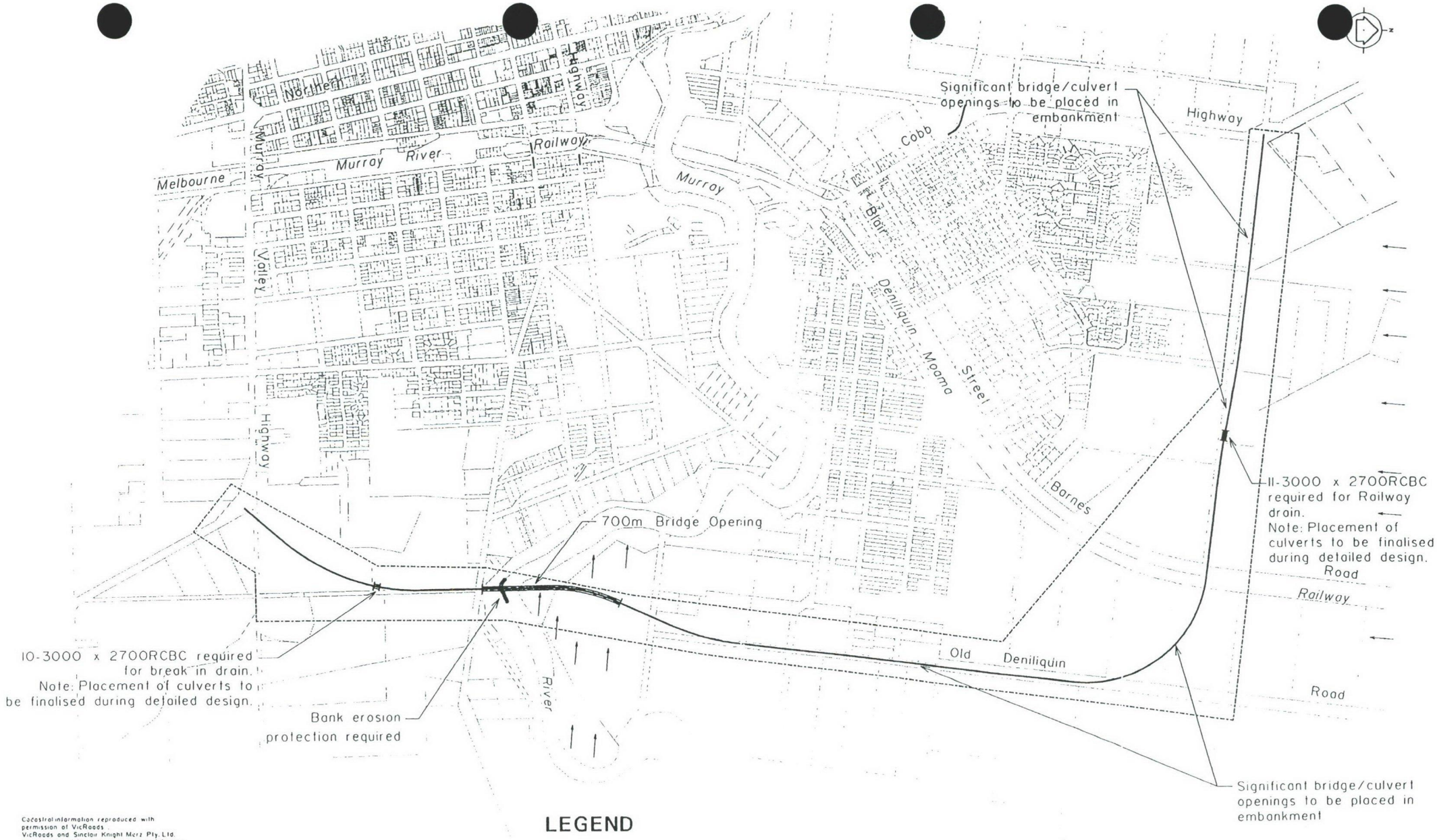
Location	Total Bdg Span (m)	Relief Bdg	100 Year ARI Flood Level (m AHD)	Afflux (mm)	Velocity (m/s)
Bridge	700	120 to 180	95.18	+ 10	0.72

Location of the relief bridges/culverts will be dependent on embankment and bridge scour.

3. Conclusions

A hydraulic planning study has been conducted for the Moama-Echuca Bridge Alignments Project. From this preliminary investigation the following conclusions can be drawn.

- The maximum predicted afflux was estimated to be 30 mm. This afflux is not expected to effect upstream properties.
- Minimum bridge spans vary from 500 m to 700 m.
- Flood relief structures are required for each alignment.
- Local drainage culverts are required on Alignment E1.
- Further hydraulic modelling is required prior to final design.



LEGEND

- Bridge Opening
- Road Alignment
- Eastern Corridor
- Breakout Flows

250 125 0 250 500 750 1000

Scale of Metres

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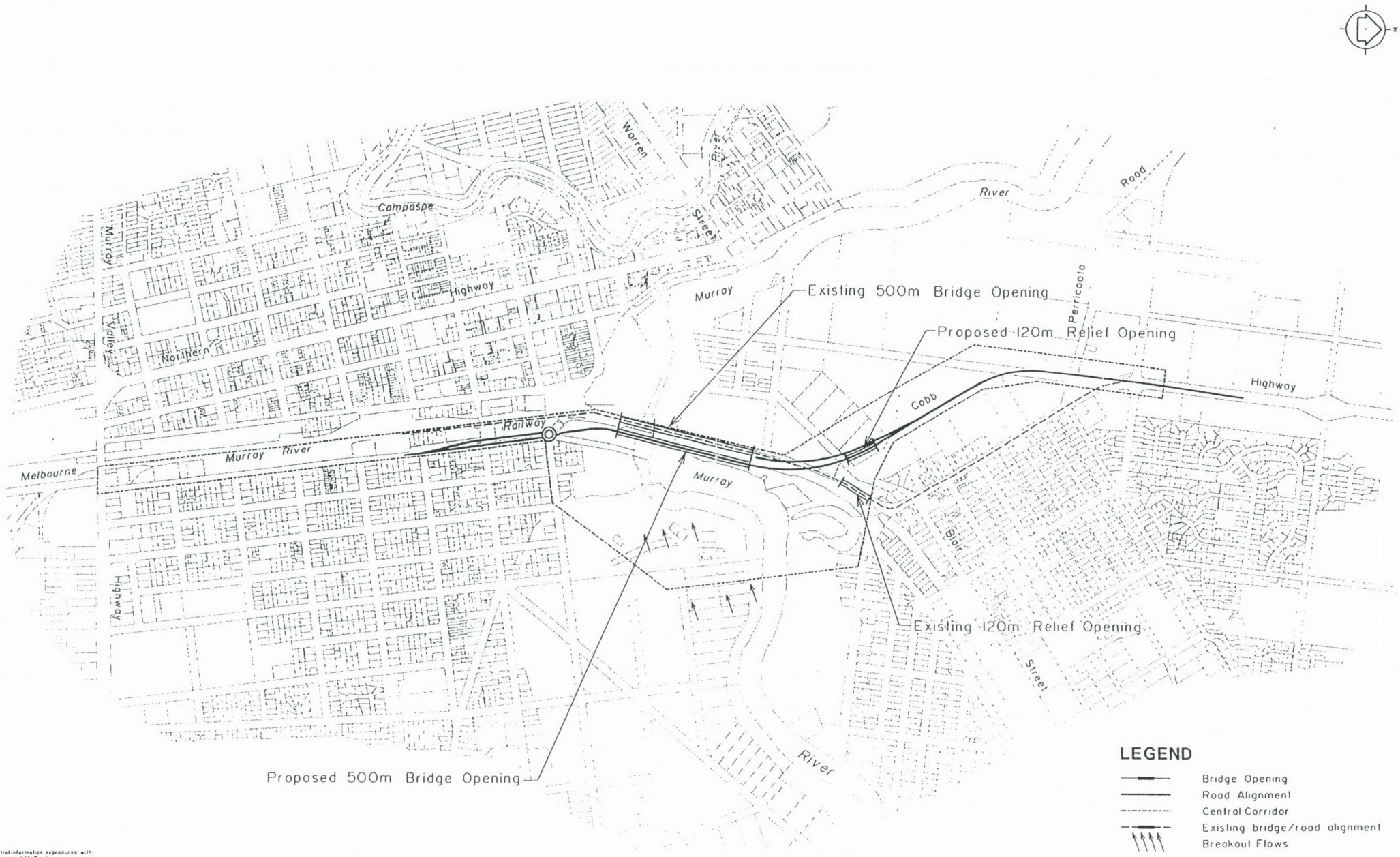
Proposed Alignment E1
FIGURE 2.1



