The economic contribution of Sydney's toll roads to NSW and Australia

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Preface

Sydney's modern day toll roads have developed over a 20 year period and now form the majority of the Sydney Orbital Network. While economic evaluations have been completed for each of the individual toll roads, these have been undertaken on an individual basis over different time periods using different variables and approaches. To date, the overall net benefits arising from this network of toll roads have not been considered. This report has been prepared to consider these issues and to complete an updated economic evaluation taking into consideration the network effects along with the consistent application of externalities that should be included in the analysis.

The report has also highlighted a number of areas in transport economic benefit forecasting which would benefit from further research and debate.

This report, which required Ernst & Young Transaction Advisory Services Limited to complete an independent evaluation of the net benefits arising from Sydney's network of toll roads, has been commissioned by Transurban. It is important to note that a condition of our agreeing to its preparation was for us to have complete independence in the preparation and presentation of the results.

The report draws on inquiries into and discussions with management of the toll road entities and a range of public and private sector organisations and publicly available information. Where we have relied on publicly available information we have identified the source of such information in the footnotes or at the end of our report. Our work has been limited in scope and time and we stress that a more detailed review with access to confidential or restricted information may reveal material issues that this review has not.

Our report may not have considered issues relevant to any third parties. Any use such third parties may choose to make of our report is entirely at their own risk and we shall have no responsibility in relation to any such use. This report may be distributed to third parties but strictly on the basis that Ernst & Young Transaction Advisory Services Limited assumes no duty of care or responsibility or liability whatsoever to third party recipients in respect of the contents of the report.

The following represents a shortened version of the complete Ernst & Young report with the focus being on the provision of the key information and outcomes of our study. We trust that the reader will find this report informative and that it encourages further debate in this important area.

Yours faithfully

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Transurban Foreword

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Transurban is an international owner and operator of toll road assets. In Sydney Transurban has an ownership interest in five assets in the Sydney motorway network. Transurban wanted to quantify the economic, social and environmental benefits generated by Sydney's network of interconnected toll roads to Australia and New South Wales.

Transurban commissioned Ernst & Young Transaction Advisory Services Limited to prepare a comprehensive independent study.

The scope of Ernst & Young's study included:

- Consultation with Government, industry and community stakeholders to ensure a balanced view in their findings
- Data collection and financial analysis of the direct and indirect benefits and costs, including forecast costs and benefits, of Sydney's motorway network to NSW and Australia
- Analysis of the forecast and actual impact of Sydney's motorway network on the environment
- Assessment of the decision to privately finance these projects in terms of costs, benefits, and the timing for completion

The Ernst & Young study commissioned by Transurban will make a positive contribution towards the current analysis of the economic, social and environmental benefits of infrastructure and assist decision-makers and the community to better understand the real benefits of infrastructure in Australia.

Lisa Hunt

Group General Manager Australia

Disclaimer: *While the conclusions show specific dollar amounts for costs and benefits, these must be considered in the context of the range of inputs and assumptions noted within the report. Sources of derived information are from publicly available sources. It is important to emphasise that the methodology, investigations and conclusions contained within the study have been under the complete control of the authors. Transurban has not independently verified the reasonableness of the assumptions nor the calculations referred to in the Report. Accordingly, Transurban does not provide any assurance that the forecasts, estimates or projections set out in the Report will be realised.*

Contents

1. Summary

Today there are nine toll roads in Sydney that form the Sydney toll road network. This report provides an overview of the outcomes of our study into the economic contribution of Sydney's network of toll roads to New South Wales (NSW) and Australia. This reflects not only an analysis of the direct benefits and costs of the nine toll roads as a connected network, but further explores the socio-economic impacts on the wider community.

1.1 Key findings

- **Contribution of Sydney's toll road network to the NSW economy.** Sydney's network of toll roads has been:
  - increasing Gross State Product over time, ranging from $1.6 million in 1986 to $3.4 billion in 2020 (or 0.89% of NSW GSP), by increasing real private consumption, real investment and overseas trade.
  - increasing employment over time, ranging from an additional 100 jobs per annum in 1986 to 4,000 jobs per annum in 2020.
- **Contribution of Sydney's toll road network in comparison with other infrastructure investments.** The contribution of Sydney's toll road network to the NSW economy is comparable in size to the economic contribution of Sydney's Port Botany container terminal and around 1.5 times the economic contribution of Port of Melbourne (evaluated on a 2007 individual year net economic impact basis).
- **Direct benefits of Sydney's toll road network.** The primary direct benefits from toll roads include: travel time savings; vehicle operating cost savings; and reduced accidents and vehicle emissions.

Our review and recalculation of the total economic contribution of Sydney's toll road network indicated a net present value of $22.7 billion, approximately 15% greater than the sum of the initial valuations undertaken as part of the Environmental Impact Statements (EIS). Our recalculation of the direct benefits of Sydney's toll road network takes into account a range of factors including:

- **Higher than forecast traffic flows.** Actual traffic flows were around six percent higher than the original EIS forecasts. This resulted in an overall increase in the value of the following benefits:
  - vehicle operating cost benefits (+ 20%)
  - travel time savings (+19%)
  - accident reduction benefits (+41%)
- **Higher than forecast environmental benefits.** By appropriately accounting for the environmental implications of Sydney's toll road network it was calculated that the environmental benefit, associated with minimising greenhouse gas emissions and noise is $1.1 billion which represents an 83% increase on initial assessments.
- **Higher than forecast costs.** Actual capital costs were 33% higher than forecast and actual operating and maintenance costs were 30% higher than forecast. These higher costs partially offset the additional benefits arising from the higher than forecast traffic flows.
- **Increased congestion costs in the future.** When recalculating the direct benefits arising from toll roads, we have taken into account the extent to which increased congestion of toll roads in the medium to longer term is likely to reduce the benefits derived by users of those toll roads.

The total economic contribution of Sydney's toll road network to the NSW economy was calculated as a net economic present value of $22.7 billion.

- **Additional external benefits of Sydney's toll road network.** Traditional evaluation methods have mainly concentrated on the direct benefits and costs of toll roads. The study has found that there are a number of net external benefits that had not been accounted for, largely due to the difficulty of quantifying those net benefits. These external benefits include:
  - **Network benefits** – the direct benefits that current and potential road users derive from an expansion in the geographic coverage of the network, which provides accessibility to new places by vehicle (i.e., the value of the option of being able to use the road). These benefits include improved operability within the network where greater connectivity enables current and potential users to reach their destinations more efficiently. The results of the study estimated that network benefits, relating to improved connectivity, business and residential development, and employment opportunities were in the order of $600 million in 2007 growing to $900 million in 2020.
  - **Economy-wide benefits** – the indirect benefits to the community include:
    - The establishment of the toll road network has been a major enabler of significant socio-economic change including population expansion by facilitating improved access to areas of employment, industrial and commercial change.
    - The provision of a robust network provides reduced accidents and congestion, which in turn produce the benefit of increased reliability of deliveries for businesses with improved productivity from reduced time delays.
    - Facilitation of new residential development areas and impacts on property prices for existing residential areas.
    - Our study identified, but did not value, additional net benefits to the community from the use of private finance, including toll revenue, rather than public finance to fund road construction and maintenance. In particular, the use of private finance can enable the earlier construction of toll roads than would be possible under more traditional, publicly funded, approaches to procurement.

1.2 Study considerations

When completing the study several key issues were identified that require further examination and investment:

- **Scope for increased integration of toll roads with public transport**, such as bus lanes and park and ride stations.
- **Use of toll roads to facilitate long-term urban planning, renewal and development.**
- **Social equity and efficiency of tolls currently charged for road use.** Consideration needs to be given to the inequities and inefficiencies inherent in the current structure of tolls charged for road use. In some cases users are paying distance based levies while other users are paying a constant price, regardless of distance travelled.
- **Opportunities to improve the efficiency of toll road operations and asset utilisation to improve economic outcomes.** This might include road widening and cashless toll collection systems.
- **Need for consistency in the application of economic evaluation techniques.** In reviewing the results of previous studies it was found that there were inconsistencies between methodologies, largely linked to the exclusion of externalities such as environmental costs e.g., those arising from vehicle emissions. Further technical issues linked to ensuring like ranges of benefits are quantified and consistency in the calculation of the Benefit Cost Ratio (BCR) should also be addressed[1].

1.3 Recommendations

Key areas for further research – this study has also identified some key areas which would benefit from further research that include:

- **Improved traffic forecasts.** Our review of traffic forecasts and discussions with stakeholders indicate deviations between the original EIS forecast traffic volumes and actual volumes. Improved traffic forecasts would assist and improve efficiencies in the bidding process for projects and in the final outcome (e.g., as air quality and traffic congestion).
- **Quantification of the economic costs of traffic congestion.** Traffic congestion impacts not only upon the private and commercial motorist, but has the potential to reduce operational efficiency in the economy. Regular review and forward planning providing a multi-modal response, would minimise the impact of congestion, protecting the competitive positioning of Sydney.
- **Quantification of the network benefits of toll roads.** While there is general acceptance of the principle of an integrated transport network, comprehensive research is needed on the quantification of the benefits to the economy, including approaches to avoid duplication. This research would include identifying the ultimate impact of network benefits on the competitiveness of industry and its associated economic growth.
- **Environmentally sustainable development of toll roads.** The growing importance of climate change and environmentally sustainable development has brought with it a need to investigate further the inclusion of sustainability measures into all infrastructure provision.

[1] ATC (2006) National Guidelines for Transport System Management in Australia. Prepared by the Australian Transport Council 2006.

2. Toll roads in Sydney

2.1 The history

Toll roads are not new to Sydney. The first toll way (bridge) was constructed over 200 years ago in 1802 when tolling was used to finance the construction of a bridge over South Creek at Windsor. In 1811, the first major toll road was opened and included 16 miles of the Hawkesbury road with turnpikes (collection stations) located in the city, adjacent to what is now Central Railway station and near Parramatta. A second turnpike linking Parramatta and Windsor was opened in November 1812.

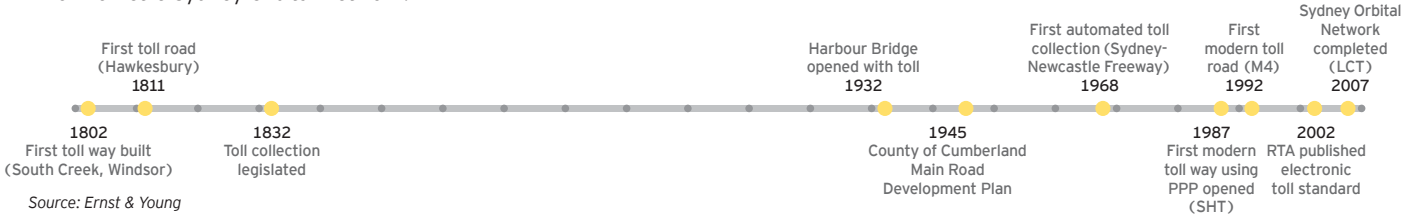
In 1832 toll collection was officially regulated through a Turnpike Act that enabled provision for toll collection on parish or local roads. This was deemed necessary to provide repairs to frequently used local roads, since all available road funding was allocated to the main arterial roads. The Harbour Bridge had tolls charged from its opening in 1932, with the toll collected manually from stations at the northern end (see Figure 1). The first automated, cash based, toll collection was carried out on the Sydney-Newcastle Freeway in 1968, followed by the Harbour Bridge in 1970.

In 1987 the Sydney Harbour Tunnel became the first modern toll road to reach financial close (using a Public Private Partnership model). In May 1992 the M4 became the first toll road to be completed, with the Sydney Harbour Tunnel and M5 (South Western Motorway) following later in the same year. The most recent toll road to be completed was the Lane Cove Tunnel in 2007, which provided the last link in the 110 kilometre Sydney Orbital Network.

Figure 1: Toll collection on the Sydney Harbour Bridge (1932)

Source: State Records NSW (13 April 1932)

Sydney, through the NSW Roads and Traffic Authority (RTA), has led the way in interoperable toll services, publishing an electronic toll system standard in 2002. The Harbour Bridge, Harbour Tunnel, Eastern Distributor and M5 were working on an interoperable (e-tag) system in 2002, which extended to the M4 in February 2003. Further enhancements have been made to this system with the provision of a safefile transfer gateway, developed by the NSW RTA, which further extends the interoperability throughout the Australian eastern seaboard (coordinating the electronic tag systems of Sydney, Melbourne and Brisbane).



Source: Ernst & Young

2.2 The Sydney Orbital Network

The Sydney Orbital Network has its origins in the County of Cumberland Planning Scheme (CCPS) developed in the early 1950s, which represented the first Government acknowledgement of the need for formal planning[2]. The scheme was dominated by a proposed series of radial roads, which lay the foundations for future motorway development.

The focus was to "redistribute and reorganise living, working and recreational centres throughout the whole of the Cumberland Plain – from the Hawkesbury to Austinmer (north of Wollongong), Penrith to the sea".[3] Plans recognised the transport problems associated with a growing population in the suburbs and focused on creating business and commercial centres away from city areas, whilst acknowledging that the majority of commerce, trade and recreational activities were city based.

