PricewaterhouseCoopers

Department of Premier and Cabinet, Victoria

East West Projects Economic Analysis

Additional impacts analysis:
Review of the assessment of the impacts of retrofitting transport links in established urban areas

December 2008

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1 Introduction

Scope

PricewaterhouseCoopers (PwC) has been appointed by the Victorian Government to critique the economic work presented in *Investing in Transport: East West Link Needs Assessment* (EWLNA) and to provide advice on the further development of the economic analysis conducted for the study.

PwC was requested to "review the full range of economic and community benefits of EWLNA projects and the supporting consultant reports to determine whether there are any critical flaws in the methodology, assumptions, data and analysis underpinning the information in the reports".

This report considers a set of wider impacts included in neither the traditional BCA nor the Wider Economic Benefits analysis, both of which have been subject to separate PwC critiques. Many – but not all - of the impacts are connected to retrofitting in urban areas.[1]

These impacts were included in *Investing in Transport: EWLNA*, in the overall benefit cost ratio (BCR) for the EWLNA projects. They were not considered by the Study Team's economic advisors (including Meyrick and SGS), but were estimated by the EWLNA team.

The impacts

The impacts considered in the EWLNA report and under scrutiny in this report seek to account for impacts that are not fully reflected in the 'traditional' cost-benefit appraisal.

The impacts included in the EWLNA report and under consideration in this review are:

1. **Community benefits of tunnelling** – aiming to capture the net community benefit of tunnelling as opposed to surface links;

[1] PwC is considering four aspects of the EWLNA analysis, covering (i) the 'traditional' BCA; (ii) Wider Economic Benefits (WEBs); (iii) Impacts connected to retrofitting infrastructure to urban areas; and (iv) Land use, social and demographic impacts.

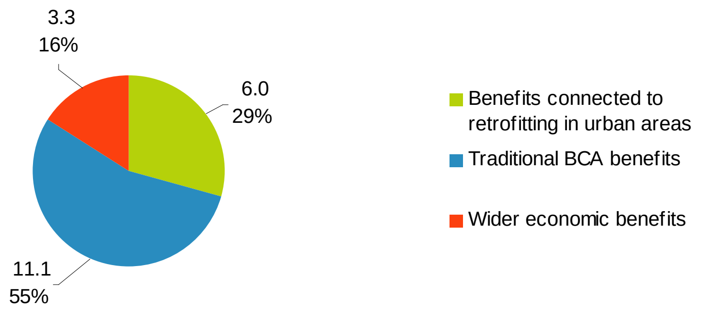
2. **Additional congestion relief** – attempts to include an allowance for the value of reduced congestion that the EWLNA team reports is undervalued in the transport model (and hence the 'traditional' BCA); and

3. **Westgate Bridge redundancy** – (not quantified) seeking to include the strategic benefit that Melbourne's economy obtains from valuing network redundancy into the analysis, i.e. providing an alternate route to the Westgate Bridge.

The EWLNA team also considers a set of **"Accessibility Benefits"** - access to jobs and services for the part of the population that are currently deemed disadvantaged, which was reviewed by SGS[2]. These benefits were not included in the overall BCR. These accessibility benefits are considered separately in PwC's review of the land use, social and demographic impacts, and are not covered in this report.

Collectively, the first two impacts (the only two quantified) total $6.0 billion in benefits. This is 29% of the total benefits captured in the BCR produced, so form a significant proportion of the 1.4 BCR produced (see Figure 1). As a further indication of scale, the inclusion of retrofitting benefits in the BCR increased the ratio from 0.7 (as analysed by Meyrick) to 1.1[3].

Figure 1 – Retrofitting benefits as a proportion of total EWLNA quantified benefits



Source: Eddington, R. 2008, Investing in Transport: East West Link Needs Assessment, p.234

As indicated in Figure 2, the community benefits from tunnelling consist of the majority of the additional benefits included in the ELWNA report.