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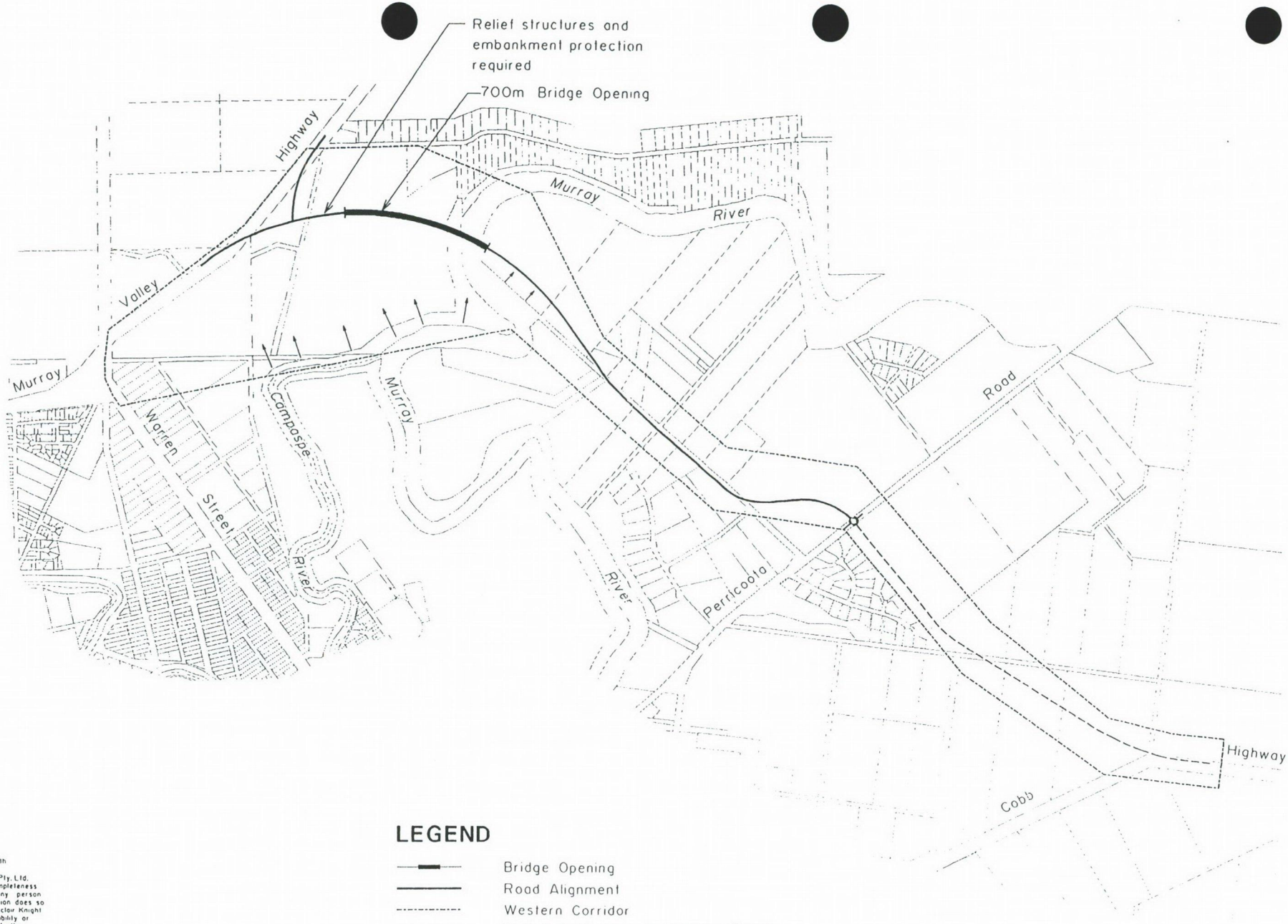
Proposed Alignment C1
FIGURE 2



LEGEND

- Bridge Opening
- Road Alignment
- Western Corridor
- Future Cobb Hwy. Connection Road
- Breakout Flows

250 125 0 250 500 750 1000

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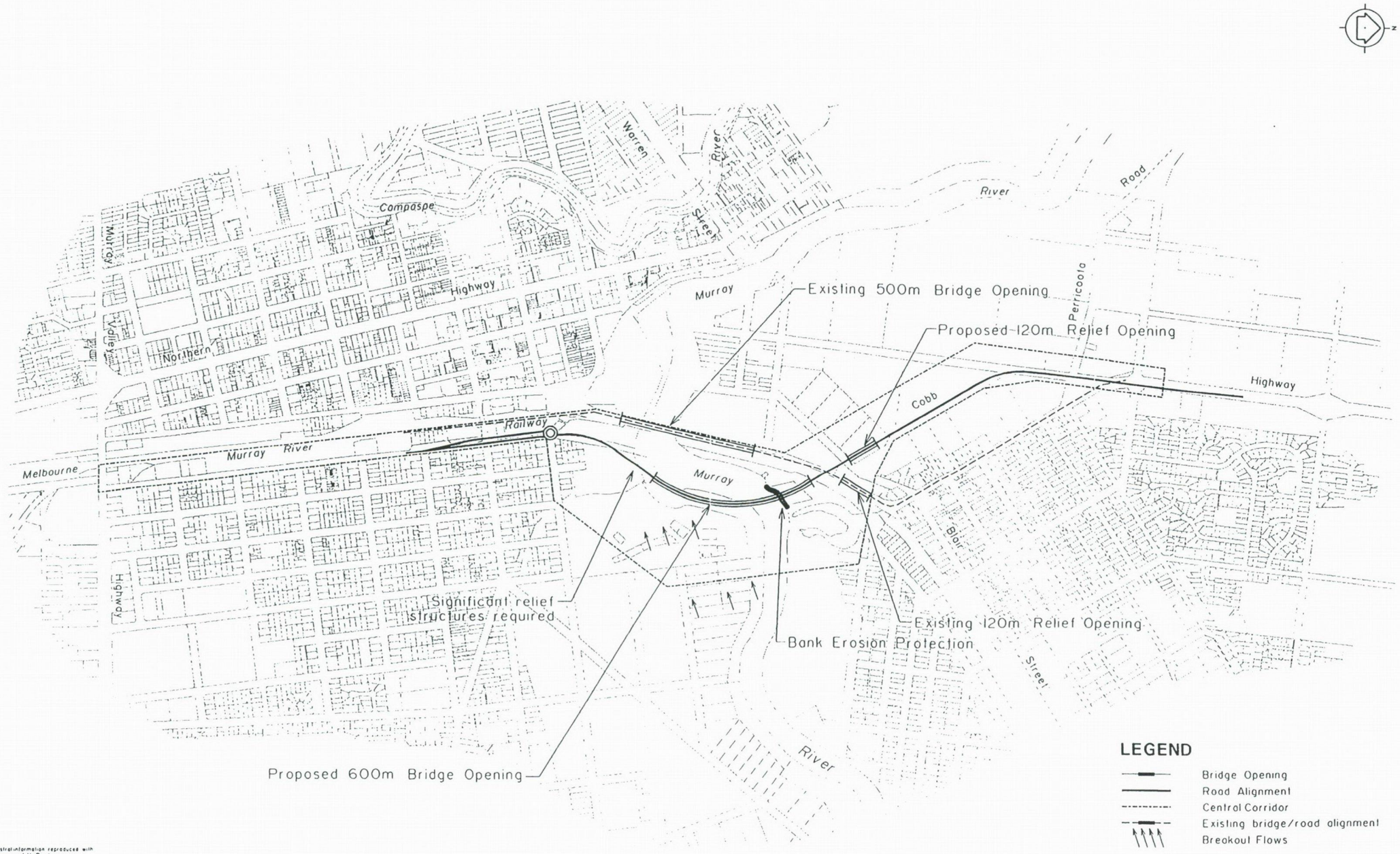
Proposed Alignment W1
FIGURE 2.4



