Information Note

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1 Introduction

1.1 Rotherham Metropolitan Borough Council (RMBC) is in the process of preparing the Local Development Framework (LDF) in order to set out the vision, objectives, spatial strategy, and policies for the development of the Rotherham area in the next 15-20 years. The LDF includes allocation of substantial housing and employment developments in the Rotherham district. This is expected to have an impact on the road network in Rotherham, which already contains a number of junctions and key corridors that are congested at peak times.

1.2 The purpose of this study is to assess these impacts making use of the Sheffield and Rotherham transport model, and look at developing a mitigation strategy to reduce the overall impact of LDF developments.

1.3 Following this introduction, this note includes sections on:

- The Local Development Framework and Developments;
- Model Updates and Validation;
- Forecasting Methodology including Do-Minimum schemes;
- Presentation of the impacts in the Do-Minimum;
- Proposed Mitigation Schemes and Impacts;
- Summary and Conclusions.

1.4 In addition there are seven appendices to this note:

- Appendix A – Map showing the location of Do-Minimum improvements schemes and proposed mitigation measures
- Appendix B – Risk Matrix used to review and scope improvements to the transport model and define the forecasting methodology
- Appendix C – Sectored trip demand matrices
- Appendix D – Network-wide statistics
- Appendix E – Junction Performance Plots

- Appendix F – Flow Difference and Delay Difference Plots
- Appendix G – Traffic Count Locations in Rotherham 2008-2012

2 The Local Development Framework and Developments

LDF Core Strategy

2.1 The Rotherham LDF Core Strategy sets out a plan for delivering **8,283 households** and **235 Ha of employment land** across the borough **during the plan period to 2028**. Details were provided by RMBC planners and are summarised by NTEM area in Table 2.1.

Table 2.1 LDF Core Strategy Developments to 2028 by NTEM Area

NTEM Area	Households	Employment Land (sqm)				Estimated Jobs
		B1	B2	B8	Total	Total
Rotherham rural	0	7	11	4	22	1904
Rotherham	4251	57	40	17	114	12738
Thurcroft	435	2	2	2	6	505
Thorpe Hesley	164	0	0	0	0	0
Rawmarsh	744	10	18	0	28	2539
Aughton	506	2	3	0	5	504
Wath upon Dearne	178	6	9	2	17	1584
Swinton	418	0	0	0	0	0
Anston/Dinnington/Laughton Common	755	14	14	9	37	3280
Maltby	645	3	3	0	6	602
Wales	187	0	0	0	0	0
Total	**8283**	**100**	**100**	**35**	**235**	**23655**[1]

[1] It has been assumed that 48% of the new jobs at LDF development sites will replace existing jobs in Rotherham, so the net increase in jobs in Rotherham is expected to be 12,301

2.2 RMBC have assumed a housing mix of 16/84 for apartments/houses. The same housing split has been assumed at each site. This housing split is based on historical planning applications in Rotherham over the past few years.

2.3 RMBC have assumed an overall employment mix of 42/43/15 for B1/B2/B8. The employment mix differs at each site based on the information provided by RMBC planners.

2.4 Given that the precise details of any future development cannot be known at present, RMBC have assumed that 35% of each employment site will be available for development (with the remainder utilised for access roads, landscaping, car parking and so on) and that development will be of 1 storey (which is considered appropriate for the majority of B1, B2 and B8 uses). This broadly accords with local experience of developments within Rotherham. In addition to these assumptions, data extracted from the TRICS database for industrial sites (B2, B8) shows that as development size increased the ratio of site area to GFA decreases. The factor for site area to GFA of 35% was therefore reduced for larger B2 and B8 sites in line with the data in TRICS.

2.5 For B1 development RMBC assumed that each 19sqm GFA will generate 1 job, and for B2 or B8 development that each 67sqm GFA will generate 1 job. These assumptions of jobs to floor area are broadly in line with the employment densities suggested in "Planning For Employment Land: Translating Jobs Into Land, Roger Tym & Partners for Yorkshire Forward, 2010". The Roger Tym report utilises calculations based on gross internal area, but for the purposes of this study we have used net developable site area.

2.6 In summary, the following assumptions have been applied in order to estimate the number of jobs from the employment site area:

- B1 Office
  - Ha to GFA factor of 0.35
  - 1 job per 19sqm GFA
- B2 General Industrial and B8 Warehousing
  - Ha to GFA factor of 0.35 for sites less than 5 Ha
  - Ha to GFA factor of 0.25 for sites between 5 Ha and 10 Ha
  - Ha to GFA factor of 0.20 for sites more than 10 Ha
  - 1 job per 67sqm GFA

2.7 Not all of the jobs created at the LDF sites will be 'new jobs' for Rotherham or for that locality; it is recognised that new jobs created may displace existing jobs in the borough. This study acknowledges that over the plan period some sites currently used for employment purposes will be lost to other uses, and this will impact on travel patterns which should be reflected in the transport modelling. Displacement percentages from government guidelines and as used in the Regional Econometric Model suggest around 25% for most general industrial, with a higher rate for retail (70%) or hotel/catering (65%), slightly less (22%) for business services. It is impossible to estimate where these losses will occur or predict their actual extent, however the Employment Land Review factors in 113 hectares of current employment land that it is considered will likely be lost over the plan period. This figure is based on past trends and is equivalent to 48% of the total land provided for future employment development in the Core

Strategy (113ha/235ha). Therefore RMBC have assumed that 48% of the new jobs will replace existing jobs in the borough; so the **net increase in jobs during the plan period is 12,301**.

2.8 The locations of the Core LDF developments are shown in Figure 2.1 on the following page.

Other Developments

2.9 In addition to the 8,283 households included in the LDF Core Strategy, there are 6,385 households across the borough already with planning permission (including 2,500 at the Waverley New Community site), giving a **total increase of 14,668 households during the plan period to 2028**.

2.10 A new Tesco store is planned to be built in the north east corner of the town centre to the south and west of St Ann's roundabout, with a new signalised junction replacing the existing ramps between Drummond Street and Centenary Way. This development has been specifically included in the forecasts due to its location, importance, new infrastructure and significant trip generation. Details of trip generation and road layout were obtained from the Transport Assessment, provided by RMBC. For the purposes of developing future year trip forecasts, we have assumed the existing Tesco store in the town centre will be replaced by a development that generates a similar level of trips.

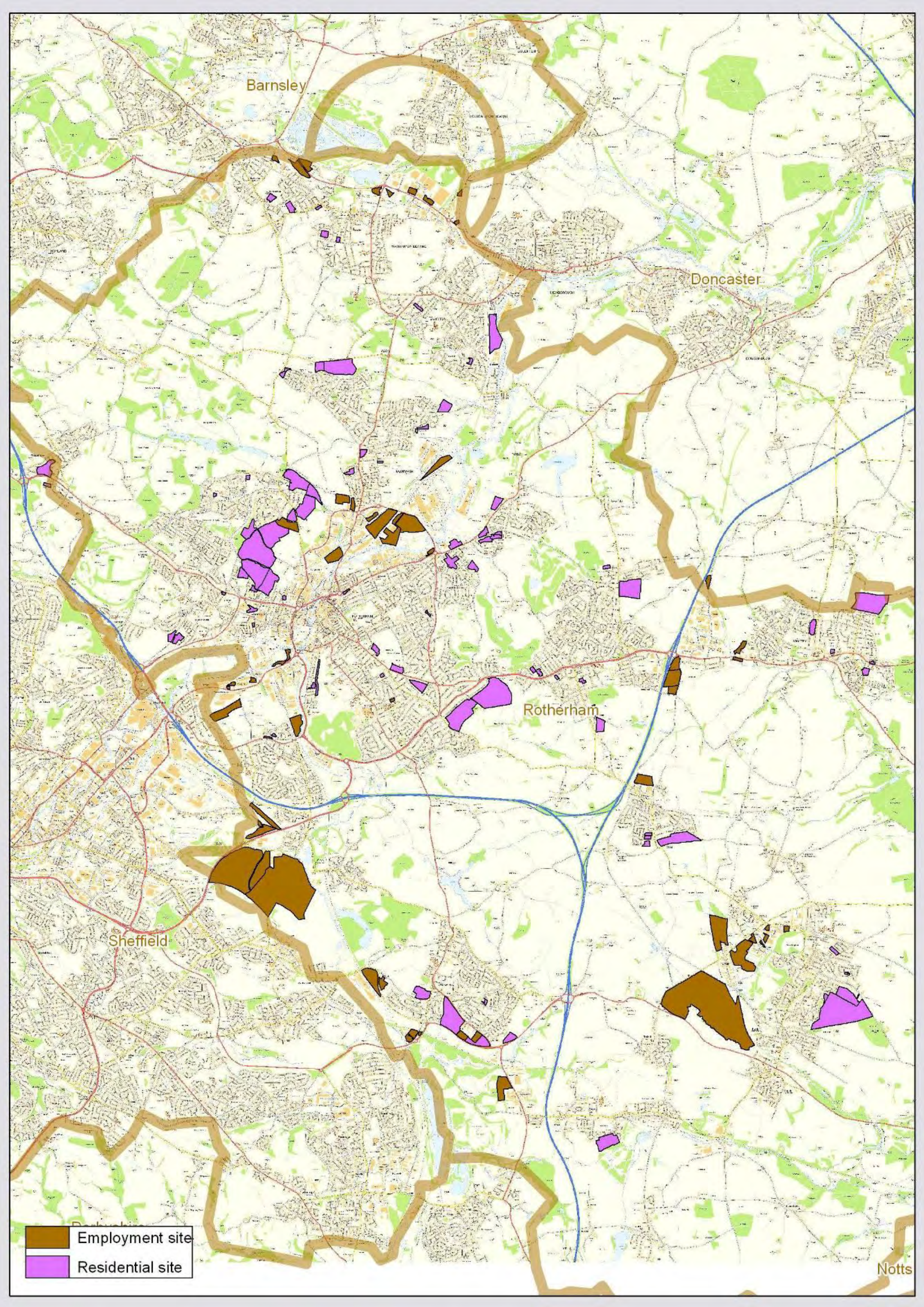

Figure 2.1 Rotherham Core LDF Development Locations

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3 Model Updates and Validation

The Model Review

3.1 The Sheffield and Rotherham Multi-Modal Transport Model (SRTM) comprises a SATURN highway assignment, PT-TRIPS public transport assignment and DIADEM demand model. It covers the transport network in Sheffield and Rotherham in full 'simulation' coding (all junction interactions modelled in detail), and the links between Sheffield and Rotherham and surrounding towns and cities in less detailed 'buffer' coding (connectivity and speed/flow relationships are modelled, but not detailed junction interactions). All trips to/from/within Sheffield and Rotherham are included in the travel demand matrices, with trips passing through Sheffield and Rotheham and on the M1 and M18 motorways also included.

3.2 Two version of the SRTM model were available: SRTM2 and SRTM3. A review of the suitability of both versions of the model to assess the impacts of Rotherham's LDF was undertaken as a first stage of this study. A risk matrix was developed to record the review and also identify potential issues with the model and suggest options to address the issues. Based on the review SRTM2 was chosen for this study. The risk matrix is provided in Appendix B.

3.3 The SRTM2 model includes morning and evening peak hours (0800-0900 and 1700-1800 respectively) and an average interpeak hour (average 1000-1600) and has a base year of 2008. It has recently undergone scrutiny and was approved by the Department for Transport (DfT) for use in appraising the Waverley Link Road major scheme in 2010/11.

Model Updates

3.4 The risk matrix (attached as Appendix B) was discussed with RMBC and used to scope the model updates and forecasting methodology. The model updates can be summarised as follows:

- Add 67 new model zones (and corresponding centroid connectors) to better represent transport access to/from the LDF developments
- Add transport schemes that have become operational between 2007 and 2011
- Update the model assignment parameters using values in the latest Transport Analysis Guidance (TAG) Unit 3.5.6 (April 2012)
- Uplift the demand matrices (highway and PT) to 2011 using growth rates from the DfT's National Trip End Model (NTEM)
- Re-validate the SATURN highway model to new counts and journey time data in Rotherham to a new base year 2011, following guidance in the DfT's new TAG Unit 3.19 (May 2012) where practical given available data and timescales

3.5 Following a review of the model zoning system and LDF development locations, 67 new zones were added to the Rotherham area in order to better represent how traffic from LDF developments accesses the network. New zones are time consuming to create, and therefore not all LDF developments have been allocated to a unique model zone. Larger developments or those located in areas of the model that have a high level of detail have been allocated their own model zone. Smaller developments have been grouped together into a single new zone and in less detailed areas of the model smaller developments have been added to existing zones.

3.6 Figure 3.1 shows the model zone system for Rotherham including the 67 additional zones added to better represent the LDF developments. The zones are coloured if they contain an LDF development with either new housing (green) or employment space (brown).

