MOSS VALE
TRAFFIC MODEL AUDIT REPORT

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1 Executive Summary

Transport Modellers Alliance (TMA) was commissioned by Wingecarribee Shire Council (WSC) to undertake an independent traffic model audit of the Moss Vale Traffic Model prepared by Cardno on behalf of Aoyuan, the developer of the Chelsea Gardens master planned community.

While models might have been undertaken in accordance with the with RMS Modelling Guidelines the local context for impact definition is not specifically captured by the guidelines (noting that the original intention of the guidelines was to provide a framework for a dialogue on the key requirements of model assessments and is not necessarily prescriptive). The main distinction here being that one hour assessment periods required in the guidelines, do not capture the shorter term demand peaks experienced by regional towns.

This together with residual queuing on Argyle Street, that propagate throughout the day but become more prevalent around school peaks, require that the typical residential development peak periods may not apply as the greatest network impacts are likely to occur on a Friday during the school peak.

We have identified 26 points that the modeller may wish to respond to, with several of these being sufficiently significant as to call into question the findings of the assessments undertaken. As these concerns call into question whether the model accurately replicates existing traffic conditions, and we can identify that it is not coded in accordance with industry guidelines, then currently the model is not considered fit for purpose.

These significant concerns relate to:

- The Base Aimsun model does not reproduce realistic traffic assignments that take account of delays associated with congestion. This means the Base model cannot be relied upon to forecast accurate traffic volumes on key routes within the study area.
- The Base model does not conform to RMS Modelling Guidelines in relation to:
    - Signal timings that do not conform to RMS requirements or reflect effects of pedestrian delays to traffic, also the mid-block crossing on Argyle Street is missing.
    - No site visit note has been provided as evidence that local driver behaviour and vehicle characteristics have been understood and adopted by the modeller.
    - While *network wide vehicle turning count calibration* criteria has generally been met, the more onerous *core area calibration criteria* is more appropriate- given the sensitive nature of Argyle Street. Additionally, the critical Illawarra Highway / Argyle Street roundabout calibration requires modification before it can be assessed.
- Model coding issues that will overestimate network capacity include:
    - Public buses and school buses (approximately 20 services) have been omitted, which means that friction and resultant traffic delay associated with bus drop-off and pick-up is not represented in the model.
    - Spring Street capacity constraint has not been adequately captured and is required to be modelled accurately as it affects assignment within the study area.
    - Illawarra Highway / Argyle Street roundabout overestimates capacity and as this intersection is crucial to the operation of the town centre network it must be modelled accurately.
- Due to lack of supporting information, questions remain around the Development Model:
    - How does the 12 x 12 matrix in the 2016+CG models that has been provided reflect the development trips anticipated?
    - As no Aimsun intersection and network statistics have been provided in tabulated form across scenarios, the development impacts cannot be assessed. Reliance on uncalibrated SIDRA modelling for performance impacts should be avoided.

Additional concerns that require to be addressed are summarised in the table below,

Area	Summary Details
Traffic Data	Traffic survey data collected on a Thursday, which could be up to 15% lower than Friday volumes. This means the model could potentially be overestimating available road capacity within the Moss Vale network at peak times
	Data collection methodology does not take account (or even acknowledge) the constrained capacity on Argyle Street and the likelihood that observed intersection volume throughputs are lower than the traffic demand
	Origin-destination survey data was not used during the model calibration / validation process. This means the distribution of traffic on the network was not grounded in real-world observations, instead relying solely on the theoretical distribution derived from Council's strategic TRACKS model.
Demand Development	Shift in trip lengths (from TRACKS model) towards shorter distance trips applied in the Aimsun model are potentially less impactful on the network operation.
	Heavy vehicle matrices don't reflect Moss Vale travel patterns.
Driver/Vehicle Behaviour	Heavy vehicles kinematic limitations are not reflected, light vehicle lengths are too short, vehicle standstill distance is insufficient - these will all lead to an underestimate of delay and queue lengths in the model.

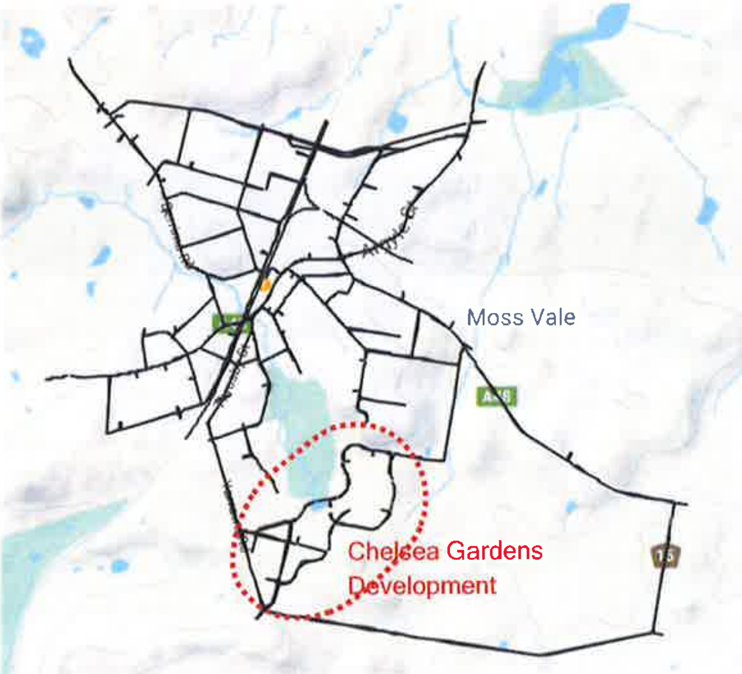
2 Introduction

2.1 BACKGROUND

Aoyuan, the developer of Chelsea Gardens has commissioned a traffic study to assess the impact of their development, that is anticipated to include an additional 1200 residential lots, which represents an approximately 30% increase in the number of existing residential dwellings in Moss Vale. The purpose of this report is to document the findings of a review and audit undertaken by TMA on behalf of Wingecarribee Shire Council (WSC). The following key elements have been examined:

- Traffic data collection and its application in the modelling process
- Aimsun and SIDRA modelling approach and assessment results
- Commentary on whether the models are considered fit-for-purpose.

The model assumptions and model development process are compared to industry best practice and commentary is provided as to the extent and severity of any deviations from the Traffic Modelling Guidelines, RMS.



Source: Google Maps

FIGURE 1 MOSS VALE MODEL EXTENT

The Moss Vale Model Study extent, shown in Figure 1 and indicates that the Chelsea Gardens Development is located to the south of Moss Vale town centre and is connected to the main service road of Argyle Street (which serves the Moss Vale township as well as providing connections to the adjacent townships to the north including Bowral and Mittagong) via Yarrawa Road and Throsby Street. The study area also includes the proposed Moss Vale Bypass (north of Moss Vale Town Centre) linking Suttor Road, Lackey Road and Berrima Road.

2.2 AUDIT BACKGROUND AND STRUCTURE

The intention of this audit is to identify any issues in the data, assumptions or modelling undertaken in the assessment of impacts of the Chelsea Gardens Development. Council wishes to ensure that a robust modelling outcome is achieved which provides all parties with confidence in the use of the model for traffic planning in conjunction with the development.

This audit presents a review of the models, reports and data provided under audit, and summarises the findings or each element of the review to identify any anomalous or non-conforming elements. Where the auditor has discovered an element of concern or an observation of modelling assumptions a severity rating has been applied to provide an indication of likely impact on model assessment results obtained. These have been rated according to the following scale:

- Minor, Non-conforming element is not critical to the valid operation of the model.
- Medium, Non-conforming element is important for the valid operation of the model but may be reasonably explained.
- Major, Non-conforming element is critical to the valid operation of the model and cannot (on the face of information provided) be reasonably explained.

Typically, the presence of any critical non-conforming elements that are not addressed would indicate that the model is not fit-for-purpose and should be modified accordingly if model assessments are to be relied upon.

2.3 DATA RECEIVED

TMA has conducted this review based on the following data provided by WSC and the modelling consultant (Cardno). The specific documents and traffic models provided for the review are outlined in Table 1.

TABLE 1 AUDITED MATERIAL AND DATA

Material	Filename	Description
Aimsun Models	8201822101_Chelsea Gardens_Base Model.zip 8201822101_Chelsea Gardens_Base+CG Model.zip	Moss Vale Aimsun models scenario provided and assessed: Files provided by Cardno • 2018 Base • 2036 without Bypass • 2016+CG (Underpass)
Traffic Data	8201822101_Chelsea Gardens_Surveys.zip 8201822101_Chelsea Gardens_SCATS.zip	2018 Traffic Survey and SCATS signal data. Files provided by Cardno
Reports	8201822101_Chelsea Gardens Moss Vale Base Model Development Report_rev1.pdf 8201822101_Chelsea Gardens Moss Vale Traffic Study_rev1.pdf 8201822101_Chelsea Gardens_Arthur St signals memo.pdf 8201822101_Chelsea Gardens_2016+CG Tech Memo.pdf 8201822101_Chelsea Gardens_Addendum to the Future Modelling Report .pdf	Moss Vale Traffic Reporting which includes Base Model Development Report, Chelsea Gardens Traffic Study and Technical memo of Arthur Street signal testing. Files provided by Cardno
SIDRA Model	8201822101_Chelsea Gardens_Arthur St signals_SIDRA files.zip	SIDRA network models that are used in Technical memo of Arthur Street signal testing. Files provided by Cardno
Traffic Data	WSC Argyle St Traffic data 2016, WSC Parking data, WSC Tube Count data, N5249 Moss Vale.zip	Historical traffic survey data from Wingecarribee Shire Council. Files provided by WSC
Technical Note	Chelsea Gardens Review (WSC Conclusion) 12-11-20.pdf	Preliminary model review note documented by Wingecarribee Shire Council. Files provided by WSC

3 Review of the Traffic Model Datasets

The traffic model datasets that have been collected as part of the modelling study have been reviewed as they form the basis from which the base traffic models have been calibrated and validated. As this data forms a key aspect of the model development process it has a major impact on the assessments obtained.

Table 2 lists the different traffic datasets collected in the development of the Moss Vale Traffic Model and provides audit commentary on this traffic data together with an indication of the likely severity of impact on model assessment findings.

TABLE 2 TRAFFIC DATASET REVIEW

Audit Item #	Audit Item Name	TMA Comment	Severity
1	**Classified Intersection Count** 26 intersections have been surveyed on 30/08/2018, 7:30-9:30 in morning peak and 15:00-18:00 in the afternoon peak.	• This time period is generally considered to be adequate for the analysis of a residential development • The peak traffic condition is expected to occur in relation to the school activity traffic, which starts around / before 3:00pm. If the traffic survey had commenced at 2:30pm this would have been better at identifying not just the impact from the school activity traffic but also the likely peak conditions on the network.	Medium
2	**Travel Time Survey** The travel time survey is undertaken on 30/08/2018 at the Argyle Street corridor, between Yarrawa Road and King Road.	• The main corridor of the network has been covered, however, it is desirable if other arterial roads (Illawarra Hwy / Yarrawa Road) can be surveyed for validation. Given that these form key parts of alternative paths through the network. • Only one probe vehicle has been used to conduct the travel time survey, the actual peak of the road network which is expected to be at around 15:00 pm when the school traffic activities are the highest. This is evident on the travel time survey run 27, the eastbound route is required 6 minutes and 25 seconds to complete, while the other eastbound runs are used less than 4 minutes to complete. An increased samples size or on another day would be desirable to provide more information on the traffic conditions of Argyle Street, particularly around the school peak.	Minor
3	**Origin Destination Survey** Section 6.1 of Chelsea Garden BMDR documents that the OD survey is used in the demand assumption.	• After discussion with Cardno it is apparent that the OD survey is incomplete and was not used in the process of demand development with models wholly dependent on TRACKS prior matrices. Base Model Development Report (BMDR) could be modified to reflect this.	Minor
4	**SCATS Data (SCATS History file)** The SCATS data for the intersection of Argyle Street / Kirkham Street was collected on 30th and 31st of August 2018.	• This matches the date the traffic survey was conducted. However, the SCATS data of the mid-block crossing near Illawara Hwy / Waite Street has not been collected.	Minor

4 Demand Development Review

The process of taking survey data and outputs from other models (TRACKS) to derive an accurate estimate of the traffic patterns (distribution) across the study network relies heavily on an arithmetic adjustment process but also requires a degree of common sense in interpreting the network as well as experience in applying recognised methods to similar study areas.