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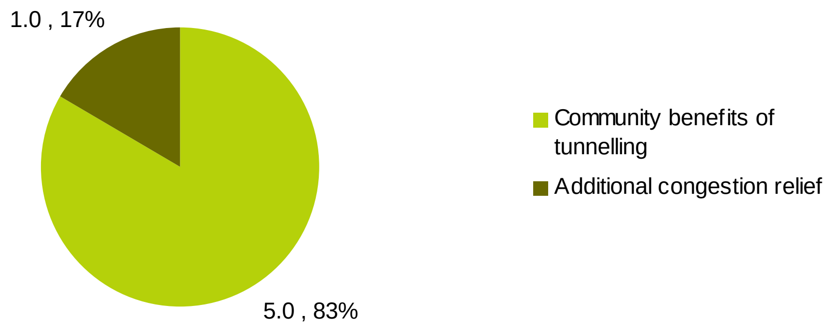
[2] Eddington, R. 2008, *Investing in Transport: East West Link Needs Assessment*, p.234-235
[3] In dollar terms, $17.1bn:$15.0bn.

Figure 2 – Retrofitting benefits included in the EWLNA report



Source: Eddington, R. 2008, Investing in Transport: East West Link Needs Assessment, p.234

PwC's approach

This review considers whether there are any substantial flaws in the analysis conducted for the EWLNA study team. This matters, for two important reasons. First, to check that the conclusions drawn by the EWLNA team remain valid. Second, for 'whole of Government' reasons, since if retrofitting benefits are included in one project analysis, they should – ideally – be included in other projects to assist comparison.

This note considers three elements of this question for each type of benefit:

- **Theory** – we consider and comments on the theoretical arguments for *and against* the economic validity of including each of the retrofitting benefits, and in particular on the EWLNA projects, outlining the argument for and against, but ultimately reaching a view on the theoretical applicability to Victoria alone;
- **Methodology** - we consider the methodology used by the EWLNA team to assess the retrofitting benefits, and to make a judgement as to whether the methodology accurately assesses the benefits and does not risk significant double counting;
- **Data** – we consider the assumptions and input data used by the EWLNA team to assess the benefits in this case, to consider if those assumptions are justified and if the data used is valid.

The note concludes with views on whether any factors covered in the above analysis are significant enough to call into question the BCR conclusions drawn by the EWLNA team. This review attempts to use plain English, so that it is understandable by non transport economists, however some residual jargon is unavoidable.

It should be noted that the services included in this proposal do not constitute either an audit in accordance with Australian Auditing Standards or a review in accordance with Australian Auditing Standards applicable to review engagements. This is a top down assessment of principles using sample testing based on a negative assurance basis.

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2 Community benefits of tunnelling

Introduction

The EWLNA report made two major infrastructure recommendations including:

- a new 17 kilometre rail tunnel linking Melbourne's fast-growing western and south-eastern suburbs; and
- a new 18 kilometre cross city road corridor that will involve tunnelling for the West Melbourne to the Eastern Freeway and potentially for the inner west to port link (which could alternatively be constructed as an elevated road).[4]

The package of interventions also included a significant truck action plan, bus priority measures, cycling routes and recommendations relating to vehicle efficiency.

The study team reported a number of benefits from the road and rail tunnelling, including improved reliability, capacity and amenity on surface streets, as well as allowing existing neighbourhood streets and parks to be largely protected.[5]

In an attempt to capture such tunnelling benefits, the EWLNA team calculated an estimated value of tunnelling that was added to the benefits produced from the traditional BCA.

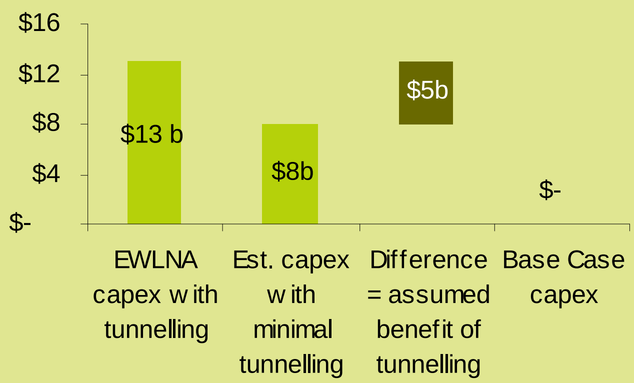
Theory, Methodology & Data

The theory applied by the EWLNA team to estimate the benefit of tunnelling, as well as the methodology employed and data used are detailed in Table 1, along with PwC's analysis.

