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Zenith *Victoria* Technical Note

Static Traffic Assignment – Estimation, Calibration and Validation

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Static Traffic Assignment – Estimation, Calibration and Validation

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29-10-2012	A	TV	AMA	TV	Draft Report
06-12-2012	B	AMA	AMA	AMA	Updated report cover

Contents

1 Introduction

This Technical Note is one of a series of papers that collectively describe the Zenith Travel Model of *Victoria*.

The subject of this note is the estimation, calibration and validation of the Static Traffic Assignment (STA) component of the Victorian Zenith model. Particular focus is given to the development of route choice model parameters, which are used to calculate probabilities for tolled and untolled routes.

This document does not, however, provide a broad or detailed description of the Zenith STA methodology. A sister document, entitled *"Zenith Technical Note - Static Traffic Assignment – Methodology"* provides a detailed description the Zenith STA, and it is assumed that the reader will have read this methodology document prior to reading this note.

The two documents are complementary:

- **Zenith Technical Note - Static Traffic Assignment – Methodology** *(sister document)* - describes the general Zenith STA method in detail,
- **Zenith Victoria Technical Note – Static Traffic Assignment – Estimation, Calibration and Validation** *(this document)* **–** describes the development and validation of the input parameters used in the Victorian implementation of the Zenith STA

The remainder of this document is structured as follows:

- Section 2 describes the set of available data sources;
- Section 3 discusses model estimation and calibration; and
- Section 4 discusses the application of the model to Victorian toll roads.

2 Data Sources

This section describes the data sources used to estimate, calibrate and validate the Zenith STA.

The data sources are:

- **CityLink Usage Surveys –** in late 2003, VLC conducted a mixed stated and revealed preference survey on behalf of the Southern and Eastern Integrated Transport Authority (SEITA), the authority responsible for the planning and procurement of the EastLink toll road in Melbourne. The surveys were used to develop the route choice model parameters which underpinned VLC's forecasts for EastLink. The model parameters have evolved since that time based on more recent information, but the structure remains the same.
- **Traffic counts** – VLC has access to traffic counts from VicRoads' homogenous flow database. VLC also has access to counts at various locations on both CityLink and EastLink, which can be used to validate the model's toll road predictions.

VLC also has access to the Victorian Integrated Survey of Travel and Activity 2007-08 (VISTA07). As part of this survey, car drivers were asked to record the key roads used as part of their journey. VLC has used this data to construct an alternative (and more recent) revealed preference data set, and has begun the process of exploring more advanced model structures based on this data. This work is not yet complete, and is not discussed further in this document.

More information about the 2003 CityLink Usage Survey is provided in the following sub-section.

2.1 2003 CityLink Usage Surveys

In late 2003, VLC conducted a survey of CityLink usage on behalf of SEITA. The surveys were collected to support traffic forecasting for the EastLink toll road (note that EastLink was not completed until 2008).

The survey used a cluster sampling technique, with 1,030 individuals surveyed in 19 clusters. The survey clusters are shown in Figure 1 below, with the CityLink toll road shown in blue. The survey locations were deliberately chosen to maximise the diversity of survey data collected, in terms of the range of travel time savings achievable using CityLink, the range of toll levels, and range of trip lengths.

The survey was conducted as follows:

- The survey was an "individual" survey rather than a "household" survey,
- Multiple members of the same household could be interviewed, but this was not compulsory,
- To be eligible for the survey, individuals were required to have a valid driver's licence, and have access to a car.

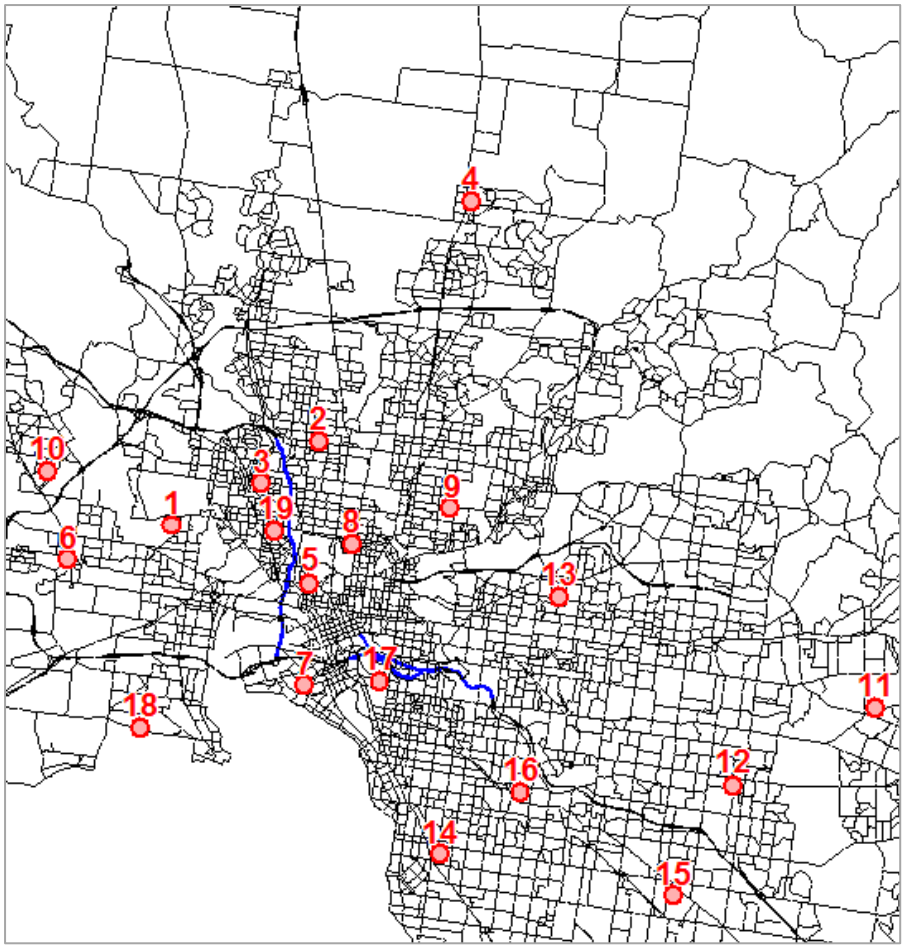


Figure 1 – CityLink Usage Survey Cluster Locations

The survey consisted of three parts:

- Green form - Collection of demographic information
  - Occupational Status
  - Access to a company car
  - Place of work
- Blue Form - Collection of recent actual "cross town" trip details
  - Origin / destination
  - Trip purpose
  - Departure time
  - Route taken (including CityLink entry / exit locations if CityLink was used)
  - Vehicle type
  - Personal payment of toll?
  - Trip duration
  - Estimated time saving (if CityLink was used)
  - E-Tag account holding
- Red Form – Collection of hypothetical "cross town" trip details for a set of pre-defined destinations
  - Whether the respondent would consider driving or taking a taxi to the defined destination
  - Estimated journey time

- Likely route taken (including CityLink entry / exit locations if the respondent would use CityLink)
- Whether the respondent would be required to personally pay the toll
- Estimated time saving (if the respondent said they would use CityLink)

The survey was deliberate in requesting details of "cross town" journeys, to maximise the likelihood that CityLink would be considered as an alternative. For interviews conducted in the South & East, this meant asking about journeys made to the inner city and the North & West, and vice versa. This led to two versions of the survey form (one for South & East, one for North & West).

The survey also included a mix of revealed and stated preference data. The revealed preference data, collected in the Blue Form, asked about the route taken as part of actual journeys. The stated preference data, collected in the Red Form, asked about the interviewee's likely route for cross town journeys to a series of well-known locations. Statistics relating to the survey sample are presented in Table 1 below.

	Blue Form (actual journeys, revealed preference)	Red Form (hypothetical journeys, stated preference)
Count of "all trip records"	2,672	2,306
Count of "usable trip records"	1,527	1,428
Trip records where CityLink was used	488	438

Table 1 - Survey Summary Statistics

In Table 1, the distinction is drawn between "all trip records", and "usable trip records". "Usable", in this context, refers to trip records where the respondent was faced with a legitimate choice between tolled and untolled routes. For this to be the case, the toll road (CityLink) had to provide a time saving compared with the untolled route. In the remaining "unusable" trip records, the untolled route was fastest (and of course cheapest). These records were not used in the estimation of model parameters.

The survey forms and survey instructions for respondents living in the South & East are included in Appendices A and B respectively.

3 Model Estimation and Calibration

The estimation of the route choice model was performed using the 2003 CityLink Usage Survey dataset described in Section 2.1. The primary aim of this work was to develop a model capable of estimating the likely usage of toll roads given varying levels of travel time saving and toll.

The survey collected data relating to both revealed and stated preferences. This led to the development of three separate models: one based on revealed preference, one based on stated preference, and one based on the combined dataset. We had most success with the revealed preference only dataset, and this formed the basis of the adopted model.

