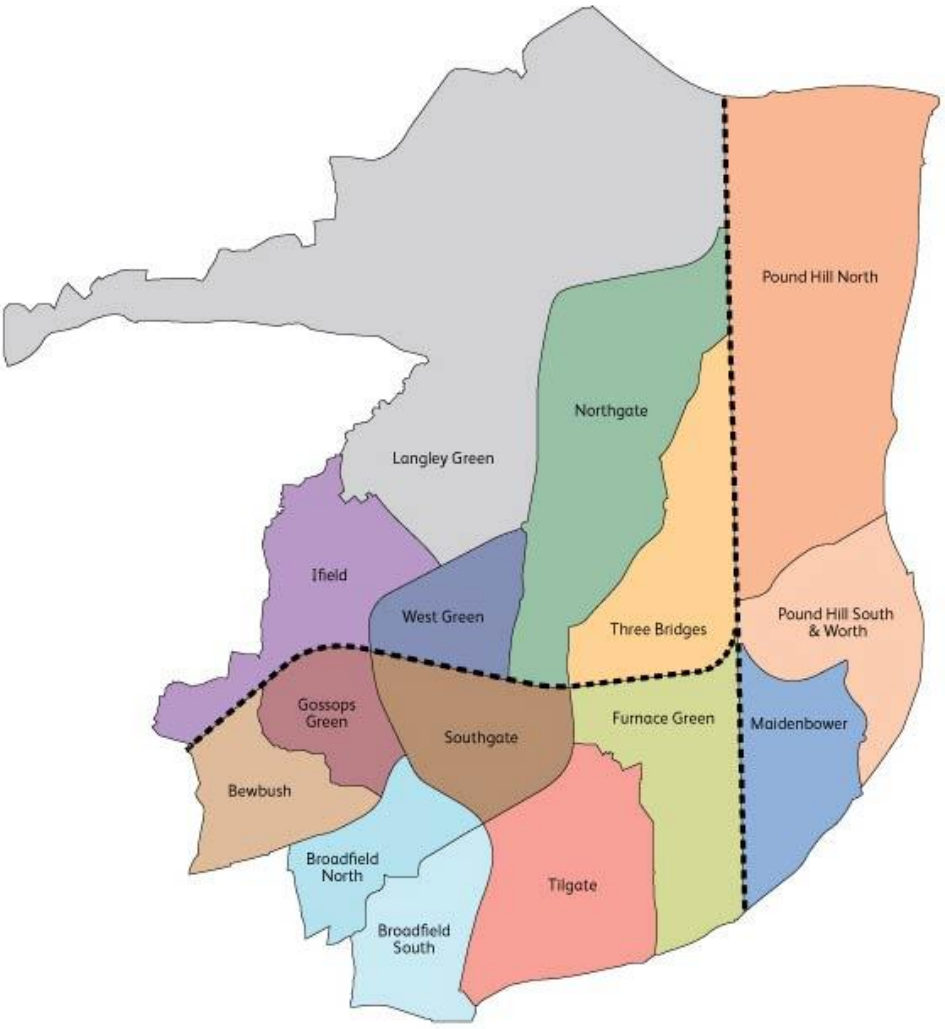
Crawley Borough Council Local Plan Transport Strategy

LPTS Stage 2 Report
Document reference: CBCLPTS02
Revision: 03
Issued: August 2014



Document Control Sheet

Project Name:	Crawley Borough Council Local Plan Transport Strategy
Project Number:	CO03022434
Document / Report Title:	LPTS Stage 2 Report
Document / Report Number:	CBCLPTS02

Issue Status/Amendment	Prepared	Reviewed	Approved
Issue 1	Name: Tim Lynn Signature: Date: 17.01.14	Name: Wayne Garside Signature: Date: 20.01.14	Name: Neil Anderson Signature: Date: 21.01.14
(Enter Details of Amendment) Issue 2 revisions to include WSCC / CBC changes	Name: Tim Lynn Signature: Date: 17.06.14	Name: Wayne Garside Signature: Date: 18.06.14	Name: Neil Anderson Signature: Date: 18.06.14
(Enter Details of Amendment) Issue 3 revisions to include final WSCC / CBC changes	Name: Tim Lynn Signature: Date: 05.08.14	Name: Wayne Garside Signature: Date: 06.08.14	Name: Neil Anderson Signature: Date: 06.08.14
(Enter Details of Amendment)	Name: (print) Signature: Date:	Name: (print) Signature: Date:	Name: (print) Signature: Date:

Executive Summary

A transport modelling appraisal has been undertaken to assess the impact of Crawley Borough Council's proposed Local Plan land-use allocation, on the transport network at AM peak 2029, following a two-stage process. The objective of stage-2 has been to determine if the proposed allocation of land-use developments around Crawley could be accommodated without unacceptable stress on the transport network. Where stresses have been identified, stage 2 has examined if certain remedial interventions could be introduced to mitigate the impacts. Three scenarios have been represented, a reference case, a preferred strategy and an alternative strategy. These include background growth of trips outside Crawley, together with site-specific trips arising from Crawley land-use developments.

As a result of future growth, the modelled scenarios show a greater increase in all-mode trips within, to, or from Crawley, than in the wider West Sussex County. Proportionate growth for public transport trips would be much greater than for highway trips. Mode split between highway and PT, in the Crawley local area, would increase from base year in all future scenarios, but would not vary between the reference case, preferred and alternative strategy scenarios.

Outcomes from stage 2 have indicated that there are a number of locations, inside and outside Crawley, where excessive stress would arise. 'Excessive' stress is judged to entail a ratio of flow to capacity greater than 100%, on the most congested arm of a road junction. At certain strategic network locations around Crawley, Horsham and across the wider County, the excessive stress would arise in all scenarios. Here, the stress would not be significantly worse with the Local Plan strategies, than with the reference case, so no remedial interventions have been suggested. Mitigation would be the responsibility of WSCC.

There is one location where excessive stress would occur in the preferred strategy, but not in the reference case, namely A2011 Crawley Avenue / A2004 Northgate Avenue / Hazelwick Avenue junction and, similarly, one location in the alternative strategy, namely M23 Junction 9 Gatwick Airport. These junctions would need remedial intervention. The remaining junctions that merit mitigation in the preferred or alternative strategies, because their ratio of flow to capacity is significantly greater than in the reference case and above 90%, but still below 100%, would comprise: A23 Crawley Avenue / Ifield Avenue (in the preferred strategy only); and A23 London Road / Manor Royal; and A2011 Crawley Avenue / B2036 Balcombe Road; (each in both the preferred and alternative strategies).

Outline remedial interventions have been tested, using the Crawley hybrid and detailed junction models, to mitigate the adverse stress caused by Local Plan development in the above scenarios and locations. The schemes have been tested and shown to perform satisfactorily. The Local Plan strategies would not cause significant change in annual average daily traffic flows in the vicinity of Ashdown Forest Special Area of Conservation. Any predicted rise in flow volumes would be much less than the threshold for significant impact, set by habitats regulations.

In conclusion, the stage-2 study has indicated that the Crawley Local Plan preferred and alternative strategies could be successfully delivered at AM peak 2029, within National Planning Policy Framework transport impact acceptability guidelines, provided that recommended remedial interventions are introduced to mitigate localised highway congestion, under these development scenarios. Initial intervention would also be advantageous from the County highway authority to mitigate stress in the reference case, at around 30 junctions across Crawley, Horsham and wider County, where congestion is predicted as a knock-on into the development scenarios.

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1. Introduction

1.1. Overview and Objectives

1.1.1. Stage 1 of the Crawley Borough Council Local Plan Transport Strategy (CBCLPTS) was drafted in 2012. Its purpose was to assess the impact on the transport network of three, broad, land use development options in Crawley Borough, compared with a baseline situation. The West Sussex County Transport Model was used to assess the transport assessments at a coarse, strategic level, at 2029 AM peak.

1.1.2. Stage 2 is a refinement of the study. It assesses preferred and alternative strategic development outcomes, for Crawley, at a more detailed level along with outline designs of necessary interventions to accommodate the development. Ultimately, the focus of this report is to show:

- If the preferred or alternative strategies can be delivered without adverse or unacceptable effects at 2029; and
- How their transport impacts can be successfully resolved, to be no worse than in an equivalent reference case at 2029.

1.1.3. Amey was commissioned by Crawley Borough Council (CBC) to undertake the stage 2 study, using a derivative of the West Sussex County and Crawley Town Centre SATURN highway and CUBE public transport (PT) multi-modal transport models.

1.1.4. Future scenarios have been tested in stage 2, for the weekday AM peak at 2029, to coincide with the Local Plan timeframe from 2015 to 2030. The future scenarios comprise:

- A 'Reference Case', with committed developments and transport schemes, only;
- A 'Preferred Strategy' with committed developments, preferred key housing sites, preferred town centre and edge of town centre sites, preferred H1 sites and preferred employment sites; and
- An 'Alternative Strategy', as the preferred strategy, but with the addition of potential site allocations / consultation sites and potential strategic employment sites.

1.1.5. Details of the assumed future year network scenarios are discussed in section 3, whilst components of the future year travel demand scenarios are summarised in section 4 and Appendix A.

1.1.6. Crawley Borough Council's preferred strategy sites are those which could be delivered mainly during the first ten years of the Local Plan. Public consultation on these sites was carried out towards the end of 2012. In total, these preferred sites would deliver some 1,150 dwellings over and above reference case committed housing of 2,625 dwellings, in Crawley Borough by 2029 in the preferred strategy. This would give around 3,775 dwellings in the preferred strategy, including reference case commitments.

1.1.7. The alternative strategy entails additional sites, which could be developed in due course, but which have some barriers to easy delivery in the short term. Public consultation on these sites was carried out in summer 2013. These additional sites could eventually provide in the order of 440 dwellings, in Crawley Borough by 2029, over and above the preferred strategy and reference case sites, amounting to an overall total of about 4,215 dwellings in the alternative strategy, including preferred strategy and reference case housing.

1.2. Study Approach

1.2.1. The approach to the study has been to predict the state of transport 'supply', i.e. the available transport network and facilities, and the state of transport 'demand', i.e. the pattern of trips wishing to travel between geographic origins and destinations, under different future year scenarios and to then assess the resulting performance of the transport system under these 'supply' and 'demand' conditions.

1.2.2. This supply and demand assessment has been carried out using a computer model to predict network flows and operating conditions, on both the highway and public transport systems. The ultimate aim has been to advise how the supply and demand conditions should be influenced, controlled, or changed, to allow the system to perform satisfactorily.

1.3. Scope of Report

1.3.1. In scope, the stage 2 report comprises the following:

- Chapter 2 outlines the content of the multi-modal model;
- Chapter 3 discusses the future year transport supply networks;
- Chapter 4 describes the forecast demand scenarios at 2029;
- Chapter 5 summarises the modelling results and output analysis;
- Chapter 6 draws conclusions from the findings.

2. Outline of Stage-2 Model

2.1. Overview

2.1.1. This section provides a description of the structure and content of the transport model that has been used to appraise the CBC Local Plan Transport Strategy.

2.2. Base Year Model

2.2.1. The West Sussex County Transport Model (WSCTM), rather than the Crawley Town Centre Model (CTCM), was chosen as the tool for stage-1 of the study, because it indicated how strategic development options in Crawley would impact upon the wider area county transport network and because the coarseness of the WSCTM fitted with the coarse specification of the stage-1 development options.

2.2.2. It was then intended to use the Crawley Town Centre Model (CTCM) for stage-2 of the study, when it would be more important to test and understand localised outcomes within Crawley. However, the CTCM structure was unusually complex and difficult to interpret. Amey's modelling team could not obtain advice as to how the model operated.

2.2.3. It was judged futile to try to understand and operate the full CTCM. Instead, it was decided to update the WSCTM to include the detailed network and zoning for Crawley Town Centre from the CTCM, whilst retaining the wider area trip patterns and functionality of the WSCTM, outside Crawley.

2.2.4. Accordingly, Amey assembled a 'hybrid' 2008 Base Year SATURN model, combining the core of the existing (2006) CTCM with the periphery of the (2008) WSCTM, to assess the optimum Local Plan land use strategy and transport interventions for Crawley Borough. The resulting hybrid model has been checked for base year accuracy and validity at 2008.

2.3. Network Update

2.3.1. The hybrid model network has been developed to provide the necessary detail to gauge the localised impacts of Local Plan development in Crawley. This entailed updating the existing WSCTM network for Crawley Town. The network update was achieved by transplanting the network detail included within the CTCM into the WSCTM.

