Reading Transport Model

Highway Model Forecast Report

On behalf of **Reading Borough Council**

Reading Borough Council
Working better with you

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1 Introduction

1.1 Background

1.1.1 Peter Brett Associates LLP (PBA) was commissioned by Reading Borough Council (RBC) to update the Reading Transport Model (RTM). This report summarises the methodology which has been adopted in order to build the future year SATURN models of Reading. The purpose of this model is to assist in assessing the relative effects of different transport schemes to alleviate transport issues in and around Reading.

1.1.2 The aim of the project is to develop a traffic model with a base year of 2015 and future years of 2021 and 2031 that will be used to test the relative effects of transport infrastructure schemes and development proposals within the Reading area. The immediate need for the RTM is to support a local growth fund bid to the Thames Valley Berkshire Local Enterprise Partnership (TVB LEP) for the East Reading Mass Rapid Transit Scheme.

1.2 Model Area

1.2.1 The area covered by the model is shown in Figure 1-1. The model includes the whole of the Reading urban area, therefore covering areas within Wokingham Borough Council and West Berkshire Council areas.

1.2.2 The RTM is a highway network model being developed using the established SATURN software. The model will consist of an AM peak hour model (08:00 to 09:00), an average Inter Peak (IP) hour model (10:00 to 16:00) and a PM peak hour model (17:00 to 18:00). The model consists of five user classes: car commute, car employer business, car other, Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV).

1.2.3 The base year model devlopment, calibration and validation is report in '*29781-5506 Reading Transport Model – LMVR'*, PBA, October 2016.

Figure 1-1: Reading Transport Model – Study Area

1.3 Future Model Applications

1.3.1 When considering the use of the RTM for future work, the following should be considered:

a. Although it is desirable for the models reflect the day to day variations, in practice models are tools with limited ability to capture all the intricate sensitivities inherent in a network like Reading's. The model represents average weekday conditions, and therefore it is not possible to replicate the day to day variability and sensitivities accurately. The model has been created to consider the availability of route choices even though it may not be possible to match in every case, actual flows and journey times for specific competing routes. The model has therefore been validated to replicate directional cordon and screen line flows as priority over individual link flows, for example. The stability of the model is demonstrated through achieving acceptable convergence criteria, which therefore confirms its robustness.

b. In considering the compliance of the RTM with WebTAG validation criteria and guidelines, it is important to understand the purpose for which the model is required. Guidance notes on validation acceptability are provided in TAG Unit M3.1. As stated in the guidance, this does not guarantee that a model is 'fit for purpose' and likewise a failure to meet the specified validation standards, does not mean that a model is not 'fit for purpose'. A model that meets the specified validation standards may not be fit for the particular purposes and conversely, a model that fails to meet to some degree the validation standards maybe useable for certain applications. On this basis, the validation of the RTM prioritises areas of the network at which interventions and development are proposed. The use matrix estimation has been minimised to alter the prior matrices in an effort to meet calibration and validation standards. It should be noted that the model has been created to test schemes that are currently known. Consideration as to the suitability of the model to test all future schemes should be taken at that time. The model may need to be updated before testing each scheme and/or development proposal, and should therefore reviewed prior to its use.

1.4 Report Purpose and Structure

1.4.1 This report details the methodology used to create do-minimum (DM) highway forecast models and is split into the following sections:

- Section 2 provides a description of the methods used for forecasting traffic demand and supply for highway modes.
- Section 3 describes the assumptions used for the forecast demand.
- Section 4 provides details of the future year transport supply.
- Detail of the travel conditions predicted by the forecast models is given in section 5.

2 Forecast Methodology

2.1 Overview

2.1.1 Forecast models have been developed for the future years of 2021 and 2031. The forecast methodology has followed guidance contained in the Department for Transport (DfT) WebTAG Unit M4 - Forecasting and Uncertainty. This has necessitated the development of an uncertainty log to inform development and infrastructure that has a reasonable likelihood of being implemented by the modelled forecast years. The uncertainty log was compiled using information on future developments provided by RBC and Wokingham Borough Council. The WebTAG classifications are set out in Table 3-1.