In 1987-88 the Department of Main Roads (now RTA) developed *Roads 2000* that put forward a vision for Sydney's road system to the year 2000. *Roads 2000* predicted that the majority of traffic growth would be in the South and North West and that there would be an increasing need to supply infrastructure for East West traffic movement between the growing and already established areas of Sydney. It aimed to achieve an expanded road network to growth centres such as the South West region and major new freeways linking the new areas to the industry, employment and recreation facilities of established Sydney. A key component of *Roads 2000* was the Orbital Network, linking all major incoming highways in a bypass route around the city.

The Sydney Orbital Network is based on six toll roads and short sections of inter-connecting freeways. In addition, there are a number of other toll roads/freeways that form part of the greater Sydney network. These are included in Table 1.

Table 1: Sydney Orbital Network and interconnecting roads

Toll road	Interconnecting/linking freeway(s)
Sydney Orbital Network	
M1 Eastern Distributor	Southern Cross Drive, General Holmes Drive and M5 East
M5 South West Motorway	
Westlink M7	
Hills M2	
Lane Cove Tunnel	Gore Hill Freeway and Warringah Freeway
Sydney Harbour Tunnel	(or Sydney Harbour Bridge and Cahill Expressway)
Other major Sydney roads	
▸ M4 (Strathfield to the Blue Mountains)	▸ F3 Freeway (Sydney to Newcastle)
▸ Cross City Tunnel (Sydney eastern suburbs to the Inner West and Cahill Expressway/Sydney Harbour Tunnel)	▸ King Georges Road, Princes Highway and Southern Freeway (Sydney from the South West Motorway to Wollongong)
▸ Hume Highway (Sydney to Canberra)	

Source: NSW RTA

[2] Broomham (2001)
[3] Broomham (2001), pg 138

The location of each of the toll roads and primary interconnecting roads are shown in Figure 2.

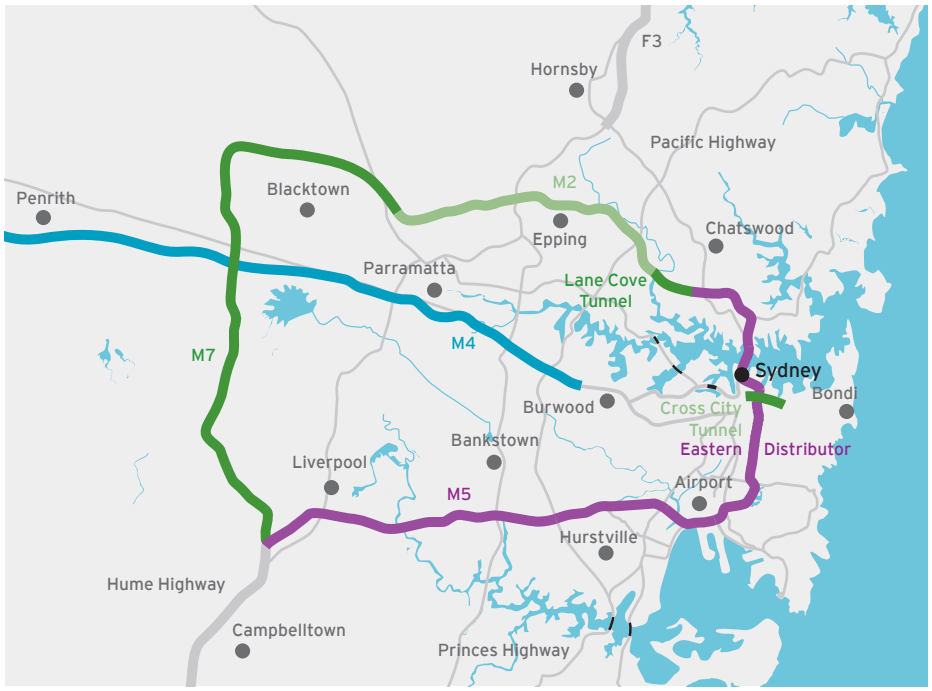
Although, in total there are nine toll roads which make up the Sydney toll road network, eight of these are the primary focus of this report. The Harbour Bridge is the exception, as was considered outside the scope of this study. Brief details on each of the toll roads included in the study are attached as Appendix A.

2.3 Community views on toll roads

Historically, community views on toll roads differ considerably. Views range from strong support from motorists who have experienced the benefits of using those roads, through to significant opposition from sections of the community who believe toll roads do not provide a sustainable solution to Sydney's transport problems, based on a perception these roads eventually become congested. The divergence of views is reasonable given that each section of the community tends to view the toll roads in terms of their own individual, readily observable benefits and costs incurred, without recognition for the benefits and costs to the wider community which are far more difficult to observe and quantify. These include the benefits that the community derives from the expansion of the existing road network, such as reduced cost of goods and services arising from more efficient transportation.

It is these less readily observable benefits and costs that are not often recognised in studies. This lack of recognition can give rise to misleading interpretations of the true benefits and costs of toll roads. These total benefits and costs form the key focus of this study.

Figure 2: Sydney's toll roads (in Sydney's Orbital Network)



Source: Transurban

3. Study objective and methodology

3.1 Study objective

The objective of this study is to examine the economic contribution of Sydney's network of toll roads to NSW and Australia. In particular, this study seeks to take a broader view of the economic contribution of Sydney's toll roads by looking beyond the obvious direct benefits and costs to some of the less recognised but equally important benefits and costs to the wider community. These include areas such as network benefits, economy-wide impacts and improved financing efficiency.

This report reassesses the direct and indirect benefits and costs of Sydney's toll roads with a view to determining the extent to which the original evaluations under or overestimated the net benefits arising from those toll roads by updating the original estimates for known actuals and by examining some of these commonly overlooked impacts of Sydney's toll roads.

While this report was commissioned by Transurban, the study was undertaken independently by Ernst & Young.

3.2 Methodology

In order to assess the contribution of Sydney's network of toll roads to the NSW and Australian economies, Ernst & Young has sought to extend the traditional approach used to evaluate the benefits and costs of investment in toll roads to include consideration of both the direct and indirect benefits and costs of toll roads. Our methodology involved:

- Reviewing and adjusting the results of the original benefit-cost analysis of each toll road to be able to evaluate the individual toll roads as a network.
- Extending and updating those original benefit-cost analyses based on the most up-to-date data publicly available. The approach maintained the consistency of the identification and quantification of additional benefits and costs of toll roads.
- Using a general equilibrium model to estimate the broader network and economy-wide net benefits arising from the construction and use of toll roads.

The study methodology included stakeholder consultations with State and local government, regional development organisations, industry organisations, toll road operators and owners, and other private sector organisations. Industry and socio-economic data was analysed to demonstrate the impact of the toll roads on households and businesses along with the output from an industry survey conducted by Ernst & Young.

3.3 Report outline

The remainder of the report is structured as follows:

- Section 4 compares the approaches adopted in the past when assessing the benefits and costs of toll roads.
- Section 5 updates past studies to reflect current evaluation techniques and actual results rather than the forecasts completed at the time of the inception of the toll road.
- Section 6 extends the evaluation to include a consideration of quantifiable network benefits along with the economic benefits and costs of using general equilibrium modelling.
- Section 7 considers the qualitative socio-economic impacts based on the demonstrable experience of the Sydney Orbital Network.
- Section 8 highlights a number of key issues for further consideration in the future development of toll roads along with areas for further research to improve toll road economic evaluations going forward.

Figure 3: Study process

4. Approaches to assessing the benefits and costs

Economic assessments of toll roads, along with any major infrastructure in NSW, are included in Environmental Impact Statements (EIS) that support the Government's decision to either approve or reject the construction of a toll road. Traditional economic assessments of toll roads have focused primarily on the direct benefits and costs of those roads for toll road operators and users.

4.1 Direct benefits and costs

The direct benefits are those that toll road users are expected to derive from the use of those toll roads, which include reductions in vehicle operating costs and travel time savings due to improved traffic flow and reductions in road congestion. The direct costs estimated under traditional evaluations are incurred by toll road operators in the course of constructing and operating those toll roads.

4.2 Indirect benefits and costs

Only a small number of the original EIS economic evaluations for the Sydney toll road network have considered some of the net external benefits arising from the construction and use of the toll road, such as the net benefits arising from a reduction in accidents and environmental damage. Other important net external benefits arising from the construction and use of toll roads have not been taken into account, largely because of the problems associated with quantifying those net benefits.

Table 2 below provides an assessment of the benefits and costs that were included in the EIS economic evaluations of Sydney's toll roads. As demonstrated, the range of benefits and costs included has become more comprehensive as techniques for completing economic evaluations in EIS has developed.

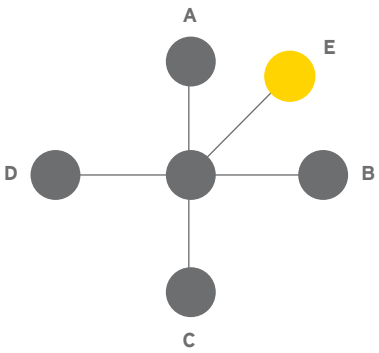
Table 2: Consistency of evaluation of benefits and costs

			SHT*	M5	M4	M2	ED*	CCT*	M7	LCT*
Benefits										
Direct benefits	Direct benefits derived by toll road operators	Toll revenue	√	√	√	√	√	√	√	√
		Economies of scale and scope	√	√	√	√	√	√	√	√
	Direct benefits derived by toll road users	Travel time savings	√	√	√	√	√	√	√	√
		Vehicle operating cost savings	√	√	√	√	√	√	√	√
		Accident cost savings	–	–	–	–	√	√	–	√
		Environmental cost savings	–	–	–	–	√	√	–	√
	Direct external benefits derived by all transport users		–	–	–	–	–	–	–	–
Indirect benefits	Indirect external benefits arising from reduced transport costs		–	–	–	–	–	–	–	–
	Indirect external benefits arising from reduced congestion and accidents		–	–	–	–	–	–	–	–
	Indirect external benefits arising from reduced enviromental costs		–	–	–	–	–	–	–	–
	Indirect external benefits arising from the use of more efficient finance		–	–	–	–	–	–	–	–
Costs										
Direct costs	Direct costs incurred by toll road operators	Capital costs	√	√	√	√	√	√	√	√
		Operating and maintenance costs	√	√	√	√	√	√	√	√
	Direct costs incurred by toll road users	Tolls	√	√	√	√	√	√	√	√
		Vehicle capital costs	√	√	√	√	√	√	√	√
		Vehicle operating costs	√	√	√	√	√	√	√	√
		Accident damage caused by the individual toll road users	√	√	√	√	√	√	√	√
	Direct external costs incurred by toll road users	Congestion costs	–	–	–	–	–	–	–	–
		Accident damage caused by other toll road users	√	√	√	√	√	√	√	√
		Environmental costs incurred by toll road users	–	–	–	–	–	–	–	–
Indirect costs	Indirect external costs arising from congestion and accidents		–	–	–	–	–	–	–	–
	Indirect external costs arising from environmental damage		–	–	–	–	–	–	–	–
	Indirect external costs arising from inefficient tolls		–	–	–	–	–	–	–	–

Source: NSW RTA Environmental Impact Statements

* SHT= Sydney Harbour Tunnel, ED = Eastern Distributor, CCT = Cross City Tunnel, LCT = Lane Cove Tunnel

Figure 4: Network impacts concept



Source: Ernst & Young

Where possible, this study has attempted to include the benefits and costs not included in the initial EIS economic studies.

Even if a toll road becomes congested, it can still generate significant net benefits for the overall community if the positive network benefits and real resource cost reductions arising from the construction and use of those toll roads are sufficiently high to offset the increased congestion costs.

In particular, past evaluations have not taken into account the positive network externalities generated by toll roads, nor the net benefits that other sections of the community indirectly derive from the construction and use of toll roads.

Network externalities generated by toll roads include the direct external benefits that existing and potential toll road users derive from the addition of a new toll road to the road transport network. Adding a new toll road to the existing network increases the value of the road network for all existing and potential road users by increasing the geographic size of the network, increasing the number of locations that toll road users can access. Figure 4 describes the network impacts of the establishment of a new road. If road E is built it benefits the users at E. It also has implications for individuals at nodes A, B, C and D. These impacts can be through use, but also arise because of the option to use the road and access the new destination.

The value of the network is also increased with improvements to the vehicle carrying capacity of the network, increasing the total volumes of users who can gain access to those locations.

The addition of a new toll road increases the overall value of the transport network to all transport users by expanding the range of transport options available to users even if they never use the toll road to gain access to those additional transport options.

However, the addition of a new toll road may have direct external costs, such as congestion costs and accident costs, (i.e., negative network externalities) which may be incurred by toll road users which tends to reduce the direct benefits e.g., time savings, that individuals and businesses derive from their use of toll roads.

Indirect external community net benefits resulting from the construction and use of toll roads include the increase in economic activity brought about by an expansion in the transport network and a reduction in the cost of transport. These net benefits include the impacts that arise from the development of new residential areas and new industry clusters.

Indirect external community net benefits also arise from reductions in accidents and traffic congestion and reductions in the environmental costs associated with toll road construction and use.

