Appraisal Framework Module 4.

Surface Access: Dynamic Modelling Report

Gatwick Airport Second Runway

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1. Introduction

1.1 Background

1.1.1 The Airports Commission (AC) was established in 2012 by the UK Government to examine the need for additional UK airport capacity and to recommend how any additional capacity requirements can be met in the short, medium and long-term. The AC is due to submit a Final Report to the UK Government by the summer of 2015, assessing the environmental, economic and social costs and benefits of various solutions to increase airport capacity, considering operational, commercial and technical viability.

1.1.2 Shortly after its inception, the AC issued tenders for support contracts to engage independent technical advice on a range of aspects of the Commission's work. Jacobs together with sub-consultants Leigh Fisher and Bickerdike Allen Partners were appointed as the sole supplier on the Airport Operations, Logistics and Engineering Support Contract (ref: RM1082), which runs throughout the AC's lifespan up until the summer of 2015.

1.1.3 A key milestone in the AC's operational life was the delivery in December 2013 of an Interim Report. Following a general call for evidence, the Interim Report detailed the results of analysis of the capacity implications of forecast growth in UK aviation demand and a preliminary appraisal on a long-list of proposals put forward by scheme promoters to address the UK's long-term aviation connectivity and capacity needs. The associated appraisal process identified three short-listed options, two focussed on expanding Heathrow Airport and one on expanding Gatwick. These options were subsequently developed and appraised further during an assessment that was published for consultation on the 11th November 2014.

1.1.4 The pre-consultation surface access assessment constituted a static appraisal using spreadsheet-based demand-forecasting tools. These models helped quantify the surface transport capacity implications of each expansion option. Following feedback from the AC's surface access stakeholders (the Department for Transport (DfT), the Highways Agency (HA), Network Rail (NR), and Transport for London (TfL)), further assessment of the surface access implications of the three expansion options was undertaken during the consultation period, which ended on the 3rd February 2015. This work is referenced as 'post-consultation' in the remainder of this report.

1.2 Study scope

1.2.1 Jacobs were commissioned to undertake the aforementioned post-consultation surface access assessment of the short-listed expansion options, which had three key aims as follows:

- To undertake further sensitivity-testing of the pre-consultation models to determine the impact of key variables on airport-related surface access demand, notably incorporating trip distribution forecasts from the DfT's National Air Passenger Allocation Model (NAPAM);
- To provide a more detailed dynamic assessment of the capacity and level-of-service implications of airport expansion associated with each short-listed option, accounting particularly for the following:
  - the extent to which road and rail trips (including non-airport trips) change their route to avoid congestion/over-crowding, and the associated knock-on impacts;
  - the extent to which new rail services related to currently uncommitted infrastructure may induce an increase in background demand;
  - the wider impacts of crowding on the rail network providing secondary connections to airport services, notably the London Underground;
  - the effect of forecast demand on junction performance and the resulting congestion impacts, both on the strategic road network and on roads in the vicinity of the airports;

- To provide traffic forecasts compatible with the requirements of the air quality assessment that will be undertaken as a part of a separate environmental work-stream - the data requirements for this work-stream are summarised in Appendix A.

1.2.2 The ultimate aim of the study was to provide further guidance to the AC on the feasibility of, and likely surface transport issues associated with each expansion option, with specific reference to three objectives set out in the AC's Appraisal Framework:

- **Objective 1** - to maximise the number of passengers and workforce accessing the airport via sustainable modes of transport;
- **Objective 2** - to accommodate the needs of other users of transport networks, such as commuters, intercity travellers and freight; and
- **Objective 3** - to enable access to the airport from a wide catchment area.

1.2.3 This report is the **dynamic modelling appraisal report** for the post-consultation surface access assessment of Gatwick Airport Second Runway. For reference, the pre-consultation reports are available to download from the AC's website[1]. The aforementioned surface access environmental impacts are considered as part of a separate work-stream.

1.3 Methodology overview

1.3.1 Three work-streams were undertaken as part of the dynamic modelling post-consultation assessment, summarised as follows:

- Enhanced distribution/mode-share modelling – this involved enhancements to the spreadsheet models developed pre-consultation – the air passenger and on-airport employee surface access forecasts arising from the enhanced models provided inputs for the following two work-streams;
- Dynamic rail modelling – rail surface access forecasts from the enhanced spreadsheet models were input into the network-based 'Railplan model' (version 7, supplied by TfL) to assess the dynamic impacts of increasing airport-related rail trips on network performance in London and the South-East of England – Railplan was chosen for this purpose as it is an industry-standard model used by TfL and Network Rail to assess rail schemes in London and the South East;
- Dynamic highway modelling – highway surface access forecasts from the same spreadsheet models were also input into an adapted version of TfL's South London Highway Assignment Model (SoLHAM) to assess the dynamic impacts of increasing airport-related road trips on network performance in London and the South-East – SoLHAM was chosen as a starting point as it is a detailed network-based highway capacity model of South London, which was validated to a 2009 base year and is used by TfL to assess road schemes in South London.

1.3.2 SoLHAM required adapting for the purposes of this study since the model 'simulation' area (the area where signal junctions are coded in detail) only extended as far south as the M25. As a result, a separate West Sussex County Council SATURN model was referenced to improve network detail and refine the zone system in the area around Gatwick Airport. An alternative approach of using the HA's 'M25 model' was investigated but was rejected due to the lack of local network detail around Gatwick and the age of model development and validation.

1.3.3 The pre-consultation assessments focussed on a single AM peak-hour demand forecast for each of the airport expansion options in 2030 – this was the peak-hour for airport passenger trips, which was estimated from flight arrival/departure profiles and assumed terminal lag times. During the post-consultation assessment, the 2030 forecast year was retained but a range of time periods were assessed, driven by the requirements of the dynamic modelling work-streams. For the highway modelling, an AM peak hour (0800-0900) and a PM peak-hour (1700-1800) was required to be consistent with the SoLHAM modelled time periods, along with an average Inter Peak (IP) hour

[1] https://www.gov.uk/government/publications/additional-airport-capacity-surface-access-analysis

covering the period 1000-1600. For the Railplan modelling, 3-hour AM peak (0700-1000) and 6-hour IP (1000-1600) periods were modelled.

1.3.4 As a result of the difference in time periods, the outputs from the pre and post-consultation models are not directly comparable. In addition, the capacity analysis undertaken pre-consultation was static in nature – demand associated with a new Second Runway at Gatwick was added to estimates of background demand in the spreadsheet model and the capacity implications were assessed without consideration of the impacts of crowding and congestion on route choice and journey timing. The dynamic nature of the capacity assessments undertaken post-consultation means that the resulting forecasts do account for these elements and are consequently different from those reported previously.

1.3.5 Furthermore, as discussed in Section 2.1, the number of passengers assumed to be using Gatwick was different in the pre-consultation assessment when compared with post-consultation work. Pre-consultation, passenger forecasts from various 2014 Gatwick Airport Ltd (GAL) submissions to the AC were used to assess surface access impacts. During post-consultation analysis, a decision was taken to use AC forecasts of passenger numbers for all three expansion options to ensure a greater degree of consistency across all the options. Also, as discussed in Section 2.2, the number of Gatwick employees assumed post-consultation (where an AC forecast was used) was also different when compared with the earlier work (where GAL forecasts were used) for similar reasons.

1.3.6 The post-consultation assessment was undertaken with reference to a Core and an Extended Transport Baseline, which together listed transport infrastructure and services expected or likely to be in place by 2030 regardless of any airport expansion that may be delivered in the UK. Details of the schemes included in these baselines are provided in Appendix B – the Core Baseline only included those schemes that were fully committed and funded when the pre-consultation assessment commenced.

1.3.7 The primary focus of all the analysis was on the Extended Baseline, as by 2030 it was judged very likely that further enhancements to the UK transport network would have been delivered above and beyond the works that were fully committed.

1.3.8 Constructing an appropriate Extended Baseline for a 2030 assessment involved making significant assumptions about the likely state of the transport network by that time, and this was a central factor in the decision not to extend the scope of the surface access assessment to include later years. There is currently a high degree of uncertainty surrounding some of the included schemes, not just in terms of their delivery but also their final form and characteristics, which in some cases are continually evolving as development work is progressed. The assessment detailed in this report was based on the best assumptions on the state of the 2030 transport network at the time of writing, and was informed by discussions with the AC's stakeholders before the pre-consultation assessments were published. Some meetings between Jacobs and the stakeholders were also held during post-consultation work, mainly related to technical modelling issues and clarifications on feedback received.

1.3.9 Appendix D provides some indicative examples of road and rail trips between the airport and key locations in the UK in the 2030 Extended Baseline scenario described above, including summary crowding/congestion forecasts derived from the dynamic modelling undertaken during this study and described in the subsequent chapters of this report. The UK locations were identified based on trip distribution forecasts for the Second Runway from the DfT's NAPAM.

1.4 Report structure

1.4.1 The remainder of this report is structured as follows:

- Chapter 2 describes the core and alternative airport expansion scenarios that were tested during post-consultation;
- Chapter 3 summarises the enhancements that were made to the pre-consultation spreadsheet models and the sensitivity tests that were undertaken in response to feedback received from the

AC's stakeholders during the pre-consultation stage, and reports the resulting changes in forecast peak period surface access demand to and from airport as a result;

- Chapter 4 summarises the outputs from the Railplan modelling of the core expansion scenario for a Second Runway at Gatwick;
- Chapter 5 summarises the outputs from the dynamic highway modelling of the core expansion scenario for a Second Runway at Gatwick, using the adapted SoLHAM model;
- Chapter 6 provides a summary of the three work-streams undertaken and draws out key conclusions based on the outputs.

2. Airport expansion scenarios

2.1 Overview

2.1.1 The pre-consultation spreadsheet models forecast demand related to each airport expansion option based on a range of assumptions and parameters used to convert two key headline inputs into peak-hour surface access trips to and from the airport. These key headline inputs are total annual passengers handled by the airport, including the proportion interlining (i.e. transit passengers who do not use surface access modes), and the total number of on-airport employees.

2.1.2 As with all the short-listed airport expansion options, the basis of the pre-consultation analysis for a Second Runway at Gatwick was the scheme promoter's own forecasts, and sensitivity tests were carried out using the passenger numbers from two AC scenarios. The headline passenger numbers associated with these scenarios are shown in Table 2-1.

Table 2-1: Post-consultation assessment scenarios

Scenario	Current runway capacity				Capacity expansion (extra/extended runway)			
	Total annual pax	Annual interlining pax	Interlining %	Annual surface access pax	Total annual pax	Annual interlining pax	Interlining %	Annual surface access pax
GAL submission	46,000,000	~	8.0%	42,320,000	65,000,000	~	8.0%	59,800,000
Carbon-Capped Assessment of Need	41,082,700	2,067,868	5.0%	39,014,832	45,599,168	2,881,146	6.3%	42,718,022
Carbon-Traded Low Cost is King	43,720,928	1,627,538	3.7%	42,093,390	72,025,032	18,841,440	26.2%	53,183,592

2.1.3 In terms of employees, the GAL submission figure of 29,685 on-airport staff associated with the delivery of the Second Runway was used in all the capacity expansion scenarios, while a figure of 24,430 (also sourced from the GAL submission) was used for the airport without expansion.

2.1.4 For the post-consultation work-stream, it was decided that an appropriate AC forecast should be used as the core scenario rather than the scheme promoter's own figures, and this core scenario was applied in the dynamic rail and highway modelling work-streams. This was to reduce reliance on the scheme promoter forecasts and also to allow the incorporation of trip distribution forecasts derived from the DfT's NAPAM, which was run to generate outputs specifically for each AC scenario.

2.2 Core scenario

2.2.1 For Gatwick with a Second Runway in place, the AC scenario resulting in the highest number of airport passengers in 2030 was the Carbon-Traded Low Cost is King (CT LCK) scenario. The passenger forecasts for this scenario are summarised in Table 2-1, indicating a total of 43.7 million passengers per annum (mppa) using the airport without expansion in 2030, increasing to a total of 72.0mppa with the Second Runway in place in the same year. The proportion of those passengers that were interlining was forecast to rise from 3.7% without expansion up to 26.2% with the Second Runway in place.

2.2.2 In terms of employment, the AC produced two scenarios expressed as ratios of passengers per annum (ppa) per on-airport employee for Gatwick in 2030, summarised as follows:

- 2030 low productivity employment scenario = 1,509ppa/employee (assumed year-on-year increase of 0.5% in the ppa/employee ratio from a base 2011 figure);
- 2030 high productivity employment scenario = 2,095ppa/employee (increase of 2.25% in ratio).

2.2.3 For the purposes of the post-consultation analysis, a mid-range of 1,802ppa/employee was used to calculate an estimate of total on-airport employment associated with the CT LCK passenger scenario described above. This resulted in the key headline numbers summarised in Table 2-2 forming the core post-consultation scenario that was assessed using Railplan and the adapted SoLHAM.

Table 2-2: Post-consultation 2030 core scenario headline inputs for Gatwick Second Runway (Carbon-Traded Low Cost is King passenger forecasts with mid-range employment ratios)

Airport expansion	Annual passengers	% interliners	Annual surface access passengers	On-airport employees
Current runway capacity	43,702,928	3.7%	42,093,390	24,256
With Second Runway	72,025,032	26.2%	53,183,592	39,959

2.3 Alternative scenarios

2.3.1 In addition to the core scenario, airport-related forecasts were also produced for two other passenger scenarios, summarised in Table 2-1, with one alteration. Previously, the Carbon-Capped Assessment of Need (CC AoN) sensitivity test was undertaken using the GAL submission employee estimates. In post-consultation work, the employee assumptions related to this scenario were updated to incorporate the mid-range AC employee ratio described above. In contrast, for the GAL submission passenger scenario, the GAL employee forecasts were retained. This resulted in the summary headline inputs for the post-consultation alternative scenarios shown in Table 2-3.

Table 2-3: Post-consultation 2030 alternative scenario headline inputs for Gatwick Second Runway

Scenario	Airport expansion	Annual passengers	% interliners	Annual surface access passengers	On-airport employees
Carbon-Capped Assessment of Need (mid-range employee ratio)	Current runway capacity	41,082,700	5.0%	39,014,832	22,793
	With Second Runway	45,599,168	6.3%	42,718,022	25,298
GAL submission	Current runway capacity	46,000,000	8.0%	42,320,000	24,430
	With Second Runway	65,000,000	8.0%	59,800,000	29,685

2.3.2 It should be noted that while revised airport-related demand forecasts were produced for these scenarios alongside the core scenario for comparative purposes using the enhanced spreadsheet models, the impacts were not modelled using Railplan or the adapted SoLHAM as part of this study.

2.4 Scenario comparison

2.4.1 The tables above indicate that with the Second Runway in place, the CT LCK scenario with the mid-range employee ratio applied produces the highest absolute numbers of passengers and employees in 2030 when compared with the two alternative scenarios.

2.4.2 The GAL submission scenario results in the largest net change in annual passengers using surface access (i.e. accounting for interlining trips) at Gatwick in 2030 when the Second Runway expansion option is compared with the single-runway ‘do nothing’ option. This net change in surface access passenger numbers is illustrated for all three scenarios in Figure 2-1. Figure 2-2 indicates that the net change in employees as a result of the Second Runway is most pronounced in the CT LCK scenario with the mid-range employee ratio applied.