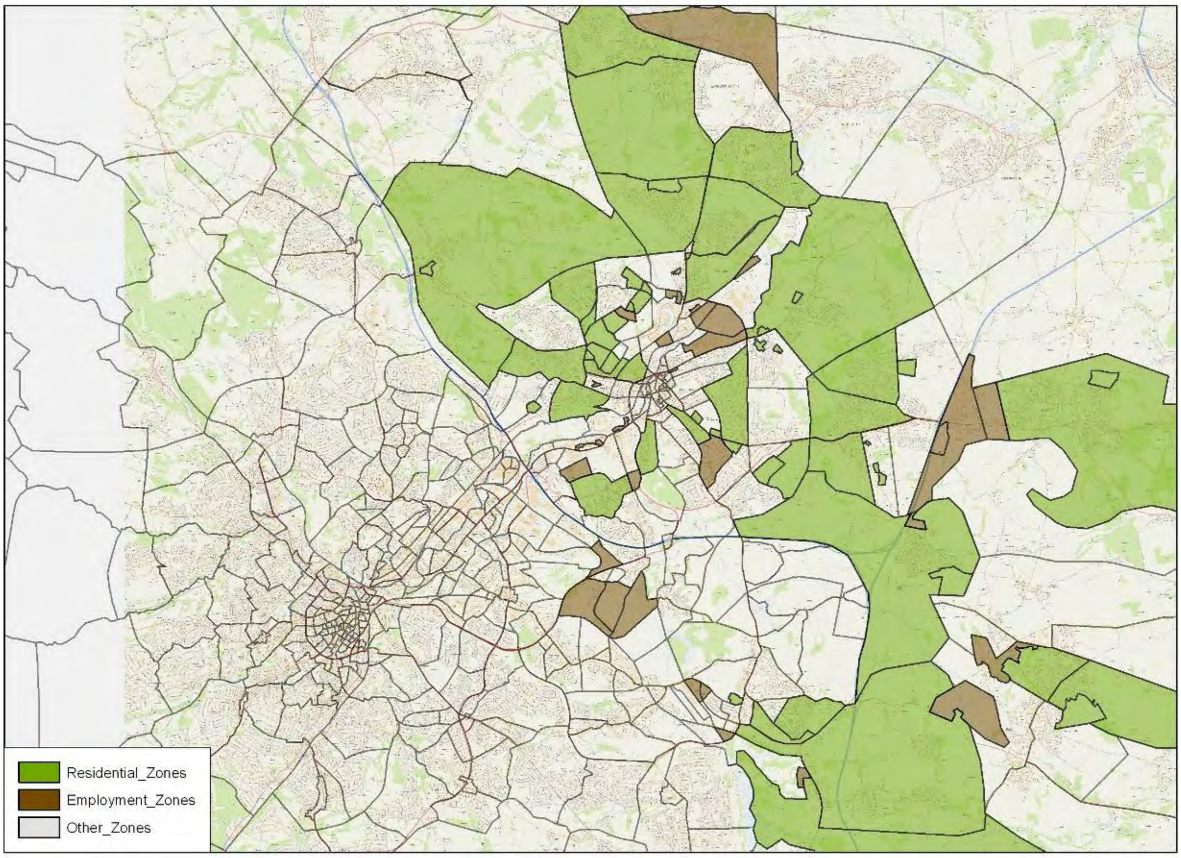

Figure 3.1: Model zones containing LDF developments

New Transport schemes

3.7 RMBC provided details of new transport schemes that have become operational between 2007 and 2011, as listed in Table 3.1. The locations of the new base year schemes are shown on the figures presented in Appendix A.

Table 3.1 New Transport Schemes 2007-2011

ID	Description
i	College roundabout traffic signals
ii	St Ann's roundabout traffic signals
iii	Centenary Way/Greasbrough Road (Trades Club) traffic signals
iv	Mushroom roundabout traffic signals
v	Whiston crossroads traffic signals - add MOVA queue detection system

ID	Description
vi	Ravenfield crossroads traffic signals
vii	B&Q signal controlled access Rotherham Road
viii	M18 Junction 1 signals

3.8 RMBC also told us about two other schemes, however these were not included because the model does not contain sufficient detail in order to represent them:

- East Bawtry Road/Leasegate Road traffic signals
- Wales Bar crossroads traffic signals

New Data Collection

3.9 Traffic count data collected between 2008 and 2012 was available at several locations in Rotherham, including Manual Classified Turn Counts (MCCs) at the major roundabouts on the town centre ring road, and Automatic Traffic Counts (ATCs) across the borough.

3.10 A programme of new count data collections (both MCCs and ATCs) was specified for this study to plug gaps in the existing data and strengthen the model in the most important areas. These counts include ATCs around the town centre to supplement the MCCs collected in the last few years, MCCs and ATCs around the Bassingthorpe Farm area, and ATCs at other locations to plug gaps in the screenlines. Appendix G contains maps of all the counts collected between 2008 and 2012. Figure 3.2 shows the MCCs and ATCs collected especially for this study.

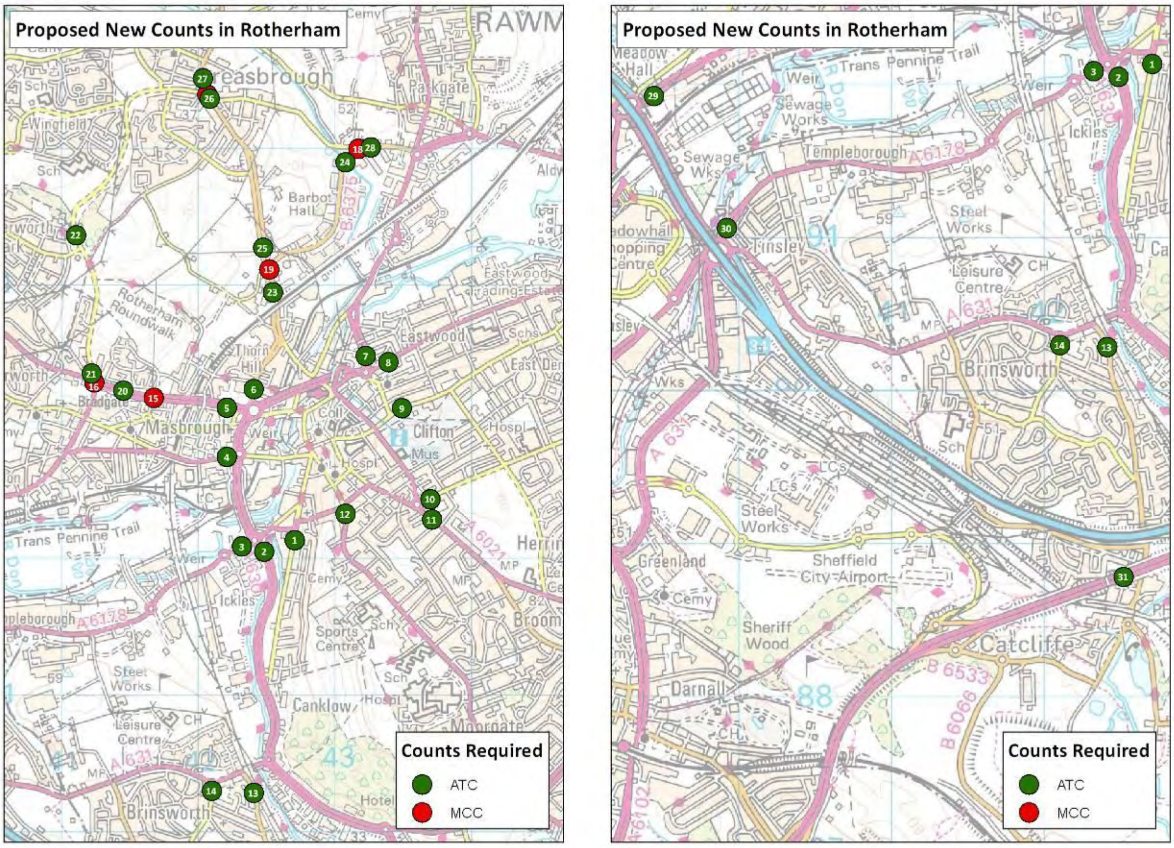

Figure 3.2: New counts collected in 2012 for this study

3.11 ATC data at several locations across Rotherham were used to factor the 2008-2012 counts to a consistent and neutral month in 2011.

3.12 Automatic Number Plate Recognition (ANPR) data were available from several cameras and used to calculate the median speed on 17 routes (eight routes in two directions plus one route in one direction) in Rotherham for weekdays during neutral weeks (ie no school holidays) in 2011. Figure 3.3 shows the location of the ANPR cameras and the 17 routes journey time routes.

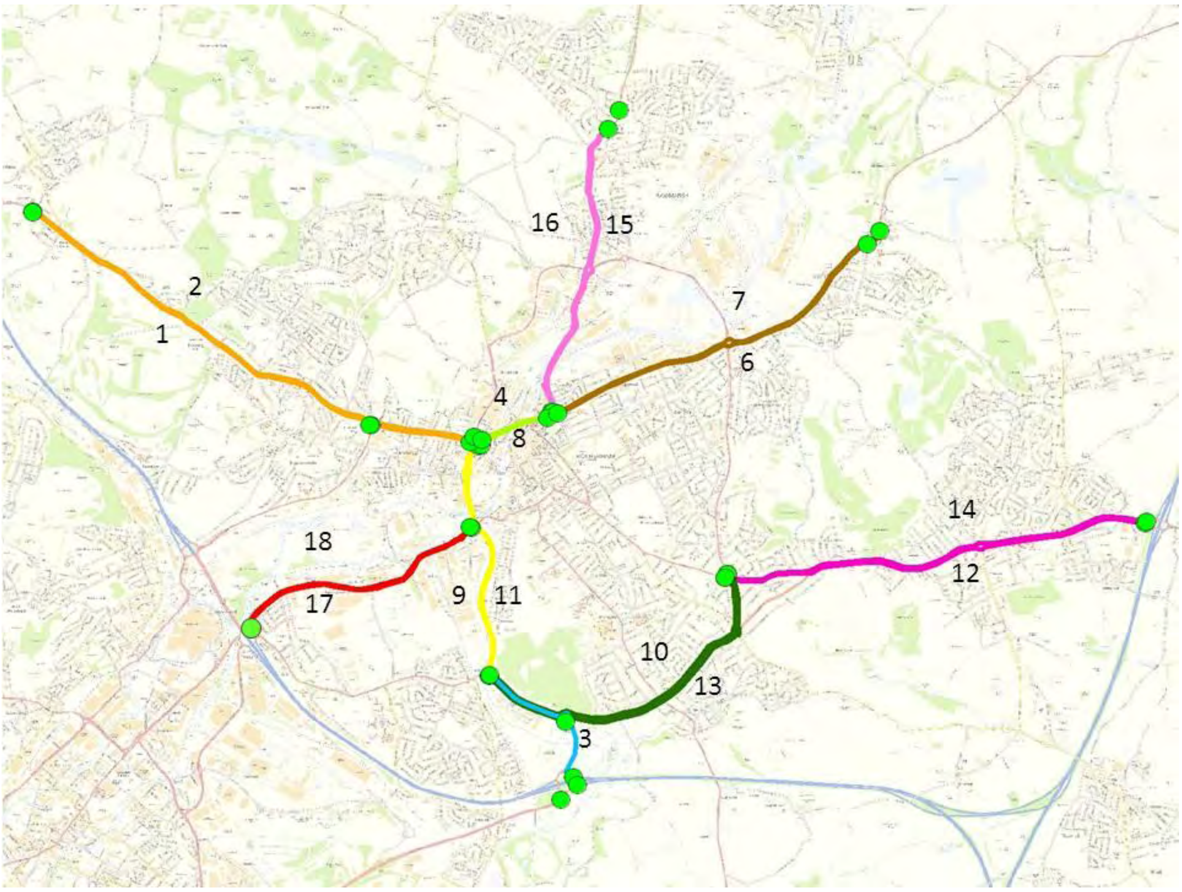

Figure 3.3: ANPR Camera Locations and Journey Time Routes

Model Validation

3.13 The revised model validation is discussed in detail in the Model Validation Update Note. The remainder of this section provides a summary.

3.14 An initial assessment of the goodness of fit between the assigned flows and observed counts demonstrated the need to adjust the model to improve the fit. The most common method for improving the goodness of fit is to make use of the matrix estimation tool in SATURN. In line with guidance in TAG Unit 3.19, counts were organised into cordons and screenlines in order to increase the confidence in the data. Three screenlines of counts in Rotherham were kept separate from those used in matrix estimation for use as an independent validation check.

3.15 The matrix estimation was carried out in three steps as follows:

- Step 1: Adjustments made to the matrices to better match the cordon or screenline totals by vehicle type for the RSI cordons and mini screenlines across the borough

- Step 2: Adjustments to the matrices to better match the individual link and turn counts (MCCs supplemented by ATCs) by vehicle type at the major roundabouts on the town centre ring road and in the Bassingthorpe Farm area
- Step 3: Final adjustments to the matrices using all counts in Rotherham at the individual link/turn level by vehicle type

3.16 TAG Unit 3.19 states that 85% of link and turn flows should meet either criteria as defined in Table 2 (extracted from TAG below).

Table 2 Link Flow and Turning Movement Validation Criteria and Acceptability Guidelines

Criteria	Description of Criteria	Acceptability Guideline
1	Individual flows within 100 veh/h of counts for flows less than 700 veh/h	> 85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 veh/h	> 85% of cases
	Individual flows within 400 veh/h of counts for flows more than 2,700 veh/h	> 85% of cases
2	GEH < 5 for individual flows	> 85% of cases

3.17 The GEH statistic is a measure of the goodness of fit between two variables, and is defined as:

$$GEH = \sqrt{\frac{(M-C)^2}{(M+C)/2}}$$

where: M = modelled flow and C = observed count

3.18 Table 3.2 shows the link and turn flow validation achieved. The model exceeds the TAG criteria of 85% of counts passing criteria 1 or 2 for all three time periods.