Finally there are indirect external net benefits arising from the use of private finance to fund the construction and operation of toll roads. This replaces the annual appropriations of government revenue financed through State or Federal Government tax revenue or borrowing i.e., raising taxes in the future to repay loans.

4.3 Funding for transport infrastructure

The indirect external impacts arising from the use of private finance over public finance have not been adequately considered in traditional economic evaluations of toll roads.

In this case private finance refers to the use of privately raised funds rather than general taxation revenue to procure the road and user charges (tolls) to repay the debt and/or equity used to finance the project. The indirect external impacts are outlined below:

- The net benefits the community derives from bringing forward the construction of the toll road. Private financing has enabled toll roads to be completed and opened to the public significantly earlier than under traditional procurement methods.
- Improved equity with which road funding is raised by spreading the costs over the current and future generations of road users, although toll roads financed via public funds also experience this benefit.
- The benefits NSW derives from inter-state investment in its toll roads less the interest, dividends, loan repayments and repatriations of profits to any inter-state investors in the toll roads.
- The benefits Australia derives from foreign investment in its toll roads, less any interest, dividends, loan repayments and repatriations of profits to non-resident investors in the toll roads.
- Improved risk management as risks are borne by investors rather than taxpayers.
- Releasing public funds for investment in the provision of other essential services.

In addition to the above, the use of private finance and tolls to finance the construction and operation of roads helps to avoid the costs that the community would otherwise have to incur if those roads were publicly funded from taxation revenue. It is important to realise that the tax system does not simply redistribute revenue within the economy. Rather, in the course of raising and redistributing revenue, the tax system has the unintended effect of distorting decisions to save, invest, produce and consume. This imposes a cost on the community by encouraging a less efficient use of the community's resources. These costs of taxation (referred to as deadweight costs of taxation) are avoided through the use of private finance, including toll revenue, to finance the construction and maintenance of roads. Publicly funded toll roads also experience deadweight costs as a result of tax distortions.

While the deadweight costs of taxation are avoided using private finance, these are partially offset by the potential deadweight costs from the use of a toll road (where the toll does not take into account relevant social costs such as the costs of pollution, road damage by heavy vehicles or congestion during peak hours). While a toll may satisfy the financial requirements for a return on investment, the level of the toll may not match the social costs of operating the toll road. Publicly funded toll roads also experience a similar deadweight cost as a result of a mismatch between the toll levels and the social marginal cost of the use of the toll road.

Therefore, although there are external benefits associated with the use of private finance to fund the construction and operation of toll roads, there are also external costs which tend to partially offset these benefits.

The exclusion of these other external benefits and costs from evaluations of proposed toll roads inevitably means that there is a risk that the original evaluations either under or overestimated the potential net benefits arising from the construction and use of these toll roads. In particular, there is a risk that the exclusion of the potential network benefits arising from the use of toll roads and the indirect benefits of toll roads to the wider community, could have significantly underestimated the potential net benefits arising from Sydney's toll road network.

Adding a new toll road to the existing network increases the value of the road network for all existing and potential road users.

5. Valuation of the direct benefits and costs

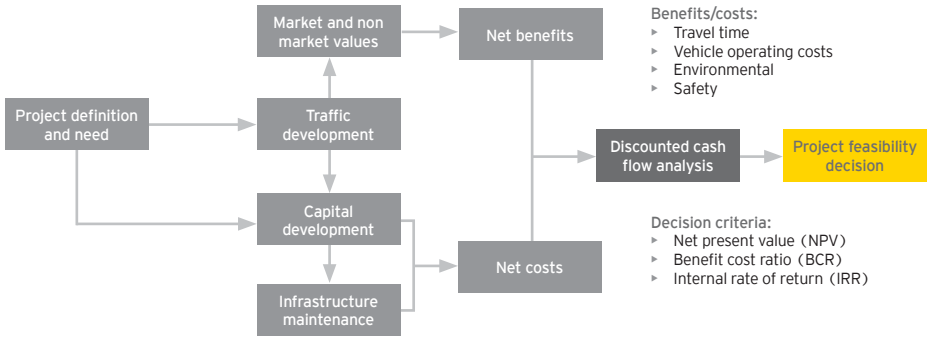
As discussed in Section 3, a three-part process was used to determine the direct benefits and costs of the NSW toll road network. This section presents the results of that process, shown in Figure 5.

- **Establishing the investment decision benefit-cost outcomes** for the original economic study, produced typically as part of the Environmental Impact Statement (EIS) process (Section 5.1).
- **Updating and re-evaluating the benefit-cost studies** based on changes in traffic and operating conditions and through the inclusion of actual costs of construction and operation (Section 5.2).
- **Extending the benefit-cost studies** to include any variables that may not have been included in the initial EIS process, in particular, environmental impacts such as air quality, noise impacts and greenhouse gas (ghg) emissions (Section 5.3).

The construction of a benefit-cost study for a road development typically follows the process shown in Figure 6. The process involves capturing the market and non market capital and operating benefits and costs in order to determine project feasibility[4].

Figure 5: Net benefits methodology

Figure 6: Road user cost benefit analysis process



Source: Ernst & Young

[4] Using Net Present Value (NPV), Benefit Cost Ratios (BCR) and Internal Rate of Return (IRR) as decision criteria.

5.1 Investment decision benefit-cost outcomes

The first part of the analysis involved establishing the investment decision benefit-cost outcomes, produced as part of the original EIS studies, which support the Government's decision to approve the construction of a particular road. For comparability the benefit and cost estimates were updated to 2007 values.

5.1.1 Direct costs incurred by toll road operators – capital costs

One of the most obvious costs associated with toll roads are the capital costs of construction. For the purpose of the analysis, all costs of construction were brought up to current prices, inflation adjusted. The NPV of the capital investment, adjusted for 2007 dollars, was estimated at $5.7 billion.

5.1.2 Direct costs incurred by toll road operators – operating and maintenance costs

Toll road operators also incur ongoing operating and maintenance costs associated with the day-to-day running of a toll road including, but not limited to, toll operating systems and infrastructure, pavement maintenance, maintenance of areas immediately surrounding the road (such as grassed areas) and operating and traffic management systems.

Estimates of the operation and maintenance costs based on the original EIS studies adjusted for 2007 values are $1.4 billion in NPV terms.

5.1.3 Direct net benefits derived by toll road users

There are three main quantifiable direct benefits that can arise from the establishment of a new toll road. The quantifiable net benefits, largely based on resource costs, have traditionally included:

- **Travel time savings** – measured as the total travel time saved multiplied by an explicit value of time. The time value differentiated between private individuals, business (operators) and freight consignees.
- **Vehicle operating cost (VOC) savings** – the VOC savings or costs are calculated based on standardised per kilometre vehicle costs, adjusted for estimated average vehicle speed, and differences in vehicle kilometres travelled.
- **Avoided accident costs (accident savings)** – standardised (published) values for accidents are estimated based on historical estimates of costs for a range of fatal injury, serious injury or other injury categories. The costs are differentiated by road type and vehicle class. Accident cost savings are generally linked to travel on safer, better designed roads and reduced kilometres travelled (where applicable).

The original valuations of road user benefits and costs have been converted into 2007 values to give an indication of the forecast benefits of the Sydney toll road network in current dollar terms. The direct benefits estimated for toll road network users and any flow on benefits to the overall road network, in terms of reduction in traffic on other roads, such as local roads, are:

- $21.0 billion in travel time savings.
- $3.7 billion in vehicle operating costs.
- $1.0 billion in accident reductions.

5.1.4 Direct costs incurred by toll road users and direct benefits for toll road operators

One of the obvious costs associated with using a toll road is the toll that must be paid. In the traditional road user economic study, the impact of the toll on road users and on toll road operators is not considered from an economic perspective. The standard argument for the adoption of this approach is that tolls are simply a transfer from one economic agent to another and do not result in a net change in economic welfare. However, there are additional benefits and costs associated with the use of tolls that should at least be recognised. These benefits and costs of using tolls to finance roads are considered in the next stage of the analysis, where the initial evaluations are updated and re-evaluated.

5.1.5 External costs borne by toll road users

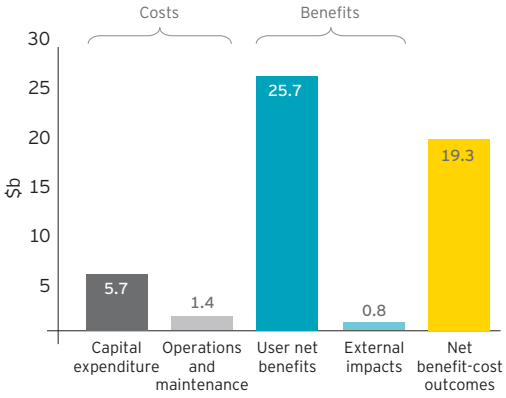
Toll road users do not just bear the costs arising from their own use of the road. They also bear some of the external costs arising from the actions of other toll road users. The provision of toll roads is generally accepted to reduce the level of these external costs through reduced emissions, congestion and accident damages.

In the initial studies undertaken for the economic justification of Sydney's toll roads, only three of the toll roads included external, or non-user, impacts such as environmental impacts. The external cost value, in NPV terms, when converted to 2007 dollars is valued at approximately $800 million over the course of the evaluation period. In this section of the report, environmental impacts are calculated for all toll roads. No additional analysis has been done on the remaining external impacts as they tend to be road/location specific and outside the scope of this study.

5.1.6 Initial benefit-cost summary outcomes

The original toll road network evaluations were undertaken as separate (incremental) analysis rather than as an overall network analysis. In order to consolidate these for the purpose of valuing the network as a whole, the individual toll road results, taken from the EIS studies, were converted to 2007 values and aggregated. Based on the initial investment and traffic information, the total network value was calculated to be **a net present value of $19.3 billion**.

Figure 7: Initial benefit-cost summary outcome



Source: Ernst & Young analysis

5.2 Estimated actual net benefits: updating and re-evaluating the benefit-cost studies

The next step in the research was to consider whether the original estimates (as detailed in Table 3 in sub section 5.3) were realised after the toll road was constructed and became operational. The extension of the existing benefit-cost studies to take account of actual performance, where known, involved the following adjustments:

- Updating the existing traffic modelling outcomes for actual traffic realised since the opening of the toll roads.
- Adjusting the economic benefits and costs experienced by road users depending on whether the road being considered had experienced higher or lower traffic levels.
- Inputting actual capital and operating costs where they differ from those that were planned.
- Undertaking an assessment of congestion effects based on changes in traffic levels.
- Converting into 2007 dollars in order to allow comparisons across the road network.

5.2.1 Updated traffic data

Traffic estimates used in the revised analysis were based on actual levels of traffic on toll roads supplied by toll road operators, the RTA or were obtained from other publicly available sources. To update the traffic modelling, used in the calculation of the original benefit-cost studies, the actual traffic results were compared with the forecast traffic levels used in the EIS data and analysis. The percentage change across the years of actual operation was calculated. These percentage changes were then applied to the traffic inputs of the benefit-cost model, as the traffic forecasts are the major driver of the benefit and cost streams of the road

The original toll road evaluations produced at the EIS phase estimated a net economic present value to the economy of $19.3 billion when updated to 2007 dollar values.

user benefit-cost analysis. This method of updating the traffic numbers for actual and forecast traffic levels, outlined above, was considered to be the most appropriate approach to traffic revision. A more definitive outcome could only be achieved by undertaking detailed network traffic modelling.

Figure 8 shows the average percentage change in traffic over the evaluation period, when the actual levels of traffic are compared with the modelled forecasts used in the initial investment decision economic study.

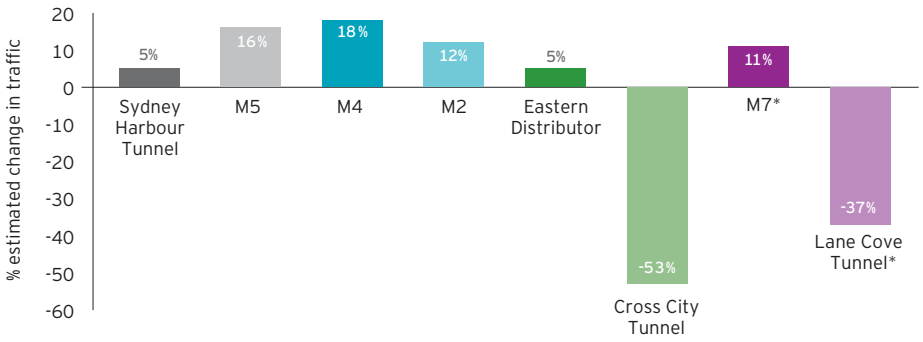
A review of the EIS traffic forecasts relative to actual traffic numbers for most of Sydney's toll roads, in Figure 8, indicate that there have been deviations that were not considered in the original planning for the toll roads. Factors that may have influenced changed traffic patterns include population and income shifts and changes in demand elasticities for toll road use as acceptance and understanding increases. These factors combined have contributed to significant deviations of actual from estimated demand.