3.1 Segmentation

As part of our analysis we segmented the data in numerous ways. Of these, the following three-way segmentation was found to be most useful:

- Airport Travel
- Company Car (for non-airport travel)
- Non-Company Car (for non-airport travel)

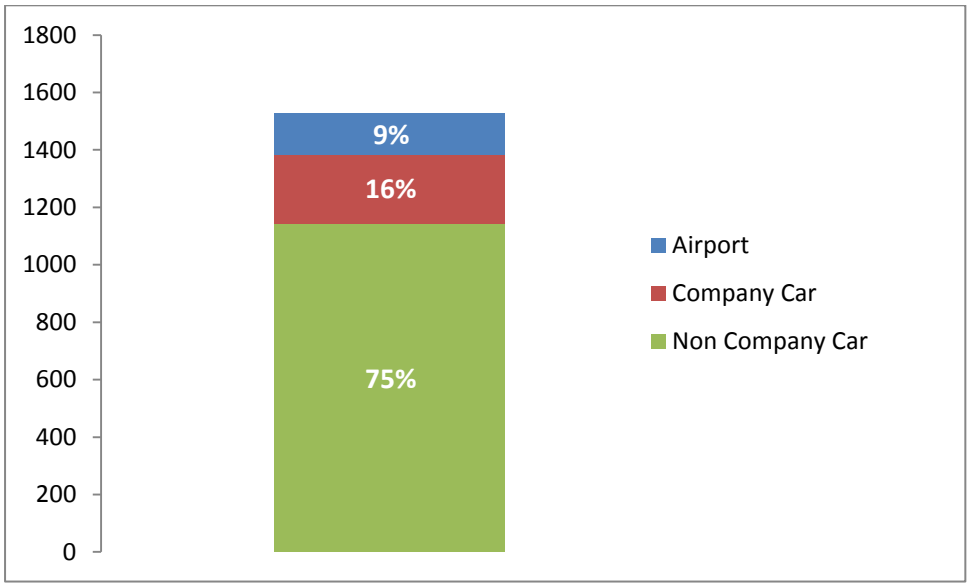


Figure 2 - Breakdown of the Survey Dataset by Segment

Of the 1,527 usable trip records in the revealed preference dataset, 9% were made to the airport, 16% were made in a company car, and the remaining 75% were made in a non-company car.

It is worth noting that the above proportions do not necessarily reflect the breakdown of trips *in the real world*. Our survey was deliberately constrained to collect cross town travel only, and this will result in a disproportionately large number of airport trips in the sample. This does not, however, bias the estimated model parameters, given that each segment was estimated separately.

The importance of this segmentation is illustrated in Figure 3 below, which shows the relative proportions of tolled and untolled users for each segment. Of the 144 surveyed airport trips, 72% reported using CityLink. For trips made in company cars and non-company cars, the proportion of CityLink users dropped to 38% and 26% respectively. Recognising that these proportions are based on a sample survey, 95% confidence intervals have been calculated, from which we can statistically assert (with >95% confidence) that the population of airport trips comprises a larger proportion of CityLink users than the

remainder of the travel market. We can also assert that the market of company car trips comprises a larger proportion of CityLink users than the non-company car market.

These findings are intuitive; it is understandable that airport trips would favour CityLink given the high value of time associated with these trips, and the importance of arriving on-time. It is also logical that trips made in a company car would be more likely to use CityLink, given that the toll costs incurred by company cars are often paid for by the company (rather than the individual).

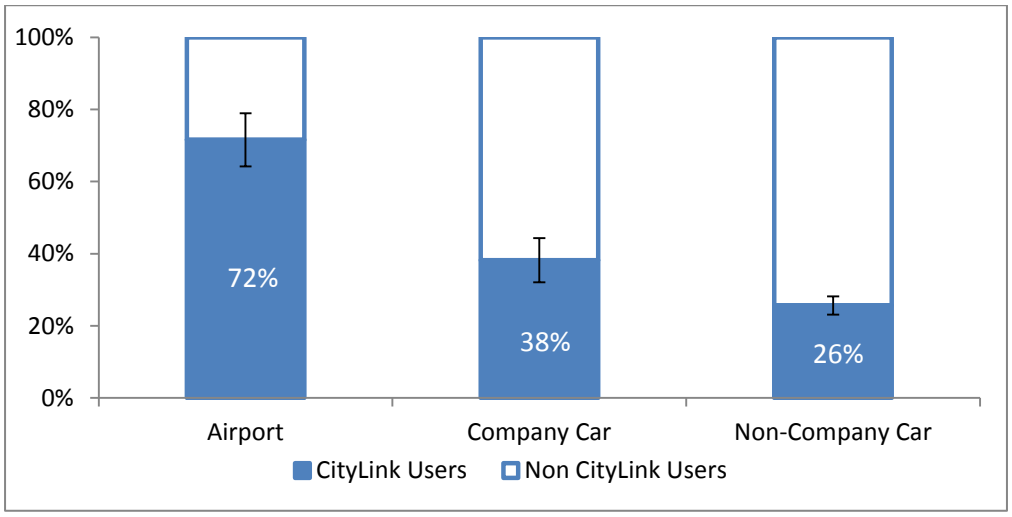


Figure 3 – Breakdown of CityLink and Non-CityLink Users for each Segment

During the model development phase, we also observed differences in behaviour between those living in the south & east (referred to as south), and those living in the north & west (referred to as north). These differences weren't explainable in terms of the variables included in the survey, and so we further segmented users into two spatial segments, which are shown in Figure 4 below.

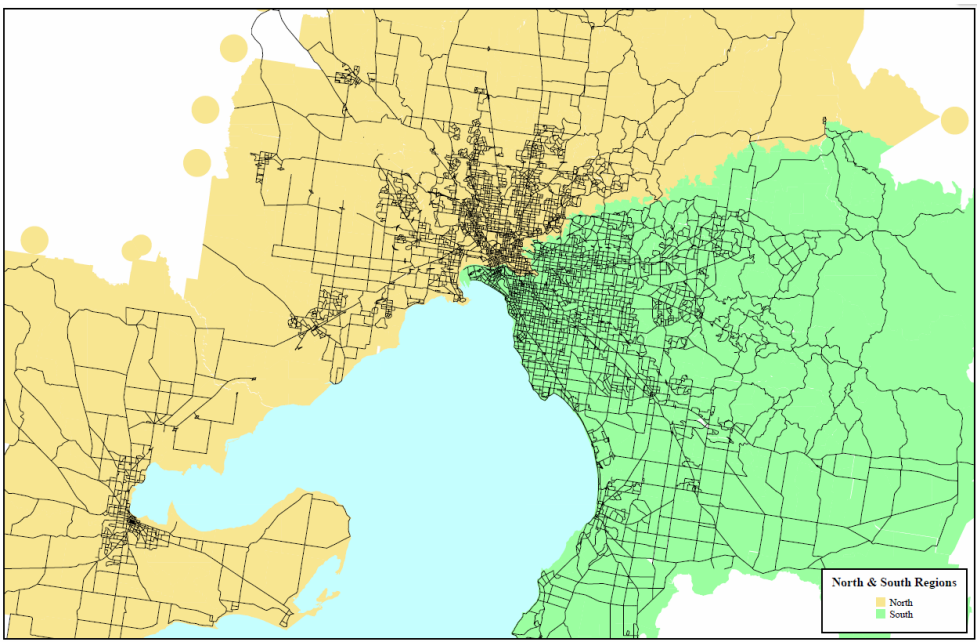


Figure 4 - Spatial Segments - North / South

Potential explanations for this difference in behaviour include:

- Higher incomes, on average, in the south,
- Attitudes toward CityLink – the development of CityLink involved a mix of new infrastructure, and the upgrading and tolling of some existing infrastructure. For those in the north, a large amount of existing infrastructure became tolled (the Tullamarine Freeway), and we have speculated that this may have resulted in some level of "protest" against using CityLink.

While effective in explaining the usage of CityLink, the use of spatial segmentation is not perfectly ideal, and in the future we aim to explain these spatial variations in terms of social-demographic variables. This may be possible using the VISTA dataset which we are currently analysing.

As a result of this spatial segmentation, the toll choice model was developed for 5 segments:

- Airport travel
- Non-Company Car North
- Non-Company Car South
- Company Car North
- Company Car South

The implementation of this segmentation is relatively straight forward:

- All trips are spatially segmented (north / south) based on their "production" end. In the case of home based trips, the home location determines the spatial segment.
- The airport market only includes passengers and "meeters & greeters" – it does not include those travelling to the airport for other activities (e.g. those who work at the airport),
- Car driver trips are disaggregated into company car and non-company car using simple proportions by trip purpose, which were derived from Australian Household Travel Surveys. The company car proportions are listed in Table 2 below.

Trip Purpose	Proportion Company Car	Source
Home Based Work	15.7%	Household Travel Surveys
Home Based Education – Secondary	0.0%	Household Travel Surveys
Home Based Education - Tertiary	3.4%	Household Travel Surveys
Home Based Shopping	6.8%	Household Travel Surveys
Home Based Recreation	8.6%	Household Travel Surveys
Home Based Other	7.8%	Household Travel Surveys
Work Based Work	43.7%	Household Travel Surveys
Work Based Shopping	19.6%	Household Travel Surveys
Work Based Other	15.1%	Household Travel Surveys
Shopping Based Shopping	5.1%	Household Travel Surveys
Shopping Based Other	6.5%	Household Travel Surveys
Other Non-Home Based	7.4%	Household Travel Surveys
Visitor Home Based Shopping	6.8%	VLC Estimate
Visitor Home Based Recreation	8.6%	VLC Estimate
Visitor Home Based Other	7.8%	VLC Estimate
Visitor Non-Home Based	7.4%	VLC Estimate
Special Recreation Based Home	8.6%	VLC Estimate
Special Recreation Based Visitor Accommodation	7.4%	VLC Estimate
External Trips	10.0%	VLC Estimate

Table 2 - Proportion of Trips made by Company Car per Trip Purpose

Work based work (business) trips have the highest proportion of company cars (43.7%), with education trips having the lowest (0.0% for secondary school, and 3.4% for tertiary). 15.7% of home based work trips use a company car, compared with 6.8% for home based shopping and 8.6% for home based recreation.