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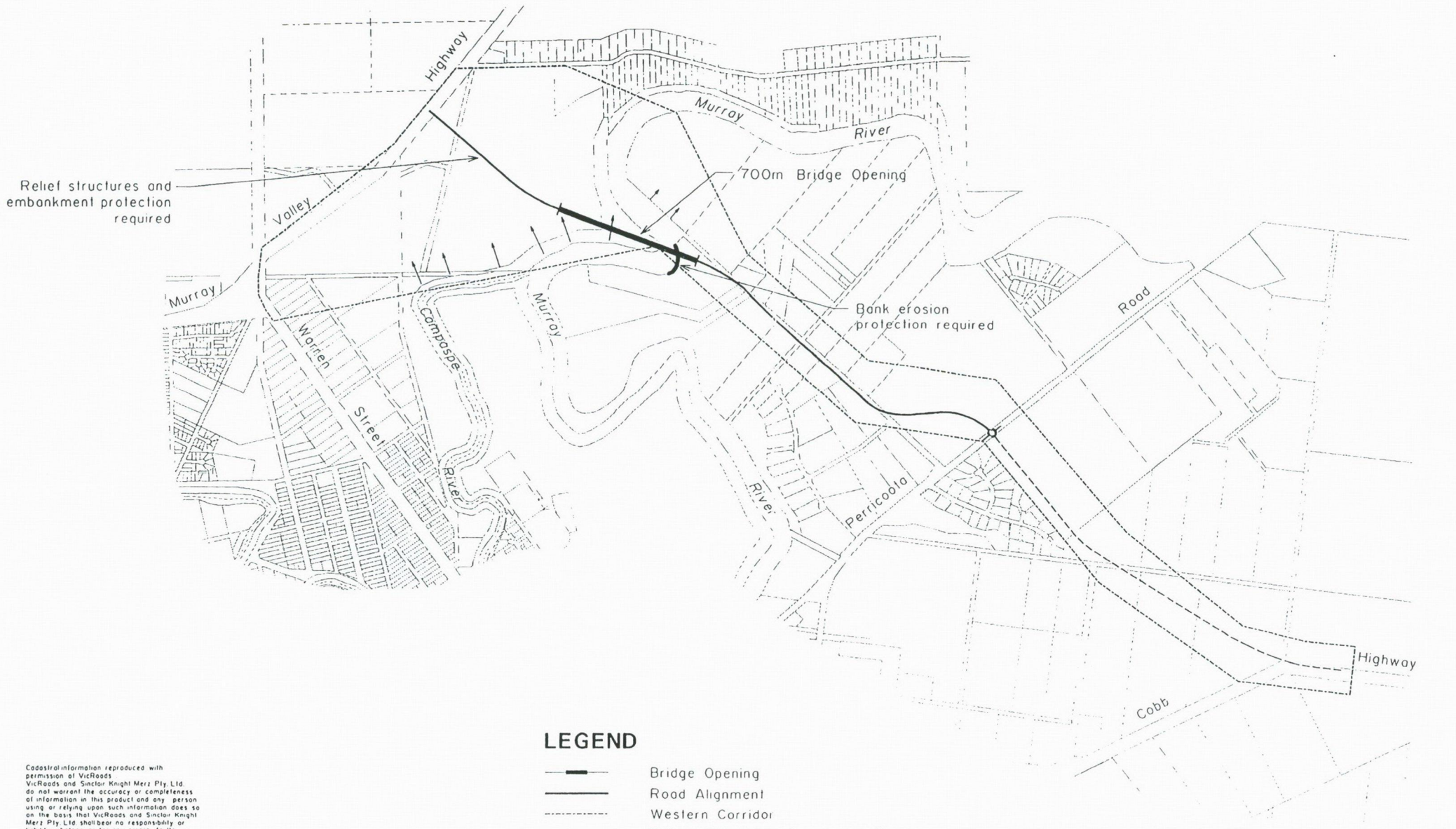
Proposed Alignment C2
FIGURE 2



LEGEND

- Bridge Opening
- Road Alignment
- Western Corridor
- Future Cobb Hwy. Connection Road
- Breakout Flows

250 125 0 250 500 750 1000

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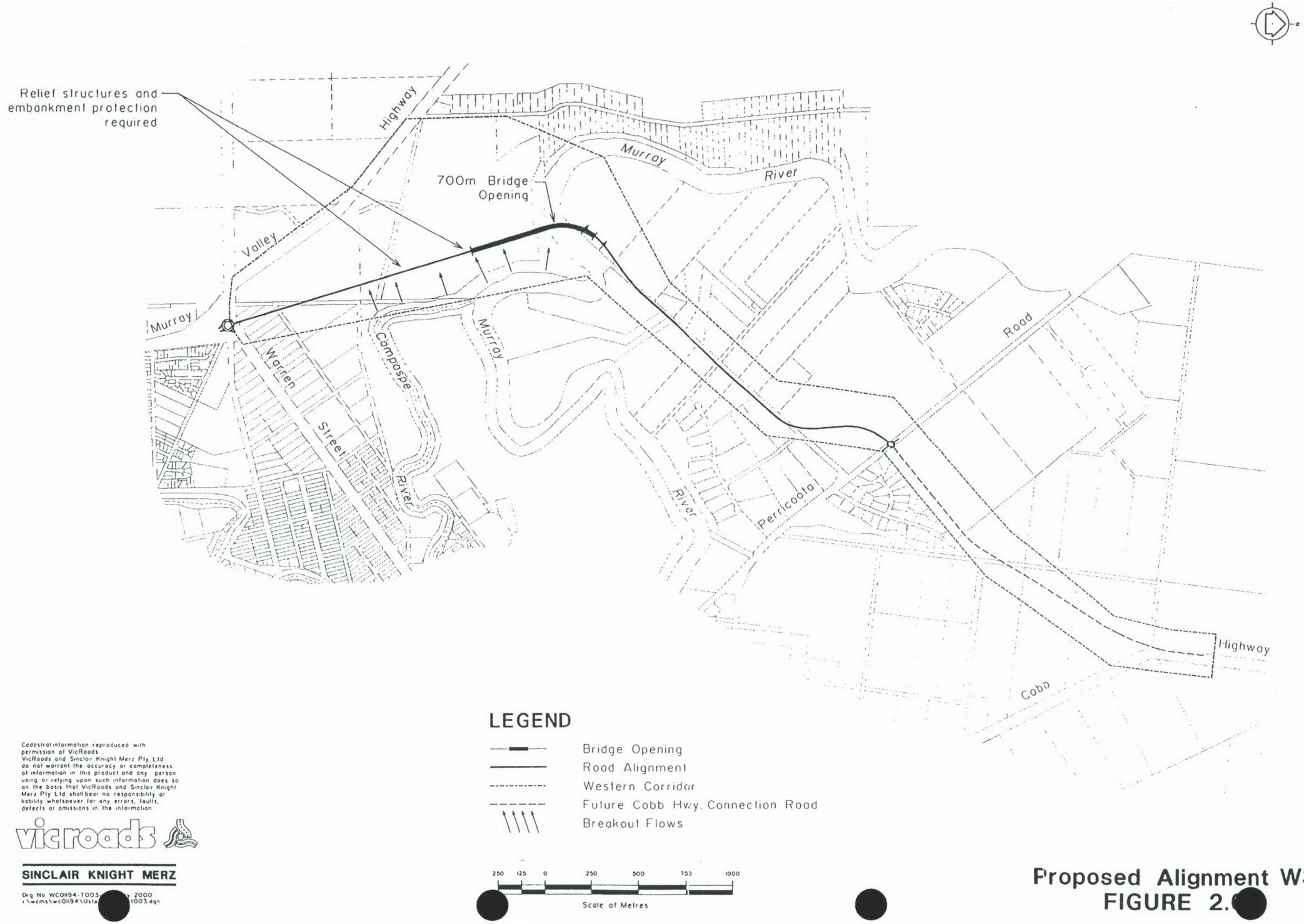
Proposed Alignment W2
FIGURE 2.5



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Proposed Alignment W3
FIGURE 2.

Vic Roads
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Hydraulics Study
Echuca - Moama Bridging Alignments

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Vic Roads
May 2000

Hydraulics Study
Echuca - Moama Bridging Alignments

Phase 2

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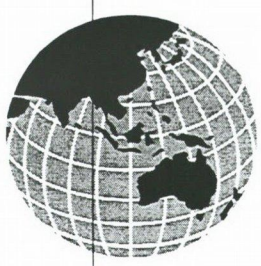

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1. Introduction

Sinclair Knight Merz was commissioned in April 2000 to revisit the hydraulics investigations previously undertaken by SKM in *Moama Echuca Bridge Alignment Options* (January 2000) to investigate a range of bridge alignments for a proposed crossing over the Murray River at Echuca/Moama.

The purpose of this commission is to review the hydraulic modelling undertaken to-date, including underlying assumptions, and to refine and compare impacts of the remaining options.

The work produced in SKM (Jan, 2000), was based on simple hydraulic modelling using HEC-RAS , based on conditions (ie. water levels and flows) reported in the earlier (draft) floodplain management study (SKM, 1999).

This work has been reviewed as well as the original flood study (SKM 1997) and floodplain management study (SKM, 1999). Based on this review an attempt was made to find ways of confirming and/or refining the work, taking into consideration available hydrological and hydraulic data. It was found that simple improvements on the previous work would be difficult due to the fact that there is no additional surface information and the hydrology of the system is complex and not easily revisited.