Table 3-1 WebTAG Probability Classification of Future Development Inputs

Probability of the Input	Status	Core Scenario Assumption delays)
Near certain: The outcome will happen or there is a high probability that it will happen	Intent announced by proponent to regulatory agencies. Approved development proposals. Projects under construction	This should form part of the core scenario
More than likely. The outcome is likely to happen, but there is significant uncertainty	Submission of planning or consent application imminent. Development application within consent process.	This could form part of the core scenario [Refer to Section Developing the Core Scenario]
Reasonably foreseeable. The outcome may happen, but there is significant uncertainty	Identified within a development plan. Not directly associated with the transport strategy/scheme, but may occur if the strategy/scheme is implemented. Development conditional upon the transport strategy/scheme proceeding. Or, a committed policy goal subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty.	These should be excluded from the core scenario but may form part of the alternative scenarios
Hypothetical: There is considerable uncertainty whether the outcome will ever happen.	Conjecture based upon currently available information. Discussed on conceptual basis. One of a number of possible inputs in an initial consultation process. Or a policy aspiration	These should be excluded from the core scenario but may form part of the alternative scenarios

2.1.2 Demand data for these forecasts were generated by growthing up trips from the base year. The base year is 2015. This was done by incorporating committed development within the Reading area, and using the forecast increase in trip ends as estimated by the National Trip End Model (NTEM).

2.1.3 In order to add the trips generated by committed development, appropriate trip rates were applied to the development quanta. These rates were derived from existing Transport Assessments (TAs) for the developments where available. When a TA was not available, or the trips rates from a TA of a similar development not applicable, data from TRICS was used to provide the level of trip generation.

2.1.4 The distribution of trips to and from the site has been taken from a zone in the base year model which had similar characteristics in terms of land use and location.

2.1.5 TEMPro software with NTEM database version 7.1 has been used to forecast the growth in trip ends, which is the currently adopted version.

2.1.6 The trip end forecasts were capped to avoid the inclusion of committed development and therefore double counting of growth. The total increase in jobs and households resulting from the committed development was subtracted from the total increases contained in the NTEM database. This was done within TEMPro using the alternative planning assumptions option. The subtraction was applied proportionally across all NTEM zones within Berkshire.

2.1.7 The committed development and TEMPro growth provided reference case forecasts of highway demand, which were subsequently altered as a result of the demand modelling process.

2.1.8 All the committed highway infrastructure projects from 2015 to the forecast years in the Reading area have been added to the validated 2015 modelled highway network, as well as all schemes in the Reading urban area. This also included infrastructure changes in Winnersh and Shinfield. The highway schemes are listed in Section 3.1.

