Response to the West Gate Tunnel Transport Impact Assessment transportation modelling report in the West Gate Tunnel Environment Effects Statement

This report responds to the *West Gate Tunnel Transport Impact Assessment*, prepared by GHD on behalf of the Western Distributor Authority. The WGTTIA is an assessment of the current transportation situation, and a comparison of the forecast situation in 2031 using a 'base case' and a 'project case' (see figure below). In the WGTTIA, discussion of the impacts of WGT completion are a comparison between the build and no-build cases. Where, for example, an 8-minute travel time saving between the M1-M80 intersection and the CBD is forecast, this refers to the travel times in 2031 if the project is built versus not being built – not to 2017 observed travel times. The WGGTIA indicates an expected 55,000-67,000 vehicles per day to use the WGT in 2031, as indicated in Table 1. While the forecasts indicate that this will reduce the strain on the Westgate Bridge, Footscray Road, Dynon Road, and Ballarat Road, each of these existing links will still see an overall increase in use between the build case and the present base case.

The WGTTIA uses Veitch Lister's (VLC) 'Zenith' travel demand modelling software, which predicts strategic network impacts of new travel infrastructure. Incorporated into the build and no-build forecasts are demographic, economic, and land-use and infrastructural assumptions. The purpose of this report to is provide feedback on these assumptions. I first provide a brief overview of efficacy of travel demand forecasting using four-step models; following this I address each of the assumption sets briefly. Primary areas of concern are around the land-use assumptions and transportation infrastructure assumptions. The WGTTIA also uses the VISSIM microsimulation software to forecast impacts on the travel network at the road-section and intersection level, however critique of this approach is beyond my current expertise.

Table 1: Summary of the forecast traffic changes in the WGTTIA, all figures in thousands of vehicles per day. 2016 is the base case, 2031 NB is where WGT is not constructed, and 2031 B is where WGT is constructed. Compiled from WGTTIA except "B vs 16", which is the average of the build scenario minus the average of the 2016 observations.

Bridge	Lanes	2016	2031 NB	NB vs 16	2031 B	B vs NB	Build vs '16
WG Bridge	10	181-221	221-271	45	196-240	-28	+17
Footscray	4-6	35-43	46-56	13	39-49	-8	+5
Dynon	4	39-48	47-58	10	44-53	-4.5	+5
Ballarat	4	36-44	43-52	7	39-67	-4	+13
WG Tunnel	4	n/a	n/a	n/a	55-67	n/a	+61

Travel Demand Forecasting

To provide context, I will briefly sketch out the technique used to produce the numbers in the WGTTIA – the four-step model of travel demand forecasting. The WGTTIA was, in part, prepared using a modified four-step travel demand model. These are statistical and econometric tools used to forecast the level of travel demand at the network level, and may be modified by the incorporation of new roads or

links to test their potential impacts. The four steps are generation, distribution, mode assignment and route assignment[1]:

1. Generation: the number of trips starting in a block, through employment and residential observations and external forecasts,
2. Distribution: the number of trips ending in a block, through employment and residential observations and external forecasts,
3. Mode assignment: using probability to predict the proportion of trips using available modes,
4. Route assignment: assumes travel time equilibrium as assigns trips along the available paths.

Australia's recent history with transportation mega-project demand forecasting is less than stellar; however, this is not a uniquely Australian phenomenon. There is a focus in the academic literature on the efficacy of travel demand forecasting – forecasting is statistically biased and imprecise. A 2014 literature review by Morten Nicolaisen and Patrick Driscoll[2] indicates that for toll roads, such as the WGT, the observed use of the road ends up being less than the initial demand forecasts, after a year of operation. A 2009 study by Robert Bain[3], a well-respected and experienced traffic consultant and academic, demonstrated that on average, over 104 toll road projects observed traffic after one year of operation was 23% lower than forecast traffic. A similar study by Zheng Li and David Hensher[4] in 2010 of five Australian toll road projects showed a 43% inaccuracy. Imprecision is also a problem with traffic forecasts: a 2013 study by David Hartgen indicates that approximately half of road project forecasts are incorrect by more than 20%[5]. These inaccuracies stem from a variety of complementary or conflicting sources, which may act to compound or cancel out errors.

Sources of Bias in Modelling

There are numerous mechanisms through which bias and imprecision in forecasting occurs. These include inherent bias in the modelling process, bias derived from transport-land-use dynamics, 'optimism' bias, and 'pessimism' bias. Each of these may be manifest in the forecasts for the WGT. Internal model mechanics, such as the specific econometric and statistical techniques employed in the model, are an important inherent source of bias. Often these processes are 'black-boxed' and are unavailable for public scrutiny. This is certainly the case in the WGTTIA. The literature indicates that the models should be subject to external peer-review. While the report indicates that the WGT model was subject to peer-review, it is unclear if the modelling suite was – and in either case, these peer-reviews are not readily publicly available.