The deviations of planned from actual traffic volumes may result in:

- The selection of non-preferred design options, resulting in a less efficient and equitable toll road outcomes.
- Decision makers being provided with incomplete information to be able to evaluate complementary or supplementary transport infrastructure needs and answer questions such as:
  - How should public transport be linked in with the new toll road infrastructure?
  - How will the toll road impact upon alternatives such as provision of rail infrastructure?
  - Should there be associated park and ride/kiss and ride facilities provided at nearby public transport interchange points?
  - How many lanes should there be and what are the options for future expansion?
  - How will alternative traffic routes be impacted?
- Detrimental impacts for air quality and traffic congestion on surface streets following construction, particularly where the traffic numbers are in excess of those used in the design parameters.

Further to this, where the traffic figures are used during financing discussions there may also be impacts on the bidding process that could influence the level of fees paid and toll charged and ultimately the financial viability of projects.

Figure 8: Adjustment in traffic levels based on actuals



Source: NSW RTA, Transurban and the NSW Auditor General, Connector Motorways and media reports.

* It should be noted that as the Westlink (M7) and the Lane Cove Tunnel (LCT) are still relatively new toll roads, the traffic levels shown in Figure 8 may not necessarily represent the long term trend traffic levels. Consequently, these numbers were not used in updating the benefit streams in the subsequent analysis, only using the original EIS modelled inputs.

5.2.2 Direct capital costs of toll roads

To update the direct capital cost inputs, a review was undertaken on the actual level of capital expenditure involved in constructing Sydney's toll road network. This information was obtained through a variety of sources including the RTA, toll road operators and other NSW government agencies, such as the Treasury and the Department of Planning.

The NPV of actual expenditure on the Sydney toll road network is estimated at $7.6 billion in 2007 dollars. The actual total expenditure on capital was 33% greater than the planned capital expenditure contained in the initial economic evaluations. The difference between actual and planned capital expenditure across the individual toll roads ranged from -40% to +85% across the toll roads.

The results show most toll road developments have eventually required a higher capital cost than was initially included in the EIS economic studies. EIS studies are conducted at the approval stage. After the approval stage of the assessment the project typically goes through a design and construction phase, either privately or internally within government. At this time the project budget is set, and in the case of private construction, project contracts are agreed. There is often a difference between the cost assessments at the EIS stage and the detailed costing/ bid process due to scope or time changes. This is not a surprising result given the nature of planning and the possibility for contingencies to arise during the final design and construction process.

5.2.3 Direct costs incurred by toll road operators

The operating and maintenance cost component of the benefit-cost studies have been updated using actual cost data from toll road operators. Where actual information was not available the operating and maintenance costs were adjusted based on changes in traffic volumes.

The initial investment decision valuations for operating and maintenance direct costs were NPV $1.4 billion in 2007 dollars. When adjusted for actual results or changes in traffic volumes, the NPV of those costs increase to $1.9 billion over the evaluation period, an increase of approximately 30% over the initial economic evaluations.

5.2.4 Direct net benefits derived by toll road users

The net user benefits have been updated using the difference in actual and EIS planned traffic volumes.

The updated valuations were then converted into 2007 dollars to produce the following outcomes:

- vehicle operating cost savings of $4.4 billion, an increase in benefits of 20%;
- travel time saving savings valued at $24.9 billion, an increase in benefits of 19%; and
- accident reduction benefits valued at $1.4 billion, an increase of 41%.

It is generally understood that traffic growth results in increased congestion. Where a toll road has experienced more than 10% growth in traffic levels (over the modelled EIS traffic forecasts used in the original economic assessments), a congestion factor of 25% was applied to account for the reductions in overall user net benefits caused by the increased congestion. In other words, the congestion factor limits the growth in user benefits in recognition that there may be some reduction in the transit time savings, for example. This congestion impact has not been applied to the accident cost savings since these savings already account for congestion.

5.2.5 Direct costs to toll road users and direct benefits to toll road operators

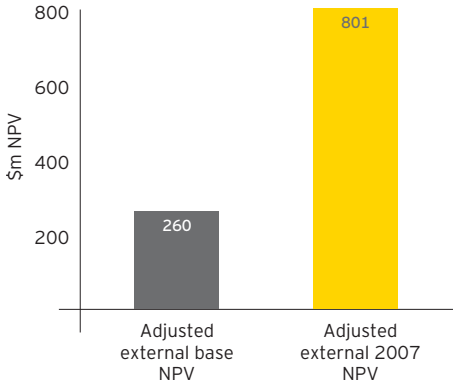
The application of tolls to a road network does not simply redistribute revenue from one section of the community to another, which is the common assumption made when assessing the effect of tolls on the economic benefits and costs of a road investment. Rather, in the course of redistributing that revenue, a deadweight cost is imposed on the community.

For example, to raise sufficient revenue to fund the high cost of constructing a new toll road, it may be necessary to charge road user tolls that exceed the efficient price of using those toll roads i.e., above the perceived benefit they receive from use. This may have the unintended effect of discouraging some motorists from using those roads, reducing the efficiency with which the economy operates. As noted previously, where a toll road is funded by taxation, these deadweight costs of using tolls to raise revenue are replaced by the deadweight costs of taxation, a cost that would normally be greater. The deadweight costs associated with tolls or taxation to raise revenue have generally been ignored in previous evaluations of the net benefits of toll roads.

5.2.6 External costs borne by road users

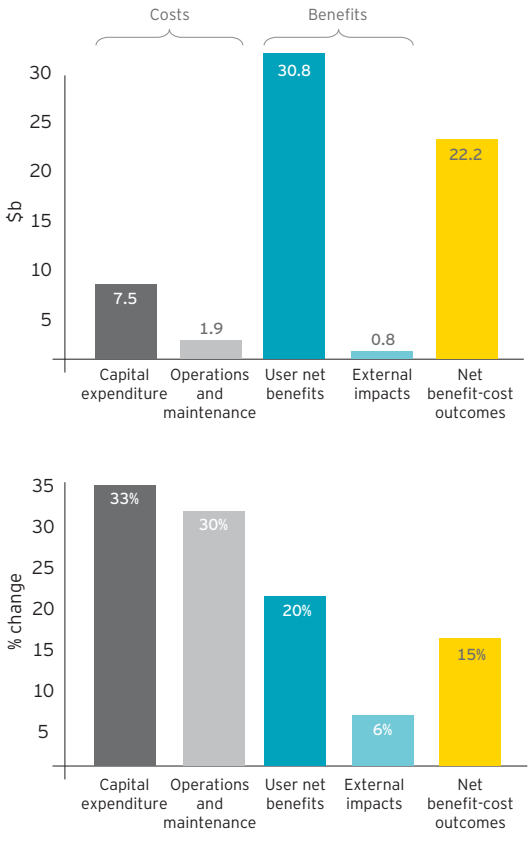
In the initial evaluation, only three of the toll road economic studies included a valuation for external impacts. These external impacts included environmental impacts, property values and public transportation impacts. Based on the actual traffic levels, the external impacts not including environmental, which is undertaken later in this Section, were updated. Figure 9 shows the updated level of external impacts in evaluation dollars and 2007 dollar values.

Figure 9: Adjusted external impacts – updated for traffic and time



Source: Ernst & Young analysis

Figure 10: Benefit and cost summaries – updated outcomes and rates of change



Source: Ernst & Young analysis

5.2.7 Updated benefit-cost summary outcomes

Using the updated benefit-cost studies, the following inputs into the network and broader economic impacts have been captured and are presented in Figure 10. The values of the inputs in 2007 dollars are:

- Capital expenditure costs of $7.5 billion, a 33% increase on the initial investment decision capital expenditure. This difference in capital expenditure is typically the result of changes in design and construction parameters that occur between the planning stage (EIS) and the eventual bid process for road development, rather than being a function of cost overruns.
- Operating and maintenance costs of $1.9 billion. A 30% increase on the initial investment assessment.
- Net user benefits of $30.8 billion, a 20% increase, based on increased traffic volumes, on the initial investment decision forecasts, using the toll road networks. Even with increased congestion the user benefits are estimated to be greater than planned.
- External benefits of approximately $800 million an increase over the initial studies of 6%.

The net benefit outcome under the updated analysis is $22.2 billion. The outcomes of the updated analysis and the rates of change between the original valuations and the estimated actuals are presented in Figure 10.

5.3 Extending the benefit-cost studies

The next step of the study involved extending the original benefit-cost studies to include some of the variables that have either been inconsistently included, or not included, in previous benefit-cost studies of toll roads. The increased understanding and importance of environmental issues is one of the more significant changes to the economic evaluation of roads in recent times.

Table 3 shows the included and excluded variables contained in the original investment decision benefit-cost studies.

Table 3: Inclusion and exclusion of variables

	SHT	M5	M4	M2	ED	CCT	M7	LCT
Operations and maintenance	✓	✓	✓	✓	✓	✓	✓	✓
Travel time savings	✓	✓	✓	✓	✓	✓	✓	✓
Accident cost savings	✓	✓	✓	✓	✓	✓	✓	✓
Environmental impact savings	x	x	x	x	✓	✓	✓	✓
Other impacts	x	x	x	x	✓	✓	x	x

Source: Ernst & Young analysis

The environmental variables have been calculated and included in the benefit-cost assessment of the toll road network. The "Other impacts" that have been included in a number of the economic studies tend to be investment specific, for example, relating to particular property surrounding a road and therefore not necessarily comparable across studies. For this reason, no extension has been undertaken of the other impacts in this evaluation.

The environmental impacts of road developments have been updated using the actual traffic numbers and the RTA economic parameters for the evaluation of environmental impacts. The environmental impacts typically considered in road investment include noise, air and greenhouse gas. The environmental impacts are considered indirect impacts as they are not classified as market impacts; there is no existing priced market for environmental impacts in Australia and impact road users and non road users.

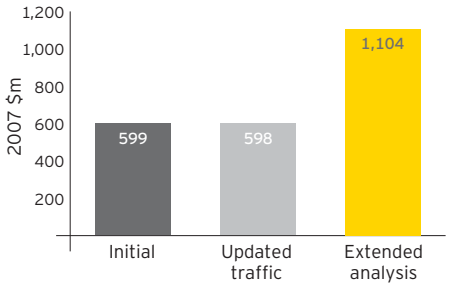
Figure 11 provides the outcomes of the environmental evaluation extension. The valuations were updated for changes in actual traffic levels as a means of representing the actual environmental impacts of the toll road developments. In addition, environmental impacts were estimated for those roads that did not have a valuation included in their initial economic evaluation.

The initial investment valuation of environmental benefits of the road network in 2007 NPV terms was $599 million for the three roads: the Cross City Tunnel, the Lane Cove Tunnel and the Eastern Distributor. When all of Sydney's toll roads are included and actual traffic volumes are used, the value of the environmental benefits is estimated to be $1.1 billion. This represents a 50% increase on original estimates of the environmental benefits of the toll road network.

As part of this study, we have not measured the impacts associated with the use of private finance to fund investment in new roads. In particular, when evaluating the net benefits of toll roads to the NSW and Australian economies, it is important to consider the net benefits arising from the use of private rather than public finance to fund investment in new roads. In practice, however, these indirect external benefits and costs of toll roads to NSW and Australia are difficult to evaluate in view of the uncertainty currently surrounding both the current deadweight costs arising from taxation in Australia and the extent of inter-state and foreign ownership of NSW toll roads and the rate of return paid to inter-state and international investors in those toll roads.

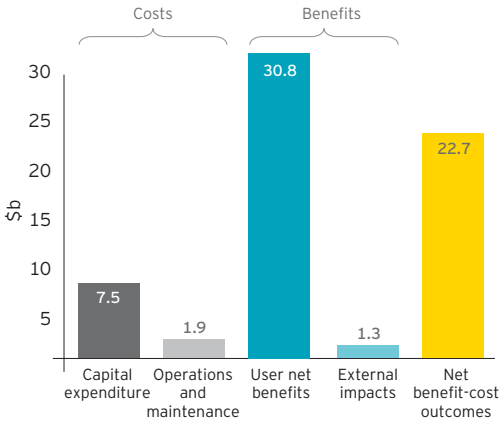
As a result, we have had to exclude these important benefits and costs from our analysis and the revised estimates of benefits and costs that NSW and Australia derive from investment in new toll roads are therefore understated.

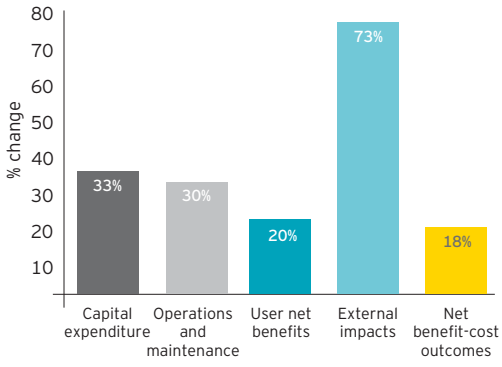
Figure 11: Inclusion of environmental impacts – NPV 2007 dollars



Source: Ernst & Young analysis

Figure 12: Benefit and cost summaries – updated outcomes and rates of change





Source: Ernst & Young analysis

5.4 Summary of net benefits assessment

A three stage process of updating the economic impact of Sydney's toll road network on the economy has been adopted. This update process involves adjusting for actual traffic outcomes and an extension of the existing net benefits to include accepted economic analysis parameters, such as environmental externality benefits and costs.