2.1.9 All highway infrastructure coding has been undertaken consistently with the coding of the base year network.

2.2 Forecast Demand Assumptions

2.2.1 Forecast developments that have been included within the DM are detailed within Table 2-2.

Table 2-2: Do-Minimum Forecast Developments

Development	Included in 2021	Included in 2031
Shinfield Residential	Yes	Yes
Shinfield Science Park	Yes	Yes
Greenpark Phases 1 & 2	Yes	Yes
42 Kenavon Drive	Yes	Yes
Station Hill Site		Yes
Former Sorting Office, Caversham Road		Yes
37-42 Market Place	Yes	Yes
60 Queens Road	Yes	Yes
Kings Reach, 38-50 Kings Road	Yes	Yes
Zenith House, 7 Cheapside	Yes	Yes
Gerrard House, 30 Gerrard Street	Yes	Yes
Kings Point, 120 Kings Road	Yes	Yes
St Martin's Precinct, Church Street, Caversham	Yes	Yes
5-9 Berkeley Avenue	Yes	Yes
Dee Park Estate, Spey Road	Yes	Yes
Wells Hall, Upper Redlands Road	Yes	Yes
Hanover House 202, Kings Road	Yes	Yes
University of Reading	Yes	Yes
Kennet Island Phase 3 (excl 3A), Manor Farm Road	Yes	Yes
Pingemead Business Park & Land adj to Longwater Avenue	Yes	Yes
Aldwych House, 2 Blagrave Street	Yes	Yes
Energis House, Forbury Road	Yes	Yes
Former Sorting Office, Caversham Road		Yes
Station Hill Site		Yes
Yell House, Queens Walk	Yes	Yes
Thames Tower, 37-45 Station Road	Yes	Yes
Hodsoll Road	Yes	Yes
Unit 1 Paddock Road Industrial Estate, Paddock Road, Caversham	Yes	Yes
University of Reading, The Chancellers Way & Shinfield Road	Yes	Yes
Ridgeway Primary School, Willow Gardens	Yes	Yes
Dee Park Estate, Spey Road	Yes	Yes
Royal Berkshire Hospital, London Road	Yes	Yes
Royal Berkshire Hospital, London Road	Yes	Yes
252 Kings Road	Yes	Yes
Reading International Business Park, A33 Relief Road		Yes
Plot 3.2 400-450 Longwater Avenue		Yes
Plot 8 600 South Oak Way		Yes

Land North of Island Road	Yes	Yes
Pingemead Business Park & Land adj to Longwater Avenue		Yes
Plot 17 500-600 Longwater Avenue		Yes
Junction of Basingstoke Road and Manor Farm Road	Yes	Yes
Kennet Island Manor Farm Road		Yes
Worton Grange, Imperial Way	Yes	Yes
Worton Drive	Yes	Yes
177 Basingstoke Road	Yes	Yes

2.3 Trip Rates

2.3.1 For developments in Reading Town Centre, it is expected that there will be limited parking, which will effectively reduce the highway trip rates from currently observed levels. Trip rates for these developments were therefore derived from town centre sites within the TRICS These trip rates are shown in Table 2-3.

Table 2-3: Town Centre Development Trip Rates

		AM		IP		PM	
		From	To	From	To	From	To
Employment (Per 100 sq.m)	Cars	0.072	0.648	0.156	0.134	0.638	0.047
	OGVs	0.003	0.003	0.001	0.001	0.000	0.000

2.3.2 For all other developments, highway trip rates were taken from the TRICS database. These are summarised in Table 2-4.

Table 2-4: Non Town Centre Development Trip Rates

		AM		IP		PM	
		From	To	From	To	From	To
Employment (per 100 sq.m)	Cars	0.215	1.296	0.298	0.285	1.168	0.156
	OGVs	0.004	0.006	0.003	0.003	0.002	0.001
Healthcare (per 100 sq.m)	Cars	0.285	0.857	0.504	0.498	0.744	0.331
	OGVs	0.001	0.002	0.003	0.003	0.001	0.001
Housing (per household)	Cars	0.315	0.108	0.125	0.125	0.130	0.259
	OGVs	0.001	0.000	0.001	0.001	0.000	0.000
Retail (per 100 sq. m)	Cars	0.108	0.359	2.807	2.957	2.112	1.313
	OGVs	0.000	0.000	0.005	0.005	0.000	0.000
Hotel (per room)	Cars	0.217	0.128	0.099	0.085	0.090	0.166
	OGVs	0.003	0.003	0.002	0.002	0.001	0.001
School (per employee)	Cars	1.455	2.171	0.348	0.340	0.455	0.333
	OGVs	0.000	0.000	0.003	0.003	0.000	0.000
Warehousing (per 100 sq.m)	Cars	0.020	0.038	0.042	0.037	0.043	0.016
	OGVs	0.008	0.01	0.011	0.014	0.011	0.008

2.3.3 The trip rates above were used to generate the total number of trips into and out of the development, and therefore the modelled zone containing that development.