[1] Ortuzar, J., & Willumsen, L. (2011). *Modelling Transport.* West Sussex, UK: John Wiley & Sons.
[2] Nicolaisen, M. S., & Driscoll, P. A. (2014). Ex-Post Evaluations of Demand Forecast Accuracy: A Literature Review. *Transport Reviews*, 34(4)
[3] Bain, R. (2009). Error and optimism bias in toll road traffic forecasts. *Transportation, 36*(5)
[4] Li, Z., & Hensher, D. A. (2010). Toll Roads in Australia: An Overview of Characteristics and Accuracy of Demand Forecasts. *Transport Reviews, 30*(5)
[5] Hartgen, D. T. (2013). Hubris or humility? Accuracy issues for the next 50 years of travel demand modeling. *Transportation, 40*(6)

Demographic, economic, and other types of forecasts are also instrumental in the creation of models. These, however, are all externally sourced. In the WGTTIA, the demographic forecasts indication a 44% increase in population of the western suburbs of Melbourne by 2031. These figures were produced by SGS Economics & Planning in a process external to VLC's Zenith – were there errors in the SGS forecast, these may be compounded in the VLC forecast. The process and assumptions of these forecasts would need to be separately critiqued. Similarly, economic and other forecasts, such as employment, economic growth, fuel prices, public transport fare, and others, are externally sourced and require additional focused critique.

These are forms of bias in travel demand forecast accuracy that derive from the political and selection process. Optimism bias is also known as 'strategic misrepresentation', and arises when demand figures are presented in a more positive light, or inflated, to win the bidding process. Selection bias is where the process of selection inadvertently causes forecasts with higher ranges of error to be selected because they appear to be more advantageous[6]. I am not able to assess the presence of either of these processes in the WGTTIA, as they require greater insight into the practices of those doing the forecasting. This does not rule out optimism bias or selection bias as a potential source of error for the WGT though.

Transport-land-use Dynamics and Induced Demand

This category relates to the ability of the model and its inputs to assess the interaction between the transportation network and how land is used throughout the city, including, but not limited to, induced demand. The way that *WGTTIA* handles induced demand raises questions. Induced demand is the observed phenomenon whereby the provision of new travel infrastructure leads an increase in the amount of travel observed in a city. This is a complex process, whose individual components and exact causal relations are contested[7]. Induced demand includes changes in route selection (the new infrastructure makes for an easier trip), destination change (the new infrastructure facilitates longer trips), time-of-travel changes (the new infrastructure facilitates more trips at a time), and additional journeys (the new infrastructure allows more trips per person). The 2031 build and no-build cases for the WGT, by VLC's Zenith model, incorporate route change, destination change, and mode change. It does not incorporate time-of-travel change, journey addition, or relocated trips.

Importantly, *WGTTIA* assumes little to no land-use change by 2031 because of the construction of the new infrastructure. The *WGTTIA* uses the Victoria in Future 2014 land-use forecasts, in which the WGT was not yet committed, so it is not incorporated into land-use projection. This is an unreasonable assumption, because land-use change arising from the construction of new roads is a factor correlated to induced demand – specifically on the destination change mechanism. For example, constructing the WGT might lead to more people choosing to live on the western edge of Melbourne and commute in to

[6] Xu, X., Chen, A., Wong, S. C., & Cheng, L. (2015). Selection bias in build-operate-transfer transportation project appraisals. *Transportation Research Part A: Policy and Practice, 75*

[7] Næss, P. (2011). The Third Limfjord Crossing: A Case of Pessimism Bias and Knowledge Filtering. *Transport Reviews, 31*(2)

jobs in the CBD. If this happened, traffic numbers on the road might be higher than the numbers projected by the WGTTIA. It is unclear, outside of the land-use numbers being external, that this was not updated or incorporated. There is precedent to do this in Victoria: the Melbourne Metro Rail Tunnel (MMRT) Program and Extended Program cases[8] both include land-use change arising from their construction; the Base Case (no-build) does not include land-use change because the project would not have been built. This is a key oversight in the *WGTTIA*: the potential for land-use change is brushed aside as low, and no evidence is presented to indicate that this is the case.

"Pessimism" Bias in the "No-Project" Scenario

This is reasonably similar in character to induced demand, and relates to how the modelling process deals with existing-yet-unbuilt transportation project proposals, and the assumption of constant traffic growth over the forecast period. This creates bias and imprecision in the 'no-build' scenario – for WGT, the 2031 forecast where the road is *not* built. The 2031 no-build scenario predicts that 80% of trips will be taken by road, a reduction from 85% in 2014. In the western suburbs, these number are 87% and 90% respectively. Because of an overall increase in travel demand, the number of trips on roads is predicted to increase by 48% by 2031[9].