2.3.2. Figure 1 illustrates the hybrid extended network and the component parts taken from the CTCM and WSCTM networks.

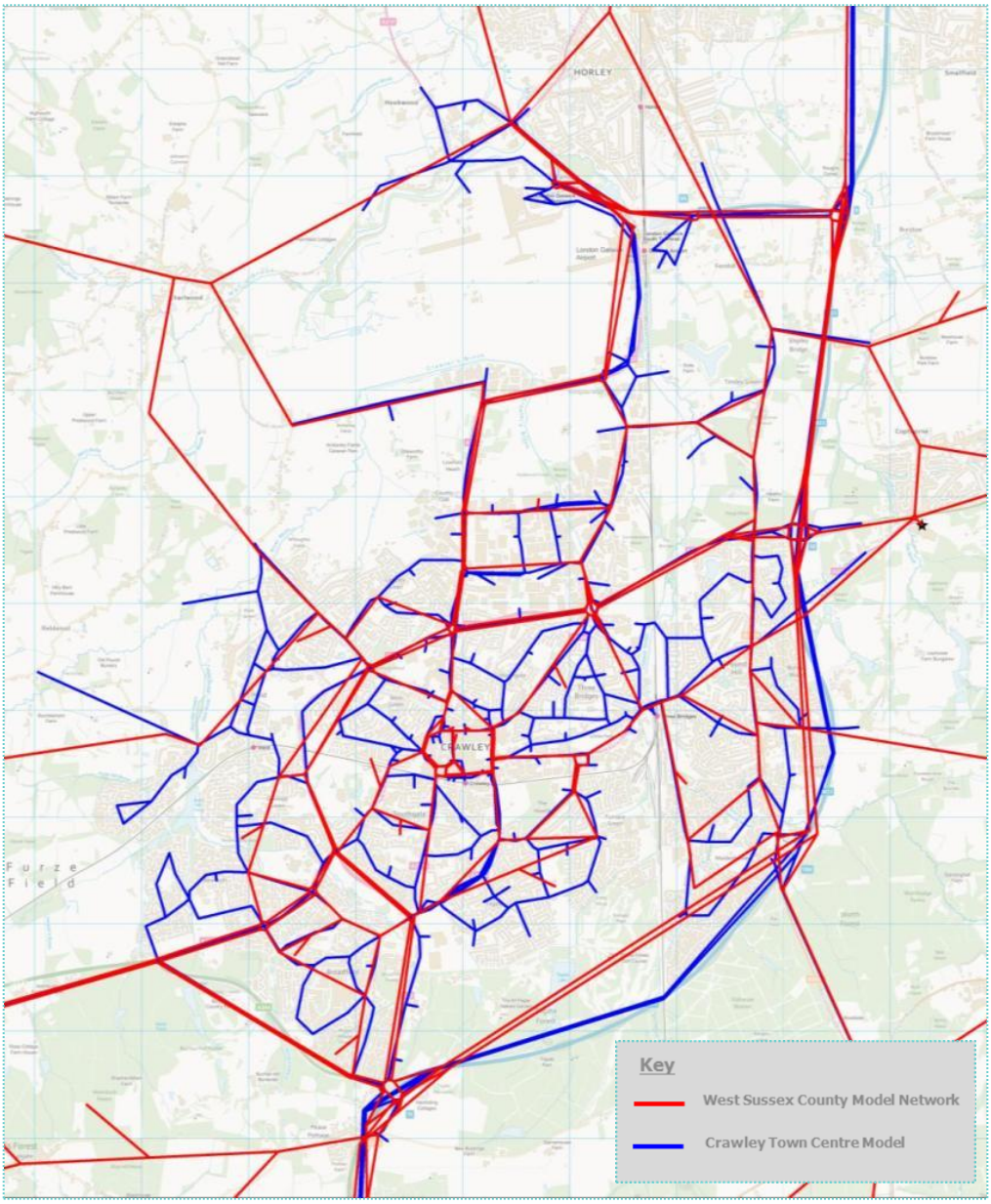

Figure 1: Updated Model Network

2.4. Zoning Update

2.4.1. The zoning update was undertaken in the same way as the network update, by substituting the coarse Crawley zones in the WSCTM with the core zone detail from the CTCM.

2.4.2. Figure 2 shows the hybrid extended zone system and the constituent parts taken from the CTCM and WSCTM networks.

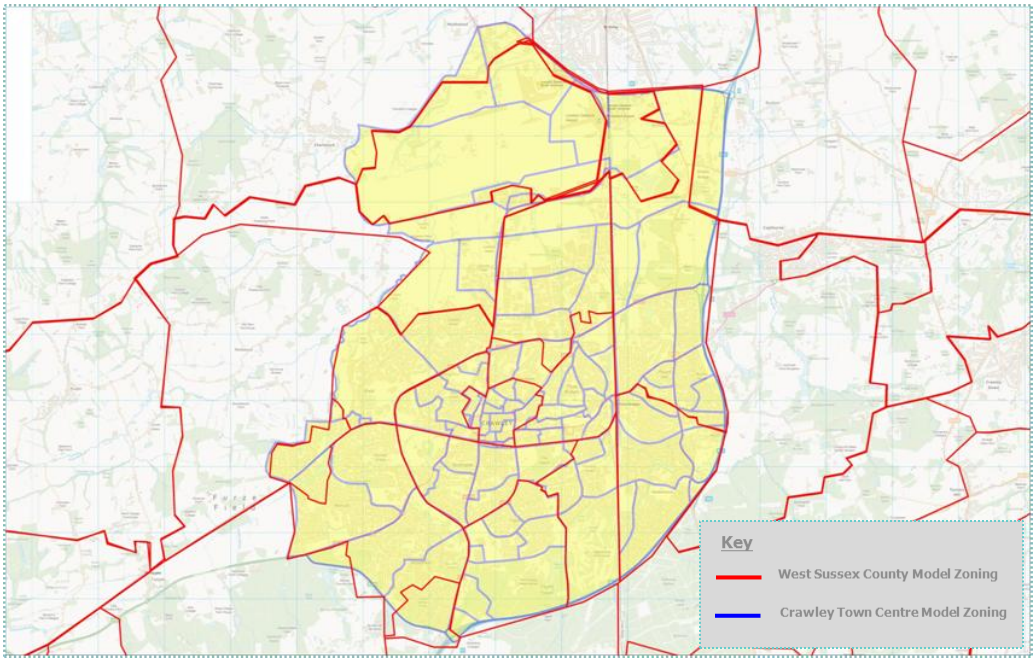

Figure 2: Updated Model Zones

2.4.3. Figure 3 gives further detail of the extended hybrid zoning system.

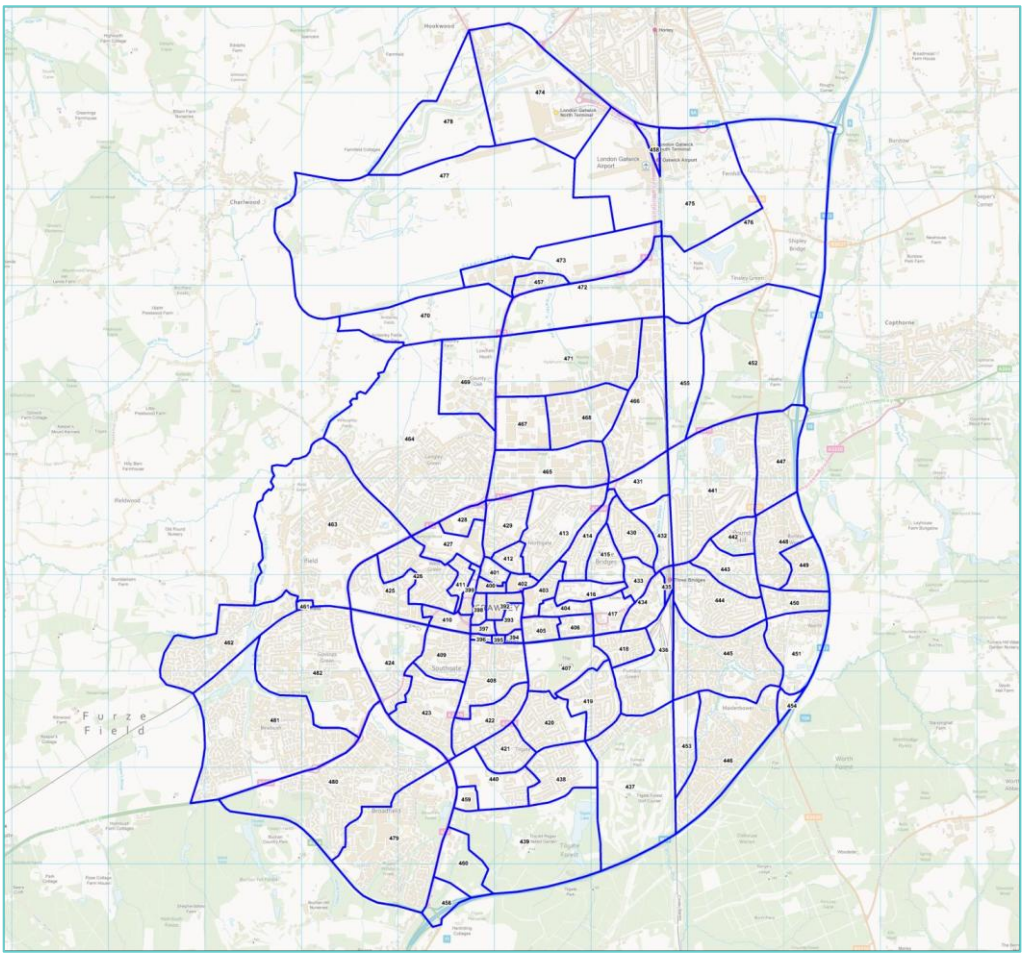

Figure 3: Crawley Town Hybrid Model Zones

2.5. Matrix Updates

2.5.1. The source WSCTM matrix contained 391 zones (including 16 for Crawley Town). The matrix was modified as follows:

- 91 new zones were created to represent the CTCM zoning system within Crawley, giving an overall total of 482 zones in the hybrid model;
- Trips within Crawley, between the 91 CTCM zones, were retained in the hybrid model;
- Two-way movements between the existing 16 Crawley Zones in the WSCTM and zones outside Crawley Town were retained, but recoded to the updated zoning system using CTCM trip end distribution; and
- Internal movements between the original 16 Crawley Town Zones in the WSCTM were set to zero, but the empty zones were still retained in the hybrid model and excluded from any of the forecast demand model mechanisms.

2.5.2. Regional traffic forecasts from the National Transport Model (RTF13) showed negligible traffic growth in the South East region between 2003 and 2010. Furthermore, traffic growth between 2006 and 2008 was only 0.19%pa, or 0.37% overall, so no growth adjustment was required in order to match the 2006 CTCM internal trips with the 2008 WSCTM Crawley Town external trips, in the hybrid 2008 model.

2.5.3. Matrix estimation was applied carefully to the hybrid 2008 AM matrix, to improve the representation of poorly observed movements and match observed traffic counts. The iterative process was controlled, to maximise the convergence between modelled and observed flows and by allowing only a small matrix adjustment factor (maximum of 3.0), to discourage creation of excess short-distance trips.

2.5.4. The AM peak trip volumes in the 'hybrid' WSCTM, before and after matrix estimation and including heavy goods vehicles (HGV), are shown in Table 1 below.

Table 1: Final Matrix Totals

	AM Peak 2008 (All-Vehicle PCU)
2008 'Hybrid' WSCTM (pre estimation)	155120
2008 'Hybrid' WSCTM (post estimation)	155362
% Difference	<1%

2.5.5. Table 1 shows no significant distortion in the AM peak 2008 highway trip matrix during the estimation process. However, the enhanced matrix enabled stronger validation of the 2008 hybrid model.

2.6. Highway Assignment Calibration/Validation

2.6.1. Model calibration and validation were undertaken, to check the accuracy of the highway assignment, by comparing modelled flows with observed counts. For stage-2, all 2005 and 2006 count data were used in calibration and matrix estimation, to ensure reliable trip movements in the AM hybrid model. Consequently, flow validation against independent counts was not possible. This approach has been accepted by DfT and Highways Agency, in past studies (e.g. A5117 Deeside Park Junctions Improvement, Cheshire). One count dataset was reserved for overall link flow 'calibration'. A separate set was assembled as a series of cordons and screen-lines for flow 'validation'.

2.6.2. The assignment outcome, for the core area of Crawley, showed the base year 2008 hybrid model to be reliable, as it achieved a close match between observed and modelled link flows, when compared with DfT criteria (WebTAG Unit 3.19). Some 90% out of 163 calibration links had a GEH of 5.0 or less (target – 85%). Also, across 12 directional validation cordons and screen-lines, over 90% of combined flows within each cordon and screen-line (target – 85%), were within 5% of observed, whilst 92% had a GEH of 4.0 or less (target – 80%).

2.6.3. In the wider county area of the hybrid model, across 138 highway links, it was found that 87% (120 links) had a GEH of 5.0 or less across the wider network (target – 85%). This indicated acceptable model accuracy across West Sussex as well as within Crawley.

2.6.4. Journey time validation also showed acceptable accuracy in the hybrid model. In Crawley, 90% of routes (target – 85%) had a modelled time within 15% of observed.

2.6.5. The 2008 hybrid AM peak model achieved a satisfactory level of convergence, in terms of 'proximity' of chosen route costs and 'stability' of assigned flows, between iterations. This indicated that the base model outcome is reliable and would not change if it was subject to further iterations.

2.6.6. The public transport segment of the WSCTM was also enhanced to incorporate local detail within Crawley, from the CTCM, using the same method as for the highway model. Validation of the PT hybrid model was not verified, as passenger flow and journey time data within Crawley were not available.

2.6.7. A comparison of modal shares was made between the hybrid 2008 AM base model and 2011 Census data for West Sussex County, to confirm the accuracy of the model. Although the hybrid outcome excludes many shorter, local trips, the overall mode shares were comparable:

- 2011 Census for W Sussex – 42,958 PT trips (15%); 247,790 car trips (85%);
- 2008 hybrid model for W Sussex – 18,331 PT trips (11%); 150,339 car trips (89%).

2.6.8. The hybrid base 2008 multi-modal model was accepted by WSCC as being sufficiently accurate to be used for further forecasting and scheme impact appraisal tasks.