The outcomes of this upgrade and adjustment exercise are presented in Figure 12.

In summary, the revised estimates (expressed in 2007 dollars) suggest:

- Capital expenditure valued at a NPV $7.5 billion, an increase of 33% over the original evaluation outputs. The initial capital values included in the original investment decision analysis were based on planned design and construction scenarios. It is possible that design changes may have also contributed to increased costs evaluated at the bid stage.
- Operating and maintenance costs, valued at a NPV $1.9 billion, an increase of 30% over the original evaluation outputs. As in the case of capital expenditure, operations and maintenance were likely to have changed between the planning stage and the actual construction stage. The figures used in this report reflect this scenario.
- User net benefits of $30.8 billion, an increase of 20% over the original evaluation outputs. User benefits consist of travel time savings, vehicle operating impacts and accident savings. The impacts are driven in the main by traffic using the toll roads, substituting for the use of local roads. The overall increase in benefits is directly linked to the higher than originally forecasted levels of traffic using the toll roads (specified in the EIS assessments). It is important to note that these figures have also been adjusted, downward, to reflect the impacts of congestion associated with the growth in traffic.
- External impacts including environmental impacts valued at a NPV $1.3 billion, an increase of 73% over the original evaluation outputs. The large proportional increase in external impacts is as a result of the inclusion of environmental net benefits across all of the toll roads. In the initial investment decision evaluations only three of the eight evaluations had included environmental impacts such as noise, air and greenhouse gas emissions.
- Based on the addition of the updated external impacts, which was the only addition in this last stage of analysis, the net benefit outcome for Sydney's toll road network has been estimated to be $22.7 billion.

5.5 Future extensions of the benefit-cost analysis of toll roads

There are direct and indirect impacts that have not been captured in this analysis, or in any of the initial investment decision assessments, that will need to be captured through future improvements in the benefit-cost assessment technique, particularly in relation to new toll road developments.

When evaluating the net benefits of toll roads to the NSW and Australian economies, it is important to consider the net benefits arising from the use of private rather than public finance to fund investment in new roads.

This is a complex issue that involves the consideration of a range of benefits and costs that are typically overlooked including:

- The benefit that NSW derives from inter-state investment in its toll roads less the interest, dividends, loan repayments and repatriations of profits to any inter-state investors in the toll roads (which need to be taken into account when evaluating the net benefits of toll roads from the perspective of NSW).
- The benefit that Australia derives from foreign investment in its toll roads, less any interest, dividends, loan repayments and repatriations of profits to non-resident investors in the toll roads (which need to be taken into account when evaluating the net benefits of toll roads from the nation's perspective).
- The net benefits the community derives from using tolls and private finance to fund the construction of toll roads, rather than alternative sources of finance such as annual appropriations of government revenue financed through State or Federal Government tax revenue or government borrowing (future tax revenue). The determination of this net benefit involves consideration of a range of factors including:
  - the deadweight costs of raising finance through NSW or Federal Government taxes;
  - less the deadweight costs associated with raising revenue through tolls.

In practice however, these indirect external benefits and costs of toll roads to NSW and Australia are difficult to evaluate in view of the uncertainty currently surrounding both:

- the current deadweight costs arising from taxation in Australia; and
- the extent of inter-state and foreign ownership of NSW toll roads and the rate of return paid to inter-state and international investors in those toll roads.

As a result, we have had to exclude these important benefits and costs from our analysis. This means that our revised estimates of benefits and costs that NSW and Australia derive from investment in new toll roads still understate the magnitude of those actual impacts.

After updating the economic studies for changes in traffic and benefit-cost inputs, the net benefit of Sydney's toll road network has been estimated to be $22.7 billion.

6. Valuation of the network and economy-wide benefits and costs

In order to appropriately capture the full impact of Sydney's toll roads, the network and economy-wide impacts of Sydney's toll roads need to be assessed. These impacts are difficult to quantify and in the past have not been included in the traditional cost benefit analysis framework. Network implications include connectivity, business and residential development and employment opportunities.

A general equilibrium model developed by the Centre of Policy Studies at Monash University was used to estimate the economy-wide impacts of the construction and operation of the Sydney toll roads to both the NSW and Australian economies.

To capture the economy-wide impacts of the development of Sydney's toll road network the following data inputs (Figure 13) were required:

- benefit-costs inputs for each of the roads – measures the direct user benefits and community externalities such as environmental impacts.
- network benefits – which captures the connectivity of the road system and the opportunities associated with the development of housing and industry along the road network.

Because the current general equilibrium models do not appropriately adjust for the impact of network connectivity and network development, these impacts must be estimated outside the model using data from a survey of businesses operating around the toll roads and other industry data from various government and official sources, including the Australian Bureau of Statistics (ABS) and local councils. A total of 220 companies and organisations were invited to participate in the NSW toll roads economic survey, conducted in 2007.

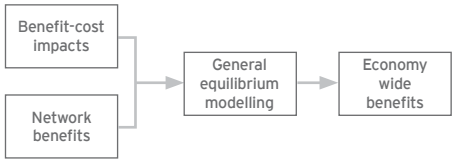
6.1 Network benefits

Three types of network benefits were considered including:

- connectivity.
- business and residential development.
- employment opportunities.

These benefits refer to improvements within the economy linked to improvements in the ease of movement across the geography and the implications of this ease of movement on patterns of production and patterns of consumption. The benefits are demonstrated in Figure 14.

Figure 13: General equilibrium modelling inputs



Source: Ernst & Young

Figure 14: Network approach

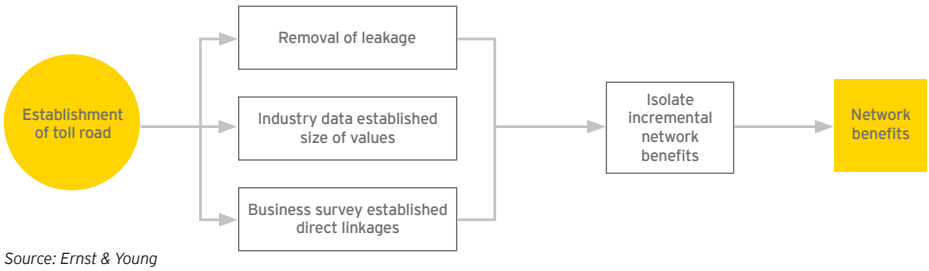
Source: Ernst & Young

The types of developments and the impact on the economy that are referred to include, but are not limited to, locations such as Norwest Business Park, defence facilities at Moorebank and residential at Bringelly and Rouse Hill.

The value of Sydney toll roads network effect was constructed on the basis that the valued benefits could be directly attributable to the toll roads. The process involved in constructing these network benefits is shown in Figure 15.

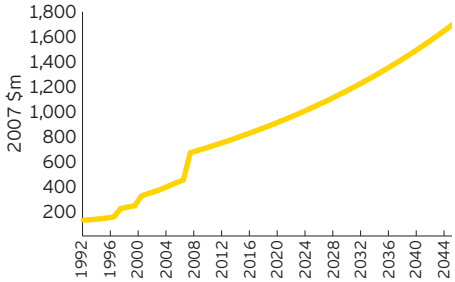
The development of toll roads has resulted in network benefits. These benefits include the changes within the economy due to improvements in the ease of movement across the geography and the implications of this ease of movement on the levels and patterns of production and consumption.

Figure 15: Network benefits



Source: Ernst & Young

Figure 16: Value of toll road network benefits



Source: Ernst & Young analysis

The establishment of toll roads has facilitated significant areas of both residential and business related development in the Greater West and North West areas of the Sydney Metropolitan region. As illustrated in Figure 16, the network benefits have been estimated to range from $600 million in 2007 to $1.0 billion in 2025 and $1.7 billion in 2045. The value of network benefits steadily increases over time relative to the base NSW economy, i.e., the network impacts are incremental to the underlying economy.

The network benefits associated with the growth of industry in Sydney, in conjunction with the benefit-cost information, is incorporated into the general equilibrium model to capture the total economy impacts of toll road construction and operation.

6.2 Economic impact model assumptions

The detailed Computable General Equilibrium (CGE) modelling for this study was undertaken by the Centre of Policy Studies (CoPS) at Monash University using 'The Enormous Regional Model' (TERM). TERM is a bottom up CGE model of Australia which treats each region of Australia as a separate economy. In this version of TERM there are 144 industry sectors in 57 regions.

TERM has a high degree of regional detail and is well suited to examining the regional impacts of shocks and in particular, supply side shocks. TERM was chosen for the study of Sydney's toll road network because it has a particularly detailed treatment of transport costs.

The general equilibrium modelling of Sydney's toll road network was undertaken using the process illustrated in Figure 17.

The economy was regressed to a level pre-toll roads (1986). Direct impacts of toll road construction and operation were added to the economy at this point and the operation of the general equilibrium model produced an overall economic impact on the NSW and Australian economies.

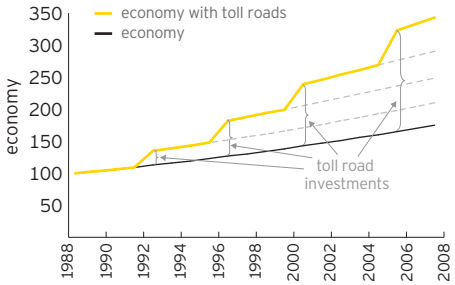
6.3 Impacts on the New South Wales and Australian economies

The assessment of the economy-wide impacts of toll road development was undertaken using general equilibrium analysis. The analysis estimates the historical and future growth in the economy as a result of the investment in and operation of the toll road network. The results of the analysis are shown in Table 4.

Key results of the modelling indicate that at the NSW economy level:

- The impacts of Sydney's toll road network on the NSW economy have been estimated to range from $1.6 million in 1986 to $3.4 billion in 2020 in Gross State Product (GSP) terms. The value of the growth in the NSW and Australian economies as a percentage of the total economy is shown in Table 5. The improvements to the transport network are forecast to contribute an additional 0.89% to GSP in NSW by 2020 compared to the no toll road development scenario.
- There is net improvement in real private consumption ranging from $0.6 million and $1.0 billion per annum over the evaluation period. Real consumption increase represents the actual increase in the value of the goods and services consumed within the NSW and Australian economies due to the toll road network.
- The impact on real investment in NSW ranges from $5 million to over $1.0 billion per annum as a result of the construction and operation of the Sydney toll road network.
- Exports experience positive and negative impacts as a result of the toll roads, with impacts ranging from negative $252 million to a positive $1.6 billion. The range of import values experienced as a result of the toll road network is $1.2 million to $639.2 million. As a whole, the overseas trade position has improved as a result of the Sydney toll roads network.
- The estimated employment impacts of the toll road network are calculated to produce an increase in employment estimated to range from 100 per annum to 4,000 per annum[5]. The growth in employment on an annual basis is greater when construction of the toll roads is being undertaken, but the operation and general growth in the economy have an ongoing impact on State and national employment.

Figure 17: General equilibrium model process



Source: Ernst & Young analysis

Table 4: NSW and national impacts of Sydney's toll road network

Category change from base	1987	1997	2007	2015	2020
New South Wales					
Real GSP ($m)	1.6	382.3	1,831.3	2,889.7	3,402.9
Real private consumption ($m)	0.6	108.2	506.1	885.0	1,071.4
Real investment ($m)	5.0	532.5	871.8	956.8	1,074.5
International export volumes ($m)	(1.4)	0.0	839.5	1,417.9	1,614.1
International import volumes ($m)	1.2	140.9	376.3	548.6	639.2
Employment ('000s)	0.0	1.0	0.3	1.9	2.7
Australia					
Real GDP ($m)	1.2	291.9	1,615.8	2,761.5	3,183.5
Real private consumption ($m)	1.4	177.2	679.2	1,192.6	1,422.1
Real investment ($m)	4.9	526.2	943.4	1,108.1	1,189.1
International export volumes ($m)	(3.6)	(264.3)	326.5	980.7	1,166.4
International import volumes ($m)	1.6	159.1	350.4	521.4	588.6
Employment ('000s)	0.0	0.3	(1.4)	0.3	0.1

Source: CoPS and TERM

[5] These figures need to be treated with some caution. It is possible that the increased requirement for labour based on spends, could be covered by increased working hours of existing employees.

Key results of the modelling indicate that at the Australian economy level:

- The impact on the Australian economy is lower than the impact on the NSW economy, which indicates that some of the other States are negatively impacted; results range from negative $108 million to positive $3.2 billion in Gross Domestic Product (GDP) terms, equivalent to a -0.01% to 0.27% of GDP as shown in Table 5.
- There is an overall real consumption increase, which represents an actual increase in the value of the goods and services consumed within the Australian economy; this results in a change in net real private consumption of between negative $8.4 million and positive $1.4 billion over the period of evaluation.
- These impacts worsen the balance of trade position of the Australian economy. The overseas trade figure, in total, worsens as imports are greater than exports required to meet demand.
- As an industry, the toll road network results in an increase in employment estimated to range from negative 1,400 to a positive 2,200. The lower employment growth at a national level compared to NSW means that, all things being equal, the rest of Australia has a reduction in employment as workers move to NSW to obtain work. Overall the employment is still positive at a national level.