Figure 2-1: Forecast 2030 increase in annual passengers using surface access (Gatwick Second Runway expansion option v ‘do nothing’ option)

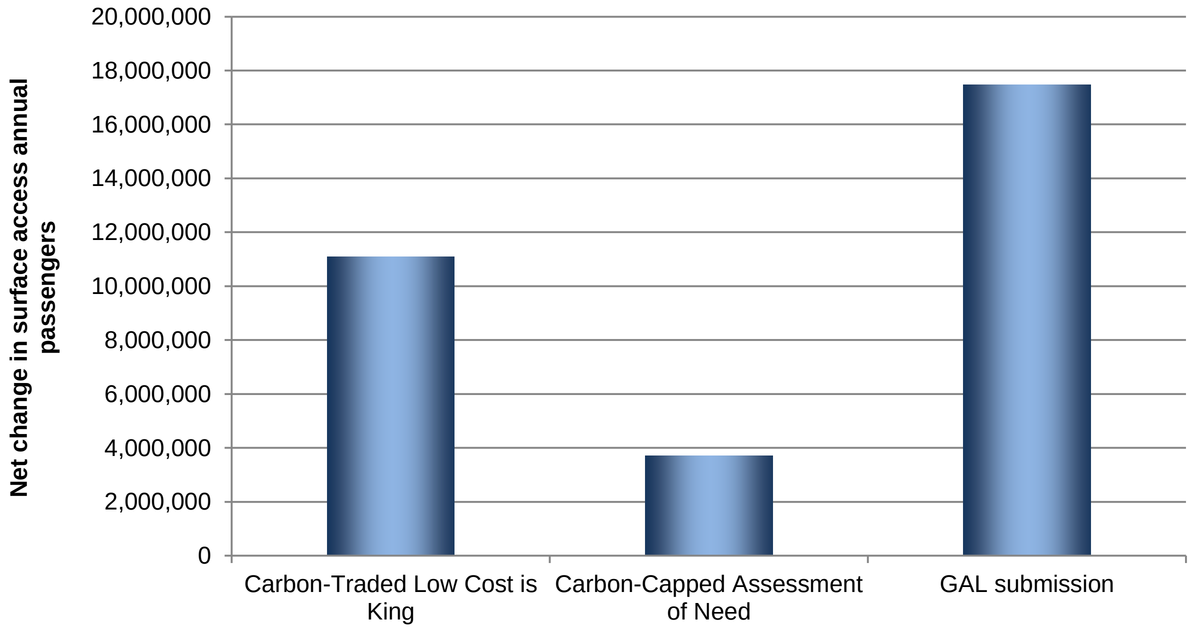
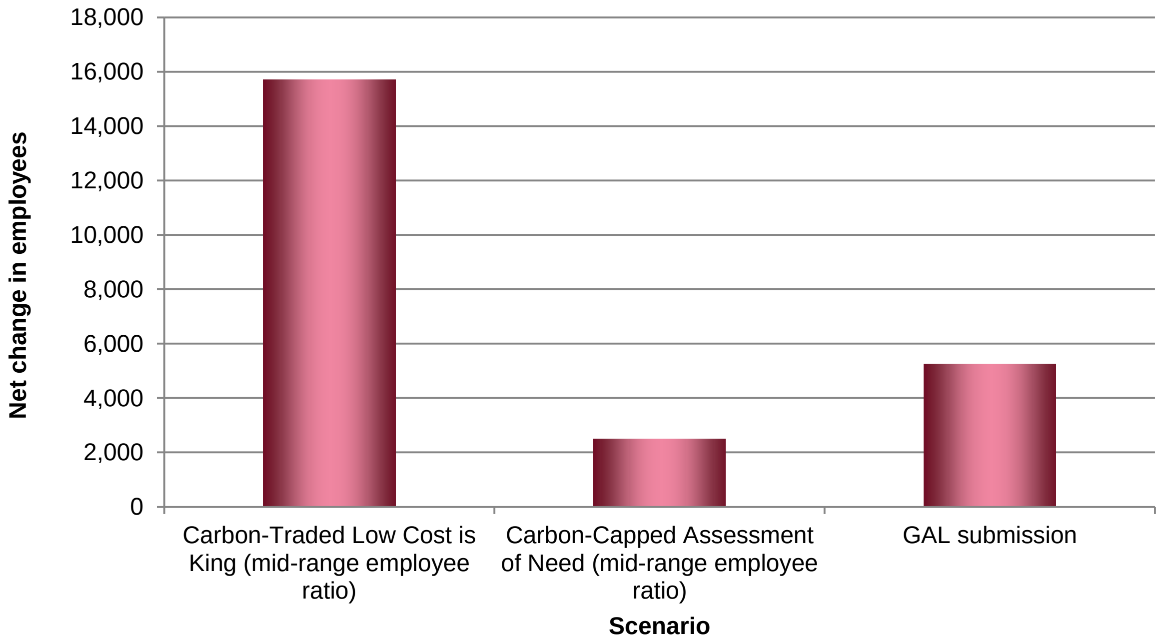


Figure 2-2: Forecast 2030 increase in employees (Gatwick Second Runway expansion option v ‘do nothing’ option)



3. Distribution and mode share modelling enhancements

3.1 Overview

3.1.1 The headline annual passenger and employee inputs described in the previous chapter were used in the spreadsheet models initially developed during pre-consultation to generate revised airport demand forecasts for a range of time periods for each scenario. The time periods assessed were dictated by the requirements of the dynamic modelling work-streams as follows:

- For the highway modelling using the adapted SoLHAM, three time periods were required:
  - an AM peak-hour (0800-0900);
  - an average Inter-Peak (IP) hour (between 1000 and 1600);
  - a PM peak-hour (1700-1800);
- For the Railplan modelling, two time periods were required:
  - a 3-hour AM peak period (0700-1000);
  - a 6-hour IP period (1000-1600).

3.1.2 Forecasts for the time periods described above were generated using passenger and employee arrival and departure profiles sourced from the GAL submission. A number of enhancements were also made to the model, post-consultation, to provide more robust forecasts. These enhancements are summarised as follows:

- for the two AC scenarios, the pre-consultation passenger surface access distribution assumptions were replaced with outputs corresponding to each scenario from the DfT's NAPAM;
- employee mode split assumptions were applied at district level to account for the different travel options likely to be available to employees in 2030 based on their home location (pre-consultation a single headline mode split was applied to all employees regardless of their home location) – this process was undertaken with reference to information on current employee travel behaviour sourced from the GAL submission.

3.1.3 Apart from those inputs listed above and the number of Gatwick passengers and employees defined in Chapter 2, all other inputs to the post-consultation model were retained from the previous work, as documented in the Technical Appendices document supporting the pre-consultation appraisal report[2].

3.1.4 In addition to the above enhancements, the district-level outputs from the models also needed to be converted to Railplan and adapted SoLHAM zone-level inputs. In London and the South-East, both zone systems were very detailed, with individual districts divided into multiple zones. The conversion process therefore involved disaggregating demand from a large number of districts, accounting for the forecast 2030 distribution of population and jobs by zone within each district; the proximity of the zones to the airport (in the case of employees); and the accessibility of zones to rail stations. During this process, zones within the airport boundary were assumed to generate no demand.

3.1.5 The surface access demand forecasts produced by the enhanced spreadsheet model are summarised in Section 4 for both the core and alternative scenarios described in Chapter 2. For the purposes of reporting, the AM and PM peak hours have been used to summarise the difference in impact between the scenarios.

3.1.6 A number of sensitivity tests were also undertaken on the core scenario 2030 model in response to feedback received from the DfT and the AC surface access expert panel during pre-consultation work. These tests and the resultant changes in forecast demand during the peak hours are summarised in Section 4

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/371824/4-surface-access--lgw-2r-appendices.pdf

3.2 Core and alternative scenario model outputs

3.2.1 As described above, peak-hour demand forecasts were produced for the core scenario and the two alternative scenarios using the enhanced spreadsheet model. The resulting difference in model outputs is reported for the following characteristics – each of these characteristics in discussed in more detail in the remainder of this section:

- Trip distribution;
- Mode share;
- Vehicle and rail trip demand.

Trip distribution

3.2.2 The forecast distribution of passenger trips (both without any expansion and with the Second Runway in place) for the CT LCK, CC AoN and the GAL submission scenarios is summarised in Figure 3-1. In the case of the AC scenarios the relevant NAPAM distribution was applied while for the submission the 2012 CAA distribution was applied.

3.2.3 The graphs indicate that in the submission test using the CAA data, 46.3% of trips come from Greater London, 35.5% of trips come from the South East of England (excluding Greater London), and 18.2% of trips come from the rest of the UK. In terms of key districts, the City of London accounts for 1.5% of total passenger demand, Kensington and Chelsea 3.2% and Westminster 7.9%. Outside London, Crawley accounts for 1.5 % of trips and Brighton & Hove for 3.4%.

3.2.4 The NAPAM distributions associated with the AC scenarios (i.e. CT LCK and CC AoN) both have a slightly higher percentage of trips from the rest of the UK when compared with the GAL submission. The GAL submission has 18.2% of trips from the rest of the UK compared with 19.2% and 20.3% for CT LCK respectively with and without expansion, and 21.8% and 21.5% for CC AoN, again with and without expansion.

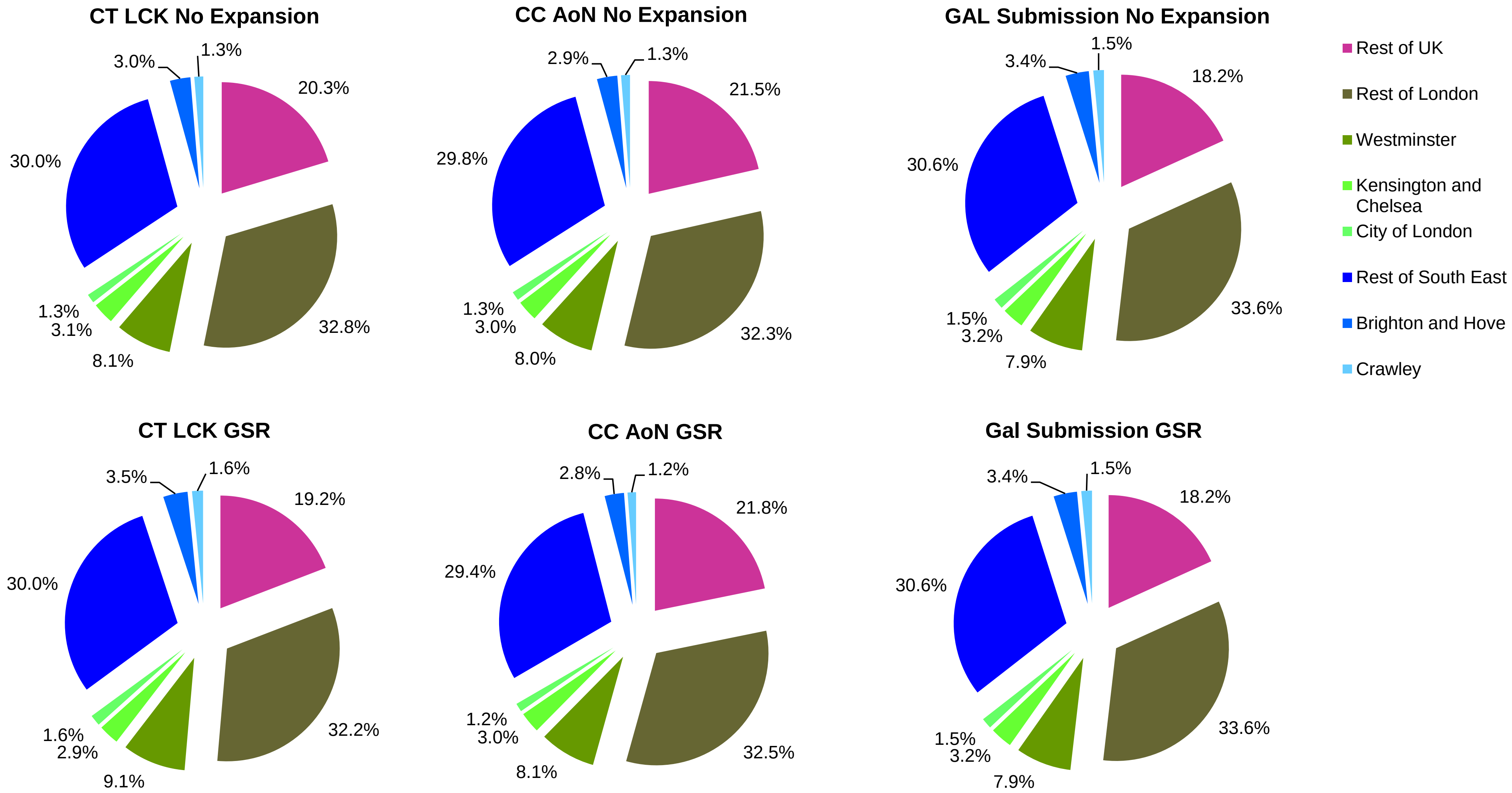
3.2.5 For all the ‘no expansion’ options the percentage of trips from the key London districts (Westminster, Kensington and Chelsea, and City of London) is similar, but from the rest of London both the NAPAM distributions have slightly fewer trips. In the expansion option the difference is slightly greater, with 1.4% fewer trips coming from the rest of London and 1.2 % more trips coming from Westminster when CT LCK is compared with the GAL submission. CC AoN figures for the rest of London and for Westminster are between CT LCK and the submission.

3.2.6 The split of trips for Crawley, Brighton & Hove and the rest of the South East is similar for CT LCK and the GAL submission – varying by at most 0.6% in both the no expansion and second runway scenarios.

3.2.7 The CC AoN option has a similar percentage split of trips from Brighton & Hove and Crawley but has fewer trips from the rest of the South East and more trips from the rest of the UK for both the ‘no expansion’ and Second Runway scenarios. CC AoN has over 0.5% fewer trips from the rest of the South East than CT LCK and 1.2% fewer than the GAL submission. It has 2.6% more trips from the rest of the UK when compared with CT LCK and 3.6% when compared with the GAL submission.

3.2.8 In summary the NAPAM distributions have slightly more trips from outside London than the GAL submission, with a higher proportion in the CC AoN scenario than in the CT LCK scenario. In the ‘no expansion’ scenarios the key London districts have a similar share of trips and in the Second Runway scenarios there is more variation in the share of trips from key London districts.

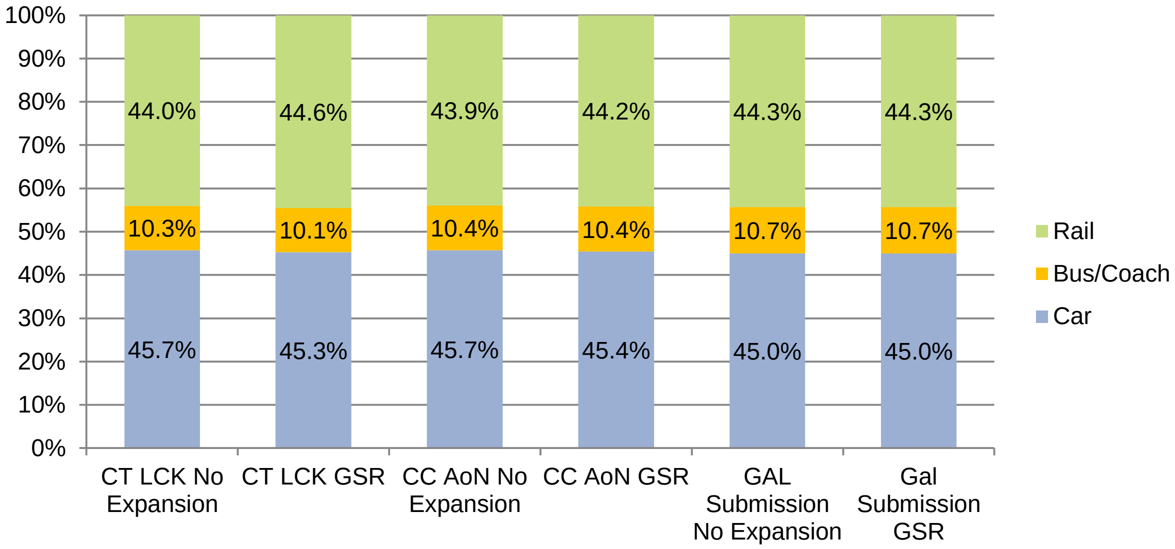
Figure 3-1: Passenger distribution percentage splits



Mode share

3.2.9 Figure 3-2 shows the headline passenger mode share for the different distributions and expansion options.

Figure 3-2: Headline passenger mode share



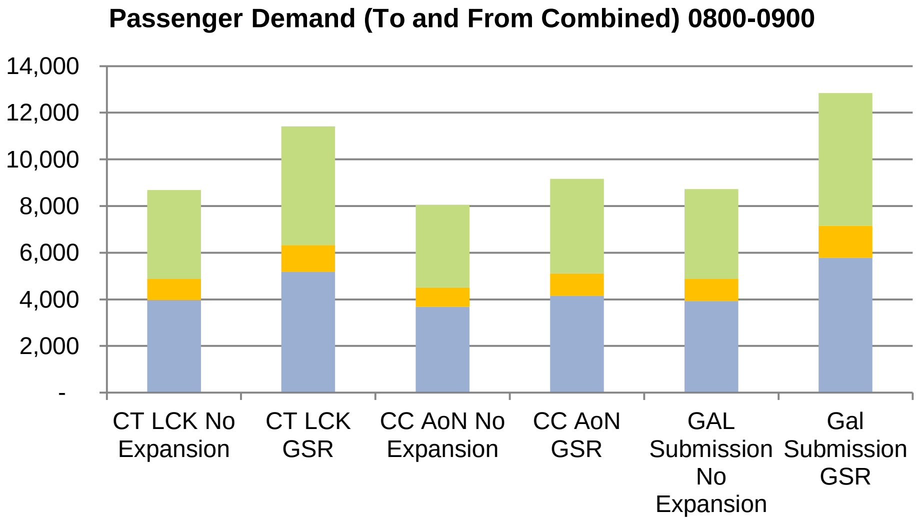
3.2.10 The graph indicates that there are only slight variations in passenger mode share between the different scenarios and expansion options. This is expected as the difference in the forecast distributions between the models is also very similar, as illustrated in the section above.