In the course of the data review however, the hydraulic model constructed for floodplain management study (SKM, 1999) was retrieved. By modifying the model to include the proposed bridging options an alternative method of investigating the bridging options was available. The advantage of this method was it uses results consistent with the previous flood study and provides an ideal cross-check of the previous report (SKM, Jan 2000)

The previous report (SKM, Jan 2000) reviewed six alignments. VicRoads has since reduced - based on a number of criteria - the number of alignments being investigated to three. These are alignments C1, C3 and W1.

2. Model Reconfiguration

2.1 Central Alignments Reconfiguration

The detail of the model in the vicinity of the existing bridge was updated. The existing model had a single river branch to represent flow under the bridge and through the relief structure located on the Moama side near Horseshoe Lagoon. To improve the detail around this section the model was adapted to include a relief branch.

The addition of the relief branch involved truncating the current bridge cross-section between the bridge and the relief structure, to form two new cross-sections, with one representing flow through the bridge and another to represent flow through the relief structure. Furthermore two new cross sections up and down stream of the relief were added to allow the introduction of the new branch. These new cross-sections were derived from the existing cross-sections up and downstream cross-sections. Another addition in the vicinity of the existing bridge was to extend the next downstream cross-section past the bridge by 400 m on the right-hand bank of the floodplain to better represent the conditions on the flood plain.

2.2 Western Alignment Reconfigutation

The detail of the model in the vicinity of the proposed western alignment was also revised. Downstream of the proposed western alignment the river takes a wide sweeping bend. It was felt that the model configuration did not represent the current situation sufficiently well for the purposes of this study – that is most likely in times of flooding a breakout would occur just upstream of the proposed alignment, moving across the floodplain and bypassing the wide sweeping bend, rather than lumped with a single broad cross-section.

To rectify this situation the cross-sections were modified and another branch was added to the model to represent the shorter path available to the flow via the break-out.

When modelling the proposed bridge alignment this new branch served to model the flow passing through the relief structure.

2.3 Bridge Structures

Once the model was reconfigured the model was re-run to represent, firstly existing conditions. Then structures representing the main and relief bridges were introduced into the model and the model run to assess the impact of these structures. All structures were modelled as clusters of large culverts with each culvert representing individual bridge spans. Bridge span lengths were provided by VicRoads and were, for the main bridge 85 m central span, 50 m spans adjacent to central and 22 m spans thereafter. The span lengths for the relief structure were 10 m. The alignments were assessed independently.

3. C1 Modelling and Bridge Sizing

There already exists a rail/ road bridge including relief structure adjacent to this alignment. Furthermore, by placing the new piers in line with the existing piers expansion and contraction loses through the bridge opening will be minimised. This will help minimise upstream afflux.

The previous report (SKM, Jan 2000) indicated that a total bridge span required for the central alignment would need to be approximately 500 m. Discussion with VicRoads has determined that the existing structure has a total span of approximately 450 m. The proposed bridge and relief structure widths shall not be less than the existing bridge.

To model this situation the main and relief bridge structures were entered into the model (Chainage 999.9 at the main river branch in the model). Bridge spans equal to the existing structure were trialed. Also, one of the down stream cross-sections was modified. The modification was necessary as the proposed alignment includes a bypass of Maninya street on a road embankment across the floodplain. This embankment reduces the volume of the flood plain.

3.1 Results

Table 3.1 summarises the results for a C1 alignment for a 1 in 100 year flood. As can be seen the addition of the bridge and relief structure appears to have little impact on the maximum flood level with an estimated afflux of 0.02 m. The water level for existing conditions at the next cross-section upstream of the bridge (ie Model chainage 999.2) is 95.37 m. Note that unlike the western alignment (See Section 5.2 discussion) the peak afflux at the central alignment occurs at the peak flow. This is believed due to the more confined floodplain at the central alignment.

Table 3.1: Results at 1 in 100 year Peak Flow

Notional length	(m)	450
Actual length modelled	(m)	449
Bridge afflux	(m)	0.02
Discharge through relief branch	(m^3/s)	Approx 200
Discharge through main channel	(m^3/s)	Approx 1015
Average velocity	(m/s)	0.56

3.2 Discussion of C1 Option

The C1 option is viewed as the more critical in terms of the consequences of increased flooding due to afflux resulting from a new bridge. The conditions of afflux imposed were not to make the flooding conditions within the towns any worse than existing. The nearest building upstream is a sawmill, located 100 m from the bridge. From this our imposed afflux conditions were a 0.0 m rise 100 m upstream from the bridge. We would expect a 0.0 m afflux at this point if the afflux at the bridge is only 0.02 m. However, with no model cross-sections in this vicinity, this would need to be confirmed with detailed modelling of the preferred option.

The existing relief structure on the Moama side is 120 m in length. The dimensions of the new relief have been assumed as similar to those of the existing. However, as the existing and new relief structures will not be parallel and flow patterns between these structures will be curves, the length of the new relief structure may need to be longer. The purpose of the relief structure is to take the flow bypassing the bridge back towards the floodplain and away from the land between the town and the road embankment. To achieve this a levee may be necessary to train the flow from the existing relief structure into the proposed relief structure.

The Moama Floodplain Management Committee has raised a number of issues regarding the Central options. The concerns were that a number of developments which have occurred in the flood plain have had an incremental effect on the flood water heights. As the proposed central option, in particular the northern approach road, will further constrict the flood plain, the residents of the area are sensitive to the development and concerned that it will increase the height of major floodwaters in their area.

If the new bridge option uses pier spacings and alignments matching those already existing, the afflux due to the addition of the bridge will be minimised. The Meninya Street bypass is an understandable concern as the road embankment joining the bridge to the Cobb Hwy runs parallel to Meninya Street and would result in the loss of some flood plain volume. However, this loss of flood plain would have a minimal impact on flooding because the lost land lies on the upper section of the flood plain. This has been tested in the model runs undertaken for this alignment.

4. C3 Bridge Sizing

The C3 alignment has the same proposed crossing of the river as C1. However, on the Moama side of the new river bridge, C3 would connect to the existing Cobb Highway and utilise the existing relief structure to access Maninya Street.

This alignment option does not include the bypass of Maninya Street on a road embankment across the floodplain as proposed for C1.

4.1 Results

Table 3.1 summarises the results for a C3 alignment for a 1 in 100 year flood. As can be seen the addition of the bridge and relief structure appears to have little impact on the maximum flood level with an estimated afflux of 0.02 m. The water level for existing conditions at the next cross-section upstream of the bridge (ie Model chainage 999.2) is 95.37 m.

Table 4.1: Results at 1 in 100 year Peak Flow

Notional length	(m)	450
Actual length modelled	(m)	449
Bridge afflux	(m)	0.02
Discharge through relief branch	(m^3/s)	Approx 200
Discharge through main channel	(m^3/s)	Approx 1015
Average velocity	(m/s)	0.56

4.2 Discussion

The results for C3 shown in Table 4.1 indicate that the C3 option is virtually equivalent to option C1. Therefore, the road embankment in C1 is expected to have little impact on flooding.

5. W1 Modelling and Bridge Sizing

The modelling of the western option involved the addition of two bridge structures into the reconfigured model. In the previous study (SKM, Jan 2000) the main bridge has been estimated at 700 m with the need for a relief structures at 150 m to contain breakout flow upstream of the bridge. As the road embankments run perpendicular to the flood plain there was no need to alter any cross sections as there is no loss of floodplain volume. The modelling investigated firstly whether these estimated bridge sizes were adequate and secondly whether there was any capacity to reduce the span of the main bridge while minimising the upstream afflux.

In undertaking our analysis the relief bridge was placed in the new model branch and fixed at 150 m. The main bridge was placed on the main river branch (Model chainage 1005.7).

5.1 Results

Table 5.1 and Table 5.2 summarise the flood level and flow information for the time of peak flow and the time of peak velocity. As can be seen from Table 5.1 the addition of the bridge and relief appears to have little impact on the flood level for a 1 in 100 year flood, although constricting the opening to 400 m appears to begin having an affect on the upstream flood level. Table 5.2 demonstrates that the maximum afflux occurs at the time of maximum velocity. The peak water level in the existing condition upstream of the bridge (Model chainage 1005.05) is 95.18.

