Appendix A Modelling Methodology Notes

Brentwood Local Development Plan

Development Scenario Testing:

Trip Generation and Distribution Method

On behalf of **Brentwood Borough Council**

BRENTWOOD BOROUGH COUNCIL

Project Ref: 28085 | Rev: AA | Date: September 2014

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1 Introduction

1.1 Background

1.1.1 Peter Brett Associates LLP (PBA) was commissioned by Brentwood Borough Council (BBC) to prepare a robust transport modelling evidence base that will inform of the impact of proposed future development within the borough within the context of the emerging Local Plan that covers the period 2015 to 2030. The results of the modelling will form a key part of the evidence base to support the emerging Local Plan.

1.1.2 The modelling work proposed within this study will be based on the previous work undertaken by PBA for BBC, earlier in the Local Plan development stages. This new study will develop this previous work to produce traffic distributions for a reference case and a 'with development' scenario for AM and PM peaks. These outputs will then feed into more detailed junction modelling assessments.

1.1.3 The method proposed for this work uses a hybrid OmniTRANS and spreadsheet modelling approach, which will then provide outputs that feed into individual junction assessment models.

1.2 Advantages of the Proposed Methodology

1.2.1 The application of OmniTRANS in the proposed method to assign vehicle trips generated by the spreadsheet model to the road network has a number of advantages over a purely spreadsheet-based method. These advantages can be summarised as follows:

a) The spreadsheet-OmniTRANS hybrid model allows trip rates derived from National Travel Survey (NTS) data to be used so that trip generation by purpose can be generated, thus allowing the trips for each purpose to be distributed separately using trip attractors and distance weights that are appropriate for each trip purpose. This is an advantage over merely using Census journey-to-work trip distribution data, which is only valid for work-related trips, to distribute trips for all purposes.

b) The gravity-modelling approach used in a hybrid model is sensitive to the amount and proximity of attractors (e.g. workplaces), including attractors that are components of development sites (e.g. employment sites), which any pre-defined existing distribution (such as Census journey-to-work) cannot take into account.

c) Similarly, by first conducting the distribution stage on person trips (all modes) then conducting the mode share stage, the hybrid model ensures that an appropriate proportion of pedestrians and cyclists will make short-distance trips, including trips to/from development attractors. This would not be the case if a pre-defined distribution of vehicle trips is used.

d) Use of the OmniTRANS network for the assignment of development trips by-passes the need for a time-consuming manual assignment of development trips through junctions with large trip matrices as the starting point.

1.3 Content of this Note

1.3.1 This note describes our method for the generation and distribution of trips to be tested on the highway network to inform the Brentwood Local Plan proposals.

1.3.2 Appendix B presents further details of the method which was previously agreed for the 2013 study. Appendix C contains scoping discussions with the Highways Agency during agreement of this method.

2 Trip Generation and Distribution Method

2.1 Introduction

2.1.1 A spreadsheet-based approach will be used to calculate the number of trips generated by each development site and the distribution of the trips across the road network. This will be conducted for each development scenario to be tested.

2.1.2 In a previous exercise conducted in the summer of 2013 as part of this project, sets of spreadsheets for the trip generation, distribution and mode share of person trips were created. The outline methodology for this work is described in this Chapter.

2.1.3 The method has six stages, as follows:

1) Determining the zoning system
2) Trip generation by zone
3) Trip distribution
4) Car trip generation
5) Modelling outputs

2.1.4 A flow diagram to illustrate these stages is contained in Appendix A. The remainder of this note describes the stages in detail.

2.2 Determining Study Area Assessment Zones

2.2.1 The study requires the identification of the number of car trips generated by development along the major road network links within the study area. This involves first identifying the origin of the trip, then identifying the destination and then deciding which route (road links) the trip is likely to take to travel between the origin and destination.

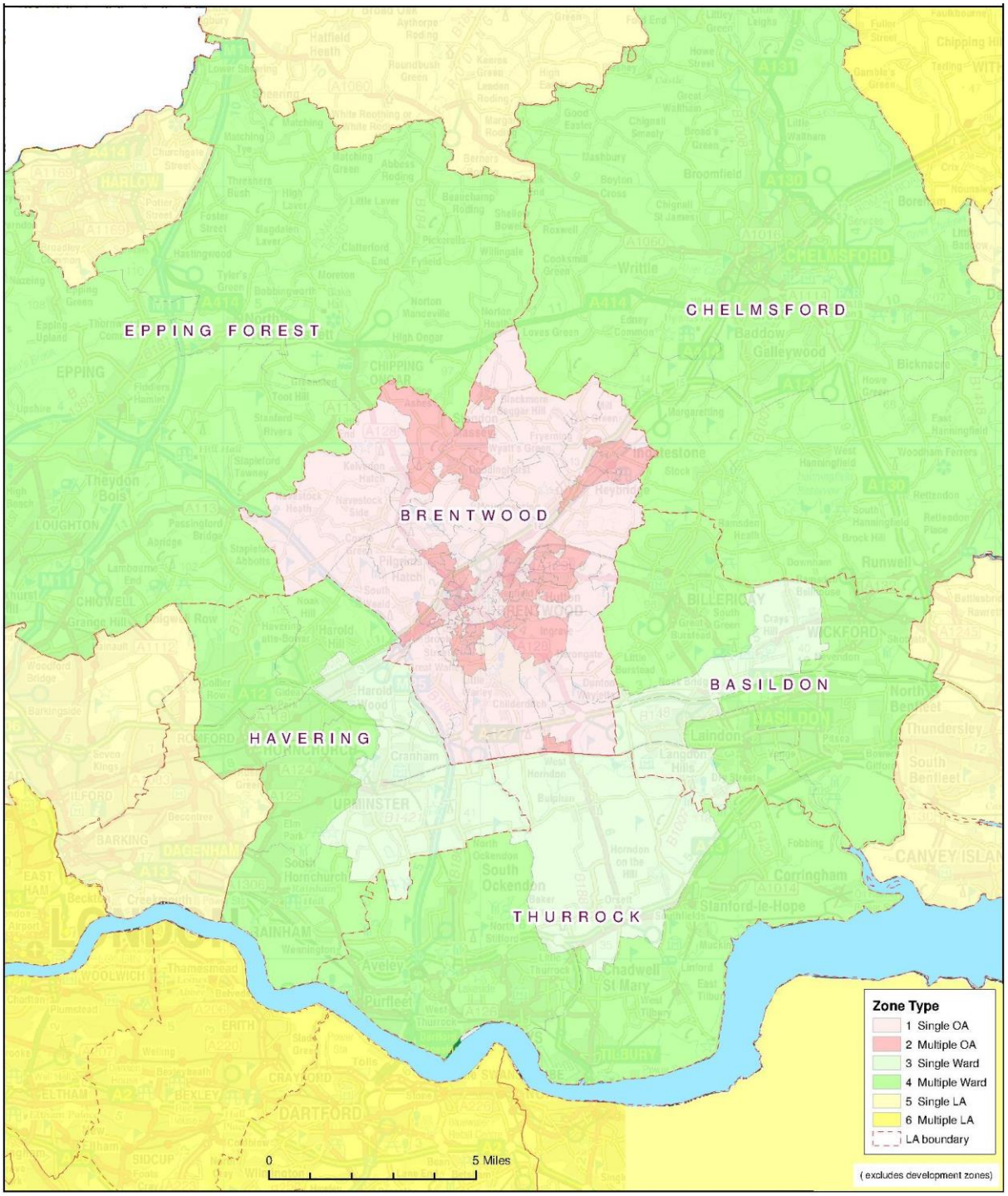
2.2.2 For the purposes of this strategic-level study, trip origins and destinations have been grouped into zones. This enables the magnitude of the flow of trips between zones to be calculated with flows then being distributed on the road network according to the road links between zones. This approach of identifying broad zones of origins/destinations and the flow of trips between them rather than identifying the flow of trips between individual origins and destinations is considered suitable for this study.