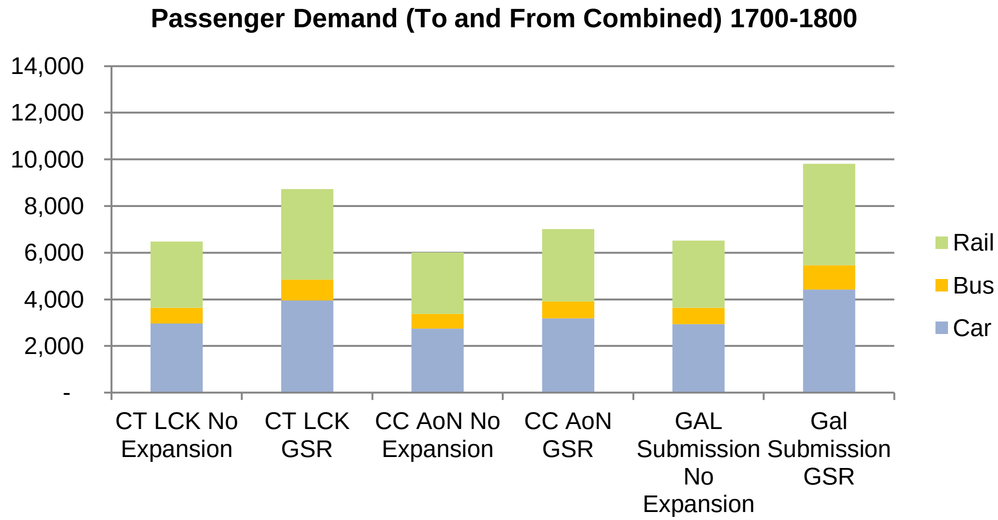
3.2.11 The forecast for rail mode share in the CT LCK no expansion scenario is 44.0%, compared with 44.6% for CT LCK with the Second Runway, and 43.9% and 44.2% in the CC AoN scenario with no expansion and with the Second Runway respectively. The bus/coach headline mode share for CT LCK with no expansion is 10.3% falling to 10.1% with the Second Runway, while in the CC AoN scenario with no expansion the share is 10.4% and remains the same with expansion. The passenger car share in the CT LCK scenario with the Second Runway is 45.3% compared with the CC AoN scenario with Second Runway at 45.4%. The test using the GAL submission numbers produces a forecast rail mode share of 44.3% with 45.0% using car and 10.7% using bus/coach.

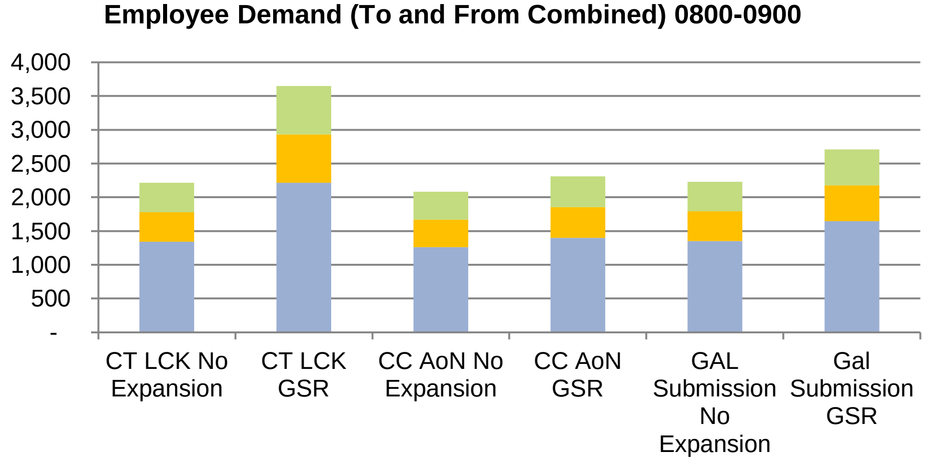
Total demand forecasts (person trips)

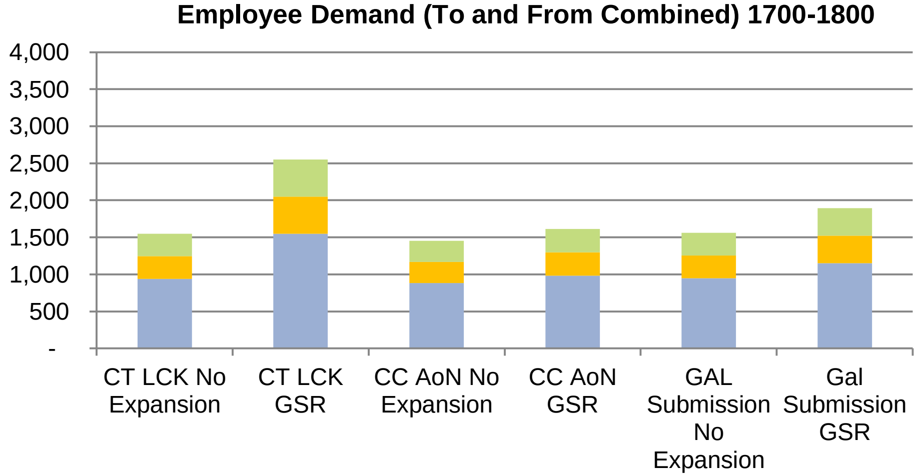
3.2.12 Figure 3-3 shows the total person-trip demand to and from Gatwick for both passengers and employees in the AM peak hour (0800-0900) and the PM peak hour (1700-1800) in all scenarios.

Figure 3-3: Total passenger and employee demand – combined person trips TO and FROM Gatwick by time period









3.2.13 Given the similarities in the distribution and mode share forecasts across the core and alternative scenarios described earlier in this section, the difference in total demand is largely driven by the difference in headline passenger and employee growth forecasts and interlining ratios associated with each scenario, as summarised in Chapter 1.

3.2.14 As is to be expected, forecast airport demand is higher in all scenarios with the Second Runway in place. The greatest MPPA demand for passengers occurs in the CT LCK scenario, which has the highest forecast of 72.0mppa associated with the Second Runway. However the maximum peak day demand is from the GAL submission – this is because the GAL submission assumes far fewer interliners than the CT LCK scenario. The AM peak hour forecasts are higher than the PM peak hour in each scenario, mainly as a result of the distribution of employee trips across the day – many arrive for work during the AM peak but have variable-length shifts meaning that departures from the airport are more evenly distributed throughout the afternoon and evening.

3.2.15 In the CT LCK scenario with the Second Runway in the AM peak hour (0800-0900), total employee demand amounts to 3,646 trips in both directions with passenger trips totalling 11,415. In the PM peak hour employee trips total 2,551 and there are 8,727 passenger trips.

3.2.16 In the CC AoN scenario total demand is lower as the headline passenger input reduces to 45.6mppa with the Second Runway in place. In the AM peak hour, the employee trip forecast is 2,309 while the passenger trip forecast is 9,169. In the PM peak hour these numbers reduce to 1,615 and 7,010 respectively.

3.2.17 Passenger demand is higher and employee demand lower for the GAL submission test (which incorporates headline inputs of 65mppa and 29,685 employees) when compared with the CT LCK scenario. Total employee demand with the Second Runway is 2,709 in the AM peak hour while passenger demand is 12,835. In the PM peak hour these numbers decrease to 1,895 and 9,813 respectively.

Demand forecasts by mode

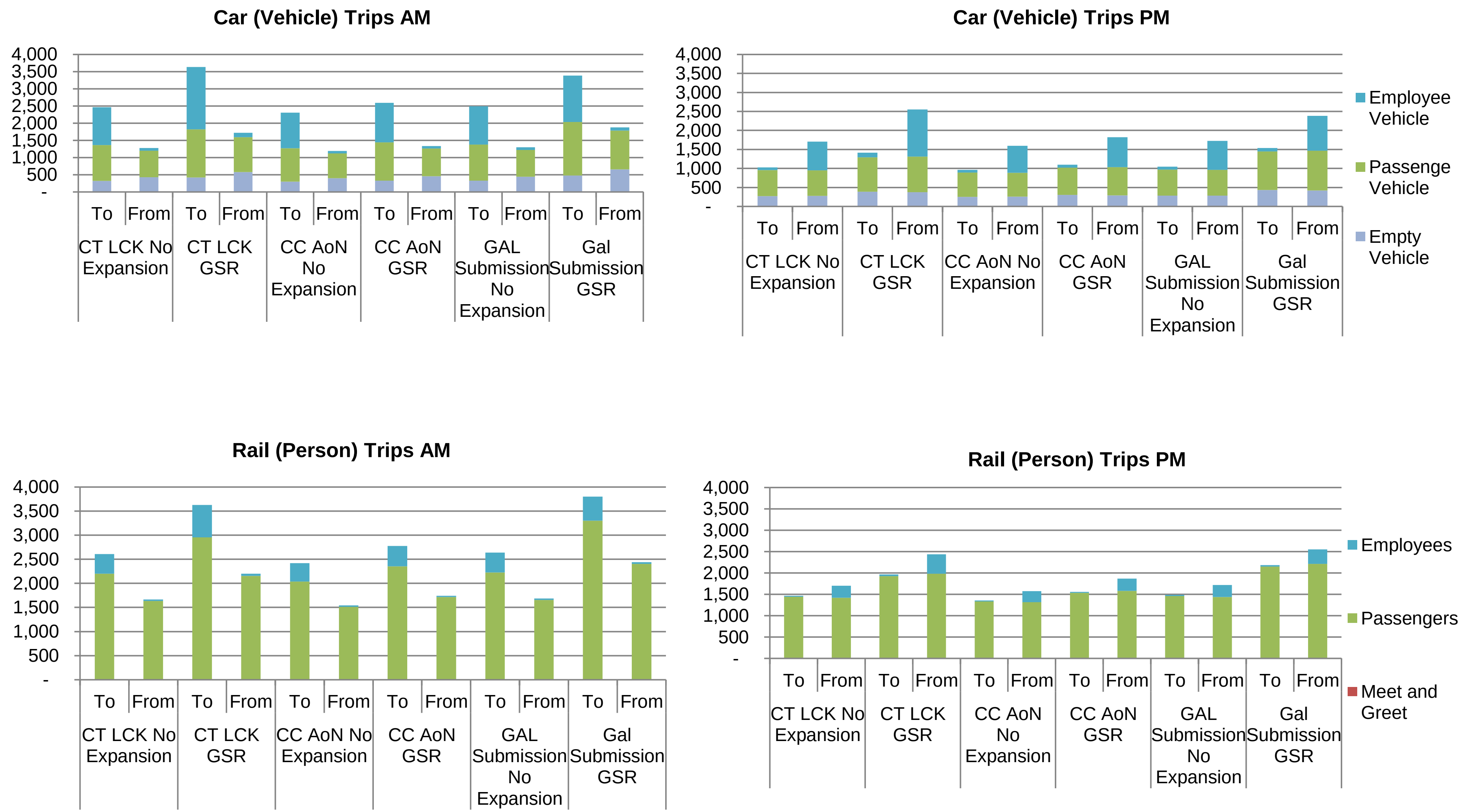
3.2.18 Figure 3-4 summarises the total forecast vehicle trips (accounting for assumptions about average vehicle occupancy and empty taxi/kiss & fly trips) and rail trips (accounting for assumptions about rail ‘meet & greet’ demand) split by direction to and from the airport in each scenario. As indicated above, the difference between the scenarios is largely driven by the changing headline passenger and employee inputs.

3.2.19 For employees, average vehicle occupancy was assumed to be 1.14 and no empty vehicle trips were assumed to be generated as a result of employee travel. For passengers, an average car occupancy rate of 2.1 was assumed, which was a composite of different rates for business and leisure passengers. 39% of taxis were assumed to operate empty on one leg of their journey in and out of Gatwick, and rail meet & greet was calculated at a rate of 0.4% of all airport passenger rail trips.

3.2.20 The graph indicates that in the CT LCK scenario with the Second Runway, the airport generates 3,635 inbound car trips in the AM peak hour. This reduces to 2,589 in the CC AoN scenario and to 3,382 in the GAL submission test. In the PM peak hour, 2,549 car trips leave the airport in the CT LCK scenario with the Second Runway, falling to 1,821 in the CC AoN scenario and 2,386 in the GAL submission test.

3.2.21 In terms of rail demand, the GAL submission test generates the highest forecast as rail demand is determined by airport passengers to a greater extent when compared with car demand, where employees are more significant. As indicated in the previous chapter, the GAL test had the highest surface access MPPA input out of all three scenarios. AM peak hour rail demand inbound to the airport is forecast at 3,799 in the GAL submission test compared to 3,625 in the CT LCK scenario with the Second Runway and 2,800 in the CC AoN scenario. The pattern repeats in the PM peak with an overall lower forecast demand.

Figure 3-4: Network demand for rail and car – 0800-0900 and 1700-1900



3.2.22 Passenger demand is similar in both directions in both time periods for each scenario tested, but employee demand is much more tidal in nature, with higher flows towards Gatwick in the AM peak hour and away from the airport in the PM peak hour. In the peak direction (towards Gatwick in the morning and away from Gatwick in the evening), employee car vehicle demand accounts for approximately 45% of all car vehicle demand (excluding empty drive-backs) but in the counter-peak direction it is much lower at approximately 4%.

3.2.23 Empty vehicle trips contribute approximately 20% of all road network demand depending on the direction. As empty vehicle trips are calculated from passenger demand, they are broadly evenly split between the peak and counter-peak direction for all scenarios and thus constitute a greater share of demand in the counter-peak direction due to the lower level of employee demand. Additional rail demand created by meet & greet trips is very low in all scenarios.

3.3 Sensitivity testing

3.3.1 In addition to testing the core and alternative headline input scenarios, a number of sensitivity tests were also undertaken on the core CT LCK scenario and the results are described in this section. A number of tests were requested by various stakeholders during pre-consultation, as follows:

- Changing the Value of Times (VoT) used to calculate Generalised Cost (GC) for business and leisure passengers travelling to and from the airport – requested by the DfT;
- Changing the methodology for calculating base year mode share using the CAA passenger survey data – requested by the DfT;
- The impact of rail pricing on demand – requested by the AC surface access expert panel;
- Airport passenger luggage impacts on rail capacity – requested by the AC surface access expert panel.

3.3.2 For the purposes of undertaking these sensitivity tests, only the forecasts associated with the Second Runway have been reported. As evidenced in the previous section, the ‘no expansion’ tests produce similar results for a lower overall level of demand.

Value of Time (VoT)

3.3.3 The VoTs used in the core scenario are 69p per minute for business passengers and 27p per minute for leisure passengers. These values are composite 2012 values for UK and non-UK resident trips sourced from an SKM report on airport passenger use of HS2[3]. In pre-consultation analysis, a decision was taken to use current VoTs in the models due to the uncertainties surrounding changes in rail fares and car operating costs in future years. This approach was retained in the core scenario in post-consultation work.

3.3.4 During pre-consultation, the DfT requested that the models be tested using VoTs sourced from the South East and East of England Regional Air Services Study (SERAS) model, which was initially developed in 2001. For the purposes of sensitivity testing during post-consultation, two sets of VoTs were applied from SERAS – the 2012 forecast and the 2030 forecast. Table 3-1 summarises these values alongside those used in the core scenario, indicating that while the core scenario business VoT is lower than both SERAS values, the leisure VoT is higher.

[3] http://webarchive.nationalarchives.gov.uk/+/http:/www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/appraisalmaterial/pdf/airportdemandmodel.pdf

Table 3-1: Values of Time (VoT) applied in core scenario and sensitivity tests

Journey purpose	Value of Time (pence per minute)		
	Post-Consultation Core Scenario	2012 SERAS	2030 SERAS
Business	69.2	81.9	119.1
Leisure	27.0	17.7	25.7

3.3.5 Changing the VoTs in the model impacts on both main mode and rail sub-mode share for passengers and consequently the car and rail demand forecasts. In broad terms, as VoT increases, so does the attractiveness of time saving vis-a-vis other costs (i.e. rail fares, car operating costs) in the model.

3.3.6 Figure 3-5 illustrates the impact of changing VoT on the rail sub-mode forecast from the model for business and leisure passengers. For business passengers, VoT is higher in the SERAS tests, resulting in a shift to Gatwick Express (GEX, which is assumed to be retained as a premium fare service in 2030) from standard fare services. In the core CT LCK scenario, 40.2% of business passengers are assumed to use GEX, compared to 42.6% in the SERAS 2012 test and 49.6% in the SERAS 2030 test.

3.3.7 In contrast, for leisure passengers the highest VoT is applied in the core scenario and the result is that the highest proportion of leisure passengers use GEX in this scenario, at 27.6% of the total. The SERAS 2012 test involves applying the lowest VoT for leisure passengers, resulting in the lowest forecast GEX rail sub-mode share forecast of only 20.7%.

3.3.8 Figure 3-6 illustrates the impact of changing VoT on the main mode share forecast from the model. The impacts here are less obvious than the rail sub-mode shifts described above, since the relative attractiveness of car, rail and bus/coach by location is more variable than the difference between premium and standard rail options. In the case of business passengers there is very little difference in mode share since trip origins/destinations tend to be clustered in locations where one mode choice is clearly more attractive than the others (i.e. rail in the case of trips to and from central London).

3.3.9 However, the graphs for leisure passengers do indicate an increase in bus/coach mode share in the 2012 SERAS test. This is to be expected since the lowest VoT for leisure passengers is applied in this test, meaning that passengers are more likely to select less expensive modes of transport.

3.3.10 Figure 3-7 illustrates the overall mode share for all passengers in the three VoT tests, illustrating that the uplift in bus/coach trips in the SERAS 2012 test observed for leisure passengers is carried through to the main mode share for all passengers.