The GSP/GDP outcomes experienced at the NSW and Australian level are presented in Figure 18. The growth experienced in the NSW economy as a result of the construction and operation of Sydney's toll road network is greater than that experienced by the Australian economy. The growth in NSW must therefore result in leakages into the NSW economy from other States as a result of the toll road network.

Table 5: NSW and national impacts as a percentage of total economy

Category change from base (%)	1987	1997	2007	2015	2020
New South Wales					
Real GSP	0.00	0.13	0.55	0.80	0.89
Real private consumption	0.00	0.06	0.27	0.43	0.50
Real investment	0.01	0.62	0.91	0.92	0.98
International export volumes	(0.00)	0.00	1.77	2.74	2.96
International import volumes	0.00	0.23	0.55	0.74	0.82
Employment	0.00	0.07	0.02	0.11	0.16
Australia					
Real GDP	0.00	0.03	0.16	0.25	0.27
Real private consumption	0.00	0.04	0.12	0.20	0.22
Real investment	0.00	0.19	0.30	0.33	0.34
International export volumes	(0.00)	(0.15)	0.17	0.47	0.53
International import volumes	0.00	0.08	0.16	0.22	0.24
Employment	0.00	0.01	(0.03)	0.01	0.01

Source: CoPS and TERM

6.4 Economic impact comparisons

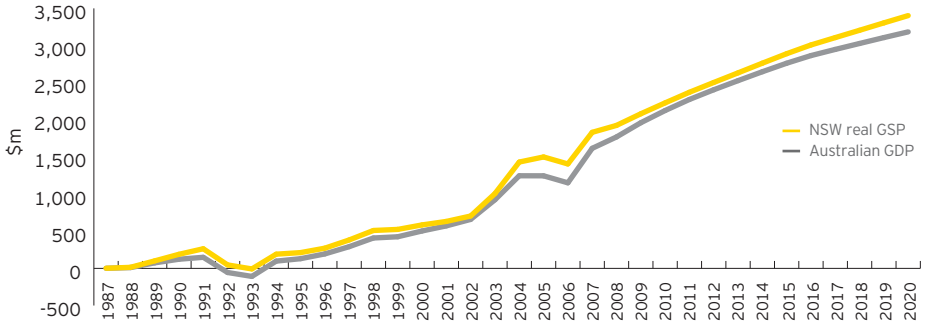
By comparing economic valuations from a range of study outcomes, an understanding of the relative size of the impact can be determined. Figure 19 demonstrates the results of the economic contribution of a range of both developed infrastructure and annual events. For the purposes of comparison, the infrastructure development economic outputs have been selected for comparison for a particular year to ensure direct comparability with single year events.

In making these comparisons, it is important to note that some level of caution should be used. While attempting to provide similar approaches and studies for comparison, Ernst & Young expect that different methodologies and assumptions (e.g., Input-Output vs General Equilibrium) have been used.

Based on the studies selected, it can be said that the economic impact of Sydney's toll road network is:

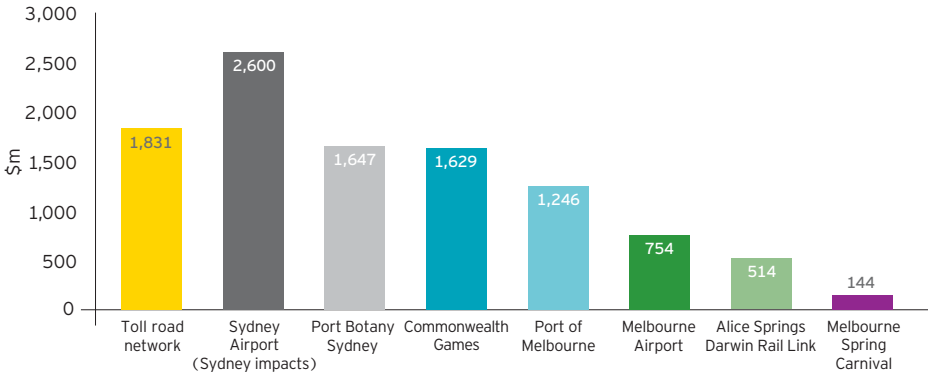
- Comparable to both the economic impact of Sydney's Port Botany container terminal and the estimated economic impacts of the 2006 Melbourne Commonwealth Games.
- Lower than the economic contribution of the Sydney Airport precinct.
- Approximately 1.5 times the economic contribution of Port of Melbourne.
- Approximately 2.5 times the economic impact of Melbourne airport.

Figure 18: Sydney toll roads impact on NSW GSP and Australian GDP comparison



Source: CoPS and TERM

Figure 19: Comparisons of (annualised) economic impact – GSP/GDP $m



Source: Ernst & Young, Ernst & Young, Economic Impact of Sydney Airport, 2003; URS, Port Botany Expansion Environmental Impact Statement, 2003; KPMG, Economic Impact Study of the Melbourne 2006 Commonwealth Games Post Event Analysis, 2006; PwC, Economic Analyses of the Port of Melbourne, 2007; SKM, Melbourne Airport Economic Impact Study, 2003, Access Economics, Economic and Budgetary Impacts of the Alice Springs – Darwin Railway Project, 1999; Racing Victoria, 2006 Spring Racing Carnival Economic Benefit, 2006.

7. Socio-economic impacts on Sydney

Although it is difficult to establish whether toll roads have been a key driver of socio-economic change, it is clear that the establishment of the toll road network has facilitated significant socio-economic change including population shift, industrial and commercial change, residential relocation and environmental and social change.

The construction of Sydney's toll roads has facilitated the high population growth and rapid industrial development that is typified by the growth experienced in Western Sydney over recent years (see Figure 20). As the population has expanded, the outer suburbs of Sydney have provided relatively cheaper residential options and improved living standards in terms of larger residential lots, increased open space, and cleaner air. This is more clearly demonstrated in the Figures 20-25.

The improvements to Sydney's road network are helping to ensure the efficient movement of people and goods and services around Sydney. The toll roads have improved consumer choice about where they choose to live, with consumers no longer being constrained by their employment location.

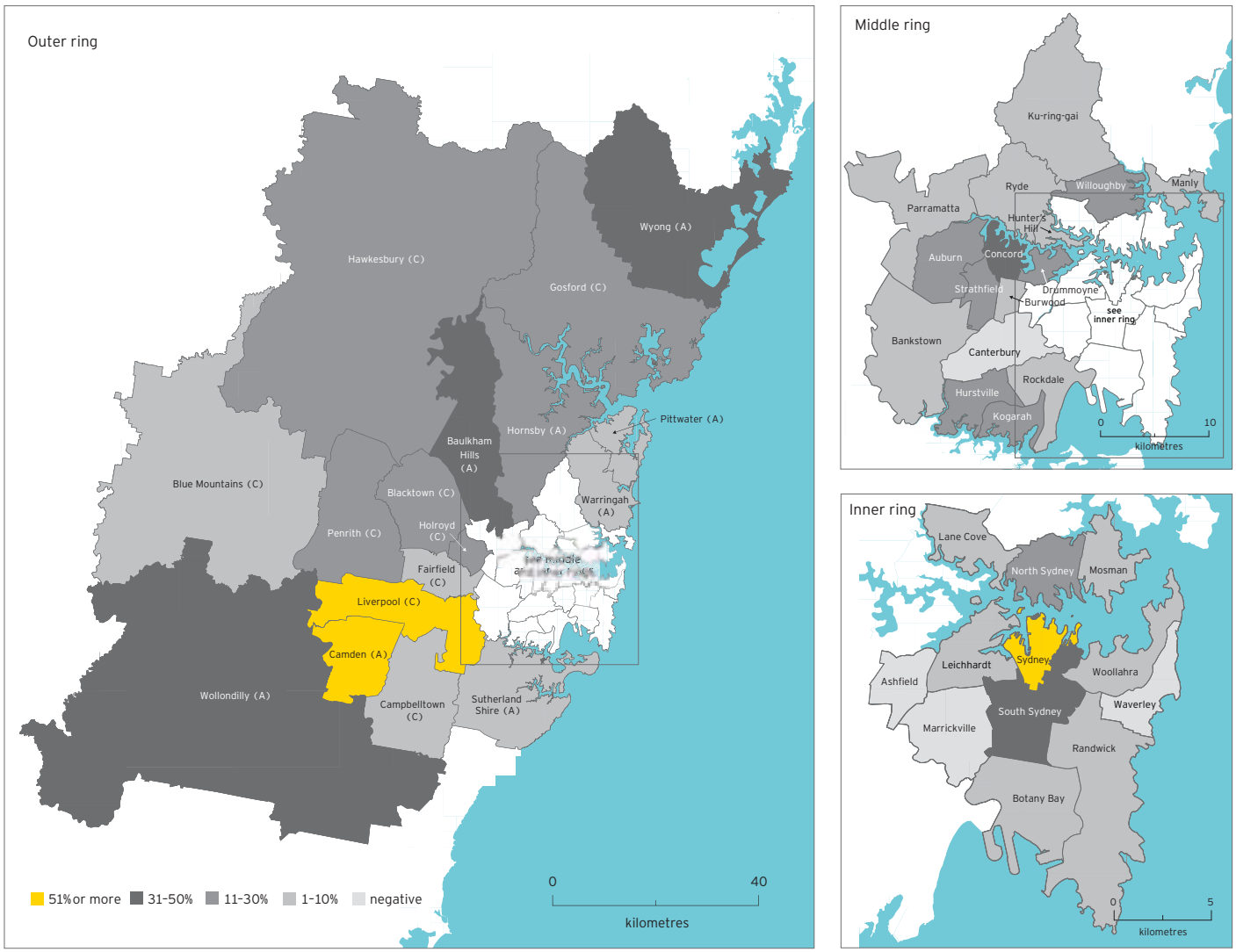
This growth is expected to continue. For example, Greater Western Sydney is projected to grow at an average annual rate of 1.1% for the next 20 years against the background of an overall Sydney average growth of 0.9%.

Sydney's unemployment rate has been steadily falling over the last ten years with the West and South West Sydney areas having seen the largest falls. This corresponds with increased industrial and commercial employment opportunities in these localities that have shifted from traditional inner locations due to improved transport linkages and access to cheaper land along with access to a labour pool.

The changes in the outer Sydney areas have also seen an increase in manager/professional roles accompanied by a drop in trade, technician or labourer roles. This trend is complementing the direction of Sydney's economy towards higher value business activities in design, finance and business services.

The construction of Sydney's toll roads has facilitated the high population growth and rapid industrial development that is typified by the growth experienced in Western Sydney over recent years.

Figure 20: Percentage change in population between 1991 and 2005 (inner, middle and outer rings)



Source: ABS Australian Social Trends (2006)

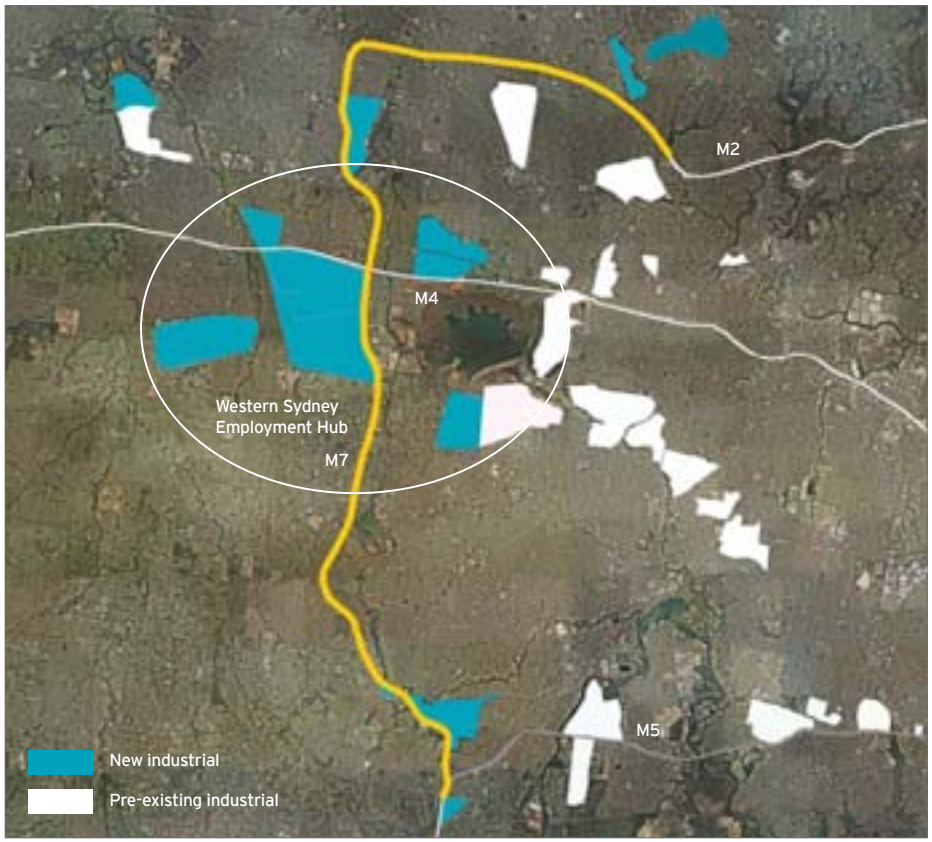
7.1.1 Industrial and commercial change

Sydney has the largest regional economy in Australia and is the nation's established corporate and financial capital. In 2004-05, Sydney contributed almost 70% towards NSW Gross Regional Product (GRP)[6]. The property and business services industry is the largest contributor (17%) to the Sydney Gross Regional Product, followed by manufacturing (15%), finance and insurance (14%), and wholesale trade at (7.5%).