2.3.4 The generated trips were then divided by journey purpose and vehicle type into Commute, Other, Business, LGV, and HGV trips. In order to reflect the fact that a zone containing mostly residential land uses will have a different set of trip purposes to a zone containing mostly employment land uses, the split was done separately according to the land use type for the development.

2.3.5 The total development trip generation was then combined into a set of matrix trip ends by trip purpose and time period for each land use.

2.3.6 The distribution of trips generated by the development was taken from similarly located model zones in the base year demand. The distribution was considered separately for each trip purpose and land use.

2.3.7 By applying the appropriate trip distribution to the zone containing the development, a set of matrices by trip purpose, land use and time period were generated. These were aggregated by land use type to provide development demand matrices consistent with the model segmentation.

2.3.8 Trip end growth in modelled zones which do not contain any new development in the future has been ascertained from TEMPro, using NTEM v7.1.

2.3.9 A mapping between modelled zones and NTEM zones was established to enable the appropriate growth factor to be used in the model. For a few modelled zones, the zone fell into

more than one NTEM zone, in which case the NTEM zone, into which the largest area of the model zone fell, was used.

2.3.10 The committed employment development details generally are referred to employment in terms of gross floor area, rather than jobs. Employment densities have therefore been used to convert floor area to jobs. These densities are taken from the TRICS sites used to generate trip rates. They have also been sense checked against the 3rd edition (November 2015) of the Home and Communities Agency's 'Employment Densities guide'.

2.3.11 The total increase in households and jobs due to the committed developments is summarised Table 2-5.

Table 2-5: Increase in Households and Jobs by Forecast Year

Year	Increase in Households	Increase in Jobs
2021	2,603	9,051
2031	5,185	14,356

2.3.12 Within TEMPro, alternative planning assumptions were applied to subtract the development jobs and households from the NTEM forecasts. This allows that the total trip end growth to be corrected to be consistent with NTM levels. The development jobs were subtracted pro rata from all NTEM zones in Reading.

2.3.13 The demand matrix trip totals in the base and forecast years for highway trips by user class, is summarised in Table 2-6.

Table 2-6: Base and Forecast Matrix Trips by User Class and Time Period

	AM			IP			PM		
	Base	2021	2031	Base	2021	2031	Base	2021	2031
Commute	35668	39299	41184	7501	7885	8136	25860	28322	29759
Other	18284	19866	21286	26929	29356	31306	34255	36812	39202
Business	4962	5440	5630	3994	4224	4363	5914	6443	6688
LGV	5298	6218	7528	5342	6264	7581	4988	5907	7145
HGV	4611	5018	5548	5563	6049	6688	1868	2057	2280

3 Forecast Supply

3.1 Future Highway Schemes

3.1.1 The future schemes that have been coded into the 2021 and 2031 SATURN networks include the following schemes:

- M4 Junction 10
- Shinfield Bypass and link across M4
- Bath Road junction changes associated with Ikea

3.1.2 The validated 2015 base year network was used as the starting point. Drawings for these schemes were obtained from the relevant planning documents in the case of the Ikea and Shinfield junctions and from Wokingham Borough Council, for junction 10 changes.

4 Traffic Forecast Analysis

4.1 Introduction

4.1.1 This section provides an analysis of the forecast year models to demonstrate that the models are behaving logically and to expectation. The analysis includes a presentation of convergence statistics to show that the models are stable and conform with WebTAG guidance for model convergence. The analysis also presents summary statistics in terms of network performance as measured by parameters such as total network trips assigned, total network journey times and total network kilometres travelled.