Figure 3-5: VoT impact on sub-rail mode share for business and leisure passengers

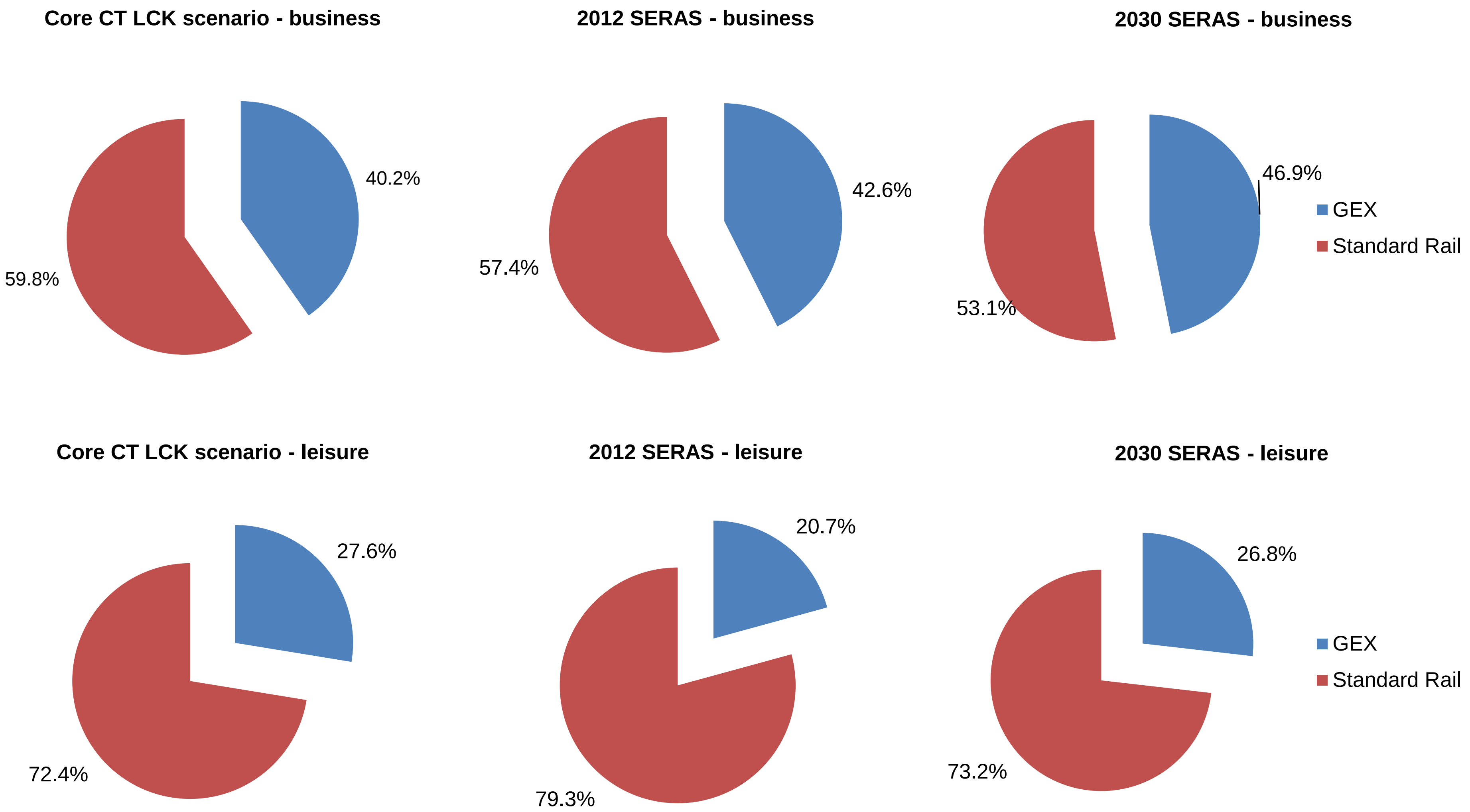


Figure 3-6: VoT impact on main mode share for business and leisure passengers

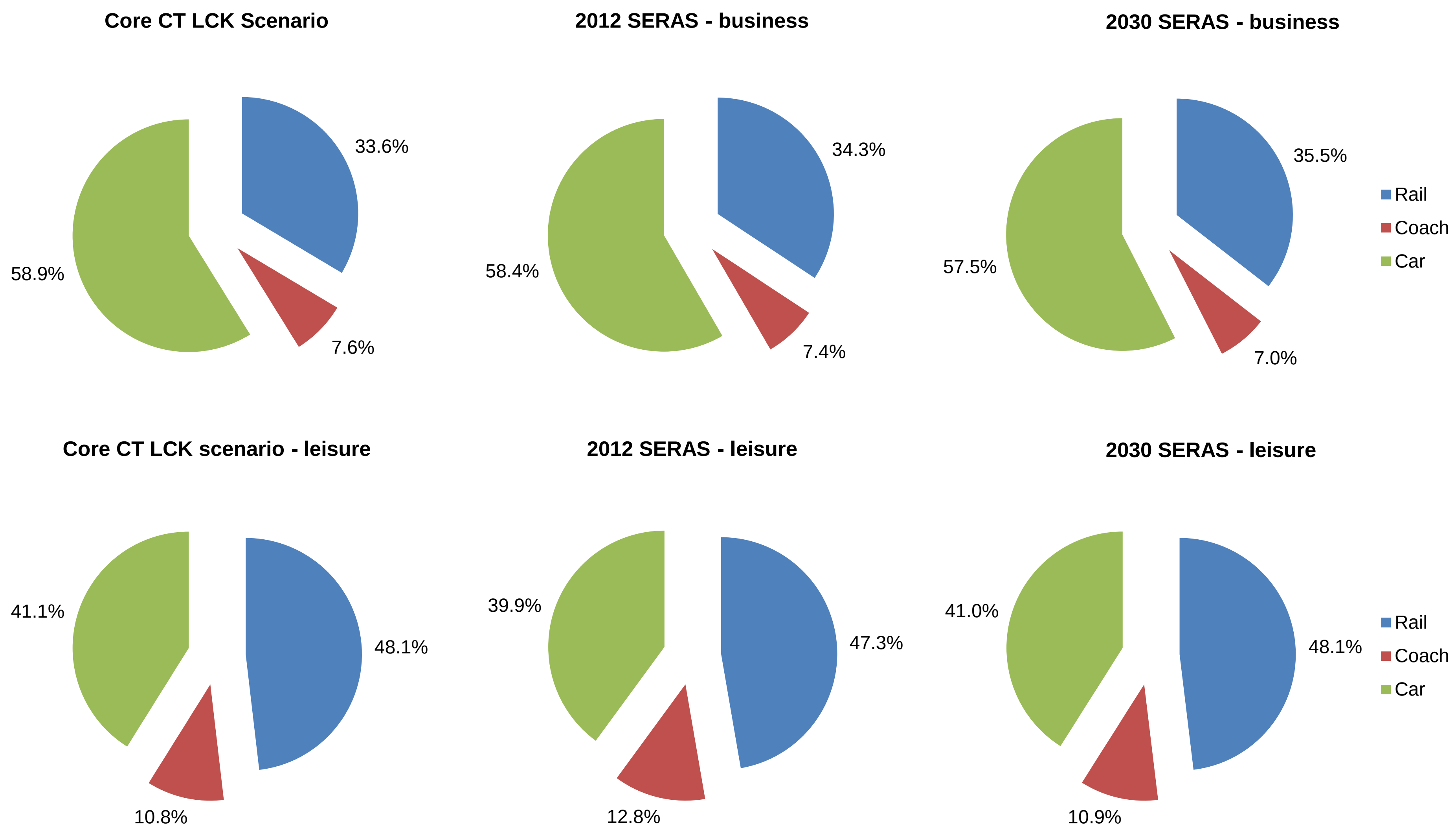
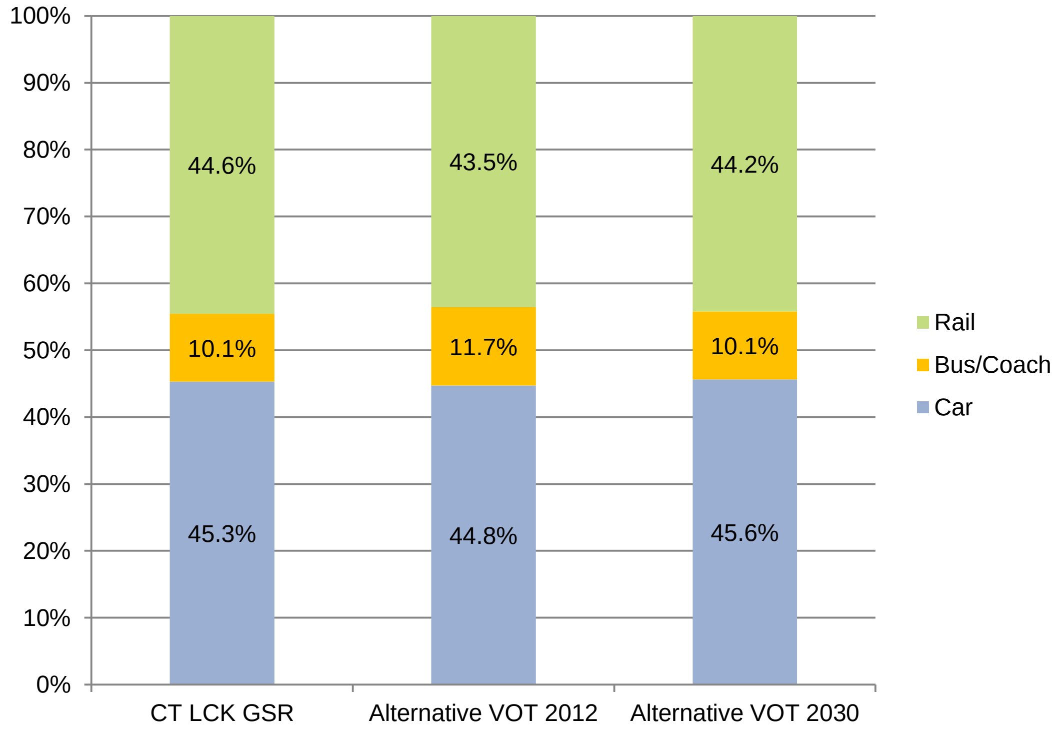


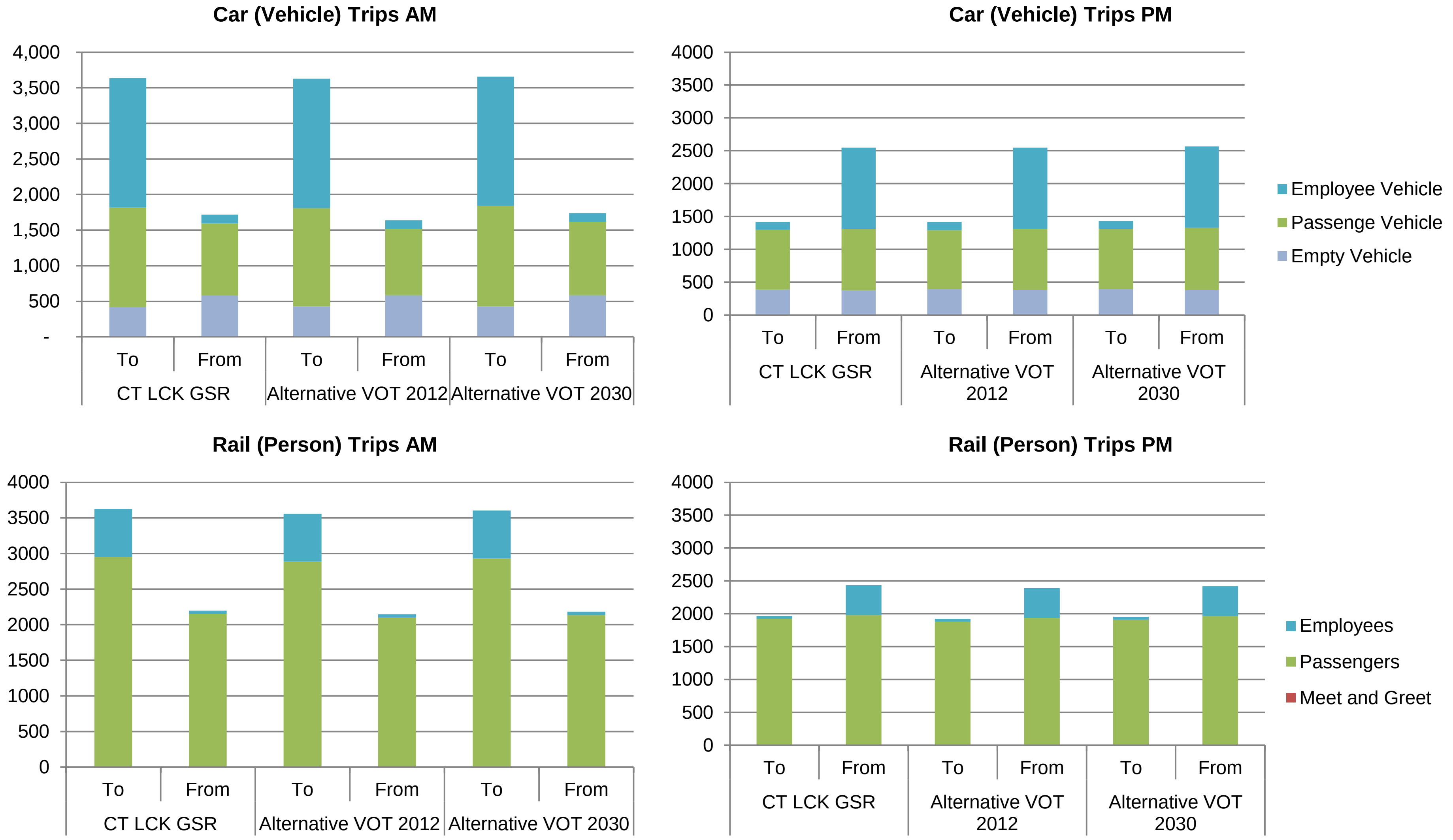
Figure 3-7: VoT impact on main mode share for all passengers



3.3.11 Figure 3-8 summarises the impact of changing VoT on total airport-related car vehicle and rail passenger demand in the CT LCK scenario with the Second Runway in place.

3.3.12 The graphs indicate that the Alternative 2030 SERAS VoT generates the highest car demand, marginally higher than the CT LCK scenario, in line with the forecast car mode share for passengers, which is higher in this scenario than in the other tests. For rail conversely, the highest number of trips is generated in the CT LCK scenario, again linked to the impact of VoT on the mode share forecasts described above.

Figure 3-8: Impact of VoT on car vehicle and rail passenger forecasts



Base mode share assumptions

3.3.13 As with the pre-consultation modelling, the core CT LCK 2030 scenario forecast is based on an assessment of the final mode of travel to the airport as recorded in the CAA 2012 passenger survey data. It was suitable to retain this approach in post-consultation work as final/first rail sub-mode airport demand inputs were required from the spreadsheet model for the dynamic rail assessment summarised in the following chapter.

3.3.14 In addition, representative districts were identified for more remote regions from the airport so that GCs did not have to be estimated for all districts in the UK – this made the spreadsheet model development process more efficient. Representative districts were identified partly based on the distribution of trip origins evident in the 2012 CAA survey data, with excluded districts generating low current demand volumes – the representative districts accounted for 89% of all trips to Gatwick in 2012.

3.3.15 During post-consultation, the DfT requested that sensitivity tests were undertaken to understand the potential impacts related to the use of final rather than primary mode (which may for example over-emphasise the demand impacts on modes local to the airport, such as courtesy buses), and the use of representative districts for remote regions. The 2012 CAA data indicated that key trip-generating districts in remote regions tended to correlate with regional public transport hubs (Manchester in the case of the North West for example, or Newcastle in the case of the North East), which may result in a forecast that over-estimates public transport demand and under-estimates car demand to and from these regions.

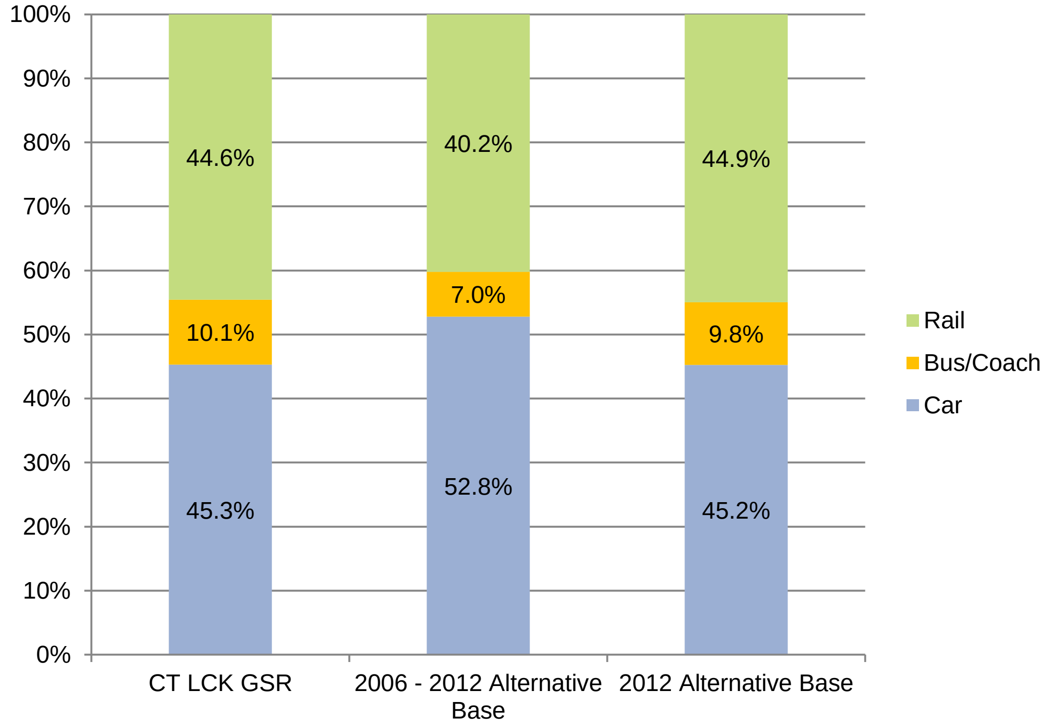
3.3.16 To facilitate these sensitivity tests, the DfT provided summaries of primary mode share by district calculated from CAA passenger survey databases for multiple years up to 2012, incorporating a weighted-average mode share from remote regions. Two sensitivity tests were subsequently undertaken, one using the revised 2012 CAA database and another using a composite database for all years between 2006 and 2012. The second included a larger number of records, providing a more representative data set for regions where the number of annual trips to the airport is low.