Table 1 Elements of the community benefits of tunnelling included in the EWLNA report

Element	Description
Theory	The theory applied by the EWLNA team is that there is a large community benefit in placing infrastructure in a tunnel as it: • allows existing neighbourhood features of streets and parks to be largely protected; and

[4] Ibid, p.11
[5] Ibid, p.83 & Chapter 5, p.137 & Chapter 9, p.235

Element	Description
	• can improve the amenity of local areas currently impacted by high traffic volumes. *PwC response: there are significant economic benefits to tunnelling that should be assessed. These benefits are likely to include: reduced congestion on surface roads where a new surface links causes significant changes to the surface network; noise reduction, reduced landscape impact including preservation of parklands, visual amenity, and potential reductions in local air pollution (depending on the treatment of emissions from the tunnel) and savings in land acquisition costs from tunnelling developments.*
Methodology	Due to time constraints, the EWLNA team assumed that any additional construction cost for underground, as opposed to above-ground, development is representative of the additional community benefits that are likely to be gained from tunnelling. It therefore estimated the community benefit of tunnelling by calculating the additional construction cost of tunnelling over and above what might be incurred to deliver a similar project with minimal tunnelling. *PwC response: the issue with this approach is that the capital costs of tunnel boring are used as a proxy for community benefits of tunnelling. Ideally, the benefits accruing from underground provision (e.g. noise reduction, improved amenity, reduce surface air pollution) should be estimated in separate calculations which quantify the direct changes for each attribute.*
Data	The data types used by the EWLNA team to estimate tunnelling benefits are presented graphically in the figure below.  *PwC response: the methodology applied by the EWLNA team was a high level estimate of the difference with*

Element	Description
	and without tunnelling for the EWLNA project costs. Given that there are externality and other values that may be applied to capture some of the values obtained from tunnelling (as discussed below in Table 2); the direct estimation and calculation of each of the benefits would have produced a more accurate estimate of the benefits of tunnelling.

Source: Eddington, R. 2008, Investing in Transport: East West Link Needs Assessment, Chapter 9, p.235; and Australian Transport Council (ATC) 2006, National Guidelines for Transport System Management in Australia, Volumes 3, p.24

Recommendations

The EWLNA team acknowledges that the costs of tunnelling are only a proxy for the actual benefits of placing transport links underground in urban areas. This proxy can be improved, since many of the benefits of tunnelling are in fact directly measurable in the traditional CBA.

This allows a direct and specific comparison of the impact of an underground link (the project case); against either the base case or an alternative project case with the new link overground.

Therefore, PwC makes the following recommendation:

Table 2 PwC recommendations for the community benefits of tunnelling

No.	Description of recommendation
Recommendation #1	The impact of tunnelling should be re-assessed and calculated using a direct estimate of each benefit. These benefits should be included in the traditional BCA. The benefits will include: • decongestion impacts caused by major new corridors cutting across existing networks (which would be picked up by the transport modelling outputs such as passenger hours) – noting that if decongestion benefits are included for remaining road users, then value of travel time benefits cannot also be included for these road users to avoid double counting; • savings in land acquisition costs from tunnelling developments (both of which should be captured in a conventional BCA comparison of options);

No.	Description of recommendation
	• reduction in local air pollution (depending on the treatment of emissions from the tunnel); • noise reduction (based on reduced noise from tunnels and also fewer vehicle kilometres); • nature and landscape impacts including loss of parklands (during construction and operation); and reduced loss of visual amenity. • urban separation; and potentially • reduction in water pollution.[6] If these impacts are incorporated into the traditional CBA, then – to avoid double counting - the tunnelling benefit should be removed from the overall BCA calculation.

Source: Eddington, R. 2008, Investing in Transport: East West Link Needs Assessment, Chapter 9, p.235; and Australian Transport Council (ATC) 2006, National Guidelines for Transport System Management in Australia, Volumes 3, p.24; Austroads, Update of RUC Values to June 2005, p.18; and Victorian DOI, Cost Benefit Analysis Workbook, August 2007

[6] The externalities above are not included in the generalised cost of travel and hence need to be taken into account in the appraisal as a resource correction. Assessing these externalities would require detailed engineering design to predict the differential impact on these externalities of tunnelling options versus surface links. Values for these could be generated from the following sources:

- Victorian Department of Infrastructure (DOI), *Cost Benefit Analysis Workbook*, August 2007 – for rail and passenger/freight vehicles;
- Austroads, *Update of RUC Values to June 2005*, p.18 – for road transport; and
- ATC 2006, *National Guidelines for Transport System Management in Australia*, Volume 3: Appendix C, p.101 – for road transport.