2.2.3 Zones within the study area were identified based on detailed Census boundaries. The Census-based zones were at single and multiple Output Area level within Brentwood BC, at Census ward level for neighbouring local authorities, and at local authority level to cover the wider area of London, Essex, Hertfordshire and Kent.

2.2.4 Additional zones were created to represent the proposed areas of major development sites. These development zones represented the larger sites with extant planning permissions and brownfield allocations for the baseline, plus additional zones for sites listed in Options A, B1,B2 and C of the 'Brentwood LDP Working Paper' (April 2013).

2.2.5 The zone system used for the study area is shown in Figure 1.

Figure 2: Zone system used in the study



2.3 Trip Generation

2.3.1 The origin of trips is assumed to be residential dwellings. The number of trips generated by each zone will therefore be calculated by first determining how many people live in each zone and then considering how many trips each person is likely to make. This will be calculated as follows:

Identifying residential population figures

2.3.2 Since the zones are set by the Census boundaries, the residential population figures in the Census 2011 will be used to determine the existing population of each zone.

2.3.3 In the case of the zones created to represent the future major development sites, for which population figures are not available, the residential population will be calculated by applying the mean number of residents per household for Brentwood (from Census 2011) to the number of proposed residential units for each site.

2.3.4 The growth in resident population to the required forecast year of 2026 will be calculated using the Office for National Statistics (ONS) residential population projections (available to 2021 by local authority, extrapolating beyond this where necessary), allowing for the increases in population from developments so as not to double-count the growth.

Person trip rate assumptions

Residential trips

2.3.5 Person trip rates from the National Travel Survey (NTS) will be applied to the residential population figures. Person trip rates appropriate to the area (level of urbanisation) will be extracted from the NTS.

2.3.6 Generated trips will be categorised by broad trip purpose as follows:

a) Trips to/from work

b) Trips to/from education establishments made by the student

c) Trips to/from education establishments made by people escorting students

d) Trips to/from food retail outlets,

e) Trips to/from non-food retail outlets,

f) Trips made for ‘other’ purposes, i.e. leisure, visiting friends, religious worship.

2.3.7 For each trip category, the number of trips generated by each of the following three age groups will be identified using Census age-group splits.

a) 0 to 16 years,

b) 17 to 64 years,

c) 65 years+

Non-residential trips

2.3.8 The reason for calculating generated trips for all zones in the zoning system, as opposed to merely the development residential element, is that the non-residential elements of developments will attract trips from the existing residential areas as well as development residents. Hence non-residential development trip numbers will be calculated at the trip distribution stage.

Trip Distribution

Recreating the road network

2.3.9 The road network within the study area will be recreated by extracting data from the Ordnance Survey (OS) MasterMap Integrated Transport Network[1] (ITN) digital road network, with mean link speeds derived from TrafficMaster[2] data.

2.3.10 Both the zoning system and the road network will be imported into OmniTrans in order to generate matrices of travel times and distances through the road network, between all zones, for use in the trip distribution and mode share elements of the spreadsheet analysis.

Distributing the home-based trips

2.3.11 The home-based generated trips will be distributed separately for each trip purpose using appropriate trip attractors and the distance matrix from the OmniTrans model using a gravity-modelling approach.

2.3.12 For the 2013 spreadsheet modelling, matrices were created to determine what proportion of work, education and retail trips would be attracted by each zone. These 'matrices of weights' were created, and will be applied to the trip generation numbers, as follows:

a) For work trips a matrix of weights was calculated using distance weights (which reduce as the distance increases) derived from Census journey-to-work data for Brentwood and the number of workplaces in each zone. The normalised matrix of weights will be applied to the generated work trips in order to distribute them across all zones. For trip purposes other than work trips the Census journey-to-work data is not appropriate for the distance weightings, so a gravity modelling approach will be used instead.

b) For the education trips, a matrix of weights was calculated separately for Age group 5 to 10 Primary age (using primary schools as trip attractors), Age group 11 to 16 Secondary age (using secondary schools) and Age group 17 to 64 (using Tertiary education establishments).

c) The location of local stores was a component of the weights of both the shop-food trips and the shop-non-food trips. In addition, the shop-food trips used supermarket locations and the shop-non-food trips used various non-food retail locations, namely town centres, local retail parks and larger shopping centres (Lakeside, Bluewater, Westfield).

[1] OS MasterMap ITN Layer uses a link and node structure (connected into a single network) to depict the road infrastructure in Great Britain. The ITN layer includes route restriction information such as banned turns and one-way restrictions.

[2] TrafficMaster uses Global Positioning System (GPS) data to gather information on link speeds on the road network.

Non-home based trips

2.3.13 Non-home based trips will be generated and distributed using a similar method to that of the home-based trips. However, a double-distribution approach will be necessary; where trips are distributed firstly to find the trip origins (using the origin purpose weights), then distributed again to find the trip destinations (using the destination purpose weights).

2.3.14 The non-home-based modelled trip purposes are simply 'work' and 'other' (hence work-to-work, work-to-other, other-to-work and other-to-other).

2.4 Calculating Mode of Travel

2.4.1 The trip distribution stage will result in all-mode trip matrices for each purpose (home-based and non-home-based) for the selected time period for all transport modes. The next stage involves deriving the car driver trip matrices from the all-mode matrices.

2.4.2 The walk and cycle shares of trips for each distance band for each trip purpose will be calculated using NTS data. Walking and cycling trips will be separated from the all-mode trip matrices to leave the remainder; non-walk/cycle matrices.

2.4.3 For work-related trips, the car driver trips will be separated from the non-walk/cycle trips using the corresponding Census 2001[3] journey-to-work travel mode share for that particular origin-destination combination. For the purpose of this modelling exercise, the development zones inherit the car driver mode shares of the Census zones that they fall within.

2.4.4 For the other trip purposes (not work related), the car driver trips will be separated from the non-walk/cycle trips using the NTS mode shares for each particular trip purpose (including non-home based purposes), for the time period in question.

2.5 Resulting Car Driver Trip Matrices

2.5.1 Following the mode of travel stage of the spreadsheet-based exercise car trip matrices will be formed by aggregating the car driver matrices across all trip purposes for each required time period. Car trip matrices will be generated for all Local Plan development scenarios to be tested.