Table 5.1: Results at 1 in 100 Year Peak Flow

Notional length	(m)	400	550	700
Actual length modelled	(m)	444	576	708
Bridge afflux	(m)	0.02	0.01	0.01
Discharge through relief branch	(m^3/s)	231	222	222
Discharge through main channel	(m^3/s)	1306	1312	1312
Average velocity`	(m/s)	0.77	0.68	0.60

Table 5.2: Peak Afflux in Channel

Notional length	(m)	400	550	700
Actual length modelled	(m)	444	576	708
Water level for peak afflux (chainage 1005.05)	(m - AHD)	93.40	93.40	93.40
Bridge afflux (peak)	(m)	0.03	0.03	0.03
Discharge through relief branch	m^3/s	17	<1	<1
Discharge through main channel	m^3/s	1078	991	992
Average velocity (peak)	m/s	1.06	1.02	0.99

5.2 Discussion of Results

This option is viewed as less critical than option C1 as the upstream development is further away allowing more time for any afflux to reduce. It is understood that the nearest development is located about 300 m upstream. Thus the afflux conditions imposed on the design would require no afflux at a distance of 300 m upstream of the bridge.

The initial results seem to indicate that there is capacity to reduce the bridge span from the 700m indicated in the previous report. This result is concluded because there is little change in the maximum flood level upstream of the bridge structure, with smaller bridge openings. Detailed investigation of the results indicates that various issues are interacting here. Most importantly the peak velocity through the bridge structure, which corresponds to the peak head loss does not occur during at the time of peak discharge and peak flood level. This means that the bridge is not having its greatest effect on the flood levels, when the flood levels are at their largest.

It can be shown that the peak afflux is occurring just before the flow breaks out of the channel (see relief structure/branch flow - Table 5.2). At this point, moderate reductions in the span of the bridge will have little impact as the flow is subject only to the piers in the channel, which remain unchanged by the moderate span reduction. This observation of peak velocity occurring at bank full flow is a likely result of the MIKE11 software package being utilised. MIKE11 uses an average value of velocity across the cross-section and thus when breakouts occur, with a greater flow area available, average velocity across the cross-section would likely decrease.

Another issue which may be influencing the results is that there is evidence of the flood plain downstream of the Echuca-Moama area being quite confined. This would be leading to backwater effects which would tend to drown the flows at the bridge site. When this occurs velocities drop and thus the head loss across the bridge is reduced, resulting in low afflux upstream.

Concern was expressed by residents on the effect that the adoption of the western option would have on flooding and especially on the residents of Echuca East. The western alignment is located approximately 5.8 km down

stream from the existing rail/road bridge. From our modelling results, there is no impact of the western alignment (for the bridge spans trialed) within the town.

The conclusion for these results is that a 550 m to 600 m long main bridge may ultimately be possible for the western alignment.

6. Comments on Flow Concurrency

The Moama-Echuca flood study (SKM, May 1997, p 33) found that the 1 in 100 year design event at Echuca-Moama is defined by a flood level of 95.45 m AHD at the Echuca gauge. This report also noted that because of the interactions between the Murray and Campaspe Rivers differing combinations of events in both rivers could cause the same flood.

The previous report (SKM, Jan 2000) indicated that flow volumes were around 50% more along the western alignment than the central alignment. The more detailed modelling undertaken in this study has provided better detail of the interaction of the Murray and Campaspe River flows, as follows. In the model run that we have considered there are three peaks to be considered-the peak flow in the Murray River at the existing bridge, the peak flow at the western alignment and the peak flow in the Campaspe River. In the design 1 in 100 year event these peaks occur at differing times. The peak recorded flow in the Campaspe is 940 m^3/s. This occurs about four days before the Murray peak arrives. Before the Murray River peak arrives, the recession from the Campaspe combines with the rising waters in the Murray to give the peak flow through the western alignment. The peak flow recorded for the western alignment is 1537 m^3/s. A day later the peak of the River Murray flood arrives and the peak flow is recorded at the central alignment (1215 m^3/s).

It can be concluded from these figures that the Campaspe can have a large influence on the flood levels in Echuca and Moama. However, the flood peaks do not arrive simultaneously, so the peak flow in the western section is about 25% more than the flow past the central alignment.

7. Note on Accuracy

As stated in the proposal while this study has provided an approach to the problem it can still only be regarded a preliminary. The accuracy of the modelling has been limited as the original model was not specifically set up for this purpose. The original Moama Flood study and model focussed on broader scale flooding rather than specific bridge hydraulics. Whilst the model has been modified to represent the bridge crossings reasonably well, a more detailed modelling of the preferred option will ultimately be essential to determine the more detailed location / sizing of bridging.

8. Conclusion

This report has confirmed the results of the previous study with the possible opportunity for a reduction in the span of the western alignment. It is also apparent that satisfactory bridging can be achieved for both alignments without adversely impacting on upstream water levels and flooding within the towns.

The results of this study remain preliminary and further analysis will be required at the time of detailed design to confirm bridging requirements for the preferred alignment.

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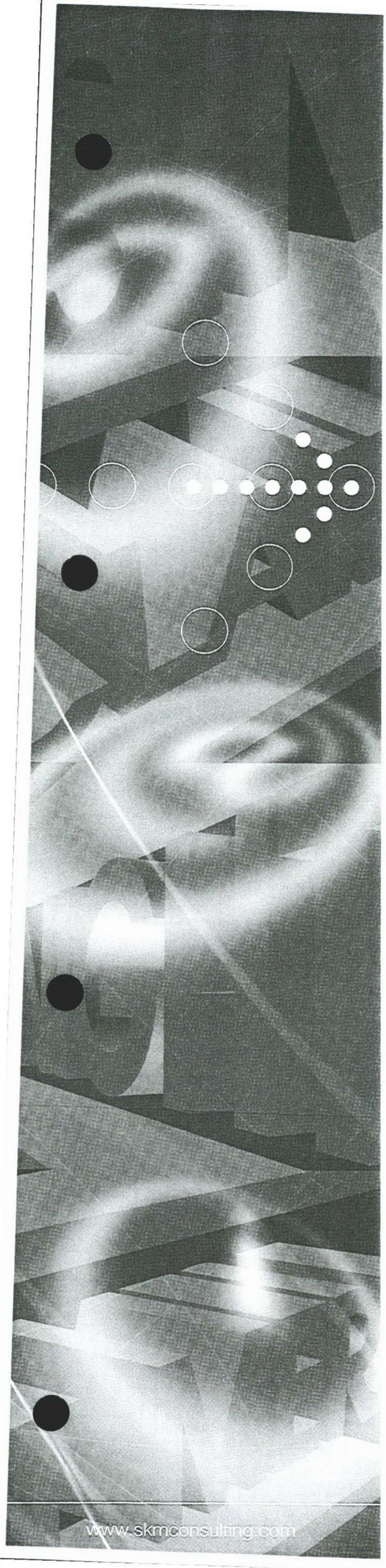

Murray River Crossing at Echuca/Moama

An Investigation of the Design Floods for the Western Alignment

VicRoads

Final 1

May 2001

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Summary

Hydraulic analysis of the proposed bridges has been based on the flood study carried for Shires of Campaspe and Murray in 1997. The study showed that a flood in Moama Echuca can be caused by different combinations of floods in the Murray and Campaspe Rivers. The 1997 study included an analysis of five historical floods where the peak flows in each river occurred 6 to 9 days apart. However, there have been historical flood events in 1870 and 1975 where the rivers have peak concurrently. This current study is in response to public inquires regarding the assumptions made about timing of the peaks in the Murray and Campaspe Rivers and in particular the effects of these assumptions for the sizing of the Western Alignment.

The analysis undertaken in the 1997 study was repeated with data from 16 additional historical flood events (21 flood events in total used in the analysis). The results of the analysis show the peaks in the two rivers have occurred between 1 day and 14 days apart. The average time between peak flows is 8 days with the Campaspe River peaking prior to the Murray River. Also, the results indicate that for larger floods the time between the peaks in the two rivers tends to increase.

The complex interaction of floods in the Murray and Campaspe Rivers at the Western Alignment makes the estimation of the 1 in 100 year flood level difficult. There are methods available for the estimation of the 1 in 100 year flood level at the Western Alignment, however they require significant effort to undertake and are considered unwarranted at this time.

The hydraulic modelling analysis to date has used a 1 in 100 year flood in the Murray and a 1 in 50 year flood in the Campaspe with a 6 day lag between the peaks as the design flood combination for the Western Alignment. This design flood combination was chosen as it resulted in a 1 in 100 year flood level in Echuca. Further hydraulic modelling was undertaken using different combinations of floods in the Murray and the Campaspe with different lags between the peaks.

The flood level modelled at the Western Alignment for a combination of a 1 in 100 year flood in the Murray and a 1 in 50 year flood in the Campaspe with coincident peaks at the rivers' junction was 95.38 m AHD. This is about 0.2 m higher than the flood level from the previous modelling. The estimated afflux (the local rise in water level upstream due of an obstruction) was 0.02 m and is 0.01 m higher the afflux from the previous hydraulic modelling.