3 Additional congestion relief

Introduction

Melburnians rely heavily on the road network because of their high dependency on private motor vehicles. Victoria's freight task is also dominated by road transport. Because of this, road congestion is a significant issue. As reported in the EWLNA study, congestion on Melbourne's roads is growing and predicted higher traffic volumes will generate even higher levels of congestion in the future along important cross city and central city access routes.[7]

Some potential impacts from future increased road congestion include:

- high increases in traffic expected on the West Gate Freeway (and the M1 route generally), the Western Ring Road, Calder Freeway and Geelong Road;
- increased levels of traffic congestion along key east west arterial routes, such as Footscray Road, Dynon Road, Geelong Road and Bell Street; and
- constraint on the broader network as traffic demand grows given the limited number of river crossings to and from the city's west.[8]

The transport developments recommended by the ELWNA team are expected to reduce congestion on the network. As the EWLNA team estimated that the transport model used in the traditional BCA undervalues congestion, they attempted to capture additional congestion benefits for inclusion in the BCR.

Theory, Methodology & Data

The theory applied by the EWLNA team to estimate the benefit of additional congestion relief, as well as the methodology employed and data used are detailed in Table 3, along with PwC's responses.

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[7] Ibid, p.92 & Chapter 4, p. 100
[8] Ibid, Chapter 4, p. 100

Table 3 Elements of the additional congestion relief benefits included in the EWLNA report

Element	Description
Theory	The theory applied by the EWLNA team is that there is a substantial economic and community benefit due to reduced congestion resulting from the EWLNA projects. However, the team believes that the transport model which underpins the traditional BCA undervalues the reduction in congestion attributable to the various transport projects as it does not accurately represent peak period queuing. For this reason the team considered that an additional value should be included in the BCR calculation to capture the undervalued decongestion benefit. *PwC response: decongestion benefits are typically significant benefits of both road and rail projects and should be measured in appraisal.*[9]
Methodology	Due to time constraints, the EWLNA team estimated an indicative allowance of $1 billion for decongestion benefits based on the relativities of peak period travel times. *PwC response: PwC has not undertaken a review of the Veitch Lister transport model as part of this critique. Without detailed understanding of the model, we can only suggest that generally, incorporation of decongestion benefits for remaining road users via a transport model (which better captures the wider decongestion effects) as opposed to a high level estimate is likely to be a more robust methodology.* *However, if a high level estimate is used, then there is a risk of double counting since a traditional BCA would commonly capture the following decongestion benefits:* • *reduced travel time;* • *reduced vehicle operating cost;* • *change in the number and/or severity of crashes; and* • *reduced environmental externalities when there is a shift from road to public transport.*
Data	The data used by the EWLNA team to estimate the benefits of additional congestion relief included relative peak period travel times.

[9] *See ATC 2006, Volume 4, p.103.*

Element	Description
	From these, the team increased the benefits included in the traditional BCA by an amount equal to 9% of the traditional benefits, to account for additional queuing congestion. *PwC response: the methodology applied by the EWLNA team provided a high level estimate of the EWLNA projects' benefits of reduced queuing congestion. Given that there are decongestion and unreliability values that are inherently included in a BCA analysis (eg the value of travel time savings for all remaining road users), the calculation of these values via the traditional BCA could provide a more accurate approach to estimate these benefits.*

Source: Eddington, R. 2008, Investing in Transport: East West Link Needs Assessment, Chapter 9, p.235; and ATC 2006, National Guidelines for Transport System Management in Australia, Volume 4, p.103

Recommendations

PwC's recommendations on the additional congestion relief benefits and their inclusion in the EWLNA project BCR on page 234 of Chapter 9 of *Investing in Transport: East West Link Needs Assessment* are presented in Table 4.