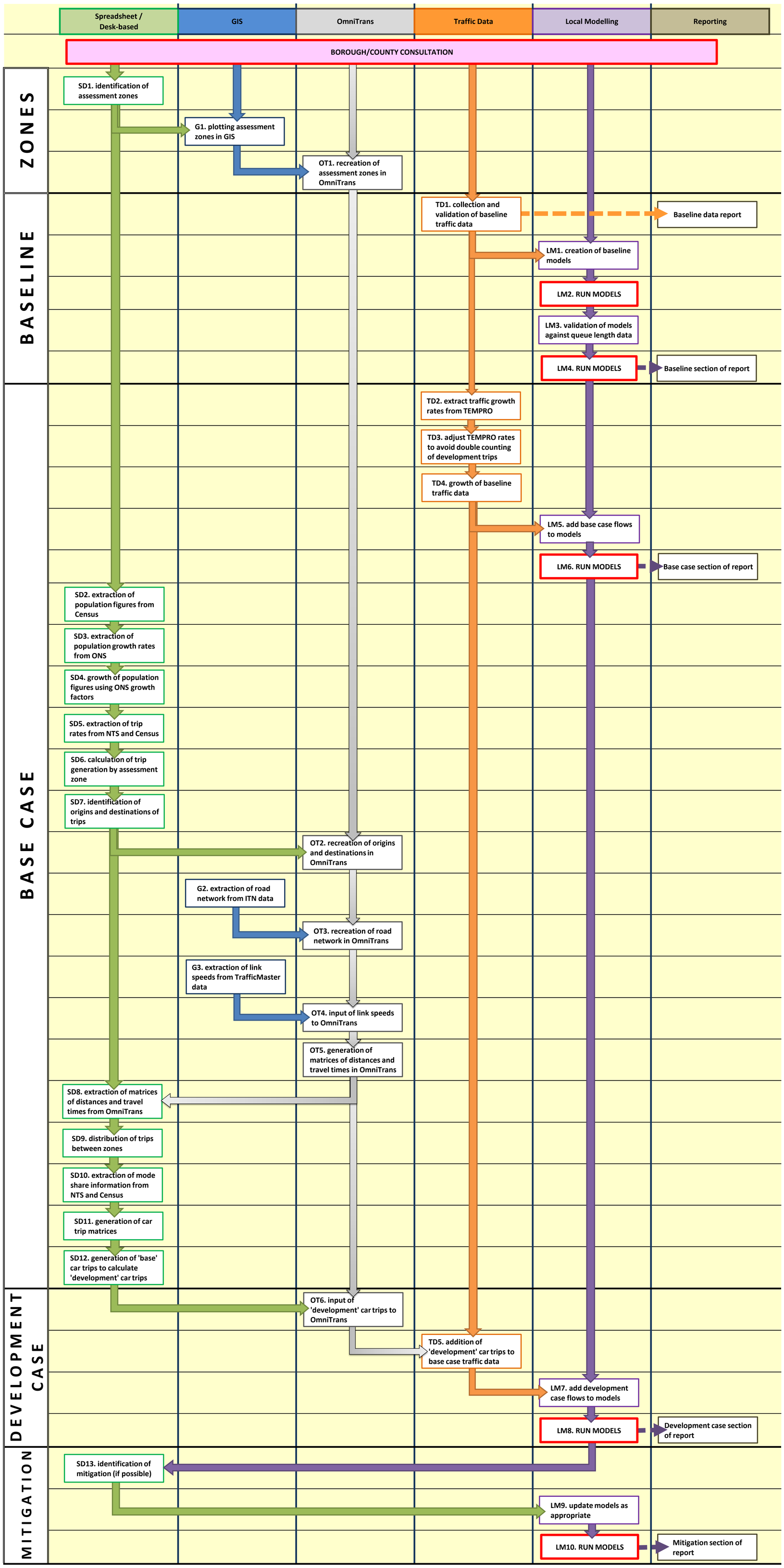
2.5.2 The resulting car trip matrices will include base trips (due to the calculation of generated trips for existing residential areas). In order to be able to identify the number of trips generated by the Local Plan development it will be necessary to separate the 'base' and 'development' trips within the matrices. A set of 'base' car trip matrices, without 'development' trips will therefore be generated and subtracted from the car trip matrices for each scenario. The car trips remaining after subtraction will represent the net development car trip matrices for each development scenario.

2.5.3 The net development car trip matrices will be assigned to the network in OmniTrans that was used to calculate the distance and travel time matrices (see Trip distribution section above). The assigned trips will be extracted from OmniTrans as a network diagram to enable the visualisation of link loads across the network resulting purely from the development traffic.

2.5.4 The network diagram will also show turning movements at junctions which will then be input into the junction models in addition to the base traffic for each option being tested and each time period in order to assess the impact of the development traffic on the junctions.

[3] Census 2001 data is used for this stage as the appropriate data from the Census 2011 is not currently available

Appendix A Trip Generation and Distribution Method flow diagram


Spreadsheet / Desk-based
GIS
OmniTrans
Traffic Data
Local Modelling
Reporting
BOROUGH/COUNTY CONSULTATION
ZONES
SD1. identification of assessment zones
G1. plotting assessment zones in GIS
OT1. recreation of assessment zones in OmniTrans
BASELINE
TD1. collection and validation of baseline traffic data
Baseline data report
LM1. creation of baseline models
LM2. RUN MODELS
LM3. validation of models against queue length data
LM4. RUN MODELS
Baseline section of report
BASE CASE
TD2. extract traffic growth rates from TEMPRO
TD3. adjust TEMPRO rates to avoid double counting of development trips
TD4. growth of baseline traffic data
LM5. add base case flows to models
LM6. RUN MODELS
Base case section of report
SD2. extraction of population figures from Census
SD3. extraction of population growth rates from ONS
SD4. growth of population figures using ONS growth factors
SD5. extraction of trip rates from NTS and Census
SD6. calculation of trip generation by assessment zone
SD7. identification of origins and destinations of trips
OT2. recreation of origins and destinations in OmniTrans
G2. extraction of road network from ITN data
OT3. recreation of road network in OmniTrans
G3. extraction of link speeds from TrafficMaster data
OT4. input of link speeds to OmniTrans
OT5. generation of matrices of distances and travel times in OmniTrans
SD8. extraction of matrices of distances and travel times from OmniTrans
SD9. distribution of trips between zones
SD10. extraction of mode share information from NTS and Census
SD11. generation of car trip matrices
SD12. generation of 'base' car trips to calculate 'development' car trips
DEVELOPMENT CASE
OT6. input of 'development' car trips to OmniTrans
TD5. addition of 'development' car trips to base case traffic data
LM7. add development case flows to models
LM8. RUN MODELS
Development case section of report
MITIGATION
SD13. identification of mitigation (if possible)
LM9. update models as appropriate
LM10. RUN MODELS
Mitigation section of report

Appendix B Outline Methodology for Previous (August 2013) Work

2.5.5 The spreadsheet model calculated matrices of home-based person trips for various purposes and transport modes, for the one-hour AM peak period 0800-0900. The output car driver trip matrices represented all car trips arriving and departing from Brentwood BC developments in the baseline and in the four 'Brentwood LDP Working Paper' (April 2013) options. The OmniTrans specialist transport modelling software was used to develop a model road network and zoning system. Matrices of travel times and distances (using the network) were generated in OmniTrans and used in the spreadsheet model. The spreadsheet output matrices were each assigned to the road network in OmniTrans so that the level of potential additional vehicles on road links across the borough could be visualised and assessed.

2.5.6 OmniTrans Model :

a) The zoning system that formed the geographical basis for the modelling work was constructed in a GIS and constituted Census-based zones for the existing population and proposed development zones.
b) The Census-based zones were at single and multiple Output Area level within Brentwood BC, at Census ward level for neighbouring local authorities, and at local authority level to cover the wider area of London, Essex, Herts., and Kent.
c) The development zones represented the larger sites with extant planning permissions and brownfield allocations for the baseline, plus additional zones for sites listed in Options A, B1,B2 and C of the 'Brentwood LDP Working Paper' (April 2013).
d) The road network was extracted from the ITN digital road network, with mean link speeds derived from TrafficMaster GPS data. The peak-period link speeds were used to generate the matrices of travel times and distances through the road network, between all zones.