This 48% increase in demand for road space is facilitated by an existing program of road construction – something that the model correctly incorporates, despite a lot of these projects being incomplete. For WGT, these are the transportation outcomes assumptions (section 6.2.2). The 2031 no-build scenario travel demand forecast includes the CityLink/Tullamarine Freeway Widening, the M80 Upgrade, and the very extensive Outer Suburban Arterial Roads program. This represents more than 100km of freeway lanes, and more than 700km of additional arterial roads. Additional road-based works include the West Gate Distributor, which is an upgrade to the Shepherd Bridge over the Maribyrnong. It also includes the Melbourne Metro Rail Tunnel; however, it is unclear if this is just the tunnel, or the Extended Program per the MMRT Business Case[10]. This does not include projects that have not been committed to[11]. WGT is small fraction of the road infrastructure being built between now and 2031.

An emerging field in the literature indicates that this 48% prediction might be unnecessarily pessimistic, because the construction of travel infrastructure facilitates these increases in demand. Morten Nicolaisen and Petter Næss analyse the no-build scenarios in 35 plans in Denmark and England, and show that in more than 70% of these plans, actual traffic demand did not reach the end-of-period forecast levels when

[8] Public Transport Victoria (2016). *Melbourne Metro: Public Transport Demand Forecasts for Business Case.* Available at: http://metrotunnel.vic.gov.au/__data/assets/pdf_file/0020/40484/MM-Business-Case-Feb-2016-APPENDIX-05.PDF

[9] This figure excludes road-based public transport, such as trams and buses. Interesting, the demand for public transport is predicted in the very same model to increase by 106%!

[10] Public Transport Victoria (2016).

[11] These include the MMRT2 Tunnel, which would also cross the Yarra between Fishermans Bend and Newport, additional shipping port facilities at Bay West and/or Hastings, and, of course, the East West Link.

projects were not constructed[12]. The average demand overestimation was approximately 7%. In simpler terms, it is possible that the no-build scenario is overestimating the extent of future congestion, thereby making the build option a more attractive alternative. Ultimately, a primary reason for the WGTTIA to deem the new road to be necessary is because of all the other roads built between now and 2031, which would enable more cars to be on the road and so increase the demand for road space.

Additional Comments

There are a few other items in the WGTTIA that might warrant attention:

- In addition to the WGT being dependent on an existing package of road construction and upgrades, it also appears to be quite dependent on CBD access ramps. Internal calibration by VLC indicates that removing these links from the model saw a 10% reduction in travel demand through the tunnel. This represents approximately 6,100 trips per day.
- A core rationality used to justify the project is 'network resilience' - the provision of an additional crossing of the Maribyrnong. It is unclear how WGT can achieve this if it is to also absorb the forecast growth in traffic. A back-of-the-envelope calculation of the inward morning peak capacity of the WGT is approximately 7,200 in a two-lane configuration, and up to 10,800 in a three-lane configuration[13]. After this point, average speed will drop off, and 'congestion' will result. The forecast number of users in the AM Peak for 2031 is 6,600 (p. 264): very close to the stated capacity of the tunnels. Were there an incident on the West Gate Bridge, WGT may not offer very much additional redundancy in the road network anyway.
- An extensive program of metro-wide road expansion and building (more than 700km of new or improved arterial road) will result in a 48% increase in road network demand by 2031; and a relatively limited set of improvements to public transport (the MMRT and associated improvements) will result in a doubling of demand for public transport. The report is forecasting a large increase in public transport patronage and presenting a new road tunnel as the solution. Spending the money on public transport might be a better way of meeting growing transport demand from the outer west.

Conclusion

It is not possible to say, with any more certainty than the forecasts themselves, whether the numbers presented in the *WGTTIA* are accurate. The numbers presented in the *WGTTIA*, however, are based on a practice that has a poor history of accuracy and rests on numerous assumptions that may not come to be. Key areas of concern are the lack of inclusion of updated land-use data, which effectively implies that the WGT will not alter land-use; that the WGT appears necessary in the model, in part, because of roads

[12] Nicolaisen, M. S., & Næss, P. (2015). Roads to nowhere: The accuracy of travel demand forecasts for do-nothing alternatives. *Transport Policy, 37*

[13] The WGTTIA indicates a rule-of-thumb 1,800 car-units per lane per hour, after which point the Level of Service (a measure of congestion and delay) will drop to E or F.

that have not been constructed yet; and that the models indicate large growth in public transport usage, but offer a road as a solution. We have choices about many of these, and we can choose the future transportation network we want our city to have.

Nathan Pittman | PhD Candidate in Urban Planning
Melbourne School of Design
The University of Melbourne, Victoria 3010 Australia
E: nathan.pittman@unimelb.edu.au | unimelb.edu.au