4.2 Highway Model Convergence

4.2.1 The highway assignment methodology is based on Wardrop User Equilibrium (UE). The convergence of the 2021 and 2031 models is summarised in Table 4-1 and Table 4-2 respectively. Data is given for the final four assignment/simulation loops for each model in line with WebTAG guidance. The results show that all the models achieve acceptable convergence and in particular all models achieve a gap value of less than 0.1%. A gap of under 1% is regarded as satisfactory and this is more than achieved by all the models. Good model convergence indicates that the models are stable and model results may be considered to be robust.

Table 4-1: 2021 RTM Convergence Statistics

AM				IP				PM			
Iteration	% Gap Delta	% Flow	%Cost Delays	Iteration	% Gap Delta	% Flow	%Cost Delays	Iteration	% Gap Delta	% Flow	% Cost Delay
122	0.023	98.7	98.8	20	0.0035	98.6	99.9	126	0.017	98.6	98.9
123	0.012	99.2	99.1	21	0.0061	98.7	99.7	127	0.017	98.7	98.7
124	0.024	99.1	99.0	22	0.0026	98.6	99.8	128	0.019	98.6	98.7
125	0.021	98.9	99.0	23	0.0064	99.0	99.7	129	0.017	98.6	98.8

Table 4-2: 2031 RTM Convergence Statistics

AM				IP				PM			
Iteration	% Gap Delta	% Flow	%Cost Delays	Iteration	% Gap Delta	% Flow	%Cost Delays	Iteration	% Gap Delta	% Flow	% Cost Delay
147	0.481	91.7	95.9	27	0.0031	99.2	99.7	70	0.015	98.6	99.5
148	0.128	81.2	94.8	28	0.0051	99.3	99.7	71	0.014	99.0	99.6
149	0.205	92.7	96.2	29	0.0033	99.1	99.7	72	0.018	98.5	99.4
150	0.117	89.3	95.9	30	0.0035	99.2	99.8	73	0.010	98.7	99.4

4.2.2 All the models except the 2031 AM have a low % GAP value of less than 0.1%, and a high %Flows and %Delays value which indicates that a satisfactory level of convergence has been achieved within the highway model.

4.2.3 Despite the 2031 AM model not meeting the required criteria, it is considered that the convergence is close to the guidance criteria and therefore adequate for forecasting purposes. This would be reviewed on a case by case basis with use of the model. This is also supported by the network summary statistics, which show that the model is behaving as expected.

4.3 Network Summary Statistics

4.3.1 Network summary statistics have been extracted from the models and these are shown in Tables 4-3. The summary statistics are a measure of network wide performance. It is generally expected that as traffic growth increases in the future, network performance may deteriorate as congestion increases.

Table 4-3: Network Summary Statistics

Year	Scenario	Trips (PCU's/HR)	Total Travel Time (PCU/Hr)	Total Travel Distance (PCU KM/HR)	Average Speed (KMH/HR)	Over Capacity Queues (PCU HRS/HR)
2021	AM	75842	19651	668785	34.0	3602
2031	AM	81180	22797	703910	30.9	5347
2021	IP	53780	9136	448912	49.1	193
2031	IP	58076	9984	484902	48.6	206
2021	PM	79543	23660	669725	28.3	6875
2031	PM	85134	28029	703691	25.1	9808

4.3.2 The model summary statistics indicate that the models are behaving as expected, and that the underlying trends in the summary statistics are logical. Between 2021 and 2031 for each time period, trips on the network increase between 2021 and 2031 due to increased growth or demand. Consequently, network speeds may fall and queues increase. Longer routes may also be used as drivers seek seemingly quicker but longer routes to avoid congested local routes. These trends are largely evident across all three time periods when 2021 statistics are compared to 2031 performance statistics.

4.3.3 There is a noticeable increase in overcapacity queues in the AM peak model between 2021 and 2031. An analysis of the models using SATURN's graphics module P1X, suggests that this is due to a cumulative increase at various locations in the network rather than at a specific location. There are, however, a number of junctions that have been identified in the future networks which consistently have delays greater than 5 minutes. These can be considered as junctions that would warrant further consideration when ascertaining the implications of future intervention schemes. The junctions are identified in Section 4.4.