3.2 Initial Parameter Estimation and Goodness of Fit

As detailed in the sister document: *"Zenith Technical Note - Static Traffic Assignment – Methodology"*, the Zenith STA includes two utility functions: one which applies to the "upper level" binary choice between tolled and untolled routes, and another which applies to the "lower level" choice between alternative tolled routes.

The utility functions are:

Upper Level – Toll vs No Toll: $V_r = \beta^U_{time} \times time_r + \beta^U_{toll} \times toll_r$
Lower Level – Tolled route vs Tolled route: $V_r = \beta^L_{time} \times time_r + \beta^L_{toll} \times toll_r$

Where:
V_r is the estimated mean utility of route r
$time_r$ is the travel time for route r (in minutes)
$toll_r$ is the toll payable (in cents) for route r (in the case of an untolled route, this is zero)
β^U_{time}, β^U_{toll}, β^L_{time}, β^L_{toll} are model parameters

Both functions are linear in travel time and toll, and neither includes an alternative specific constant. The only difference between the functions is the value taken by the model parameters (the βs).

3.2.1 Parameter Estimation

During the initial parameter estimation process, our focus was deliberately directed toward the estimation of the upper level parameters, with the lower level parameters set equal to the upper level parameters (this was the only technically feasible option, given limitations in our own software at the time).

The initial parameter estimates, calculated using maximum likelihood techniques, are presented in Table 3 below. Note that tolls are measured in 2008 AUD.

Market Segment	β^U_{time}	β^U_{toll}
Airport	-0.436	-0.00492
Company Car - North	-0.445	-0.0065
Company Car - South	-0.3402	-0.00362
Non-Company Car - North	-0.357	-0.00722
Non-Company Car - South	-0.2631	-0.0045

Table 3 - Initial Estimated Model Parameters

Toll usage curves, depicting the probability of toll road usage at varying levels of travel time saving and toll are presented in Table 4 below. As expected, toll usage increases with increasing travel time saving, and decreases at higher toll levels.

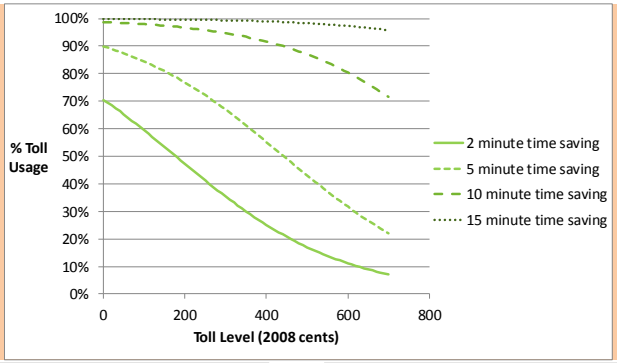
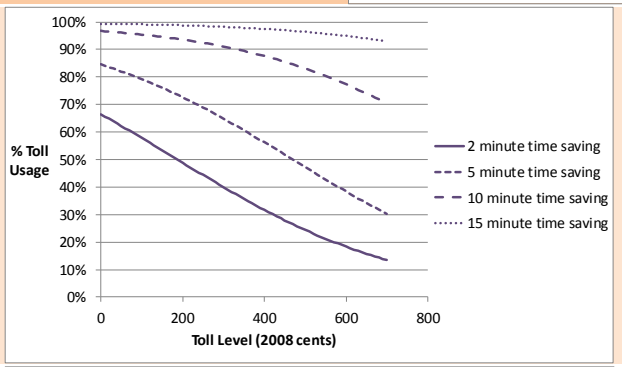
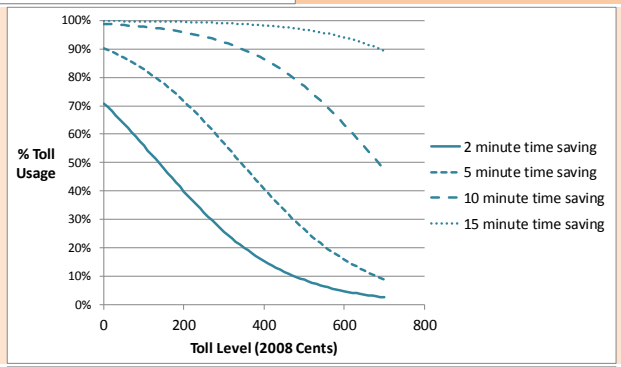
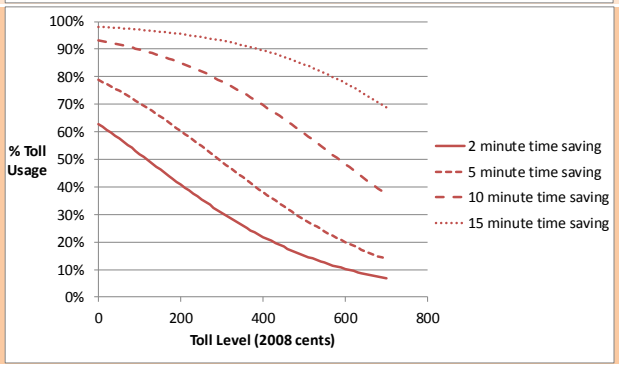
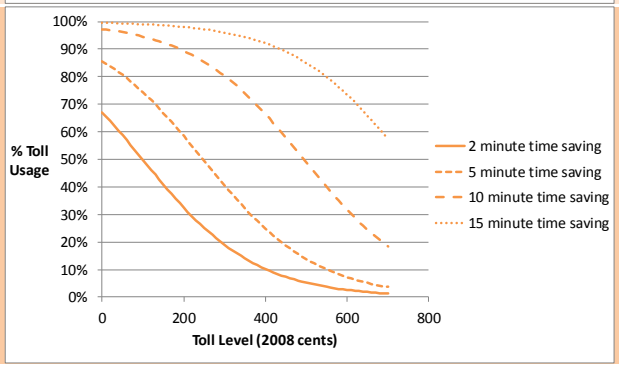
	North	South
Airport		
Company Car		
Non-Company Car		

Table 4 - Toll Usage Curves by Segment

The relative likelihood of toll usage between market segments is more clearly illustrated in Figure 5 below, which shows toll usage at varying toll levels (and a fixed time saving of 5 minutes). For any given time saving and toll, airport trips are most likely to pay tolls, followed by company cars and then non-company cars.

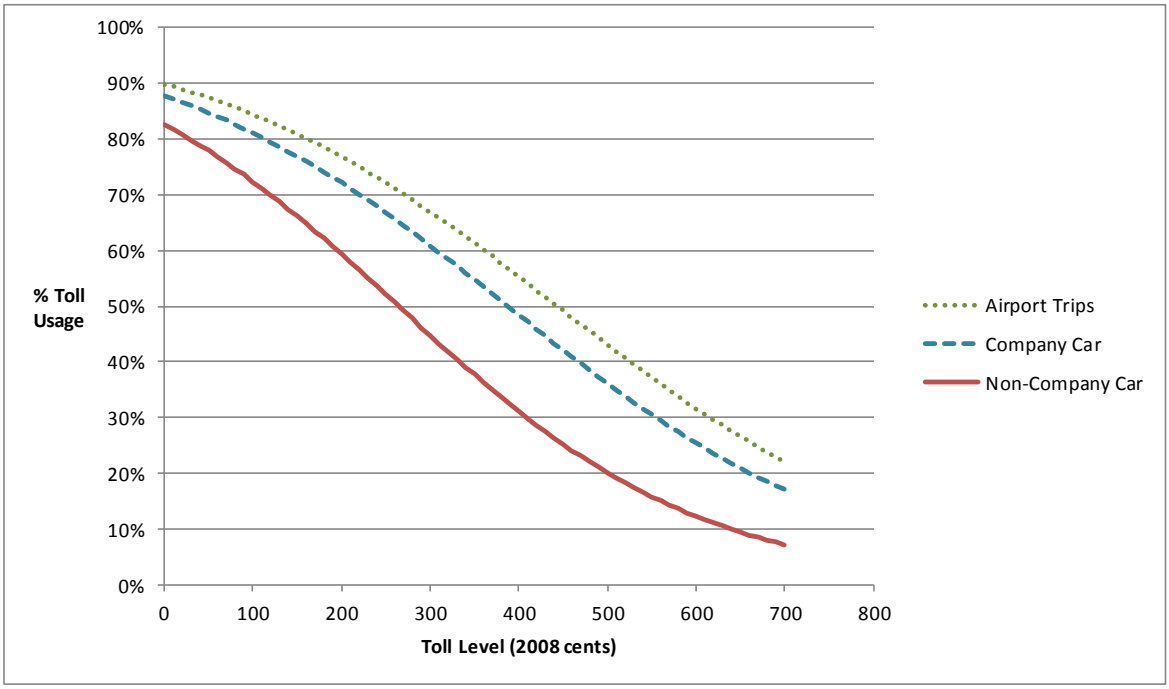


Figure 5 - Toll Usage by Airport, Company Car and Non-Company Car for a 5 minute time saving

3.2.2 Goodness of Fit

The resulting models were applied to the surveyed respondents to assess "goodness of fit". Note that the entire dataset was used for both training and testing, and no form of cross validation was used. This is a weakness of the analysis, and may lead to an optimistic assessment of predictive accuracy. We intend to cross validate when developing the next generation of models.