2.5.7 Spreadsheet Model - Trip Generation:

a) The initial 'Zone Data' sheet collated the number of proposed housing units for each housing development zone and the number of estimated proposed employees for each employment development zone. Similarly, the number of households and workplaces was collated for each Census-based zone using Census data. The option for testing (baseline housing/baseline housing and employment/A/B1/B2/C) is also determined at this stage by user selection (drop-down box).
b) The resident population of each zone by age group (0-16, 17-64, 65+) was calculated for development zones using the mean population per dwelling for Brentwood from Census 2011 data (and obtained directly from Census data for the Census-based zones). The Brentwood mean population densities were 0.475 age 0-16, 1.469 age 17-64, and 0.458 age 65+ residents per dwelling, giving an all-age rate of 2.402 residents per dwelling.
c) Within the'Trip Generation' sheet the number of home-based trips generated by each zone was calculated. This used the zone data for the required user-option in conjunction with trip rates from the National Travel Survey (NTS) - see Table below. (All NTS data used in this project was extracted using population selection criteria appropriate for the size and location of Brentwood). This provided all-mode trip numbers generated for each broad purpose by the resident population of each zone (as home-to-purpose and purpose-to-home). The trip purposes modelled were work, education, escort-education, shop food, shop non-food and 'other'.

Table 1: NTS Trip Rates

National Travel Survey					
Extracted Trip Rates for the Brentwood Project					
Period 0800 - 0900, All-mode rates.					
	Trips per person				Equivalent Trips
	Age 0-16	Age 17-64	Age 65+		per household
Home-to-purpose :					
Work & Empl Business	0.00025	0.14153	0.00381		0.20977
Education	0.37640	0.02016	0.00003		0.20843
Shop Food	0.00040	0.00263	0.00883		0.00809
Shop Non-Food	0.00046	0.00262	0.01152		0.00934
Escort Education	0.03577	0.05074	0.00252		0.09268
Other	0.04391	0.02757	0.02737		0.07390
All Purposes	0.45720	0.24525	0.05409		0.60221
Purpose-to-home :					
Work & Empl Business	0.00010	0.00345	0.00039		0.00530
Education	0.00020	0.00002	0.00000		0.00012
Shop Food	0.00002	0.00078	0.00156		0.00187
Shop Non-Food	0.00001	0.00100	0.00692		0.00464
Escort Education	0.00625	0.01489	0.00129		0.02544
Other	0.00301	0.00910	0.00807		0.01850
All Purposes	0.00959	0.02925	0.01824		0.05587
Non-home-based :					
Work/EB to Work/EB	0.00006	0.00685	0.00013		0.01014
Work/EB to Other (NHB)	0.00173	0.00136	0.00017		0.00289
Other (NHB) to Work/EB	0.00024	0.01766	0.00028		0.02619
Other (NHB) to Other (NHB)	0.02899	0.00977	0.00402		0.02997
Total NHB	0.03102	0.03563	0.00460		0.06919

2.5.8 Spreadsheet Model - Trip Distribution:

a) The home-based generated trips were distributed separately for each trip purpose using appropriate trip attractors and the distance matrix from the OmniTrans model.

b) For work trips a matrix of weights was calculated using distance weights (which reduce as the distance increases) derived from Census journey-to-work data for Brentwood, and the number of workplaces in each zone. The normalised matrix of weights was applied to the generated work trips in order to distribute them across all zones. For trip purposes other than work trips the Census data could not be used for the distance weightings, so a gravity modelling approach was used instead.

c) For the education trips, a matrix of weights was calculated separately for Age 0-16 Primary age (using primary schools), Age 0-16 Secondary age (using secondary schools) and Age 17-64 (using Tertiary education establishments). Only existing schools were used, hence the tendency for larger developments to include new schools would cause

education trip lengths and car driver trip numbers to be lower than those estimated in this exercise.

d) The location of local stores was a component of the weights of both the shop-food trips and the shop-non-food trips. In addition, the shop-food trips used supermarket locations and the shop-non-food trips used various non-food retail locations, namely town centres, local retail parks, and larger shopping centres (Lakeside, Bluewater, Westfield).

e) Non-home based trips were generated and distributed using a similar method to that of the home-based trips. However, double-distribution approach was necessary, where trips were distributed firstly to find the trip origins (using the origin purpose weights), then distributed again to find the trip destinations (using the destination purpose weights). The non-home-based modelled trip purposes were simply 'work' and 'other' (hence work-to-work, work-to-other, other-to-work and other-to-other).

2.5.9 Spreadsheet Model - Mode Share:

a) The trip distribution stage (above) resulted in trip matrices for each purpose (home-based and non-home-based) in the morning peak, for all transport modes. The next stage involved deriving the car driver matrices from the all-mode matrices.
b) Walking and cycling trips were separated from the all-mode trip matrices to form non-walk-cycle matrices. The walk and cycle shares of trips for each distance band, for each trip purpose, were used in this exercise. The distance-related walk and cycle shares were derived from NTS data.
c) For work-related trips, the car driver trips were separated from the non-walk-cycle trips using the corresponding Census 2001 journey-to-work share for that particular origin-destination combination. For the purpose of this modelling exercise, the development zones inherited the car driver shares of the Census zones that they fall within.
d) For the other trip purposes (not work related), the car driver trips were separated from the non-walk-cycle trips using the morning-peak NTS mode shares for each particular trip purpose (including non-home-based purposes), irrespective of origin and destination. This approach was deemed adequate for this trip modelling exercise.

2.5.10 Development Car Trip Numbers and Visualisation :

a) The spreadsheet model was used to estimate car trip numbers for each modelling option and obtain the corresponding (all-purposes) car trip matrices. For each option, two versions of the matrix were calculated: with all development trips included (including baseline developments), and without the baseline development trips (by subtracting the baseline-only matrix).
b) Matrices were imported into the OmniTrans model and assigned to the road network. Each option could then be visualised in terms of AM peak development traffic on links across the whole study area.

2.5.11 Mode Shares :-

Input Mode Share Data

Walk & Cycle :	Dependent on trip length (using NTS share-versus-distance curves, by purpose)
Work-trip car-driver share (of Car+PT) :	Dependent on trip-end locations (from Census JtW data)

Car-driver share of Car+PT (common to all zones, from NTS) :

Education (Age 17+)	14.55%
Escort Education	93.18%
Shop Food	78.17%
Shop Non-Food	76.40%
Other	82.32%

Resulting Mode Shares (All-Age, Person Trips)

For home-based trips departing from a sample of housing development sites

Output from model using Option C, AM peak 0800-0900.

Zone : 14
Site : LDP Ref 100
Location Type: Brentwood town centre

Home-to-	All-mode Trips	Non-w-c Trips	Walk/Cyc Share	Driver Trips	Driver Share	Passenger/ PT / Other
Work	42.15	35.26	16.35%	24.07	57.11%	26.55%
Educ (0-16)	35.91	13.31	62.94%	0	0.00%	37.06%
Educ (17+)	5.96	2.99	49.83%	0.43	7.21%	42.95%
Escort Educ	18.62	10.02	46.19%	9.34	50.16%	3.65%
Shop Food	1.63	0.94	42.33%	0.73	44.79%	12.88%
Shop Non-F	1.88	1.36	27.66%	1.04	55.32%	17.02%
Other	15.43	10.62	31.17%	8.74	56.64%	12.18%
Home-to-All	121.58	74.5	38.72%	44.35	36.48%	24.80%