Table 4 PwC recommendations for additional congestion relief benefits

No.	Description of recommendation
Recommendation #1	If possible, the transport model used should be amended in order to better capture wider congestion in the normal manner, allowing the CBA to capture the benefits of congestion according to standard methodologies.
Recommendation #2	If the transport model does underestimate the level of actual congestion experienced by remaining road users, then the 'missing' congestion impacts should in theory be calculated. However, estimating the missing decongestion benefits needs care. In a public transport project, the convention is that a generalised value of decongestion is incorporated into the traditional BCA for non-switching road users who benefit from PT improvements. Importantly, these users are <u>not</u> attributed benefits from reduced travel time (VOTT). This is reflected in both the DoI

No.	Description of recommendation
	and ATC Guidelines. However, the EWLNA BCA appears to have calculated travel time savings for all road users. Therefore, applying a generalised value of decongestion for non-switching road users, *in addition to* a VOTT for all users, is likely to double count the benefits to those road users. This suggests that the best way to incorporate missing decongestion benefits would not be through a value of decongestion 'uplift', but by estimating the extent to which the transport model underestimates VOTT savings for road users. However, this raises a further methodological issue, because the current EWLNA approach seems to include a VOTT for non-switching road users who, according to the guidelines, should only receive a decongestion value. This risks overestimating the benefits. But, improving the situation in the case of the ELWNA projects is complicated by the multimodal nature of the projects. In theory, because there are also road improvements in the project, there will be some travel time savings for road users *that are due only to the road improvements*. Conventionally, VOTT should be applied to these road users instead of a generalised decongestion value. However, unless the traffic model can specifically separate these road user benefits from the road user benefits resulting from the public transport improvements, it may simply be more feasible to measure VOTT across all road users and <u>not</u> to include decongestion at all - noting the likelihood of overstatement from this approach. *Therefore, PwC recommends that the EWLNA team:* • *measure VOTT across all road users;* • *estimate an uplift on VOTT which reflects transport model underestimations;* • *do <u>not</u> include a value for decongestion; and* • *note the likelihood of overstatement from this approach.*

Source: Eddington, R. 2008, Investing in Transport: East West Link Needs Assessment, Chapter 9, p.235; and ATC 2006, National Guidelines for Transport System Management in Australia, Volume 4, p.47 & 57

4 The benefits of network alternatives

Introduction

There are a limited number of Yarra River crossings and cross city travel options to and from the west, which is already a significant constraint on the overall transport network in Melbourne – and will become an even greater constraint as travel demand grows. The West Gate Bridge, which is the main river crossing from the west to central Melbourne is already one of the main locations of congestion within the EWLNA Study Area and metropolitan wide. Current daily traffic volumes on the Bridge are 165,000 and are predicted to grow more than 40% to 235,000 trips per day by 2031.[10]

A number of previous reviews have drawn attention to congestion on the bridge and suggested duplication of the bridge as a possible solution, including the Victorian Competition and Efficiency Commission (2005) and the Victorian Freight and Logistics Council (2006).[11]

The EWLNA Study Team shared the widespread concerns about the short- and long-term vulnerability of Melbourne's transport network as a result of over-reliance on the West Gate Bridge. The team believes that Melbourne needs the 'insurance' of a long-term alternative to the West Gate Bridge and that action should commence as soon as possible to develop and deliver such an alternative.[12]

Theory, Methodology & Data

The theory applied by the EWLNA team to estimate the benefit of building network redundancy (in particular West Gate bridge redundancy), as well as the methodology employed and data used are detailed in Table 5, along with PwC's responses.

[10] Ibid, Chapter 4, p.96 & 98
[11] Ibid, Chapter 5, p.136
[12] Ibid.

Table 5 Elements of the network redundancy benefits included in the EWLNA report

Element	Description
Theory	The theory is that there is a benefit gained from creating transport network redundancy. The EWLNA report indicates that the development of the cross city road corridor will provide network redundancy for the West Gate Bridge (currently relied upon as the major river crossing). In particular, the EWLNA report suggests that a chief benefit of the alternative to West Gate Bridge is economic – considering "what would be the economic consequences for Melbourne if that critical trade route was not available?" *PwC response: a traditional BCA could capture the benefits of an alternative river crossing to the West Gate Bridge, in the sense that it models impacts on decongestion or travel time, number of trips as well as mode of travel resulting from different trip times. This would mean that reliance on the West Gate Bridge in the Base Case would be captured in the significant capacity constraints and resulting travel times relative to a Project Case that removes this congestion.* *In addition, the economic impacts resulting from reliance on the West Gate Bridge are effectively already encompassed in the value of travel time methodology applied in the traditional BCA. This is because the valuation of travel time approach effectively assumes that:* "Savings in travel time convert non-productive time to productive use and that, in a free labour market, the value of an individual's working time to the economy is reflected in the wage rate paid. This benefit is assumed to be passed into the wider economy and to accrue in some proportion to the producer, the consumer and the employee, depending on market conditions" (see UK Department for Transport 2007, Values of Time and Operating Costs, p.2). *Therefore 'daily' benefit of alternatives in terms of reduced congestion or travel time, including during short periods of effective closure, is covered in EWLNA BCA in annual travel time savings.* *However, the issue is whether the indirect, second round or genuinely additional knock-on impacts of a major disruption – such as the closure of the bridge for a year for safety reasons – is captured by these*