The combination of a 1 in 100 year flood in the Murray and a 1 in 100 year flood in the Campaspe with coincident peaks at the rivers' junction was also simulated using the hydraulic model. This combination resulted in a modelled flood level at the Western Alignment of 95.47 m AHD which is about 0.3 m higher then the flood level from the previous hydraulic modelling. It was found the estimated afflux for this design flood combination was the same as the afflux from the previous modelling with a value of 0.01m.

1. Introduction

This report outlines investigations into the estimation of design floods for use in the sizing of bridge configurations for the Western Alignment and the sensitivity of the impacts of the bridge configuration to the magnitude of design floods.

The Western Alignment option crosses the Murray River just downstream of its confluence with the Campaspe River. For this and all possible alignments, the interaction of the Murray and Campaspe Rivers during floods must be considered in the design. The VicRoads study team has received inquiries from the public regarding the current design flood used to size the bridge configurations for the Western Alignment. In particular these inquiries have focused on the magnitude of the design flood and timing difference assumed between peaks in the Murray and Campaspe Rivers.

Sinclair Knight Merz was commissioned by VicRoads in January 2001 to undertake investigations to address the issues raised by the public inquiries concerning the Western Alignment option. The investigations had the following key elements:

- Review previous studies
- Investigate the timing difference (lag) between the peaks in the Murray and Campaspe Rivers.
- Investigate methods of estimating design floods at the Western Alignment.
- Test the sensitivity of the impacts of the bridge to a range of lags and combinations of various Murray and Campaspe design floods.
- Prepare a "plain english" explanation of the estimation of the design floods used in the sizing of the Western Alignment.

The outline of the report is as following:

Section 2 – Review of previous studies and further investigations into the estimation of the design flood

Section 3 – Sensitivity testing of the impacts of the Western Alignment to a range of design floods.

The summary at the start of this report aims to provide VicRoads with a "plain english" explanation of the estimation of design floods for use in future reports.

2. Estimation of Design Floods for the Western Alignment

2.1 Review of Design Floods Used in Bridge Sizing

The size of a flood at the Western Alignment is influenced by the following factors:

- flood magnitude in the Murray and Goulburn Rivers
- flood magnitude in the Campaspe River
- the lag between the arrival of the peaks in the Murray River and Campaspe River at the confluence.

The Moama Echuca Flood Study (SKM 1997) estimated design floods for the Murray at Lower Moira, Goulburn at Yambuna and the Campaspe at Rochester and design flood levels at the Echuca gauge. The study investigated the lag between historical peaks in the Murray at Echuca and the Campaspe at Rochester and adopted an average 6-day lag for the design purposes (with the Campaspe peaking prior to the Murray). A hydraulic model was used to route the three design floods from the three rivers through the floodplain. Various combinations of the design floods from the three rivers were found to result in a peak flood level at the Echuca gauge equivalent to 100 year ARI design flood level. This result highlighted that a given flood level at the Echuca gauge can be the result of different combinations of flood magnitudes in the Murray and Campaspe Rivers.

One combination of the design floods, which resulted in the 100 year ARI flood level at the Echuca gauge, was the following:

- 100 year ARI flood in the Murray River and 50 year ARI flood in the Campaspe River assuming a 6 day lag between the Murray peak at Echuca and the Campaspe peak at Rochester.

The investigation of the lags between peak times, as outlined above, used data at the Echuca and Rochester gauges. It should be noted the hydraulic model employed to simulate flooding behaviour extends along the Campaspe River for about 8 km upstream of the Murray confluence. The gauge at Rochester is approximately a further 20 km upstream of the limit of the hydraulic model. To correctly simulate the lags between Echuca and Rochester, it is necessary to delay the Campaspe design flood by two days for input to the hydraulic model. This allows for the travel time of the peak between the Rochester and hydraulic model limit. A lag of 6 days in the peaks between Rochester and Echuca is approximately equivalent to a lag of 4 days between the peaks at the Murray-Campaspe confluence. Further, a lag of 2 days between the peak at Echuca and Rochester is equivalent to concurrent peaks at the confluence.

The hydraulic modelling of the bridge configurations to date (SKM 2000a, SKM 2000b) has used the above design flood combination as the model inflows. Using this combination the modelled peak flow at the Western Alignment is 1537 m^3/s (SKM 2000b).

Public inquires have been made to VicRoads regarding the assumptions made in the estimation of the design flood used for the Western Alignment and in particular the use of a 6 day lag.

2.2 Investigation of Lags between the Murray and Campaspe Rivers Peaks

SKM (1997) investigated the lags between the Murray and Campaspe peaks. The analysis compared the date of the peaks at Echuca and Rochester from five large historical floods (1974, 1981,1983,1992,1993). The results show the Campaspe at Rochester peaks between 6 days and 9 days before the peak of the Murray at Echuca.

This current study undertook a similar comparison using the available data from 21 historical floods including the five events used in SKM(1997). The 21 floods selected have concurrent data at both Echuca and Rochester gauges. Unfortunately concurrent data at both sites was not available for any additional floods. It is noted the 1975 flood event has been quoted (Alf Grigg and Assoc. 2000) to have had concurrent peaks in the Murray and the Campaspe. The observed data obtained from Theiss for the Campaspe at Rochester showed a period of missing data from 15/09/1975 to 18/11/1975 corresponding to the flood event. As a result the 1975 flood events could not be included in the analysis.

Table 2-1 shows the selected floods listed in chronological order, the peak levels and the lags between the peaks at Echuca and Rochester and the approximate lag at the confluence. The approximate lag at the confluence is estimated by allowing a travel time of 2 days for the Campaspe peak from Rochester to the confluence. Note a positive lag indicates the Campaspe peak arrives before the Murray peak.

The lags between the peaks for the Campaspe at Rochester and the Murray at Echuca range from +1 day to +14 days for the events analysed with an average lag of +7.7 days and a median lag of +8 days. At the confluence, the lags vary from –1 day to +12 days. Two of the selected floods, May 1983 & December 1985, have lags at the confluence of 0 and -1 days respectively, indicating concurrent peaks at the confluence can occur.

Figure 2-1 displays a plot of the peak levels at the Echuca Gauge against the lag of the peaks at Rochester and Echuca for the selected flood events. It can be seen that for the selected events there is a tendency for the higher peak levels at Echuca to be associated with longer lags. Also of note, are the May 1983 & December 1985 events, which produced concurrent peaks at the confluence but resulted in the two lowest peak levels at Echuca from the selected events.

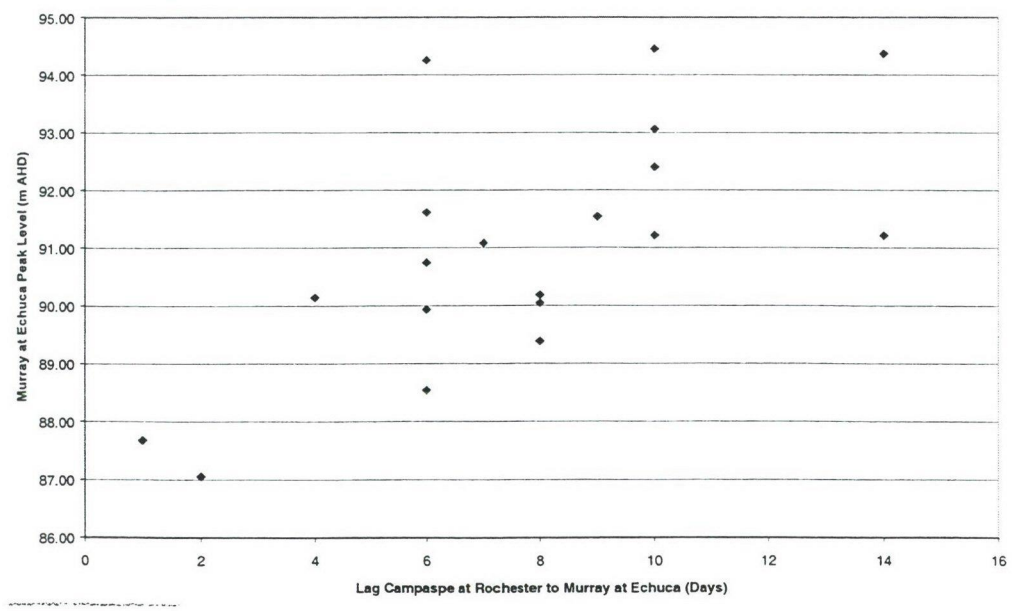
It is noted that the results obtained are drawn from data for 21 flood events. More robust results would be obtained if concurrent data were available for additional flood events. Despite this, the trend evident from the 21 events suggests that large events are less likely to be concurrent.