Zone : 29
Site : Sylvia Avenue
Location Type: Outskirts of Shenfield

Home-to-	All-mode Trips	Non-w-c Trips	Walk/Cyc Share	Driver Trips	Driver Share	Passenger/ PT / Other
Work	6.71	6.38	4.92%	4.16	62.00%	33.08%
Educ (0-16)	5.72	2.6	54.55%	0	0.00%	45.45%
Educ (17+)	0.95	0.67	29.47%	0.1	10.53%	60.00%
Escort Educ	2.96	1.47	50.34%	1.37	46.28%	3.38%
Shop Food	0.26	0.25	3.85%	0.19	73.08%	23.08%
Shop Non-F	0.3	0.3	0.00%	0.23	76.67%	23.33%
Other	2.44	2.2	9.84%	1.81	74.18%	15.98%
Home-to-All	19.34	13.87	28.28%	7.86	40.64%	31.08%

Zone : 32
Site : LDP Ref 020
Location Type: West Horndon

Home-to-	All-mode Trips	Non-w-c Trips	Walk/Cyc Share	Driver Trips	Driver Share	Passenger/ PT / Other
Work	52.43	52.05	0.72%	27.24	51.95%	47.32%
Educ (0-16)	44.66	32.46	27.32%	0	0.00%	72.68%
Educ (17+)	7.41	7.41	0.00%	1.08	14.57%	85.43%
Escort Educ	23.16	17.09	26.21%	15.92	68.74%	5.05%
Shop Food	2.02	1.89	6.44%	1.47	72.77%	20.79%
Shop Non-F	2.34	2.34	0.00%	1.78	76.07%	23.93%
Other	18.47	17.69	4.22%	14.56	78.83%	16.95%
Home-to-All	150.49	130.93	13.00%	62.05	41.23%	45.77%

Appendix C Comments (by Highways Agency) and Responses (by PBA) relating to the Outline Methodology for the previous work (PBA, Nov 2013)

HA: The methodology of separating the car driver trips from the person trips looks acceptable, except for the non-work trips where the trips are separated from the person trip matrices based upon NTS proportions only. This is likely to have a significant effect upon the longer distance trips on the strategic road network which could be under-represented. Longer distance trips (except those into London rail hubs) are more likely to travel by car. We would need to understand what impact this is likely to have before agreeing to this approach and a new approach may potentially be required.

PBA: For the time period being modelled (AM Peak), when looking at the home-based non-walk-cycle trips being generated by our development zones (which are then subject to the CAR-PT split which is in question here) :

1) Home-based work trips constitute 55% of all HB trips and these are OK regarding the long-distance mode split (Census JtW used; different splits for different destinations)
2) Education/escort-education constitutes 22%. These are all typically short distance; long-distance mode split not an issue.
3) Shopping constitutes only 4% - half of these are food shopping (typically short distance) and some of the non-food shopping will also be short distance.
4) Other constitutes 18% in total. When broken down into component purposes, the majority you would expect to be short-distance (eg medical, escort shopping, visit friends)
5) (Non-home-based trips constitute only 16% of all trips generated.)

Hence the majority of the non-work trips are not long-distance.

For those that are long-distance or will be impacting on the strategic road network, the proportions (of HB trips) that are assumed to be car drivers (using the NTS splits – applied to all distances and destinations (the issue in question) are : Education: 14.5% (few students drive themselves), Escort-Educ: 93.2%, Shop-food: 78.2%, Shop-non-food: 76.4%, Other 82.3%. Hence, the % by car is fairly high for purposes that could impact on the strategic road network anyway.

The upshot is that longer-distance trips on the strategic road network, that are being made by residents of the development zones, are (in my opinion) not being under-estimated.

HA: The OmniTRANS model appears to be a highway only assignment model with demand modelling being done externally although this requires some clarification. We would like also to look at the validation report for the transport model to ascertain its geographical coverage, how it has been constructed and how well it replicates base year scenarios (and what survey data were used to construct and validate the model). We could also ascertain how synthetic the trip matrices are and whether any survey data has been used in their construction. We need to agree whether the model is of an adequate standard for use.

PBA*:* The OmniTrans model is only a model in the loosest sense and hasn't been subjected to the usual validation rigour of a proper model. It is merely being used to assign the car driver trips (calculated in the spreadsheets) onto the road network, to visualise the impact of the developments on road links. Existing base traffic hasn't been calibrated/validated as it's not of interest in this exercise, which was intended to be a quick look at where traffic from/to the development sites might be going to/coming from. Hence the 'model' has been used to estimate the additional traffic on the road network

as a result of the developments, without knowing/needed an accurate and validated base. The only reason that trips generated by the existing residential population (in the non-development zones) has been dealt with is that the development sites with employment content will attract a proportion of these trips.

RESPONSE NOTE

Job Name: Brentwood Local Development Plan

Job No: 28085

Note No: 1

Date: 21st October 2014

Prepared By: Phil Longman

Subject: **Response to Essex County Council and Highway Agency comments on PBA Trip Generation and Distribution Method for the Brentwood Local Development Plan Transport Study**

Ref	Essex County Council Comment	PBA Response	Action
Para. 1.1.2	It is unclear what scenarios will be tested within the proposed modelling. Reference is made to previous work to produce a reference case and a `with development' scenario for AM and PM peaks. Further clarification should be included in the methodology for clarification. Essex County Council (ECC)/EH would recommend the following scenarios, which have been included in modelling undertaken for other districts. ECC would recommend the following: • 2014 AM Base • 2014 PM Base • 2030 AM Base • 2030 PM Base • 2030 AM Base + Committed Development *(Do minimum)* • 2030 PM Base + Committed Development *(Do minimum)* • 2030 AM Base + Committed Development + LDF Development	The scenarios that we intend to test are as recommended by ECC with the exception of the 2030 Base scenarios. The base scenario for assessment will be the 2030 Base + Committed Development (do minimum) scenarios. This covers the flows on the network at present, future background traffic with committed development and with the planned growth identified in the Local Development Plan. We believe that it is not necessary to run the 2030 Base scenarios on their own to obtain the results required for the study.	None required

RESPONSE NOTE

Ref	Essex County Council Comment	PBA Response	Action
	• 2030 PM Base + Committed Development + LDF Development These scenarios have proved useful in considering the flows on the network at present, background traffic, with committed development, and with the planned growth identified in the Local Development Plan. This assists in identifying a clear indication of the impact of the planned housing growth.		
Section 1.2	**Advantages of the Proposed Methodology.** The proposed methodology appears to use OmniTrans for development trips only. Whilst this is acceptable (the ECC spreadsheet model approach would be similar), it does not appear to consider the reassignment of trips due to development impact. In sensitive areas (such as Wilsons Corner), rerouting could impact on surrounding areas. It is unclear if PBA will be considering such issues.	The scope of this project (attached as Appendix A) did not include the reassignment of trips. The assessment would therefore consider a 'worst case' on the major routes with no reassignment of trips to ease congestion on the junctions identified for assessment.	None required
Section 2.2.4 & 5	**Determining Study Area Assessment Zones.** The identification of assessment zones appears to be reasonable within the Brentwood area. However, the neighbouring areas maybe a bit too generalised. For example, the proposals in Dunton (it's not clear if PBA have accounted for this development if they're basing their zones on sites named in a Working Paper of April 2013) may demand that the surrounding area is broken down further as within the Brentwood area.	Any key development sites on the Brentwood border or beyond can be given their own zones in the zoning system, as required. When we have been provided with consented development information we will create additional zones as deemed necessary. Please advise what additional zones you would like to be created for assessment.	**ECC** to advise on additional zones for assessment
Section 2.3.3	**Identifying Residential Population Figures.** ECC/EH consider calculating residential population using a mean number of residents per household is too broad an approach. It would be more appropriate to identify residential population using comparable wards.	Agreed. We will change the method to reflect this.	**PBA** to change method