Industrial and commercial operations have benefited from improvements in the transport infrastructure and the overall transport network through the development of the toll roads and the wider Sydney Orbital. These operations have formed business clusters around the toll roads, particularly the M5 and the M7 in suburbs such as Bankstown, Silverwater, Fairfield, Wetherill Park and Ingleburn. Similarly, areas in Sydney's north have benefited, the Metropolitan Strategy nominating Macquarie Park as a specialised Centre in the Inner North Subregional Strategy. Located adjacent to the M2 and now serviced by the Lane Cove Tunnel, Macquarie Park is designated as a nationally significant research and employment centre that includes Macquarie University as well as businesses specialising in IT&T, pharmaceuticals, medical & services and communications.

Over the last 20 years, an additional 3,100 hectares of industrial zoned land was created across Sydney, with the majority resulting from the rezoning of rural land to industrial land as part of planning for new urban development in the Western Sydney region. Population growth in Western Sydney is demonstrated in Figure 20. Of particular note are the new industrial growth areas of the Western Sydney Employment Hub that includes areas in and around Prospect reservoir (see shaded area in Figure 21)[7].

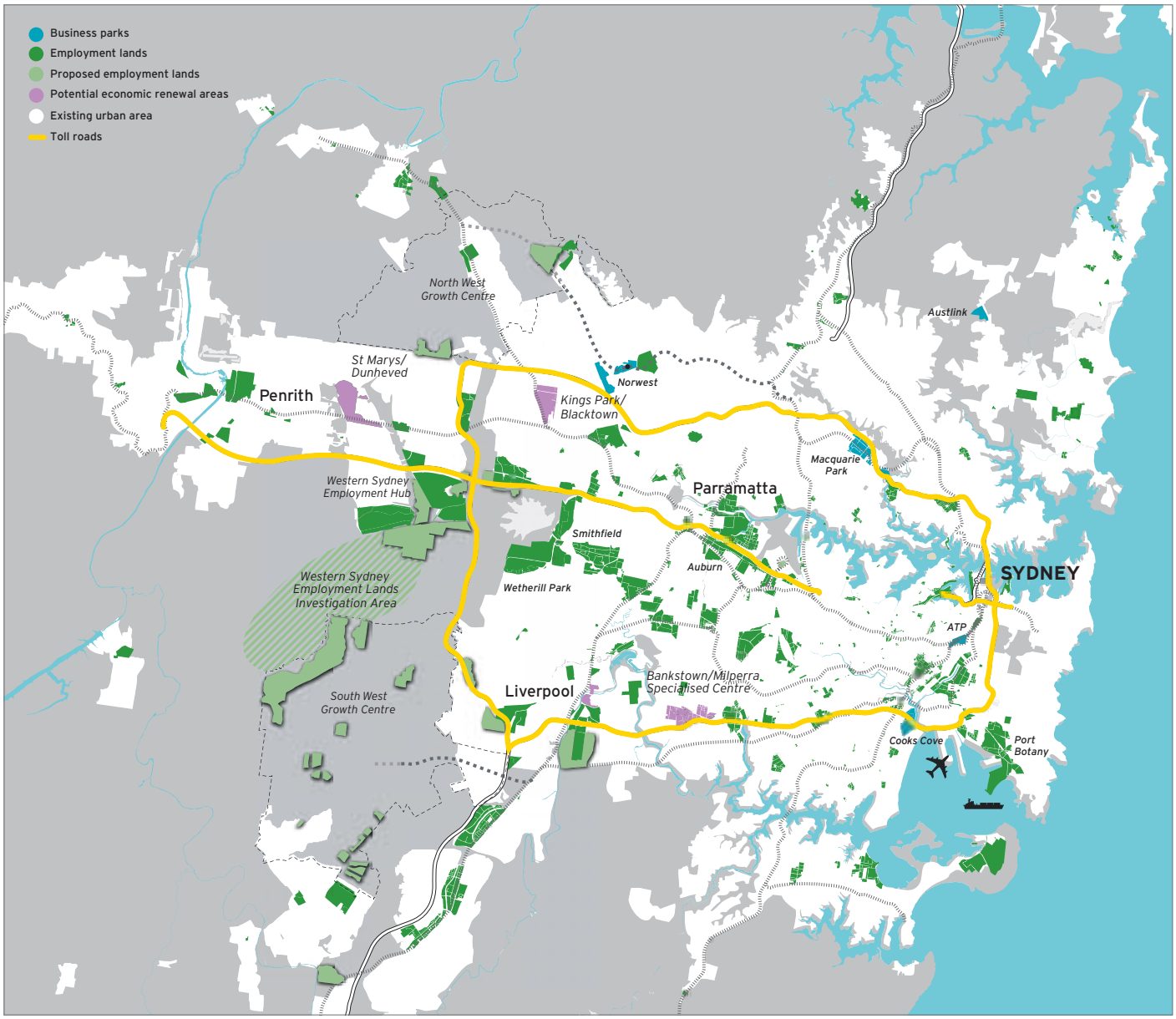
Figure 21: New and old industrial parks associated with the M7 (1990 to 2007)



Source: Google and GWSEDB (2007) – Image © DigitalGlobe, Image © Sinclair Knight Merz

[6] Greater Western Sydney Economic Development Board (2006).
[7] Note that the definition of new and old industrial lands are provided to show indicative proportional changes in industrial land use only, and are not the exact areas of change.

Figure 22: Sydney's existing and proposed employment lands



Source: NSW Department of Planning (2007)

Over the next two decades, future releases of employment zoned land for office/ industrial development will be concentrated around the M7 area, particularly in Sydney's North West where employment growth is expected to increase by around 40%. This is demonstrated in Figure 22 and Figure 23.

7.1.2 Residential change

The development of Sydney's toll road network has also, in part, facilitated an expansion of residential development in Sydney's outer suburbs. The majority of dwellings growth in Sydney between 1994 and 2004 occurred in the West and South West areas of Sydney (see Table 6).

A representation of one of the many changes, in this case the South West of Sydney around the junction of the M5 and M7, has been included in Figure 24. The establishment and continued development of suburbs such as Hoxton Park, Horningsea Park, Carnes Hill and Prestons becomes readily apparent when comparing the before (1998) and after (2007) images.

An estimated 640,000 new homes will be required to cater for the growth in Sydney's population to 5.3 million by 2031. Around one third of the new homes are predicted to be located in new releases in Sydney's North West and South West, see Figure 23. The remainder are to be built in already established suburbs, with around half of these in the Greater Western Sydney region. Sydney's toll road network will continue to provide vital linkages between the growing residential areas in Sydney's West and the inner city.

Table 6: Sydney's dwelling growth by sub region (1994 to 2004)

Sub-region	Dwellings in 1994	Dwellings in 2004	% share of dwellings growth
Sydney City	45,040	76,833	17%
East	110,770	122,184	6%
South	84,176	95,198	6%
Inner West	219,414	248,629	16%
Inner North	111,132	129,256	10%
North	79,549	88,024	5%
North East	81,537	90,081	5%
West Central	197,689	228,297	16%
North West	235,111	250,924	8%
South West	121,729	128,570	4%
Central Coast	124,651	139,016	8%
Total	1,410,798	1,597,012	100%

Source: NSW Department of Planning (2005)

Figure 23: Sydney's new growth centres

Source: Google Earth (2007) – Image © DigitalGlobe, Image NASA, Image © Sinclair Knight Merz, Image © GeoEye

Figure 24: Hoxton Park and surrounding area[8]

Source: NSW Department of Lands

Source: Google Earth (2007) – Image © 2008 DigitalGlobe

7.1.3 Environmental and social change

The environmental impacts of Sydney's road based (orbital) network have not been widely researched. However, independent work conducted for Interlink Roads Limited (M5 operators) has found that the use of the M5 was estimated to reduce car emissions up to 95% for hydrocarbons, 66% for oxides of nitrogen, 50% for carbon dioxide and up to 50% for particulates. For the Sydney network as a whole, vehicles emissions were found to reduce by 1.6% for oxides of nitrogen, 2.6% for particulates, 2.8% for carbon dioxides and 4% for hydrocarbons[9].

Similar to environmental impacts, the impact of toll roads on social change has not been fully examined. In one particular instance, the Eastern Distributor has been linked to social improvements with good urban design associated with recognised improvements in the public domain. These include a land bridge adjacent to the NSW Art Gallery and pedestrian bridges adjacent to Moore Park enhancing accessibility for non motorised traffic, tiered landscaping combined with high quality finishes and treatments provide enhancing visual amenity for motorists and residences alike[10]. A spatial representation of the identified changes is shown in Figure 25.

In addition to these changes, major residential developments in South Sydney have benefited from improved accessibility to the motorway land e.g., Victoria Park. The rejuvenated industrial sites used for the development are also, themselves, a function of the ED/M5 provision[11].

Figure 25: Social improvements around the Eastern Distributor

Source: Google Earth (2007) – Image NASA, © 2008 MapData Services PtyLtd, PSMA, Image © DigitalGlobe

[8] Hoxton Park is at the intersection of the M5 and M7 (South West Sydney).
[9] M5 South West Environmental Impacts. Prepared by Integrated Management Information Systems, Masson Wilson, Twiney and SKM and Prof. H Watson for Interlink Roads (December 2003).
[10] NSW Premiers Department (2005) *Richmond Report.*
[11] Itself made possible through the provision of improved transport accessibility (M5/ED) to the cheaper industrial development areas of the central and outer western Sydney.

8. Issues for further consideration

The outcomes of this study highlight the importance of effective transport infrastructure to support the economic and social development of a community. In particular, our analysis of the Sydney Orbital Network has highlighted some of the key benefits of these vital projects and has also identified a number of areas which would benefit from further examination to enhance the effectiveness of the provision of these important community assets.

The research has also identified a number of areas that require consideration in the future development, analysis and delivery of toll roads. These include:

- **Use of toll roads as a facilitator of long-term urban planning.** The provision of major transport infrastructure facilitates the commercial, industrial and residential development (or redevelopment of distressed areas) and, in conjunction with the provision of appropriate planning overlays, can be used as a driver of development to enable the achievement of long-term objectives. There is considerable recent press that is focused on additional network nodes within Sydney such as the F3–M2 connection, F6 extension and the M4 East. The function of these nodes as key facilitators for urban development and their additional value as network connectors should be clearly understood and considered in future planning decisions.
- **Increasing integration of public transport systems with roadways.** The high prevalence of car ownership and high reliance on cars in Sydney's West and South West areas has the potential to produce undesirable social outcomes and possibly marginalise lower socio-economic and disadvantaged groups. The provision of roadways without a consideration of the provision of additional public transport (such as park and ride areas at railway stations, new rail lines and bus routes) has the potential to further marginalise these disadvantaged groups while also increasing negative environmental impacts.

  The development of stronger partnerships for the provision of integrated toll road and public transport solutions would enhance community development and encourage the economic development of socially disadvantaged communities. Further integrated use of bus lanes with toll roads, such as developed with the M2, would also provide suitable and effective means for commuters to make use of the toll road infrastructure while reducing the environmental impact and congestion externalities on their fellow motorists.

- **Efficient and equitable tolls.** A number of practices have been introduced in the current tolling regimes, which have resulted in both perceived and real inequities between various road users. Differential charging of tolls leads to inefficient travel choices being made based on incorrect price signals. Inconsistency of charges between toll roads, and similarly, the cash back system introduced for the M5 and M4, contributes to the concern that there is social inequity between areas serviced by toll roads with and without the system.

  Distance based tolling, such as that used on the M7, is a more equitable and efficient method to collect tolls than the open system used on other toll roads in Sydney. The introduction of distance based tolling (or other alternatives) for all toll roads in the Sydney Orbital Network and for future toll roads could be investigated to determine if the overall equity and efficiency in the system could be improved by their introduction.

  Casual user pass systems that are expensive, lack interoperability and are cumbersome for those motorists infrequently using the toll roads are seen to reduce the efficacy of the network. Improvements in this area would enhance the customer experience across the entire network. Other potential improvements in this area include ensuring that casual users are treated in a consistent manner at all toll gates. That is, it is important to ensure consistent signage, payment methods and layout for all casual users.

- **Approaches to reducing congestion on toll roads.** There is concern over the growing levels of congestion on Sydney's roadways and toll roads. In particular, with the current Sydney Orbital Network:

  - The M5 East tunnel is attributed to provide significant congestion during both morning and evening peak periods[12].
  - The use of toll booths and the need for cash to pay tolls is believed to result in increased congestion and traffic delays around the toll booth areas.