The above results support the estimation of the average lag found in SKM (1997). However, the above analysis does not provide direct information on the magnitude of the 100 year ARI flood at the Western Alignment. The following section outlines a method to estimate the 100 year ARI peak flow at the Western Alignment.

■ Table 2-1 Timing of Murray and Campaspe Peaks

Campaspe River at Rochester		Murray River at Echuca		Lag Echuca - Rochester (Days)	Lag At Confluence (Days)
Date of Peak	Peak Gauge Height (m)	Date of Peak	Peak Gauge Height (m)		
18/1/1974	4.98	24/1/1974	90.08	6	4
17/5/1974	9.11	23/5/1974	92.54	6	4
6/10/1974	9.02	16/10/1974	94.12	10	8
2/8/1978	6.11	12/8/1978	88.51	10	8
8/8/1978	6.83	22/8/1978	88.73	14	12
29/9/1978	5.00	6/10/1978	89.93	7	5
30/9/1979	8.56	10/10/1979	89.08	10	8
28/6/1981	5.64	6/7/1981	93.88	8	6
5/8/1981	8.82	19/8/1981	86.70	14	12
4/5/1983	4.61	6/5/1983	87.00	2	0
30/7/1983	7.50	8/8/1983	91.84	9	7
9/9/1983	9.15	19/9/1983	88.13	10	8
19/10/1983	4.98	25/10/1983	86.72	6	4
22/8/1984	5.27	28/8/1984	90.16	6	4
6/10/1984	5.91	12/10/1984	87.23	6	4
12/12/1985	6.12	13/12/1985	86.48	1	-1
23/6/1987	6.20	1/7/1987	88.26	8	6
28/7/1988	4.81	1/8/1988	89.26	4	2
12/9/1988	7.36	20/9/1988	87.91	8	6
18/10/1992	N.A.	27/10/1992	N.A.	9	7
5/10/1993	N.A.	13/10/1993	N.A.	8	6

■ Figure 2-1 Peak Levels for Murray at Echuca



2.3 Outline of Detailed Approach to Design Flood Estimation at the Western Alignment

As outlined in Section 2.1, the magnitude of floods at the Western Alignment is a function of the flood magnitude in the Murray, Goulburn and Campaspe Rivers and the lags between the peaks in the Murray and Campaspe Rivers.

To estimate the ARI of a flood at the Western Alignment requires the consideration of the correlation of the flood magnitudes between the three rivers and the effect of the floodplain storage on the combination of the flood inflows from the three rivers.

Laurenson (1974) developed a method for the analysis of systems, which incorporate both stochastic and deterministic components. The estimation of design floods at the Western Alignment can be thought of a system containing both stochastic and deterministic components. The correlation of the flood magnitudes can be considered as the stochastic component, while, the effect of the floodplain storage can be considered as the deterministic component.

The determination of the correlation of flood magnitudes can be achieved by an analysis of available flood data. The hydraulic model can be used to simulate the effect of the floodplain on the combinations of the inflows from the three rivers.

The application of the above method to estimate the design floods for the Western Alignment is possible, however, would require substantial computational effort.

2.4 Conclusions

The results presented in Section 2.2 and the method outlined in Section 2.3 were discussed with VicRoads. It was agreed that while the method outlined in Section 2.3 would yield design flood estimates at the Western Alignment, the additional effort could not be justified at this point in time.

In lieu of the estimation of the design floods at the Western Alignment, sensitivity testing using the hydraulic model was undertaken to assess the performance of the bridge configuration to a range of design flood magnitudes. Details of the sensitivity testing are provided in Section 3.

3. Sensitivity Testing of Western Alignment Bridge Sizing

3.1 Overview

Given the complexities in estimating the 100 year ARI peak flow at the Western Alignment, a number of sensitivity model runs were undertaken to assess the impact of different design flood combinations on key hydraulic design parameters for the bridge.

Key hydraulic parameters for the design of the bridge include the following:

- Peak flood level at the bridge
- Peak flow through the main bridge structure
- Peak flow through the relief structure
- Bridge afflux
- Velocity through main bridge structure

To test the sensitivity of the above parameters to the design flood magnitude, the following design flood combinations were used as inputs to the hydraulic model:

- 100 year ARI flood in the Murray River and 50 year ARI flood in the Campaspe River assuming a 4 day lag between the Campaspe and Murray peaks at the confluence. This is equivalent to design flood combination used in the modelling to date.
- 100 year ARI flood in the Murray River and 50 year ARI flood in the Campaspe River assuming a 2 day lag between the Campaspe and Murray peaks at the confluence.
- 100 year ARI flood in the Murray River and 50 year ARI flood in the Campaspe River assuming concurrent peaks for the Campaspe and Murray at the confluence.
- 100 year ARI flood in the Murray River and 100 year ARI flood in the Campaspe River assuming a 4 day lag between the Campaspe and Murray peaks at the confluence.
- 100 year ARI flood in the Murray River and 100 year ARI flood in the Campaspe River assuming concurrent peaks for the Campaspe and Murray at the confluence.

The sensitivity testing was undertaken on the bridge configuration with a width of 550 m obtained from SKM(2000b). This bridge width of 550 m is the minimum width recommended by SKM(2000b) for the Western Alignment. The design inflow hydrographs were taken from SKM (1997) in line with previous modelling.

3.2 Results

Table 3-1 displays the various hydraulic design parameters resulting from the design flood combinations trialed. The total peak flow at the bridge is obtained by the addition of the peak flows through the main channel and relief structure. As noted in SKM(2000), the maximum afflux due to the bridge was found to occur at bankfull conditions in the main channel when the maximum velocity occurs. It is unlikely that the afflux at bankfull conditions will adversely impact adjacent properties as overbank flooding has only just started to occur at this condition. The afflux shown in Table 3-1 is the afflux occurring at the time of the peak flow.

■ **Table 3-1 Sensitivity of Bridge Design Parameters for the Western Alignment**

Design Flood Combination	Max. Flood Level at Bridge (m AHD)	Max. Flood Level at Echuca (m AHD)	Peak Flow Main Channel (m^3/s)	Peak Flow Relief Structure (m^3/s)	Total Peak Flow at Bridge (m^3/s)	Bridge Afflux at Peak Flow (m)	Max. Average Velocity through Main Channel (m/s)
100 yr Murray 50 yr Campaspe 4 days lag at confluence (Previous model base case)	95.16	95.30	1312	222	1534	0.01	0.68
100 yr Murray 50 yr Campaspe 2 days lag at confluence	95.38	95.46	1411	247	1658	0.01	0.70
100 yr Murray 50 yr Campaspe Concurrent at confluence	95.38	95.45	1446	217	1663	0.02	0.74
100 yr Murray 100 yr Campaspe 4 days lag at confluence	95.40	95.51	1405	247	1652	0.01	0.68
100 yr Murray 100 yr Campaspe Concurrent at confluence	95.58	95.63	1524	248	1772	0.01	0.75

The maximum flood levels and the total peak flows at the bridge show an increase when the lag is reduced from 4 to 2 days for the combination of a 100 year ARI design flood in the Murray River and a 50 year ARI design flood in the Campaspe River. For this combination of design floods, the further reduction in lag from 2 days to concurrent peaks results in no change in the maximum flood level at the bridge. This is due to the shape of the design flood hydrographs being relatively constant over the peak.

An increase in the maximum flood levels and the total peak flows at the bridge is seen when the lag is reduced from 4 days to concurrent peaks for the combination of 100 year ARI design floods in both the Murray and Campaspe Rivers. There is a 420 mm increase in the maximum flood level at the bridge from the previous model base case if 100 year ARI floods are adopted for both the Murray and Campaspe Rivers with concurrent peaks. Similarly, the peak flow has increased from 1534 m^3/s for the previous model base case to 1772 m^3/s for concurrent 100 year ARI floods in the both the Murray and Campaspe.

The ARIs of the peak flow resulting from the above design combinations at the bridge have not been determined and would require the application of the method outlined in Section 2.3. However, it should be noted the above design flood combinations (apart from the previous model base case) result in maximum flood levels at Echuca greater than the 100 year ARI level.

The bridge afflux is unaffected by the variation in the design flood magnitude and the lag, except for an increase to 0.02 m for the combination of 100 year ARI in the Murray and 50 year ARI in the Campaspe with the 2 day lag. The insensitivity of afflux is due to the backwater effects at the bridge caused by a downstream constriction in the floodplain.

The afflux is a function of the velocity and depth of flow through the structure. The design combinations with concurrent peak flows at the confluence result in the higher maximum average velocities through the main channel structure. The lower flow depth for the combination of 100 year ARI in the Murray and 50 year ARI in the Campaspe with concurrent peaks results in a small increase in afflux for this combination.