Observed and modelled toll usage was compared for a range of travel time savings. Figure 6 to Figure 10 present the analysis for each market segment, with blue indicating that the observed toll usage exceeds the modelled toll usage, and orange indicating the reverse (i.e. that modelled toll usage exceeds observed). The data has been grouped into ranges of travel time saving, and these ranges are deliberately varied between segments to ensure an adequate survey sample in each band.

It can be seen that travel time savings and toll usage generally increase together. This is despite the positive correlations which may exist in the data between time savings and the toll level. Given the uncertainty associated with the observed sample estimates (indicated by the 95% confidence intervals), the model and observed data appear to be satisfactorily correlated. The one apparently systematic area of difference is for high time savings (in excess of 10 minutes), where the model appears to over-estimate toll usage.

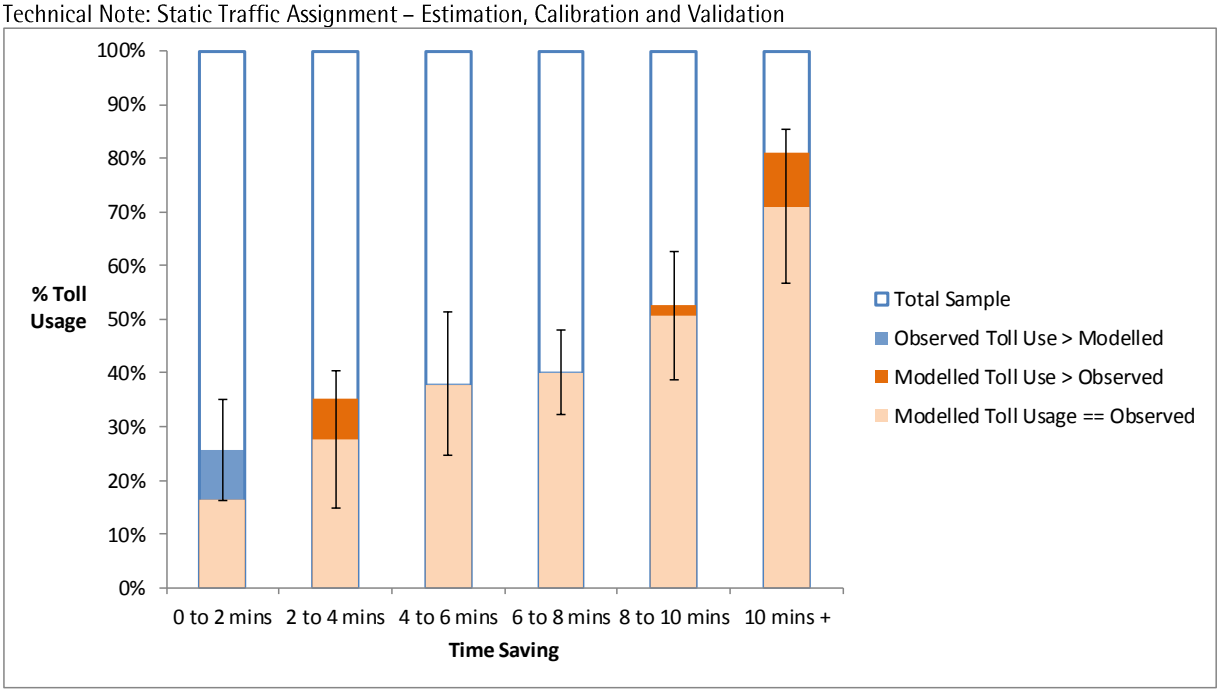


Figure 6 - NON-COMPANY CAR SOUTH - Observed and Modelled Toll Usage by Travel Time Saving

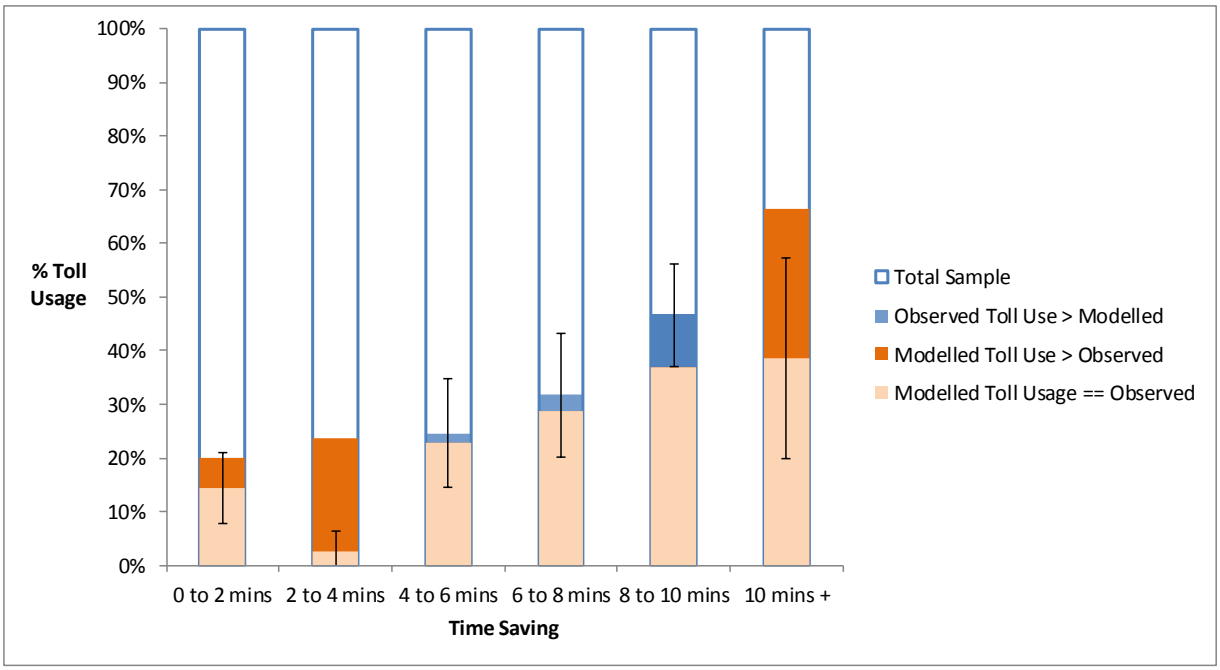


Figure 7 - NON-COMPANY CAR NORTH - Observed and Modelled Toll Usage by Travel Time Saving

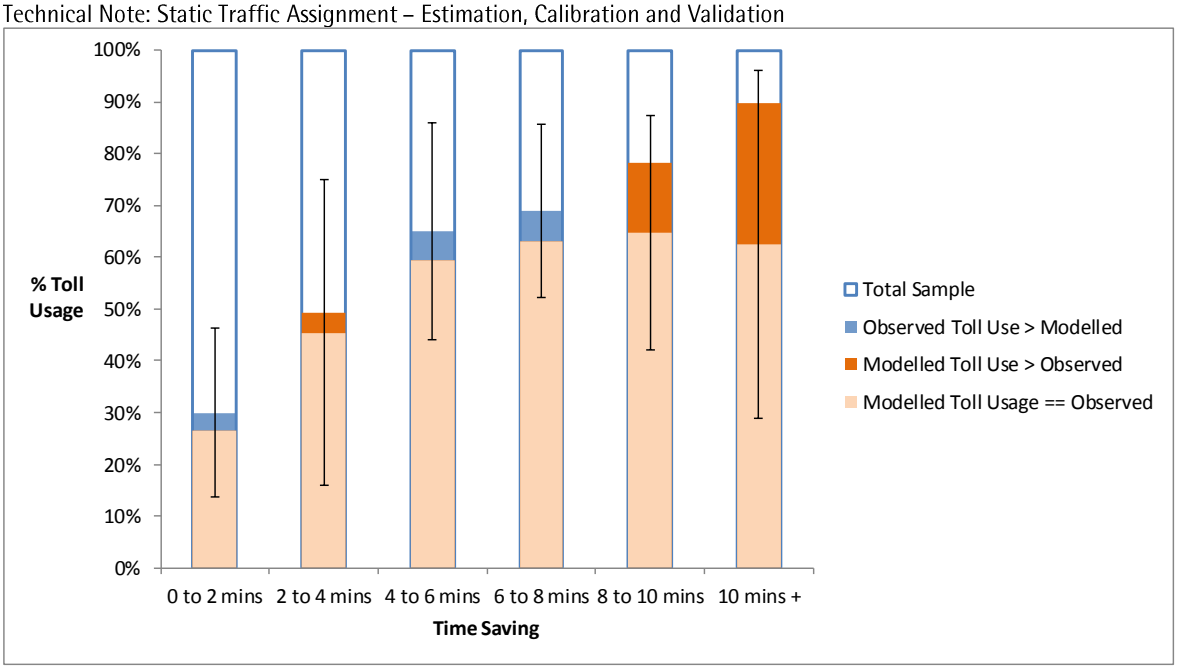


Figure 8 - COMPANY CAR SOUTH - Observed and Modelled Toll Usage by Travel Time Saving