4.1 SUMMARY OF FINDINGS - DEMAND DEVELOPMENT

The demand development process has been reviewed and the TMA comments are summarised in Table 3.

TABLE 3 DEMAND DEVELOPMENT PROCESS REVIEW

Item		TMA Comment	Severity
5	Survey Data used and its application.	• The traffic survey data indicates that the Friday traffic volumes are around 15% higher than the Thursday used in the model assessments. • The traffic survey data indicates that the 2018 data has lower volumes than the traffic data collected in 2011. • This indicates that there could be seasonality impacts or traffic movements could be suppressed by the constrained capacity of Argyle Street. • Some peak spreading is evident, particularly in the Argyle Street, southbound ATC data indicating a protracted period of congestion over several hours. • As traffic surveys only capture those vehicles that were able to pass through an intersection during the peak period, they do not potentially capture the actual demand which be higher than the traffic volumes surveyed (particularly on approaches exhibiting substantial queuing).	Medium
6	Demand Development Process	• Demand matrices are developed based on the 2018 traffic survey with 2016 TRACKS model providing the prior matrix for demand adjustment process. • The Heavy (HV) matrix from the TRACKS model is neglected, with heavy vehicles assumed to be a simple 5% of the total traffic matrix pattern. As the HV matrix is typically expected to be aligned with the land-use and generally different to the car traffic pattern, this is not considered appropriate. • The iterative demand adjustment process documented is not evident in the Aimsun model provided.	Medium
7	Trip Length Distribution and Adjustment	• The adjusted and profiled traffic demands in the Aimsun models results in a substantially increased proportion of short by 15% over the original TRACKS demand model. • The modelling consultant has made changes to the trip distribution particularly between traffic loading from internal zones and external zones, however the need for this process to be undertaken has not been justified or at least documented.	Minor

4.2 TRAFFIC SURVEY DATA APPLICATION

Traffic conditions in Moss Vale during peak periods are dominated by congestion along Argyle Street - in particular around the intersection of Argyle Street and Kirkham Street, but also around the roundabout controlled intersection of Argyle Street and Illawarra Highway and Suttor Road. For example, in the PM peak the westbound queue on Argyle Street regularly extends from Kirkham Street back to the east of Illawarra Highway, a distance of some 900m. Substantial queues in both directions along Argyle Street can be encountered at numerous times of the week, including peak periods and also during the middle of the day.

4.2.1 Time periods

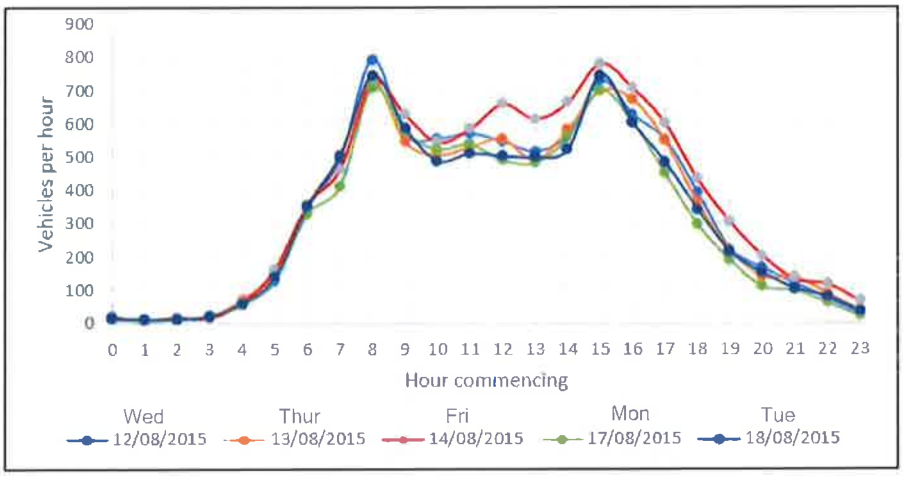
The model was built for weekday AM and PM peaks, with one-hour analysis periods, preceded by one hour warm-ups:

- AM peak Analysis period - 0815 to 0915
- PM peak Analysis period - 1530 to 1630

The day selected for modelling was a Thursday.

This would appear to contradict what is generally taken to be the peak periods in Moss Vale which is generally taken as the afternoon school peak period and PM period on a Friday.

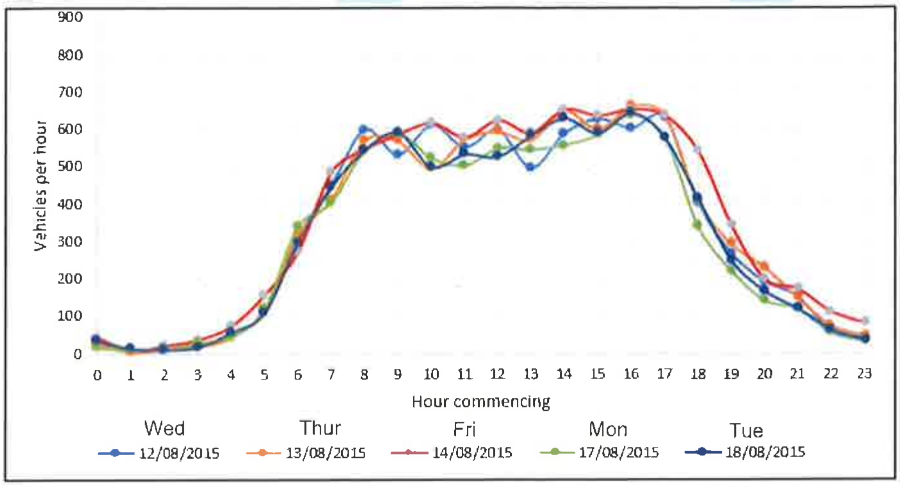
The following two figures show hourly traffic volumes on Argyle Street (north of Kirkham Street) for five weekdays in August 2015 (RMS ATC count data provided by WSC). The data series for the Friday has its line set to red to be easily distinguished.



Source: Analysis of RMS ATC data (5 weekdays in August 2015) provided by WSC

FIGURE 2 HOURLY TRAFFIC PROFILE - ARGYLE ST NORTH OF KIRKHAM ST MOSS VALE, NORTHBOUND

Figure 2 shows the northbound traffic profile and clearly shows that Friday's series is the highest throughout most of the day, and the hour commencing 1500 is the highest hour. Thursday's series (orange) is some 100 vehicles per hour (about 15%) lower than the Friday for the hour commencing 1500.



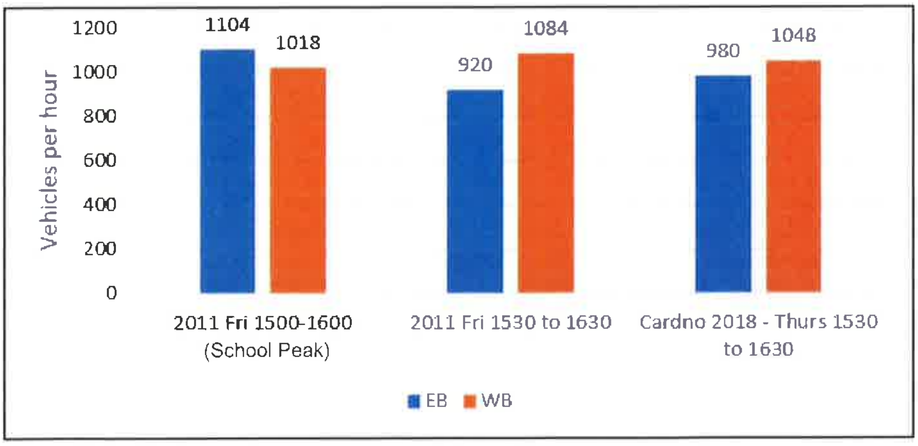
Source: Analysis of RMS ATC data (5 weekdays in August 2015) provided by WSC

FIGURE 3 HOURLY TRAFIC PROFILE - ARGYLE ST NORTH OF KIRKHAM ST MOSS VALE, SOUTHBOUND

Figure 3 indicates Friday is the busiest day; of note is that the traffic profile on each day slowly increases from around the hour commencing 1000 through to the hour commencing 1700. This shaped profile, with the hour-to-hour variation (as opposed to a distinct, short peak) indicates protracted congestion along Argyle Street Southbound.

This analysis indicates that the afternoon model was built for a relatively quiet day, not a peak day (like Friday) - this is unusual and is likely to over-state the available capacity for future project traffic.

A further comparison of traffic flows is provided for the railway screen line[1] in Figure 4. This screen line's traffic volumes are a critical indicator of the traffic capacity of Moss Vale.



Source: 2011 data from WSC PARAMICS model study; 2018 data from CARDNO Aimsun model study

FIGURE 4 - DIRECTIONAL TRAFFIC FLOWS ACROSS RAILWAY SCREEN LINE IN MOSS VALE

[1] Moss Vale is almost bisected by the main rail line between Sydney and Melbourne, with two crossing points for vehicular traffic: Argyle Street between Railway Street and Arthur Street, and Spring St west of Throsby Street. Combining traffic volumes on this section of Argyle Street and Spring Street provides a 'screen line' volume.

Figure 4 indicates that for the afternoon analysis hour of the 2018 model (1530-1630) traffic volumes across this screen line were 124 vehicles less in the Eastbound direction and 30 vehicles more in the Westbound direction than in the school peak hour (1500-1600) in 2011.

The 2018 model data also shows some 60 vehicles more eastbound and 36 vehicles less than the same time period (1530-1630) in 2011.

Given there has been growth in Moss Vale's population since 2011, it would be expected that the traffic volumes modelled in a recent model, based on 2018 traffic surveys, would be more than surveys taken in 2011. As model volumes used are lower in 2018 than in 2011, this suggests that the current AIMSUN model is not modelling the peak period of traffic demand in Moss Vale.

The BMDR needs to justify why Thursday was chosen as the day to be modelled and why the afternoon period model was built to ostensibly lower demand than the 2011 model.

4.3 DEMAND DEVELOPMENT METHODOLOGY

Wingecarribee Shire Council (WSC) has a strategic model (TRACKS) of the shire, which covers the main towns including Moss Vale. This model has been updated over a number of Census periods, based on fresh Census data. The TRACKS model referenced in Step A of Figure 5, was updated (independent of WSC) by TRACKS modelling experts using 2016 Census data and other field data.

The use of a sub-area cut from the TRACKS model for Moss Vale is considered an appropriate input to demand development.

The BMDR identifies field data used to support the demand development process:

- Turning movement counts at intersections (section 2.3.1 of BMDR)
- Travel times (section 2.3.2 of BMDR)
- OD survey (section 6.1 of BMDR)[2]

The use of an OD survey to be able to check key modelled OD cells, with field based direct measurements is considered good practice and provides confidence in the demands. However, on 11 Jan 2021 we were advised that despite the BMDR indicating that OD surveys were used, that in fact, due to field or administration issues, the survey was not completed or used. This gap in data availability is discussed further under the demand development heading.

Step B splits the TRACKS matrix into LV and HV using a flat factor of 5%. That is, the LV and HV matrices have the same trip distribution. This approach is difficult to understand when a strategic model with HV functionality is available and is discussed further in 4.4.2 below.

Step C uses AIMSUN functions to adjust the demands to better fit field data.

Step D uses traffic profile information to further adjust the adjusted demands from Step C, in the process disaggregating these hourly matrices into quarter hour matrices.

The remaining steps shown in Figure 5 (i.e., from Step D down) were not able to be verified as there is no evidence of Meso SRC scenario has been iteratively running to adjust the demand until both calibrated turns and travel time requirement satisfied as described in Section 3.3 of the BMDR.

[2] Cardno advise that these OD surveys had issues and the data was not used.

