Project:	**Highways England Spatial Planning Arrangement**	Job No:	**60572359 DM014.003/004**
Subject:	**South Caldecotte VISSIM Audit**		
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Executive Summary

This technical note consists of a modelling audit of the A5/A4146 Kelly's Kitchen Roundabout VISSIM models, provided by BWB to support the proposed South Caldecotte development south of Milton Keynes. The audit includes a review of demand development, base model calibration/validation and forecast model audit. The audit was carried out based on WebTAG guidance and best practices based on the VISSIM Model Audit Process (VMAP) from Transport for London.

The note draws attention to the elements coded and the vehicle data used in the model. Elements that have been audited are:

- Vehicle Inputs and routes;
- Turning Count data and Journey times;
- Signal Operation;
- Priority Rules & Conflict areas;
- Reduced Speed Areas & Speed Distributions;
- Network Operation & Routing;
- Driving Behaviour; and
- Calibration Results.

Issues/Errors that were found in the model have been classified into three levels:

- **MINOR –** The issues found are likely to produce minimum changes in the results.
- **MEDIUM –** The issues found could have a medium impact on the results.
- **SIGNIFICANT –** The issues are considered as an error and are likely to have a large/ significant impact on the results.

*The modelling issues that are considered to be **SIGNIFICANT** are listed below*

- The audit reveals that the validation criteria used in the model have been misinterpreted from WebTAG. Based on the WebTAG recommendations listed below, the journey time routes should be redefined to create longer routes; if shorter routes are used it is recommended that modelled journey times are within 15% of observed journey times, since the 1 minute threshold is only applicable to routes of 3 km or more.
  - WebTAG unit M3.1, table 3 Journey Time Validation and Acceptability Guideline states that "Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%) for 85% of the routes";

- However, WebTAG Unit M3.1 section 4.4 Journey Times for Calibration and Validation states the route definition recommendation, "The validation routes should be neither excessively long (greater than 15 km) nor excessively short (less than 3 km)."

- There are no changes in the speeds coded on the roundabout - this is considered a significant error in the network coding, as even if there are no speed limit changes, the vehicles approaching and within the roundabout will travel at reduced speeds;

- The definition of desired speed distributions is considered unrealistic, in general all the desired speeds are too fast and will not represent reality;

- AECOM considers that there is a need to provide further details regarding the location of survey data used for the calibration and validation of the base model;

- Some signal heads are associated to different signal controllers in AM and PM modelled periods; and

- Inconsistency checks between the AM and PM peak models show that different types of reduced speed areas and desired speed decisions were used. The road layout is the same in both peak hours so there is no reason for these differences.

*The following lists modelling issues that are considered to be **MEDIUM** are listed below*

- The analysis of the link and connector structure highlighted some overlapping connectors to define routing and lane changes. This approach is acceptable in static models but additional measures should be put in place to avoid overestimating the capacity, mainly in congested / queueing areas such as roundabouts, where blocking back may not be realistically represented;

- Different detectors have been used in AM and PM signal controllers which may cause different operation in some cases. The detector position is a physical network characteristic and should be exactly the same in all the models; and

- The AM and PM peak models are not coded consistently.

In addition to the SIGNIFICANT and MEDIUM issues highlighted above, there are a number of MINOR issues raised which are highlighted in green throughout this technical note, which are expected to have a minimal impact on the operation of the models. However, it is recommended that these are considered further by the modellers and addressed where necessary – as the cumulative impact may be more significant.

Based on the overall findings from the model audit, it is concluded that the Base Year models provided do not accurately replicate the baseline network operation and therefore are unlikely to provide the basis for accurate forecast year modelling results. The impact of the proposed development on the A5/A4146 Roundabout cannot therefore be estimated robustly. It is recommended that the concerns raised within this technical note are addressed (alongside any relevant concerns raised within the review of the associated Transport Assessment) and that revised base and forecast models are presented for review to support the planning application going forward.

1 Introduction

1.1.1 This Technical Note (TN03) provides a summary of the auditing work conducted for VISSIM models developed for the A5/A4146 Kelly's Kitchen Roundabout by BWB. The VISSIM models have been provided to support a proposed employment development site at South Caldecotte, to the south of Milton Keynes. This Technical Note should be read alongside Technical Note 01 (TN01), which documents the review of the Transport Assessment (TA) associated with the proposed development, which the VISSIM model has been used to inform. At this stage AECOM are unaware of a planning application having been submitted.

1.1.2 The VISSIM models received by AECOM include:

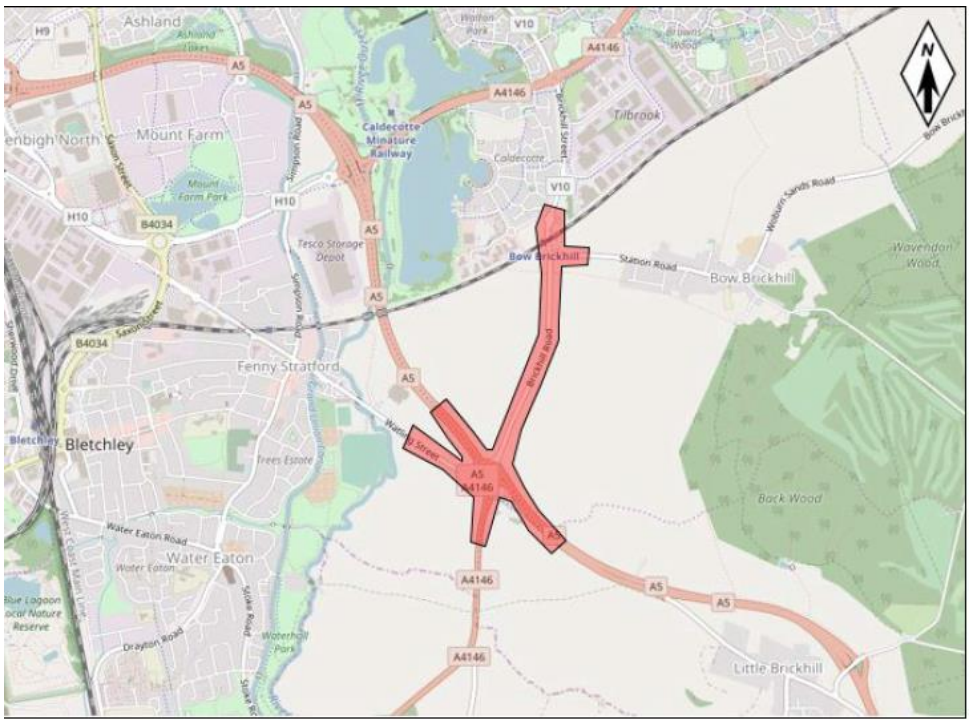
- The Base year 2017 AM/PM peak models;
- 2018 Future Base (Reference Case) year AM/PM peak models;
- 2023 Future Base (Reference Case) year AM/PM peak models;
- Future year 2023 and 2031 AM/PM peak models without and with development, without 'mitigation'; and
- Future year 2023 and 2031 AM/PM peak models without and with development, with 'mitigation'

1.1.3 It should be noted that the 'mitigation' scheme is the scheme that is committed as part of the Eaton Leys planning permission. It is not a mitigation scheme proposed to mitigate this South Caldecotte development. Whilst the Eaton Leys development has planning permission, it has not yet been built out and the mitigation scheme has not been implemented. Therefore, the TA is proposing to assess the operation of the existing layout and the layout if the proposed mitigation scheme is implemented. Once the operation of these two layouts following the South Caldecotte development is understood, further discussion will take place on the way forward.

2 2017 Base Model Review

2.1.1 The 2017 base model is assumed to be the calibrated / validated model - the 2018 and 2023 'Future Base' models are assumed to be 'Do Minimum' or 'Future Base' scenarios with no changes in the network and only general growth applied to the demand. The review of these models has been included in the forecasting section.

Figure 1. Model scope.



2.2 Traffic Data

2.2.1 All models that were audited are set up to km/h instead of mph in terms of vehicle speed. Therefore, in this report km/h is used in relation to model issues.

2.3 Traffic Composition

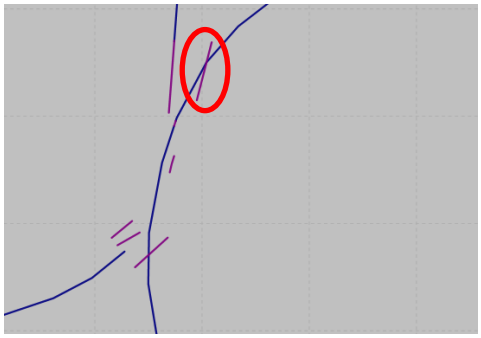
2.3.1 Different inputs have been coded for different "Lights" and "Heavies". HGV includes MGV (58%) and HGV (42%) which is in line with the DfT split, while Lights composition only include cars. LGVs are not included in the model and these could have been defined in the traffic composition.