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Murray River Crossing at Echuca/Moama

A Hydraulic Analysis of the 200 year ARI Flood for the C1 Alignment

VicRoads

Final 1

July 2001

Murray River Crossing at Echuca/Moama

A Hydraulic Analysis of the 200 year ARI Flood for the C1 Alignment

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1. Introduction

This report presents the method and the results of the additional hydraulic modelling undertake to assess the hydraulic impact of the C1 Alignment under a 1 in 200 year ARI design flood event.

The aim of the study was to investigate the hydraulic impacts and performance of the proposed C1 alignment for a range of design flood events which achieved a 1 in 200 year ARI peak flood level at the Echuca Wharf Gauge.

2. Methodology

The 1 in 200 year ARI peak level at the Echuca Gauge was estimated at RL 95.6 m AHD by the Moama Echuca Flood Study (SKM 1997). Due to the complex interactions of flood flows in the Murray, Goulburn and Campaspe Rivers at Moama Echuca, the 1 in 200 year ARI peak level can result from the combination of various flood magnitudes in the three rivers.

Figure 37, in the 1997 flood study (see attached figure), displays relationships between the magnitude (ARI) of floods in the Murray and Campaspe Rivers and the peak flood level at Echuca Wharf. It should be noted that in the derivation of these relationships the same ARI for design floods in the Murray and Goulburn Rivers was assumed.

This current study used the information in Figure 37 (SKM 1997) to determine combinations of design floods in the three rivers to result in a 1 in 200 year ARI peak level at Echuca. The following combinations were estimated to result in the required peak flood level (200 year ARI) at Echuca:

- - 25 year ARI in Murray/Goulburn and 200 ARI year Campaspe
- - 70 year ARI in Murray/Goulburn and 100 ARI year Campaspe
- - 100 year ARI in Murray/Goulburn and 70 year ARI Campaspe
- - 200 year ARI in Murray/Goulburn and 45 year ARI Campaspe

3. Results

The above design flood combinations were input to the MIKE11 hydraulic model, developed as part of the 1997 study, and routed through the floodplain to assess the impacts of the proposed C1 alignment. This study adopted the 1997 study assumption regarding the timing of the peak flow in the three streams, ie. the Campaspe peaks at Rochester 6 day prior to the peak of the Murray at Echuca. Key results of the hydraulic modelling of the C1 alignment under a 1 in 200 year ARI flood event are presented in Table -1.

It was found that the combinations of the 100 year ARI flood in the Murray/Goulburn with the 70 year ARI flood in Campaspe, and the 100 year ARI flood in Campaspe with the 70 year ARI flood in the Murray/Goulburn, resulted in a peak level at Echuca less than the 1in 200 year ARI level (95.6 m AHD). A combination of the 100 year ARI floods in all three rivers was found to achieve a peak level similar to the 1 in 200 year ARI level.

■ **Table -1 C1 Alignment - 1 in 200 year ARI flood event - Key Hydraulic Results**

Model Run	Design Flood ARI (years)			Max Level at Bridge (mAHD)	Max Level at Echuca Gauge (mAHD)	Peak Flow in Bridge Main Channel (m^3/s)	Peak Flow in Relief Structure (m^3/s)	Total Peak Flow at Bridge (m^3/s)	Bridge Afflux at Peak Flow (m)	Max Average Velocity through Main channel (m/s)
	Murray Flood	Goulburn Flood	Campaspe Flood							
1	25	25	200	95.59	95.57	935	230	1164	0.02	approx 0.6
2	70	70	100	95.48	95.48	1010	218	1228	0.02	approx 0.6
3	100	100	70	95.46	95.44	1026	219	1245	0.02	approx 0.6
4	200	200	45	95.60	95.58	1108	243	1351	0.02	approx 0.6
5	100	100	100	95.57	95.55	1043	228	1271	0.02	approx 0.6

The variation in the total peak flows (main channel plus relief) at the bridge with the design flood combinations is as expected. The first combination of the 25 year ARI in the Murray/Goulburn with the 200 year ARI in the Campaspe results in the lowest peak flow at the bridge due to the relatively small flows in the Murray/Goulburn. The peak water level for this first combination results from the backwater effect of the Campaspe River. Conversely, the fourth combination results in the highest peak flow at the bridge due to the larger floods in the Murray and Goulburn Rivers compared with the Campaspe River.

The afflux due to the C1 alignment was found to be 0.02 m for all of the design flood combinations modelled. It should be noted the affluxes due to the C1 alignment during the 200 year ARI flood events is of the same order as the affluxes for the 100 year ARI flood events.

The velocity results are given as approximate values. There was some instability in the model results at the peak flow. The values are considered adequate for the purposes of this study.
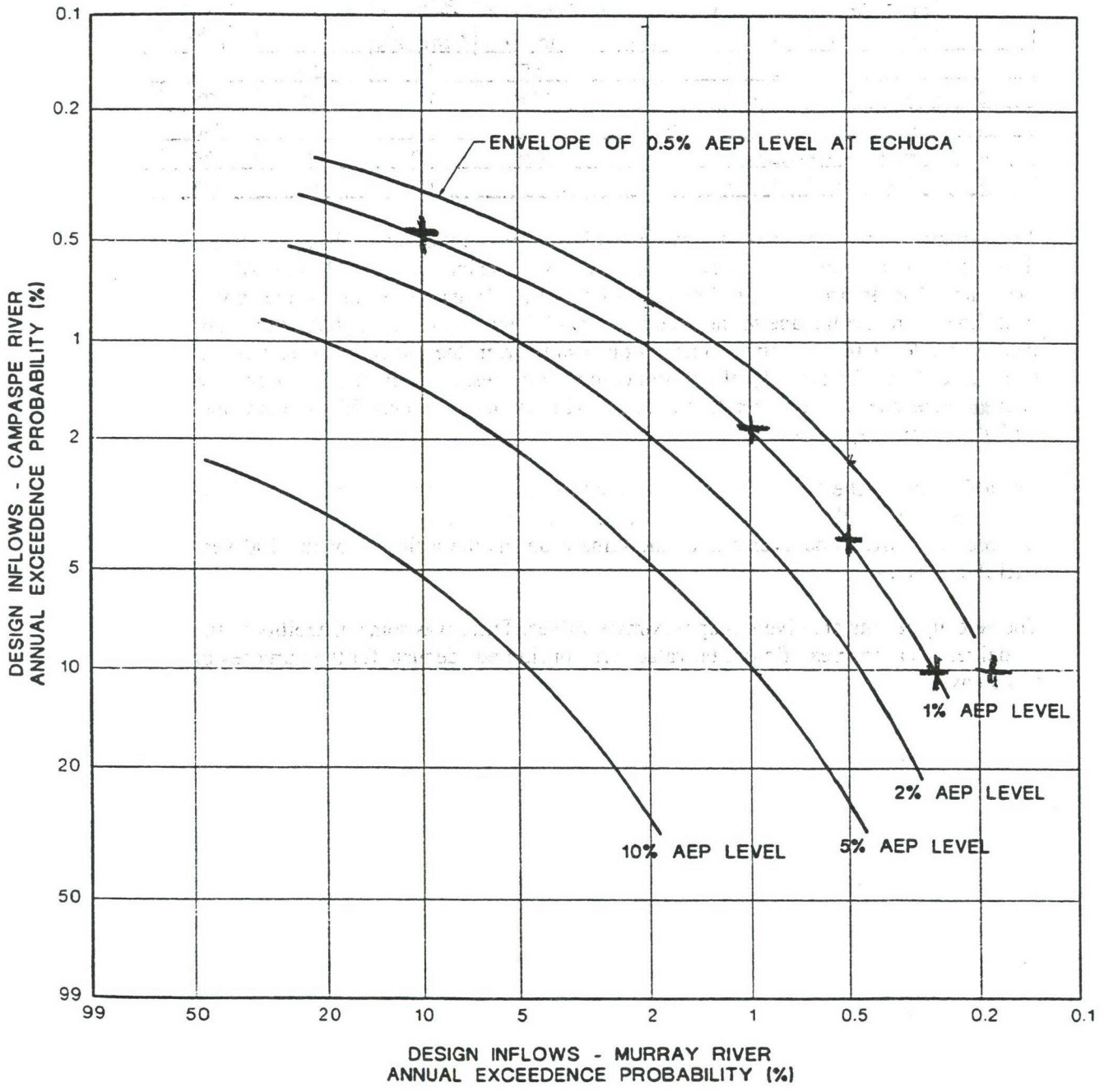
Figure 37
RELATIONSHIP BETWEEN MURRAY AND CAMPASPE DESIGN INFLOWS AT ECHUCA GAUGE
Moama/Echuca Flood Study