Table 3.2: Link and Turn Flow Validation

	Number of Counts	Percent Pass Criteria 1 (TAG)		Percent Pass Criteria 2 (GEH<5)	
		Cars	Total	Cars	Total
		Morning Peak			
RSI cordon link counts	60	95%	97%	95%	97%
Mini screenlines	42	98%	98%	98%	98%
Rotherham town centre ring road	97	99%	99%	97%	97%

	Number of Counts	Percent Pass Criteria 1 (TAG)		Percent Pass Criteria 2 (GEH<5)	
		Cars	**Total**	**Cars**	**Total**
Bassingthorpe Farm	65	100%	100%	97%	97%
All Rotherham	**318**	**95%**	**95%**	**93%**	**93%**
		Inter-peak			
RSI cordon link counts	60	98%	97%	98%	98%
Mini screenlines	42	100%	100%	100%	100%
Rotherham town centre ring road	97	100%	100%	100%	100%
Bassingthorpe Farm	65	100%	100%	100%	100%
All Rotherham	**318**	**97%**	**97%**	**96%**	**95%**
		Evening Peak			
RSI cordon link counts	60	92%	92%	92%	92%
Mini screenlines	42	100%	100%	100%	100%
Rotherham town centre ring road	97	99%	99%	97%	97%
Bassingthorpe Farm	65	97%	95%	97%	97%
All Rotherham	**318**	**94%**	**94%**	**92%**	**92%**

3.19 Table 3.3 contains a summary of the journey time validation showing the percentage of the 17 journey time routes where modelled times are within 15% of observed times. TAG recommends that 85% of model journey times are within 15% of the observed time. We have achieved this for the inter-peak (88%), but have fallen short of the recommended target for the morning (65%) and evening peaks (76%). It makes sense that the inter-peak was easier to validate than the peaks because junction delay becomes less stable as the junction nears its capacity in the peaks.

3.20 For the routes that fall outside the 15% target there is a fairly even balance of routes that are slow or fast, which gives confidence that the model is not systematically too slow or fast. In addition, most journey times are within 25% of the observed time which gives confidence that there are no major issues with the model.

3.21 We looked into the routes that do not meet the 15% target and made some improvements to the network coding to try and achieve a better validation. However we have only made corrections and improvements to the network that are realistic; within these limits and the timescales available it was not possible to improve the journey time validation further. We believe this is an acceptable compromise because the purpose of the model is to assess the traffic impacts of the LDF, which relies on accurate model flows and a sound forecasting procedure. The model is not intended to be used for economic appraisal where accurate journey times would be important.

Table 3.3: Journey Time Validation

		%Difference between model time and observed time					
No	**Description**	**AM**		**IP**		**PM**	
1	College rdbt – M1 J35	-11%	OK	-8%	OK	-3%	OK
2	M1 J35 – College rdbt	-1%	OK	2%	OK	3%	OK
3	Bawtry rdbt – M1 J33	35%	FAST	-21%	SLOW	-37%	SLOW
4	College rdbt – St Ann's rdbt	-17%	SLOW	-8%	OK	-4%	OK
8	St Ann's rdbt – College rdbt	-7%	OK	9%	OK	8%	OK
6	A630 School ln – St Ann's rdbt	-2%	OK	14%	OK	10%	OK
7	St Ann's rdbt – A630 School ln	-27%	SLOW	-13%	OK	4%	OK
11	College rdbt – Bawtry rdbt	-52%	SLOW	-6%	OK	18%	FAST
9	Bawtry rdbt – College rdbt	6%	OK	12%	OK	0%	OK
10	Bawtry rdbt – Stag rdbt	-5%	OK	7%	OK	-19%	SLOW
13	Stag rdbt – Bawtry rdbt	-24%	SLOW	-21%	SLOW	-4%	OK
12	M18 J1 – Stag rdbt	-1%	OK	13%	OK	4%	OK
14	Stag rdbt – M18 J1	-8%	OK	2%	OK	14%	OK
15	A633 Dale rd – St Ann's rdbt	-11%	OK	12%	OK	6%	OK
16	St Ann's rdbt – A633 Dale rd	-22%	SLOW	-10%	OK	7%	OK
17	Ickles rdbt – M1 J34	11%	OK	13%	OK	28%	FAST
18	M1 J34 – Ickles rdbt	10%	OK	10%	OK	14%	OK
Proportion of routes within +-15%		**65%**		**88%**		**76%**	
Proportion of routes within +-25%		**82%**		**100%**		**88%**	

4 Forecasting Methodology

Overview

4.1 The Forecasting Report describes the forecasting methodology in detail. The approach can be summarised as follows:

- Future Year Networks:
  - Added likely highway schemes based on the uncertainty log developed during 2010 for the Waverley Link Road and Bus Rapid Transit North major scheme bids, updated to reflect recent changes;
  - Added further highway schemes that RMBC are planning to deliver;
  - Removed ramps onto Centenary Way and replaced with a signalised junctions, as part of the new Tesco proposal;
  - Added likely PT schemes (BRT North, Tram-train, Supertram additional vehicles); and
  - Updated values of time, vehicle operating costs and PT fares.
- Future Year trip demand matrices were updated in two stages:
  - Stage 1 – Unconstrained growth (assumes same costs as the base year)
    - NTEM background growth 2011-2028
    - LDF development trips added (adjusted in line with NTEM growth – see below for an explanation of the method)
  - Stage 2 – Constrained to future year costs
    - Used DIADEM to adjust demand in response to changes in VOT, VOC ,fares and congestion

Future Year Networks

4.2 Details of future proposed highway schemes in Rotherham were provided by RMBC and included in the future year Do-Minimum network, as described in Table 4.1. The locations of the Do-Minimum schemes are shown on the figures presented in Appendix A.

Table 4.1 Do-Minimum Transport Schemes

ID	Description
A	The A57 Improvement Scheme will improve the existing A57 Worksop Road-Sheffield Road between M1 J31 and Todwick crossroads. The scheme will replace the existing single-carriageway route with a re-aligned dual carriageway and provide junction improvements
B	Tinsley Link, a new highway link under the M1 J34 between A6178 Sheffield Rd and

ID	Description
	Meadowhall Way, allowing local traffic to cross the motorway without impacting ion J34 South. To be delivered as part of the BRT North major scheme bid.
C	Schemes included as part of the Waverley New Community mitigation measures: ■ improvements along Highfield Spring and at the Highfield Spring / Poplar Way junction ■ re-instatement of the old Highfield Spring link between Highfield Lane and Orgreave Rd ■ Signalisation of Highfield Lane / Orgreave Lane junction ■ Signalisation of the Rotherham Road / Retford Road junction ■ Note that RMBC instructed us not to include previously planned improvements at the Catcliffe junction between Sheffield Parkway and Poplar Way
D	Temporary flow metering on the south arm approach to Rotherway roundabout to increase the gap available for traffic approaching the roundabout from the west, primarily a problem in the evening peak
G	Signals installed at the junction of Doncaster Road with Magna Lane and Oldgate Lane
H	Removal of the ramps between Dummond Street and Centenary Way to be replaced with a signalised junction as part of the new Tesco mitigation plans
I	SCOOT Urban Traffic Control is to be installed at 11 junctions around the town centre, including St Ann's rdbt, the new Tesco's junction on Centenary Way and College rdbt.

Future Year Trips: Stage 1 – Unconstrained Demand Matrices

4.3 The method to produce future year trip demand matrices can be summarised as follows:

- Calculate trip generations and mode share for the LDF developments (8,823 HH and 23,65 jobs) by applying trip rates from TRICS to housing units or employment floor area
- Adjust the LDF trip generations and mode share to match the trips generations implied by the National Trip End Model (NTEM)
- Use a gravity model to distribute the LDF trips
- Calculate the background growth in trips, which includes the addition of 6,385 households and the re-allocation of 11,354 jobs, plus the effects of increasing car ownership
- Combine the LDF development trip generations with background growth to give the correct number of trips at each LDF development whilst maintaining the overall level of growth associated with a net increase of 14,668 households and 12,301 jobs and the increase in car ownership between 2011 and 2028

4.4 Further explanation is provided in Forecasting Note.

Future Year Trips: Stage 2 – Constraining Demand Matrices to Future Year Costs

4.5 The SRTM2 DIADEM demand model was updated as part of this study in order to constrain the future year demand to future year costs, and to be able to test public transport mitigation measures in the model. However technical issues with DIADEM prevented its use within the timescales for submitting this report. Therefore the assessment of the impact of the LDF is currently based on the unconstrained future year demand.

4.6 It is proposed that a sensitivity test is carried out using constrained future year demand that has been adjusted by the DIADEM demand model, to understand the impact that future year costs may have on the analysis.

5 Presentation of Impacts

5.1 The following sections discuss the impacts of the LDF on the transport network by comparing the 2011 Base with the 2028 Do-Minimum 'with LDF' scenario. They also describe the types of schemes that could be required to mitigate the impacts of the LDF and shows how effective these schemes might be. This section describes how the impacts will be presented, focusing on four types of analysis:

- overall change in traffic patterns;
- aggregate network statistics;
- junction performance plots; and
- identification of problematic junctions.

Overall change in traffic

5.2 We present the change in the number of trips between different areas of interest, at both a 10x10 matrix level and as a desire line map. This type of analysis helps to understand the overall change in travel patterns and can help explain why problems occur on the network at certain locations.

Aggregate Network Statistics

5.3 The network statistics provide a measure of the overall network performance and help to quantify the impact of the increased traffic levels and the impact of any subsequent mitigation.

5.4 The aggregate network statistics include:

- Vehicle-kilometres (the total number of kilometres travelled within Rotherham);
- Vehicle-hours (the total time travelled within Rotherham);
- Vehicle-delay (the total time spent queuing or waiting at traffic lights within Rotherham);
- Average vehicle speed; and
- Average delay per vehicle-kilometre (the average delay per kilometre travelled).

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Junction Performance Plots

5.5 The junction performance plots use a traffic light colour scheme to identify junctions that are operating close to and over capacity. The volume to capacity ratio (V/C) for each turning movement at the junction is assessed, and the worst V/C at each junction is shown on the plot. Green indicates no problems (V/C less than 85%); amber indicates that at least one turning movement at the junction is approaching capacity and delays are starting to be incurred (V/C between 85% and 100%); and red shows that at least one turning movement is above capacity with potentially significant queues (V/C more than 100%).

5.6 The plots are presented for the 2011 Base, 2028 Do-Minimum and 2028 With Mitigation scenarios.

Identification of Problematic Junctions

5.7 The junction performance plots have been analysed and the key problem junctions and movements shown on a map, with a corresponding table showing the change in delay between the Base and Do-Minimum, and the impact any subsequent mitigation has at reducing the delay.

6 Overall change in traffic

6.1 This section presents the following:

- LDF development trip generations using the TRICS and NTEM method
- Overall growth in car trips across Rotherham and surrounding areas
- How the pattern of traffic is expected to change as a result of the location of the LDF developments

LDF Development Trip Generation

6.2 Table 6.1 and Table 6.2 show the adjustment made to the LDF trip generations in order to control to NTEM targets. NTEM gives a more realistic estimate of the development trip totals because:

- the TRICS approach assumes all developments will be 100% complete and 100% occupied, which is unlikely in reality;
- the TRICS approach double counts trips between new developments;
- there is a wide range of TRICS trip rates (for example household origin trips in the AM peak hour range from 0.09 to 0.67 over approximately 60 surveys) so it is not clear where on the scale the Rotherham developments would be; and
- the level of trip making in the model is consistent with the number of trips in NTEM.

Table 6.1 LDF Development Trip Generation – Car Trips

	TRICS	NTEM	Difference
Morning Peak Hour			
Origin trips	6882	3357	-51%
Destination trips	9300	4790	-48%
Total	16182	8147	-50%
Inter-peak Hour			
Origin trips	4011	3370	-16%
Destination trips	4284	3304	-23%
Total	8295	6674	-20%
Evening Peak Hour			
Origin trips	9515	4836	-49%
Destination trips	5434	3809	-30%
Total	14949	8644	-42%

Table 6.2 LDF Development Trip Generation – Public Transport Trips

	TRICS	NTEM	Difference
Morning Peak Hour			
Origin trips	471	522	11%
Destination trips	502	725	44%
Total	974	1247	28%
Inter-peak Hour			
Origin trips	125	553	342%
Destination trips	153	513	234%
Total	279	1066	282%
Evening Peak Hour			
Origin trips	400	545	36%
Destination trips	233	455	96%
Total	632	1000	58%

6.3 The mode shares of the LDF developments, based on the outturn matrices adjusted to NTEM growth, are shown in the charts below. The mode share is similar in each time period but there is a noticeable difference by trip purpose, with only 1% of employer's business trips travelling by public transport, increasing to 10% for commute trips and 18% for other trips. Note that walk/cycle trips have been excluded from this analysis.

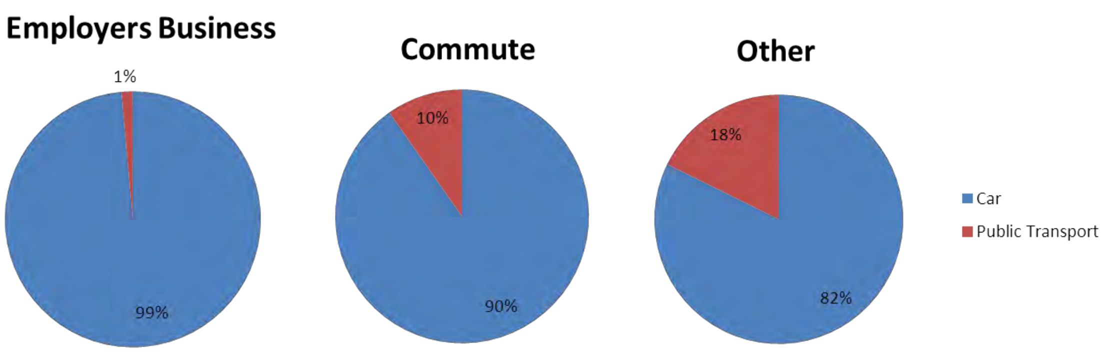

Figure 6.1: Mode Share of LDF Development Trips

Overall Growth in Car Trips

6.4 Table 6.3 to Table 6.5 show the growth in car trips for Rotherham and the surrounding areas. The growth has been broken down to show the LDF development growth and background growth.