2.3.2 The likely impact would be **MINOR**.

2.4 Network Coding

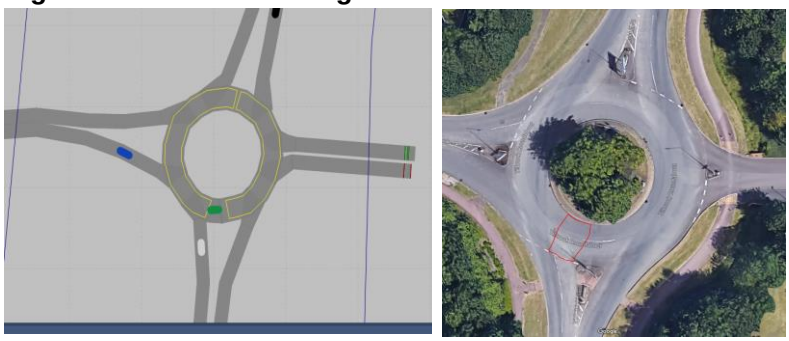
2.4.1 The use of overlapping connectors to manage static routes is considered acceptable, but the length and location of these "routing connectors" should be chosen to minimize any possible overestimation of the capacity. As shown in Figure 2 below, the "routing connectors" used in the base model are too long and too close to a signal head, where the queue will extend back and cause capacity overestimation due to vehicles queueing on top of each other.

Figure 2. Network coding error.



2.4.2 Figure 3 shows another network coding issue found in Tilbrook Roundabout, where 2 lane approaches and 2 lane roundabout should have been coded.

Figure 3. Network coding error.



2.4.3 The impact of correcting these issues is likely to be **MINOR** and are unlikely to impact notably on the operation of the strategic road network.

2.5 Vehicle Inputs

2.5.1 Survey data collected for the model has not been provided for the audit, so peak hour and flow calculation cannot be included in this review.

2.5.2 In any case, vehicles inputs have been reviewed, and there are some concerns about vehicle input 1A in the PM peak, where the flows from 8:30 to 9:00 are 50% higher than the rest of the modelled time for that same input. This pattern has not been observed anywhere else.

2.5.3 The likely impact of addressing this issue is likely to be **MINOR.**

2.6 Signal Coding

2.6.1 There are inconsistencies between the detectors coded in AM and PM models (see Figure 4). Detectors are considered a network element which represent physical loops in the road and should be exactly the same in both models. The presence of these detectors is likely to affect the signal operation and green time distribution at the roundabout. The signal synchronization could be improved based on site observations of survey video footage – for example, there is underutilized green time on the A4146 approach.

2.6.2 Additional errors have been identified in the 2017 Base model's signal controllers associated with signal heads (see Table 1). Moreover missing signal heads have also been identified in the 2023 Future Base PM model.

2.6.3 The impact of this issue is likely to be **SIGNIFICANT.**

Figure 4. Inconsistent detector definition.

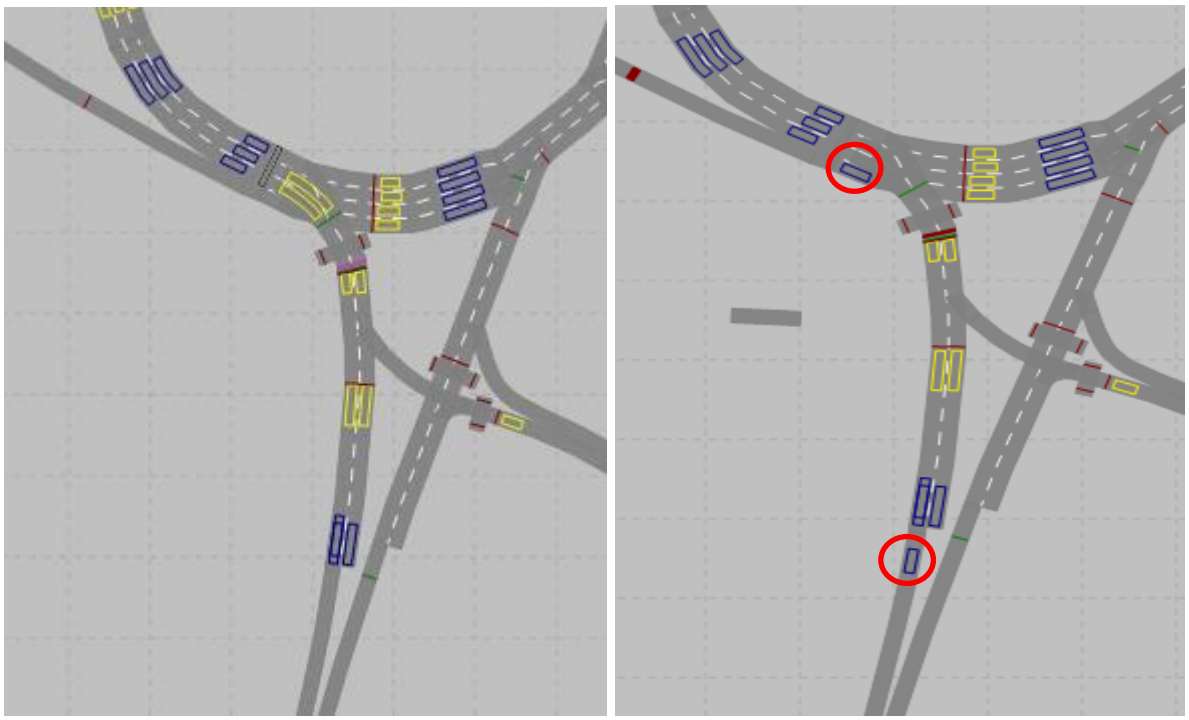
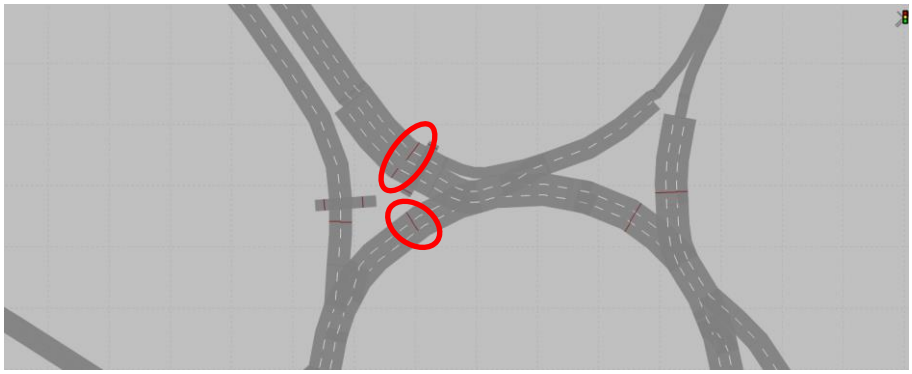


Table 1. Signal controllers comparison.

2017 Base

Signal head location (Link – Lane)	Signal Group AM (Controller – Phase)	Signal Group PM (Controller – Phase)
28 - 2	6 - 2	6 - 2
28 - 1	8 - 1	8 - 1
25 - 1	2 - 1	2 - 1
43 - 3	3 - 1	2 - 2
43 - 2	3 - 1	2 - 2
43 - 1	3 - 1	2 - 2
25 - 2	3 - 2	2 - 1
25 - 3	3 - 2	2 - 1

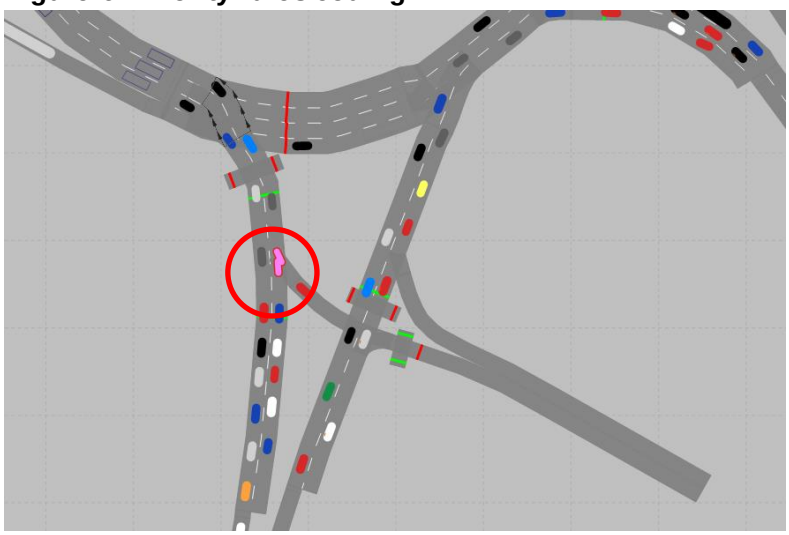
Figure 5. Missing Signal heads



2.7 Priority Rules and Conflicting Areas

2.7.1 The priority rules coded in the model are not calibrated, producing unrealistic behaviour and overestimating the capacity. Due to the proximity of the signal head the likely impact on this model would be **MINOR.** However, if the congestion and traffic through the junction increases or the capacity of the approach increases it may cause additional delay. See Figure 6 for an example of incorrectly coded priority rules.

Figure 6. Priority rules coding.