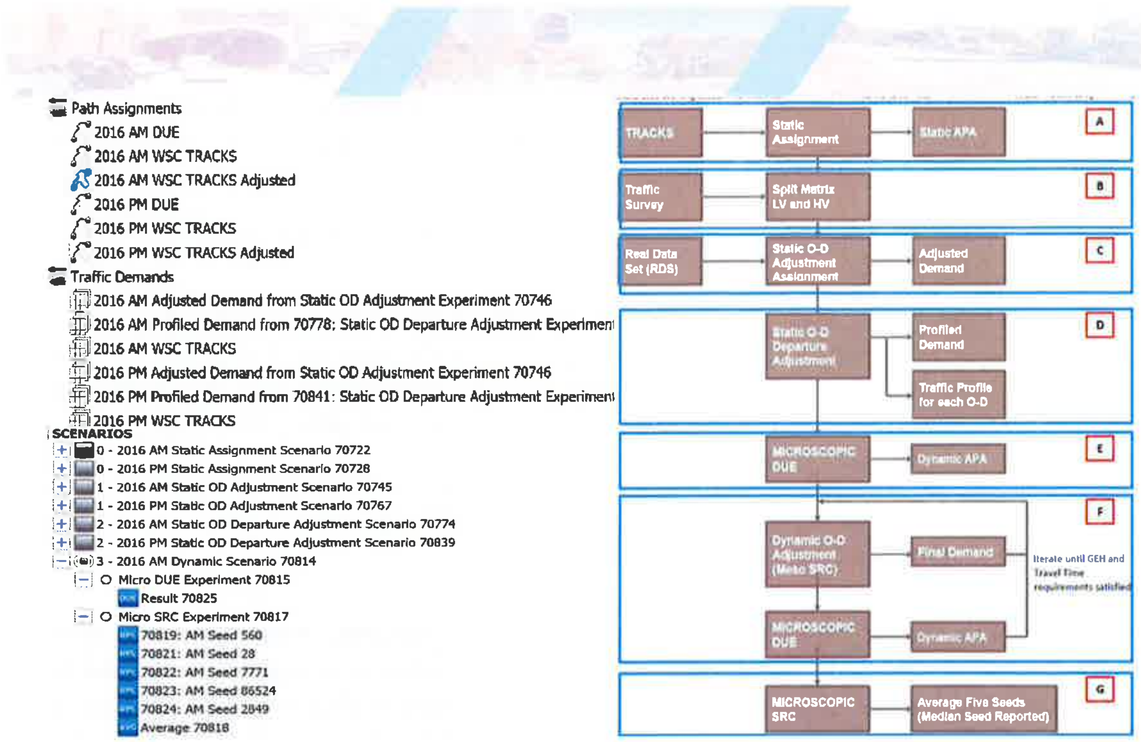


FIGURE 5 MOSS VALE MODEL DEMAND DEVELOPMENT PROCESS

4.4 TRIP LENGTH DISTRIBUTION AND ADJUSTMENT

This section covers demand development to produce calibrated matrices. One key measure of the effectiveness of this process is to hold trip lengths to what was provided in the original demand matrices provided by TRACKS prior to any adjustment process.

4.4.1 Origin destination surveys

The BMDR indicates at section 6.1 that OD surveys were taken to support the development of demand matrices. As noted previously this is considered good practice, further, it provides the opportunity to extract further information about key travel times through the traffic system. Unfortunately, we were recently advised (11 Jan 2021) that in fact the OD surveys were abandoned due to issues with field work or administration. These surveys are typically affected by vandalism and equipment malfunctions, but are still very worthwhile preserving as they provide a direct estimate of key OD cells in the demand matrices, providing an empirically based level of confidence in these critical cells. Our experience is that even if there is some issue with some stations, it is generally still possible to salvage some useful information for use in demand development.

4.4.2 Heavy vehicle demands

Heavy vehicle demands are based on a constant slice of the LV matrix (i.e., HV/(LV+HV) = 5%).

The use of a constant proportion matrix as a starting point for HV demands when a strategic model is available with HV functionality is hard to fathom. The explanation in the BMDR is:

> *Although the TRACKS model which was used to generate the demand matrices is capable of providing data for light and heavy vehicles, the process of separating the two vehicle types is time consuming. The creation of sub-area matrices was estimated by Stantec to increase the time required for demand estimation be threefold as the matrices needed to be broken up to assign each to the model and then tracked separately to produce sub-area matrices.*
>
> *Cardno commissioned intersection counts and OD surveys. This data was used to estimate the vehicle splits across the network which was then split into heavy vehicles from the TRACKS demand matrices. It was observed that heavy vehicles comprised approximately*

five (5) per cent of vehicles during the peak periods. As the proportion heavy vehicle proportion was estimated using survey data, it is likely to be acceptably realistic and therefore unlikely to negatively affect the model results.

(Section 6.1 BMDR)

The above explanation does not advance a compelling technical argument to abandon the advantage of HV demands based on a strategic model. Not using the strategic model to its fullest potential (especially as the OD Surveys were abandoned) is disappointing, when the justification that is offered is very weak.

Using a constant proportion HV matrix assumes:

- that zones generate LV and HV trips at a constant rate
- that the balance (ins and outs) of LV and HV trips at each zone are the same
- that the trip distribution is the same for LV and HV.

These assumptions cannot be supported, based on experience, HV demand matrices tend to be more sparse than LV matrices, with fewer cells, as freight movement serves a more limited pattern of land use and is restricted to a more limited road network. This is the case in Moss Vale with zones that vary from primarily residential, to commercial and retail town centre, to light and heavy industrial areas.

The justification, along the lines that:

> 'intersection counts indicated 5% HV, therefore 5% is ok'

ignores the fact that HV% varies differently at each intersection by period, approach, movement.

The implications of this approach for matrix estimation are that much more adjustment is required on the starting point HV matrices, than the LV starting point matrices. It would be far better to use HV matrices from TRACKS as the starting point, in conjunction with the HV counts taken in the field and detailed land use information to shape the HV matrices. It is more likely overall calibration and validation of the model would be improved.

Getting the vehicle class mix of the modelled traffic stream closer to the real world is more likely to better reflect traffic density as well as heavy vehicle effects on speeds and gap acceptance in the model.

A comparison of HV turning movement counts from the field and models should be undertaken to ascertain how well they fit. If this indicates substantial differences at critical locations then it is recommended that the HV matrices are re-estimated, starting from the TRACKS HV sub-area matrices.

4.5 REVIEW OF DEMAND CHANGES THROUGH CALIBRATION PROCESS (FIGURE 5 - STEPS A, B, C AND D)

4.5.1 AM light vehicle trip length distribution analysis

Figure 6 below shows the changes to the trip length distribution from the initial pattern matrix from TRACKS to the adjusted matrix and the adjusted and profiled matrix. This process has added a substantial number of trips to the matrix (TRACKS was 3724 and adjusted and profiled was 4319 trips) and most of these trips have been added in the shorter trip lengths.

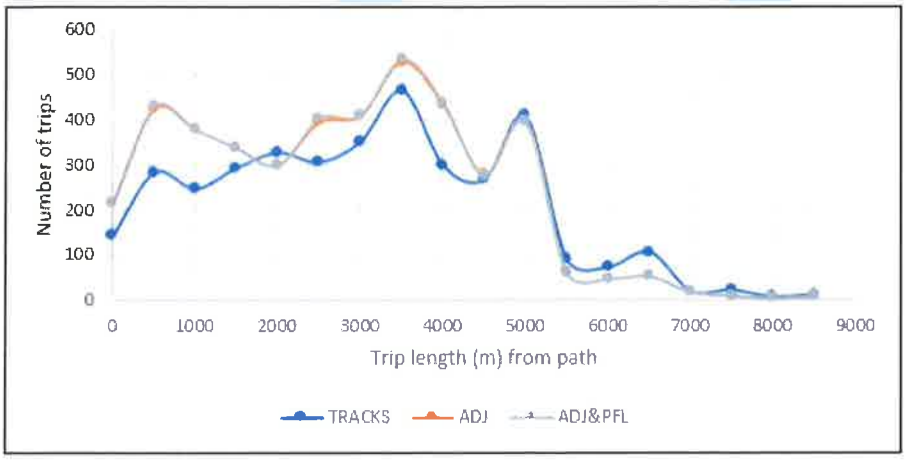


FIGURE 6 - AM PEAK TRIP LENGTH DISTRIBUTION COMPARISON (LIGHT VEHICLES, # OF TRIPS)

The need to add extra trips into demand from strategic matrices is well understood, however, this has traditionally been because the strategic models tend to have coarse networks, which mean they tend to exclude short trips as well as their demands not being as tightly calibrated as operational models. The TRACKS model covering Moss Vale appears from the network information we have received, to be very fine grained (approximately 200 zones). Consequently we are not convinced that network coarseness is the source of the justification for all these extra short trips.

The BMDR does not discuss this in detail or provide explanations for the need to add so many short trips into the AM LV matrix or does it address what trips they are.

Figure 6**Error! Reference source not found.** indicates there is little change in trip length distribution between the adjusted matrices and the adjusted and profiled matrices.

Figure 7 below repeats the comparison using % of trips in the trip length distribution plot. The key feature highlighted by this comparison is the reduction in the longer trips from the TRACKS matrix to the adjusted and profiled matrix.

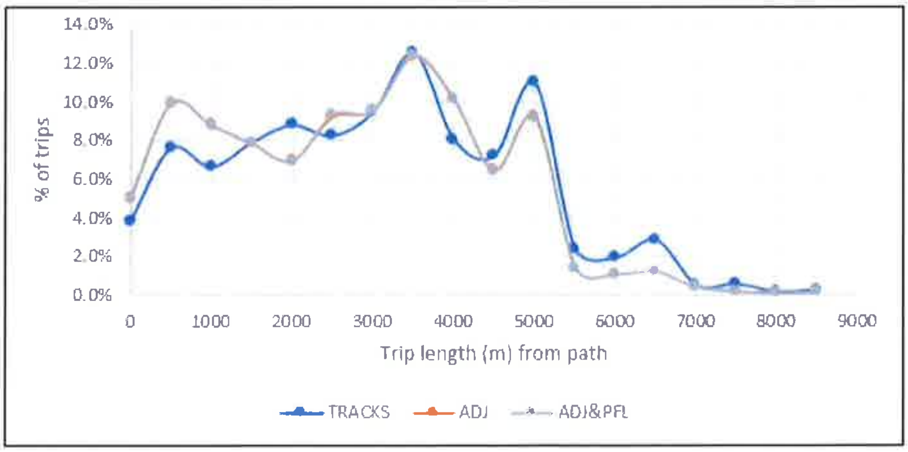


FIGURE 7 - AM PEAK TRIP LENGTH DISTRIBUTION COMPARISON (LIGHT VEHICLES, PROPORTION OF TRIPS)

4.5.2 PM light vehicle trip length distribution analysis

Figure 8 below shows the changes to the trip length distribution from the initial pattern matrix from TRACKS to the adjusted matrix and adjusted and profiled matrix. As with the AM light vehicle matrix, this process has added a substantial number of trips to the matrix (TRACKS showed 3626 trips and when adjusted and profiled this was increased to 4387 trips) with most of these trips being added to the shorter trip lengths: some 350 trips added during this process are shorter than 1 km.

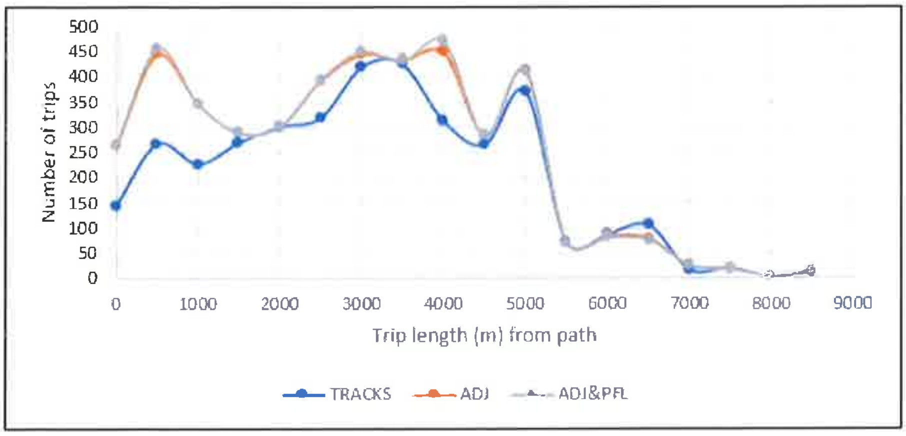


FIGURE 8 - PM PEAK TRIP LENGTH DISTRIBUTION COMPARISON (LIGHT VEHICLES, # OF TRIPS)

As with the comments for the AM light vehicle adjustments, we are not convinced that network coarseness is the source of the justification for all these extra short trips.

Again, the BMDR does not discuss this in detail or provide explanations for the need to add so many short trips into the PM LV matrix or does it address what trips they are.

Figure 8 indicates there is little change in trip length distribution between the adjusted matrices and the adjusted and profiled matrices, except around the 500m trips and the 4000m trips.