2.7. Future Year Model

2.7.1. The 'Hybrid' AM peak Crawley stage-2 model has been projected to forecast year 2029. It includes the following travel choice mechanisms to represent future changes in the level of trip demand, changes in available transport facilities and changes in travel costs:

- Trip generation and attraction at O-D zones;
- Trip distribution and destination choice;
- Travel mode choice;
- SATURN highway route choice assignments; and
- CUBE PT route choice assignments.

2.7.2. The hybrid Crawley model operates with essentially the same mechanisms and parameters as the West Sussex County Transport Model.

2.7.3. Each future year model scenario has been checked for satisfactory convergence and stability.

2.7.4. In stage-2 of the study, various future scenarios have been forecast from the 2008 base and tested to cover a range of possible outcomes with respect to trip demand and transport supply. The scenarios are as follows:

- A 'Reference Case', representing:
  - Background trip end growth based on adjusted NTEM planning data (applied to cars and transit passengers) and RTF13 vehicle kilometres (applied to goods vehicles), at district level;
  - Committed land use development trip O-D movements (for sites with planning permissions), in specific model zones; and
  - Committed transport schemes (highway and PT interventions, with funding and approvals).
- A Preferred Strategy, representing:
  - Background trip end growth as Reference Case, but with further adjustments for site-specific developments (identified by CBC), comprising:
  - Committed sites (as in Reference Case);
  - Preferred strategy key housing sites;
  - Preferred strategy town centre and edge-of-centre housing sites;
  - Preferred strategy H1 housing sites;
  - Employment development sites; with
  - Committed transport schemes (highway and PT interventions, with funding and approvals – as in Reference Case); and
  - Highway intervention schemes tested to mitigate unacceptable congestion impacts at key road links and junctions.
- An Alternative Strategy - as Preferred Strategy, but with the addition of:
  - Potential residential site allocations and consultation sites;
  - Potential strategic employment sites; and
  - Additional highway intervention schemes tested to mitigate unacceptable congestion impacts at key road links and junctions.

3. Future Year Transport Supply Networks

3.1. Overview

3.1.1. This section describes the transport networks that have been included in the future year multi-modal model, under the respective Crawley stage-2 forecast scenarios. The network elements represent the 'supply' side of the model, as defined in section 1.2.

3.1.2. Many of the network components are consistent with those in the stage-1 appraisal, but changes have been made to reflect the evolving CBC Local Transport Plan strategies.

3.2. Transport Network Scenarios

3.2.1. Three network scenarios have been modelled under stage-2 of the Crawley study, for the AM peak at 2029, with and without various transport scheme interventions to remedy congestion. These scenarios were as follows:

- Reference Case, with committed schemes only;
- Preferred Strategy, with planned improvements and also with new remedial schemes from the current study; and
- Alternative Strategy with planned improvements and also with new remedial schemes from the current study.

3.2.2. Initially, the preferred and alternative strategy scenarios have undergone model assignment without inclusion of remedial schemes. This was in order to identify network locations where further intervention to mitigate development impact would be needed.

Reference Case

3.2.3. The 'Reference Case' represented the supply situation if only committed transport schemes were introduced on to the current highway and PT network. This is the scenario against which the planned development impacts were to be judged, to identify if they would cause the network to become worse off, in terms of operational 'stress' (i.e. congestion and delay).

Preferred Strategy

3.2.4. The preferred strategy supply scenario to be tested initially entailed all of the reference case schemes, plus some remedial schemes already proposed by WSCC / CBC. Subsequently it was revised to include newly identified remedial schemes. The new remedial schemes were aimed at reducing network stress to an acceptable level, at highway locations where the preferred strategy demand would cause significant congestion and delay, but where the network would operate satisfactorily, or within acceptable thresholds of stress, in the reference case.

3.2.5. There are a number of highway locations where significant stress would arise with both preferred strategy and reference case demand, but where impact mitigation would still be desirable, in order to deliver the District Plan. The stage-2 appraisal has identified these locations, but new remedial schemes have only been devised where there would be a significant worsening of network stress with the preferred strategy.

Alternative Strategy

3.2.6. The alternative strategy comprised all of the reference case and preferred strategy schemes, together with some further remedial schemes already identified by WSCC / CBC. Since the Crawley stage-2 alternative strategy would entail greater local development and trip volumes, when compared with the preferred strategy, there were some further highway locations where additional stress would arise over and above the level in the preferred strategy. Extra remedial schemes have been newly investigated to resolve this excess network stress.

3.2.7. Details of the highway and PT network scheme interventions included in each model scenario, at AM 2029, are described in the following sections. The objective has been to represent a balanced range of highway, PT and policy initiatives, within the limitations of a broad-scale strategic model.

3.3. Reference Case Network Scenario

3.3.1. Completed transport initiatives, implemented since 2006 Crawley Town Centre Model, together with committed future schemes, have been added into the hybrid model Reference Case scenario. These include certain initiatives being considered by WSCC and CBC in the Strategic Infrastructure Plan (SIP). Those reference case schemes in the core area of the model, around Crawley, are as follows:

Highway Initiatives

- A23 Handcross to Warninglid – carriageway improvements;
- Worth Rd Traffic Calming, Crawley;
- Grattons Drive Traffic Calming, Crawley;
- Worth Park Avenue Pedestrian Crossings, Crawley; and
- Fastway bus services on routes 10, 20 and 100.
- Crawley Fastway Bus Lanes – Haslett Avenue East and Gatwick Road;
- A23 Gatwick – airport link road between A23 / South Terminal and airport perimeter road / North Terminal;
- New link road joining A2011 Crawley Avenue with B2036 Balcombe Road (north) – to access North East Sector development;
- B2036 Balcombe Road / Steers Lane – signalisation for NE Sector;
- B2036 Balcombe Road / B2037 Antlands Lane – roundabout capacity improvement for NE Sector;

- B2036 Balcombe Road / C206 Radford Road – signalisation for NE Sector;
- C206 Radford Road / Steers Lane – signalisation for NE Sector;
- Gatwick Road / C206 Radford Road – roundabout capacity improvement for NE Sector;
- B2036 Balcombe Road / Crawley Avenue link – signalised junction for NE Sector;
- A2011 Crawley Avenue / Balcombe Road link – signalised junction for NE Sector;
- New junction on Steers Lane – to access NE Sector development;
- New junction on B2036 Balcombe Road – to access NE Sector development;
- C206 Radford Road – signalised shuttle arrangement at railway bridge for NE Sector;
- Pegler Way / High Street – clockwise signalised gyratory improvement to accommodate new Morrison development right in / right out signalised access at Sussex House site;
- M23 Junction 10 roundabout – signalisation to accommodate North East Sector development;
- A2011 Crawley Avenue / Gatwick Road / A2004 (Hazelwick) roundabout – signalisation to accommodate North East Sector development;
- Kilnwood Vale development – bus gates to / from north side (Woodcroft) and south side (Sullivan Drive) at Bewbush estate;
- Kilnwood Vale access junction – new roundabout on A264 Crawley Road;
- Kilnwood Vale access junction – new signals on A264 Crawley Road;
- M23 Junction 11 / A264 Pease Pottage – signalisation and approach widening from A264 west; and
- A2220 Horsham Road / A23 Crawley Avenue – roundabout dedicated left turn slip from A2220 Horsham road to A23 northbound.

Public Transport initiatives

- Bus route 200 – improved service frequency (2 per hour each way) Horsham / Ifield / Manor Royal / Gatwick airport, through Kilnwood Vale;
- Bus route 300 – improved service frequency (2 per hour each way) Ifield / Manor Royal, through Kilnwood Vale;
- Bus route 23/24 – service re-routing (1 per hour each way) through Kilnwood Vale;
- Bus route 4/5 – service extension (4 per hour each way) to / from Kilnwood Vale and to / from B2036 Balcombe Road serving NE Sector developments;
- New bus route 500 – shuttle service between Crawley / NE Sector / Manor Royal / Gatwick airport (3 per hour each way);

- Fastway route 100 – improved service frequency (5 per hour each way) Maidenbower / Crawley / Manor Royal / Gatwick airport; and
- Fastway route 10 – service re-routing (10 per hour each way) through Kilnwood Vale.

3.3.2. Further committed schemes have been included in the wider county area of the Reference Case network, consistent with those identified for the original West Sussex County Transport Model (Forecasting Report July 2011, Tables 3.1 and 3.2).

3.3.3. All of the completed and committed network interventions, specified for the Reference Case have also been incorporated in the Preferred Strategy and Alternative Strategy model networks.

3.4. Preferred Strategy Network Scenario

3.4.1. There are some additional, planned transport interventions that have been included in the preferred strategy scenario, to represent access schemes for new development. Again, these include schemes being considered by WSCC and CBC in the Strategic infrastructure Plan. Such access schemes would be instigated by the developers concerned and would likely be a condition of WSCC approval for a proposed development. Those new preferred strategy initiatives that are supplementary to the committed reference case schemes (above) are listed below.

Highway Initiatives

- The Boulevard – Closure to through traffic (i.e. vehicle access only and pedestrian priority) and vehicle speed management, to accommodate Town Centre North development;
- Northgate Avenue / Woodfield Road – junction signalisation;
- Kilnmead – vehicle speed management to accommodate Town Centre North;
- A23 London Road / Gatwick Road (Beehive junction) – roundabout signalisation;
- M23 Junction 9a – roundabout signalisation to accommodate Gatwick Junction development;
- Gatwick Airport North Terminal / A23 Longbridge – roundabout slip lane improvements;
- Manor Royal – bus lane eastbound from Faraday Road to Gatwick Road;
- Fleming Way – bus lane eastbound from Faraday Road to London Road;
- Crawley bus station – southbound bus-only left turn to Station Way;
- Three Bridges rail station – improved bus access on Haslett Avenue East;
- A23 Crawley Avenue / A2219 London Road – northbound bus-only link through the junction to operate with southbound existing bus-only link; and

- Pegler Way – single 2-lane two-way carriageway; with restricted one-way southbound movement on High Street (with traffic management).

Public Transport initiatives

- Bus route 2/3 – service re-routing (8 per hour each way) through Town Centre North developments; (route 3 is reverse of route 2 for modelling purposes);
- Bus route 526 – service re-routing (2 per hour each way) through Town Centre North developments; and
- Bus route 527 – service re-routing (2 per hour each way) through Town Centre North developments.

3.4.2. In addition to the above preferred strategy interventions, which have been tested initially, several possible remedial highway schemes have also been modelled, to try to mitigate the preferred strategy impact at locations of significant stress. These are outlined in section 5.

3.5. Alternative Strategy Network Scenario

3.5.1. There are a number of transport interventions that have been considered by WSCC and CBC for accessing and accommodating alternative development options. Some are included in the Strategic Infrastructure Plan. The alternative strategy schemes in the core area of the model are as follows:

Highway Initiatives

- A23 Crawley Avenue / Ifield Avenue and Ifield Avenue / Ifield Drive – linked signal arrangement to accommodate West of Ifield development.

Public Transport initiatives

- Bus route 4/5 – service extension (4 per hour each way) to/from West of Ifield development;
- Bus route 200 – service re-routing (2 per hour each way) through West of Ifield development;
- Bus route 300 – service re-routing (2 per hour each way) through West of Ifield development;
- Bus route 526b – service re-routing (4 per hour each way) through Gatwick Junction development; and
- Bus route 527a – service re-routing (4 per hour each way) through Gatwick Junction development.

3.5.2. Again, the alternative strategy has been tested initially with the above interventions, but then several possible remedial highway schemes have also been modelled, to try to mitigate the alternative strategy impact at locations of significant stress. These are outlined in section 5.

3.6. Model Assignment Packages

3.6.1. The future transport interventions, identified in section 3, have been combined with the forecast demand components, noted in section 4, to produce the CBC model assignment package outcomes shown in Table 2.

Table 2: Summary of Crawley Stage-2 Model Assignment Packages

Assignment Content	Model Assignment Package AM Peak 2029				
	Reference Case	Preferred Strategy	Alternative Strategy	Preferred Strategy with Remedial Schemes	Alternative Strategy with Remedial Schemes
Travel Demand Components					
Committed Development	Yes	Yes	Yes	Yes	Yes
Preferred Strategy Development	No	Yes	Yes	Yes	Yes
Alternative Strategy Development	No	No	Yes	No	Yes
Network Intervention Scenarios					
Committed Schemes	Yes	Yes	Yes	Yes	Yes
Preferred Strategy Agreed Schemes	No	Yes	Yes	Yes	Yes
Alternative Strategy Agreed Schemes	No	No	Yes	No	Yes
Preferred Strategy New Remedial Schemes	No	No	No	Yes	Yes
Alternative Strategy New Remedial Schemes	No	No	No	No	Yes

3.6.2. The packages shown in Table 2 have been assessed using the stage-2 Crawley hybrid AM peak model at 2029.

4. Forecast Demand Scenarios

4.1. Overview

4.1.1. This section describes the sources of origin to destination trips, for the Local Plan stage-2 appraisal, which form the 'demand' side of the future year model scenarios, as defined in section 1.2. The key components are similar to, but slightly changed from, the stage-1 model. The differences arise from amendments to the land-use configuration in the Local Plan and from the operation of the 'variable demand model' which determines trip patterns from changes in travel costs.