2.7.2 Conflict areas 16 and 24 have been coded with a different safety distance factor in the AM and PM peak models (Figure 7**Figure**). All the differences between AM and PM models should be justified in the LMVR and evidence should be provided to support the changes.

Figure 7. Conflict Areas.

Conflict Areas

Select layout... <Single List>

Coun	Link1	VisibLink1	Link2	VisibLink2	Status	FrontGapDef	RearGapDef	SafDistFactDef	AddStopDist	ObsAdjLns	AnticipRout	AvoidBlockMi
4	8	100.0	16	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
5	22	100.0	10002	100.0	2 waits for 1	0.2	0.2	0.5	0.0		0.0 %	100.0 %
6	22	100.0	10003	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
7	22	100.0	10004	100.0	2 waits for 1	0.5	0.5	1.5	0.0		0.0 %	100.0 %
8	22	100.0	10005	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
9	22	100.0	10006	100.0	2 waits for 1	0.2	0.2	0.5	0.0		0.0 %	100.0 %
10	22	100.0	10007	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
11	16	100.0	10012	100.0	1 waits for 2	0.2	0.2	0.5	0.0		0.0 %	100.0 %
12	10012	100.0	10015	100.0	2 waits for 1	0.5	0.5	0.5	0.0		0.0 %	100.0 %
13	10013	100.0	10015	100.0	1 waits for 2	0.2	0.2	1.0	0.0		0.0 %	100.0 %
14	10010	100.0	10015	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %

Conflict Areas

Select layout... <Single List>

Count: 79	Link1	VisibLink1	Link2	VisibLink2	Status	FrontGapDef	RearGapDef	MinGapBlockDef	SafDistFactDef	AddStopDist	ObsAdjLns	AnticipRout	AvoidBlockMinor
1	7	100.0	15	100.0	Passive	0.5	0.5	0.5	1.5	0.0		0.0 %	100.0 %
2	8	100.0	15	100.0	Passive	0.5	0.5	0.5	1.5	0.0		0.0 %	100.0 %
3	7	100.0	16	100.0	Passive	0.5	0.5	0.5	1.5	0.0		0.0 %	100.0 %
4	8	100.0	16	100.0	Passive	0.5	0.5	0.5	1.5	0.0		0.0 %	100.0 %
5	22	100.0	10002	100.0	2 waits for 1	0.2	0.2	0.2	0.5	0.0		0.0 %	100.0 %
6	22	100.0	10003	100.0	Passive	0.5	0.5	0.5	1.5	0.0		0.0 %	100.0 %
7	22	100.0	10004	100.0	2 waits for 1	0.5	0.5	0.5	1.5	0.0		0.0 %	100.0 %
8	22	100.0	10005	100.0	Passive	0.5	0.5	0.5	1.5	0.0		0.0 %	100.0 %
9	22	100.0	10006	100.0	2 waits for 1	0.2	0.2	0.2	0.5	0.0		0.0 %	100.0 %
10	22	100.0	10007	100.0	Passive	0.5	0.5	0.5	1.5	0.0		0.0 %	100.0 %
11	16	100.0	10012	100.0	1 waits for 2	0.2	0.2	0.2	1.0	0.0		0.0 %	100.0 %
12	10012	100.0	10015	100.0	2 waits for 1	0.5	0.5	0.5	1.5	0.0		0.0 %	100.0 %
13	10013	100.0	10015	100.0	1 waits for 2	0.2	0.2	0.2	1.0	0.0		0.0 %	100.0 %

2.8 Reduced Speed Areas

2.8.1 The speed distribution used in reduced speed areas 5, 6, 7, 30, 31, and 32 are different between the AM and PM peaks, which will impact the saturation flow in the signal heads 9, 8, 7 and 1, 2, 3 respectively. Reduced speed areas and saturation flows reflect the physical characteristic of the road network and should be identical in all the models. Figure 8 gives an example of this error.

2.8.2 Reduced speed areas 46 to 49 in AM peak model are not coded in PM peak model.

Figure 8. Reduced speed areas.

Reduced Speed Areas / Speed Elements By Vehicle Class

Select layout... Speed reductions

Cou	No	Name	Lane	Pos	Length	TimeFrom	TimeTo	DesSpeedDistr(10)	
1	1		33 - 4	21.172	5.000	0	99999	25: 25 km/h	2
2	2		33 - 3	21.173	5.000	0	99999	25: 25 km/h	2
3	3		33 - 2	20.685	5.000	0	99999	25: 25 km/h	2
4	4		33 - 1	20.634	5.000	0	99999	25: 25 km/h	2
5	5		42 - 3	32.238	5.000	0	99999	30: 30 km/h	3
6	6		42 - 2	32.565	5.000	0	99999	30: 30 km/h	3
7	7		42 - 1	32.574	5.000	0	99999	30: 30 km/h	3
8	8		4 - 1	9.249	5.000	0	99999	25: 25 km/h	2

AM

Reduced Speed Areas / Speed Elements By Vehicle Class

Select layout... Speed reductions

Cou	No	Name	Lane	Pos	Length	TimeFrom	TimeTo	DesSpeedDistr(10)	DesSpeedDi
4	4		33 - 1	20.634	5.000	0	99999	25: 25 km/h	25: 25 km/h
5	5		42 - 3	32.238	5.000	0	99999	20: 20 km/h	20: 20 km/h
6	6		42 - 2	32.565	5.000	0	99999	20: 20 km/h	20: 20 km/h
7	7		42 - 1	32.574	5.000	0	99999	20: 20 km/h	20: 20 km/h
8	8		4 - 1	9.249	5.000	0	99999	25: 25 km/h	25: 25 km/h
9	9		4 - 2	9.002	5.000	0	99999	25: 25 km/h	25: 25 km/h
1	10		43 - 1	15.895	5.000	0	99999	25: 25 km/h	25: 25 km/h

PM

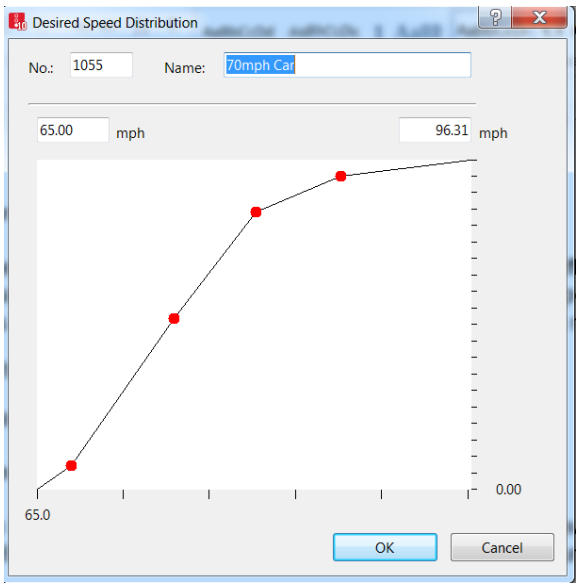
2.8.3 The likely impact of this issue is **MEDIUM.**

2.9 Speed Distribution

2.9.1 Several speed distributions have been set up in the models, but only 3 distributions have been used in desired speed decisions (40mph, 60mph and 70mph). The lower and upper limits in all these distributions are considered unrealistic unless additional proof is provided.

2.9.2 As shown in Figure 9, the 70mph speed distribution will set up a minimum speed of 65 mph with 93% of the vehicles with a speed higher than 67.5 mph. This distribution will result in 48% of the vehicles above the speed limit. Similar issues have been observed on 60mph speed distribution (81% of vehicles above the speed limit) and 40mph which has no distribution at all.

Figure 9. 70 mph speed distribution.



Count: 6	X	FX
1	65.00	0.00
2	67.51	0.07
3	74.89	0.52
4	80.85	0.84
5	86.97	0.95
6	96.31	1.00

2.9.3 The impact of the way speed distribution has been applied on the accuracy of results is estimated to be SIGNIFICANT.

2.10 Driving Behaviours

2.10.1 Default VISSIM driving behaviour has been modified to reduce the lateral stand distance from 1 to 0.2, the impact of this change will only affect stopped vehicles and it is considered to be **MINOR.**

3 Calibration and Validation Results

3.1.1 No issues have been found when replicating calibration results for the AM or PM peak. No issues have been found with turning count calibration, although the results are likely to change if all the issues identified above are resolved.

3.2 Turning Count Calibration

3.2.1 The survey data used in the model has not been provided so no review of the comparison has been undertaken.

3.2.2 Turning count calibration results on the report show close correlation between modelled outputs and surveyed data, however, the results are likely to change if all the issues identified in this report are resolved. The main concern is the latent demand on vehicle input 5 and 13, on the A4146 which reaches a maximum of 250 vehicles in the AM peak and 180 vehicles in the PM peak. This latent demand and the longer than observed journey times in that section are probably caused by a lack of capacity in the model on the A4146 approach to the roundabout, which causes longer than observed queues and latent demand.

3.2.3 The impact of the latent demand could be considered as **SIGNIFICANT** due to the unknown location of the flow surveys. It is assumed the flows were collected on each arm of the roundabout near the junction.