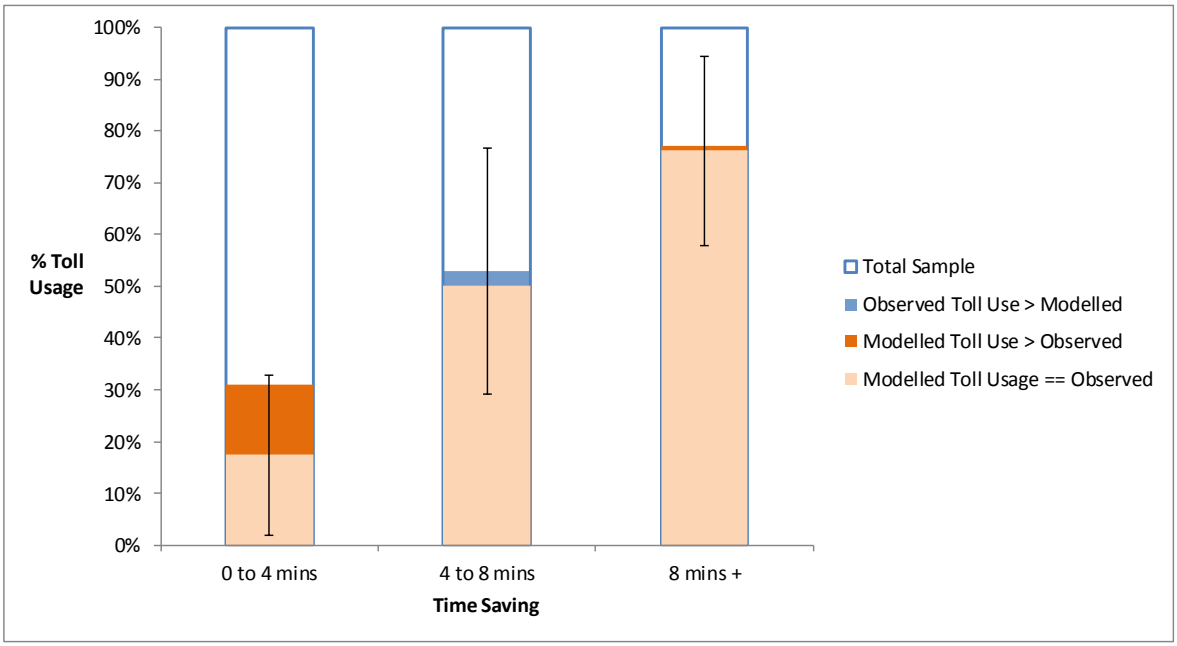


Figure 9 - COMPANY CAR NORTH - Observed and Modelled Toll Usage by Travel Time Saving

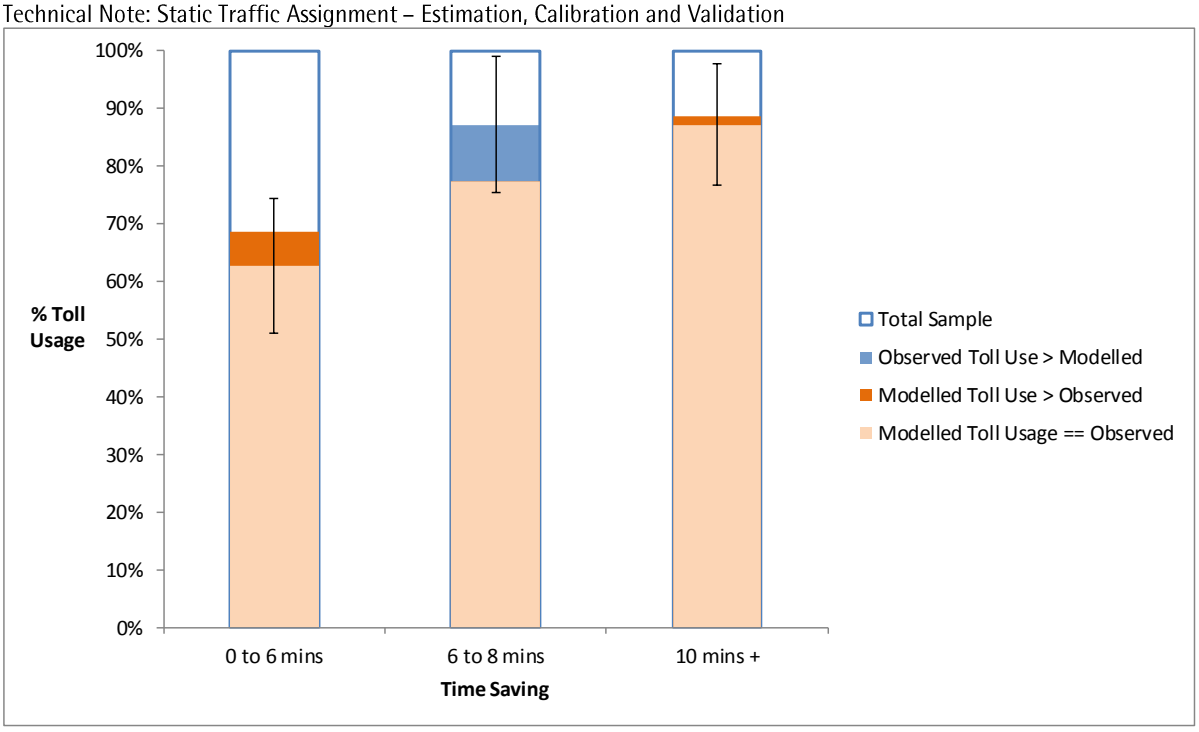


Figure 10 - AIRPORT - Observed and Modelled Toll Usage by Travel Time Saving

3.3 Lower Level Parameters

The "lower level" parameters are responsible for the allocation of demand to the set of tolled alternatives (the "upper level" parameters control the split of tolled and untolled users). Originally, when the model was first developed, we did not distinguish between lower and upper level parameters – the same parameters were used at both levels. However, over time it became apparent that the model was under-estimating the allocation of demand to more expensive tolled links, which would attract higher value of time users.

This led us to decrease the toll parameter at the lower level ($\boldsymbol{\beta}^{L}_{toll}$). After some experimentation (in Brisbane, Sydney and Melbourne), the value of $\boldsymbol{\beta}^{L}_{toll}$ was set to half of $\boldsymbol{\beta}^{U}_{toll}$.

This adjustment also has some intuitive justification. The original upper level parameters were estimated based on the full sample of tolled and non-tolled users in the CityLink Usage Survey. However, the lower level parameters are applied to tolled users only. Tolled users are not representative of the full population – they are, by definition, those people who are prepared to pay tolls! - and it is intuitive that they would be less sensitive to tolls than the rest of the population.

3.4 Commercial Vehicles

The 2003 CityLink Usage Survey did not collect any data relating to commercial vehicles. As such, the model parameters for commercial vehicles have been estimated based on empirical evidence (e.g. traffic counts), as well as supporting evidence derived from an Ernst and Young report examining the elasticises of HCVs to toll levels (dated October 2009).

The adopted parameters for light and heavy commercial vehicles are:

Market Segment	β^{U}_{time}	β^{U}_{toll}
Light Commercial Vehicles	-0.500	-0.0013
Heavy Commercial Vehicles	-0.417	-0.0013

Table 5 - Model Parameters for Light and Heavy Commercial Vehicles

3.5 Recent Parameter Calibration

The validation of the toll model was recently updated to reflect the latest available count information. In so doing, it became evident that the model was systematically under-estimating toll usage using the original model parameters, and that they were in need of updating.

The final outcome was a 40% reduction in the toll parameters (β^{U}_{toll} **and** β^{L}_{toll}**).** This could be a result of:

- Increase in toll road acceptance or Value of Travel Time Saving (VTTS) of toll roads over time. This may relate to increases in real earnings, greater proliferation of e-Tags, or a general acceptance of tolls.
- Induced destination switching – growth in traffic may also be a result of changes in travel patterns gradually induced by the toll roads. For example, projects such as CityLink and EastLink will affect major life-changing decisions such as the choice of home or work location. These decisions play out over an extended period of time. At the margin, those who alter their home / work location or other travel patterns as a result of toll roads will more naturally be toll road users (a person who refuses to pay tolls is unlikely to change their travel patterns as a result of a new toll road).
- Model misspecification – it is possible that one or more of the model's limitations are being compensated for by biased parameter estimates. As the effect of these limitations evolves over time, the model's parameters would require modification.

The need for such a significant change in model parameters does lead us to question the temporal stability of the model's toll choice parameters, and the forecasting capability of the model in relation to toll roads. However, it is worth also noting that Melbourne was still relatively new to toll roads when the original CityLink Toll Usage surveys were conducted. It is to be expected that Melbournians will gradually become accustomed to tolls, increasing their likelihood of toll usage. The question is: are we now at a stable state, or are we still in the midst of transition?

Either way, we think it wise and timely to conduct a new survey of toll usage encompassing both CityLink and EastLink, from which many of these questions could be answered. This would help to increase confidence in the ability of the model to accurately forecast future toll road volumes.

4 Application to Melbourne Toll Roads

As described in Section 3.5, the model parameters have been recently updated to reflect updated traffic counts. A comparison of modelled and observed traffic flows is presented in Table 6, with corresponding scatter plots for each period presented in Figure 11 to Figure 13.

Overall, it appears that the model slightly over-estimates daily volumes on toll roads, and slightly under-estimates toll road demands in the peaks. It is also evident that there is greater variability between modelled and observed estimates during the peaks (reflected in lower correlation measured by the R^2 statistic). Taken together, this suggests that the model may be less reliable in estimating travel time savings during peak conditions, and may have a tendency to under-estimate peak travel time savings. This would not be surprising – static traffic assignment models have well-known limitations in relation to the estimation of delays under heavy congestion (particularly delays resulting from intersections and queuing, etc.). These findings suggest that peak period modelling of tolled demands should be an area of focus for future research and development.