4.3.4 In all scenarios, speeds in 2031 are lower than those in 2021 for the equivalent time period. This suggests that despite increased vehicle kilometres in 2031 due to both increased demand and re-routeing to longer routes, the use of longer routes is not necessarily adequate to offset falling speeds due to congestion. This suggests that drivers may take longer routes, although there is a limit as to the extent of re-routeing to longer routes.

4.3.5 It is also noted that the PM peak model is the most congested, followed by the AM peak. The IP model is the least congested. All these trends are generally in line with expectation and further give confidence that the forecast models are showing logical trends and are robust.

4.4 Junction Delays

4.4.1 Analysis has been undertaken to identify junctions with excessive delays. Junctions with delays greater than equal to 5 minutes (300 seconds) have been considered to fall into this category. These junctions will require further consideration when ascertaining the implications of any future intervention schemes. The junctions are shown in Table 4-4 for the AM peak, Table 4-5 for the IP and Table 4-6 for the PM peak.

Table 4-4: AM Junctions delays (seconds)

Node Number	Type	Location	2021DMAM	2031DMAM	Diff (seconds)
1055	Signals	Sonning Bridge	757	841	84
1130	Signals	Cemetery Junction	302	401	99
1228	Signals	London Rd / Eldon Rd	339	365	26
1006	Signals	George St / Gosbrook Rd	277	338	61
1118	Priority	Priory Ave / Rectory Rd	1	732	731
1890	Priority	A340	209	350	141
1186	Signals	A327 / Pepper Ln	280	363	83

Table 4-5: IP Junctions delays (seconds)

Node Number	Type	Location	2021DMIP	2031DMIP	Diff (seconds)
1186	Signals	A327 / Pepper Ln	634	606	-28

Table 4-6: PM Junctions delays (seconds)

Node Number	Type	Location	2021DMPM	2031DMPM	Diff (seconds)
1055	Signals	Sonning Bridge	1057	1237	180
1000	Signals	Caversham Bridge	362	466	104
1259	Signals	Cow Lane Bridges	370	463	93
2716	Priority	Approach to Oxford Rd / Chatham St	340	417	77
1243	Priority	Kingsgate St / Kings Rd	403	555	152
1288	Signals	Coley Ave / Berkeley Ave	301	346	45
1361	Signals	Burghfield Rd	449	599	150
2052	Signals	A33 / Basingstoke Rd	314	356	42
1187	Signals	A327 / Elmhurst Rd	382	429	47
1186	Signals	A327 / Pepper Ln	904	986	82
2072	Signals	A327 / Elm Rd	352	452	100
2071	Signals	A327 / Whitley Wood Rd	404	492	88
2714	Signals	Mill Lane	332	427	95
1467	Signals	A329 / Robinhood Ln	308	414	106
1006	Signals	George St / Gosbrook Rd	270	337	67
1130	Signals	Cemetery Junction	292	333	41
1794	Priority	Approach to Coppid Beech Roundabout	214	358	144

4.4.2 These tables again show that the PM model is the most congested with 18 junctions having a delay of greater than 3 minutes in either 2021 or 2031. This compares to only 7 in the AM and 1 in the IP.

4.4.3 The most notable change in the AM is at the junction of Priory Avenue / Rectory Road which is located in Caversham close to the traffic lights on Caversham Bridge. The increase in demand

from the north of Reading wanting to cross the Thames leads to local roads in this area becoming congested.

4.5 Summary

4.5.1 The models have been demonstrated to converge well and achieve WebTAG convergence criteria. Summary statistics have been presented and these are considered to be logical and to meet expectation on the likely future network conditions. A number of junctions with excessive delays have been identified that will require further consideration when ascertaining the implications of future intervention schemes. In conclusion, the forecast models are considered logical and robust to form the basis against which the known future intervention measures can be compared against.