3.3 Journey Time Validation

3.3.1 The audit reveals that the validation criteria used in the model have been misinterpreted from WebTAG. Based on the WebTAG recommendations listed below the journey time routes should be redefined to create longer routes. If shorter routes are used it is recommended to use 15% difference as validation criteria, not 1 minute – which is only appropriate for routes over 3 km.

- WebTAG unit M3.1, table 3 Journey Time Validation and Acceptability Guideline states that "Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%) for 85% of the routes".
- WebTAG Unit M3.1 section 4.4 Journey Times for Calibration and Validation states the route definition recommendation, "The validation routes should be neither excessively long (greater than 15 km) nor excessively short (less than 3 km)."

3.3.2 This criteria misinterpretation produces the acceptance of routes like D-GW in the PM peak, where the difference of 47 seconds represents more than 50% of the observed journey time (90 seconds) or A'GW-B in AM where the 17 seconds difference represents more than 80% of the observed journey time (21 seconds). These are just 2 examples, where the validation criteria is not acceptable.

3.3.3 The 60 seconds difference used as validation criteria represents 24% to 261% of the observed data depending on the route. It is clear that applying this criteria is not suitable and a 15% difference should be used.

3.3.4 Additional checks have been undertaken to evaluate the model journey time validation following WebTAG criteria (modelled journey times should be within 15% of observed journey times). This comparison showed that only 48% of the routes in the AM and PM peak would have been validated, see Table 2 compared with the 100% validation included in the LMVR.

Table 2. Journey Time Validation Checks

AM

Route	Observed	Distance (m)	Model	Difference	Percentage
A-GW	135	1326.9	129	-6	-4%
A-B	21	826.9	38	17	81%
A-C	115	946.8	80	-35	-30%
A-D	110	995.5	109	-1	-1%
B-GW	144	740.5	162	18	13%
B-A	217	1628.8	191	-26	-12%
B-C	66	850.7	50	-16	-24%
B-D	59	821.0	60	1	2%
B-E	73	1363.9	99	26	36%
C-GW	133	777.7	187	54	41%
C-A	172	1553.2	157	-15	-9%
C-B	99	1067.9	91	-8	-8%
C-D	50	824.1	34	-16	-32%
C-E	73	1287.5	70	-3	-4%
D-GW	55	731.4	62	7	13%
D-A	115	1454.4	142	27	23%
D-B	47	969.7	72	25	53%
D-C	96	1090.0	115	19	20%
D-E	53	1189.7	51	-2	-4%
E-GW	63	1115.9	71	8	13%
E-B	33	903.8	48	15	45%
E-C	70	1024.4	92	22	31%
E-D	105	1073.9	118	13	12%
				Validated	48%

PM

Route	Observed	Distance (m)	Model	Difference	Percentage
A-GW	201	1326.9	187	-14	-7%
A-B	23	826.9	36	13	57%
A-C	82	946.8	77	-5	-6%
A-D	122	995.5	84	-38	-31%
B-GW	43	740.5	41	-2	-5%
B-A	147	1628.8	163	16	11%
B-C	67	850.7	50	-17	-25%
B-D	92	821.0	50	-42	-46%
B-E	63	1363.9	88	25	40%
C-GW	254	777.7	204	-50	-20%
C-A	150	1553.2	141	-9	-6%
C-B	117	1067.9	101	-16	-14%
C-D	52	824.1	34	-18	-35%
C-E	74	1287.5	70	-4	-5%
D-GW	90	731.4	43	-47	-52%
D-A	154	1454.4	119	-35	-23%
D-B	60	969.7	85	25	42%
D-C	117	1090.0	118	1	1%
D-E	40	1189.7	50	10	25%
E-GW	153	1115.9	168	15	10%
E-B	46	903.8	50	4	9%
E-C	88	1024.4	88	0	0%
E-D	105	1073.9	92	-13	-12%
				Validated	48%

3.3.5 The poor validation of the base model means that it does not reflect observed delay and capacity – it does not provide an accurate basis for the forecasting models or to evaluate the impact of the proposed developments. The impact of this issue is considered to be **SIGNIFICANT.**

3.4 Saturation Flow

3.4.1 No data was provided on saturation flow calibration at the signalised stoplines. It is recommended that this information is provided to provide reassurance that the model is representative of the observed saturation flow values – otherwise, the capacity of modelled stop-lines may not be accurately represented.

3.4.2 The impact of these issues is likely to be **MEDIUM.**

3.5 Signal Control

3.5.1 MOVA has been replicated with VisVAP coding and PC MOVA software has not been used. Although it is generally known that PC MOVA can replicate MOVA controllers in the closest way, VisVAP coding can also give a reasonable representation of the signal operation. However, the modelled average stage length should be compared to MOVA logs to prove that the MOVA controller is closely represented. In this case, where the MOVA logs were not available for the day of the surveys, the modelled stage length could be compared against green times estimated from the video footage and included in the LMVR.

3.5.2 Although no evidence has been provided to show that the calibration of MOVA is correct compared to on site operation, the signals have been coded as demand dependent to replicate MOVA operation dynamically and the model operation is considered correct compared with the MOVA setting files provided.

3.5.3 AECOM consider that there is a need to provide further details regarding the calibration and validation of the base signal operation.

3.5.4 The likely impact of this is cannot be estimated with the information provided.

3.6 Summary

3.6.1 The audit of the base year model shows that there are fundamental coding and consistency errors and the model has not been sufficiently calibrated, since modelled journey times do not match observed journey times. It is, therefore, advised to get these issues addressed before taking the model forward for modelling the impact of proposed developements and assessing future year models. The base model is not considered to be suitable for carrying out the future year modelling work due to the issues highlighted in earlier sections of this Technical Note.

4 Future Year Model

4.1 Background

4.1.1 Two versions of the future year models (for 2023 and 2031) have been produced, for the existing junction layout and for a proposed hamburger layout, which is a condition associated with planning permission granted for a residential development at Eaton Leys. The hamburger scheme has not yet been implemented. The two scenarios have been modelled to determine the impact of the proposed development in both scenarios.

4.2 Future Year Demand

4.2.1 The traffic growth has been calculated applying TEMPRO growth factors to 2017 observed flows.

4.2.2 Vehicle inputs from 2017 base, 2018 and 2023 future base models have been compared to review the background growth applied to the model. The comparison highlighted a 20% flow decrease from 2017 to 2018 in input 5 (A4146) in the PM peak. A 3% decrease is also observed in the same location for the AM peak. The flows in the models are not consistent with the Flow Diagrams presented in the TA, so this is likely to be an error.

4.2.3 The likely impact of these differences would be **SIGNIFICANT.**

4.2.4 The rest of the forecast year demand is in line with the flow diagrams included in the TA.

4.3 Network Operation

4.3.1 Due to the significant issues found during the base year review, it is considered that the network operation for the forecasting models has to be reviewed and re-optimized once the base model is corrected and has achieved a satisfactory calibration level.

4.3.2 Differences in the signal controllers have been observed in all the models. The south approach (A4146) has been coded with one (signal controller 6 in the models) or two signal controllers (signal controllers 6 and 8 in the models), depending on the year and the peak modelled. This inconsistency it is not a reflection of actual scheme changes (it is also present in 2018 and 2023 Future Base models) and will cause significant differences in the model operation making any comparison between models unreliable.

4.3.3 The likely impact of these differences would be **SIGNIFICANT.**

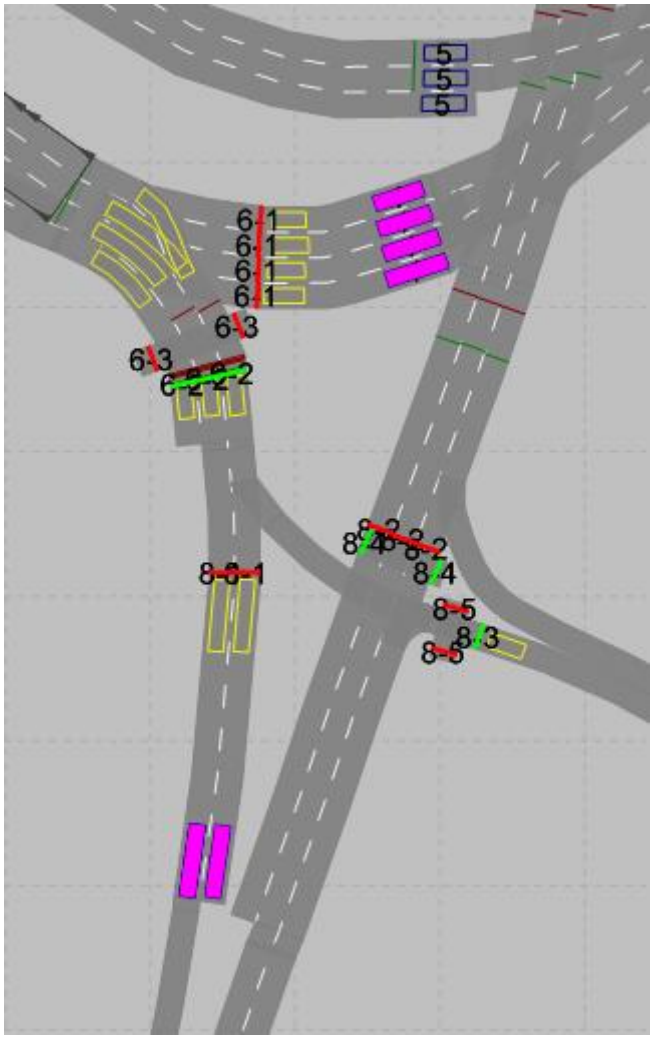
4.4 Signal Optimization

4.4.1 Due to the significant issues found during the base year review, it is considered that the signal optimization would be affected by the changes applied to the base models. However, some checks of the basic signal operation have been undertaken, and different detector configurations between the years have been highlighted. Additional errors with the signal controllers associated with each signal head have been detected in 2023 Base + Dev models.