6.5 The background growth within Rotherham includes the impact of changes in car ownership between 2011 and 2028, and the impact of gaining 3,885 households[2] and losing 11,354 jobs. The household increases and job reductions have been spread across the borough in proportion to the existing numbers of households and jobs. The net effect is a reduction of 3,399 (6.3%) and 3,196 (5.6%) car trips in the morning and evening peak, respectively.

6.6 The background growth for areas outside Rotherham reflect the growth rates from NTEM, which take account of background growth (car ownership etc) and assumptions about the increase in household and jobs within NTEM V6.2. At first glance the number of trips for areas outside Sheffield and Rotherham may look low, this is because the matrices contain all trips to/from/within Sheffield and Rotherham, and trips from other areas that pass through Sheffield and Rotherham, therefore not all trips from areas outside Sheffield and Rotherham are included in the matrices.

6.7 The different levels of growth across the NTEM areas in Rotherham reflect the allocation of LDF developments to each area. The highest increase in car trips is in the Rotherham urban area which sees a net increase of 4,389 (14%) and 4,839 (15%) car trips in the morning and evening peak hours, respectively. This is logical given that two of the largest developments are both contained within the Rotherham urban area: Bassingthorpe Farm and Waverley New Community, which comprise 1,934 (13%) and 2,500 (17%), respectively, of the total increase in households to 2028. The highest percentage increase in car trips is in Anston/Dinnington which sees a net increase of 441 (20%) and 576 (21%) car trips in the morning and evening peak hours, respectively. Again this is logical given the large amount of new employment floorspace and housing units planned near Dinnington.

6.8 LDF development growth also occurs outside Rotherham because the LDF trips are not contained entirely within Rotherham (indeed, as shown later, the majority go to Sheffield).

[2] 3,885 are the 6,385 households with planning permission less 2,500 at Waverley New Community, which have been included with the LDF developments for modelling reasons to ensure they are added to the correct model zone

Table 6.3 Growth in car trips 2011 to 2028 – Morning Peak Hour

NTEM Area	2011 Base Trips	Background Growth	LDF Development Trips	2028 Future Trips	Growth 2011 to 2028	% Growth 2011 to 2028
Rural	3,440	-257	530	3,713	273	8%
Rotherham urban	31,643	-2,109	6,499	36,032	4,389	14%
Thurcroft	375	-33	108	450	75	20%
Thorpe Hesley	903	-76	93	920	17	2%
Rawmarsh	3,478	-322	911	4,067	589	17%
Aughton	4,013	-293	650	4,369	357	9%
Wath upon Dearne	3,197	40	448	3,685	489	15%
Swinton	1,277	-24	100	1,354	76	6%
Anston/Dinnington	2,237	-238	679	2,678	441	20%
Maltby	2,525	-74	262	2,713	188	7%
Wales	1,170	-13	101	1,258	88	8%
Rotherham Total	**54,257**	**-3,399**	**10,381**	**61,240**	**6,983**	**13%**
Sheffield	124,898	12,866	4,517	142,282	17,384	14%
Barnsley	6,796	723	254	7,773	977	14%
Doncaster	5,523	676	195	6,395	871	16%
Chesterfield	7,267	571	275	8,113	846	12%
Nottingham	3,070	363	118	3,550	481	16%
Rest of GB	15,019	1,431	551	17,001	1,982	13%
Model Total	**216,830**	**13,232**	**16,292**	**246,354**	**29,524**	**14%**

Table 6.4 Growth in trips 2011 to 2028 – Average Inter-peak Hour

NTEM Area	2011 Base Trips	Background Growth	LDF Development Trips	2028 Future Trips	Growth 2011 to 2028	% Growth 2011 to 2028
Rural	2,080	-103	392	2,370	290	14%
Rotherham	24,750	-614	5,150	29,286	4,536	18%
Thurcroft	268	-16	81	333	65	24%
Thorpe Hesley	508	-19	46	535	26	5%
Rawmarsh	4,047	-242	1,109	4,913	867	21%
Aughton	2,315	-101	387	2,600	286	12%
Wath upon Dearne	1,952	40	316	2,308	356	18%
Swinton	826	21	57	904	78	9%
Anston/Dinnington	1,949	-177	659	2,430	481	25%
Maltby	1,442	13	147	1,602	160	11%
Wales	839	25	69	932	94	11%
Rotherham Total	**40,974**	**-1,173**	**8,412**	**48,213**	**7,239**	**18%**
Sheffield	102,116	11,820	3,882	117,818	15,702	15%
Barnsley	4,468	618	171	5,257	789	18%
Doncaster	3,301	488	145	3,934	633	19%
Chesterfield	4,626	563	179	5,368	742	16%
Nottingham	2,705	388	106	3,199	495	18%
Rest of GB	11,709	1,395	451	13,555	1,846	16%
Model Total	**169,900**	**14,099**	**13,347**	**197,346**	**27,446**	**16%**

Table 6.5 Growth in trips 2011 to 2028 – Evening Peak Hour

NTEM Area	2011 Base Trips	Background Growth	LDF Development Trips	2028 Future Trips	Growth 2011 to 2028	% Growth 2011 to 2028
Rural	3,478	-231	517	3,765	286	8%
Rotherham	33,319	-1,936	6,775	38,159	4,839	15%
Thurcroft	384	-34	113	462	79	21%
Thorpe Hesley	1,194	-92	117	1,219	25	2%
Rawmarsh	4,572	-367	1,160	5,365	793	17%
Aughton	3,602	-240	558	3,920	318	9%
Wath upon Dearne	2,963	57	415	3,435	472	16%
Swinton	1,074	-13	86	1,147	73	7%
Anston/Dinnington	2,940	-279	855	3,516	576	20%
Maltby	2,411	-63	255	2,603	192	8%
Wales	1,489	3	123	1,615	125	8%
Rotherham Total	**57,427**	**-3,196**	**10,973**	**65,205**	**7,778**	**14%**
Sheffield	133,183	13,445	4,827	151,455	18,272	14%
Barnsley	7,648	877	274	8,799	1,151	15%
Doncaster	5,783	706	202	6,692	909	16%
Chesterfield	7,528	637	281	8,446	917	12%
Nottingham	3,601	426	148	4,175	575	16%
Rest of GB	16,024	1,596	583	18,203	2,179	14%
Model Total	**231,194**	**14,493**	**17,288**	**262,974**	**31,781**	**14%**

Overall growth in LGVs and OGVs

6.9 Growth in Light Goods Vehicles (LGVs) and Other Goods Vehicles (OGVs) was based on forecasts from the National Transport Model (NTM), which predicts growth in LGVs of 53% and OGVs of 28% between 2011 and 2028. The rate of growth in goods vehicle trips far exceeds the growth in car trips.

Change in the Distribution of Traffic

6.10 This section shows the distribution of trips and how it changes compared to the base year. Sectored trip matrices are presented in Appendix C showing the change in all sector-to-sector trips. Figure 6.2 and Figure 6.3 show the main changes in car trip distribution for the morning and evening peak hours, respectively. They show that the biggest increase in trips is between Rotherham and Sheffield. This is logical because for any new residents in Rotherham, the biggest pool of local jobs to choose from is in Sheffield. And conversely, for new employment in Rotherham, the biggest pool of potential employees live in Sheffield. The distribution of LDF trips was determined by a gravity model, which calculates the likely distribution profile based on the relative attractiveness and the travel cost of each zone; the gravity model was calibrated to base year trip length distributions for each travel mode and trip purpose.

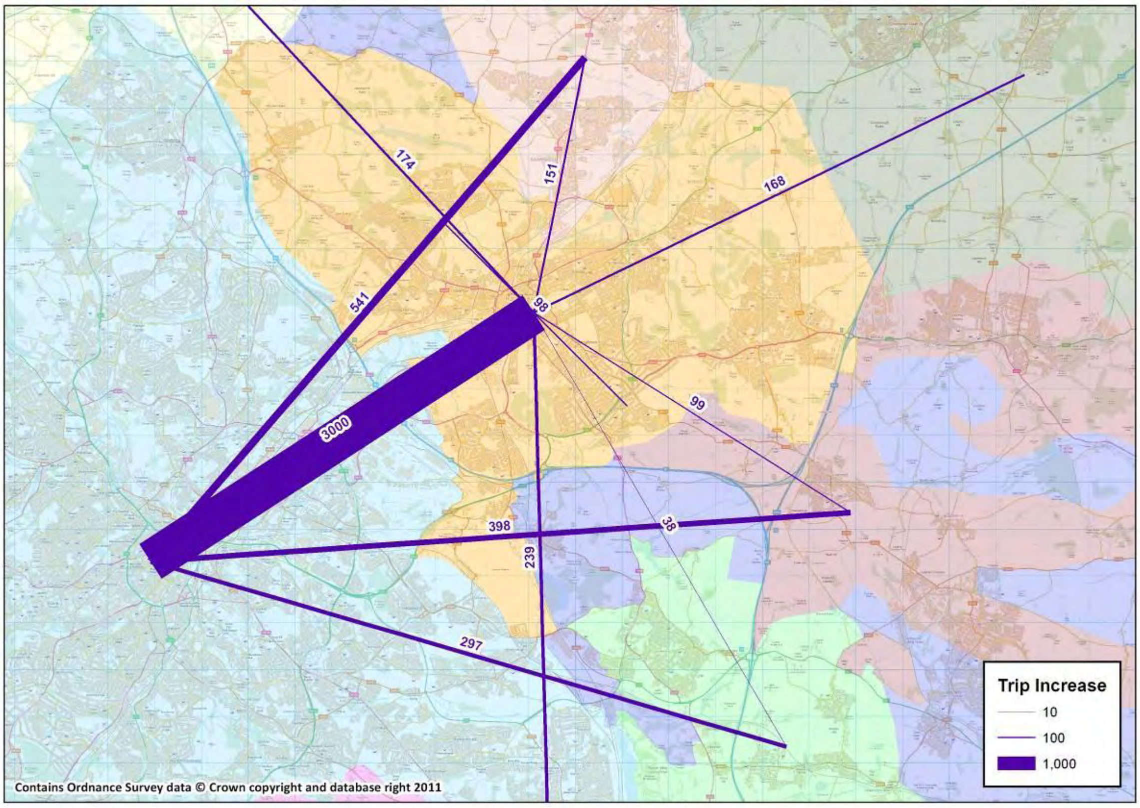

Figure 6.2: Change in trip distributions 2011-2028 – Morning Peak Hour

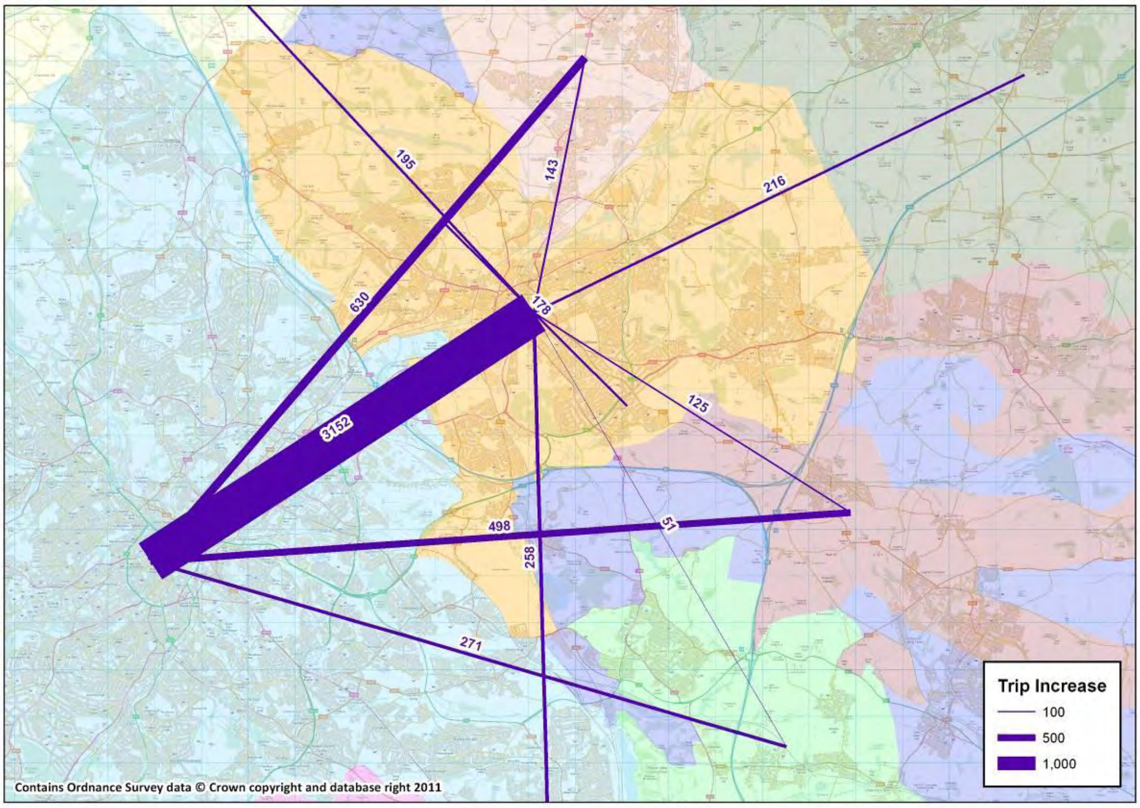

Figure 6.3: Change in trip distributions 2011-2028 – Evening Peak Hour

7 Overall Network Performance

7.1 The impact on overall network performance is presented in Table 7.1. The changes between 2011 and 2028 take account of the following:

- Background growth in traffic 2011-2028;
- Rotherham LDF development traffic;
- Do-Minimum highway schemes (defined in Table 4.1); and
- Changes in values of time and vehicle operating costs on route choice.