3.3.17 Ideally, the tests would be carried out by re-calibrating the model parameters in the base year to the alternative mode share data provided by the DfT. These parameters would then be used to re-forecast 2030 mode share. However, it was not feasible to undertake such an exercise within the scope of this study due to the reporting timescale. As indicated during the pre-consultation reporting, the spreadsheet models are incremental in nature, producing a final 2030 forecast by applying the modelled change in mode share between 2012 and 2030 for each district to the observed base year data for that district. As a result, the sensitivity tests were undertaken by replacing the observed final mode share in the 2030 CT LCK model with the revised primary mode data provided by the DfT.

3.3.18 The DfT did not provide data on rail sub-mode share (GEX v Standard Rail services) or car sub-mode share (Taxi, Kiss & Fly, Short and Long-Stay Parking), therefore these sub-mode share forecasts in the model are retained from the 2030 CT LCK scenario. The 2030 distribution from the DfT NAPAM for the CT LCK scenario was also retained along with all other parameters.

3.3.19 The impact of the two sensitivity tests on headline passenger mode share when compared with the core CT LCK scenario is summarised in Figure 3-9. The graph indicates that the main change is a reduction in bus/coach mode share, from 10.1% in the core CT LCK scenario to 7.0% in the 2006-12 test and 9.8% in the 2012 test. This suggests that bus is currently more commonly used as a final non-primary mode, for example as part of a rail-air service or a shuttle service from nearby hotels. Overall 2030 forecast PT mode share is lowest in the 2006-12 test at 47.2%, compared with 54.7% in the 2012 test, suggesting a shift away from car over the period between 2006 and 2012.

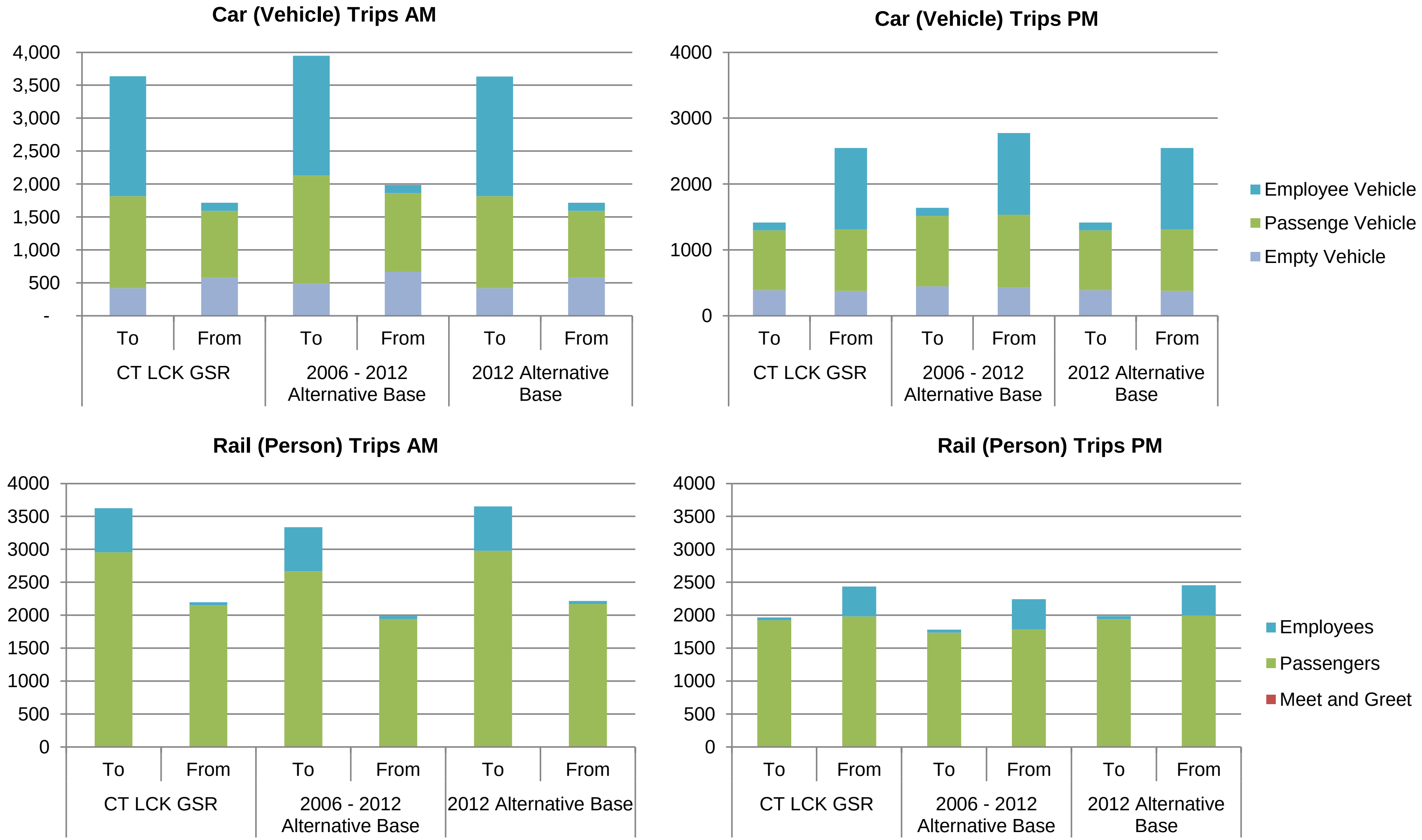
Figure 3-9: Impact of alternative base mode share data on 2030 forecast mode share



3.3.20 Figure 3-10 illustrates the impact of the changes in passenger mode share described above on the overall trip demand forecast by the model in 2030, indicating there is very little change in demand as a result. The highest rail mode share was forecast in the alternative 2012 test scenario, and this corresponds to the highest forecast of airport passengers travelling to and from Gatwick by rail.

3.3.21 In terms of vehicle demand, the test with the highest forecast airport passenger car mode share (the alternative 2006-12 base test) similarly results in the highest forecast of vehicle trips travelling to and from the airport.

Figure 3-10: Impact of base mode share on car vehicle and rail passenger forecasts

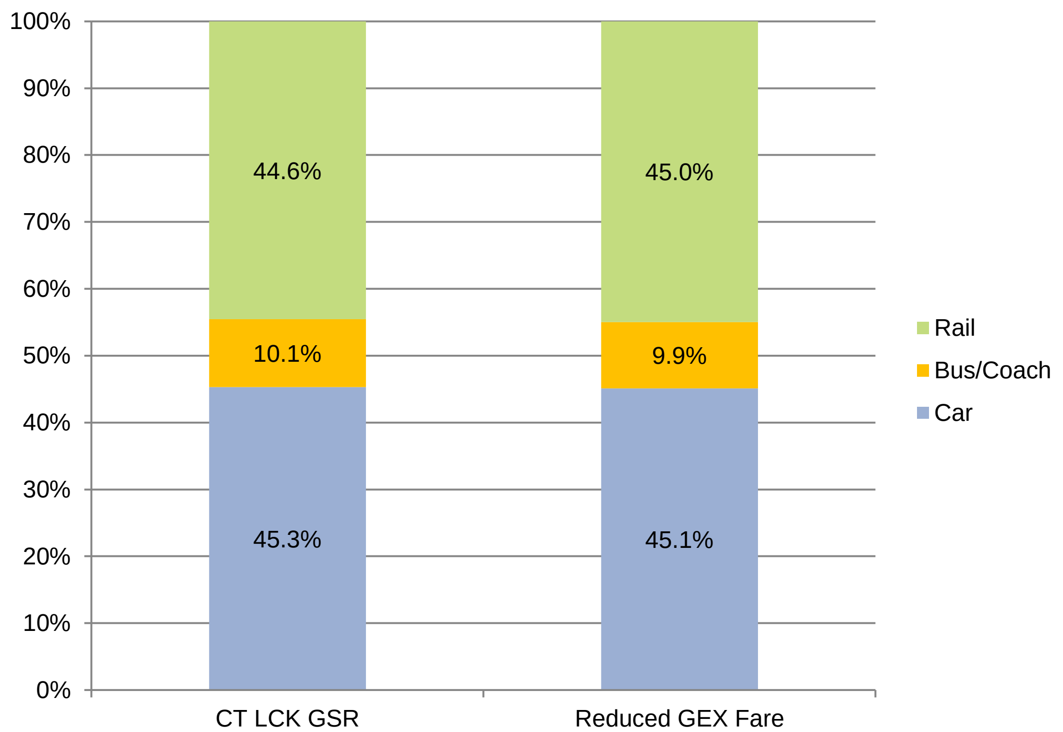


Rail pricing

3.3.22 One of the sensitivity tests requested by the AC's surface access expert panel following the pre-consultation appraisal involved assessing the impact of reducing the fare of premium rail services to provide more effective rail capacity and relieve crowding on standard price rail services. In the case of the Gatwick Second Runway option, the test was carried out on the core CT LCK scenario model with the fare of GEX reduced to match standard services for a comparable journey to Victoria. A premium fare is currently only levied on the section of the route between the airport and Victoria and so for the purposes of this study, GEX refers only to this section of the route. Passengers who use Gatwick Express from Brighton are classed as standard rail passengers in this analysis.

3.3.23 The impact of this reduction in GEX fare is, as would be expected, to increase overall rail share marginally as passengers are attracted from other modes – this slight shift to rail is illustrated in Figure 3-11.

Figure 3-11: Impact of GEX standard fare on core CT LCK scenario headline mode share



3.3.24 Reducing GEX fare has more of a pronounced impact on rail sub-mode choice, as illustrated in Figure 3-12. The graphs indicate that among business passengers, GEX sub-mode share increases from 40.2% in the core CT LCK scenario to 46.1% with GEX operating with a standard fare. For leisure passengers, GEX sub-mode share increases from 27.6% to 36.8%.

3.3.25 The graphs in Figure 3-13 summarise the impact of reducing GEX rail fare on forecast car vehicle and rail passenger demand in the core CT LCK scenario model. As would be expected, given the marginal impact on headline mode share described above, the change in car trip forecasts is very low. In the AM peak for example, the number of airport passenger car vehicles inbound to Gatwick decreases from 1,396 to 1,389. In terms of rail, inbound airport passenger demand increases from 2,945 to 2,973 in the AM peak.

Figure 3-12: Impact of GEX standard fare on core CT LCK scenario rail sub-mode share

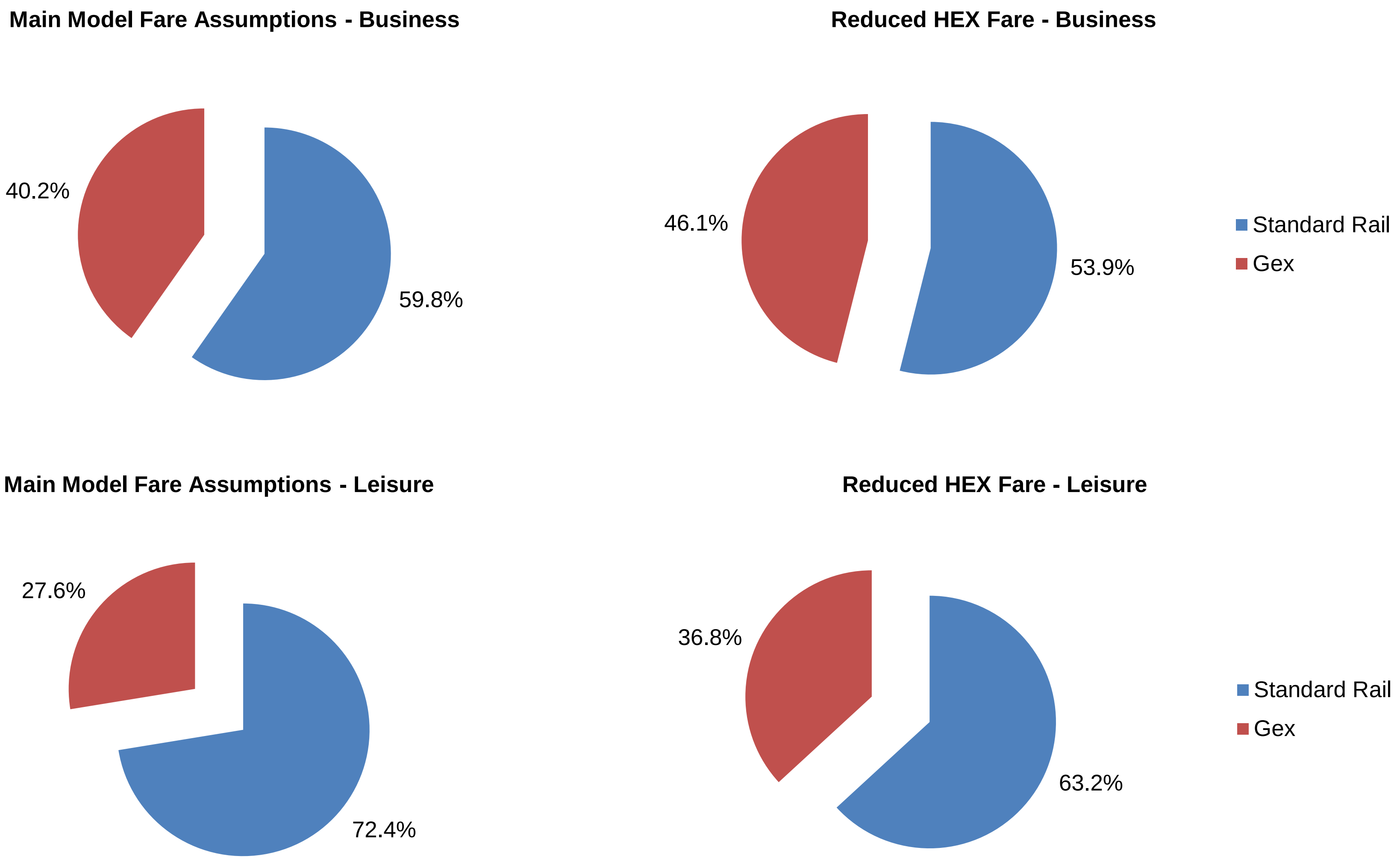
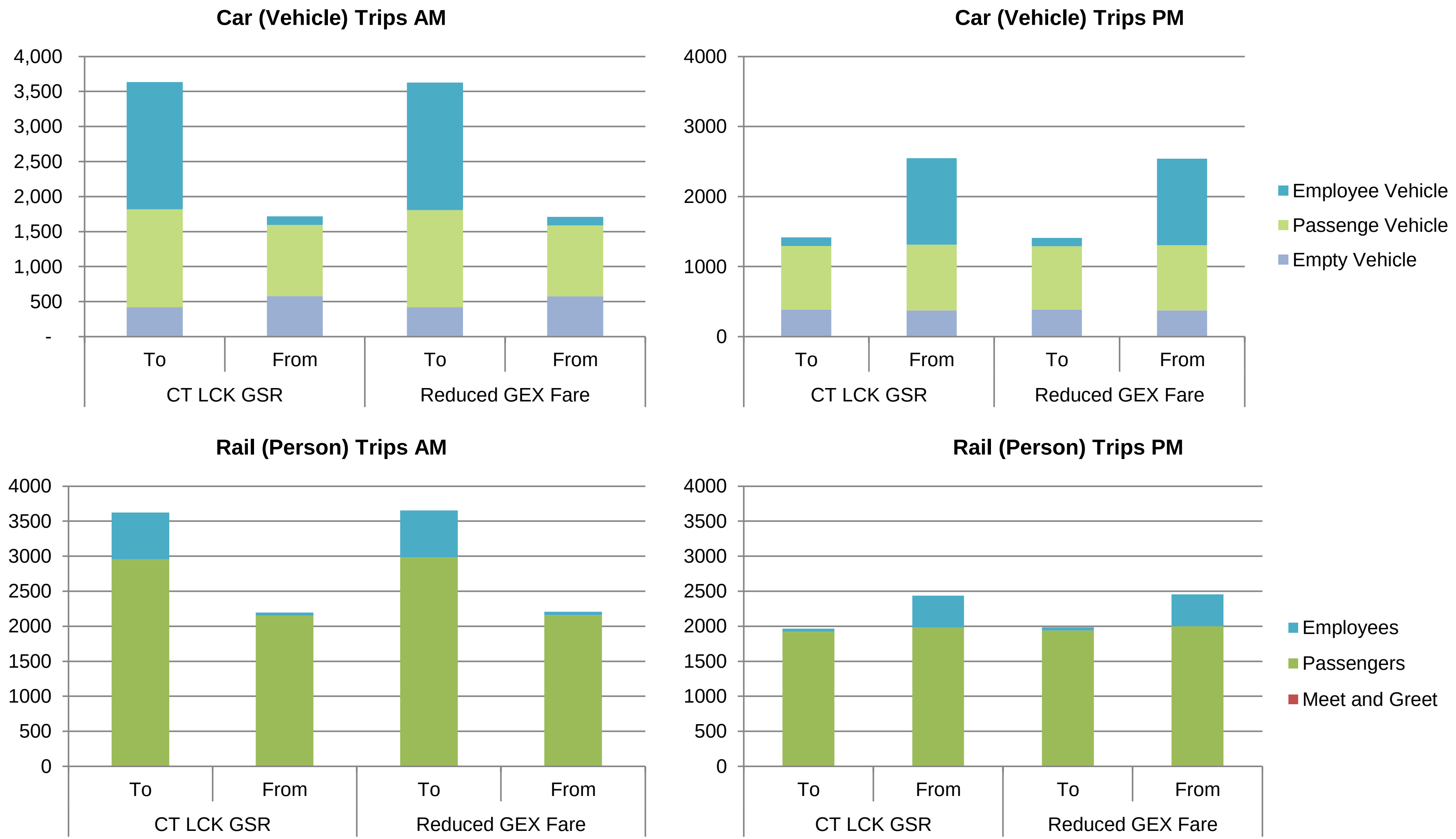


Figure 3-13: Impact of GEX standard fare on core CT LCK scenario rail passenger and car vehicle demand forecasts



Airport passenger space requirements

3.3.26 Another sensitivity test requested by the AC's surface access expert panel during pre-consultation related to the impact of airport passenger luggage on rail capacity. The nature of the spreadsheet model used to forecast airport demand during this study means that the only way this could feasibly be tested would be by factoring the final rail demand forecasts produced by the model.