  Solutions for these and other current and potential future congestion points need to be investigated with the objective of easing current concerns and informing the design of future toll roads.

  Greater reliance on rail for freight movements (with inter-modal terminals to the west) and demand management, such as network or congestion pricing, are also seen as credible options to improve the situation. Similarly, the use of improved cashless systems that integrate across the total network could be considered as part of longer term upgrades of existing toll roads and for inclusion in future toll roads.

- **Consistency of economic evaluation techniques.** It is important to use a consistent approach when carrying out economic analyses of toll road projects. In reviewing the results of previous studies, it was found that there were inconsistencies between methodologies, largely linked to the exclusion of externalities such as environmental costs (emissions).

[12] M5 South West Environmental Impacts. Prepared by Integrated Management Information Systems, Masson Wilson Twiney, SKM and Prof. H Watson for Interlink Roads (December 2003).

Further technical issues linked to ensuring like ranges of benefits are quantified, as well as consistency in the calculation of the BCR, should also be addressed[13].

Based on the analysis completed, we also believe that further research is required on a number of areas to enhance and further validate the impacts of the provision of toll roads and transport infrastructure in general:

- **Improvements in approaches to traffic modelling.** Our review of the EIS traffic forecasts relative to actual traffic numbers for most of Sydney's toll roads has shown significant deviations that were not included in the original planning for the toll roads. Improved traffic modelling would also assist and improve the efficiencies in the bidding process for projects.
- **Identification and more detailed quantification of the network benefits of the provision of transport infrastructure.** There is significant theoretical discussion of the principle of an integrated transport network (such as the Sydney Orbital Network) providing benefits to the economy. However, minimal research has been completed on the quantification of these benefits, including approaches to avoid duplication when assessing the benefits and costs of each part of the network.
- **Impacts of reduced transportation costs.** Investigation into the impact of reduced transportation costs on the competitiveness of industry and its associated economic growth is limited. Additional research on the prevalence and level of network benefits and reduced transport costs and its impact on economic growth is necessary for future study into the establishment of transport networks.
- **Impacts of enhanced ability for user movement.** It is recognised that the provision of transport infrastructure generally enhances private and commercial accessibility. Improved measurement of employment and recreational opportunities linked to transport accessibility would assist in being able to more readily quantify the economic impacts.
- **Impacts of improved climate change/ sustainability measures.** The growing importance of climate change and sustainability has created a need to investigate the integration of sustainability measures into all infrastructure provision. Investigating the future impacts of emissions reduction targets and trading schemes should be a focus for future economic assessments of transport options.
- **Identification and quantification of the potential benefits consistent with the use of private finance rather than public finance.** The use of private finance facilitates the earlier provision of the toll road infrastructure than would have been possible under a publicly funded project and releases Government funds for other important social infrastructure needs, such as health and education. It also has the potential to reduce the deadweight costs associated with raising funds using the tax system.

Consideration of the above issues and the completion of the necessary research where required, would improve the effectiveness of the provision of transport infrastructure in the future while also assisting in the development of a more complete understanding of the impacts of that infrastructure.

[13] ATC (2006), *National Guidelines for Transport System Management in Australia*. Prepared by the Australian Transport Council (2006).

Appendix A

Summary of Sydney toll roads investigated in the study

Motorway	SHT	M4	M5	M2	ED	CCT	M7	LCT
Opening date	Aug 1992	May 1992	August and October 1992	May 1997	Dec 1999	Aug 2005	Dec 2005	Mar 2007
Capital cost	$738 million	$246 million	$380 million	$644 million	$700 million	$680 million	$1.5 billion	$1.1 billion
Upfront payment to (-ve)/by (+ve) consortia	No payment	No payment	No payment	-$66.5 million	$10.2 million	$96.8 million +GST	$193 million +GST	$79 million +GST
Annual average daily traffic (AADT)	49,000 tolled one way (2007) est. 98,000 both ways	111,642 (Dec half 2007)	116,000 (Dec half 2007)	92,691 (Dec half 2007)	47,779 (2007)	20,000 tolled 50,000 untolled (approximate)	127,871 (Dec half 2007)	53,100 main tunnel 43,000 (2007)
Present toll (full car length trip)	$3.00 one direction	$2.20 one direction	$3.30 both directions	$3.80 and $2.20 for Pennant Hills both directions	$4.50 one direction	$3.56 and $1.68 for Sir John Young Crescent both directions	31.97c/km capped at $6.39 for 20km, distance based	$2.58 tunnel $1.29 Falcon St ramp both directions
Equity contributors	Transfield 50% Goldman Sachs 50%	Transurban 50.6% Hastings Funds Management 21.5% Other 27.9%	Transurban 50.0% Hastings Funds Management 19.2% Industry Funds Management 15.4% Other 15.4%	Transurban 100%	Transurban 75.11% Industry Funds Management 14.37% UniSuper 10.53%	ABN Amro Diversified Infra Trust 94% Leighton Contractors 6%	Transurban 47.5% MIG 47.5% Leighton Contractors 5%	CKI holdings 19.6% AMP capital investments 15% John Holland & Theiss 11% Westscheme 6.5% MTAA 12% ABN Amro Diversified Infr Trust 14.9% MBL Consortium (on-sold) 21%
Operator	Sydney Harbour Tunnel Company	Statewide Roads	Interlink Roads	The Hills Motorway	Airport Motorway	Cross City Motorway	Westlink Motorway	Connector Motorways
Contractual date for opening	Aug 1992	Feb 1993	Feb 1994 and Feb 1995	Dec 1997	Aug 2000	Mar 2002	Oct 2005	May 2007
Projected date for handover	Aug 2022	May 2010	Aug 2023	May 2042	Jul 2048	Dec 2035	Feb 2037	Jan 2037

Note: Totals may not add up to 100% due to rounding.

Glossary

Accident Costs – are a component of road user costs, representing costs incurred by the individual road user (such as medical costs, expected loss of earnings), road system costs (which include management and clean-up of accident sites and compensation) and vehicle costs (repair of vehicle damage).

Benefit-Cost Analysis – is a technique for assessing the economic efficiency of resource allocation, by quantifying in monetary terms the benefits and costs of a range of alternative project proposals. The benefits and costs are defined in terms of society as a whole.

Benefit Cost Ratio (BCR) – is equal to the discounted benefits over the life of a project divided by the discounted capital costs plus discounted operating and maintenance costs. The ratio needs to be at least above one for the project to proceed.

Capital Costs – include construction, planning and design, engineering and environmental investigations and project management costs, unless these are already considered sunk costs.

Congestion – is a feature of traffic flow depending on road capacity, traffic controls, traffic demand, vehicle types and driver characteristics causing reductions in speeds, increases in travel times, frequent acceleration and deceleration, increases in vehicle operating costs and externalities such as noise and emissions.

Deadweight Cost – is the net cost the community bears as a result of inefficient taxes or charges (e.g., tolls) that unintentionally alter decisions to save, consume, produce, invest and use resources.

Direct Impact – costs or benefits that impact on users of the project.

Discount Rate – measures the rate at which future consumption is sacrificed for present consumption. It is rate at which benefits and costs in future years are discounted to be expressed in the base year.

Evaluation Period – is the timeframe over which the benefits and costs of a project are compared. It encompasses the initial period of the capital investment and the subsequent period over which the benefits of the project accrue.

External Costs – are costs incurred by the general community including environmental costs arising from traffic noise, air pollution and greenhouse gases.

Indirect Impacts/Externalities – costs or benefits associated with a project but not received or paid for by the project or project users. They arise as incidental by products of some other activity. They are benefits and costs incurred by the general community which are not transmitted through the market mechanism to those who produce or consume the good or service which causes the externality.

Internal Rate of Return (IRR) – is the discount rate at which the net present value of a project is equal to zero. i.e., where the discounted project costs equal discounted project benefits.

Kiss and ride – where a passenger is dropped-off area near a public transport station.

Net Present Value (NPV) – sum of the discounted project benefits less discounted project costs. A positive NPV result indicates that the project is a viable investment (the benefits are greater than the costs).

Network Impacts – may arise when a change/improvement in the road network stimulates or facilitates the realisation of an economic opportunity which would not have been realised in the absence of the road development. Network impacts represents the difference between the value of any new production and non road costs of that production or potential reductions in cost of production.

Opportunity Costs – is the value of resources in their next best alternative use.

Present Value – is a calculation that brings all future cashflows back to the current time period (referred to as discounting). This enables effective comparison between relevant cashflows, such as benefit and cost streams. The discounting reflects the time preference of money, or put simply, a dollar today is worth more than a dollar at some future period. Thus costs (or benefits) incurred today are worth more than the same costs (or benefits) incurred at a time in the future.

Park and ride – an arrangement whereby car users are encouraged to leave their vehicles in identified car parks and complete the remainder of their journey by some form of public transport.

Sunk Costs – a cost that has already been incurred and that cannot be undone or changed. Sunk costs are ignored in a benefit-cost analysis unless there is an opportunity cost. A sunk asset is one which, once constructed, has no value in any alternative use.

Transfer Payments – are the reallocation of income from one part of the economy to another. No new net economic activity is generated.

Vehicle Operating Costs (VOC) – refer to the costs to own, operate and maintain vehicles. VOCs include costs incurred by vehicle operators such as capital cost (purchase/depreciation/opportunity) and recurring costs (cost of fuel, tyres, oils, maintenance and repair).

Definitions produced in this report are consistent with the definitions used by the RTA and produced in the RTA Economic Analysis Manual, 1999.

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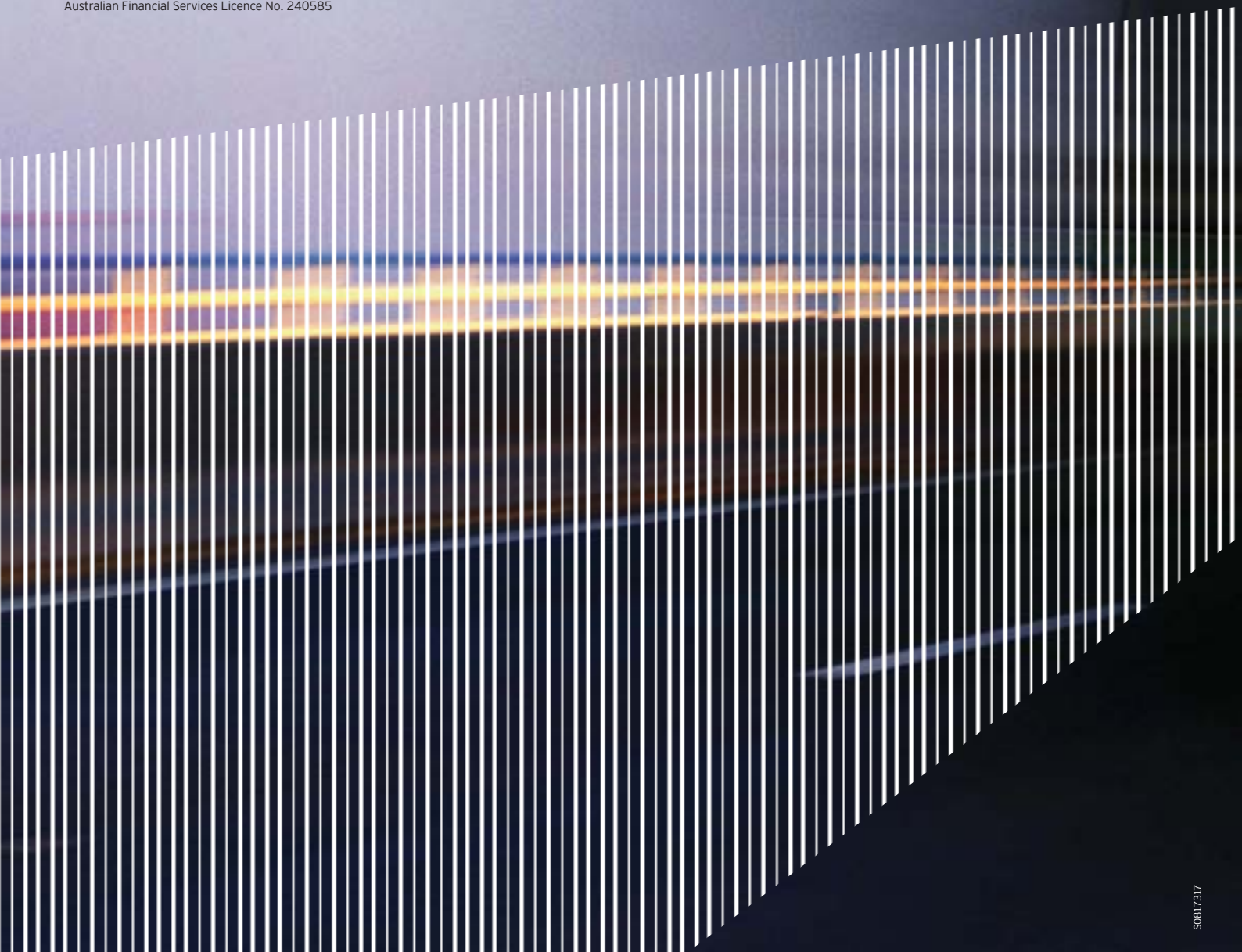

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