RESPONSE NOTE

Ref	Essex County Council Comment	PBA Response	Action
Section 2.3.4	ECC/EH assumes PBA mean to reference 2030, not 2026, as the end year of the Local Development Plan.	Correct. The development case assessment year will be 2030.	None required
Section 2.3.8	**Person trip assumptions – non-residential.** If this includes new employment etc, PBA should ensure that attraction from outside Brentwood district is considered as well as within.	The area included in the zoning system is presented in Figure 2 of the Method note and includes areas outside of Brentwood district. The extent of the zoning system was determined by considering the journey to work travel patterns inherent in the 2001 Census, which established that workers travelled from outside of Brentwood district to work within Brentwood. The assessment will therefore consider non-residential trips to attractors within Brentwood district and outside it within the extent of the zoning system. All information regarding new employment within the extent of the zoning system provided to us will be considered in the assessment.	None required
Section 2.3.12	**Trip distribution – distributing home-based trips.** ECC/EH seek clarification from PBA regarding the weightings they have used to check their appropriateness.	Work trips will be distributed using weights that have been calculated using the Census 2011 journey-to-work data for Brentwood residents. Work trips will therefore be distributed between zones according to the distribution of trips recorded in the 2011 Census. Hence the general trip-distance relationship will be consistent with Census journey-to-work. The trip-distance relationship used in the distribution of the other trip purposes is generated using a similar approach but utilising trip origin/destination data from within the National Travel Survey (NTS).	None required

RESPONSE NOTE

Ref	Essex County Council Comment	PBA Response	Action
Section 2.4	**Calculating Mode of Travel.** ECC/EH seeks clarification as to whether rail travel is accounted for in the methodology. Brentwood has high rail usage, with mainline stations at Shenfield, Brentwood and Ingatestone, leading to high level of trips to these stations.	Local variation in the proportion of trips using rail is taken into account by utilising mode share data in the Census and NTS. The proportion of trips made by each public transport mode for each local area (each set of zones that comprise a Census MSOA) within Brentwood is calculated separately using the Census journey-to-work public transport mode shares for each MSOA (or NTS mode shares for non-work trips). This will reflect the high levels of rail use for residents in the vicinity of rail stations.	None required
Section 2.4.2	ECC/EH considers that Census data provides better local mode/trip information, and is therefore more appropriate for origin destination data than NTS.	Census journey-to-work origin-destination data is used in the determination of work-related trips. Census does not include detail on travel for purposes other than work, therefore NTS information has been used for each of the other broad trip purposes being modelled. The sample size of households included in the NTS data used in this study is high and enables the extraction of trip rates for any combinations of time periods, trip purposes and mode shares. It is therefore considered more appropriate for use in the determination of non-work trips than Census data.	None required

RESPONSE NOTE

Ref	Highway Agency Comment	PBA Response	Action
HA01	The 8-9am NTS trip rates are very low even when compared to TRICS private/non-private mix. It is stated that the rates come from like for like sites ("extracted using population selection criteria appropriate for the size and location of Brentwood"). Will new housing locations in Brentwood (mainly suburban or out of town) reflect the locations within the towns from which the NTS data has been extracted? More information is required on the NTS data given the very low trip rates per household when compared to TRICS data.	Analysis conducted by PBA to compare NTS trip rates with TRICS and Census 2011 trip rates is contained within Appendix B of this note. The analysis showed that the NTS trip rate for areas of Brentwood with a low persons per household ratio were lower that TRICS trip rates. Areas of Brentwood with a higher persons per household ratio generated trip rates that were closer to those generated by TRICS. The difference in the NTS and TRICS trip rates is considered to be partly because the TRICS trip rate factor is 'per dwelling' and does not consider the number of people per dwelling. An analysis of NTS work-related trip rate compared to Census 2011 trip rates found that NTS trip rates were, on average, 10.4% lower than Census trip rates, with some local variations. As a result of this analysis we have increased the trip rates used in the assessment by applying a factor of 1.116 to the NTS trip rates.	**PBA** to use uplifted trip rates in assessment
HA02	We would recommend that trip rates are checked against other sources for robustness. While it is logical to use NTS and Census data, the latter will not be time of day related. Also, the NTS data assumes that new development residents will overall be similar to NTS derived average respondents with similar average household characteristics.		
HA03	Brentwood has a particularly high economic activity rate that would suggest higher levels of commuting than in the average NTS trip rate data. Has this been accounted for?		
HA04	It would be useful to confirm that the gravity model is adjusted by mode so that long trips are car or rail. It is noted in para 2.4.2 that walking and cycling trips will be based upon NTS data but does not elaborate.	The gravity model does consider mode by distance. The model uses distance by mode data from the NTS. This reflects the fact that the mode share for longer journeys has fewer walk and cycle trips and more car and rail trips.	None required

RESPONSE NOTE

Ref	Highway Agency Comment	PBA Response	Action
HA05	2011 Census data is now available but at local authority level only. It may be preferable to use e.g. 2001 ward or LSOA differences to the local authority averages, and apply these relative differences to 2011 Census data for the Ward or LSOA	Census 2011 data can now be accessed at Output Area level using the Neighbourhood Statistics or NOMIS websites. This information will be used in the assessment.	None required
HA06	As discussed at the meeting, we require some assessment of Crossrail impacts in addition to the methodology supplied on trip generation and distribution.	We will seek to determine the likely impact of the Crossrail proposals through a high-level assessment. We will discuss our conclusions with you before determining whether it will impact on the results of this Study.	**PBA** to undertake high-level assessment of Crossrail impacts within the Study area

Appendix A Project Brief

Document Control Sheet

Project Title	**Brentwood Local Plan Support**
Report Title	**Project Brief**
Revision	**-**
Status	**Draft**
Control Date	**March 20th, 2014**

Record of Issue

[redacted]

Distribution

[redacted]

Project Identification & Objectives

See Project Mandate Form.

Tasks

In order to meet the objective outlined in the project mandate form, the study will be divided into the appropriate stages and tasks as per the tables below:

Stage 1 – Data Analysis	**Task 1**	Review 2012 traffic data
Outcome 1: Ensure 2012 base data is sound and consistent to develop spreadsheet models		

Stage 2 – Base Year Assessment	**Task 2**	Develop base model network
	Task 3	Develop models for 23 junctions
	Task 4	Run junction models
	Task 5	Calibrate models to replicate base year network conditions
Outcome 2: Establishment of Base Year Conditions		

Stage 3 – Future Year Model Development and Impact Assessment	**Task 6**	Agree Local Plan development sites with Essex County Council (ECC) and Brentwood Borough Council (BBC) and development scenarios
	Task 7	Calculate trip generation for Local Plan development sites
	Task 8	Develop zones for Local Plan development sites and use Census Journey to Work data to distribute traffic to / from zones
	Task 9	Calculate future year traffic growth factors & committed development traffic levels
	Task 10	Create future year network and carry out (manual) assignment of Local Plan development traffic
	Task 11	Calculate percentage impact of development traffic
	Task 12	Develop and run future year models for 23 junctions
Outcome 3: Establishment of impact of proposed development sites on local highway network		

Stage 4 – Mitigation	**Task 13**	Identify mitigation measures at problem points on highway network
	Task 14	Develop Level 1 costings of mitigation measures
Outcome 4: Identification of mitigation measures and associated costs		

Stage 5 – Final Report	**Task 15**	Create report
Outcome 5: Draft/Final Report		

Methodology

BBC is preparing a Local Plan to cover a 15 year period following the expected adoption of the Plan (i.e. 2015 to 2030). Essex Highways is aware that the proposed housing will combine sites with outstanding planning permission and new residential allocations. In order to model the impact of known development on the highway network, the following will be included in the model:

- capacity of outstanding commitments at 1 April 2014 (ECC / BBC agreed position);
- new site allocations up to the end of the plan period (i.e. 2030).