3.3.27 It is clear that some account should be taken of luggage-related impacts when considering the impact of airport passengers on the rail network, since these passengers will by nature carry more luggage than non-airport users. However, developing an appropriate modelling factor would be problematic for the following reasons, and as a result has not been attempted within the scope of this study:

- The lack of credible data on which to base the calculation of a factor linking luggage space impacts to passenger space impacts on rail services;
- The variable impact related to the background level of crowding (i.e. luggage impacts will be more pronounced on crowded services where passengers do not get a seat) and the type of rolling stock (which impacts on aisle widths for example, and the amount of dedicated luggage space provided), suggesting that the impact of luggage should be assessed in relation to capacity rather than demand.

3.3.28 Desktop research indicated that one source that could potentially be used to generate a factor is the European Aviation Safety Agency (EASA) Passenger and Baggage Weight Survey, which was last undertaken in 2008/9[4]. The survey indicated that at Gatwick, which was selected as representative of the UK & Ireland region, the average weight of a passenger was 75.9kg in 2008, while the average weight of carry-on luggage was 5.6kg per passenger and checked-in baggage was 16.8kg per passenger.

3.3.29 These figures suggest that in terms of weight, a factor of 1.3 could be applied to passenger weight to forecast the impact of luggage. However, the survey includes no data about surface access mode choice to the airport (it seems likely that car passengers would carry more luggage than rail passengers) and the application of a factor calculated directly from the EASA data would be based on a very crude assumption that space requirements are directly related to weight for both passengers and their baggage.

[4] http://www.easa.europa.eu/system/files/dfu/Weight%20Survey%20R20090095%20Final.pdf

4. Dynamic rail assessment

4.1 Overview

4.1.1 Surface access demand forecasts for Gatwick (with one runway and with the Second Runway in place) in the core scenario referenced in Chapter 2 (Carbon-Traded Low Cost is King combined with the AC's mid-range employment scenario) provided the inputs for the dynamic rail modelling work-stream.

4.1.2 This work-stream was undertaken using the Railplan model, provided by TfL. Railplan is a strategic public transport model coded in Emme software that covers London and its surrounding area. The model allocates forecast public transport demand from the multi-modal LTS model to National Rail, London Underground, DLR, and Tramlink services and the London bus network. Railplan also includes an extensive walk network to represent access to the public transport system, with transfer between different services represented by interchange links. TfL's website provides further details on the LTS model[5] and the Railplan model[6].

4.1.3 TfL has recently developed Railplan Version 7 to represent baseline conditions in 2011. For the purposes of this study, the 2011 model was refined to ensure a better fit to observed counts along key rail corridors serving Gatwick. TfL also provided a Railplan 7 forecast run for 2031 based on the LTS '7031ref6' low car growth scenario, which is the central case currently used by TfL to test public transport scheme impacts. This scenario is based on the following key 2031 planning assumptions for the Greater London Authority (GLA) area, consisting of the 33 London Boroughs:

- total households: 4,119,961;
- total population: 9,839,366;
- total jobs: 5,265,000.

4.1.4 Outside the GLA area, trip forecasts are based on assumptions sourced from the DfT's Trip End Model PROgram (TEMPRO) V6.2, a component of the National Trip End Model (NTEM). The 2031 reference case also includes assumptions about the extent of the transport network in London and the South East, which are summarised in Appendix C of this report.

Process

4.1.5 The following tasks were undertaken to develop the dynamic rail modelling assessment of the Second Runway at Gatwick:

- a review of the LTS '7031ref6' inputs was undertaken with two key aims:
  - to identify the schemes in the AC's Core and Extended Baselines (summarised in Appendix B) that were not included in '7031ref6';
  - to highlight any differences in assumptions between '7031ref6' and the Core/Extended Baselines for schemes that were included;
- adjustments were made to service patterns and rolling stock characteristics on the Brighton Main Line (BML), the key rail corridor serving Gatwick in the model to reflect information provided by the AC's stakeholders during pre-consultation and published updates since then (notably the Sussex Area Route Study draft for consultation[7] published by NR late in 2014) – this included adding coding for the following:
  - 6 additional peak-hour train paths on the BML detailed in the Sussex Area Route Study, which would be provided on top of the assumed post-2018 Thameslink timetable;

[5] https://www.tfl.gov.uk/cdn/static/cms/documents/the-london-transportation-studies-model-lts.pdf
[6] https://www.tfl.gov.uk/cdn/static/cms/documents/londons-public-transport-assignment-model-railplan.pdf
[7] http://www.networkrail.co.uk/long-term-planning-process/route-studies/

  - Crossrail 2 regional option;
  - Bakerloo Line southern extension to Hayes;
  - Northern Line extension to Battersea;
  - HS2 Phase 1 (Hybrid Bill scheme) including corresponding amendments to WCML/Crossrail services in accordance with assumptions published by HS2 Ltd in 2013[8];
- a new LTS 2031 'Extended Baseline' run was requested from TfL, including the aforementioned network amendments translated from Railplan – this was to account for any induced demand impacts related to the changes in service provision associated with the Extended Baseline schemes;
  - it should be noted that HS2 is not included in LTS and so amendments were made in the model to associated services at Euston and Old Oak Common to accommodate it, and demand forecasts for HS2 itself were sourced from an associated run of the Planet Framework Model (PFM) and incorporated in the output matrices once the LTS run had been completed;
- a new GEX zone and associated links was incorporated in the Railplan Extended Baseline scenario to accommodate premium service forecasts from the enhanced spreadsheet model;
- airport-related demand forecasts from the resultant LTS runs were then removed from the matrices and replaced with the forecasts derived for the core scenario enhanced spreadsheet model, as summarised in the previous chapter;
- the Railplan Extended Baseline model was then run with associated background and airport-related demand for a range of scenarios, including the airport in its current form and with the Second Runway included.

4.1.6 Two time periods were assessed for each Extended Baseline scenario using the Railplan model – an AM peak period (0700-1000) and an IP period (1000-1600). The full list of Railplan runs completed for this study is shown in Table 4-1.

Table 4-1: Railplan model runs for Gatwick Second Runway

Year	Time period	Transport network	Background demand	AC scenario	Expansion option	Gatwick demand
2011	AMP	RP7 2011	RP7 2011	N/A	None	No change
2031	AMP	RP 7031ref6	RP 7031ref6	N/A	None	No change
2031	AMP	RP7 2031 EB	RP7 2031 EB	S3 Low Cost is King	None	1-runway CT LCK forecast
2031	IP	RP7 2031 EB	RP7 2031 EB	S3 Low Cost is King	None	1-runway CT LCK forecast
2031	AMP	RP7 2031 EB	RP7 2031 EB	S3 Low Cost is King	Gatwick	G2R CT LCK forecast
2031	IP	RP7 2031 EB	RP7 2031 EB	S3 Low Cost is King	Gatwick	G2R CT LCK forecast

4.1.7 A number of elements of the modelling process should be considered when interpreting the outputs from the Railplan assessment described in the remainder of this chapter, as follows:

- the assessment did not account for impacts associated with any additional development activity or induced employment growth as a result of airport expansion – 2031 population and job growth forecasts in LTS were provided by the GLA and the DfT's NTEM, and LTS would need to be re-run with associated changes to these forecasts to account for such impacts;

[8] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244033/Updated_economic_case_for_HS2__August_2012__-__Explanation_of_the_service_patterns__January_2013_.pdf

- Railplan does not include any bus services in the Gatwick area or long-distance coach routes between UK airports and locations outside London, and the coding of bus services between Gatwick and areas outside the GLA boundary is patchy – given the study timescale, only the rail demand from the enhanced spreadsheet models was imported into Railplan to ensure a consistent assessment across all the airport expansion options;
- the Railplan '7031ref6' scenario network only included one zone for the airport, so an independent GEX zone and associated links had to be introduced in the Extended Baseline scenario to accommodate the premium rail demand forecast derived from the enhanced spreadsheet model – rail sub-mode at Gatwick is therefore hard-coded in Railplan, with the model forecasting resultant secondary connections and the impact of increased airport demand on non-airport assignment.

4.2 Base year (2011) model outputs

4.2.1 Figure 4-1 and Figure 4-2 summarise the passenger volumes on the BML around Gatwick and north of East Croydon respectively in the 2011 AM peak Railplan model.

4.2.2 The plans indicates a total of around 24,300 passengers on the BML north of Horley travelling towards London, with less than half that volume travelling in the opposite direction. North of East Croydon, passenger volumes build up on services approaching London terminals on the BML, with flows of 35,600 in the Up direction north of Streatham Common on the Victoria branch, and 31,600 in the same direction north of Sydenham on the London Bridge branch.

4.2.3 Figure 4-3 summarises crowding on the rail network in Railplan in the 2011 AM peak. The plan indicates in black those links on the network where crowding levels reach in excess of 4 people/m^2 of standing space. For example, this includes links on Windsor Line services east of Richmond approaching Clapham Junction and on sections of the North London Line via Gospel Oak and Barking.

4.2.4 Figure 4-4 summarises crowding on the London Underground network in the same time period, illustrating that extensive sections of the network are over-crowded in the AM peak. Forecast crowding levels are above 4 people standing per m^2 on sections of the Northern Line, Jubilee Line, Piccadilly Line, Victoria Line, and Central Line.