Figure 9 below repeats the comparison using % of trips in the trip length distribution plot. The key feature highlighted by this comparison is the reduction in the longer trips from the TRACKS matrix to the adjusted and profiled matrix.

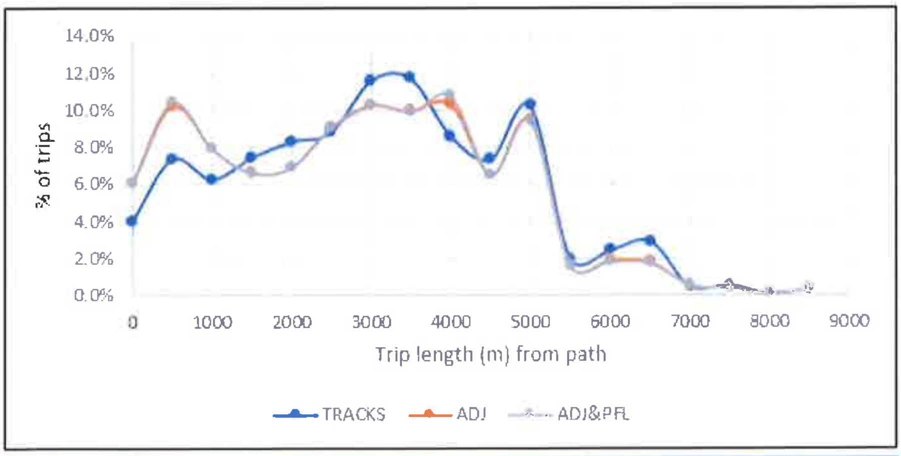


FIGURE 9 PM PEAK TRIP LENGTH DISTRIBUTION COMPARISON (LIGHT VEHICLES, PROPOTION OF TRIPS)

4.5.3 AM heavy vehicle trip length distribution analysis

Figure 10 compares the trip length distribution of the TRACKS matrix, the adjusted Aimsun matrix and the adjusted and profiled Aimsun matrix. This indicates trips are 'drawn' from the shorter lengths and some of the longer lengths to around the 3500m and 5000m trip lengths.

The actual number of trips in the TRACKS matrix is similar to the number of trips in the adjusted and profiled matrix, at 196 and 198 trips respectively. Consequently, we have not included a proportion based chart comparing trip length distributions.

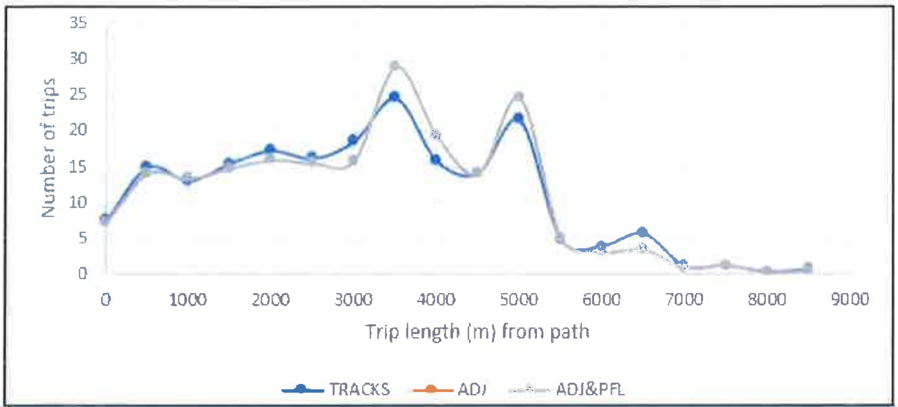


FIGURE 10 AM PEAK TRIP LENGTH DISTRIBUTION COMPARISON (HEAVY VEHICLES, # OF TRIPS)

We assume that the trip length changes are due to the matrix estimation reshaping the trip distribution. However, there is no explanation or comparison of assigned heavy vehicle volumes with field counts in the documentation.

4.5.4 PM heavy vehicle trip length distribution analysis

Figure 11 compares the trip length distribution of the TRACKS matrix and the adjusted matrix and the adjusted and profiled matrix. This indicates trips are 'drawn' from the 5000m trip lengths.

The actual number of trips in the TRACKS matrix is similar to the number of trips in the adjusted and profiled matrix, at 191 and 192 trips respectively. Consequently, we have not included a proportion-based chart comparing trip length distributions. However, it is worth noting that the total trips in the adjusted matrix dips to 178.

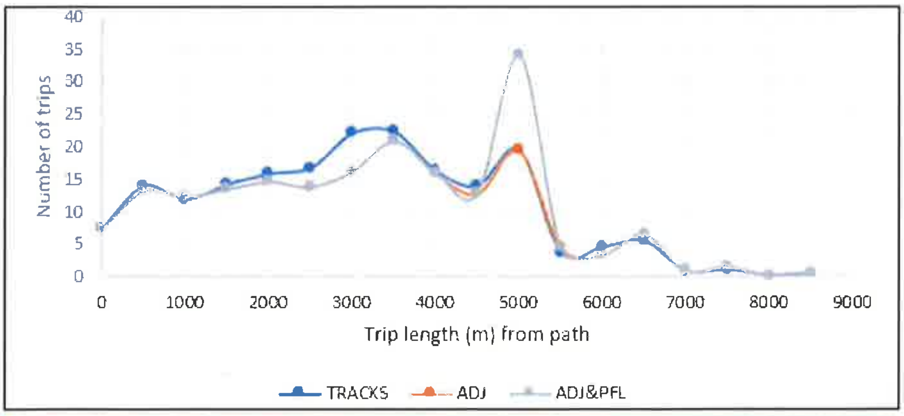


FIGURE 11 PM PEAK TRIP LENGTH DISTRIBUTION COMPARISON (HEAVY VEHICLES, # OF TRIPS)

We assume that the trip length changes are due to the matrix estimation reshaping the trip distribution, although the large increase in trips around 5000m suggests there may have been some additional process involved. However, there is no explanation or comparison of assigned heavy vehicle volumes with field counts in the documentation to demonstrate how successful this process has been.

4.5.5 AM light vehicle trip distribution changes

In order to explore the changes in trip distributions it is possible to map the demand matrices to a number of spatial aggregations. This section looks at changes in trip distributions for AM light vehicles using an aggregate sector system:

- Internal zones west of the railway are aggregated to West (W)
- Internal zones east of the railway are aggregated to East (E)
- External zones west of the railway are aggregated to Ext W
- External zones east of the railway are aggregated to Ext E

The difference in trips between the adjusted and profiled matrix and the TRACKS matrix are summarised in Table 4.

TABLE 4 - AM PEAK TRIP DIFFERENCES (LIGHT VEHICLES ADJUSTED AND PROFILED MATRIX LESS TRACKS MATRIX, # OF TRIPS)

Row Labels	E	W	E_Ext	W_Ext	Total
E	372	73	122	-16	**551**
W	143	-25	46	-64	**100**
E_Ext	-74	7	-24	-11	**-102**
W_Ext	41	-19	11	3	**35**
Total	**482**	**35**	**155**	**-88**	**584**

Key features of this comparison are:

- The increase in trips destinating in E from E and, to a lesser extent, in E from W
- Increase in E trips to E_Ext
- Increase in W trips to E_Ext
- Reduction in E_Ext trips to E
- An increase in trips from W_Ext to E

We have reviewed several of these changes in more detail, in particular looking at the increase in trips from the E sector. This has included examining changes in trips to SA1 Sector 11 (located on the west side of Argyle Street and east side of the rail line). In essence, this sector contains the railway station, some town centre retail, a small amount of on street car parking and a petrol station. In the TRACKS model this sector originates 107 trips and destinates around 135 trips. In the adjusted and profiled matrix this sector originates 267 trips and destinates 305 trips.

We cannot see a justification for this sector to have the level of demand evident in the TRACKS model (e.g., the rail station originates 24 trips in the AM peak hour and destinates 37 trips in the same period) - there is simply not enough land use in the sector. For these trips to increase by a factor of two and a half for originating trips and two and a quarter for destinating trips is hard to understand.

Whilst SA1 sector 11 is an example, there is a need for the matrix estimation to not simply be an arithmetic process, it needs to be grounded in real world travel behaviour and this includes examining land use in each SA1 sector and developing approximate upper and lower bounds to act as constraints on the adjustments, otherwise there is a danger that a simple arithmetic process will 'run away' with the matrix pushing the trip distributions away from reality. This process of constraints should be developed as part of the demand development, applied in the matrix estimation process and documented in the BMDR.

This issue is not restricted to this sector in the AM, or just to the AM period.

4.6 DEMAND CALIBRATION IN A CONGESTED NETWORK

As part of demand calibration, a process of matrix estimation was undertaken to seek to better fit the assigned demands (matrices) to traffic counts within the network. This is a standard approach and it is a step toward meeting the RMS Guidelines requirements that assigned modelled demands achieve specific criteria in terms of their fit to real world data.

The particular concern is that in some places in the network, the traffic counts (service flows - which tend to reflect traffic capacity) could substantially underestimate demands. The difference between demand and service flow is generally met by queuing traffic on the network. There is evidence of extensive queuing on Argyle Street for large periods of the afternoon which suggests that demands are significantly higher than service flows. Figure 3 above indicates a relatively flat hourly profile of traffic westbound (southbound) on Argyle Street, especially in the afternoon, which supports the claims that the town centre is congested.

Fitting demands to service flows could result in demand matrices with insufficient trips to reflect reality and this may result in less traffic on the model's network, which would tend to over-estimate network capacity available to accommodate future traffic growth.

Additional information is required to describe how the matrix estimation process was controlled, and how this issue of demand versus service flow was addressed.

5 Aimsun Model Review

5.1 SUMMARY OF FINDINGS - MODEL DEVELOPMENT REVIEW

The development of Aimsun Model has been reviewed and the comments are summarised in Table 5.

TABLE 5 MODEL DEVELOPMENT REVIEW

Item		TMA Comment	Severity
8	**Model Setup** Aimsun Version 8.2.3	• Demand matrices are developed based on the 2018 traffic survey with 2016 TRACKS model prior matrix. • The HV matrix from the TRACKS model is neglected and the assumption that the HV matrix is simply 5% of total traffic matrix pattern is in error as the HV matrix is expected to be aligned with the land-use and would generally be different to the general traffic pattern. • The iterative demand adjustment process documented is not evident in the Aimsun model.	Medium
9	**Traffic Demand Build-up** 6 traffic demands have been prepared (3 demands per peak period) with these mostly matching the demand development process described in Section 3.3 of the BMDR.	• the demand development process on Meso SRC (Step F of Figure 5) has no evidence of implementation in the models with no iterative assignments and demand adjustment provided on how they arrived at until GEH/ Travel time criteria has been met. (as described in the BMDR)	Medium
10	**Path Assignment** The path assignment is built on Micro SRC in accordance with the traffic demand scenario described in Section 5.3.1	• The Microsimulation seed runs (Micro SRC) but is using path assignment files from the static assignment instead of assignment file developed in Micro DUE (Refer to Figure 15)	Major
11	**Road / Lane / Section Type** Four Road Types have been included in the model:	• BMDR should document each of the individual road types and the reasoning on how these road types have been defined because each of them has different parameters such as capacity, lane change/ turn parameters, give way model and volume delay functions.	Medium
12	**Vehicle Type** 3 vehicle classes are defined in the model. • Car • Truck • Bus The default values from Aimsun for vehicle type parameters including vehicle dimensions, reaction times and driving behaviour were used in the model.	• From the available ATC count, the vehicle length on Light vehicle is compared against typical suburban arterial road. It is found that Moss Vale has a higher number of Class 2 vehicles (Ute), so vehicle length should be adjusted to fit the actual observation in Moss Vale instead of using standard value. • All vehicle types apply with mean speed acceptance $\geq$1, this means Car in the network are travelling in average 10% faster than the posted speed limit. • Reaction time in the regional NSW township is expected to have a slower reaction time instead of applying a default reaction time. • The reaction time on heavy vehicle is 0.8 seconds in general instead of 1.2 seconds as documented in the BMDR.	Medium
13	**Signal Plan** One hour signal plan is applied in the 2 hours model for both AM and PM peak model, including warm-up periods.	• Cycle time matches to the SCATS history file collected. However, Phase C (Kirkham Street approach) is coded to allow pedestrians in every cycle, which effectively prolonged Phase C from 20 seconds on average to 34 seconds. This artificially builds up the delay on Argyle Street and traffic queueing instead of the models effectively reflecting the traffic	Major