Location	Direction	Year	AM		PM		Daily	
			Observed	Model	Observed	Model	Observed	Model
Between Bell St & Moreland Rd	Northbound	2011	7,500	6,300	14,400	13,300	72,500	76,000
Between Moreland Rd & Bell St	Southbound	2011	11,500	13,000	7,600	7,500	64,500	77,000
South of Flemington Rd	Northbound	2011	5,400	4,500	9,000	11,000	51,500	50,500
South of Flemington Rd	Southbound	2011	7,800	10,500	5,400	5,200	51,000	52,500
South of Footscray Rd	Northbound	2011	5,500	4,300	6,900	8,800	46,500	43,000
South of Footscray Rd	Southbound	2011	5,600	8,300	5,300	4,900	44,000	44,000
North of Toorak Rd	South Bound	2011	8,700	8,700	12,700	13,400	75,000	78,500
North of Toorak Rd	North Bound	2011	13,900	13,000	9,700	10,000	73,300	76,500
Between Springvale Rd & Ringwood Bypass	North-West Bound	2011	7,600	7,400	6,700	6,900	41,500	47,000
Between Springvale Rd & Ringwood Bypass	South-East Bound	2011	6,000	6,400	8,000	7,800	40,500	48,000
Between Canterbury Rd & Maroondah Hwy	North Bound	2011	6,500	7,100	8,900	7,400	41,000	43,000
Between Canterbury Rd & Maroondah Hwy	South Bound	2011	8,100	7,000	6,800	7,500	40,500	43,000
Between Boronia Rd & Canterbury Road	North Bound	2011	6,800	7,300	9,700	7,600	43,500	43,500
Between Boronia Rd & Canterbury Road	South Bound	2011	9,200	7,200	7,200	7,700	43,500	44,000
Between Burwood Hwy & Boronia Rd	North Bound	2011	7,100	7,500	10,300	8,100	45,500	47,500
Between Burwood Hwy & Boronia Rd	South Bound	2011	9,800	7,600	7,200	8,000	44,500	47,000
Between High St Rd & Burwood Hwy	North Bound	2011	7,400	7,500	10,600	8,200	46,000	46,500
Between High St Rd & Burwood Hwy	South Bound	2011	9,900	7,800	7,300	8,100	45,000	47,000
Between Ferntree Gully Rd & High St Rd	North Bound	2011	7,700	7,700	10,800	8,400	46,500	48,000
Between Ferntree Gully Rd & High St Rd	South Bound	2011	10,000	8,000	7,300	8,300	45,000	49,000
Between Wellington Rd & Ferntree Gully Rd	North Bound	2011	8,000	7,900	9,900	8,400	45,500	49,500
Between Wellington Rd & Ferntree Gully Rd	South Bound	2011	9,300	7,900	7,700	8,400	45,000	49,500
Between Police Rd & Wellington Rd	North Bound	2011	7,600	7,800	9,400	8,200	43,500	49,000
Between Police Rd & Wellington Rd	South Bound	2011	9,000	7,800	7,400	8,400	43,500	50,000
Between Princes Hwy & Monash Fwy	North Bound	2011	6,600	7,600	8,200	6,800	40,000	41,000
Between Princes Hwy & Monash Fwy	South Bound	2011	7,800	5,800	6,600	7,400	39,000	39,000
Between Cheltenham Rd & Princes Hwy	North Bound	2011	7,300	7,500	7,300	6,200	39,500	38,000
Between Cheltenham Rd & Princes Hwy	South Bound	2011	6,700	5,300	7,100	7,400	38,500	36,500
Between Greens Rd & Dandenong Bypass	North Bound	2011	6,100	6,700	4,800	4,600	30,000	30,000
Between Greens Rd & Dandenong Bypass	South Bound	2011	4,200	3,600	6,300	6,300	30,000	28,500
Between Thompson Rd & Greens Rd	North Bound	2011	5,700	6,300	3,000	3,600	23,500	25,000
Between Thompson Rd & Greens Rd	South Bound	2011	2,500	2,600	5,900	6,000	23,500	23,500
Between Frankston Fwy & Thompson Rd	North-East Bound	2011	4,600	5,400	2,500	3,200	20,000	22,500
Between Frankston Fwy & Thompson Rd	South-West Bound	2011	2,000	2,400	4,300	5,000	18,000	20,500
			249,400	241,700	262,200	258,000	1,480,800	1,554,000

Table 6 - Comparison of Observed and Modelled Volumes for Tolled Locations in 2011

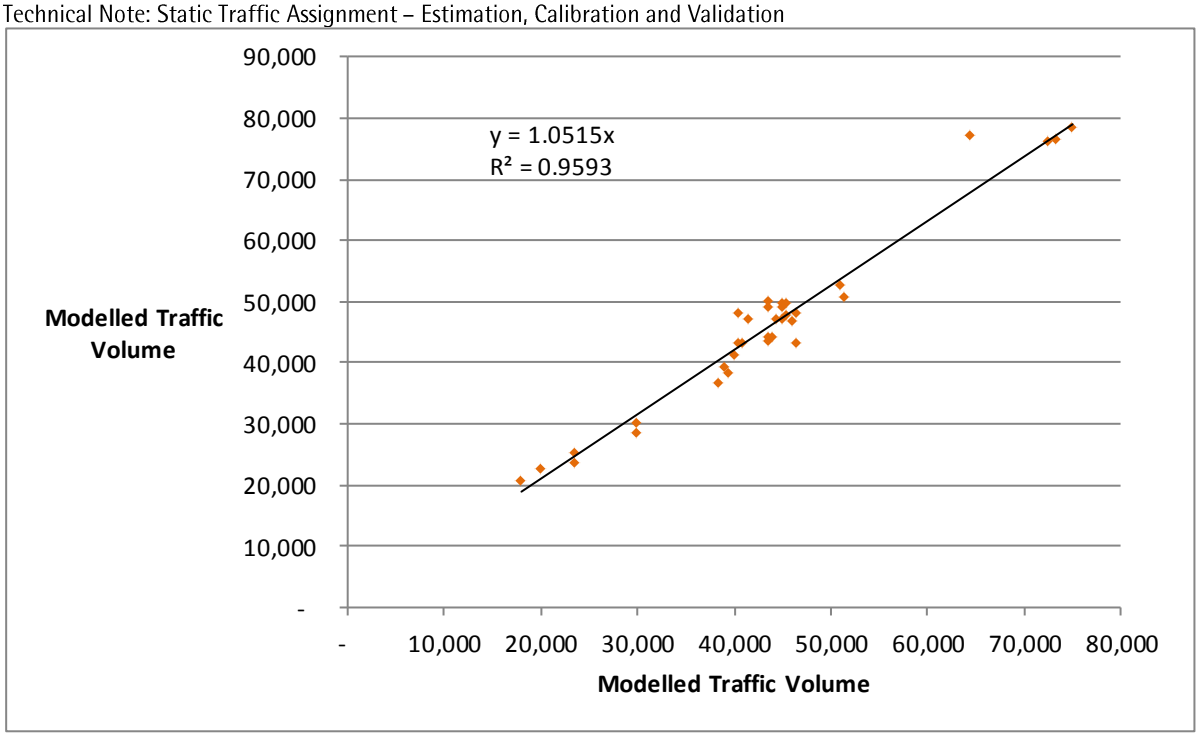


Figure 11 - Comparison of Daily Observed and Modelled Volumes for Tolled Locations in 2011

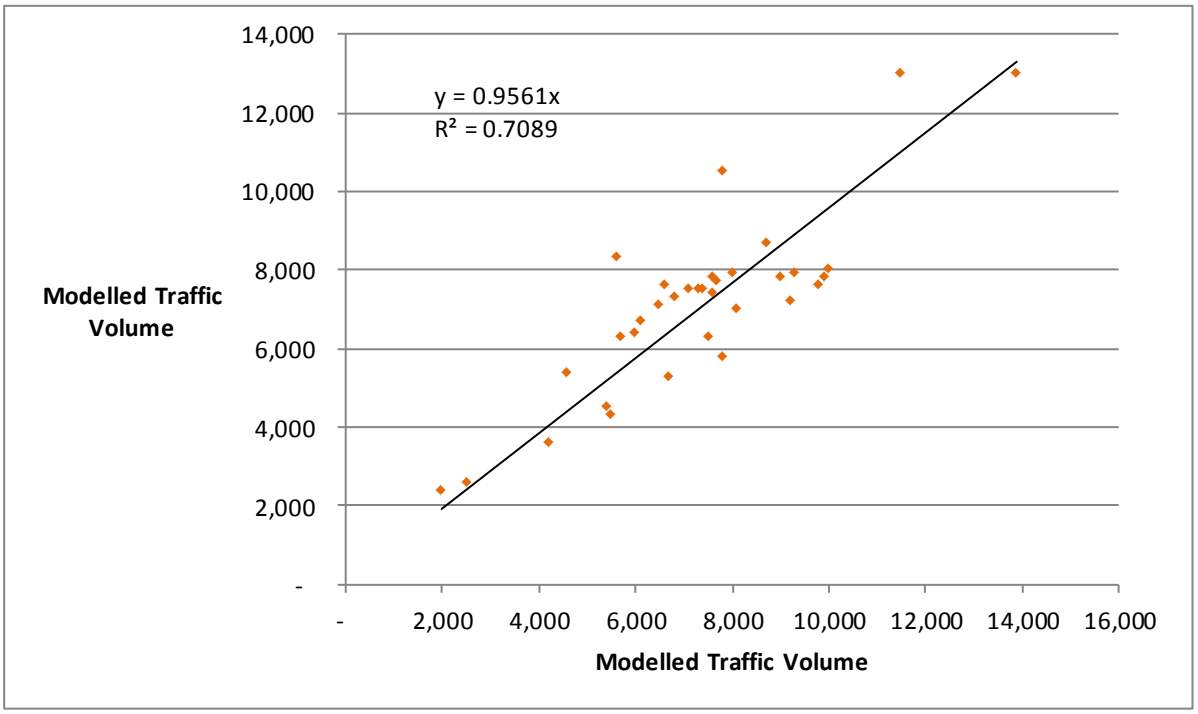


Figure 12 - Comparison of AM Peak (7-9am) Observed and Modelled Volumes for Tolled Locations in 2011