4.1.2. A broader picture of how the demand scenarios were developed was given in the stage-1 report.

4.2. Trip Demand Scenarios

4.2.1. Three AM peak demand scenarios have been assembled for stage-2, for forecast year, namely:

- Reference Case;
- Preferred Strategy and
- Alternative Strategy.

4.2.2. There are common threads within both the Reference Case and Preferred and Alternative Strategy scenarios, as described below.

Reference Case, Preferred and Alternative Strategy Case Demand

4.2.3. Growth in car and PT trip volumes from base year 2008 is assumed to be in line with the National Trip End Model (NTEM V6.2), which calculates trip growth factors by district (using TEMPRO) from the year-on-year profile of planning data (i.e. households and jobs) that it contains. The planning data in NTEM has been adjusted for stage-2 using CBC local predictions. Resulting growth factors have been applied in the transport model by identifying the model zones that correspond with each NTEM district.

4.2.4. Where details of specific future land-use allocations are known, these have been included in the model by applying TRICS trip rates to the site characteristics. The resulting trip arrivals and departures have been added to the appropriate model zone and distributed amongst origins and destinations on gravity principles. At the same time, the planning data associated with the specific developments have been removed from NTEM to avoid duplication of growth.

4.2.5. Committed residential development at Kilnwood Vale has been modelled and assessed with a worst case allocation of 2,650 dwellings, as specified in the Transport Assessment, although Horsham BC gave planning consent for only 2,500 dwellings. The difference is unlikely to make a significant impact upon the study outcomes.

4.2.6. Growth in goods vehicle movements has been calculated from the National Transport Model (NTM), which predicts vehicle kilometres by road type and location from the Road Traffic Forecasts 2013 (RTF13).

4.2.7. In the Reference Case scenario, the following site-specific committed land-use sites were included:

- Housing completions in Crawley Borough since 2008 (1,363 dwellings);
- Housing commitments in Crawley Borough – 2,623 dwellings, comprising:
- Housing commitments on preferred strategy key housing sites (2,289 dwellings; and
- Housing commitments on preferred strategy H1 housing sites (334 dwellings;
- Housing commitments in Horsham Borough (2,650 dwellings at Kilnwood Vale);
- Overall reference case housing development – **6,636 dwellings**.
- Employment completions in Crawley Borough since 2008 (gross floor area: 136,671sqm gain; 90,811sqm loss; 45,860sqm net gain, or 3,511 jobs);
- Employment commitments in Crawley Borough (gross floor area: 19,235sqm gain; 14,504sqm loss; 75,731sqm net gain, or 4,526 jobs); and
- Employment commitments in Horsham Borough (gross floor area: 9,300sqm gain, or 698 jobs), at Kilnwood Vale;
- Overall reference case employment development – **8,037 jobs**.

Preferred and Alternative Strategy Demand

4.2.8. In both the Preferred and Alternative strategies, allowance has also been made for zone-specific trips at preferred residential and employment sites. These consisted of the following:

- Preferred strategy additional housing development – 1,150 dwellings, comprising:
  - Preferred strategy key housing sites (420 dwellings);
  - Preferred strategy town centre housing sites (22 dwellings);
  - Preferred strategy edge of town centre housing sites (140 dwellings); and
  - Preferred strategy H1 housing sites (568 dwellings);
- Overall preferred strategy total housing development (including reference case) – **7,786 dwellings**; (an increase of 17.3% from the reference case);
- Preferred strategy additional employment development (gross floor area: 80,200sqm gain; 44,844sqm loss; 35,356sqm net gain), or – 2,413 jobs, comprising:
  - Town Centre North 32,500m^2 A1 retail development area; (or 27,625sqm GFA);
  - GlaxoSmithKline 44,844m^2 B1 business development area; (or 38,117sqm GFA after change of use);

- Segro West, London Road 12,360m^2 B1 business development area; (or 2,521sqm GFA);
- Thales, Gatwick Road 24,840m^2 B1 business development area; (or 5,067sqm GFA);
- BOC Edwards 22,860m^2 B1 business development area; (or 4,663sqm GFA); and
- Betts Way 12,238m^2 A1/B1/B2/B8 development area; (or 849sqm GFA of A1 retail, with 1,357sqm GFA of B1/B2/B8 business uses);

- Overall preferred strategy employment development (including reference case) – **10,450 jobs**; (an increase of 30.0% from the reference case);

4.2.9. Also, in the Alternative Strategy, predicted households and jobs arising from additional, less deliverable sites in Crawley have been included as site specific trips. These sites are as follows:

- Alternative strategy additional housing inside Crawley Borough (440 dwellings), comprising:
- Three Bridges housing site, Tinsley lane (100 dwellings);
- Southgate housing site, Goffs Park (30 dwellings);
- Broadfield housing site, Kennels (10 dwellings);
- Bewbush, Breezehurst Drive (100 dwellings);
- North of Langley Green (100 dwellings); and
- East of Brighton Road, Tilgate (100 dwellings);

- Alternative strategy additional housing outside Crawley Borough (3,500 dwellings), comprising:
- West of Ifield (3,000 dwellings); and
- Copthorne (500 dwellings);

- Overall alternative strategy total housing development (including reference case and preferred strategy) – **11,726 dwellings**; (an increase of 76.7% from the reference case);

- Alternative strategy additional employment inside Crawley Borough, comprising:
- Pound Hill North employment site 110,000m^2 B1/B2/B8 development area; (or 93,500sqm GFA of B1/B2/B8 business uses, or 3,951 jobs);

- Alternative strategy additional employment outside Crawley Borough, comprising:
- Copthorne 24,240m^2 B1/B2/B8 development area; (or 3,992sqm GFA of B1/B2/B8 business uses, or 92 jobs);

- Overall alternative strategy total employment development (including reference case and preferred strategy) – **14,493 jobs**; (an increase of 80.3% from the reference case).

4.2.10. A full breakdown of the individual development sites that constitute each of the reference case, preferred strategy and alternative strategy model scenarios, is provided in Appendix A.

4.2.11. The locations of the site-specific developments represented in the model are shown in Figure 4 in Appendix C.

4.3. NTEM (TEMPRO) Trip End Growth

4.3.1. For the period between base year 2008 and future year 2029, each model zone has residual trip end growth applied in line with the National Trip End Model (NTEM V6.2) factors. However, these factors have first been adjusted by removing NTEM planning data associated with any new site-specific developments, because these developments are represented separately in the model.

4.3.2. In essence, this means that zero NTEM growth was applied to model zones representing Crawley (main) and Horsham (rural) districts, in any of the reference case, preferred, or alternative scenarios. This was because the identified site-specific developments, in the reference case, account for all of household and job growth otherwise contained in NTEM and so these households and jobs have to be removed from NTEM to avoid duplication of trips. NTEM growth was therefore only applied to model zones representing areas outside of Crawley and rural Horsham.

4.3.3. The trip end growth factors were derived using the TEMPRO tool, for the following areas of West and East Sussex:

- Chichester;
- Arun;
- Horsham;
- Adur;
- Worthing;
- Mid Sussex;
- East Sussex; and
- Crawley.

4.3.4. Factors were similarly derived for surrounding administrative districts. The respective person trip end factors (for all travel modes combined) were then applied in the transport model to all zones within each district, by trip purpose.

4.4. Heavy Goods Vehicle Forecasts

4.4.1. Trip end growth, to 2029, for goods vehicles has been represented in the model using National Transport Model RTF13 forecasts. The base model goods vehicle movements are unchanged from 2008. The growth factors used were therefore as follows:

- 2008 to 2029: +14.2% (x1.142).

4.5. Gatwick Airport Growth

4.5.1. Future growth in the volume of air passengers and number of jobs, at Gatwick Airport, is not included in the NTEM planning forecasts. Therefore, specific adjustments have been made in the stage-2 hybrid model to include published airport growth information, as advised by CBC. These assumptions are as follows:

- Passenger growth (from 2008 to 2029): 28.7% (from 34.2m to 44.0m); and
- Employment jobs growth (from 2008 to 2029): 7.4% (from 0.0230m to 0.0247m).

4.5.2. These growth assumptions have been retained in all model scenarios.

4.6. Trip Rate Estimates for Site-Specific Developments

4.6.1. Person-trip arrivals and departures at identified development sites, during the AM peak, were calculated by applying agreed trip rates to the land use characteristics of each site (committed, preferred and alternative allocations), as summarised in section 4.2, above. The trip rates were extracted from the TRICS database for similar UK sites, by number of residential dwellings and size of employment Gross Floor Area (GFA in sqm).

4.6.2. Since the movement patterns were calculated as person-trips, they are different from the mode-specific trip rates (e.g. vehicles and transit passengers) determined by developers for the respective sites in the study area. However, they have been calculated in a similarly rigorous manner.

4.6.3. The person-trip rates for stage 2 are consistent with those used in stage 1 and are as shown in Table 3.

Table 3: Person Trip Rates for Site-Specific Developments (Derived from TRICS)			
Land Use Type **Crawley BC and Horsham BC Developments (Committed, Preferred and Alternative Sites)**	**Units of Measurement**	**Person-Trip Arrivals**	**Person-Trip Departures**
Residential	per dwelling	0.121	0.681
A1: Retailing	per 100sqm GFA	5.285	3.564
A2: Financial/Professional Services	per 100sqm GFA	1.789	0.074
B1a: Offices	per 100sqm GFA	1.789	0.074
B1b: Research/Development	per 100sqm GFA	2.235	0.305
B1c: Light Industry	per 100sqm GFA	0.601	0.235
B2: General Industry	per 100sqm GFA	0.600	0.253
B8: Storage & Distribution	per 100sqm GFA	0.038	0.019
C1: Hotel	per 100sqm GFA	0.455	0.816
D2: Leisure	per 100sqm GFA	0.868	1.060
Mixed	per 100sqm GFA	1.053	0.177

4.7. Calculated Site-Specific Person Trips

4.7.1. By applying the trip rates in Table 3 to the identified development sites, AM peak trip arrivals and departures were calculated as shown in Table 4 for the reference case, preferred strategy and alternative strategy scenarios.

4.7.2. These total person trips were added to the adjusted NTEM base year trip-end growth for the appropriate O-D zones in the model matrix, to give overall 2029 trip patterns.

4.7.3. It can be seen from Table 4 that the number of additional site-specific trips calculated for each appraisal scenario would rise from 14,195 in the reference case, to 18,445 in the preferred strategy (i.e. a 30% increase from reference case) and 23,010 in the alternative strategy (i.e. a 62% increase from reference case).

4.7.4. The trips in Table 4 were further adjusted by the workings of the variable demand model, in terms of destination choice and mode choice, to produce the final assigned trip matrices at 2029.

4.7.5. A detailed summary of the person-trip volumes calculated for each development site, under each model scenario is given in Appendix A.

Table 4: 2029 AM Site-Specific Person Trips (All Modes) Additional to Base Year 2008			
Description	**Arrivals**	**Departures**	**2-Way Trips**
Additional in Reference Case, Preferred and Alternative Strategy			
Completed Residential Developments	165	931	1096
Completed Employment Developments	1535	594	2129
Committed Residential Developments	638	3591	4229
Committed Employment Developments	4707	2034	6741
Additional in Preferred and Alternative Strategy Only			
Preferred Strategy Residential Developments	139	783	922
Preferred Strategy Employment Developments	2140	1188	3328
Additional in Alternative Strategy Only			
Alternative Strategy Residential Developments	477	2683	3160
Alternative Strategy Employment Developments	1202	202	1404
Cumulative Summary of Overall Additional Trip Totals			
Reference Case Total	7046	7149	14195
Preferred Strategy Total	9325	9120	18445
Alternative Strategy Total	11004	12006	23010

4.8. Forecast Person Trip Matrices

4.8.1. Once the various components of the model trip matrices were assembled, (i.e. residual NTEM growth and site-specific arrivals and departures), the resulting matrix person-trip totals were derived as shown in Table 5.

4.8.2. Table 5 shows the numbers of trips in the reference case, preferred strategy and alternative strategy scenarios, after assignment in the full, variable demand, multi-modal model. They include changes made within the demand model, in each matrix / network scenario, to reflect mode choice and destination choice in response to changing transport costs. The trip demands are shown as person-trips, by highway and public transport. They are also segmented into two categories, first those which are to, from, or within Crawley town and, second, those which are outside Crawley.

Table 5: Stage-2 Base and Forecast Person-Trip Matrix Totals (All Travel Modes)								
AM Model Scenario								
		Base 2008	Reference Case 2029		Preferred Strategy 2029		Alternative Strategy 2029	
		No. Person Trips	No. Person Trips	% Change from Base Year	No. Person Trips	% Change from Base Year	No. Person Trips	% Change from Base Year
Demand Segment	Travel Mode							
Trips Within/To/ From Crawley	Highway	43783	48921	11.74%	50642	15.67%	52337	19.54%
	Public Transport	3285	5927	80.43%	6248	90.23%	6498	97.82%
	All Modes	47067	54848	16.53%	56890	20.87%	58835	25.00%
Trips Outside Crawley	Highway	152206	172203	13.14%	170898	12.28%	172310	13.21%
	Public Transport	15046	17669	17.44%	17844	18.60%	17786	18.21%
	All Modes	167251	189873	13.53%	188742	12.85%	190096	13.66%
All Trips	Highway	195988	221125	12.83%	221540	13.04%	224648	14.62%
	Public Transport	18331	23596	28.72%	24092	31.43%	24284	32.48%
	All Modes	214319	244721	14.19%	245632	14.61%	248931	16.15%

4.8.3. Table 5 indicates that the 2029 reference case would entail a greater increase in all-mode trips within Crawley (17%), than in the full study area (14%), from base year 2008, owing to the concentration of development commitments inside the Borough. This growth difference would be about 3% greater for Crawley as for the wider study area.