The following scenarios have been put forward by BBC and will be the focus of the study:

- Option 1 – 6,227 dwellings and 27.35 ha of employment across BBC area;
- Option 2 – a possible variation of Option 1 to be confirmed at a later date by BBC.

An indication of the breakdown of the housing aspect of the proposed development has recently been received from BBC. However, precise details of the employment proposals are still awaited. The study will not be progressed until these details are confirmed and this brief has been ratified.

Stage 1 – Data Analysis

Task 1 – Review 2012 traffic data

A series of Automatic Traffic Counts (ATCs) and Manual Classified Counts (MCCs) were carried out on November 28, 2012. These will form the basis for the development of base and future year models with development. The following junctions have been surveyed:

- 1: A1023 Chelmsford Road / A129 Hutton Road / A1023 Shenfield Road – Signals;
- 2: A129 Rayleigh Road / Hanging Hill Lane – Mini roundabout;
- 3: A128 Ongar Road / Doddinghurst Road – Mini roundabout;
- 4: A128 Ongar Road / Western Avenue – Priority Junction;
- 5: A128 Ongar Road / William Hunter Way – Mini roundabout;
- 6: Wilson's Corner - A128 Ongar Road / A1023 Shenfield Road / A128 Ingrave Road / A1023; High Street – Double Mini roundabout;
- 7: A128 Ingrave Road / B186 Queens Road – Mini roundabout;
- 8: A128 Ingrave Road / Middleton Hall Lane / Seven Arches Road – Signals;
- 9: B185 Kings Road / B186 Queens Road – Mini roundabout;
- 10: A1023 High Street / B185 Kings Road / A1023 London Road / Weald Road;
- 11: Weald Road / Western Road – Mini roundabout;
- 12: Western Road / William Hunter Way – Mini roundabout;
- 13: A127 / A128 Brentwood Road / A128 Tilbury Road;
- 14: A127 / Childerditch Lane;
- 15: A128 Ingrave Road / The Avenue – Mini roundabout;
- 16: A128 Brentwood Road /Running Waters – Mini roundabout;
- 17: A1023 Brook Street /Mascalls Lane – Signal controlled crossroads;
- 18: B186 Warley Hill / Eagle Way / B186 Warley Road / Mascalls Lane.

After some reconsiderations of the housing and employment allocations by BBC, the following junctions have been added to the list and are scheduled to be surveyed on Thursday 27th March 2014:

- 19: B186 Warley Street / A127 eastbound;
- 20: B186 Warley Street / A127 westbound;
- 21: A127 westbound / Thorndon Avenue, West Horndon;
- 22: A1023 Chelmsford Road / Alexander Lane;
- 23: B148 West Mayne / Lower Dunton Road.

The above junctions are considered key within the town or surrounding road network and are also most likely to be impacted by the proposed Local Plan traffic. The data will be thoroughly analysed to check for any inconsistencies and will then be processed to generate peak hour data in the format of Passenger Car Units (PCUs) ready for use in the junction assessments. Standard factors will be used to convert to PCUs, unless more detailed information is available. N.B. The A127 / B148 Dunton

Interchange will also be assessed, but data is already held from May 2011 (used in assessing the impact of proposed developments within Basildon Borough Council's LDP).

Outcome 1:	Ensure 2012 base data is sound and consistent to develop spreadsheet models.

Stage 2 – Base Year Assessment

Task 2 - Develop base model networks

Microsoft Excel spreadsheet models will be constructed for the key road links relevant to the study. Each model will contain a simple schematic road network contained within the identified study area. 2012 traffic flows, which will be 'growthed' as per the National Traffic Model (NTM) and the Trip End Model Presentation Program (TEMPRO) method to a base year of 2014 (cf. details in Stage 3 Task 9), will be detailed for each link in the modelled network, and turning movements at all junctions in the modelled network will be shown. If survey data is required from an existing year prior to 2012, growth factors will similarly be used.

Copies of the road network will be made so that separate spreadsheet models can be produced to show flows related to the AM and PM peaks.

A smaller scale model will also be developed for an area including West Horndon and its peripheral routes, including a section of the A127, as this area is located at a distance from Brentwood where the two areas would have minimal impact on one another.

The base data processed within Task 1 (in PCU format) will be input to the base spreadsheet models for the Brentwood and West Horndon areas, and form the basis of the future year assessments.

Task 3 - Develop models for 23 junctions

Junction assessment models will be set up using standard Transport Planning industry software. Transport Research Laboratory's Junctions 8.0 will be used for unsignalised roundabouts and priority junctions. Meanwhile, JCT Consultancy's LinSig v3.2.16 software will be used to model all signalised intersections.

Task 4 - Run junction models

The base year models will be run and the results reported on within tables which show the Ratio of Flow to Capacity (RFC) values for the Junctions 8.0 results and Degree of Saturation (DoS) values for the LinSig results. Both the RFC and DoS values will indicate how close a junction approach is to capacity (a value of 1.0), with 0.85 considered a threshold value for roundabouts, and 0.9 for signalised junctions. Queue lengths calculated by the software programs on each approach will also be reported on.

Task 5 – Calibrate models to replicate base year network conditions

In the absence of surveyed queue length and junction saturation flow data, it will be necessary to check on the current operation of the junctions within the study area. This would involve site visits to these junctions to monitor the general operation of the approaches, with snapshot surveys of

saturation flows and queue lengths undertaken. This will ensure that the base models reproduce observed conditions.

Outcome 3: Establishment of Base Year Conditions

Stage 3 – Future Year Model Development and Impact Assessment

Task 6 – Agree Local Plan development sites with Essex County Council (ECC) and Brentwood Borough Council (BBC) and development scenarios

As detailed at the beginning of the Methodology section, once the base year scenario has been established, the future year scenario will be confirmed by all interested parties. It is expected that meetings and e-mail communications will lead to the study parameters being ratified.

Task 7 – Calculate trip generation for Local Plan development sites

Using a set of assumptions agreed with ECC / BBC, the list of Local Plan sites will be broken down into those developments to be houses and flats, and also those to be private and rented. This will then allow trip rates to be extracted from the TRICS database (Trip Rate Information Computer System) for developments of a similar nature, and subsequently, trip generation values can be calculated for each development.

Task 8 – Develop zones for Local Plan development sites and use Census Journey to Work data to distribute traffic to / from zones

Each Local Plan development sites will be allocated an existing 2001 Census Journey to Work (JTW) zone based on location and similarity of land use. The distribution of trips to and from these zones will then represent that of the development site within the modelling process.

Task 9 – Calculate future year traffic growth factors & committed development traffic levels

The proposed Local Plan development sites are due to be assessed in 2030. Using the industry recommended approach of combining TEMPRO and NTM Table 3 growth factors, EH will calculate separate growth factors for the Brentwood town and Brentwood rural areas.

Additional traffic from relevant committed developments within the borough will also be included, where appropriate, based on information from BBC and ECC.

In order to avoid double counting the Local Plan proposed development and committed developments, the growth factors calculated using the TEMPRO part of the above process will be altered using the 'Alternative Assumptions' tool within TEMPRO. The lower TEMPRO growth rate can then be assessed with the manual assignment of the committed development and Local Plan development trips without double counting. Revised TEMPRO growth factors will then be combined with the previously calculated NTM factors.