Element	Description
	standard time savings. For instance, a major disruption may cause structural changes in the operations of business which are heavy users of the bridge (for example, buying more delivery vans and employing more drivers due to extra journey times). *It is likely that these effects are underestimated: PwC has previously worked with a transport model which factored in random unplanned outages to assess delays from such disruptions (see recommendation #1 below).*
Methodology	The EWLNA team did not attempt to quantify network redundancy in the BCR calculation for the EWLNA projects (this benefit was only discussed qualitatively). *PwC response: the difficulty in determining an appropriate methodology for estimating this benefit is in avoiding double counting. As indicated in the 'theory' section, the value of travel time and externalities already included in the traditional BCA would already capture many of the benefits of a second river crossing. If the modelling could capture instances where the West Gate Bridge is closed (or a similar event greatly impacting traffic flows) however, then there may be opportunity to include this in the analysis (see Recommendation #1 below).*
Data	The EWLNA team did not attempt to quantify network redundancy in the BCR calculation for the EWLNA projects, hence no data was used aside from vehicle volumes per day.

Source: Eddington, R. 2008, Investing in Transport: East West Link Needs Assessment, Chapter 9, p.235 & Chapter 5, p.136; and UK Department for Transport 2007, Values of Time and Operating Costs, Transport Analysis Guidance (TAG) Unit 3.5.6, p.2

Recommendations

Table 6 PwC recommendations for network redundancy benefits

No.	Description of recommendation
Recommendation #1	In order to more fully capture the benefits of network redundancy, and in particular to capture enhanced reliability, PwC recommends that the following methods be explored with the traffic modeller: • *capture delay from incidents and associated road closures*

No.	Description of recommendation
	In traffic modelling undertaken for PwC in a previous transport BCA, the traffic modeller and PwC devised a methodology to estimate the impacts of incidents on the network on vehicle kilometres, hours and operating costs. This could be useful to model the impacts on the Melbourne network if, under the Base Case, the West Gate Bridge is frequently characterised by delays from road closures. The methodology previously devised by the transport modeller and PwC is summarised below: • *delays from incidents under the project scenarios and the base case were estimated and applied to normal day operations using the rates of three types of incidents (fatal crashes, road works and other incidents) to estimate frequency of occurrence. Delay rules were then applied to generate road user costs.*
Recommendation #2	PwC recommends that, if and where relevant, other major impacts on the West Gate Bridge operations are captured in the conventional BCA using historic frequencies of major unexpected outages. The chief difficulties in this analysis are ensuring that no double counting occurs vis-avis routine travel time savings.

Source: Eddington, R. 2008, Investing in Transport: East West Link Needs Assessment, Chapter 9, p.235

5 Recommendations

PwC's recommendations relating to the inclusion and estimation of retrofitting benefits in the EWLNA BCR are provided below. The recommendations aim to lead to more robust BCA results through a more accurate methodology. While it is not possible to currently indicate with any surety how the BCR will be affected by each of these recommendations, a summary of the expected impacts is also provided.

Table 7 – summary of recommendations

No.	Description of recommendation
Recommendation #1: Benefits of tunnelling	The impact of tunnelling should be re-assessed and calculated using a direct estimate of each benefit. These benefits should be included in the traditional BCA. The benefits will include: • decongestion impacts caused by major new corridors cutting across existing networks (which would be picked up by the transport modelling outputs such as passenger hours) – noting that if decongestion benefits are included for remaining road users, then value of travel time benefits cannot also be included for these road users to avoid double counting; • savings in land acquisition costs from tunnelling developments (both of which should be captured in a conventional BCA comparison of options); • reduction in local air pollution (depending on the treatment of emissions from the tunnel); • noise reduction (based on reduced noise from tunnels and also fewer vehicle kilometres); • nature and landscape impacts including loss of parklands (during construction and operation); and reduced loss of visual amenity. • urban separation; and potentially • reduction in water pollution.[13]