7.2 Note that because of the technical issues with the DIADEM demand model, the impact of values of time and vehicle operating costs on mode share and destination choice has not been taken into account, nor has the impact of the future year public transport schemes: BRT North, Tram-train and Supertram Additional Vehicles. This will be dealt with as a sensitivity test and reported in a separate addendum.

Table 7.1 Rotherham Network Statistics 2011 and 2028 Do-Minimum (excludes motorways)

	AM			IP			PM		
	2011 Base	2028 DM	%Diff	2011 Base	2028 DM	%Diff	2011 Base	2028 DM	%Diff
Car Trips	54,257	61,240	13%	40,974	48,213	18%	57,427	65,205	14%
Distance (veh-kms)	292,424	340,645	16%	230,940	282,304	22%	301,191	346,712	15%
Time (veh-hrs)	6,897	8,629	25%	5,373	6,643	24%	7,702	9,934	29%
Total Delay (veh-hrs)	987	1,760	78%	620	955	54%	1,502	2,890	92%
Delay per veh-km (secs)	12	19	53%	10	12	26%	18	30	67%
Average Speed (kph)	42	39	-7%	43	42	-1%	39	35	-11%

7.3 The figures in the table show that total vehicle-distance increases more than the increase in vehicles, this is logical as drivers are expected to take longer routes in order to avoid congestion. The average delay per vehicle-km increases by 53% in the morning peak and 67% in the evening peak, which is more than the growth in traffic because as junctions approach or exceed capacity the rate of increase in delay starts to increase. This results in the average speed reducing by 3kph (7%) in the morning peak and 4kph (11%) in the evening peak. The increase in delay in the inter-peak is less than the peaks because there is more spare capacity in the network.

7.4 Network statistics are reported separately for each area in Rotherham in Appendix D.

8 Junction Performance Plots

8.1 Junction performance plots are presented over the next few pages for the 2011 Base and 2028 Do-Minimum for each modelled time period. A full set of plots including additional zoom levels are provided in Appendix E.

8.2 The volume to capacity ratio (V/C) for each turning movement at the junction has been assessed, and the worst V/C at each junction presented on the map. Green indicates no problems (V/C less than 85%); amber indicates that at least one turning movement at the junction is approaching capacity and delays are starting to be incurred (V/C between 85% and 100%); and red shows that at least one turning movement is above capacity with potentially significant queues (V/C more than 100%).

8.3 As would be expected, there are more junctions with capacity problems in 2028 than in 2011 as a consequence of the increase in trips on the network. The capacity problems occur in logical places given the location of the LDF developments and the distribution of the LDF trips.

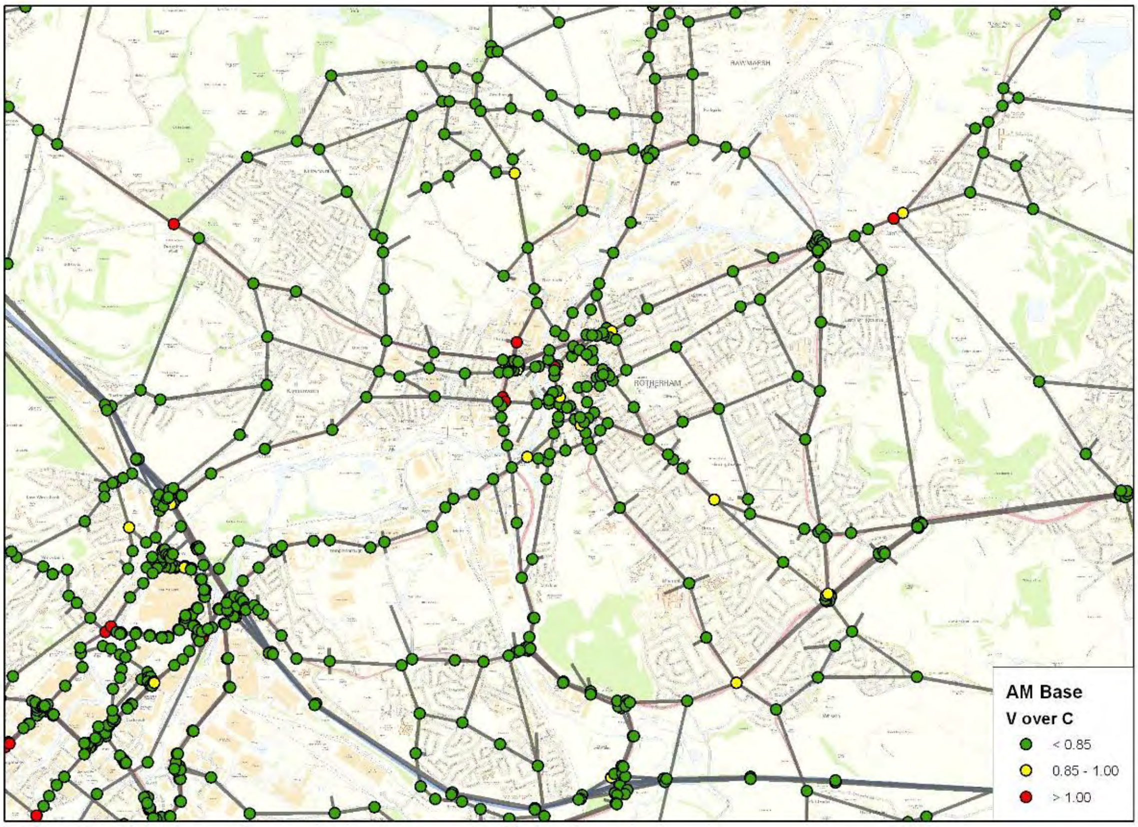

Figure 8.1: 2011 Base Morning Peak Hour Junction Performance (worst turn V/C)

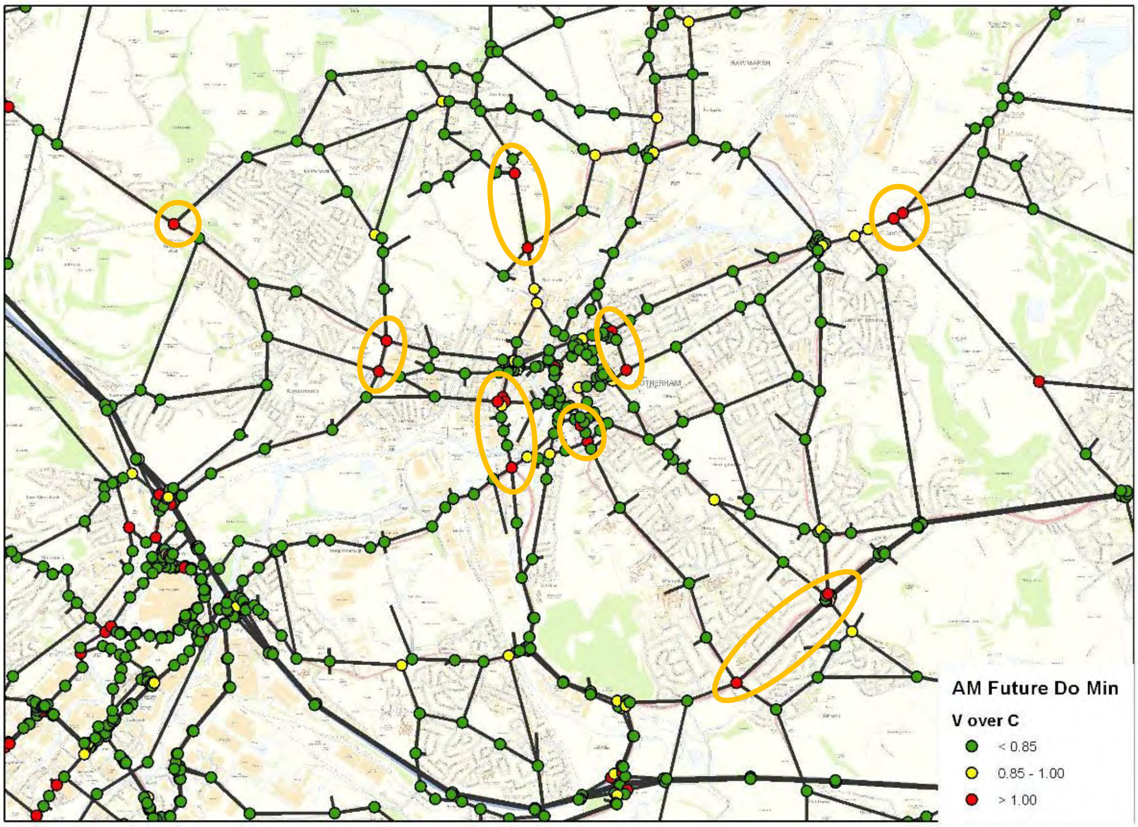

Figure 8.2: 2028 Do-Minimum Morning Peak Hour Junction Performance (worst turn V/C)

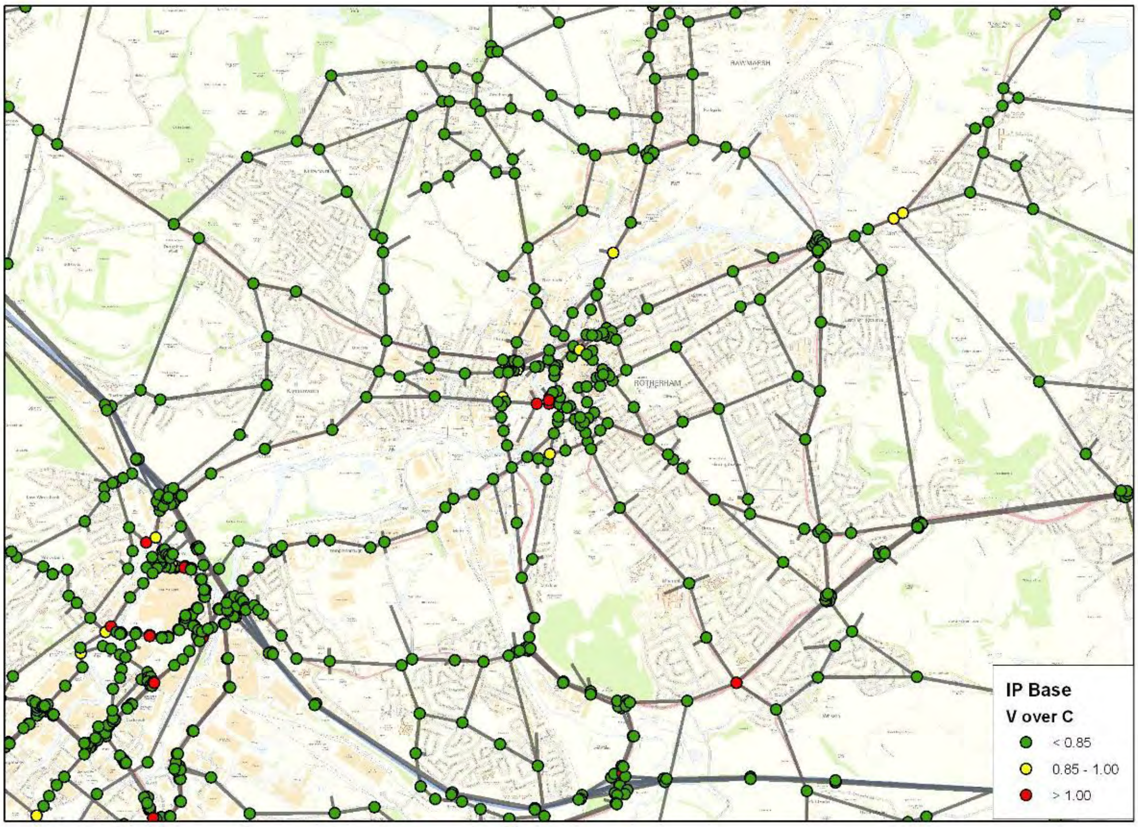

Figure 8.3: 2011 Base Inter-peak Hour Junction Performance (worst turn V/C)