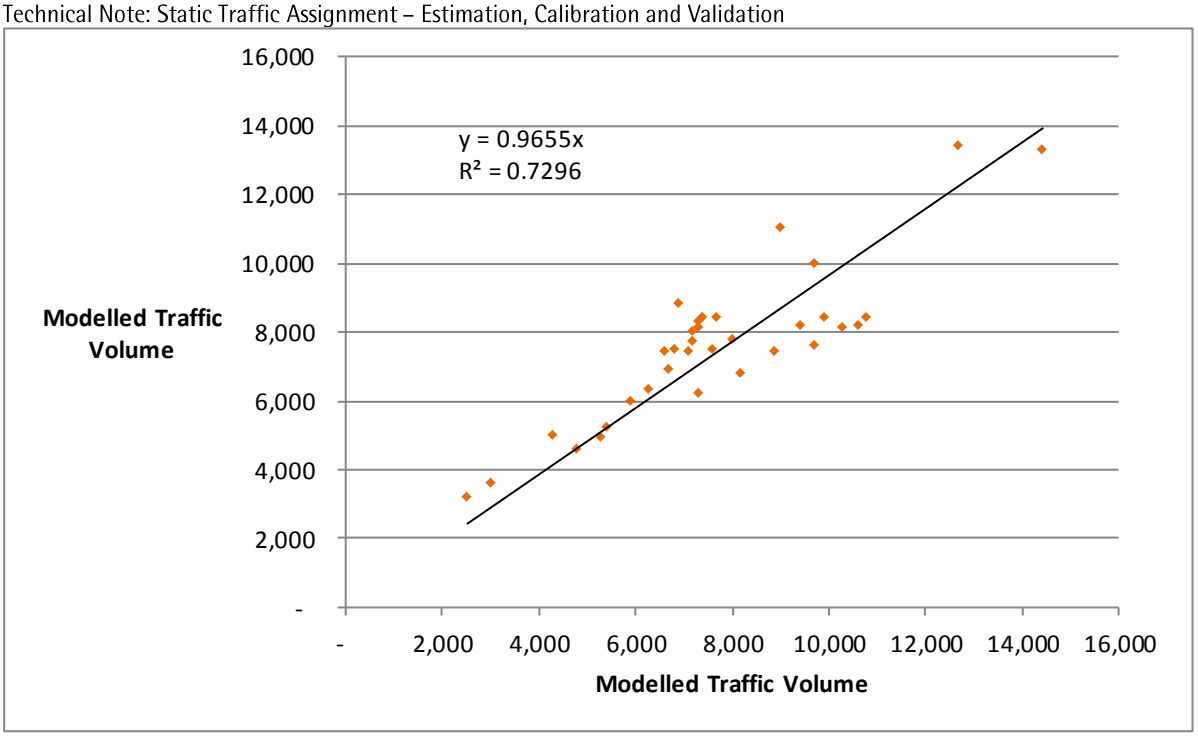


Figure 13 - Comparison of PM Peak (4-6pm) Observed and Modelled Volumes for Tolled Locations in 2011

Appendix A – Survey Forms (Respondents from South & East)

1
2 Which of the following best describes your **employment situation**?
1 *If Unemployed/Not Employed or Student – Goto Q5*

☐ Employed Full-Time ☐ Employed Part-Time ☐ Unemployed/Not Employed
☐ Secondary Student ☐ Tertiary Student

Q2 Do you have full time access to a **company car or motor vehicle**? ☐ *Yes = 1 : No = 2 – If "No" then Goto Q4*

Q3 Does you **employer pay** all your vehicle running **expenses** (i.e. petrol, City Link tolls, etc.) when?

☐ Using the vehicle for business purposes *(Yes = 1 : No = 2)* ☐ Using the vehicle for personal travel *(Yes = 1 : No = 2)*

Q4 In which **suburb** is your place **of employment**? ☐

Q5 Have you travelled by motor vehicle, motorcycle or taxi to the Melbourne CBD, the Western or the Northern Suburbs (including the Airport) in the **last month**?

☐ *Yes = 1 : No = 2 – If "No" then goto Q9*

Q6 If employed in the Melbourne CBD, the Western, or the Northern Suburbs, do you usually **travel by motor vehicle to work**?

☐ *Yes = 1 : No = 2 – If "No" then goto Q8*

Q7 Please provide details of your **typical journey to and from work**.

3 Enter details of your work commuting travel in the first two columns on the BLUE Questionnaire.

Q8 Please provide details of any **personal travel or business trips** that you have made by motor vehicle **in the last month** to the CBD, the Western or the Northern Suburbs?

Enter details of your personal or business travel in the numbered columns on the BLUE Questionnaire.
4

If less than 4 trips are recorded on the BLUE form then proceed to Q9, otherwise terminate the interview

Q9 Please provide details of some **hypothetical trips** to the CBD or beyond.

Enter details of your hypothetical travel in the specified columns on the RED Questionnaire.

5

6		Typical Motor Vehicle Travel to and from Work *(Employed Persons Only)*		7 Details of Personal/Business Travel by Private Motor Vehicle and Taxi					
	8 Actual Trip Details	**9 To Work**	**10 From Work**	**11 Trip 1**	**12 Trip 2**	**Trip 3**	**Trip 4**	**Trip 5**	**13 Trip 6**
A1	**How often** do you usually make this trip?	☐ Most days ☐ Weekly ☐ Infrequently	☐ Most days ☐ Weekly ☐ Infrequently	☐ Most days ☐ Weekly ☐ Infrequently	☐ Most days ☐ Weekly ☐ Infrequently	☐ Most days ☐ Weekly ☐ Infrequently	☐ Most days ☐ Weekly ☐ Infrequently	☐ Most days ☐ Weekly ☐ Infrequently	☐ Most days ☐ Weekly ☐ Infrequently
A2	Which **Suburb** did you **start your trip** from?								
A3	In which **Suburb** did you **complete your trip**?								
A4	For what **purpose** was the trip made?	to	to	to	to	to	to	to	to
A5	At what **time** did you **start your trip**?	: AM	: AM	: AM	: AM	: AM	: AM	: AM	: AM
A6	**How long** did it take to complete this trip?	minutes	minutes	minutes	minutes	minutes	minutes	minutes	minutes
A7	What **type of vehicle** did you use for your travel?								
A8	What **major roads** did you used to complete your journey?	If CityLink was not used, move to the next column	If CityLink was not used, move to the next column	If CityLink was not used, move to the next column	If CityLink was not used, move to the next column	If CityLink was not used, move to the next column	If CityLink was not used, move to the next column	If CityLink was not used, move to the next column	If CityLink was not used, move to the next column
A9	Where did you **enter CityLink**?								
A10	Where did you **exit CityLink**?								
A11	Did you **personally pay the toll**? *Yes = 1 : No = 2*								
A12	By using CityLink, how much **time** do you think you **saved**?	minutes	minutes	minutes	minutes	minutes	minutes	minutes	minutes

14		15 Hypothetical Details of Travel by Private Motor Vehicle and Taxi						
	16 Hypothetical Trip Details	Travel to the **Airport**	**17** Travel to the **Myer Melbourne**	**18** Travel to **South Yarra**	Travel to **Geelong**	Travel to **Footscray**	Travel to **Essendon**	**19** Travel to **Craigieburn**
H1	Would you consider **using your private motor vehicle or taxi** to travel to: *Yes = 1 : No = 2*	☐ If 'No', move to the next column	☐ If 'No', move to the next column	☐ If 'No', move to the next column	☐ If 'No', move to the next column	☐ If 'No', move to the next column	☐ If 'No', move to the next column	☐ If 'No', move to the next column
H2	What **type of vehicle** would you use for your travel?	☐	☐	☐	☐	☐	☐	☐
H3	**How long** do you estimate it would take for you to do this trip if you left home **during the off-peak**?	☐☐ minutes	☐☐ minutes	☐☐ minutes	☐☐ minutes	☐☐ minutes	☐☐ minutes	☐☐ minutes
20 4	What **major roads** would you use to complete your journey?	☐☐☐ ☐☐☐ If CityLink was not used, move to the next column	☐☐☐ ☐☐☐ If CityLink was not used, move to the next column	☐☐☐ ☐☐☐ If CityLink was not used, move to the next column	☐☐☐ ☐☐☐ If CityLink was not used, move to the next column	☐☐☐ ☐☐☐ If CityLink was not used, move to the next column	☐☐☐ ☐☐☐ If CityLink was not used, move to the next column	☐☐☐ ☐☐☐ If CityLink was not used, move to the next column
H5	Where would you **enter CityLink**?	☐	☐	☐	☐	☐	☐	☐
H6	Where would you **exit CityLink**?	☐	☐	☐	☐	☐	☐	☐
H7	Would you **personally pay the toll**? *Yes = 1 : No = 2*	☐	☐	☐	☐	☐	☐	☐
H8	How much **time** do you think you would **save** by using CityLink?	☐☐ minutes	☐☐ minutes	☐☐ minutes	☐☐ minutes	☐☐ minutes	☐☐ minutes	☐☐ minutes

Thank you for taking time to assist your Government to be in a better position to plan your roads for the future

Appendix B – Instructions for Survey Staff (South & East)

Who is to be interviewed?