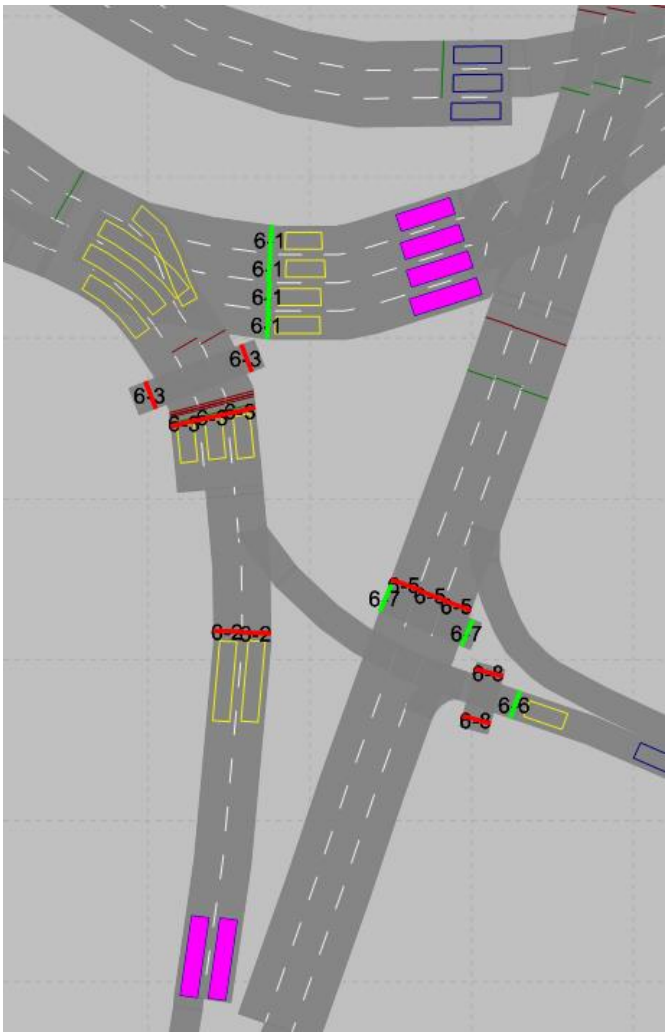
4.4.2 The signal controllers associated with signal heads in links No. 5, 15, 16, 28, 37, 40 and 41 are different in the AM and PM peak models. This is consistent in all the forecast models and layouts. This is due to the use of different signal controllers between the AM and PM peak, which will affect the synchronization and general operation of the model. Signal operation (e.g. maximums) could change between the AM and PM peak, but the signal logic (controller) should be the same for both peaks. The use of different controllers causes situations as shown in Figure 10, which produces underutilised green time with an unrealistic behaviour.

Figure 10. Unrealistic signal operation differences between AM and PM.

AM



PM



4.4.3 The use of controllers 6 and 8 has been observed in all the AM forecast models, while the PM uses the combined controller 6 for both junctions. This is also an inconsistency between base and forecast models, where AM and PM base models include controllers 6 and 8 in all the scenarios. The use of the same controller for both junctions will not represent the signal operation on site. Based on the signal information provided, the junction from the petrol station is controlled by a different stream and it is not linked to the signals on the A4146 approach.

4.4.4 The likely impact of these differences would be **SIGNIFICANT**.

4.4.5 The errors with signal heads in links No. 43 and 25 that were found in the Base models have been corrected in the forecast models. The likely impact would be **SIGNIFICANT.**

5 Consistency checks - Model coding differences between AM and PM networks

5.1.1 Almost all the AM peak model networks are consistent throughout the years (Base years 2017, 2018, 2023 and future years 2023 and 2031), the exception being forecast model 2023 Base + Dev with some inconsistencies in reduced speed areas and detectors. The same is true for the PM peak model networks.

5.1.2 However, several differences exist between the AM and PM peak networks, showing inconsistent coding of signal heads, conflict areas and priority rules. These inconsistencies have been found across all the modelled scenarios and forecasted years, excluding the aforementioned forecast model 2023 Base + Dev. The main inconsistencies and the models where they have been found have been summarised in detail in Appendix A.

5.1.3 The parameters such as priority rules, conflict areas, reduced speed areas, signal heads and signal controllers are defined by the network characteristics and should be consistent across the different models unless there is a justified reason or layout change which produces some differences.

5.1.4 The likely impact of these differences would be **SIGNIFICANT.**

6 Conclusions

6.1.1 AECOM has undertaken an audit of the A5/A4146 Kelly's Kitchen Roundabout VISSIM base and forecast models, as part of a wider review of the potential impact of the proposed South Caldecotte development on the strategic road network. A number of concerns have been raised regarding the base and forecast models throughout the note regarding the build and consistency of the models. It is recommended that these are addressed to more accurately represent the existing network operation and understand the future operation of the junction following the construction of the proposed development.

6.1.2 These concerns have been split into three categories, **SIGNIFICANT**, **MEDIUM** and **MINOR**, which provide an indication as to how notable the concerns are, however it is recommended that all of the concerns are addressed by the modellers and these categories are only indicative.

6.1.3 Based on the overall findings from the model audit, it is concluded that the base year models provided do not accurately replicate the existing network operation and therefore are unlikely to provide the basis for accurate forecast year models. In addition, there are many inconsistencies between the modelled years and peak hours modelled, so the impact of the proposed development could not be isolated from impacts caused by these inconsistencies.

6.1.4 Based on the audit findings summarised within this note it is not recommended to use the modelling results provided to assess the impact of the proposed development on A5/A4146 roundabout operation. It is recommended that the concerns raised within this technical note are addressed (alongside any relevant concerns raised within TN01 – the review of the associated Transport Assessment) and that revised base and forecast models are presented for review to support the development going forward.

Appendix A

Several inconsistencies were found between the AM and PM peak model networks in most of the forecast models, regarding signal heads, conflict areas and priority rules. Some other errors were also found in specific models. All of these inconsistencies are summarised below, providing examples and indicating in which models they appeared. The general inconsistencies that were found in most forecast models are provided first, whereas the model-specific errors are summarised in Section A.4.

A.1 Conflict Areas

Several inconsistencies regarding conflict areas were found between the AM and PM peak network models. The likely impact of these would be **SIGNIFICANT**.

The status of the conflict area on link1="5", link2="39" has been coded inconsistently between AM and PM (see Figure 11). This error is true for forecast models 2023 Base + Com, 2023 Base + Com + Dev, 2031 Base + Com and 2031 Base + Com + Dev.

Figure 11

Conflict Areas

Select layout... <Single List>

Cou	Link1	VisibLink1	Link2	VisibLink2	Status	FrontGapD	RearGapD	SafDistFact	AddStopD	ObsAdjLr	AnticipRo	AvoidBlocl
2	10014	100.0	10019	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
2	33	100.0	34	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
2	4	100.0	35	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
2	5	100.0	39	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
2	5	100.0	10038	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %

AM

Conflict Areas

Select layout... <Single List>

Cou	Link1	VisibLink1	Link2	VisibLink2	Status	FrontGapD	RearGapD	SafDistFact	AddStopD	ObsAdjLr	AnticipRo	AvoidBlocl
2	10012	100.0	10019	100.0	1 waits fo	0.2	0.2	1.0	0.0		0.0 %	100.0 %
2	10014	100.0	10019	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
2	33	100.0	34	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
2	4	100.0	35	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
2	5	100.0	39	100.0	1 waits fo	0.5	0.5	1.5	0.0		0.0 %	100.0 %
2	5	100.0	10038	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %

PM

AvoidBlock has also been coded differently in AM and PM for two conflict areas. This refers to conflict areas on link1="42", link2="10053" (see Figure 12). This error is true for forecast models 2023 Base + Com, 2023 Base + Com + Dev, 2031 Base + Com and 2031 Base + Com + Dev.