4.8.4. The preferred strategy would cause a slightly larger growth increment in all-mode trips within Crawley (21%) than in the full study area (15%), from base year 2008. This reflects the additional core strategy developments that are located in the Borough. This growth difference would be about 6% greater for Crawley as for the wider study area.

4.8.5. Moving on, the alternative strategy would show an even larger growth increment between all-mode trips within Crawley (25%) than in the full study area (16%), from base year 2008. This would largely be a result of the additional Pound Hill North employment site in the Borough. This growth difference would be about 9% greater for Crawley as for the wider study area.

4.8.6. The above differences between scenarios in volume of all-mode trips would also be mirrored by the volumes on individual highway and public transport modes.

4.8.7. In all scenarios, both inside and outside Crawley, there would be a significantly greater percentage rise in the volume of public transport trips than in highway trips, because of the lower base level of bus and rail journeys on the network. The higher rise in public transport movements, compared with highway, would become more emphasised moving through the respective scenarios from reference case, through preferred strategy to alternative strategy, especially within Crawley, owing to the increasing severity of road congestion in each scenario. Also, in the preferred and alternative scenarios, improved bus service frequencies have been modelled on routes serving key development sites. Further, there would be new bus routes and services between the North East Sector development, Kilnwood Vale, Crawley town centre, Manor Royal and Gatwick.

4.8.8. Considering trips to, from or wholly within Crawley, the largest difference between scenarios at 2029 AM would be between the alternative strategy and reference case for highway movements (increase of about 3,400 vehicle trips) and between the preferred strategy and the reference case, for highway trips (increase of about 1,700 vehicle trips).

4.8.9. It is predicted that the overall mode split between highway and PT, in the Crawley local area, would increase from around 7% in the base year to around 11% in each of the future scenarios. However, this proportionate mode split at 2029 would not vary significantly between the reference case, preferred and alternative strategy scenarios, because the modelled PT interventions are very similar in all forecast scenarios.

4.9. Travel Choice Mechanisms in the Demand Model

4.9.1. As indicated in section 2.7, the trip demand model contains several mechanisms to represent travel choices in response to journey costs, namely: trip O-D generation and attraction; trip distribution and destination choice; and travel mode choice. As the model covers only the AM peak period, it does not include time-of-day choice.

Trip End Generation and Attraction Model

4.9.2. The trip end model derives future year demands from changes in socio-economic data (car ownership/availability), demographic data (population and employment trends), and development plans. The output from the trip end model, which is based on NTEM and local planning projections, is a set of growth factors, by purpose, at a zone level, for use in a 'Fratar' growth factoring process, which updates the demand matrices to a set of balanced trip ends.

Trip Distribution and Destination Choice

4.9.3. Trip destination choice is calculated as a function of observed trip length distribution and the generalised time of travel.

4.9.4. The distribution functions determine the incremental change in demand to be applied to the observed base year flows, taking account of the effect of generalised travel time on average distance travelled. The functions are 'doubly-constrained' to origin and destination totals and are applied by journey purpose.

Travel Mode Choice

4.9.5. Travel mode choice is applied by journey purpose and is calibrated in line with initial spread parameters (lambda), based upon WebTAG guidance. It then undergoes incremental adjustment of the spread parameters and modal constants for each purpose, until the modelled mode shares match the observed shares from the car, bus and rail matrices.

4.9.6. The above components of the trip demand models are applied in an iterative process. The outturn demands derived from the first iteration are used to create new generalised times for input to the second iteration of the demand models. This process is repeated until an acceptable level of convergence between trip demand and network supply costs is achieved.

5. Model Results and Output Analysis

5.1. Overview

5.1.1. This section describes the findings from the Crawley stage-2 scenario modelling and analysis.

5.1.2. Overall network statistics and trip demand have been analysed from the stage-2 model runs and reported in attached spread sheets in Appendix B. The report analysis focuses on highway ratios of flow to capacity (RFC) at links and junctions suffering significant stress and also link traffic flows.

5.2. Forecast Model Reliability

5.2.1. The Crawley hybrid multi-modal forecast assignments at AM 2029 have been checked to ensure that the outcomes are robust and reliable, within the limitations of the model scope and content.

5.2.2. It is important that the results are derived from satisfactorily converged and stable model assignments for each scenario. Model convergence, proximity and stability are judged against the following WebTAG criteria:

- Proximity – %GAP and %Delta (difference between total assigned/simulated costs and minimum route costs, as a proportion of total costs) – Target <0.1%, over four successive iterations, for both of these criteria; and
- Stability – %FLOWS (P proportion of assigned flows within 1% of values from previous iteration) – Target >98%; and %RAAD (relative average absolute difference) – Target <0.1%; over four successive iterations, for at least one of these two criteria.

5.2.3. The statistics in Table 6 summarise the model convergence, proximity and stability values that were achieved in the forecast Crawley model.

5.2.4. The values in table 6 confirm that Crawley model assignments achieved satisfactory convergence. The only slight variability was the %GAP value on the final iteration of the alternative strategy scenario assignment, which was greater than 0.1%, but this is compensated by the satisfactory value of %Delta at 0.1%. The analysis shows that the model outcomes, in each scenario, would not change significantly if further iterations were run.

Table 6: AM Peak 2029 Highway Model Proximity and Stability Checks				
	Proximity Criteria		Stability Criteria	
Model Iteration No. (Final Four Iterations)	%Delta (<0.1%) rounded	%GAP (<0.1%) rounded	%Flows (P 98% <1%) rounded	%RAAD (<0.1%) rounded
Reference Case				
61	0.1	0.1	99.5	0.1
62	0.1	0.1	99.6	0.1
63	0.1	0.1	99.8	0.1
64	0.1	0.1	99.7	0.1
Preferred Strategy				
68	0.1	0.1	99.3	0.1
69	0.1	0.1	99.8	0.1
70	0.1	0.1	99.6	0.1
71	0.1	0.1	99.7	0.1
Alternative Strategy				
68	0.1	0.1	99.6	0.1
69	0.1	0.1	99.5	0.1
70	0.1	0.1	99.8	0.1
71	0.1	0.4	99.7	0.1

5.3. Overall Network Travel Statistics

5.3.1. Outline statistics from each model forecast scenario at AM 2029, after full assignment in the variable demand multi-modal model, have been extracted and presented in Table 7. The model statistics relate to the entirety of the West Sussex modelled network.

Table 7: Crawley Stage-2 Strategic Multi-Modal Model Summary Statistics (AM Peak) – Entire West Sussex Network								
			Base Year 2008	Forecast Scenario Year 2029				
Strategic Model Parameter	Travel mode	Units	Existing	Reference Case	Preferred Strategy	% change from Reference case	Alternative Strategy	% change from Reference case
Total Network Trips	Highway	Persons	195990	221124	221539	0.2%	224647	1.6%
	PT	Persons	18331	23596	24093	2.1%	24284	2.9%
	Combined	Persons	214320	244720	245631	0.4%	248931	1.7%
	Proportion of Highway Trips	%	91.4%	90.4%	90.2%		90.2%	
	Proportion of PT Trips	%	8.6%	9.6%	9.8%		9.8%	
Total Network Travel Distance	Highway	PCU-Kms	-	4109501	4086590	-0.6%	4114661	0.1%
	Bus	Person-Kms	-	246317	267487	8.6%	270025	9.6%
	Rail	Person-Kms	-	527221	519400	-1.5%	513626	-2.6%
	Combined	Net Kms	-	4883039	4873477	-0.2%	4898312	0.3%
Total Network Travel Time	Highway	PCU-Hrs	-	55027	54749	-0.5%	55340	0.6%
	Bus	Person-Hrs	-	9794	10578	8.0%	10703	9.3%
	Rail	Person-Hrs	-	9162	9015	-1.6%	8917	-2.7%
	Combined	Net Hrs	-	73983	74343	0.5%	74961	1.3%
Transient Queues	Highway	PCU Hrs/Hr	-	4666	4707	0.9%	4838	3.7%
Over Capacity Queues	Highway	PCU Hrs/Hr	-	2290	2275	-0.7%	2364	3.2%
Link Travel Time	Highway	PCU Hrs/Hr	-	48071	47768	-0.6%	48138	0.1%
Average Vehicle Speed	Highway	Kph	-	74.7	74.6	-0.1%	74.4	-0.4%

5.3.2. The model outcomes in Table 7 do not reveal anything unexpected. However, several characteristics are notable. Total network trips by combined highway and PT modes would increase marginally from the reference case through the preferred strategy to the alternative strategy, respectively, at AM peak 2029, reflecting the increasing scale of land-use development in Crawley. However, the largest increase would be only 2% at a strategic, county level. The proportion of PT trips would be very similar between 2029 forecast scenarios, at about 10%. This represents a small rise of about 2% from base year 2008, reflecting improved PT service provision, especially bus services within Crawley. It would also be a consequence of a greater rise in highway congestion and travel costs at 2029, relative to increasing PT costs.

5.3.3. Total network travel distance by all modes would change only marginally between the respective scenarios, falling slightly in the preferred strategy and rising slightly in the alternative strategy, despite the rise in network trips. This would reflect improved network connectivity, as highway links and PT routes are enhanced and a shift to closer trip destinations, as new land uses are introduced.

5.3.4. Total network travel time would, however, rise slightly through the respective scenarios, by more than the change in travel distance, as the overall network experiences flows that are closer to capacity.

5.4. Highway Analysis of Key Links and Junctions

5.4.1. The focus of this analysis has been to consider three forecast scenarios at AM peak 2029, before any remedial interventions to mitigate adverse traffic impacts, namely:

- The reference case;
- The preferred strategy; and
- The alternative strategy.

5.4.2. The aim has then been to identify the following critical parts of the road network, within Crawley, where unacceptable stress (i.e. congestion) is likely to occur:

- Junctions and links that will experience stress (RFC >100%) in the preferred and alternative strategies and also in the reference case to a significantly lower degree;
- Junctions and links that will experience stress (RFC >100%) in the preferred and alternative strategies, but not in the reference case;
- Junctions and links that will experience minor stress (RFC <100%) in the preferred and alternative strategies, but to a significantly greater degree than in the reference case;
- Links on which the development case will entail a flow change of >10%, alongside an RFC >85%, when compared with the reference case.

5.4.3. The results from this analysis have been used to devise potential further remedial schemes, which could reduce the stress issues to an acceptable level. These further interventions have only been examined at an indicative, outline level and not developed as detailed designs.

5.4.4. The detailed outcomes of the model assignments are contained in Appendix B.

5.4.5. Locations of the highway junctions and links where performance has been analysed are shown, in Appendix C, in Figures 5 and 6, respectively, for the wider model area and in Figures 7 and 8, respectively, for Crawley Borough.

5.4.6. Please note that figures 5 and 6 do not include road links and junctions in Horsham District, whose performance has been analysed, because of the need to keep the diagram comprehensible. The analysis area included for Horsham broadly covers the A24 and A29 running north/south, between Capel and Worthing and also includes key routes in Horsham, Broadbridge Heath, Billingshurst, Pulborough and Storrington.

5.4.7. Diagrams showing the scale of RFC expected at key junctions within the core study area of Crawley Borough, at AM 2029, before remedial intervention, are provided in Figures 9, 10 and 11, in Appendix C, for the respective reference case, preferred strategy and alternative strategy scenarios.

Network Locations with Excessive Stress in Reference Case and Preferred and Alternative Strategies

5.4.8. In addition to the critical network locations referred to above, there are a number of road junctions and links where the RFC on the most congested arm is above 100% with 2029 preferred and alternative strategies and also with the reference case. These are junctions where we have not tested remedial schemes, because they are 'no worse off' with the development strategy (i.e. RFC no more than 5% greater than in the reference case), but where some form of mitigation may be needed, to accommodate development.

5.4.9. None of these junctions shows significantly higher RFC in the preferred or alternative strategies than in the reference case and so should not be constraints on the Local Plan proposals being approved and implemented.

5.4.10. Table 8 shows details of these junctions and links.

5.4.11. There does appear, in table 8, to be a slight anomaly from the model at the junction of A264 / A22, Felbridge, East Grinstead. Here, the RFC is just above 100% in the reference case and preferred strategy, but about 10% less in the alternative strategy. This reduction in the alternative strategy is explained by heavier traffic flow on the A264 around Copthorne, which causes re-routing of traffic further east near East Grinstead, and hence less congestion on the A264 at the A22 junction.