Figure 4-1: 2011 AM peak forecast rail demand around Gatwick

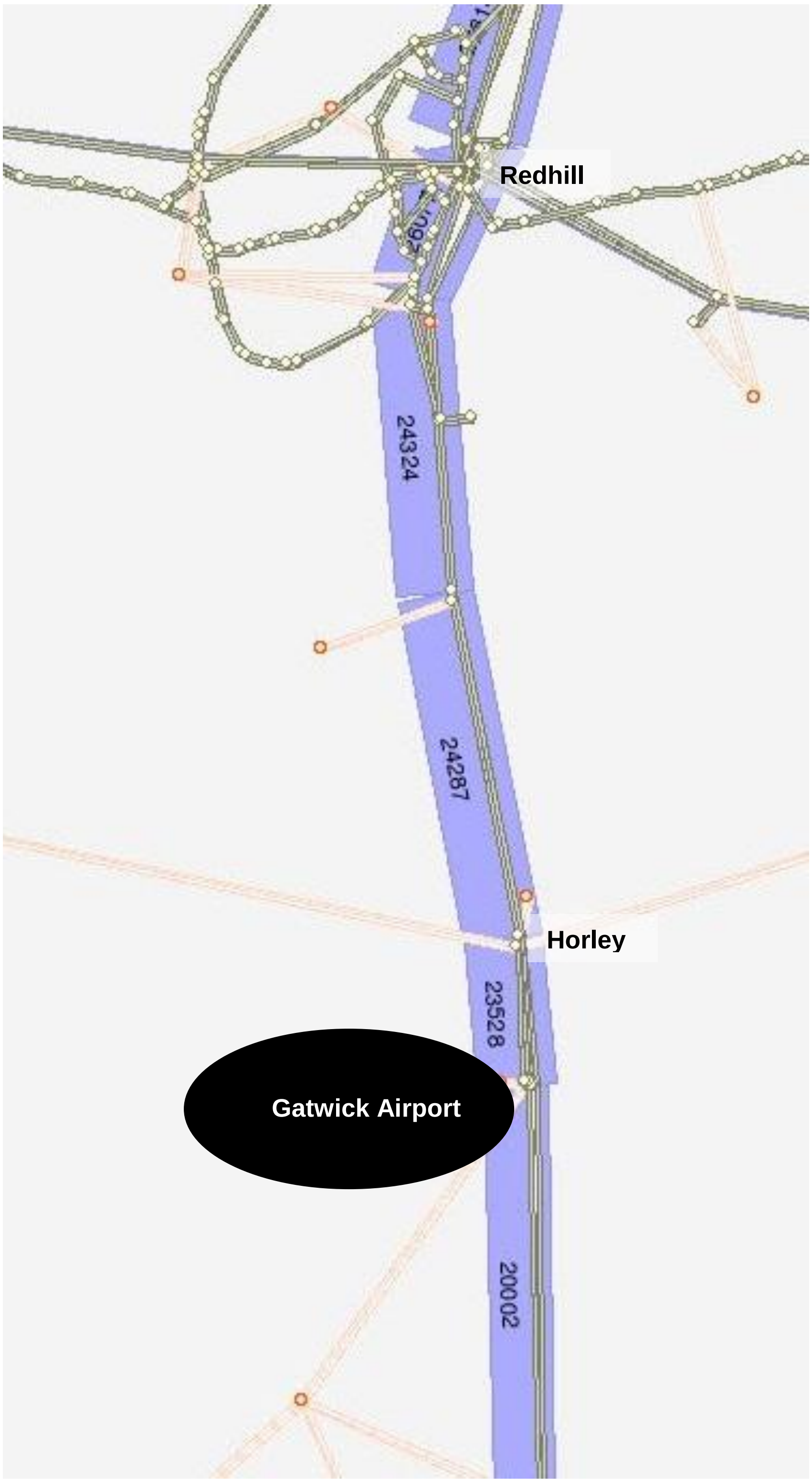


Figure 4-2: 2011 AM peak forecast rail demand north of East Croydon

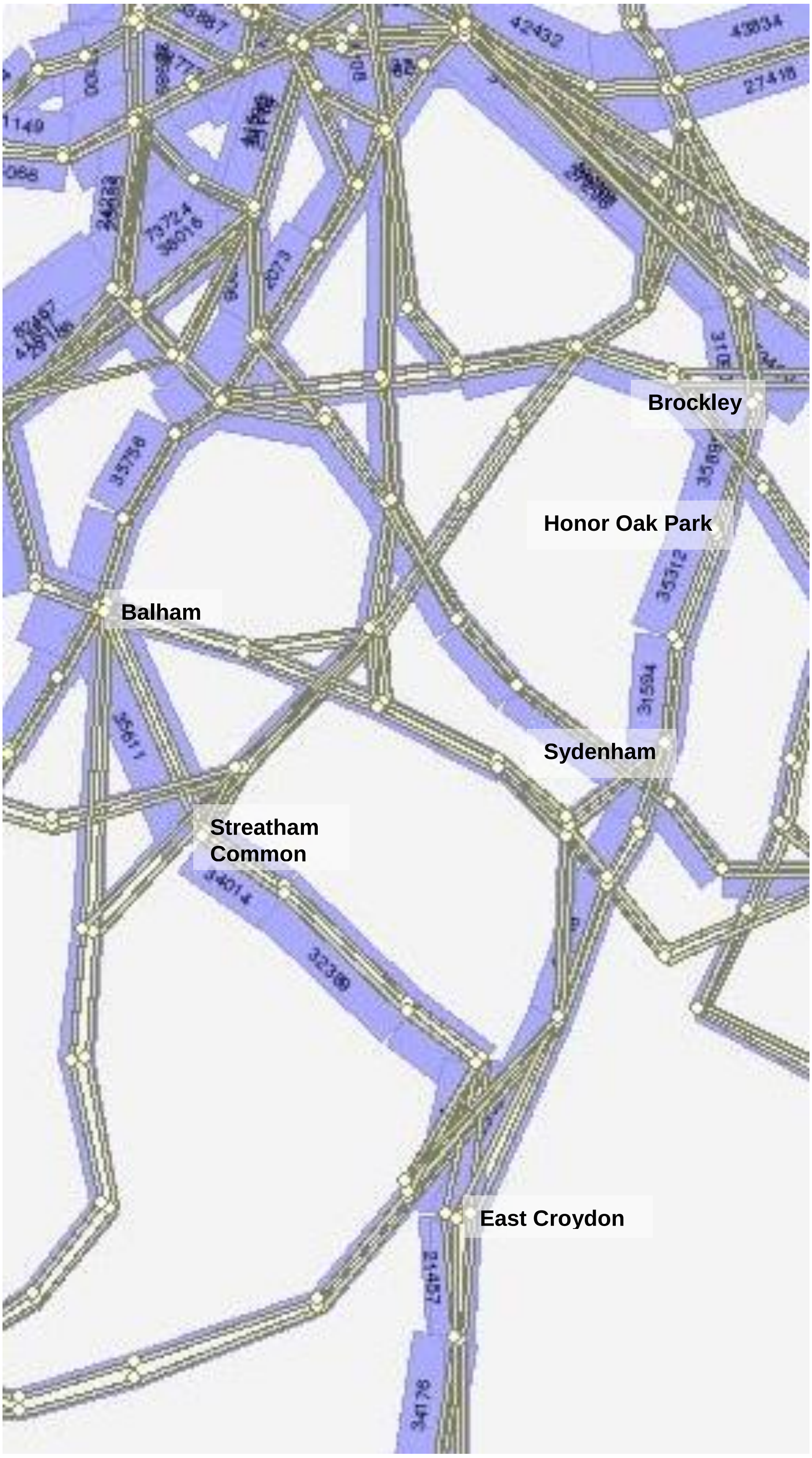


Figure 4-3: National Rail crowding – 2011 AM peak

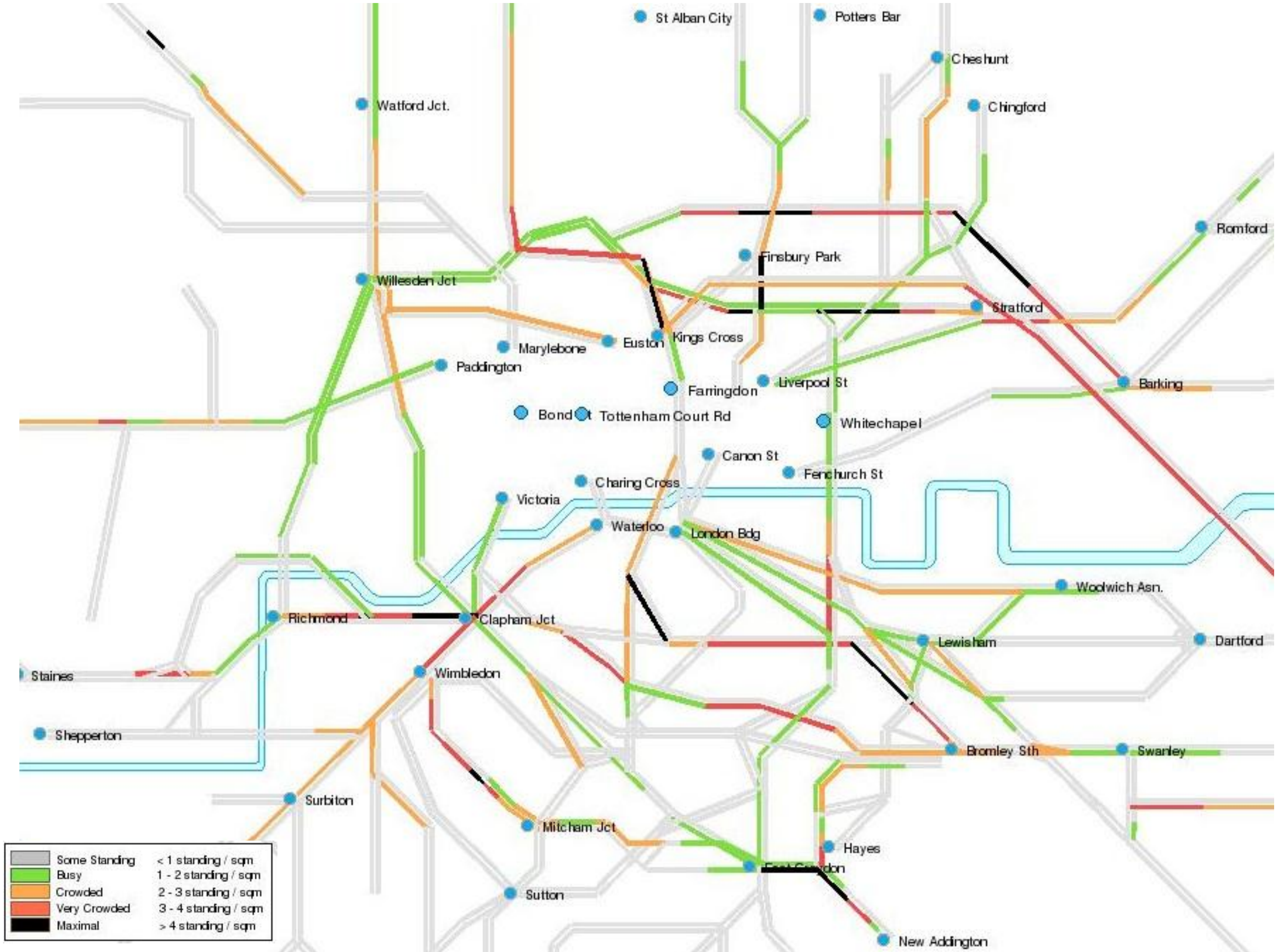
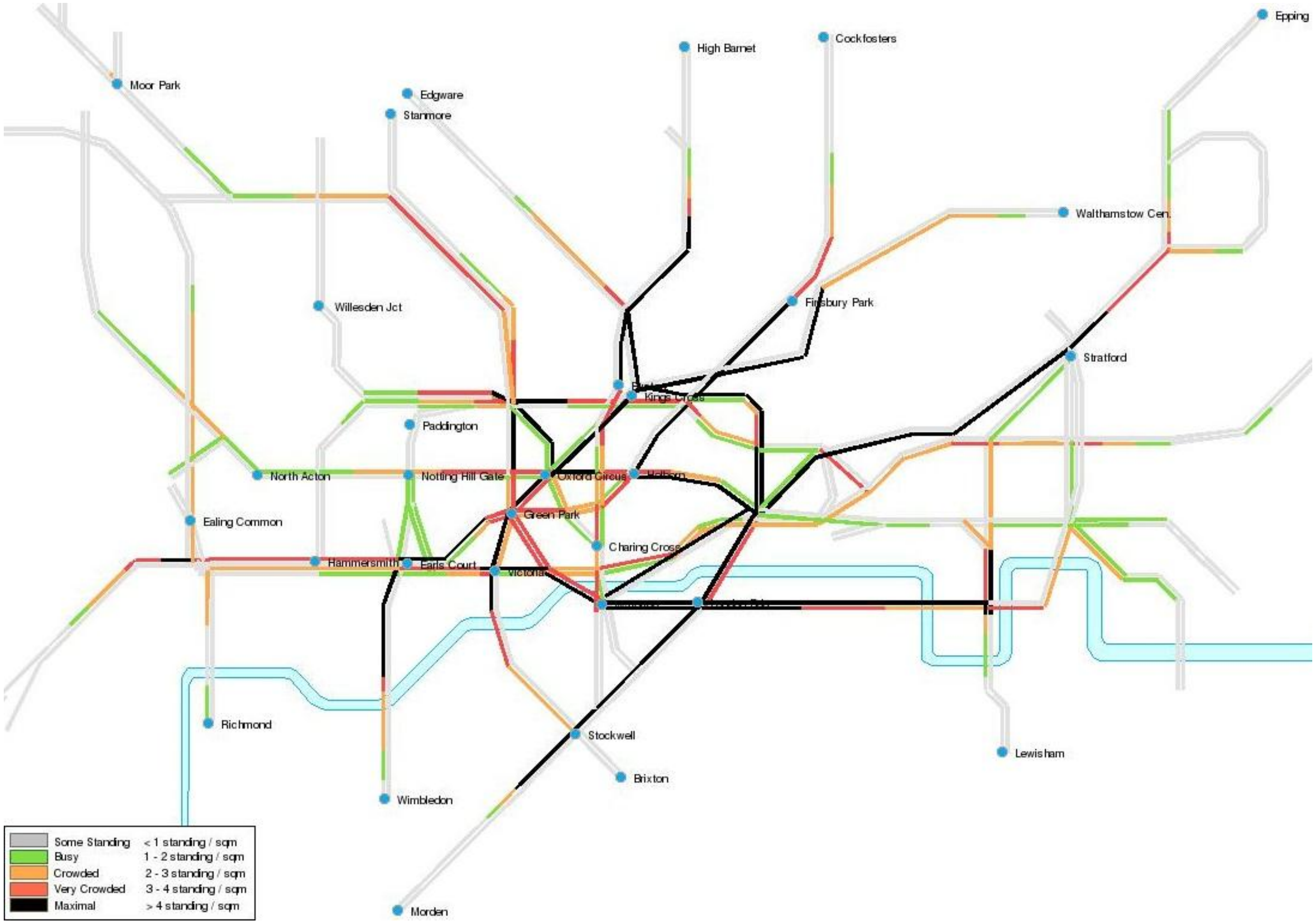


Figure 4-4: London Underground crowding – 2011 AM peak



4.3 Reference case (2031) outputs

4.3.1 Figure 4-5 and Figure 4-6 illustrate AM peak forecast flows on the BML in the 2031 reference case (7031ref6) around Gatwick and north of East Croydon respectively, while Figure 4-7 and Figure 4-8 summarise the change when the 2031 reference case is compared with the 2011 base model described in the previous section.

4.3.2 These plans indicate that flows on the BML are forecast to increase significantly from the base year by 2031 in the 7031ref6 scenario. North of Horley, AM peak flows in the Up direction increase by around 11,750 to a total flow of around 36,000, an uplift of 48%. Closer in to London, flows north of Streatham Common on the Victoria branch of the BML reach close to 50,000 in the Up direction (an increase of 40% from 2011) while on the London Bridge branch, flows north of Sydenham reach around 44,300 in the same direction, also an increase of around 40% from 2011.

4.3.3 Figure 4-9 illustrates the crowding forecasts during the AM peak in the 2031 reference case. The plan indicates that across London, the additional rail capacity provided on the network in this scenario (see Appendix C) helps to relieve many of the crowding issues identified in the 2011 AM peak.

4.3.4 Figure 4-10 illustrates forecast crowding on the London Underground network in the 2031 reference case. The plan indicates that enhanced capacity relieves some of the pressures evident on the network in 2011 (for example, crowding on the Central Line appears to reduce as a result of the introduction of Crossrail), although many lines will continue to be heavily crowded inbound to London in the AM peak.

Figure 4-5: 2031 ref case AM peak forecast rail demand around Gatwick (7031ref6 scenario)

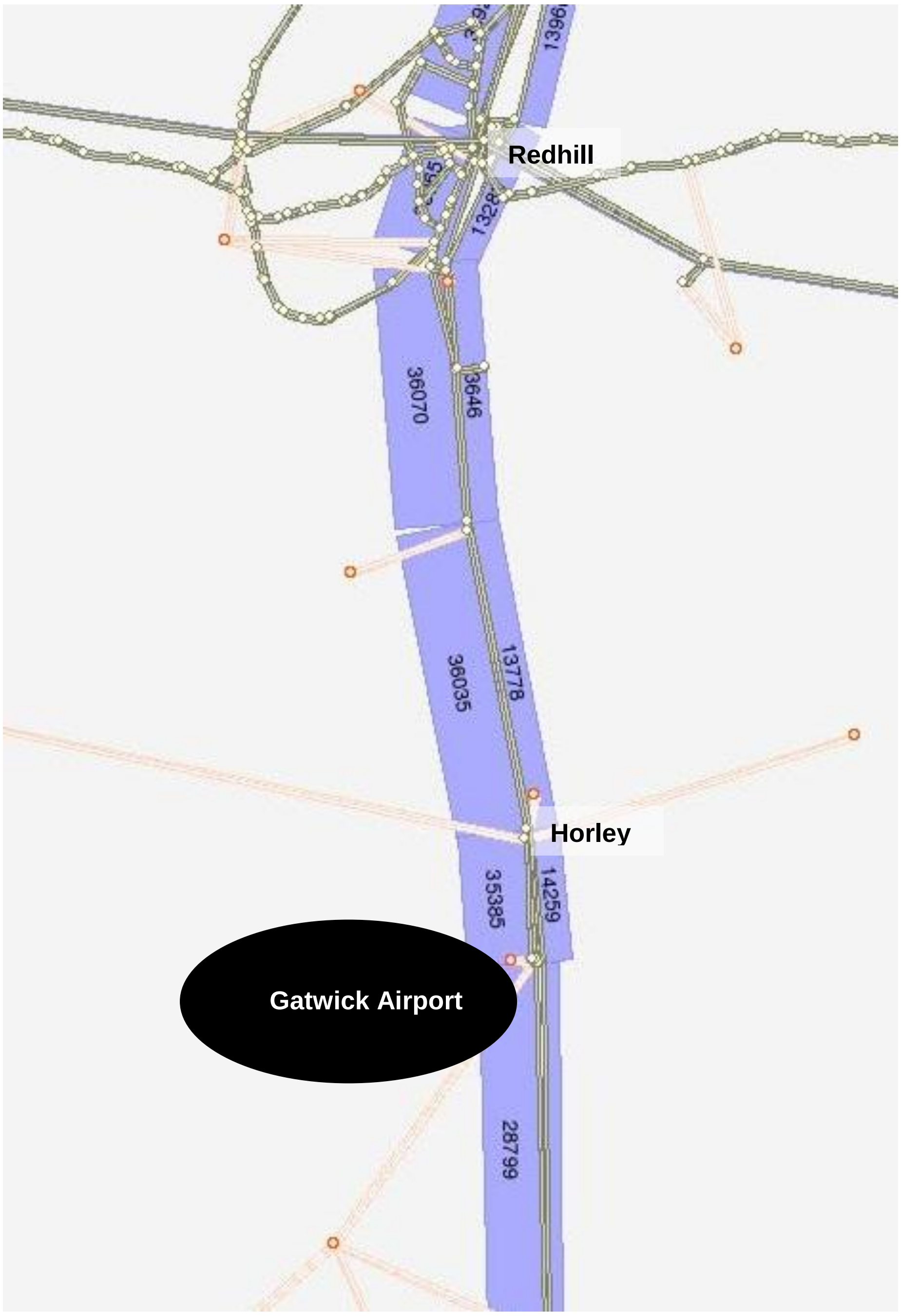


Figure 4-6: 2031 ref case AM peak forecast rail demand north of East Croydon (7031ref6 scenario)

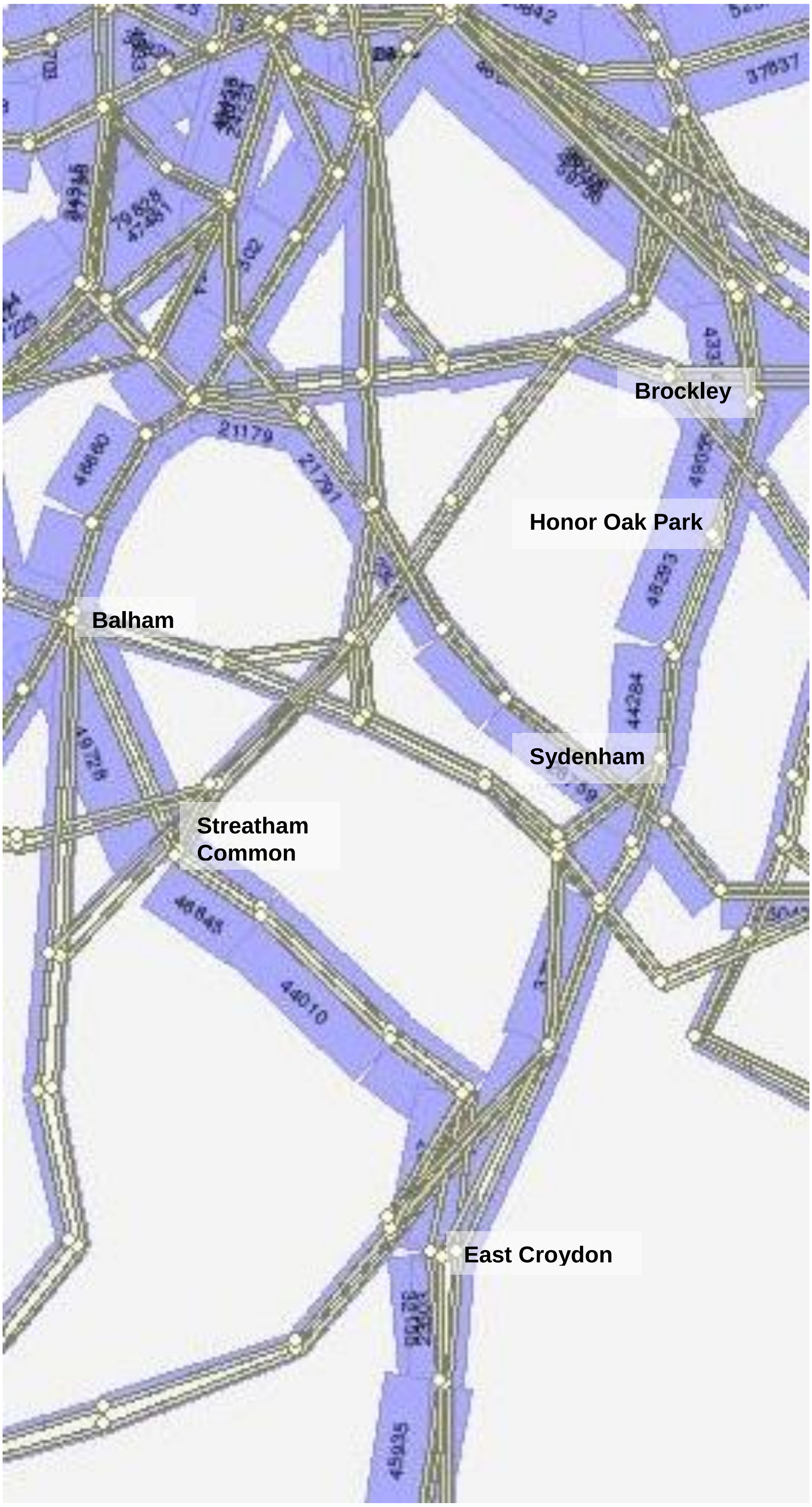


Figure 4-7: Change in AM peak volumes (2031 ref case – 2011 base)