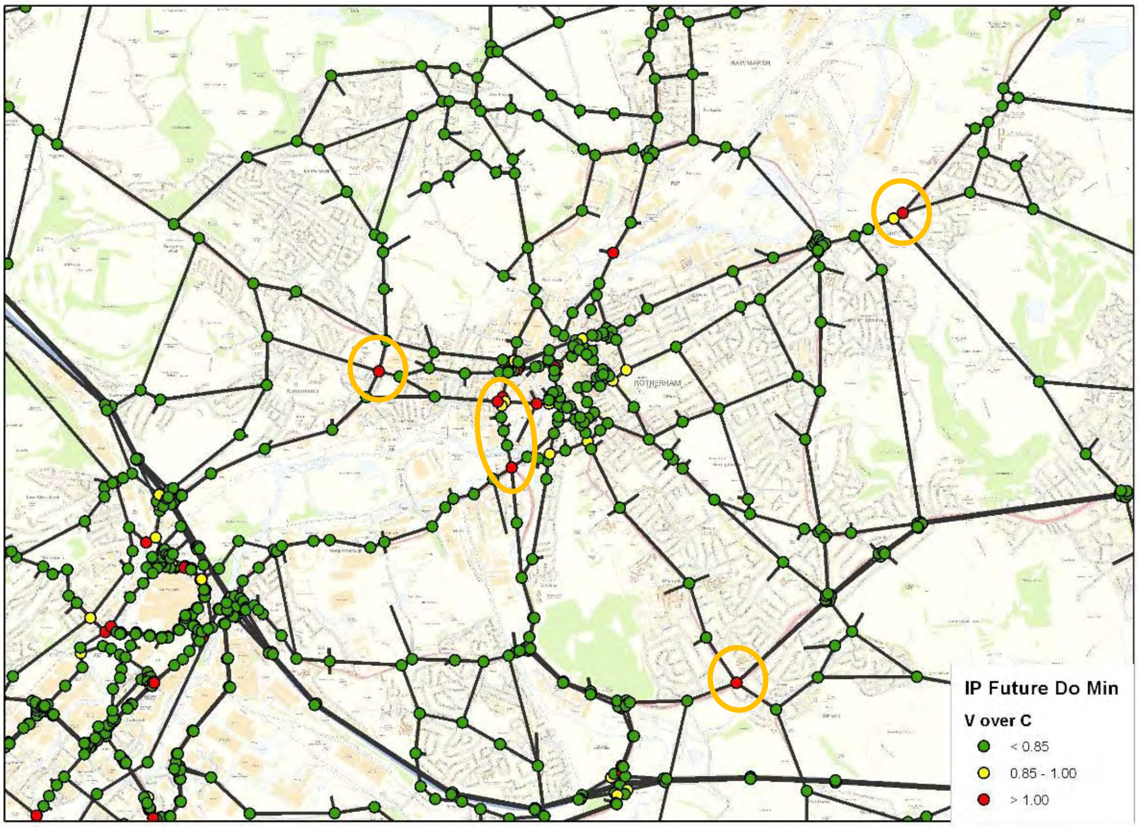

Figure 8.4: 2028 Do-Minimum Inter-peak Hour Junction Performance (worst turn V/C)

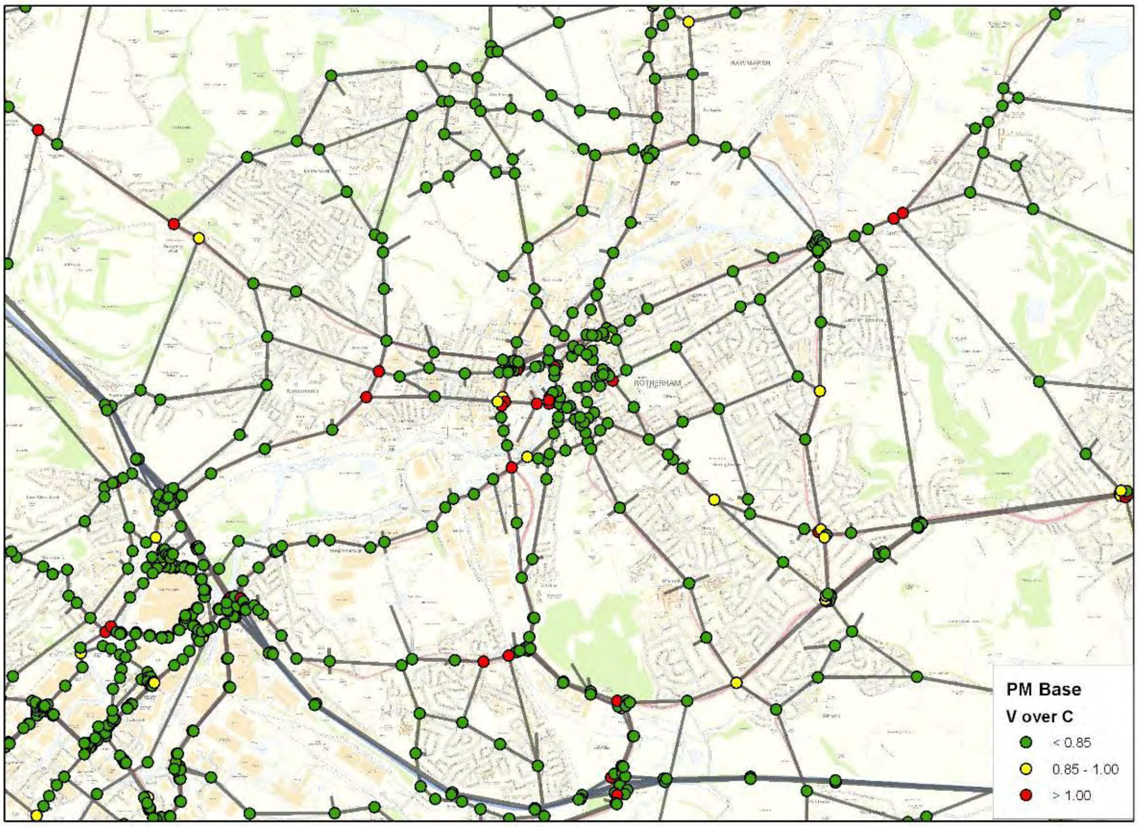

Figure 8.5: 2011 Base Evening Peak Hour Junction Performance (worst turn V/C)

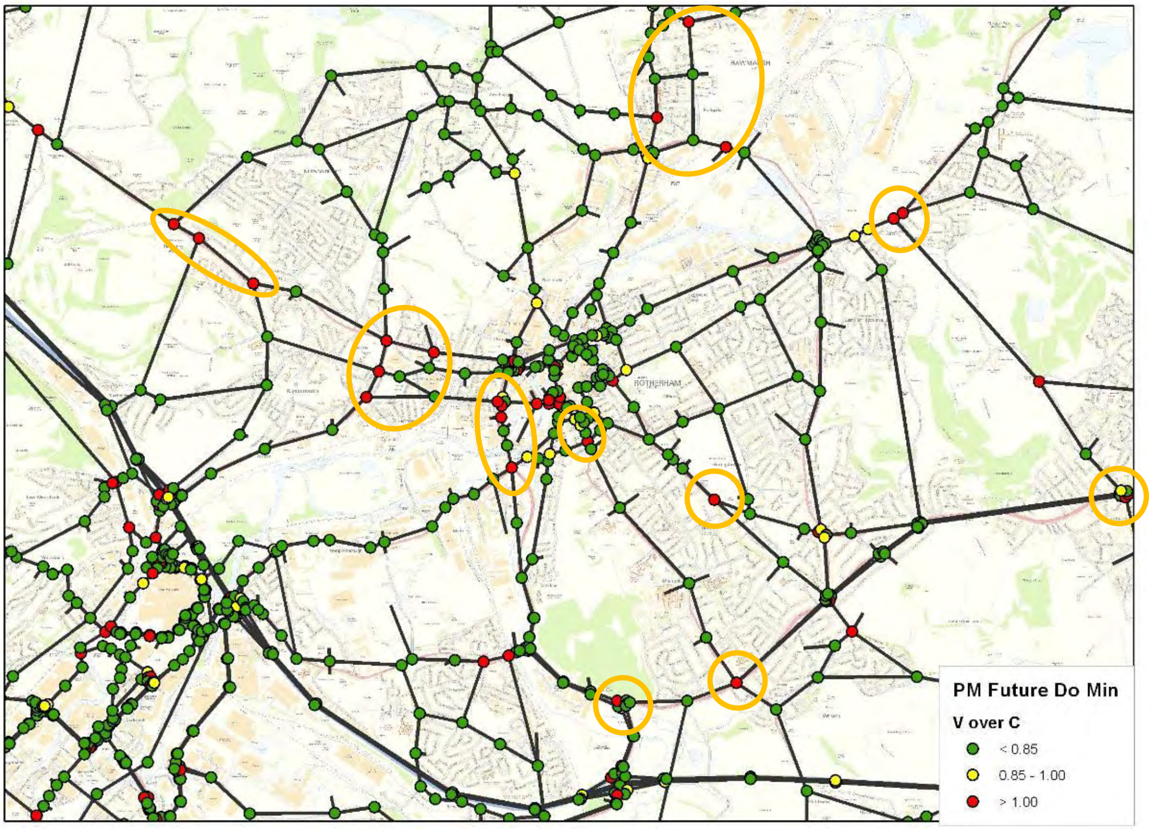

Figure 8.6: 2028 Do-Minimum Evening Peak Hour Junction Performance (worst turn V/C)

9 Identification of Problematic Junctions

9.1 We have used the junction performance plots presented above and in Appendix E, model plots showing flow difference and delay difference between the 2011 Base and 2028 Do-Minimum (presented in Appendix F), and various analysis tools available within SATURN (such as select link analysis and junction simulation tools) to identify the junctions that are likely to suffer significant delays in the 2028 Do-Minimum, and in particular the turning movements at the junction which suffer the worst delays. The locations of the problematic junctions are logical given the location of the LDF developments and the distribution of the trips generated by them.

9.2 The problematic junctions are presented in Table 9.1 and Figure 9.1 to Figure 9.2. The delay is greyed-out if less than 30 seconds, and displayed in red if more than 90 seconds.

Table 9.1: Delays at Problematic Junctions

ID	Description	2011 Base Delay (seconds)			2028 Do-Minimum Delay (seconds)		
		AM	IP	PM	AM	IP	PM
1	Right turn exit from Oaks Ln to A629 Upper Wortley Rd	50	20	38	249	68	93
2	Left turn exit from Oaks Ln to A629 Upper Wortley Rd	119	6	7	253	10	11
3	Right turn from Old Wortley Rd to A629 Upper Wortley Rd	21	17	31	71	48	211
4	All movements from South end of Fenton Rd	16	12	12	84	14	12
5	All movements from South end of Henley Rise	16	13	13	60	15	12
7	Right turn exit from Greasbrough Rd	41	41	60	155	152	170
12	Right turn exit from Scrooby Ln	23	17	19	139	33	34
16	East arm at Parkgate rdbt	7	6	5	37	10	8
17	East arm at St. Ann's rdbt	22	22	22	42	22	22
19	West arm at Pool Green rdbt	11	9	29	141	96	108
20	North arm at Pool Green rdbt	235	12	27	255	86	9
21	East arm at Pool Green rdbt	64	13	188	94	45	7
22	South arm at Pool Green rdbt	6	8	70	9	23	140
24	North arm at College Rd rdbt	16	21	22	19	23	35
24a	North East arm at College Rd rdbt	23	18	19	23	21	22
24b	East arm at College Rd rdbt	25	26	94	26	30	92
24c	South arm at College Rd rdbt	17	17	18	19	19	19

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ID	Description	2011 Base Delay (seconds)			2028 Do-Minimum Delay (seconds)		
		AM	IP	PM	AM	IP	PM
24d	West arm at College Rd rdbt	19	16	16	21	17	15
26	East arm at Ickles rdbt	35	26	70	96	74	25
27	South arm at Ickles rdbt	26	20	20	73	24	19
28	West arm at Ickles rdbt	21	20	22	25	57	40
29	Exit from Droppingwell onto A629 Upper Wortley Rd	22	14	36	43	35	273
30	East arm at Whiston crossroads	35	32	39	46	27	90
32	West arm at Whiston crossroads	44	90	50	54	61	133
33	North arm at Whiston crossroads	42	40	36	72	77	92
37	Morthen Road entry at Masons rdbt	6	7	238	6	11	268
38	A633 Warren Vale Rd west approach to rdbt with A6022	18	15	27	23	16	67
42	Thorpe Hesley access onto A629 Upper Wortley Rd	16	11	23	113	16	94
46	B6090 Wentworth Rd left turn at rdbt with A633 Warren Vale Rd	22	17	20	67	20	29
48	Left turn from Cumwell La onto A631 Bawtry Rd east of M18 J1	73	26	106	120	58	366
49	A631 West Bawtry Road west approach to Rotherway rdbt	7	5	142	14	8	116
50	A630 Rotherway north approach to Rotherhway rdbt	5	4	6	7	38	9

9.3 The problematic junctions are discussed in turn below:

- 1-5: Increased traffic on A629 Upper Wortley Road / New Wortley Road results in delays for traffic trying to join Upper Wortley Road from Oaks Lane and Old Wortley Road, and for traffic trying to join New Wortley Road from Fenton Road and Henley Rise. In addition, traffic on Fenton Road and Henley Rise has increased significantly with trips to/from Bassingthorpe Farm.
- 7: The right turn exit from Greasbrough Road onto A6123 Greasborough Road suffers from delay due to the increase in traffic on A6123.
- 12: The right turn exit from Scrooby Lane suffers increased delays in the morning peak hour due to increased traffic on Mangham Road.
- 16: Delays increase in the morning peak hour for traffic entering the Parkgate roundabout from A6123 Great Eastern Way due to increased north-south traffic through the roundabout, however the delays are relatively small