Table 8: Highway Junctions and links with RFC >100% in Preferred and Alternative Strategies and in Reference Case			
	RFC (Most Congested Movement)		
Road Junction / Link Location	Reference Case	Preferred Strategy	Alternative Strategy
Crawley Borough Local Area			
M23 Junction 11 Pease Pottage	105%	105%	100%
A264 Copthorne Way / A2220 Copthorne Road	103%	103%	103%
A264 Crawley Road / B2195	104%	104%	103%
A23 London Road / Fleming Way	100%	101%	102%
A23 Crawley Avenue / A2220 Horsham Road	100%	99%	101%
A2220 Worth Park Avenue / B2036 Balcombe Road	101%	101%	101%
A2004 Southgate Avenue / Hawth Avenue	101%	101%	100%
Gatwick Road / Manor Royal	104%	104%	104%
Gatwick Road / Fleming Way	102%	103%	105%
Worth Road highway link	117%	116%	123%
Horsham District Area			
No links with RFC >100%	-	-	-
A264 / B2195	104%	104%	103%
A264 / A24 Great Daux	106%	106%	105%
A24 / B2237 Warnham Road	102%	101%	103%
A24 / A272 Cowfold Road	104%	104%	101%
A24 / A283 Storrington Road	101%	101%	101%
A24 / A27 Warren Road	106%	106%	106%
A29 Bognor Road / A281 Guildford Road Rowhook	106%	106%	106%
A281 Albion Way / B2195 North Street Horsham	104%	104%	104%
A281 / A264 Five Oaks Road Broadbridge Heath	102%	99%	99%
West Sussex Wider Area			
A264 / A22 East Grinstead	104%	103%	91%
A272 / A281 Cowfold	104%	103%	104%
A272 / B2111 Haywards Heath	102%	101%	101%
A273 / B2116 Stonepound Hassocks	118%	118%	118%
B2112 / Haywards Heath Relief Road	101%	101%	101%
B2028 / B2037 Effingham Park	110%	110%	109%
B2115 / Leechpond Hill Lower Beeding	101%	101%	101%
B2110 Paddockhurst Road / B2036 London Road	103%	102%	102%
A273 Clayton Hill highway link Pyecombe	102%	102%	104%

5.4.12. There is a roughly equal split, between the areas of Crawley Borough, Horsham District and the wider West Sussex County, of junctions that show stress in all scenarios, at AM 2029.

5.4.13. At present, no consideration has been given to how the congestion problems in Table 8 might be resolved, as they would be a result of background growth of trip demand, and not a consequence of specific land-use developments proposed in either the preferred or alternative strategies. Resolving these problems is therefore not within the remit of this study.

5.4.14. The network problem locations, where there would be excessive stress in the reference case as well as in the strategy scenarios, will depend upon remedial attention from West Sussex County Council, which is the responsible highways and transportation authority.

5.4.15. However, it is worth noting that the congestion issue at A23 Crawley Avenue / A2220 Horsham Road roundabout might be resolved by modifying the proposed junction improvement here, associated with the Kilnwood Vale development, which has been included in all model scenarios. The modelled improvement entails 2-lane approaches from all arms, with a free-flow left lane from A2220 Horsham Road (south west) to A23 Crawley Avenue (north west).

5.4.16. There is an earlier proposed roundabout improvement, here, which comprised a revised footprint with 3-lane approaches from all arms with the same free-flow left turn. It is likely that this layout would resolve the congestion problem identified in the model.

5.4.17. The stage-2 assessment did not reveal any excessive 'stress' issues arising at the Junction of A23 Crawley Avenue and A2011 / A2219 London Road, with either the preferred or alternative strategies. In the reference case, here, the RFC would reach 100%, but this would be reduced in the strategy scenarios by a combination of signal optimisation here and transfer of some traffic on to other routes benefiting from improved junction capacity initiatives.

5.4.18. The proposed northbound dedicated bus link through the junction, in the preferred and alternative scenarios, to complement the existing southbound link, would be likely to improve travel times for bus passengers, with little adverse impact. However, the detailed impact could not be easily evaluated in the strategic model, because the PT network did not represent reduced delays for passengers at individual traffic signals.

5.4.19. It is also significant in Table 8 that several key road junctions on A264 and A24, around Horsham, would experience flows in excess of capacity in all future scenarios. The expected traffic congestion here would most likely be caused by committed development at Kilnwood Vale and Broadbridge Heath. Some remedial intervention by WSCC would be needed at these junctions to relieve congestion in the reference case, regardless of further developments in Crawley.

<u>Network Locations with Excessive Stress in Preferred and Alternative Strategies</u>

5.4.20. As mentioned earlier, we have identified three categories of excessive network 'stress, which require mitigation in the preferred and alternative development strategies. These comprise:

- RFC above 100% in all scenarios, but worse in preferred and alternative strategies;

- RFC above 100% in preferred and alternative scenarios only; and
- RFC below 100% in all scenarios, but worse in preferred and alternative strategies;

5.4.21. Taking the first category, there are certain road junctions and links where the RFC on the most congested arm is above 100% in all scenarios at 2029, but where the RFC is significantly greater in the preferred and alternative strategies than in the reference case. These are locations where further remedial interventions may be needed, to enable satisfactory network operation.

5.4.22. Table 9 shows details of these junctions and links.

Table 9: Highway Junctions and links with RFC >100% in All Scenarios but Worse in Preferred and Alternative Strategies

	RFC (Most Congested Movement)		
Road Junction / Link Location	**Reference Case**	**Preferred Strategy**	**Alternative Strategy**
Crawley Borough Local Area			
No Junctions	-	-	-
Worth Road highway link	117%	116%	**123%**
Horsham District Area			
No Junctions	-	-	-
No links	-	-	-
West Sussex Wider Area			
No Junctions	-	-	-
No links	-	-	-

5.4.23. There is only one highway link and no junctions, which would be congested in all scenarios but show noticeably greater stress in the alternative strategy than in the reference case. This is at the Worth Road highway link north west bound, between B2036 Balcombe Road and A2220 Worth Park Avenue. The congestion here reflects the traffic calming measures that are in place along the link, so it is probably reasonable to accept the disruption to free-flow on Worth Road in order to maintain a safer and more resident-friendly environment. No further mitigation has been considered here.

5.4.24. There are no locations in Horsham District or wider West Sussex that would experience excessive RFC in all scenarios, but worse RFC in the preferred or alternative strategies.

5.4.25. Considering the second stress category, several parts of the Crawley network are predicted to experience RFC in excess of 100% in the preferred and alternative strategies, but not in the reference case. These locations are shown in Table 10.

Table 10: Highway Junctions and links with RFC >100% in Preferred and Alternative Strategies Only			
	RFC (Most Congested Movement)		
Road Junction / Link Location	Reference Case	Preferred Strategy	Alternative Strategy
Junctions and Links with RFC >100% in Preferred Strategy and not in Reference Case			
Crawley Borough Local Area			
A2011 Crawley Avenue / A2004 Northgate Avenue / Hazelwick Avenue	95%	**100%**	93%
A2220 Station Way / A2004 Southgate Avenue	72%	**100%**	94%
No links	-	-	-
Horsham District Area			
No Junctions	-	-	-
No links	-	-	-
West Sussex Wider Area			
No Junctions	-	-	-
No links	-	-	-
Junctions and Links with RFC >100% in Alternative Strategy and not in Reference Case			
Crawley Borough Local Area			
M23 Junction 9 Gatwick Airport	94%	92%	**99%**
No links	-	-	-
Horsham District Area			
No Junctions	-	-	-
No links	-	-	-
West Sussex Wider Area			
No Junctions	-	-	-
No links	-	-	-

5.4.26. The model shows two locations in Crawley in the preferred strategy and one location in Crawley in the alternative strategy, which would have excessive stress compared with the reference case. There are no similar locations in Horsham or wider County areas, in either scheme scenario.

5.4.27. We have investigated the scope for remedial interventions to solve the stress points identified in Table 10. These interventions are discussed further in section 5.5, but are first outlined briefly below.

5.4.28. At A2011 Crawley Avenue / A2004 Northgate Avenue / Hazelwick Avenue gyratory, the stress in the preferred strategy is caused by a shortfall in capacity on the circulating carriageway between Hazelwick Avenue and A2004 Northgate Avenue. This could be resolved by amending the signal layout assumed here for the North east Sector development.

5.4.29. At A2220 Station Way / A2004 Southgate Avenue, an RFC of 100% was predicted in the preferred strategy only. However, this was the misleading result of a minor coding error in the original Crawley TCM which overlooked the shared northbound ahead and left turn lane from A2004 Southgate (south). Correcting this lane configuration in the model resolves the high RFC from this approach in the preferred strategy.

5.4.30. In the alternative strategy, there is likely to be adverse stress at M23 Junction 9 that would not arise in the reference case or preferred strategy. The RFC here in the alternative strategy would be 99%, on the M23 northbound exit slip to the roundabout. Although this RFC shows the peak AM average traffic flow to be below capacity, it would be likely to represent a congestion problem during normal fluctuations in flow, when the volume of traffic arriving would intermittently exceed capacity. However, there could be scope for resolving the congestion by widening the exit slip and circulating carriageway approaches and also the westbound exit towards M23 Junction 9a.

5.4.31. Finally, regarding the third stress category, a few locations in Crawley are anticipated to have RFC below 100% in all scenarios, but with significantly worse performance in the preferred and alternative strategies than in the reference case.

5.4.32. Table 11 indicates these locations.

Table 11: Highway Junctions and links with RFC <100% in All Scenarios but Significantly Worse in Preferred and Alternative Strategies

	RFC (Most Congested Movement)		
Road Junction / Link Location	**Reference Case**	**Preferred Strategy**	**Alternative Strategy**
Crawley Borough Local Area			
A23 Crawley Avenue / Ifield Avenue	89%	**97%**	81%
A2219 Pegler Way / High Street	40%	68%	**90%**
A23 London Road / Manor Royal	87%	**97%**	75%
A23 London Road / Gatwick Road	46%	**90%**	56%
A2219 London Road / Kilnmead	47%	66%	**85%**
A2011 Crawley Avenue / B2036 Balcombe Road	89%	**95%**	73%
No links	-	-	-
Horsham District Area			
A272 / B2139 Coolham Road	89%	89%	**95%**
No links	-	-	-
West Sussex Wider Area			
No Junctions	-	-	-
No links	-	-	-

5.4.33. The model shows four locations in Crawley in the preferred strategy and two locations in Crawley in the alternative strategy, which would have excessive stress compared with the reference case. There would also be one location in Horsham with excessive stress, in the alternative strategy only, but none in the wider County area in either scheme scenario.

5.4.34. Of the identified locations in Table 11 with RFC below 100%, but markedly increased stress compared with the reference case, the strategy junctions with RFC of 90% or less should not require mitigation, as these will still have spare capacity. However, we have considered possible remedial interventions to resolve junctions with RFC of 95% or more. These interventions are discussed further in section 5.5, but are first outlined briefly below.

5.4.35. At A23 Crawley Avenue / Ifield Avenue, in the preferred strategy, the high RFC would arise on the eastbound ahead movement from Crawley Avenue (west). It is likely that the congestion here could be resolved by introducing traffic signals at the roundabout.

5.4.36. At A23 London Road / Manor Royal, in the preferred strategy, the high RFC would occur on the northbound right turn from London Road to Manor Royal. It should be feasible to improve the capacity of this movement, to mitigate the high RFC.

5.4.37. This improvement would probably be advisable in the alternative strategy also, but the need is hidden in the model by approximations contained in the SATURN signal optimisation process.

5.4.38. At A2011 Crawley Avenue / B2036 Balcombe Road, in the preferred strategy, the high RFC would appear on the westbound right turn from Crawley Avenue to the new, North East Sector development access road. It should be possible to widen the main westbound carriageway of the A2011 on the junction approach to allow additional right turn capacity at the junction.

5.4.39. This mitigation would probably also be advisable in the alternative strategy.

5.4.40. Finally, at A272 / B2139 Coolham Road crossroads, in the alternative strategy, the high RFC would arise for opposed straight-ahead traffic from A272 east to A272 west. It is likely that introduction of simple, vehicle-responsive, traffic signal control here would resolve the congestion problem, because the RFC on all other approaches is low (maximum 49% ahead from A272 west to east) and, overall, there would be ample spare capacity in the junction for signals to operate effectively.

5.5. Remedial Interventions to Resolve Network Stress

5.5.1. Further modelling of the remedial network interventions outlined above in section 5.4, has been undertaken. This has entailed extra assignments of the strategic hybrid model and also detailed junction operational analysis in LINSIG (for signal junctions).

5.5.2. We have outlined and provisionally tested remedial schemes to resolve the congestion problems identified in Table 10 (for RFC greater than 100%) and in Table 11 (for RFC greater than 95%). Outcomes from the detailed LINSIG signal junction appraisals are shown in Appendix D.

5.5.3. The remedial interventions comprise highway network improvements only, at this stage, because feasible bus service enhancements have already been included in preceding runs of the preferred and strategy scenarios (see section 3.0).

Summary of Proposed Remedial Interventions

5.5.4. In summary, there are network locations at which a need for remedial intervention has been identified, in order to accommodate the preferred and alternative strategies. Impact mitigation schemes have been outlined and tested in further assignments of the hybrid transport model, so as to tackle the stress problems at these locations.

5.5.5. The scheme locations and likely performance are shown in Table 12, with RFC before and after the interventions are introduced, as predicted by the SATURN traffic assignment model and the LINSIG detailed junction models.