Figure 12

Conflict Areas

Select layout... <Single List>

Cou	Link1	VisibLink1	Link2	VisibLink2	Status	FrontGapD	RearGapD	SafDistFact	AddStopD	ObsAdjLr	AnticipRo	AvoidBlocl
8	36	100.0	50	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
8	59	100.0	10069	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
8	54	100.0	59	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
8	42	100.0	10053	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
8	10008	100.0	10018	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %

AM

Conflict Areas

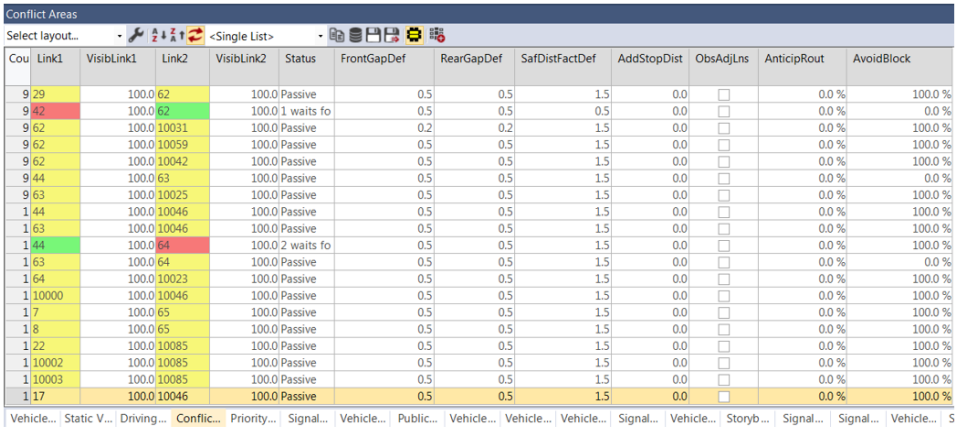
Select layout... <Single List>

Cou	Link1	VisibLink1	Link2	VisibLink2	Status	FrontGapDef	RearGapDef	SafDistFactDef	AddStopDist	ObsAdjLns	AnticipRout	AvoidBlock
8	36	100.0	50	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
8	59	100.0	10069	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
8	54	100.0	59	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
8	42	100.0	10053	100.0	Undeter	0.5	0.5	1.5	0.0		0.0 %	0.0 %
8	10008	100.0	10018	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %

PM

Finally, the AM peak model network does not have a conflict area on link1="17", link2="10046", whereas the PM peak model network does (see Figure 13). This difference also highlights a different link and connector structure between the models, as conflict areas are automatically generated by VISSIM when there is overlapping between links or connectors. This error is true for forecast models 2023 Base + Com, 2023 Base + Com + Dev, 2031 Base + Com and 2031 Base + Com + Dev.

Figure 13


Conflict Areas

Select layout... <Single List>

Cou	Link1	VisibLink1	Link2	VisibLink2	Status	FrontGapDef	RearGapDef	SafDistFactDef	AddStopDist	ObsAdjLns	AnticipRout	AvoidBlock
9	29	100.0	62	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
9	42	100.0	62	100.0	1 waits fo	0.5	0.5	0.5	0.0		0.0 %	0.0 %
9	62	100.0	10031	100.0	Passive	0.2	0.2	1.5	0.0		0.0 %	100.0 %
9	62	100.0	10059	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
9	62	100.0	10042	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
9	44	100.0	63	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	0.0 %
9	63	100.0	10025	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	44	100.0	10046	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	63	100.0	10046	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	44	100.0	64	100.0	2 waits fo	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	63	100.0	64	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	0.0 %
1	64	100.0	10023	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	10000	100.0	10046	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	7	100.0	65	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	8	100.0	65	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	22	100.0	10085	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	10002	100.0	10085	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	10003	100.0	10085	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	17	100.0	10046	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %

Vehicle... Static V... Driving... Conflic... Priority... Signal... Vehicle... Public... Vehicle... Vehicle... Vehicle... Signal... Vehicle... Storyb... Signal... Signal... Vehicle...

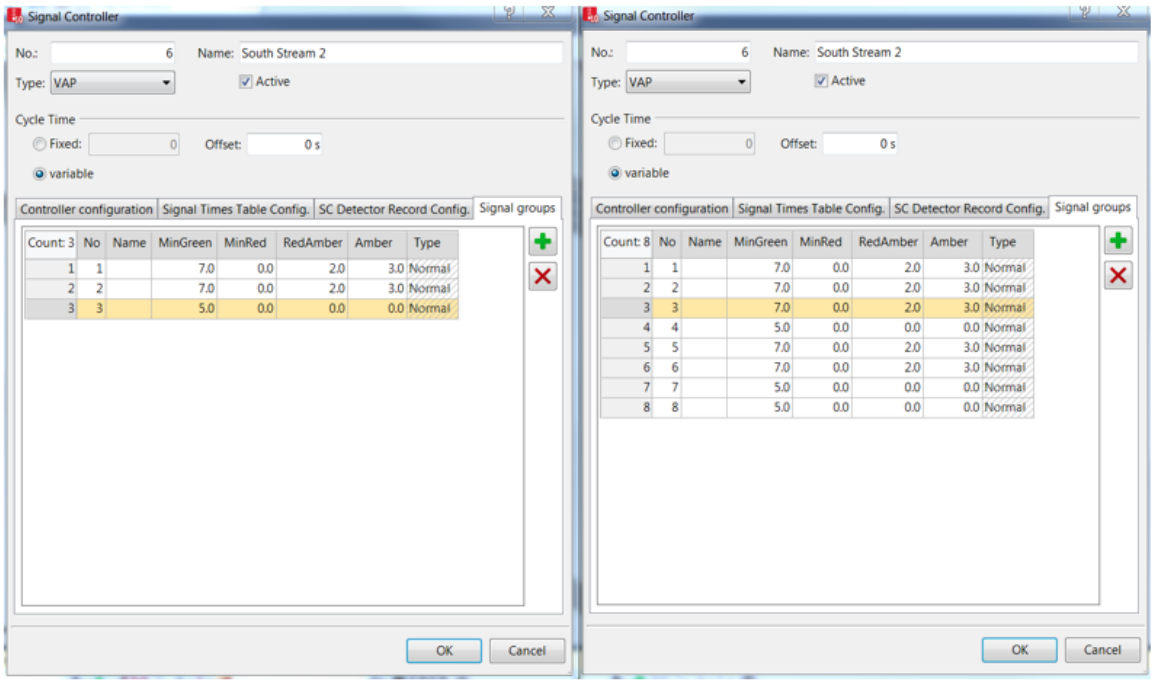
PM

A.2 Signal Heads

As mentioned in Section 4.4, there are consistent errors between the AM and PM regarding signal controllers associated with signal heads in links No. 5, 15, 16, 28, 37, 40 and 41. These errors are true for forecast models 2023 Base + Com, 2023 Base + Com + Dev, 2031 Base + Com and 2031 Base + Com + Dev. See Figure 8 for an example of the error. The likely impact would be **SIGNIFICANT**.

The previous error associated with signal controller 6 can be also seen in Figure 14. This error is true for forecast models 2023 Base + Com, 2023 Base + Com + Dev, 2031 Base + Com and 2031 Base + Com + Dev.

Figure 14



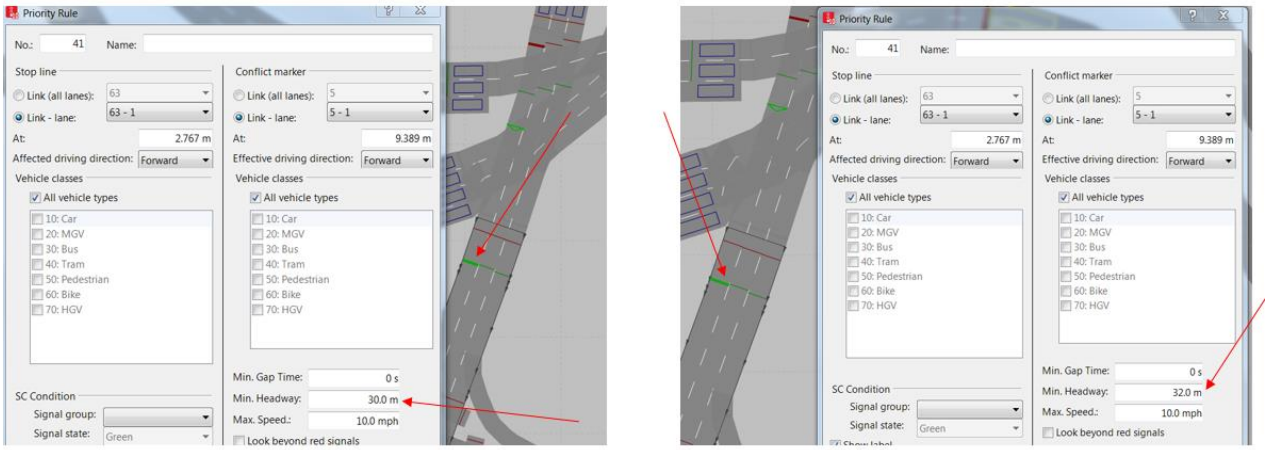
AM PM

A.3 Priority Rules

Several inconsistencies were found relating to priority rules. The likely impact of these would be **SIGNIFICANT**.