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- 17: Delays increase in the morning peak hour for traffic entering St Ann's roundabout from A630 Fitzwilliam Road, however the delays are relatively small
- 19-22: Large delays and delay increases in each time period at the Pool Green roundabout due to increased traffic through the roundabout
- 24-24d: Small delay increases at College Road roundabout due to increased traffic through the junction, large delays at the east arm (Centenary Way) in the evening peak
- 26-28: Increase in delays at Ickles roundabout due to increased north-south traffic
- 29: The exit from Droppingwell Lane is blocked by traffic queuing back on the A629 from Oaks Lane in the evening peak
- 30-33: Increased delay at the Whiston crossroads in the evening peak due to increased traffic at the junction
- 37: Large delays in the evening peak for traffic entering the Masons roundabout from B6060 Morthen Road due to increased traffic on Bawtry Road
- 38: Delays in the evening peak for traffic on the A633 Warren Vale Road northern approach to the roundabout with A6022, due to an increase in traffic to A6022 Rockingham Road
- 42: Large increases in delay in the morning and evening peaks for traffic leaving Thorpe Hesley onto the A629 Upper Wortley Road due to an increase in traffic on Upper Wortley Road
- 46: Increase in delay in the morning peak for left turning traffic from B6090 Wentworth Road at the roundabout with A633 Warren Vale Road
- 48: Large delays for the left turn from Cumwell Lane onto A631 Bawtry Rd east of M18 J1. This is particularly a problem in the evening peak for traffic exiting the new employment development
- 49-50: Large delays in the evening peak at the western approach to Rotherway roundabout, due to increased right turning traffic from Rotherway onto West Bawtry Road

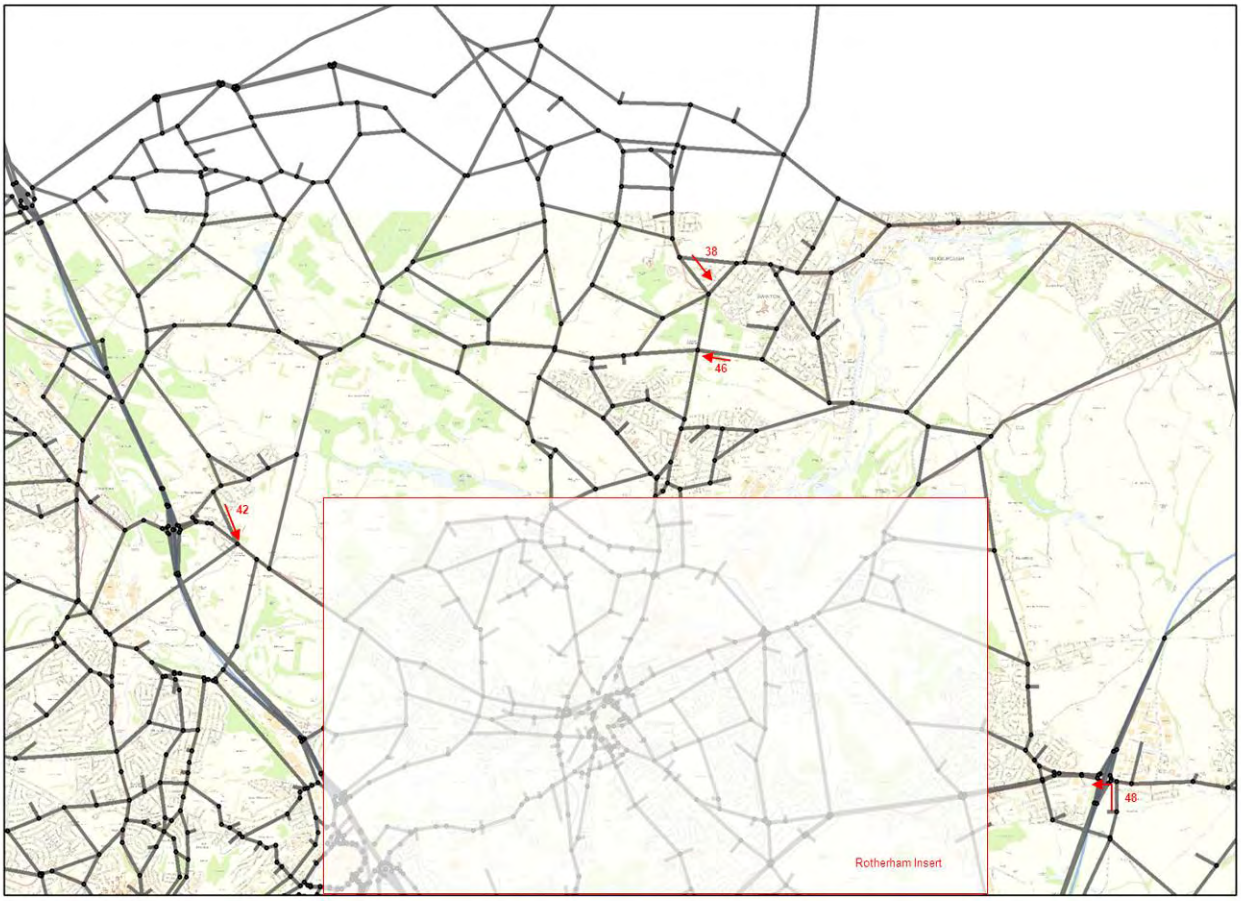

Figure 9.1: Problematic Junction Locations (1 of 3)

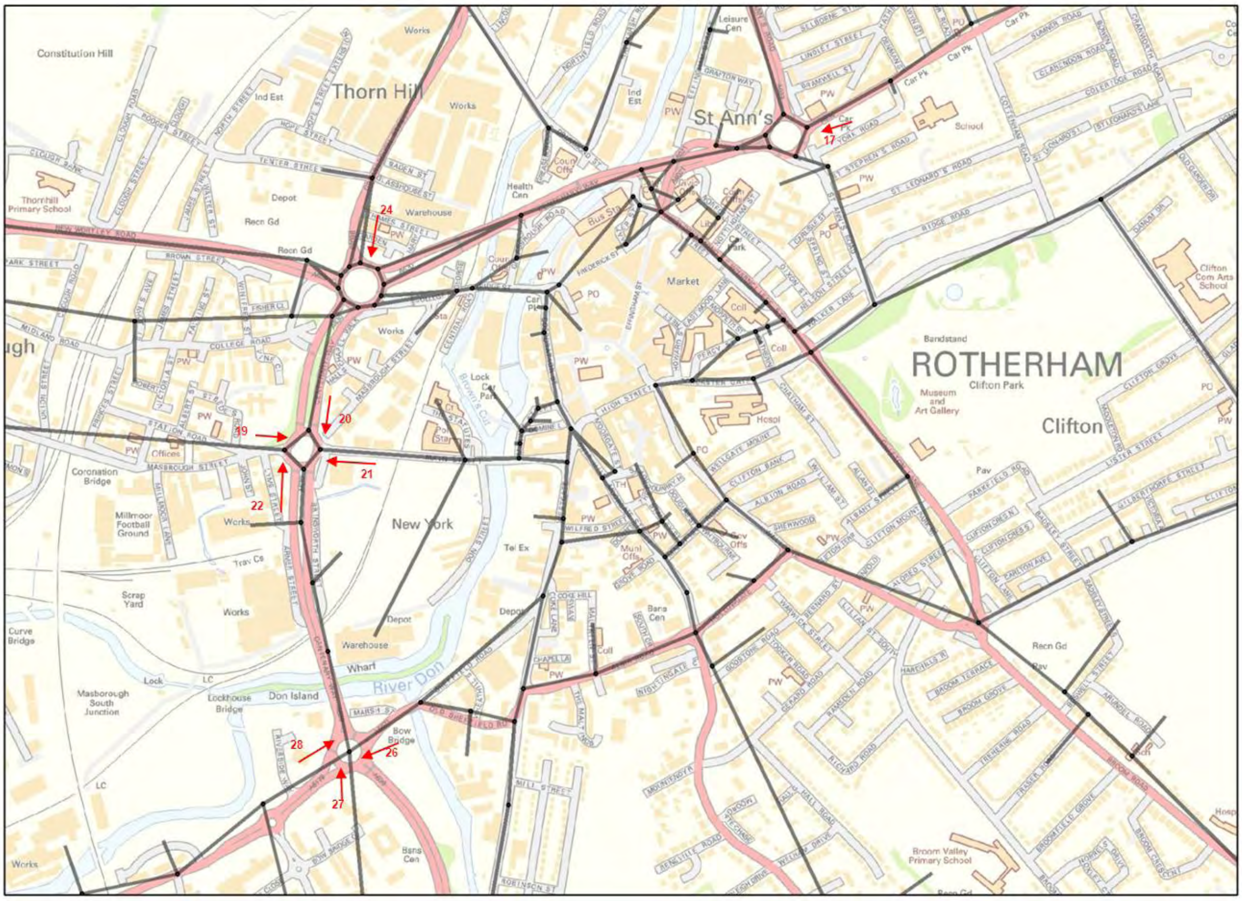

Figure 9.2: Problematic Junction Locations (3 of 3)

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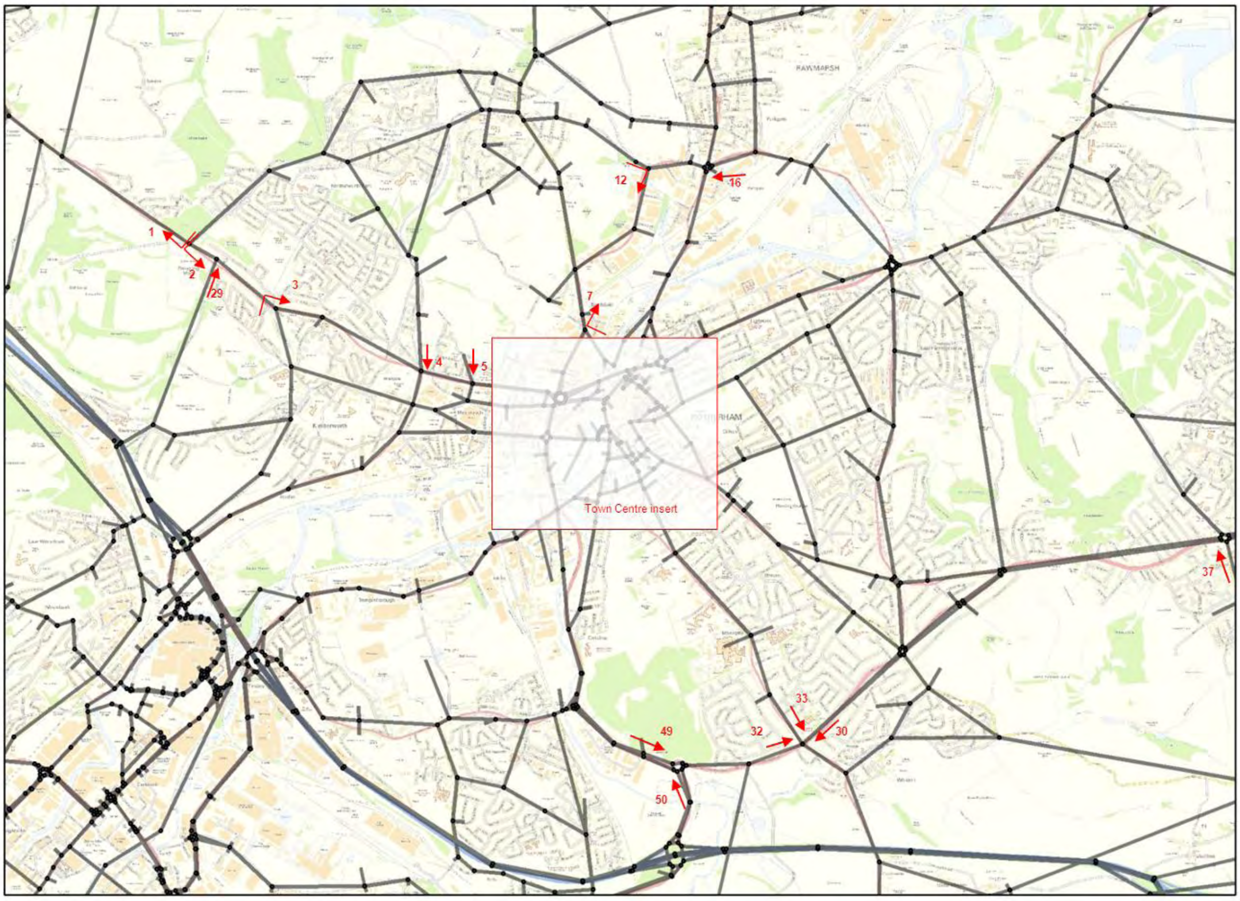

Figure 9.3: Problematic Junction Locations (2 of 3)

10 Mitigation Measures

10.1 A workshop was held with MVA and RMBC officers to analyse the results presented above and identify potential mitigation measures to address the problems. The mitigation developed for this study focusses on improving junctions on the strategic road network that have been predicted to suffer from significant delays in the 2028 Do-Minimum.

10.2 As the LDF progresses, individual developers will need to carry out their own Transport Assessments to ensure suitable access to their development and to address any localised issues, as well as considering how the development can best promote the use of sustainable travel choices. In addition, Rotherham's on-going policy of promoting sustainable travel through investment in walk and cycle routes will help to alleviate some of the delays on the highway network. The impact of these types of policies on the demand for car travel has not been taken into account in this study.

10.3 The mitigation measures identified as part of this study to alleviate the delays identified in the 2028 Do-Minimum are described in Table 10.1.