Item		TMA Comment	Severity
		behaviour on site. • This discrepancy is also contrary to the RMS modelling guidelines as the signal timing applied exceeds 10% of the average phase time on all phases within an hour. • Mid-block pedestrian crossing is missing in this model, consequently the platooning effects on Argyle Street during peak hour, in particular PM peak are not evident in the model. SCATS data should be provided to support the documentation stating that the pedestrian crossing is infrequently utilised during modelling periods.	
14	**Public Transport Line** The PT line has included both local and regional bus services, including NSW TrainLink. (Approximately 20 different routes are included)	• All buses are coded with zero dwell time (therefore no friction is included between the bus and general traffic at the bus stops) • No local school bus service is included. • There is no Public Transport Plan setup in Aimsun. Therefore, no PT service is included in any scenario.	Major
15	**Modelled Road Network** Posted speed limits appear to be matching to the real condition.	• On-street parking on Argyle Street is removed, which effectively removes the friction on Argyle Street	Medium

5.2 VEHICLE TYPE

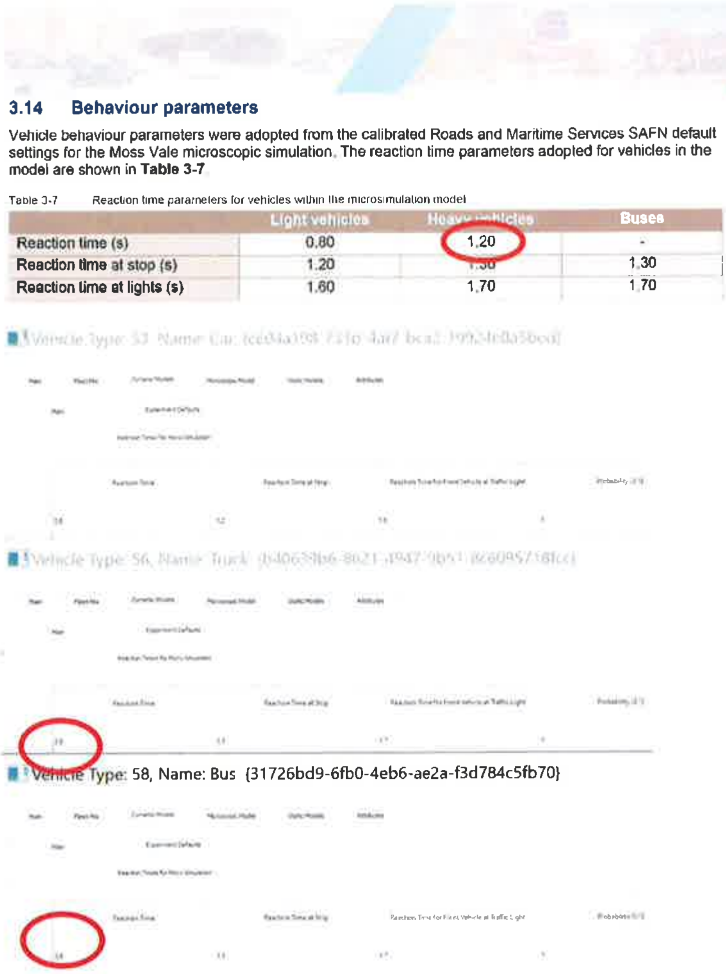
The BMDR states that the Aimsun default vehicle type parameters were used.

Our previous experience indicates that the vehicle fleet in the Highlands tends to have:

- A higher proportion of larger light vehicles
- There are more light vehicles towing (Austroads bin 2) - these vehicles take up more road space and tend to maintain larger inter-vehicle gaps in the traffic stream, they are also slower to accelerate. It appears that in contrast to Sydney, a higher proportion of trades in the Highlands use utes with a trailer as opposed to using vans. The ATC from RMS on Argyle Street north of Kirkham Street (2015) indicates that for an average weekday during both the morning peak period (0700 to 1000) and the evening peak period (1500 to 1800) bin 2 is approximately 1.9% of light vehicle volumes (bin 1 + bin 2). By way of comparison, a busy arterial road (The Northern Road in Sydney's west) has bin 2 proportions of light vehicles of 1.4% in the morning and afternoon peak periods, whilst a quieter arterial, Pittwater Road, has bin 2 proportions of light vehicles of 0.2% in the morning peak and 0.3% in the afternoon peak period.
- There are more heavy vehicles associated with rural activities (in some cases own-account haulage, which tends to use older vehicles), which tend to have more sluggish kinematics. Argyle Street is regularly used by large heavy vehicles carrying fodder, which tend to max out on dimensions rather than mass, and generally have to negotiate travel under the rail bridge across Argyle Street by proceeding at an angle, requiring co-operation of other drivers travelling in both directions.

Reaction time in the regional NSW township is expected to have a slower reaction time instead of applying a default reaction time that may be more appropriate to larger metropolitan areas.

It is noted that the reaction time of heavy vehicles is 0.8 seconds in general instead of 1.2 seconds as documented in the BMDR as shown in Figure 12.



3.14 Behaviour parameters

Vehicle behaviour parameters were adopted from the calibrated Roads and Maritime Services SAFN default settings for the Moss Vale microscopic simulation. The reaction time parameters adopted for vehicles in the model are shown in **Table 3-7**

Table 3-7 Reaction time parameters for vehicles within the microsimulation model

	Light vehicles	Heavy vehicles	Buses
Reaction time (s)	0.80	1.20	-
Reaction time at stop (s)	1.20	1.30	1.30
Reaction time at lights (s)	1.60	1.70	1.70

FIGURE 12 HEAVY VEHICLE REACTION TIME

Speed Acceptance on all vehicle classes are 1 or greater, this means the vehicle speeds in the model will tend to have an average speed matching the posted speed. This is more pronounced for Trucks with the speed acceptance mean value set to 1.05 (range 1.00 - 1.10) therefore, trucks will tend to travel above the speed limit. This assumption should be supported by site observation/speed survey.

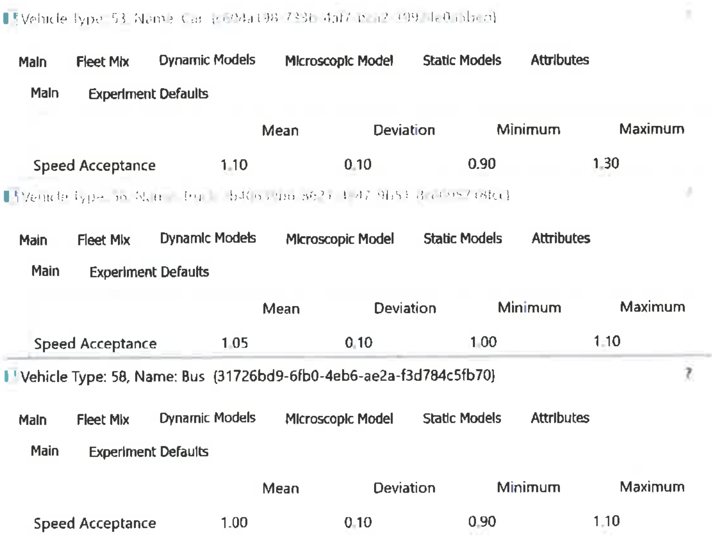


FIGURE 13 SPEED ACCEPTANCE

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Further justification of the use of the default vehicle type parameters should be provided, with adjusting vehicle type parameters and mix to better match the conditions in Moss Vale.

5.3 TRAFFIC ZONES

The following zones are listed as externals in the north east of the model extent:

- Zone 210 Headlam Road
- Zone 211 Church Road
- Zone 212 Kings Road

However, these zones should be considered as internal zones as they represent 'encapsulated' local land use, without through connections to other parts of Wingecarribee Shire.

5.4 ROAD NETWORK CODING

A feature of Argyle Street, mainly between Valetta Street and Arthur Street, is on-street parking. Use of the on-street parking leads to friction for traffic on Argyle Street.

This effect of this friction should be included in the model as it reduces through capacity and increased travel times.

5.5 TRAFFIC SIGNALS

A one hour signal plan is applied in both the AM and PM peak models. Although the cycle times match the SCATS history data collected, Phase C (Kirkham Street approach) is coded to allow pedestrians in every cycle, which effectively prolongs Phase C that operates at 20 seconds on average is extended to 34 seconds. This artificially builds up the traffic delays on Argyle Street with traffic queueing at the signals instead of effectively reflecting the traffic conditions on site. This signal representation is also contrary to the RMS modelling guidelines as the difference between actual and modelled signal timings applied exceed 10% of the average phase time on all phases within an hour.

The pedestrian signals across Argyle Street at the primary school were not modelled, with any delay effects of this operation ignored by the models.

Observations within the town centre indicate these have an appreciable impact on Argyle Street traffic in terms of delays and queuing, in the lead up to school start in the AM and after school finish in the PM (between 14:55 and 15:15).

In the AM this period of signal activity occurs during the model's analysis hour. In the PM it occurs prior to the analysis hour commencing at 15:30.

Exclusion of the effect of these signals should be justified.

Further, field observations over many years have indicated that traffic queuing on Argyle Street and Kirkham Street at the intersection of Argyle Street and Kirkham Street is sensitive to the number of pedestrians crossing Argyle Street at the Kirkham Street signals. It is not just the number of calls for the pedestrian phase, but also the number of pedestrians crossing, especially stragglers walking during flashing red period who tend to reduce the number of vehicles able to exit Kirkham Street.

The operation of the pedestrian crossings at this intersection should be validated against field data such as the video taken for the turning movement counts at this location.

5.6 PUBLIC TRANSPORT

Rail and regular bus services are described in the BMDR, yet the bus services don't appear to be running in the models because of the coding error shown in Figure 14.

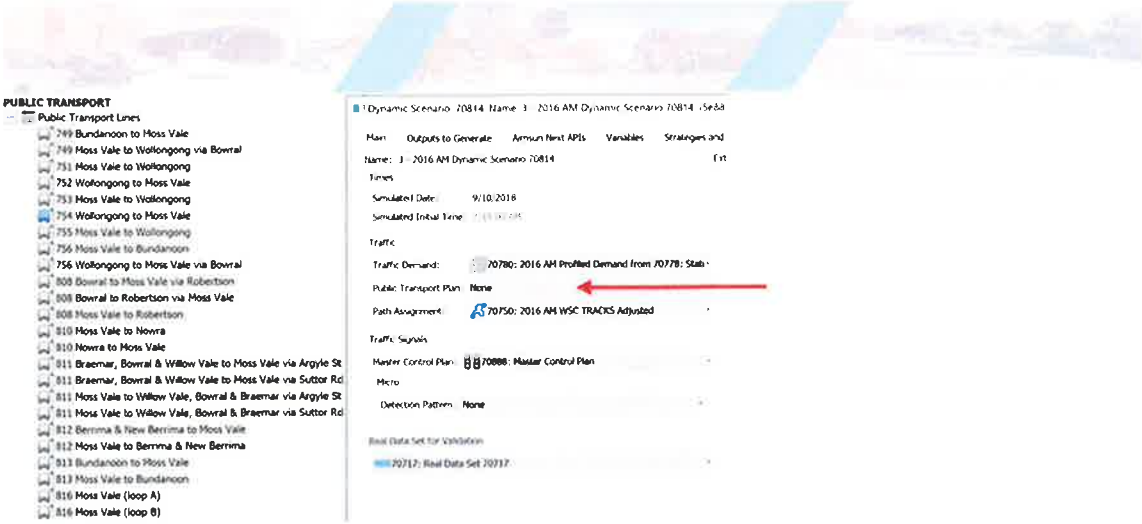

FIGURE 14 NO PUBLIC TRANSPORT PLAN SELECTED

The school bus network and services are not discussed in the report or included in the model.

In rural and regional bus contract regions, in broad terms, the regular bus network operations largely cease during the AM and PM school bus peaks with almost all buses deployed to school runs. There are some exceptions to this, but generally this is what happens.

The school bus network in the Highlands is like most rural areas, comprised of many routes with interchange between routes and some circuitous routing to provide adequate coverage of the school catchments.

This means there are numerous buses (substantially more than during regular passenger services) on the road during before and after school peaks, winding along the various roads, stopping occasionally for students to board or alight.

Including these vehicles in the model will assist to capture their real world effects on traffic density, traffic delays and travel times.

The school bus network is described at https://www.buslinesgroup.com.au/berrima-school-buses/school-timetables.html.