[13] The externalities above are not included in the generalised cost of travel and hence need to be taken into account in the appraisal as a resource correction. Assessing these externalities would require detailed engineering design to predict the differential impact on these externalities of tunnelling

No.	Description of recommendation
	If these impacts are incorporated into the traditional CBA, then – to avoid double counting - the tunnelling benefit should be removed from the overall BCA calculation. *This recommended change is likely to lead to a reduction in the BCR.*
Recommendation #2: Benefits of additional congestion relief	If possible, the transport model used should be amended in order to better capture wider congestion in the normal manner, allowing the CBA to capture the benefits of congestion according to standard methodologies. *This recommended change is likely to lead to a reduction in the BCR.*
Recommendation #3: Benefits of additional congestion relief	If the transport model does underestimate the level of actual congestion experienced by remaining road users, then the 'missing' congestion impacts should in theory be calculated. However, estimating the missing decongestion benefits needs care. In a public transport project, the convention is that a generalised value of decongestion is incorporated into the traditional BCA for non-switching road users who benefit from PT improvements. Importantly, these users are <u>not</u> attributed benefits from reduced travel time (VOTT). This is reflected in both the DoI and ATC Guidelines. However, the EWLNA BCA appears to have calculated travel time savings for all road users. Therefore, applying a generalised value of decongestion for non-switching road users, *in addition to* a VOTT for all users, is likely to double count some of the benefits to those road users. This suggests that the best way to incorporate

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options versus surface links. Values for these could be generated from the following sources:

- Victorian Department of Infrastructure (DOI), *Cost Benefit Analysis Workbook*, August 2007 – for rail and passenger/freight vehicles;
- Austroads, *Update of RUC Values to June 2005*, p.18 – for road transport; and
- ATC 2006, *National Guidelines for Transport System Management in Australia*, Volume 3: Appendix C, p.101 – for road transport.

No.	Description of recommendation
	missing decongestion benefits would not be through a value of decongestion 'uplift', but by estimating the extent to which the transport model underestimates VOTT savings for road users. However, this raises a further methodological issue, because the current EWLNA approach seems to include a VOTT for non-switching road users who, according to the guidelines, should only receive a decongestion value. This risks overestimating the benefits. But, improving the situation in the case of the ELWNA projects is complicated by the multimodal nature of the projects. In theory, because there are also road improvements in the project, there will be some travel time savings for road users *that are due only to the road improvements*. Conventionally, VOTT should be applied to these road users instead of a generalised decongestion value. However, unless the traffic model can specifically separate these road user benefits from road user benefits resulting from the public transport improvements, it may simply be more feasible to measure VOTT across all road users and not to include decongestion at all - noting the likelihood of overstatement from this approach. *Therefore, PwC recommends that the EWLNA team:* • *measure VOTT across all road users;* • *estimate an uplift on VOTT which reflects transport model underestimations;* • *do not include a value for decongestion; and* • *note the likelihood of overstatement from this approach.* *This recommended change is likely to lead to a reduction in the BCR.*
Recommendation #4: Benefits of network alternatives	In order to more fully capture the benefits of network redundancy, and in particular to capture enhanced reliability, PwC recommends that the following methods be explored with the traffic modeller: • *capture delay from incidents and associated road closures* In traffic modelling undertaken for PwC in a previous transport BCA, the traffic modeller and PwC devised a methodology to estimate the impacts of incidents on the network on vehicle kilometres, hours and

No.	Description of recommendation
	operating costs. This could be useful to model the impacts on the Melbourne network if, under the Base Case, the West Gate Bridge is frequently characterised by delays from road closures. The methodology previously devised by the transport modeller and PwC is summarised below: • Delays from incidents under the project scenarios and the base case were estimated and applied to normal day operations using the rates of three types of incidents (fatal crashes, road works and other incidents) to estimate frequency of occurrence. Delay rules were then applied to generate road user costs. *This recommended change is likely to lead to an increase in the BCR.*
Recommendation #5: Benefits of network alternatives	PwC recommends that, if and where relevant, other major impacts on the West Gate Bridge operations are captured in the conventional BCA using historic frequencies of major unexpected outages. The chief difficulties in this analysis is ensuring that no double counting occurs vis-avis routine travel time savings. As this benefit is not currently quantified in the analysis, we believe that PwC's recommendations would result in a higher BCR. *This recommended change is likely to lead to an increase in the BCR.*