- Only households that own a car are to be interviewed
- Only members of the household who hold a current driving license are candidates for interview

No household or household member is to be unreasonably coerced into answering all or part of the questionnaire. Interviewers must be courteous and friendly at all times.

Questionnaire Clarification

Q4	In which **suburb** is your place **of employment**?	

Print the name of the suburb. If the interviewee works at Tullamarine Airport enter "Airport".

A1	**How often** do you usually make this trip?	☐ Most days ☐ Weekly ☐ Infrequently

If the trip is typically made 3 or more days a week then check the "Most Days" box.
If the trip is typically made once a week then check the "Weekly" box.
If the trip is made less than once week then check the "Infrequent" box.

A2	Which **Suburb** did you **start your trip** from?	

Print the name of the suburb.

A3	In which **Suburb** did you **complete your trip**?	

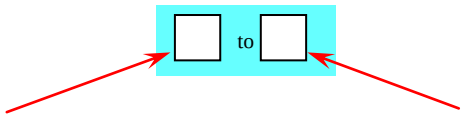
Print the name of the suburb.

A4	For what **purpose** was the trip made?	☐ to ☐

The purpose of this question is to determine the precise reason a trip was made. The directionality of the trip is also important, whether it involves travelling to the home or from the home.
The questionnaire coding convention is to code the activity at the start of the trip and the activity at the end of the trip using the codes shown in the following table. Trips made from the home should have a "1" entered in the left-hand box, and the activity at the destination entered in the right-hand box – "2" for work, "3" for shopping, etc.

Similarly a trip made to the home should have a "1" entered in the right-hand box, and the activity that was undertaken at the origin of the trip entered in the left-hand box.

If someone reports making a business trip as part of their work, but neither end of the trip was the home, then a "2" should be entered in both the left and right-hand boxes.



Origin end of trip	Destination end of trip
1 Travelling from Home	1 Travelling to Home
2 Place of Work	2 Place to Work
3 Shopping/Personal Business	3 Shopping/Personal Business
4 Social/Recreation/Entertainment	4 Social/Recreation/Entertainment
5 Secondary School	5 Secondary School
6 Tertiary/Tafe Education Institution	6 Tertiary/Tafe Education Institution
7 Airport Arrival (Business Trip)	7 Airport Departure (Business Trip)
8 Airport Arrival (Pick-Up Passenger)	8 Airport Departure (Drop-Off Passenger)
9 Serving the needs of a passenger *eg. picking up children from school*	9 Serving the needs of a passenger *eg. taking children to school*
10 Other	10 Other

A5 At what **time** did you **start your trip**? ☐☐:☐☐ AM

Print the time that the trip commenced in hours and minutes. Also indicate the period of the day by crossing out the AM or PM that does relate to the trip start time – ie. if the trip started before midday, cross out the PM like as AM ows

A6 **How long** did it take to complete this trip? ☐☐ minutes

Print the typical time it takes to complete the reported trip, asking the respondent to ignore days when there may have been an excessive amount of congestion than normal, or an accident, that caused the interviewee to take longer than expected for their travel.

A7 What **type of vehicle** did you use for your travel? ☐

Enter the number corresponding to the type of vehicle used.

1 Car
2 Motorcycle
3 Utility
4 Van
5 Light Commercial Vehicle (LCV) : any cab chassis, 1.5 – 4.5 tonne GVM, two axles
6 Heavy Commercial Vehicle (HCV) : includes rigid trucks with three or more axles or over 4.5 tonnes GVM; buses with 13 or more seats including driver, articulated trucks
7 Taxi as a fare paying passenger

A8 What **major roads** did you used to complete your journey? ☐☐☐☐☐☐

If CityLink was not used, move to the next column

Enter up to six (6) major roads that were used during the reported journey through the inner and middle suburbs of Melbourne. Attempt to code the most major routes (roads) used making the trip. The map of the inner and mid-suburban suburbs of Melbourne will assist the interviewee in re-tracing their travel movements for the reported trip.

Note: We are not interested in routes taken that are remote from the inner-city.

Individual Roads

1 Ascot Vale Road	11 Royal Parade	21 Dandenong Road
2 Ballarat Road	12 West Gate Freeway	22 Eastern Freeway
3 Bell Street	13 Western Ring Road	23 Kings Way
4 Bulla Road	14 Whitehall Street (Yarraville/Footsray)	24 Nepean Highway
5 Flemington Road	15 Wurundjeri Way	25 Queens Road
6 Francis Street (Yarraville)	16 Alexandra Avenue	26 Riversdale Road
7 Geelong Road	17 Bridge Road	27 St Kilda Road
8 Melville Road	18 Brighton Road	28 Swan Street
9 Mt Alexander Road	19 Burwood Road	29 Torak Road
10 Pascoe Vale Road	20 Camberwell Road	30 Wellington Parade

Common Combinations of Roads

31 Bell Street – Melville Road – Royal Parade
32 Bulla Road – Mt Alexandra Road – Flemington Road
33 Western Ring Road – West Gate Freeway
34 Camberwell Road – Burwood Road – Bridge Road – Wellington Road
35 Dandenong Road – Queens Road – Kings Way
36 Riversdale Road – Swan Street – Alexandra Way
37 Toorak Road – Kings Way

A9 Where did you **enter CityLink**? ☐

Enter the number corresponding to the closest entry point used to enter the CityLink toll facility. *(Note: Number 12 is left out intentionally for this question only – in order to maintain compatible entry and exit codes).*

1	Tullamarine F'way/Pascoe Vale Rd/Bell St	8	West Gate F'way
2	Moreland Rd	9	Lorimer St/Montague St
3	Ormond Rd/Brunswick Rd	10	Kings Wy/Power St/Sturt St
4	Mt Alexandra Rd/Flemington Rd	11	Batman Ave/Punt Rd
5	Racecourse Rd/Elliott Ave	13	Burnley St/Barkly Ave/Gibdon St
6	Dynon Rd	14	Twickenham Cr/Grange Rd/Loyola Gr/Yarra Bld
7	Footscray Rd	15	Monash F'way/Toorak Road

A10 Where did you **exit CityLink**? ☐

Enter the number corresponding to the closest exit point you used to exit of the CityLink facility.

1	Tullamarine F'way/Pascoe Vale Rd/Bell St	9	Lorimer St/Montague St
2	Moreland Rd	10	Kings Wy/Power St/Sturt St
3	Ormond Rd/Brunswick Rd	11	Batman Ave/Punt Rd
4	Mt Alexandra Rd/Flemington Rd	12	Church St
5	Racecourse Rd/Elliott Ave	13	Burnley St/Barkly Ave/Gibdon St
6	Dynon Rd	14	Twickenham Cr/Grange Rd/Loyola Gr/Yarra Bld
7	Footscray Rd	15	Monash F'way/Toorak Road
8	West Gate F'way		

H2 What **type of vehicle** would you use for your travel? ☐

Enter the number corresponding to the type of vehicle you would use.

1	Car	5	Light Commercial Vehicle (LCV) : any cab chassis, 1.5 – 4.5 tonne GVM, two axles
2	Motorcycle	6	Heavy Commercial Vehicle (HCV) : includes rigid trucks with three or more axles or over 4.5 tonnes GVM; buses with 13 or more seats including driver, articulated trucks
3	Utility	7	Taxi as a fare paying passenger
4	Van		

H3	**How long** do you estimate it would take for you to do this trip if you left home at **during the off-peak**?	☐☐ minutes

Print the typical time that you would expect it to take to complete this trip, asking the respondent to ignore days when there may be excessive amounts of congestion than normal, or accident/s, that caused the interviewee to calculate longer than expected for their hypothetical travel.

• **H4**	What **major roads** would you use to complete your journey?	☐☐☐ ☐☐☐ If CityLink was not used, move to the next column

Enter up to six (6) major roads that you would use during a journey through the inner and middle suburbs of Melbourne. Attempt to code only the most major routes (roads) that you would use in making this trip. The map of the inner and mid-suburban suburbs of Melbourne will assist the interviewee in anticipating their expected travel movements for this hypothetical trip.

Note: We are not interested in routes taken that are remote from the inner-city.

Individual Roads

1	Ascot Vale Road	11	Royal Parade	21	Dandenong Road
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5	Flemington Road	15	Wurundjeri Way	25	Queens Road
6	Francis Street (Yarraville)	16	Alexandra Avenue	26	Riversdale Road
7	Geelong Road	17	Bridge Road	27	St Kilda Road
8	Melville Road	18	Brighton Road	28	Swan Street
9	Mt Alexander Road	19	Burwood Road	29	Torak Road
10	Pascoe Vale Road	20	Camberwell Road	30	Wellington Parade

Common Combinations of Roads

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7	Footscray Rd	15	Monash F'way/Toorak Road

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Enter the number corresponding to the closest exit point you would use to exit of the CityLink facility.

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6	Dynon Rd	14	Twickenham Cr/Grange Rd/Loyola Gr/Yarra Bld
7	Footscray Rd	15	Monash F'way/Toorak Road
8	West Gate F'way		