5.7 TRAFFIC ASSIGNMENT

The path assignment is built in accordance with the traffic demand scenario described in Section 5.3.1 of the BMDR. However, the Microsimulation seed runs (Micro SRC) appear to be using the path assignment files from static assignment instead of the assignment file developed in Step E (Micro Dynamic User Equilibrium) which is the key step in ensuring that model assignment responds to network congestion effects.

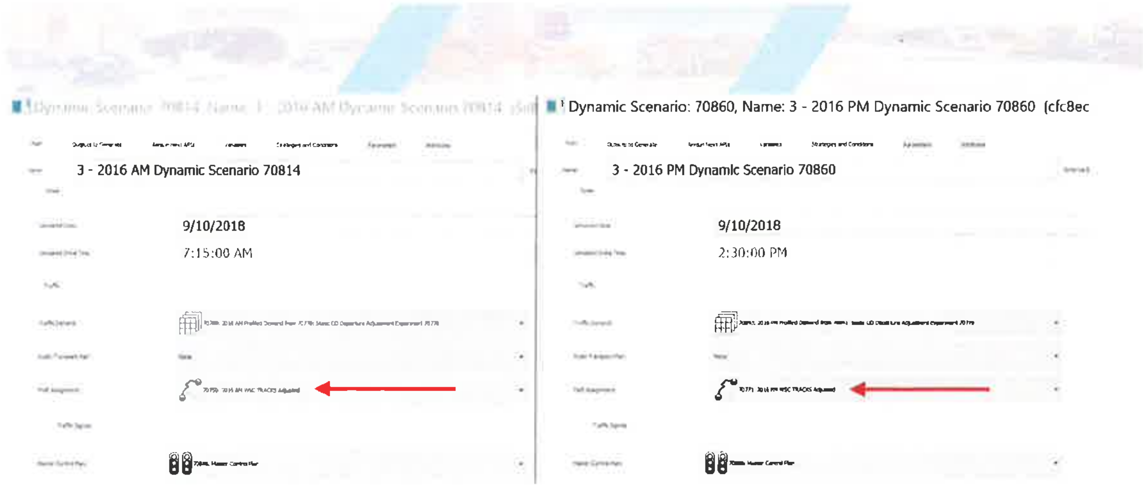

FIGURE 15 INCORRECT PATH ASSIGNMENT FILES SELECTED

Major: Incorrect path assignment files have been used/ does not match the described process in BMDR.

5.8 ROAD / LANE / SECTION TYPE

Four Road Types have been included in the model:

- Primary
- Residential
- Trunk
- Motorway (applied on railway track)

The BMDR should document each of the individual road types and the reasoning behind the selection of these road types. As they have been defined with each of them having different parameters, such as capacity, lane change/ turn parameters, give way model and volume delay functions, they are key to establishing a basis for model assignment.

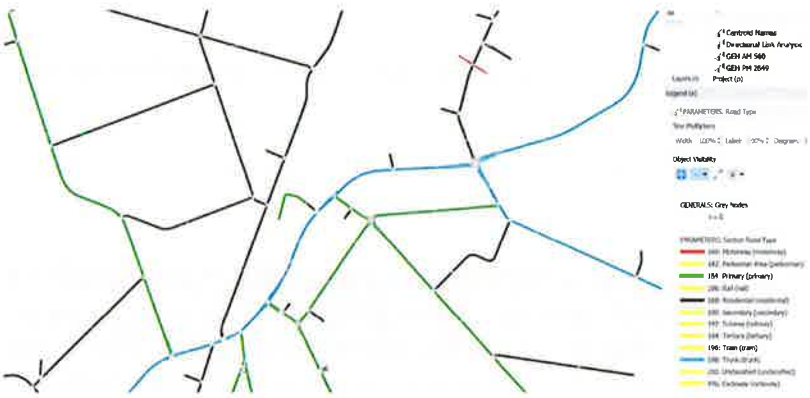

FIGURE 16 MODELLED ROAD HIERARCHY

5.9 MODEL ANALYSIS / PERFORMANCE REVIEW

The performance of Aimsun Model has been reviewed by running models to generate results and traffic movements across the network. The TMA comments on this aspect are summarised in Table 6.

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TABLE 6 MODEL PERFORMANCE REVIEW

Item		TMA Comment	Severity
16	**Model Calibration** GEH statistical network wide calibration Local driver behaviour Signal timings	• The town centre section of Argyle Street should be calibrated with Core-Area calibration criteria. • No U turn calibration on roundabout of Argyle St / Illawarra Highway (some 50 slow moving vehicles not calibrated in the current PM peak calibration). • No site visit has been undertaken (or evidence of site visit provided) to observe the actual on-road driving behaviour for local driver behaviour calibration. • Signal timing applied in models do not calibrate to SCATS history data.	Major
17	**Model Validation** Travel time validates under the RMS modelling guidelines.	• Travel time is generally low across all directions in both peak periods indicating that model is likely to be overestimating available network capacity.	Medium
18	**Visual Inspection**	• A visual inspection of the model shows network coding appears to be appropriate. However, a minor coding issue observed at the Argyle Street / Illawarra Hwy roundabout results in vehicles on the left turning lane does not conflict with vehicles in the roundabout, which overestimates the capacity of the roundabout.	Minor
19	**Results Reporting**	• No intersection Level of Service (LOS) is included in any Aimsun modelling assessment. It is difficult to quantify the intersection delay and impact as the result of the pre-Chelsea Development and post Chelsea Development.	Major

5.9.1 Model Calibration

The current model calibration is generally matching to the Network-wide Calibration criteria. However, issues are identified in the calibration process.

- Calibration process is generally satisfied except at the roundabout. The calibration method uses a simplified approach by demonstrating calibration on combined movements, typically combining through and right-hand-turn movements to obtain volumes for comparison against observed. This does not satisfy the RMS modelling guidelines.
- By watching the model closely at the modelled roundabout of Argyle Street and Illawarra Highway there are no U-turn movements observed and the calibration does not calibrate any U-turn movements at any roundabout.
- There is no evidence provided of any site visit being conducted by the modeller, without any site inspection, it is likely that this model does not accurately reflect the local driver behaviour such as gap acceptance, stationary spacing of vehicles in traffic queues as well as the driving habits of the local road users.
- The signal timing used at Kirkham Street intersection does not match within 10% of the SCATS signal timing provided and cannot be said to be calibrated to observed.
- The mid-block pedestrian crossing has been excluded in the model but the maximum utilisation of the pedestrian crossing likely occurs during the warm-up period of the model (prior to the calibration period) and this would effectively develop the traffic queueing on Argyle Street.

5.9.2 Model Validation

The Moss Vale Base Model is validated with Argyle Street travel time routes under RMS modelling guidelines. However, the modelled travel time is generally faster in both directions in the AM and PM peak models. It is recommended the abovementioned model parameters are reviewed and revised to match with the local driving conditions which are expected to slow the general traffic in the network.

In Moss Vale the typical peak period is expected to occur from the short surge traffic demand. Hence, comparison with travel time on different time intervals with variability would provide an extended full picture to understand how the model is performing and whether it validates to the on-site condition instead of just validating to average hourly data, from the criteria from the modelling guidelines.

The model validation could consider another independent dataset such as queue length data along the corridor. A qualitative queue length comparison would provide an overall understanding of the worst period of the peak hour. From the model snapshot in Figure 17, it is apparent that the traffic queueing is light in comparison with the actual queueing on Argyle Street.

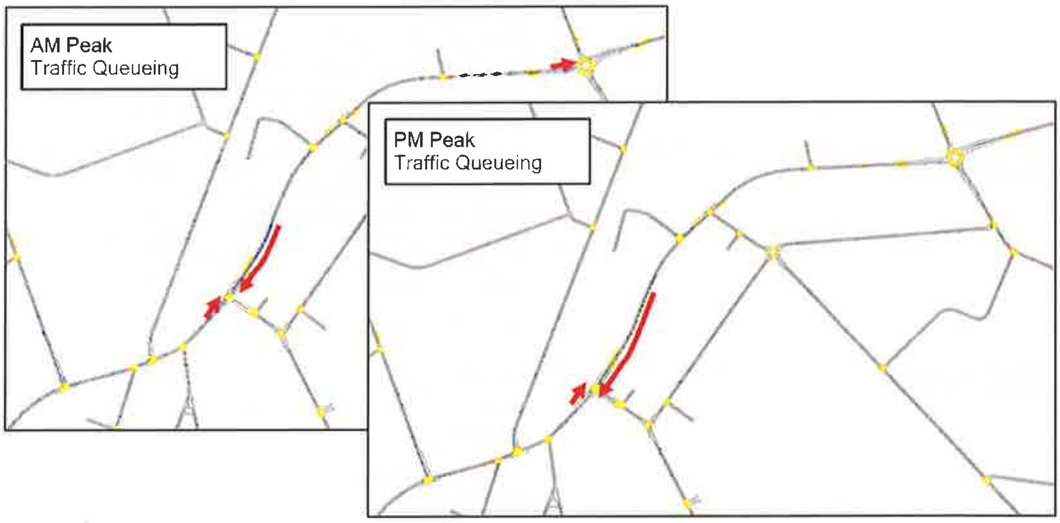

FIGURE 17 MODELLED TRAFFIC QUEUES - ARGYLE STREET

5.9.3 Visual Inspection

The overall visual inspection of the model generally appears satisfactory however, at the roundabout of Argyle Street and Illawarra Highway an aggressive turning movement is observed which its very unlikely to happen on site and is shown in Figure 18 below.

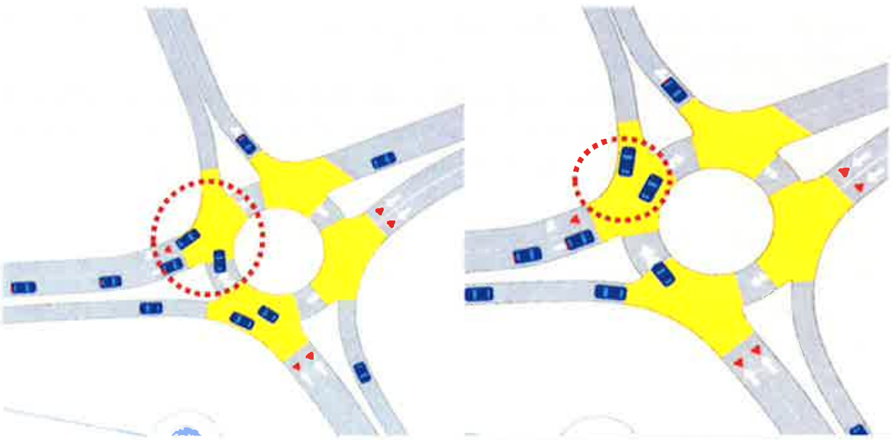

FIGURE 18 AGGRESSIVE BEHAVIOUR OVERESTIMATING CAPACITY

On observation of the model while the number of vehicles in queues appeared reasonable, the length of the queues appeared smaller than expected. This is likely because of both:

- the vehicle fleet lengths reflect the Aimsun default parameters, rather than locally calibrated lengths reflecting the local fleet (as discussed in Table 5, item 12) as well as;
- the stationary spacing of vehicles is approximately 1 metre when local observations would indicate 1.5 - 2 metres is more likely.

These concepts are shown in Figure 19 and can be readily modified in the model, through a sensitivity test, that is likely to show that both queue lengths and travel times would increase to be more in line with observation.