Table 12: Summary of Highway Locations Needing remedial Intervention

			RFC (Most Congested Movement)		
Road Junction / Link Location	**Target Scenario in which Intervention is Required**	**Outline Scope of Intervention**	**SATURN Before Intervention**	**SATURN After Intervention**	**LINSIG After Intervention**
Crawley Borough Local Area					
A2011 Crawley Avenue / A2004 Northgate Avenue / Hazelwick Avenue	Preferred Strategy	Signalised roundabout – widen circulating carriageway to 4 lanes past A2004 northbound 3-lane entry, allowing 2 lanes exiting to A2011 westbound and 3 lanes circulating past A2011 eastbound 2-lane entry	100%	97%	61%
A2220 Station Way / A2004 Southgate Avenue	Preferred Strategy	Correct modelled signal arrangement from A2004 northbound to allow 3 lanes: left-only, shared left / ahead and ahead-only lanes	100%	86%	N/A
A23 Crawley Avenue / Ifield Avenue	Preferred Strategy	Introduce linked signal junction scheme from alternative strategy at A23 / Ifield Avenue and at Ifield Drive / Ifield Avenue roundabouts	97%	84%	85%
A23 London Road / Manor Royal	Preferred Strategy	Improve capacity of 2-lane northbound right turn from A23 northbound at signals, by widening the eastbound exit on Manor Royal to 2 lanes as far as Crawley Business Quarter turn.	97%	83%	93%
A2011 Crawley Avenue / B2036 Balcombe Road	Preferred Strategy	Widen A2011 westbound to provide 2 lanes ahead and 2 right turn lanes at the signals, into the NES development access link, which has 2 lanes northbound.	95%	67%	72%
M23 Junction 9 Gatwick Airport	Alternative Strategy	Widen offside junction approaches from M23 northbound exit and circulating past northbound exit to 3 lanes each and widen westbound exit towards M23J9a to 3 lanes, with speed limit / downgrading of J9 to J9a section for safety.	99%	89%	84%

5.5.6. It can be seen that the proposed outline remedial interventions will resolve the stress problems, by reducing the high RFC problems to more acceptable levels, below 100% RFC in SATURN and below 95% in LINSIG, in the respective target scenarios. It can also be confirmed that the proposed interventions will operate satisfactorily in the non-target scenarios (i.e. in the alternative strategy for preferred strategy interventions and in the preferred strategy for the alternative strategy interventions).

5.5.7. The performance of the proposed remedial interventions has been examined in more detail using LINSIG signal junction modelling. This has confirmed that the schemes would operate with highest RFC below 95%. Although this would reflect a significant level of congestion at London Road / Manor Royal, in the preferred strategy, it would nevertheless be an improvement upon the situation without intervention.

5.5.8. Outline layouts of the proposed interventions in Table 12 are shown in Figures 12 to 16, by respective location, superimposed on highway boundary drawings obtained from WSCC.

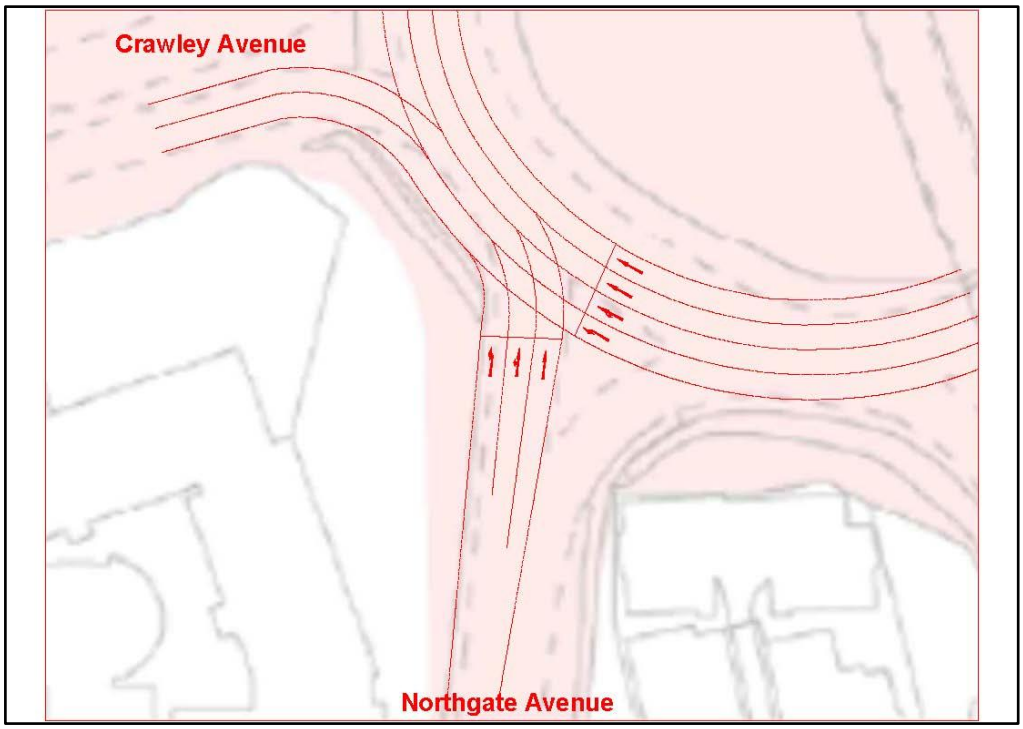

Figure 12: A2011 Crawley Avenue / A2004 Northgate Avenue / Hazelwick Avenue – Localised Carriageway Widening

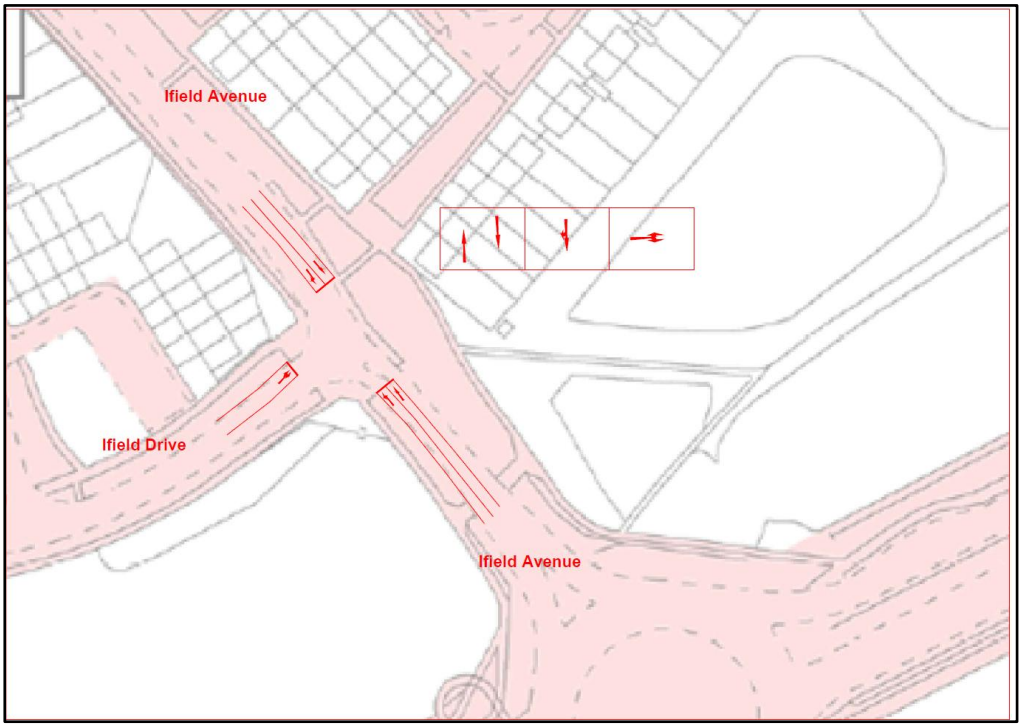

Figure 13: A23 Crawley Avenue / Ifield Avenue / Ifield Drive – Linked Signal Arrangement

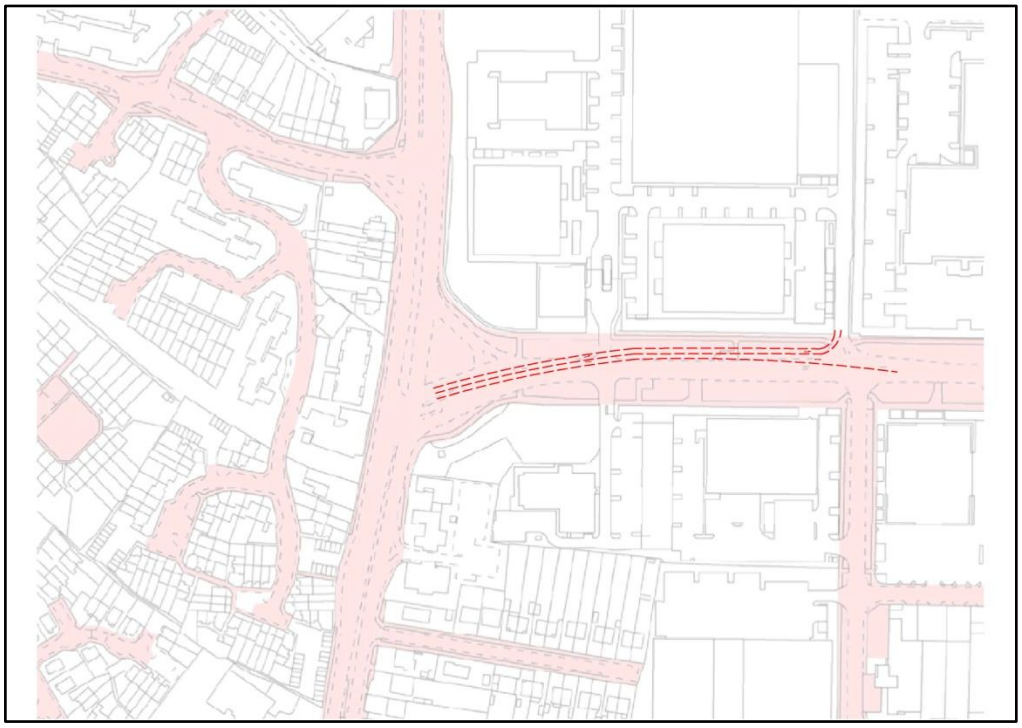

Figure 14: A23 London Road / Manor Royal – Improved Right Turn Capacity and Localised Carriageway Widening

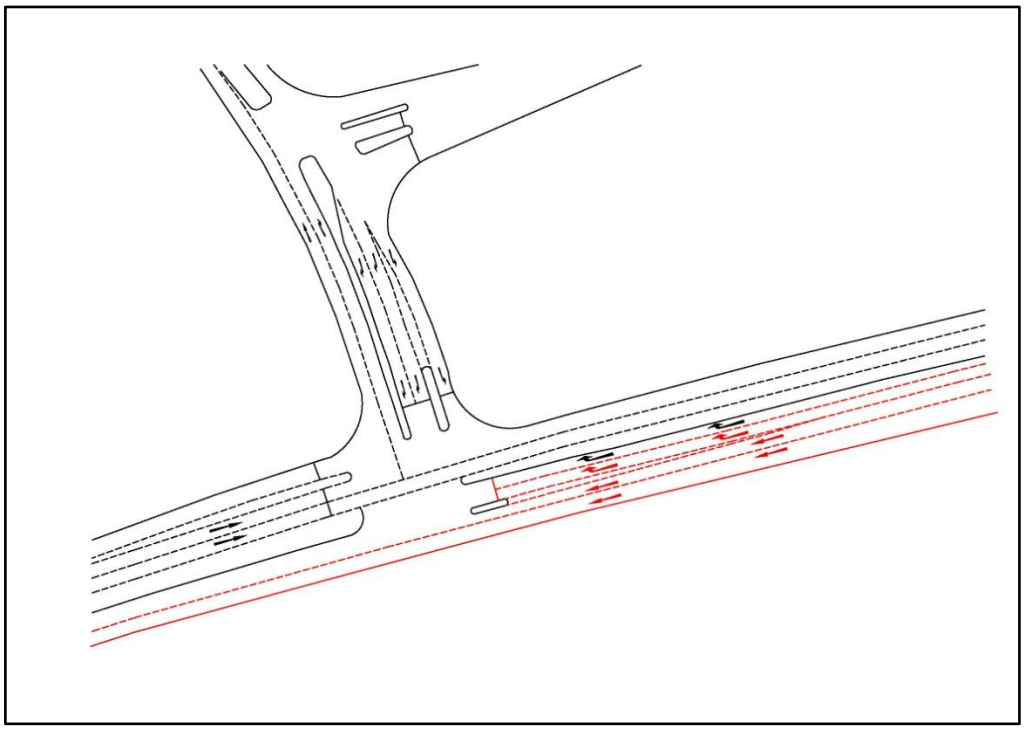

Figure 15: A2011 Crawley Avenue / B2036 Balcombe Road – Improved Right Turn Capacity and Localised Carriageway Widening

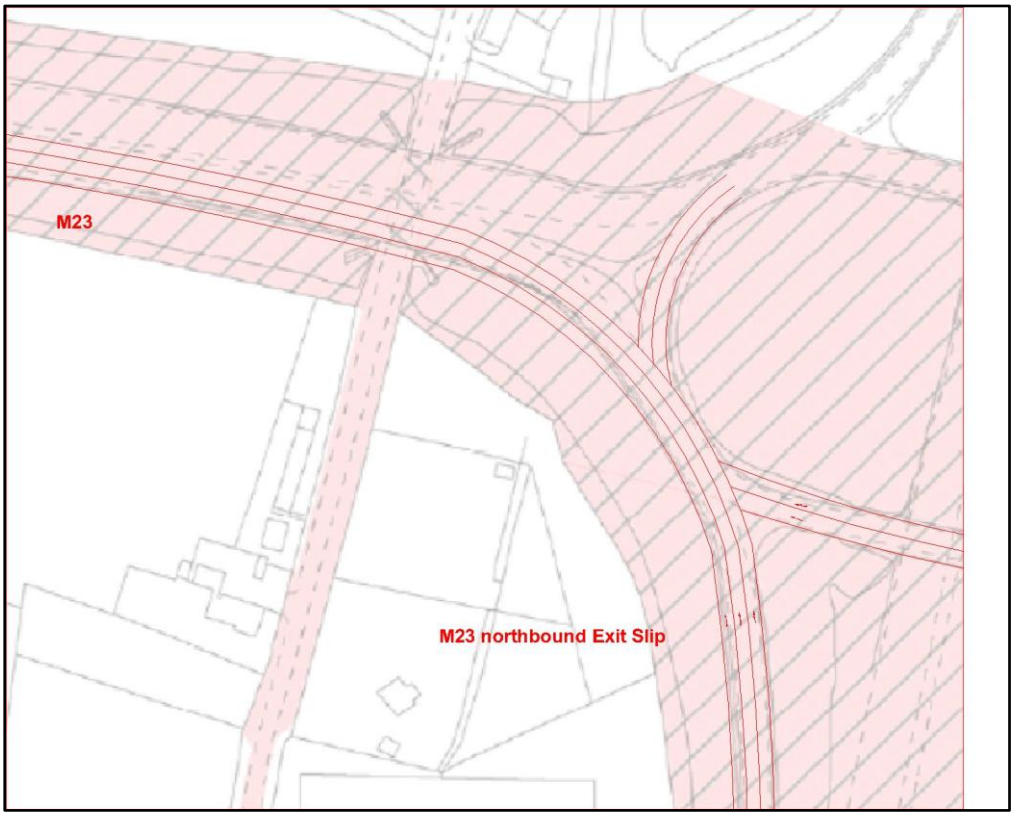

Figure 16: M23 Junction 9 Gatwick Airport – Signal Approach Widening and Localised Carriageway Widening

5.5.9. It is expected that the schemes shown in Figures 12 – 16 could be accommodated within the available highway boundaries.