Min. Headway has been coded differently between the AM and PM in priority rules No. 39-41. Figure 15 below gives an example of one of these errors. This error is true for forecast models 2023 Base + Com, 2023 Base + Com + Dev, 2031 Base + Com and 2031 Base + Com + Dev.

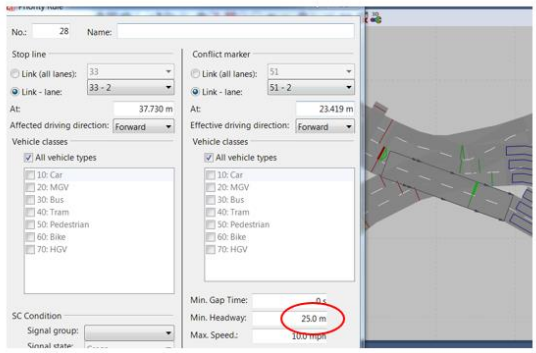
Figure 15



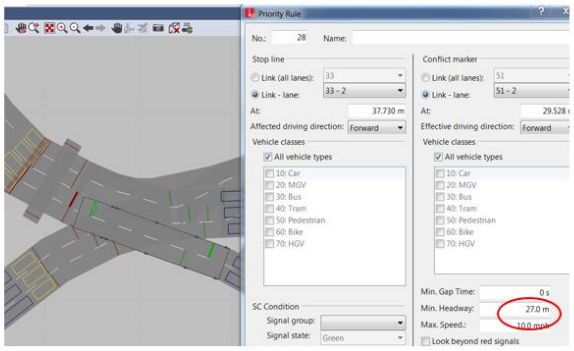
AM PM

Min. Headway has been coded inconsistently for priority rules No. 28, 32 and 44 (see Figures 16, 17 and 18). This error is true for forecast models 2023 Base + Com, 2031 Base + Com and 2031 Base + Com + Dev.

Figure 16

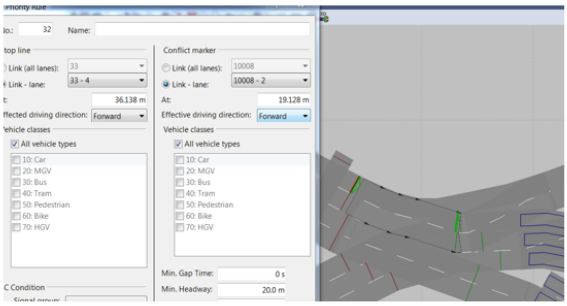


AM

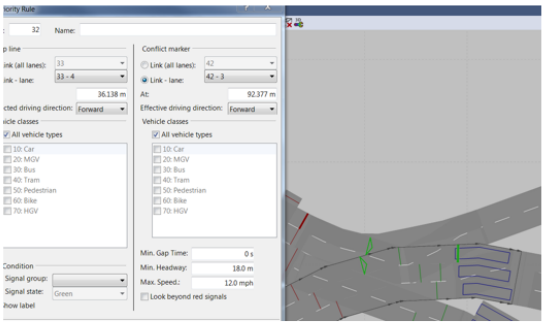


PM

Figure 17

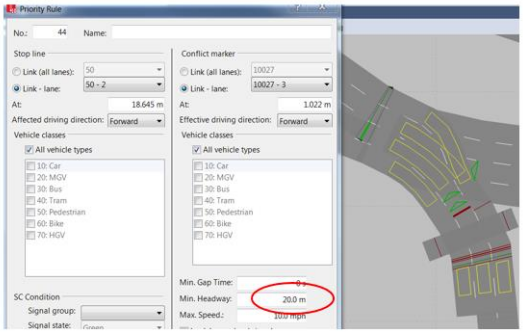


AM

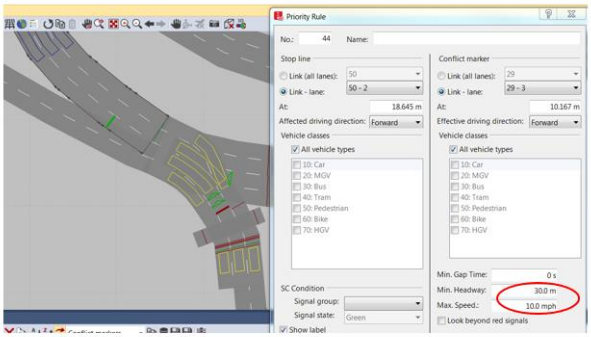


PM

Figure 18



AM



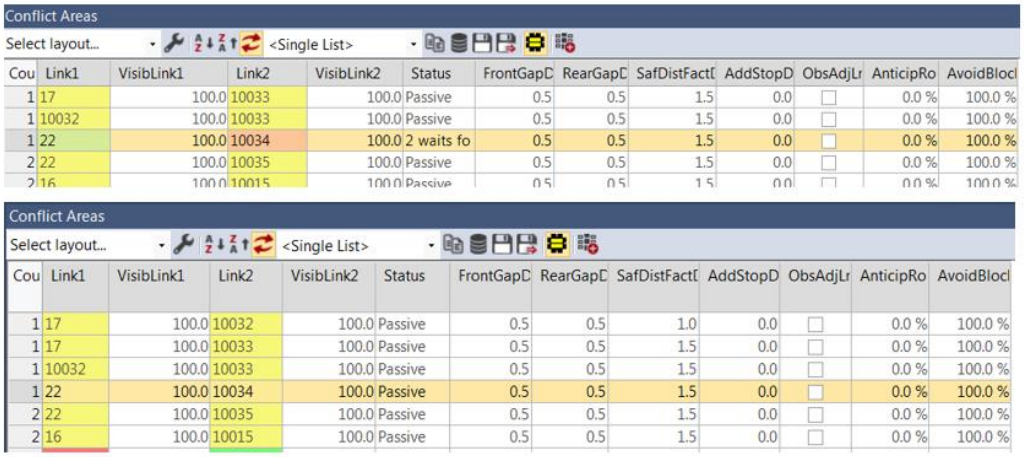
PM

A.4 Model-Specific Errors

Some inconsistencies were found relating to specific models, particularly in terms of the coding of priority rules and conflict areas. However, forecast model 2023 Base + Dev also contains inconsistencies regarding reduced speed areas and detectors, which appear between the AM and PM network models but also within the peaks when comparing the model to other forecast models. All of these inconsistencies are summarised below. The likely impact would be **MEDIUM**.

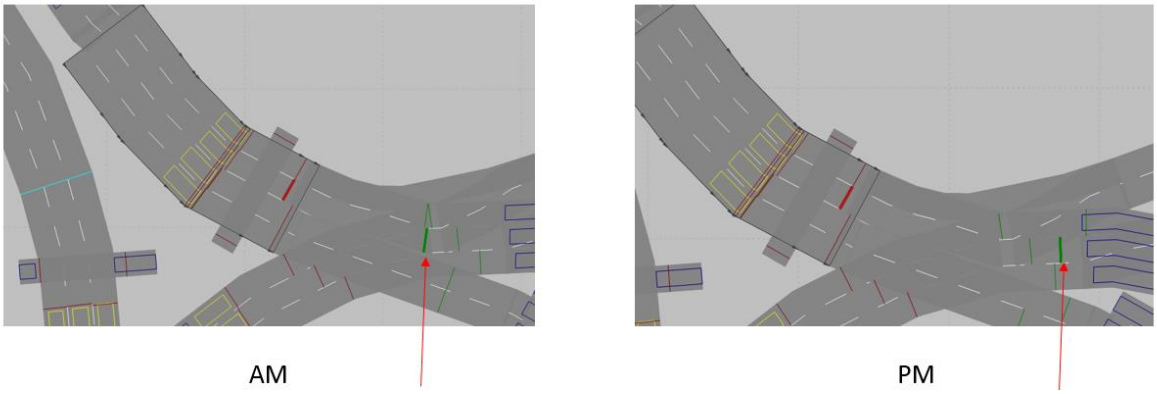
The status for the conflict area on link1="22", link2="10034" is coded differently between AM and PM in forecast model 2023 Base + Com (see Figure 19**Error! Reference source not found.**).

Figure 19



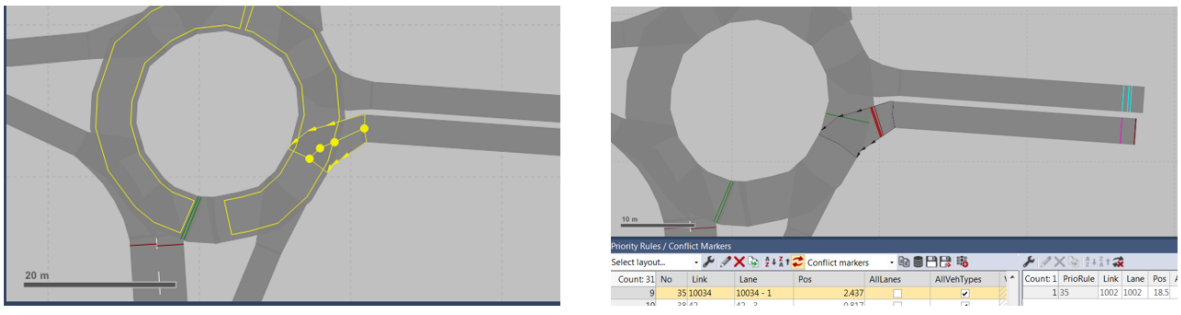
There is a discrepancy in the coding of conflict markers for priority rule No. 31 (see Figure 20). This is true for forecast models 2023 Base + Com and 2031 Base + Com.