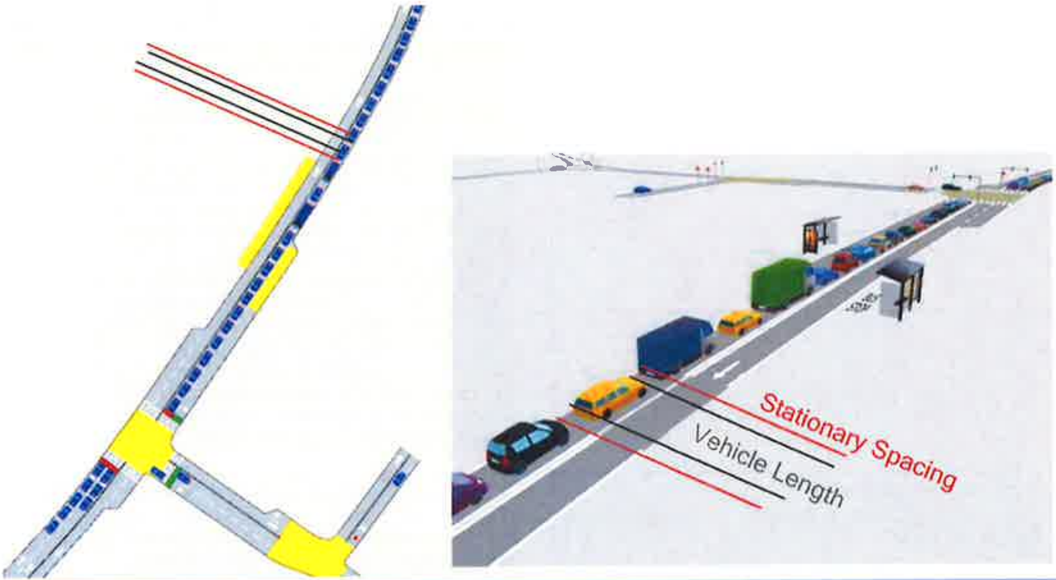

FIGURE 19 VEHICLE LENGTHS AND STATIONARY SPACING IN QUEUES

5.10 FUTURE SCENARIO REVIEW

Comments in this section are based on the provided models (*8201822101_Chelsea Gardens_Base+CG Model.ang*) and documentation (*8201822101_Chelsea Gardens Moss Vale Traffic Study_rev1.pdf* and *8201822101_Chelsea Gardens_Arthur St signals memo.pdf*)

TMA's high level commentary is provided on the Chelsea Gardens Development Traffic and Future modelling scenarios in Table 7 below.

TABLE 7 FUTURE DEVELOPMENT REVIEW

Item	TMA Comment		Severity
20	**Traffic Generation** Traffic Generation rate of 0.84 trips/ dwelling is adopted.	• The traffic generation is considered to be on the lower side.	Noted
21	**Future committed infrastructure assumptions** Section 3.2 of Chelsea Gardens Traffic Study, Future Modelling report documents a few of the proposed intersection upgrades and Stage 1 Moss Vale Bypass have been assumed in the some of the future scenarios.	• This committed infrastructure is proposed but might not necessary be fully developed. This infrastructure is proposed to support the development of the Moss Vale Enterprise Corridor.	Noted
22	**Spring Street** The assumption of the Spring Street Railway underpass.	• There is no modelled capacity constraint at Spring Street Railway underpass in various model scenarios. • The current traffic volumes (200 veh/h) is expected to be close to its capacity.	Major
23	**Chelsea Gardens Development trip assignment** Path Assignment File: 2036 DUE - without Bypass has been reviewed.	• The traffic assignment from Chelsea Gardens Development has been assessed and appears to be appropriate. • 70 - 80% of the traffic is routed on the main street (Argyle Street) while the remaining 20	Noted

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Item		TMA Comment	Severity
		- 30 % is rat running on Kirkham Street and Elizabeth Street.	
24	**"2036 without Bypass" Scenario** (*2016 + Chelsea Gardens_Arthur St signals ang 2036 without bypass*)	• Based on the traffic demand and results, this appears to be the 2018 Base + Full Chelsea Gardens Development. • No Public Transport Plan is setup • The filing structure should be revised so this will be not misunderstood.	Major
25	**"2016+CG underpass" Scenario** (*2016 + Chelsea Gardens_Arthur St signals ang 2016 + CG Underpass*)	• 2016+CG analysis is not clear on how it has developed. Aimsun demand appears to slice into a sub-area matrices with a 12 x 12 matrix, surrounds Spring Street underpass. • All SIDRA (both isolated and network) models in the traffic study are not calibrated so the results might not be representative and realistic. For example, Lackey Street is only 40 metres west of Arthur Street, however, the northbound queue at the Arthur Street approach is always greater than 40 metres. Therefore, it is expected that Lackey Street traffic would be greatly impacted by the arrangement but this is not showed in the SIDRA analysis. If comparing the result from the Aimsun model runs, the Aimsun model suggests the delay and traffic queuing is greater on Lackey Road.	Major
26	**Modelling presentation** (*8201822101_Chelsea Gardens Moss Vale Traffic Study_rev1.pdf*) All model results were graphically presented as speed plots, density plots and volumes plots.	• All plots are graphically presented, however, there is no quantitative measurable unit such as intersection delays, travel time. VHT which is numerically comparable in between different scenario. For example, the future modelling mentioned that the 2036 Base scenario, Argyle Street is saturated without Chelsea Gardens Development. However, it is undetermined that the actual travel time is increased from 2018 to 2036 base scenario and 2036 with Chelsea Gardens.	Minor

5.10.1 Traffic Generation

Traffic Generation rate of 0.84 is considered to be on the lower side. The Development self-containment looks high given there is basically nothing but housing (east Bowral, developed over the past 15-20 years could probably be used as a model to test this level of self-containment with fieldwork). The traffic report states many trips go to/from the Moss Vale Enterprise Corridor, however figures do not appear to support this. Furthermore the Moss Vale Enterprise Corridor has been rezoned for many years and not much has happened, so this may not be realistic.

5.10.2 Spring Street underpass

The capacity of the Spring Street underpass should be constrained as it is a two-way, one lane underpass with limited capacity, especially when the Railway Street stop line is just 15 metres away from a one lane section. The current traffic volume (200 veh/h) is expected to be close to its capacity. However, there are scenarios that assume there are some 430 vehicles assigned to Spring Street (Table 2 of Arthur Street Signal Testing Memo) which is not considered a practical assumption. Refer to Figure 20 below.

Table 2 Number of vehicles using Spring Street underpass

Direction	2016		2016 + Chelsea Gardens			
	Base		Argyle St / Arthur St right turn ban		Argyle St / Arthur St signals	
	AM	PM	AM	PM	AM	PM
Eastbound	69	119	174	211	138	191
Westbound	107	77	256	226	139	89
Total	176	196	430	437	277	280

Source: Google Maps

FIGURE 20 SPRING STREET UNDERPASS CAPACITY LIMITATIONS

5.10.3 Chelsea Garden Traffic Assignment

The path assignment files (both AM and PM peak) has been assessed on Centroids 191 to 199 (Chelsea Gardens Development). The assignment shows that 70 - 80% of traffic is assigned via Argyle Street (with the remaining traffic finding alternative routes via Elizabeth Street. Figure 21 is an extract of one OD path as an example, which shows that 71% of traffic is assigned on Arthur Street and then Argyle Street, while 13% of traffic travels via White Street with the remainder on Elizabeth Street, as a parallel route for Argyle Street.

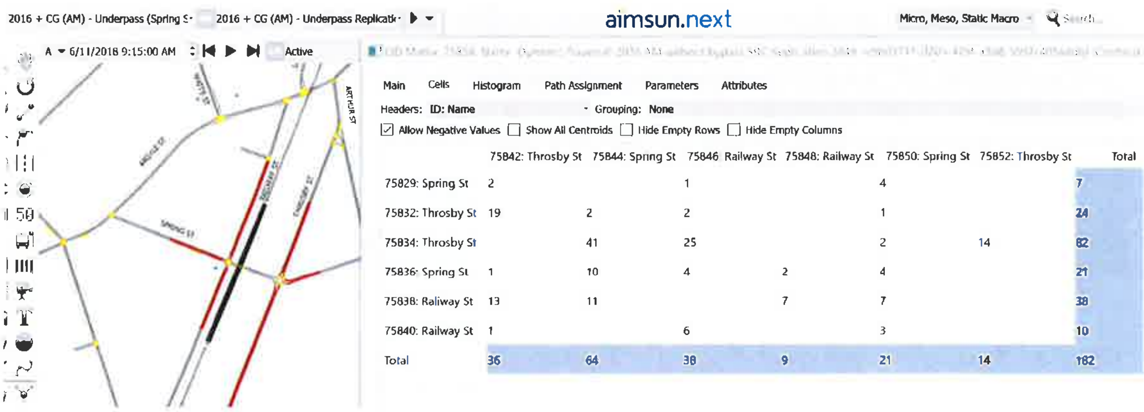
FIGURE 21 CHELSEA GARDENS AM PEAK PATH ASSIGNMENT

This suggests that apart from Argyle Street, there will be additional traffic pressure on Elizabeth Street, White Street and Illawarra Highway roundabout as the result of the development.

With the possible underestimate of congestion effects on Argyle Street (discussed in sections 4.2, 4.6, 5.5 and 5.9.2 of this audit) there is a risk that an even greater proportion of development traffic, than the 20-30% identified here may use alternative routes via Elizabeth Street. Additionally, some of the Chelsea Gardens centroids load traffic onto the local network via Fitzroy Road to the north east of the development site and onto the Illawarra Highway. The volumes of development traffic using this route could also further increase if Argyle Street delays are increased to provide a better representation of observed behaviour.

5.10.4 "2016+CG Underpass" Aimsun Scenario

It is unclear what the purpose of the "2016+CG Underpass" scenario in the Aimsun model file is. This scenario comprises of a 12 x 12 matrix surrounding the Spring Street underpass. As no documentation has been provided further explanation and findings are sought from the modeller.



	75842: Throsby St	75844: Spring St	75846: Railway St	75848: Railway St	75850: Spring St	75852: Throsby St	Total
75829: Spring St	2		1		4		7
75832: Throsby St	19	2	2		1		24
75834: Throsby St		41	25		2	14	82
75836: Spring St	1	10	4	2	4		21
75838: Railway St	13	11		7	7		38
75840: Railway St	1		6		3		10
Total	36	64	38	9	21	14	182

FIGURE 22 SPRING STREET UNDERPASS MATRIX

5.10.5 SIDRA Modelling

The use of SIDRA in a microscopic simulation network can create its own issues and as all of the SIDRA modelling in the traffic study is not calibrated, any reliance on any SIDRA modelling results should only be at a very high level, rather than seen as a definitive position of traffic performance. In addition (and unsurprisingly) the SIDRA results show discrepancies in comparison with the Aimsun model that has the same layout. Figure 22 shows significantly different queue lengths across software.

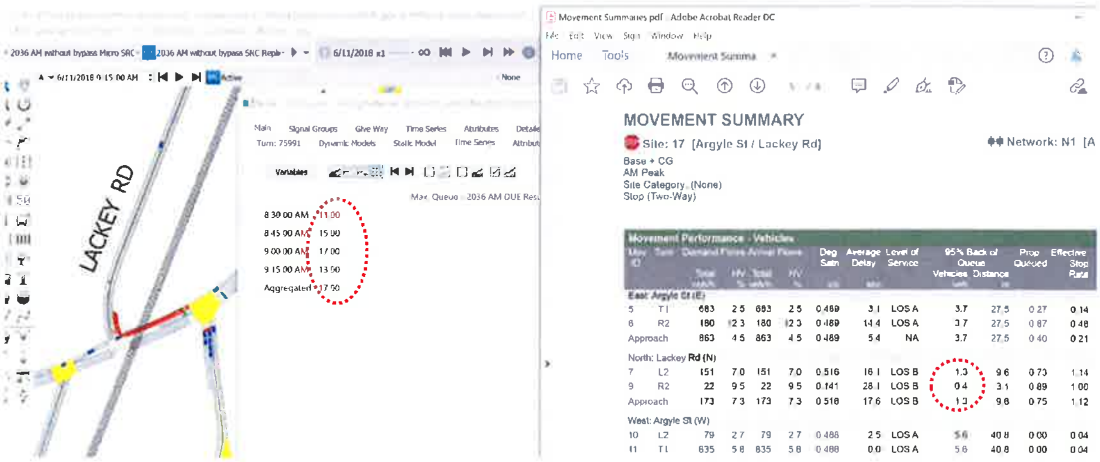


FIGURE 23 SIDRA/AIMSUN RESULTS DISCREPANCIES

6 Conclusions and Recommendations

6.1 AUDIT FINDINGS SUMMARY

This traffic model audit has found the issues identified in Table 8. Whilst several them relate to lack of adequate documentation there is also a need to further refine models and potentially extend the survey period (or provide relevant evidence) to better capture Moss Vale congestion effects.