5.6. Analysis of Traffic Flows Through Ashdown Forest

5.6.1. An assessment has been made of whether or not the Crawley Local Plan would impact upon the local air quality of the environmentally sensitive area of Ashdown Forest Special Area of Conservation (SAC), lying to the south east of East Grinstead.

5.6.2. The Crawley hybrid transport model includes several key roads that access or cross Ashdown Forest, namely:

- A275 (Lewes – East Grinstead);
- A22 (Uckfield – East Grinstead);
- A26 (Uckfield – Crowborough);
- B2110 (East Grinstead – Royal Tunbridge Wells);
- B2188 (Maresfield – Groombridge);
- B2026 (B2188 – B2110); and
- Coleman's Hatch road (East – West through Ashdown Forest).

5.6.3. Owing to the strategic nature of the Crawley hybrid model and the location of Ashdown Forest on the north east periphery of the network, the model will not provide meaningful flow assignments for B2188, B2026 or Coleman's Hatch Road. However, an assessment has been made of future traffic impacts on A275, A22, A26 and B2110, which pass by, or through, Ashdown Forest. The assessment represents a 'worst case' for these routes, which are modelled as carrying additional traffic that might otherwise travel on B2118, B2026 and Coleman's Hatch Road, within the SAC.

5.6.4. Local air quality in Ashdown Forest is required to conform to the Habitats Directive. The threshold for determining significant traffic impact upon air quality is set in the Habitats Regulations Assessment, using the Department for Transport's Design Manual for Roads and Bridges (DMRB). The threshold is defined as a 2-way flow increase of 1,000 vehicles or more, annual average daily traffic (AADT).

5.6.5. Representative local flow factors have been used to convert AM peak hour model outputs, at 2029, to AADT. The resulting flows on the Ashdown Forest routes, for the forecast scenarios, have been compared with the reference case. Outcomes are shown in Table 13.

Table 13: Daily Traffic Impact on Ashdown Forest Highway Routes 2029

	Two-Way Annual Average Daily Traffic Flow (Vehicles)		
Road Link Section	**Reference Case**	**Preferred Strategy**	**Alternative Strategy**
Two-Way Annual Average Daily Traffic Flow (Vehicles)			
A275	6608	6486	6586
A22	5965	6005	6144
A26	3962	3902	4017
B2110	2623	2503	2614
Two-Way AADT Change from Reference Case (Vehicles)			
A275	-	-122	-22
A22	-	40	180
A26	-	-60	55
B2110	-	-120	-9

5.6.6. With the preferred strategy there would be a general reduction in AADT flows around Ashdown Forest relative to the reference case at 2029, except on the A22 where there would be a slight increase of less than 50 vehicles per day (2-way). The changes in flow in the area of interest would be insignificant and markedly less than the 1,000 vehicle AADT threshold. The patterns probably reflect the shift, within the scope of the model, of the main land-use trip generators and attractors to developments in and around Crawley.

5.6.7. In the alternative strategy, there would also be fairly insignificant changes in AADT flow around Ashdown Forest at 2029. There would be modest increases in flow on A22 and A26 of less than 200 vehicles per day, relative to the reference case, but these would be well below the 1,000 vehicle AADT threshold. The increases probably reflect the larger amount of development and associated trips in the alternative strategy.

5.6.8. Overall, it is evident that the Crawley Local Plan would not cause traffic flows on the key routes to impact significantly upon Ashdown Forest.

6. Summary and Conclusions

6.1.1. A transport modelling appraisal has been undertaken to assess the likely impact of Crawley Borough Council's proposed Local Plan land-use allocation, on the transport network at 2029. This is a multi-modal highway and public transport assessment for the weekday AM peak, using a hybrid of the Crawley Town Centre Model and the West Sussex County Transport Model.

6.1.2. It is the second stage of a two-stage process. Stage 1 considered the broad impact of strategic allocations of households and jobs in coarse zones around Crawley and identified a need to reduce the overall scale of development to a more manageable level. Stage 2 has refined the development specifications to particular land-use types and locations.

6.1.3. The objective of stage-2 has been to determine if the proposed cumulative allocation of between about 3,800 dwellings ('preferred strategy') and 4,200 dwellings ('alternative strategy'), in Crawley Borough, could be accommodated without unacceptable stress on the transport network, as defined by National Planning Policy Framework (NPPF) criteria. Where stresses have been identified, stage 2 has examined if certain remedial interventions could be introduced to mitigate the impacts.

6.1.4. The underlying hybrid transport model, which was used for the study, was first validated to base year 2008 conditions, to verify that it was reliable and suitable for forecasting future development impacts.

6.1.5. Three stage-2 scenarios have been represented in the model at 2029, namely: a reference case, (comprising completed and committed development and transport schemes); a preferred strategy, (consisting of the most deliverable Local Plan residential and employment developments added on to the reference case, with associated transport access improvements); and finally an alternative strategy, (entailing additional, less deliverable, sites added on to the reference case and preferred strategy scenarios, again with appropriate transport access improvements included).

6.1.6. Background growth of trip demand outside Crawley Borough, from 2008 to 2029, has been calculated in line with DfT guidance, using NTEM and NTM. Additional site-specific trips have also been included, for each land-use development in the respective scenarios, as derived from TRICS. The quantity of additional site-specific trips, which have been calculated for each appraisal scenario, increased from 14,200 in the reference case, to 18,450 in the preferred strategy (30% increase from reference case) and 23,000 in the alternative strategy (62% increase from reference case), before minor adjustment in the variable demand model.

6.1.7. As a result of future growth, the modelled scenarios would show a greater increase in all-mode trips within, to, or from Crawley, than in the wider West Sussex County. These respective scenario trip increments, from base year, for Crawley local area, would amount to 17% in the reference case, 21% in the preferred strategy and 25% in the alternative strategy. However, the respective scenario trip increments, from base year, for the wider West Sussex area, would amount to only 14% in the reference case, 13% in the preferred strategy and 14% in the alternative strategy.

6.1.8. Proportionate growth for public transport trips would be much greater than for highway trips, especially in Crawley local area, because there is a lower base year starting point and also because bus service improvements have been modelled on key routes serving proposed development sites.

6.1.9. Overall mode split between highway and PT, in the Crawley local area, would increase from around 7% in the base year to around 11% in all the future scenarios. However, the proportionate mode split would not vary between the reference case, preferred and alternative strategy scenarios.

6.1.10. Transport impacts of the respective scenarios have been modelled and analysed to highlight any occurrence of highway network 'stress', that is to say, an unacceptable ratio of flow to capacity (RFC) that approaches or exceeds 100%, on road links and junctions, or an RFC that is considerably greater in the Local Plan strategies than in the reference case.

6.1.11. Outcomes from stage 2 have indicated that there are a number of locations, inside and outside Crawley, where excessive stress would arise at 2029, AM peak, in every scenario. Such stress would also occur at key strategic junctions on A264 and A24 around Horsham, as a consequence of committed development.

6.1.12. At all of these locations, the stress would not be significantly worse with the Local Plan strategies, than with the reference case, so no remedial interventions have been suggested. It would be for WSCC and in some cases the Highways Agency, to resolve the background congestion problems in the reference case, before remedial schemes should be considered.

6.1.13. There is one location where stress would occur in the preferred strategy, with RFC greater than 100%, but would not occur in the reference case, namely at A2011 Crawley Avenue / A2004 Northgate Avenue / Hazelwick Avenue junction. This junction would require mitigation.

6.1.14. There is also one location where stress would develop in the alternative strategy, with RFC very close to 100%, but not in the reference case, namely M23 Junction 9 Gatwick Airport. This junction would also need remedial intervention.

6.1.15. Remaining junctions at which mitigation would be needed in the Local Plan strategies, because RFC is significantly greater than in the reference case (although still below 100%), would comprise: A23 Crawley Avenue / Ifield Avenue (in the preferred strategy only); and A23 London Road / Manor Royal; and A2011 Crawley Avenue / B2036 Balcombe Road; (each in both the preferred and alternative strategies).

6.1.16. Potential outline remedial interventions have been tested in the hybrid model to mitigate the adverse stress caused by Local Plan development in the above scenarios and locations. The measures that have been tested and shown to perform satisfactorily comprise: A2011 Crawley Avenue / A2004 Northgate Avenue / Hazelwick Avenue signalised roundabout (– localised carriageway widening and lane reconfiguration, on the circulating carriageway); A23 Crawley Avenue / Ifield Avenue roundabout (– linked signal arrangement at adjacent roundabouts on Ifield Avenue); A23 London Road / Manor Royal signals (– improved right turn capacity on London Road and localised carriageway widening on Manor Royal); A2011 Crawley Avenue / B2036 Balcombe Road signals (– improved right turn capacity and localised carriageway widening on Crawley Avenue); and M23 Junction 9 Gatwick Airport signalised roundabout (– signal approach widening and localised carriageway exit widening).

6.1.17. Outline layout designs for these potential remedial schemes have been drafted on to the existing highway boundary plans to show that the schemes could be accommodated without any need for extra land-take. The proposed new scheme layouts have also been assessed using LINSIG, to confirm that the expected traffic movements would take less than 95% of available signal junction capacity at AM peak 2029.

6.1.18. It has been confirmed from the modelling appraisal that the Local Plan strategies would not cause significant change in annual average daily traffic flows in the vicinity of Ashdown Forest Special Area of Conservation. Any predicted rise in AADT on A275, A22, A26 or B2110 would be much less than the 1,000 vehicle flow increase threshold for significant impact, set by DEFRA habitats regulations.

6.1.19. In conclusion, the stage-2 study has indicated that the Crawley Local Plan preferred and alternative strategies could be successfully delivered at AM peak 2029, within NPPF acceptable transport impact guidelines. This is dependent upon recommended remedial interventions being introduced to mitigate localised highway congestion likely to be caused by preferred and alternative development strategies. It is also in the context of there being around 30 main road junctions, spread evenly between Crawley Borough, Horsham District and the wider West Sussex County, where excessive congestion would arise in all future scenarios and where remedial improvements would be needed in the reference case, to relieve network stress.

Appendix A

Appendix A: ..... Breakdown of Component Land-Use development Sites by Model Scenario

Appendix B

Appendix B: .... Analysis of Network Link and Junction Performance in Respective Model Scenarios

Appendix C

Figure 4: Transport Modelling Stage 2 Location of Site Specific Developments.....Appendix C
Figure 5: Location of Junctions for Analysis in Crawley Borough.....Appendix C
Figure 6: Location of Links for Analysis in Crawley Borough .....Appendix C
Figure 7: Location of Junctions for Analysis in West Sussex .....Appendix C
Figure 8: Location of Links for Analysis in West Sussex .....Appendix C
Figure 9: Junction RFC in Crawley Borough with Reference Case AM 2029 .....Appendix C
Figure 10: Junction RFC in Crawley Borough with Preferred Strategy AM 2029.....Appendix C
Figure 11: Junction RFC in Crawley Borough with Alternative Strategy AM 2029.....Appendix C

Appendix D

Appendix D: ..... LINSIG traffic signal performance outcomes for remedial junction improvements

A2011 Crawley Avenue/A2004 Northgate Avenue/Hazelwick Avenue junction ..... Appendix D
Ifield Avenue/Ifield Drive junction ..... Appendix D
A23 London Road/Manor Royal junction ..... Appendix D
A2011 Crawley Avenue/B2036 Balcombe Road junction ..... Appendix D
M23 Junction 9 Gatwick Airport ..... Appendix D