Task 10 – Create future year network and carry out (manual) assignment of Local Plan development traffic

Using the 2014 base skeleton network, a future year network will be created for the assessment year of 2030. In order to account for background growth, the 2012 flows will be factored using the growth factors calculated in Task 9 and combined with any committed development traffic (utilising the Alternative Assumptions tool in TEMPRO) to create 'Do Minimum' traffic flow models in 2030.

The traffic from each Local Plan site will then be assigned to these networks based on the trip distribution proportions calculated in Task 8.

Traffic flow diagrams will be created for the following scenarios in the Brentwood area:

- 2014 AM Base
- 2014 PM Base
- 2030 AM Base
- 2030 PM Base
- 2030 AM Base + Committed Development *(Do minimum)*
- 2030 PM Base + Committed Development *(Do minimum)*
- 2030 AM Base + Committed Development + LDF Development
- 2030 PM Base + Committed Development + LDF Development

Task 11 – Calculate percentage impact of development traffic

The percentage impact of the Local Plan development traffic on each key link approaching the A12 and A127 junctions will be calculated to help inform any discussions with the Highways Agency or ECC relating to the study of these junctions.

Task 12 – Develop and run future year models for 23 junctions

The calibrated junction models developed for the 2014 base case will be used as templates to test the junctions in the 2030 future year scenario, as listed in Task 10. The new traffic flows will simply replace the base year flows.

N.B. This process will not include the assessment of the capacity of individual site accesses to the proposed Local Plan sites. It is expected that this will be the responsibility of developers to ensure that they are designed to the appropriate standard and have adequate capacity.

If any further junction assessments are required in addition to those listed in Task 1, additional funding will be necessary over and above the fee set out at the end of this proposal.

The outputs of junction modelling will be tabulated and reported on for discussion with ECC and BBC.

Outcome 3: Establishment of impact of proposed development sites on local highway network

Stage 4 – Mitigation

Task 13 – Identify mitigation measures at problem points on highway network

The junctions at which mitigation measures will be investigated will be discussed and agreed with ECC and BBC prior to work starting on this task.

In order to determine the appropriate nature of any mitigation measures that might be required, sketches of potential improvements will be produced for those junctions that are forecast to experience a significant increase in congestion and delay as a result of the additional development traffic.

The effects of these improvements will then be assessed using the standard industry software as appropriate. The aim will be to achieve a nil-detriment scenario, although this may not always be possible.

It is envisaged that mitigation measures will be required at no more than three junctions across the study area, and our fee is based on this. If measures are required at more than three junctions, additional funding will be required.

Once mitigation measures have been determined, preliminary design drawings will be produced illustrating the required changes to links and junction layouts. The changes will, where possible, be designed so that they can be accommodated within the existing highway boundary. However, where this is not possible, the drawings will also highlight areas where third party land may be required.

Task 14 – Develop Level 1 costings of mitigation measures

Following completion of the preliminary design drawings, a further meeting will be proposed with ECC and BBC to discuss the outcomes of the assessments and agree final designs. After this, we will produce Level 1 costings of the measures proposed.

We will provide a broad estimate of the potential cost of constructing the mitigation measures identified using approximate rates. This will not include statutory undertakers or land costs and should not be used as a figure on which to base detailed financial calculations or negotiations.

Outcome 4: Identification of mitigation measures and associated costs

Stage 5 – Final Report

Task 15 – Create report

A summary report will be produced describing, in detail, the methodology used during the study and incorporating any relevant annotated drawings and costings.

The report will be prepared on the basis that Essex County Council are undertaking the role of CDM Co-ordinator and are aware of their duties.

We will undertake our designer's responsibilities when preparing the initial designs. However, any design work will be initial and preliminary. The degree that we will consider CDM will be commensurate with the information we have available at this preliminary stage of the project.

Outcome 5: Draft/Final Report

Proposed Deliverables / Programme

The outputs of this project and the proposed programme for each task are set out in the table below. These are based on a start date of March 24th, 2014 for the study.

Stage		Deliverable	Delivery Date	Cost (ex VAT)
1	Data Analysis (two tranches of work due to new data collection)		April 7th and April 30th, 2014	[redacted]
2	Base Year Assessment		May 16th, 2014	
3	Future Year Model Development and Impact Assessment		June 27th, 2014	
4	Mitigation		July 18th, 2014	
5	Final Report		August 8th, 2014	
6	Meetings		On-going	
7	Additional data collection		April 17th, 2014	
Total for Study				

Appendix B Comparison between NTS, TRICS and Census 2011 trip rates

Analysis conducted by PBA in response to comments received from the Highways Agency regarding National Travel Survey (NTS) trip rates. PBA used trip rates calculated from NTS for the purpose of calculating potential trips generated by residential developments in the Brentwood BC area. This is part of a spreadsheet-based modelling exercise to produce car-driver, development trip matrices. This note refers to the spreadsheet outputs on the pages following the note.

Working through the sheets in the Excel file from left to right, the first sheets present the results of comparing trip numbers from the model (which uses NTS rates) with trip numbers gained by applying TRICS rates for mixed private/non-private housing.

NTS comparison with TRICS
Two residential areas within Brentwood were chosen for the analysis: Area 1 is in central Brentwood and has a fairly low residents-per-household ratio, while Area 2 is to the SE side of Shenfield, with a higher residents-per-household ratio, presumably due to larger household units. In a version of the spreadsheet model used for this analysis, any non-residential content was removed from these areas so that generated trips were purely due to the housing element.

Predictably, the NTS (model) trip numbers were lower than the TRICS trip numbers, but one drawback with TRICS is that the persons/household ratio is not taken into account when the rates are applied per unit. Hence we see that the Area 2 trip numbers from NTS are closer to the TRICS trips than Area 1, largely because of Area 2's higher persons/household ratio.

The next stage of the analysis was to look at the criteria used in producing the NTS trip rates; tightening up the selections by choosing only months without significant amounts of holiday days, etc. The revised rates were incorporated into the model and similar comparison output sheets were produced. These showed some increase in trip numbers compared to the numbers generated by the original NTS trip rates. The key numbers to observe when comparing TRICS with NTS trip numbers are highlighted in orange and graphs of AM outgoing vehicles and incoming PM vehicles are at the foot of each sheet.
The NTS trips still show a shortfall compared to TRICS, which is to be expected for Area 1 as explained above, but still relatively low for Area 2 too.

NTS comparison with Census 2011
For this comparison we used the Census 2011 method of travel to work data for the individual Census output areas, using total travelling to work and those driving to work. The 24-hour work-related model NTS trips were found to be below (approx. 90% of) the comparable Census 2011 numbers travelling to work (by all modes), across Brentwood as a whole, but there is variation at local level; with zone 130 (part of Area 2) giving NTS numbers higher than Census 2011.

Adjustments to Project Method
The general shortfall (90% for all modes) in NTS compared to Census across Brentwood is a result of Brentwood's economic activity being higher than average, as stated in the HA comment. Hence, the spreadsheet model was modified by applying a factor of 1.116 (=1/0.896) to all work-related NTS trip rates, which therefore uplifts the work trips to Census 2011 levels. With this modification in place, a further set of comparison sheets (NTS versus TRICS) were produced. The graphs show that the NTS trip numbers are very close to TRICS for Area 2, but still lower for Area 1 (but, as mentioned above, this is a shortfall of the TRICS method of applying rates). Peak-hour reverse-direction trips are still much lower from NTS than TRICS, but common sense maybe suggests that they should be fairly low and maybe not as high as TRICS is giving. Maybe some of the TRICS surveyed sites of residential areas are 'contaminated' by non-residential content.