TABLE 8 AUDIT FINDINGS SUMMARY

Audit Item #	Audit Item Name	TMA Comment	Severity
1	**Classified Intersection Count** 26 intersections have been surveyed on 30/08/2018, 7:30-9:30 in morning peak and 15:00-18:00 in the afternoon peak.	• This time period is generally considered to be adequate for the analysis of a residential development, however: ○ The peak traffic conditions are expected to occur in relation to the school activity traffic, which starts before 3:00pm. If the traffic survey had commenced at 2:30pm this would have been better at identifying not just the impact from the school activity traffic but also the likely peak conditions on the network.	Medium
2	**Travel Time Survey** The travel time survey is undertaken on 30/08/2018 at the Argyle Street corridor, between Yarrawa Road and King Road.	• The main corridor of the network has been covered, however, it is desirable if other arterial roads (Illawarra Hwy / Yarrawa Road) can be surveyed for validation. Given that these form key parts of alternative paths through the network. • Only one probe vehicle has been used to conduct the travel time survey, the actual peak of the road network which is expected to be at around 15:00 pm when the school traffic activities are the highest. This is evident on the travel time survey run 27, the eastbound route is required 6 minutes and 25 seconds to complete, while the other eastbound runs are used less than 4 minutes to complete. An increased samples size or on another day would be desirable to provide more information on the traffic conditions of Argyle Street, particularly around the school peak.	Minor
3	**Origin Destination Survey** Section 6.1 of Chelsea Garden BMDR documents that the OD survey is used in the demand assumption.	• After discussion with Cardno it is apparent that the OD survey is incomplete and was not used in the process of demand development with models wholly dependent on TRACKS prior matrices. Base Model Development Report (BMDR) could be modified to reflect this.	Minor
4	**SCATS Data (SCATS History file)** The SCATS data for the intersection of Argyle Street / Kirkham Street was collected on 30th and 31st of August 2018.	• This matches the date the traffic survey was conducted. However, the SCATS data of the mid-block crossing near Illawara Hwy / Waite Street has not been collected.	Minor
5	**Survey Data used and its application.**	• The traffic survey data indicates that the Friday traffic volumes are around 15% higher than the Thursday used in the model assessments. • The traffic survey data indicates that the 2018 data has lower volumes than the traffic data collected in 2011. • This indicates that there could be seasonality impacts or traffic movements could be suppressed by the constrained capacity of Argyle Street. • Some peak spreading is evident, particularly in the Argyle Street, southbound ATC data indicating a protracted period of congestion over several hours. • As traffic surveys only capture those vehicles that were able to pass through an intersection during the peak period, they do not potentially capture the actual demand which be higher than the traffic volumes surveyed (particularly on approaches exhibiting substantial queuing).	Medium
6	**Demand Development Process**	• Demand matrices are developed based on the 2018 traffic survey with 2016 TRACKS model providing the	Medium

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Audit Item #	Audit Item Name	TMA Comment	Severity
		prior matrix for demand adjustment process. • The Heavy (HV) matrix from the TRACKS model is neglected, with heavy vehicles assumed to be a simple 5% of the total traffic matrix pattern. As the HV matrix is typically expected to be aligned with the land-use and generally different to the car traffic pattern, this is not considered appropriate. • The iterative demand adjustment process documented is not evident in the Aimsun model provided.	
7	Trip Length Distribution and Adjustment	• The adjusted and profiled traffic demands in the Aimsun models results in a substantially increased proportion of short by 15% over the original TRACKS demand model. • The modelling consultant has made changes to the trip distribution particularly between traffic loading from internal zones and external zones, however the need for this process to be undertaken has not been justified or at least documented.	Minor
8	Model Setup	• Demand matrices are developed based on the 2018 traffic survey with 2016 TRACKS model prior matrix. • The HV matrix from the TRACKS model is neglected and the assumption that the HV matrix is simply 5% of total traffic matrix pattern is in error as the. HV matrix is expected to be aligned with the land-use and would generally be different to the general traffic pattern. • The iterative demand adjustment process documented is not evident in the Aimsun model.	Medium
9	Traffic Demand Build-up 6 traffic demands have been prepared (3 demands per peak period) with these mostly matching the demand development process described in Section 3.3 of the BMDR.	• the demand development process on Meso SRC (Step F of Figure 5) has no evidence of implementation in the models with no iterative assignments and demand adjustment provided on how they arrived at until GEH/ Travel time criteria has been met. (as described in the BMDR)	Medium
10	Path Assignment The path assignment is built on Micro SRC in accordance with the traffic demand scenario described in Section 5.3.1	• The Microsimulation seed runs (Micro SRC) but is using path assignment files from the static assignment instead of assignment file developed in Micro DUE (Refer to Figure 15)	Major
11	Road / Lane / Section Type Four Road Types have been included in the model: applied on railway track)	• BMDR should document each of the individual road types and the reasoning on how these road types have been defined because each of them has different parameters such as capacity, lane change/ turn parameters, give way model and volume delay functions.	Medium
12	Vehicle Type 3 vehicle classes are defined in the model. • Car • Truck • Bus The default values from Aimsun for vehicle type parameters including vehicle dimensions, reaction times and driving behaviour were used in the model.	• From the available ATC count, the vehicle length on Light vehicle is compared against typical suburban arterial Road. It is found that Moss Vale has a higher number of Class 2 vehicles (Ute), so vehicle length should be adjusted to fit the actual observation in Moss Vale instead of using standard value. • All vehicles types apply with mean speed acceptance ≥1, this means Car in the network is travelling in average 10% faster than the posted speed limit. • Reaction time in the regional NSW township is expected to have a slower reaction time instead of applying a default reaction time. • The reaction time on heavy vehicle is 0.8 seconds in general instead of 1.2 seconds as documented in the BMDR.	Medium
13	Signal Plan One hour signal plan is applied in the 2 hours model for both AM and PM peak model, including warm-up	• Cycle time matches to the SCATS history file collected. However, Phase C (Kirkham Street approach) is coded to allow pedestrians in every cycle, which effectively prolonged Phase C from 20 seconds on average to 34 seconds. This artificially builds up the delay on Argyle	Major

Audit Item #	Audit Item Name	TMA Comment	Severity
	periods.	Street and traffic queueing instead of the models effectively reflecting the traffic behaviour on site. • This discrepancy is also contrary to the RMS modelling guidelines as the signal timing applied exceeds 10% of the average phase time on all phases within an hour. • Mid-block pedestrian crossing is missing in this model, consequently the platooning effects on Argyle Street during peak hour, in particular PM peak are not evident in the model. SCATS data should be provided to support the documentation stating that the pedestrian crossing is infrequently utilised during modelling periods.	
14	**Public Transport Line** The PT line has included both local and regional bus services, including NSW TrainLink. (Approximately 20 different routes are included)	• All buses are coded with zero dwell time (therefore no friction is included between the bus and general traffic at the bus stops) • No local school bus service is included. • There is no Public Transport Plan setup in Aimsun. Therefore, no PT service is included in any scenario.	Major
15	**Modelled Road Network** Posted speed limits appear to be matching to the real condition.	• On-street parking on Argyle Street is removed, which effectively remove the friction on Argyle Street	Medium
16	**Model Calibration** GEH statistical network wide calibration Local driver behaviour Signal timings	• The town centre section of Argyle Street should be calibrated with Core-Area calibration criteria. • No U turn calibration on all roundabouts including Argyle St / Illawarra Highway (some 50 slow moving vehicles not calibrated in the current PM peak calibration). • No site visit has been undertaken (or evidence of site visit provided) to observe the actual on-road driving behaviour for local driver behaviour calibration. • Signal timing applied in models do not calibrate to SCATS history data.	Major
17	**Model Validation** Travel time validates under the RMS modelling guidelines.	• Travel time is generally low across all directions in both peak periods indicating that model is likely to be overestimating available network capacity.	Medium
18	**Visual Inspection**	• A visual inspection of the model shows network coding appears to be appropriate. However, a minor coding issue observed at the Argyle Street / Illawarra Hwy roundabout results in vehicles on the left turning lane does not conflict with vehicles in the roundabout, which overestimates the capacity of the roundabout.	Minor
19	**Results Reporting**	• No intersection Level of Service (LOS) is included in any Aimsun modelling assessment. It is difficult to quantify the intersection delay and impact as the result of the pre-Chelsea Development and post Chelsea Development.	Major
20	**Traffic Generation** Traffic Generation rate of 0.84 trips/ dwelling is adopted.	• The traffic generation is considered to be on the lower side.	Noted
21	**Future committed infrastructure assumptions** Section 3.2 of Chelsea Gardens Traffic Study, Future Modelling report documents a few of the proposed intersection upgrades and Stage 1 Moss Vale Bypass have been assumed in the some of the future scenarios.	• This committed infrastructure is proposed but might not necessary be fully developed. This infrastructure is proposed to support the development of the Moss Vale Enterprise Corridor.	Noted
22	**Spring Street** The assumption of the Spring Street Railway underpass.	• There is no modelled capacity constraint at Spring Street Railway underpass in various model scenarios. • The current traffic volumes (200 veh/h) is expected to be close to its capacity.	Major
23	**Chelsea Gardens Development trip assignment**	• The traffic assignment from Chelsea Gardens Development has been assessed and appears to be	Noted

Audit Item #	Audit Item Name	TMA Comment	Severity
	Path Assignment File: 2036 DUE - without Bypass has been reviewed.	appropriate. • 70 - 80% of the traffic is routed on the main street (Argyle Street) while the remaining 20 - 30% is rat running on Kirkham Street and Elizabeth Street.	
24	**"2036 without Bypass" Scenario** *(2016 + Chelsea Gardens_Arthur St signals.ang 2036 without bypass)*	• Based on the traffic demand and results, this appears to be the 2018 Base + Full Chelsea Gardens Development. • No Public Transport Plan is setup • The filing structure should be revised so this will be not misunderstood.	Major
25	**"2016+CG underpass" Scenario** *(2016 + Chelsea Gardens_Arthur St signals.ang 2016 + CG Underpass)*	• 2016+CG analysis is not clear on how it has developed. Aimsun demand is appears to sliced into a sub-area matrices with a 12 x 12 matrix, surrounds Spring Street underpass. • All SIDRA (both isolated and network) models in the traffic study are not calibrated so the results might not be representative and realistic. For example, Lackey Street is only 40 metres west of Arthur Street, however, the northbound queue at the Arthur Street approach is always greater than 40 metres. Therefore, it is expected that Leckie Street traffic would be greatly impacted by the arrangement, but this is not showed in the SIDRA analysis. If comparing the result from the Aimsun model runs, the Aimsun model suggests the delay and traffic queuing is greater on Lackey Road.	Major
26	**Modelling presentation** *(8201822101_Chelsea Gardens Moss Vale Traffic Study_rev1.pdf)* All model results were graphically presented as speed plots, density plots and volumes plots.	• All plots are graphically presented, however, there is no quantitative measurable unit, such as intersection delays, travel time. VHT which is numerically comparable in between different scenario. For example, the future modelling mentioned that the 2036 Base scenario, Argyle Street is saturated without Chelsea Gardens Development. However, it is undetermined that the actual travel time is increased from 2018 to 2036 base scenario and 2036 with Chelsea Gardens.	Minor

6.2 RECOMMENDATIONS

To further enhance modelling assessment outcomes, the following recommendations can be made (in order of importance):

1. The BMDR should address how demands have been developed in a capacity constrained network that currently exhibits congestion on key routes across peak periods.
2. The dynamic user equilibrium (DUE) assignment should be applied to the Base models to ensure that there is appropriate traffic routeing across the network.
3. Bus coding needs to be reviewed to ensure they are included in model operation along with school bus services and realistic dwell times.
4. Delays to traffic due to pedestrians at signalised facilities should be understood and reflected in the models.
5. Aimsun microsimulation models should be used to obtain intersection performance (rather than uncalibrated SIDRA models) and these results should be quantified and tabulated for comparison across scenarios.
6. The BMDR should include an explanation and comparison of U-turning volumes on the surveyed roundabouts between observed and modelled.
7. Sensitivity test or adoption of longer vehicles in light vehicle category with larger stationary spacing between all vehicles should be implemented.
8. Discussion of a significant number of light vehicle trips have been added to the AM and PM peak matrices should be included in the BMDR.
9. A comparison of HV turning movement counts from the field and models should be undertaken to ascertain how well they fit. If this indicates substantial differences at critical

locations, then it is recommended that the HV matrices are re-estimated, starting from the TRACKS HV sub-area matrices.

10. More limited heavy vehicle kinematics are required to be implemented to better represent Moss Vale truck fleet.
11. Some effort should be made to verify that commissioned OD surveys were of no value or if something can be salvaged from them as this would support the demand development process as well as providing key travel times on the network.
12. BMDR should provide some information on the road types selected and their influence on assignment within the study area