Table 10.1 Mitigation Measures to address problems in the 2028 Do-Minimum

Problem ID	Mitigation ID	Description of proposed mitigation
1, 2	101	Signalise junction of A629 Upper Wortley Road and Oaks Lane. The A629 carries a high volume of HGVs and is uphill in the westbound direction.
3	-	Not a real issue – issue is a nuance of the model related to a nearby zone connector.
4	104	Signalise junction of A629 New Wortley Road and Fenton Road.
5	-	The delays on Henley Rise are for trips related to existing houses on Henley Rise and Bassingthorpe Farm, it does not affect the more strategic traffic onA629 New Wortley Road. The relatively small delays shown by the model could likely be addressed by geometry changes or widening on this approach. Therefore no mitigation has been proposed at this location.
7	-	No mitigation proposed for the right turn exit from Greasbrough Road onto A6123 Greasborough Road, which suffers from delay due to the increase in traffic on A6123. This exit serves only local traffic from the industrial estate and the model suggests a very low demand of less than 30 vehicles per hour for the right turn, so it does not warrant any specific mitigation scheme.
12	-	Scrooby Lane is a steep, narrow, one-way minor road that we suggest does not warrant any mitigation
16, 17	-	The SRTM2 model does not replicate the base year conditions well at Parkgate and St Ann's roundabout – the model lacks the level of queues and delays observed on the ground. It is a common limitation that SATURN cannot replicate large queues because its route choice mechanism assumes that drivers know about the travel costs of all alternative routes, and so re-routes traffic away from congestion hotspots - more so than is likely to happen in reality. However, RMBC are undertaking a more detailed micro-simulation study of the Parkgate area which will be able to provide a more robust assessment of the problems and potential solutions for this corridor. Further information is available in a note prepared by RMBC.
19-22	119	Upgrade the Pool Green roundabout to a signalised crossroads.
24	-	The proposed SCOOT system should be sufficient to mitigate the small increase in delays at the College Road roundabout, and the large delays at the east arm (Centenary Way) in the evening peak.
26-28	126	Upgrade the Ickles roundabout to a signalised roundabout.
29	-	The signalisation of A629 Upper Wortley Road and Oaks Lane (problem ID 1,2) should help to mitigate the delay for traffic turning out of Droppingwell Lane.

Problem ID	Mitigation ID	Description of proposed mitigation
30-33		The MOVA queue detection system recently installed at the Whiston crossroads should be sufficient to mitigate the worst of the additional delays shown by the model.
37	137	Signalise the Masons roundabout to allow sufficient capacity at the minor arm entries
38	-	Delays at the A633 / A6022 roundabout in Swinton are unlikely to be sufficient to warrant any improvements
42	-	RMBC have previously studied junction improvements at Thorpe Hesley and found that any benefits to local Thorpe Hesley traffic are outweighed by disbenefits to the more strategic traffic on the A629 Upper Wortley Road. Therefore no mitigation is proposed, however this remains an issue for Thorpe Hesley residents to leave the village safely and without significant delays caused by an increase in traffic on the A629 Upper Wortley Road.
46	146	A new filter lane at the roundabout for left turning traffic from the B6090 Wentworth Road onto A633 Warren Vale Road
48	148	Signalise the exit from Cumwell Lane onto the A631 Bawtry Road to allow traffic exiting Cumwell Lane to join the A631. The signals should be phased with the signals at the M18 J1.
49, 50	149	Signalise the Rotherway roundabout to manage the flow of traffic

11 Impacts of the Mitigation Measures

11.1 Model runs have been carried out to test the impact of the mitigation schemes. Table 11.1 shows the impact on the overall network performance in Rotherham.

Table 11.1: Rotherham Network Statistics – Impact of Mitigation

	AM			IP			PM		
	2028 DM	2028 Mit	%Diff	2028 DM	2028 Mit	%Diff	2028 DM	2028 Mit	%Diff
Distance (veh-kms)	340,645	339,862	0%	282,304	281,416	0%	346,712	349,283	1%
Time (veh-hrs)	8,629	8,413	-3%	6,643	6,620	0%	9,934	9,434	-5%
Total Delay (veh-hrs)	1,760	1,572	-11%	955	959	0%	2,890	2,362	-18%
Delay per veh-km (secs)	19	17	-10%	12	12	1%	30	24	-19%
Average Speed (kph)	39	40	2%	42	43	0%	35	37	6%

11.2 Table 11.1 shows that the impact on overall network performance is positive, reducing overall delay per vehicle-km by 10% in the morning peak and 19% in the evening peak. In the inter-peak delays increase slightly because traffic signals introduce additional delay when the network is not congested.

11.3 In addition to testing the mitigation measures in the model, we adjusted the signal timings at a number of junctions to represent the impact of SCOOT and MOVA, as described below:

- Improvements at nearby junctions resulted in increased traffic through College Road roundabout, resulting in delays at the north arm, east arm and south arm. However we found that this can be mitigated by adjusting the signal timings at the roundabout. The use of SCOOT at College Road roundabout should therefore be sufficient to manage any changes in traffic through the junction.
- Similarly, adjusting of signal timings to represent the use of SCOOT at Pool Green and Ickles managed the delays at these junctions to an acceptable level.
- At the Whiston crossroads we optimised the signals to represent the impact of MOVA, which reduced delays to an acceptable level.

11.4 Table 11.2 presents the results of the mitigation measures on delays at the problematic junctions. The mitigation measures have successfully reduced delays at these junctions to an acceptable level.

11.5 Delays at some junctions remain, and are discussed below:

- 7: The right turn exit from Greasbrough Road onto A6123 Greasborough Road still suffers from delay due to the increase in traffic on A6123. However, as discussed in Table 10.1, this affects only a small amount of traffic and no mitigation is proposed here.
- 29: The growth in traffic on A629 Upper Wortley Road still causes delays for traffic exiting Droppingwell Lane. We recommend this is monitored, with the potential to introduce signals to allow traffic to enter the A629 – the signals would work in phase with the Oaks Lane signals to minimise the impact on through traffic on A629.
- 42: Access from Thorpe Hesley onto the A629 Upper Wortley Road remains an issue, we would recommended upgrading the junction of A629 and B6020 from a priority give-way junction to a roundabout. Initial tests in SATURN indicate that this would alleviate the delays for traffic entering the A629 from the B6020 without introducing too much delay for through traffic on the A629.

Table 11.2: Impact of Mitigation Measures on Problematic Junctions

ID	Description	2028 Do-Minimum Delay (seconds)			2028 with Mitigation Delay (seconds)		
		AM	IP	PM	AM	IP	PM
1	Right turn exit from Oaks Ln to A629 Upper Wortley Rd	249	68	93	40	24	48
2	Left turn exit from Oaks Ln to A629 Upper Wortley Rd	253	10	11	11	9	6
3	Right turn from Old Wortley Rd to A629 Upper Wortley Rd	71	48	211	57	28	58
4	All movements from South end of Fenton Rd	84	14	12	32	35	41
5	All movements from South end of Henley Rise	60	15	12	30	14	14
7	Right turn exit from Greasbrough Rd onto A6123 Greasborough Rd	155	152	170	154	167	232
12	Right turn exit from Scrooby Ln, due to increased traffic on Mangham Rd	139	33	34	75	32	46
16	East arm at Parkgate rdbt	37	10	8	28	11	9
17	East arm at St. Ann's rdbt	42	22	22	46	22	22
19	West arm at Pool Green rdbt	141	96	108	46	46	63
20	North arm at Pool Green rdbt	255	86	9	89	32	35
21	East arm at Pool Green rdbt	94	45	7	60	85	55
22	South arm at Pool Green rdbt	9	23	140	59	33	35
24	North arm at College Rd rdbt	19	23	35	18	37	20

ID	Description	2028 Do-Minimum Delay (seconds)			2028 with Mitigation Delay (seconds)		
		AM	IP	PM	AM	IP	PM
24a	East arm at College Rd rdbt	23	21	22	35	28	21
24b	South East arm at College Rd rdbt	26	30	92	26	37	25
24c	South arm at College Rd rdbt	19	19	19	19	19	17
24d	West arm at College Rd rdbt	21	17	15	20	16	17
26	East arm at Ickles rdbt	96	74	25	38	82	44
27	South arm at Ickles rdbt	73	24	19	33	36	38
28	West arm at Ickles rdbt	25	57	40	37	36	81
29	Exit from Droppingwell Rd onto A629 Upper Wortley Rd	43	35	273	50	25	129
30	East arm at Whiston crossroads	46	27	90	38	30	38
32	West arm at Whiston crossroads	54	61	133	49	32	51
33	North arm at Whiston crossroads	72	77	92	58	30	42
37	Morthen Road entry at Masons rdbt	6	11	268	14	17	23
38	A633 Warren Vale Rd west approach to rdbt with A6022	23	16	67	21	16	44
42	Thorpe Hesley access onto A629 Wortley Rd	113	16	94	100	16	102
46	B6090 Wentworth Rd left turn at rdbt with A633 Warren Vale Rd	67	20	29	0	0	0
48	Left turn from Cumwell La onto A631 Bawtry Rd east of M18 J1	120	58	366	23	10	15
49	A631 West Bawtry Road East approach to Rotherway rdbt	14	8	116	15	10	27
50	A630 Rotherway north approach to Rotherhway rdbt	7	38	9	6	11	7

11.6 Junction performance plots are provided in Appendix E for comparison between the Do-Minimum and the 'with mitigation' scenario.

12 Summary and Conclusions

12.1 Rotherham's Local Development Framework (LDF) Core Strategy includes 8,283 households in addition to the 6,385 households already with planning permission, to be built within the plan period to 2028. The Core Strategy also allocates 235 Ha of new employment land (an estimated 23,655 jobs) within the plan period, 48% of which are assumed to replace existing jobs, giving a net increase of 12,301 jobs by 2028.

12.2 The Sheffield and Rotherham Transport Model (SRTM2) was used to assess the impact of the LDF on the transport network in Rotherham. The highway model was updated to a revised base year of 2011 using recent traffic count and journey time data, and validated using the recommended criteria in the Department for Transport's Transport Analysis Guidance. From the validated 2011 base year model a future year 2028 Do-Minimum model was prepared, taking account of LDF development traffic, background growth in traffic, changes in values of time and vehicle operating costs, and planned future year transport interventions.

12.3 Trip generations for the LDF developments were calculated by applying trip rates from TRICS to housing units and floor area. The trip generations were then adjusted to be consistent with the growth in trips forecast by the National Trip End Model (NTEM), having adjusted the underlying planning assumptions in NTEM to match the LDF Core Strategy in Rotherham. Combined with background growth in traffic, this results in an increase of 6,983 (13%) and 7,778 (14%) car trips per hour to/from/within Rotherham in the morning and evening peak hours, respectively, between 2011 and 2028 Do-Minimum.

12.4 A gravity model calibrated to base year trip length distributions was used to distribute the LDF trips. It showed that the majority of the growth in traffic is likely to be on the corridors between Rotherham and Sheffield, which is logical given the quantity of housing and employment in Sheffield.

12.5 Growth in Light Goods Vehicles (LGVs) and Other Goods Vehicles (OGVs) have been assumed to rise in line with forecasts in the National Transport Model, which predicts growth of 53% and 28% between 2011 and 2028 for LGVs and OGVs, respectively.

12.6 Details of the planned transport interventions that are due to be in place by 2028 were provided by RMBC and included in the 2028 Do-Minimum transport model.

12.7 For the morning and evening peak hours the model predicts an increase in delay per vehicle kilometre of 53% and 67%, respectively, between 2011 and 2028 Do-Minimum. The percentage increase in delay is more than the growth in traffic because as junctions approach or exceed capacity the rate of increase in delay starts to increase. The increase in delay in the inter-peak (26%) is less than the peaks because there is less traffic overall and hence more spare capacity in the network.

12.8 Although delays increase overall as a result of the increase in trips, in most areas of Rotherham the network has sufficient spare capacity to accommodate the increase in trips without significant problems. However a number of problematic junctions were identified where large delays are predicted to occur if no further improvements were made to the network. The worst of these are listed below:

- Delays for traffic trying to join the A629 Upper Wortley Road from Oaks Lane and Old Wortley Road, and for traffic trying to join the A629 New Wortley Road from Fenton Road and Henley Rise, due to increased traffic on the A629;
- Large delays and delay increases at the Pool Green roundabout due to increased traffic through the roundabout;
- Increase in delays at Ickles roundabout due to increased north-south traffic on A630 Centenary Way;
- Large delays in the evening peak for traffic entering the Masons roundabout from B6060 Morthen Road due to increased traffic on A631 Bawtry Road;
- Large increases in delay in the morning and evening peaks for traffic leaving Thorpe Hesley onto the A629 Upper Wortley Road due to an increase in traffic on the A629;
- Increase in delay in the morning peak for left turning traffic from B6090 Wentworth Road at the roundabout with A633 Warren Vale Road;
- Large delays for the left turn from Cumwell Lane onto A631 Bawtry Rd east of M18 J1. This is particularly a problem in the evening peak for traffic exiting the proposed new employment development; and
- Large delays in the evening peak on A631 West Bawtry Road at the western approach to Rotherway roundabout, due to increased right turning traffic from Rotherway onto West Bawtry Road.

12.9 A workshop was held with MVA and RMBC officers to analyse the model results and identify potential mitigation measures to address the problems. The proposed mitigation measures can be summarised as:

- Signalise junction of A629 Upper Wortley Road and Oaks Lane;
- Signalise junction of A629 New Wortley Road and Fenton Road;
- Upgrade the Pool Green roundabout to a signalised crossroads;
- Upgrade the Ickles roundabout to a signalised roundabout;
- Signalise the Masons roundabout on A631 Bawtry Road to allow sufficient capacity at the minor arm entries;
- Add a new filter lane at the roundabout for left turning traffic from the B6090 Wentworth Road onto A633 Warren Vale Road;
- Signalise the exit from Cumwell Lane onto the A631 Bawtry Road to allow traffic exiting Cumwell Lane to join the A631. The signals should be phased with the signals at the M18 J1; and
- Signalise the Rotherway roundabout to manage the flow of traffic.

12.10 The mitigation measures were tested in the model and shown to successfully reduce delays at the problematic junctions to an acceptable level, reducing overall delay per vehicle-kilometre by 10% and 19% in morning and evening peak hours, respectively.