Figure 20



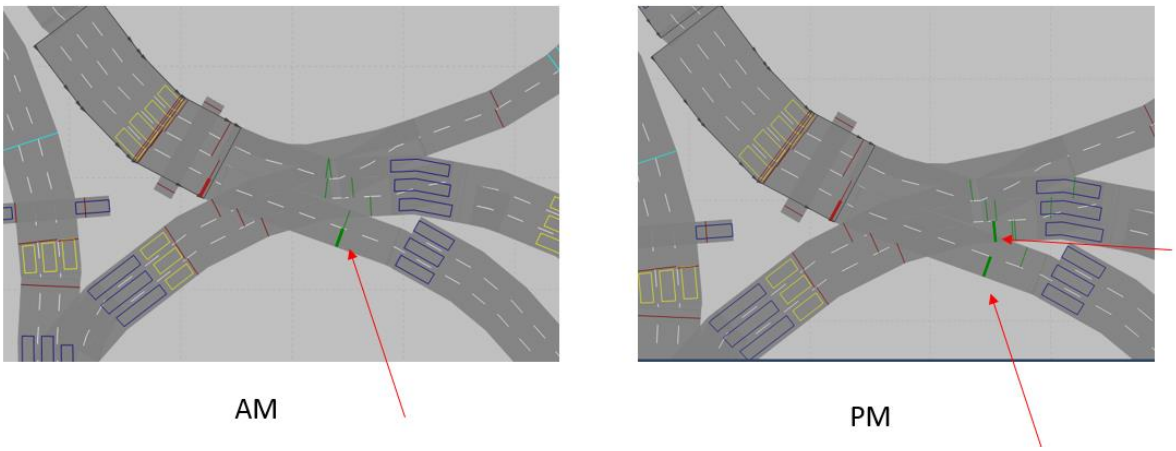
The AM peak network model does not have a priority rule equivalent to No. 35 in the PM peak network model. This is true for forecast model 2023 Base + Com (see Figure 21).

Figure 21



There is a discrepancy in the number of conflict markers assigned to priority rule No. 27 in the forecast model 2031 Base + Com (see Figure 22).

Figure 22



The status for the conflict areas on link1=”17”, link2=”10032”, link1=”17”, link2=”10040” is coded differently between AM and PM in forecast model 2023 Base + Dev (see Figures 23 and 24).

Figure 23

Conflict Areas

Select layout... <Single List>

Cou	Link1	VisibLink	Link2	VisibLink	Status	FrontGapD	RearGapD	SafDistFactD	AddStopD	ObsAdjLn	AnticipRo	AvoidBlocl
1	29	100.0	30	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	29	100.0	10030	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	17	100.0	10032	100.0	Passive	0.5	0.5	1.0	0.0		0.0 %	100.0 %
1	17	100.0	28	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %

AM

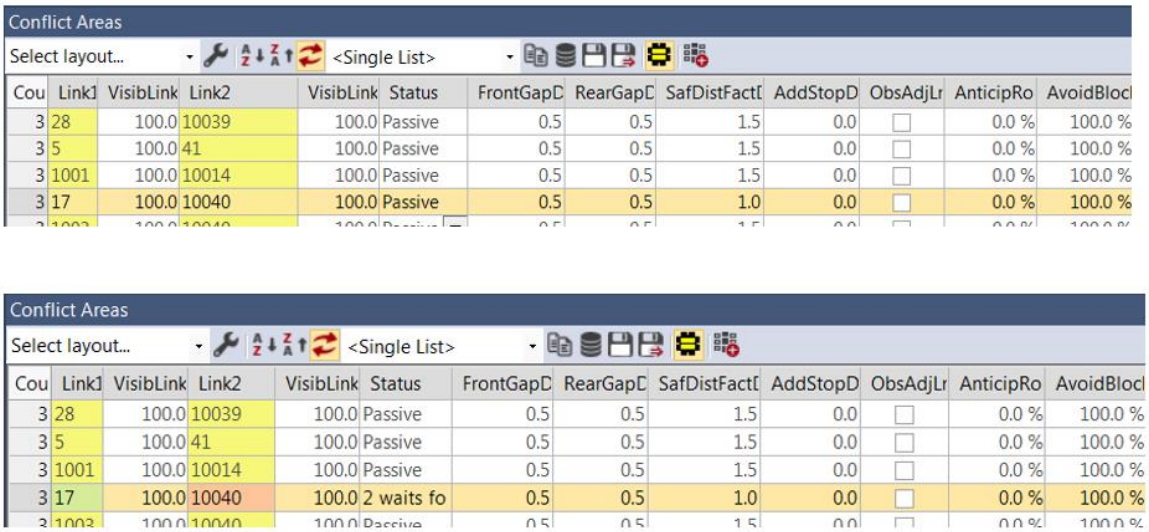
Conflict Areas

Select layout... <Single List>

Cou	Link1	VisibLink	Link2	VisibLink	Status	FrontGapD	RearGapD	SafDistFactD	AddStopD	ObsAdjLn	AnticipRo	AvoidBlocl
1	29	100.0	30	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	29	100.0	10030	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %
1	17	100.0	10032	100.0	2 waits fo	0.5	0.5	1.0	0.0		0.0 %	100.0 %
1	17	100.0	28	100.0	Passive	0.5	0.5	1.5	0.0		0.0 %	100.0 %

PM

Figure 24

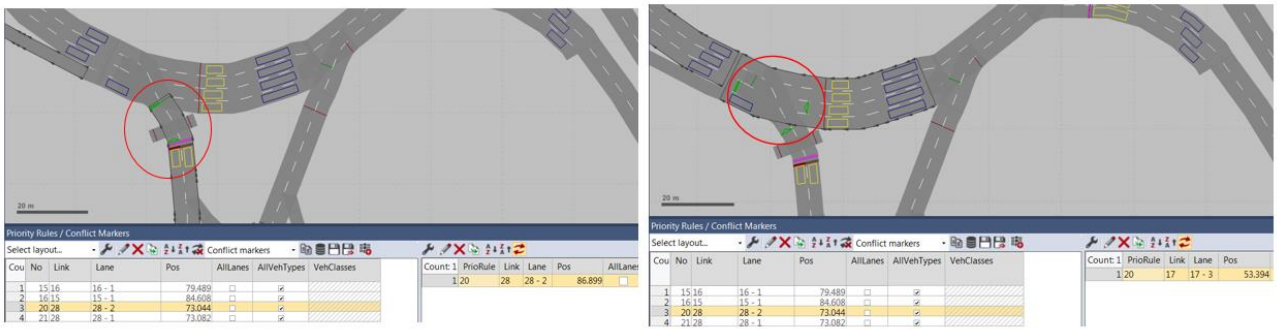


AM

PM

There is a discrepancy in the coding of Min. Headway and the placement of conflict markers for priority rules No. 20-21 (see Figure 25). This error is only true for forecast model 2023 Base + Dev.

Figure 25

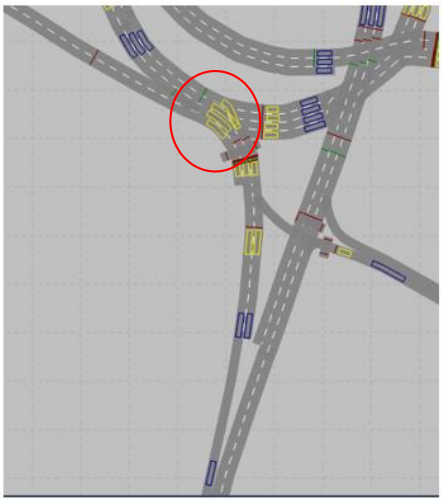


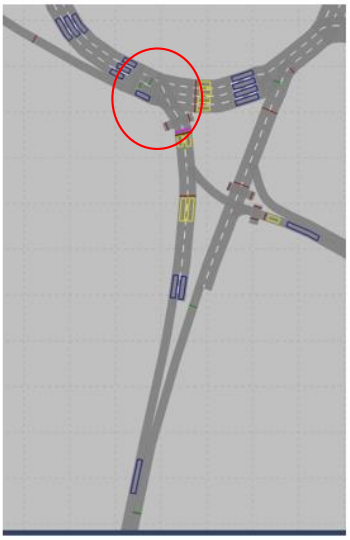
AM PM

An error with the coding of reduced speed areas and detectors was found in the forecast model 2023 Base + Dev (see Figure 26). The same error was found in all base models, but have been corrected in all forecast models except the 2023 Base + Dev. This error is present both within and between the peak network models for forecast model 2023 Base + Dev.

Figure 26

2023 BaseDev Com PM





2023 BaseDev PM