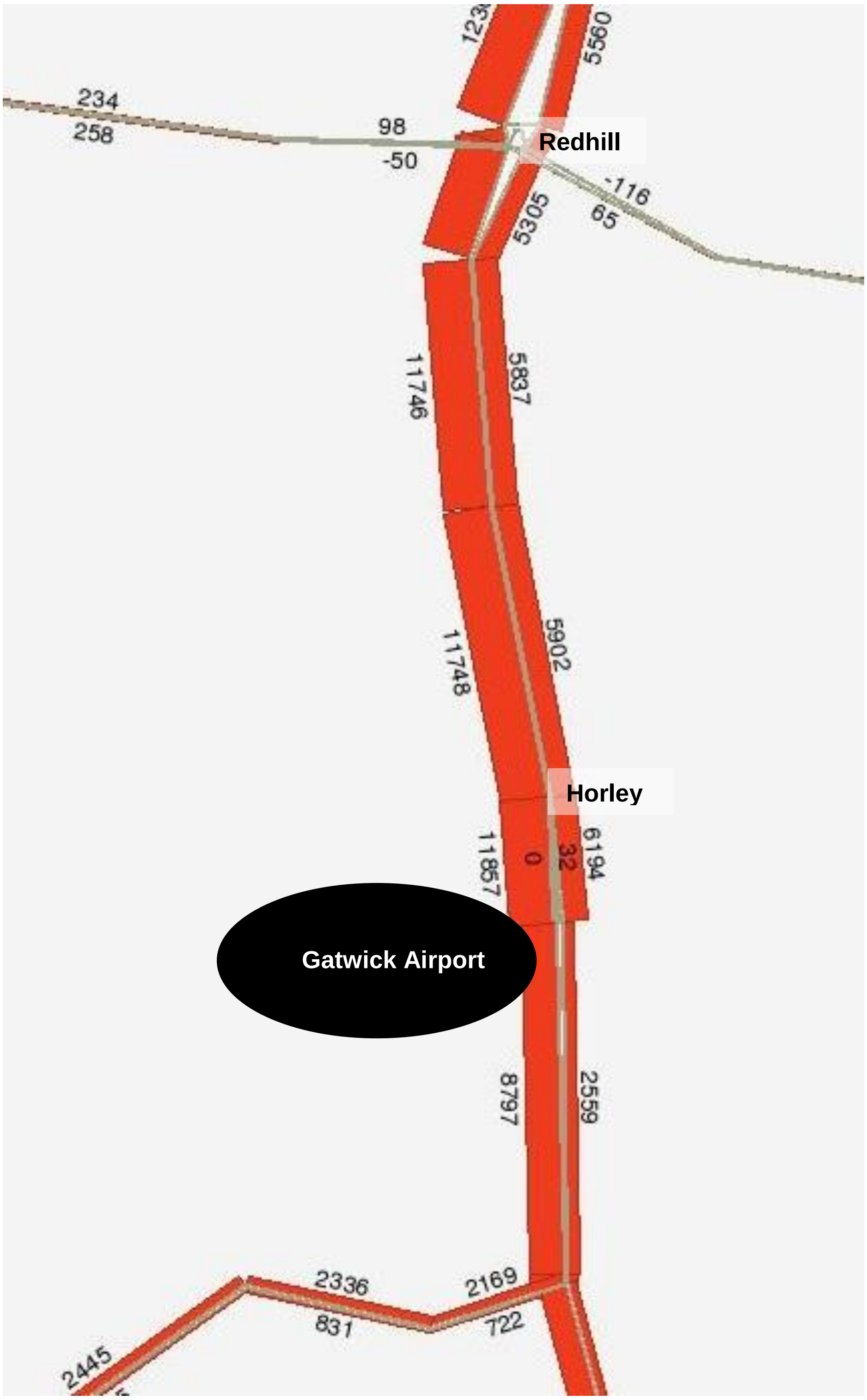


Figure 4-8: Change in AM peak volumes north of East Croydon (2031 ref case – 2011 base)

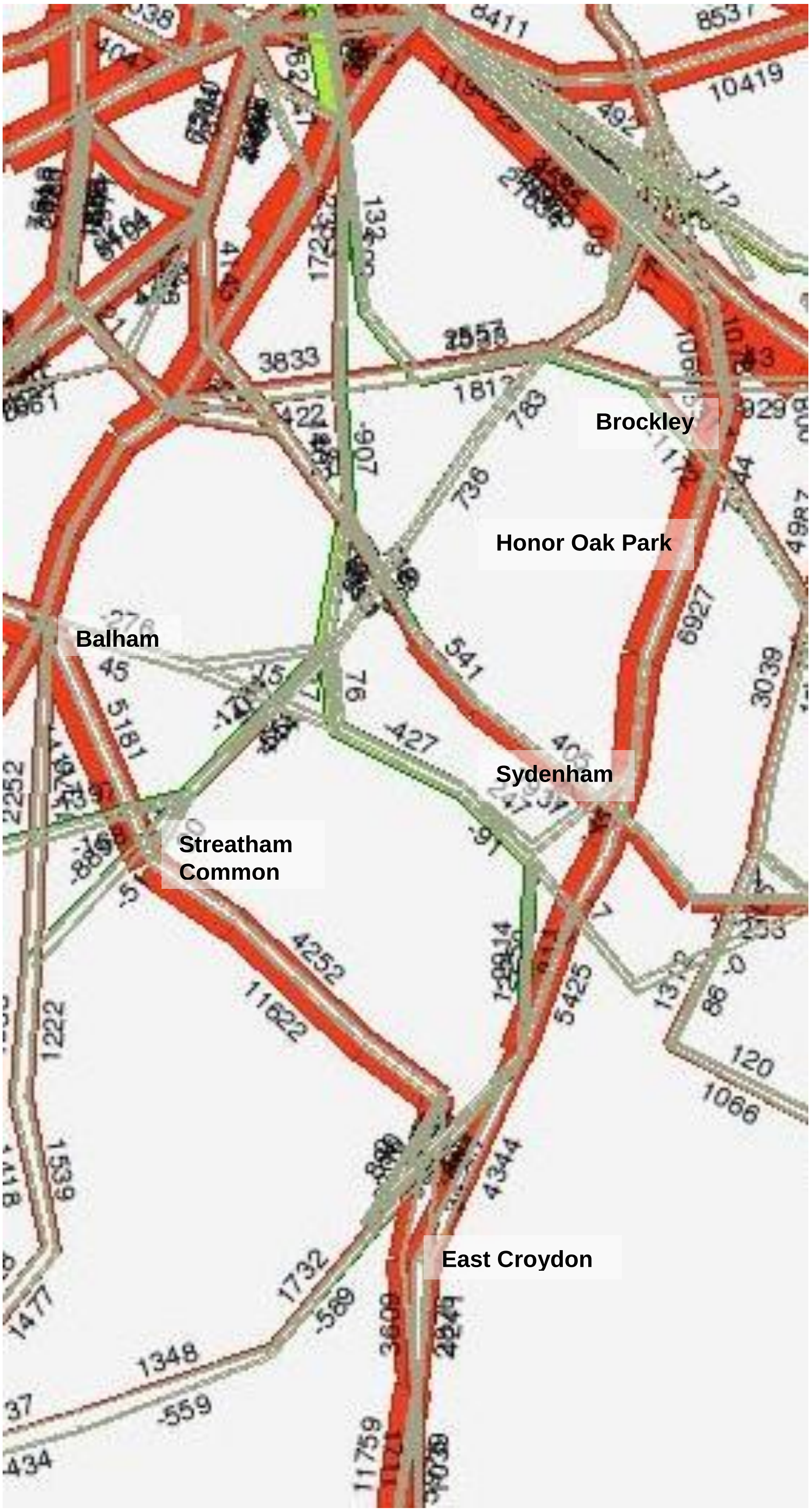


Figure 4-9: National Rail crowding – 2031 ref case AM peak

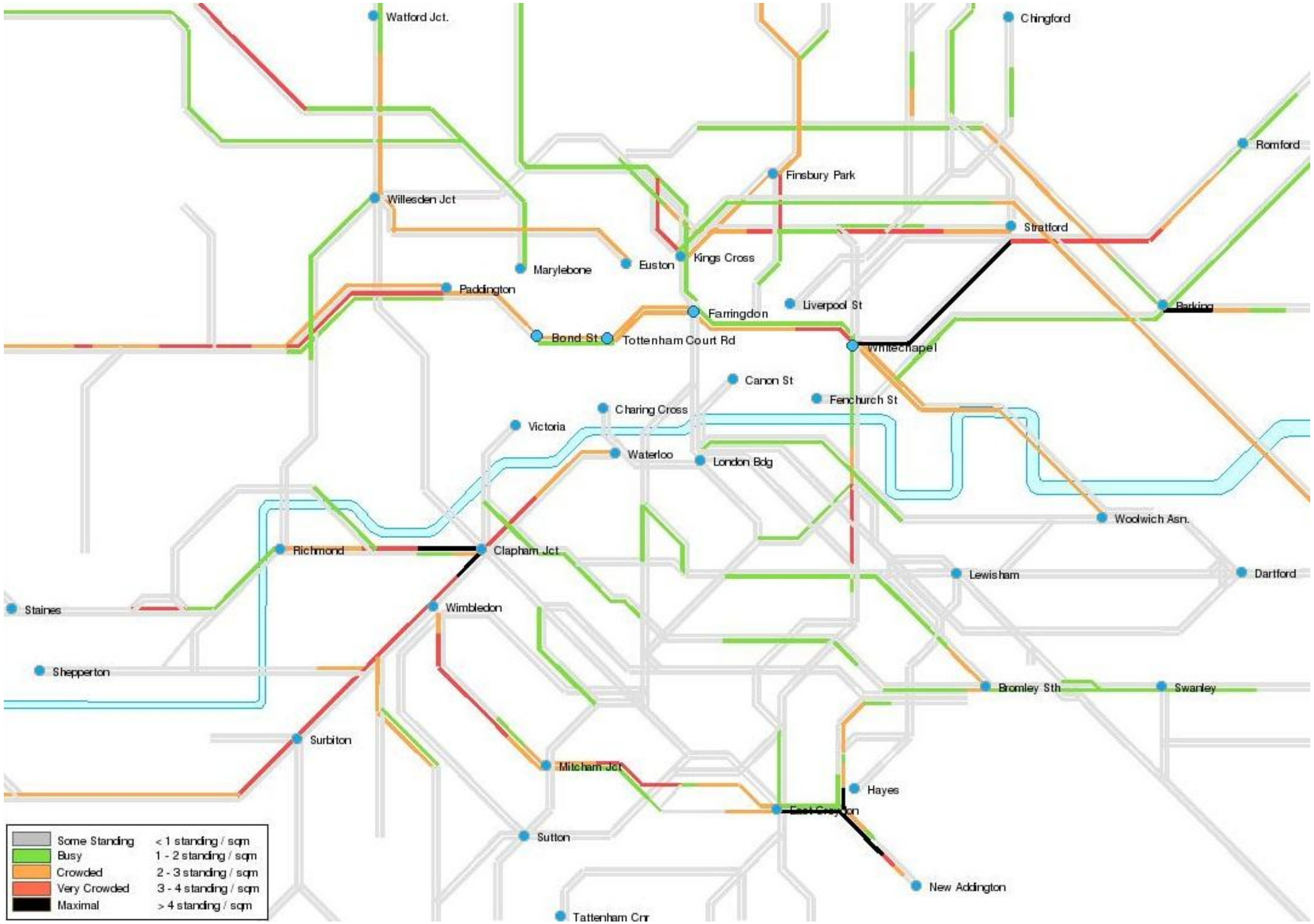
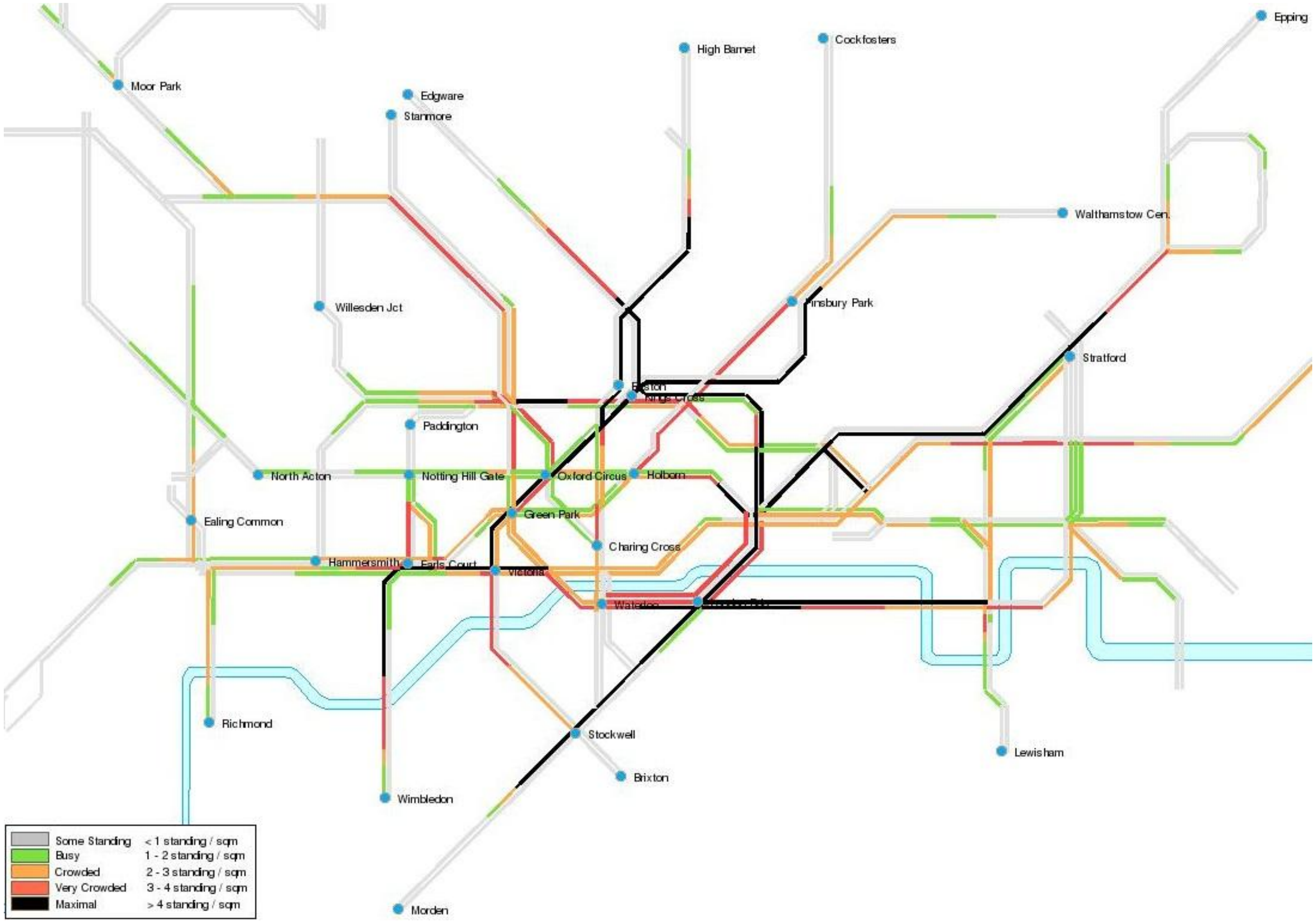


Figure 4-10: London Underground crowding – 2031 ref case AM peak



4.4 Extended Baseline 2031 assessment with Gatwick Second Runway

4.4.1 As mentioned earlier in this report, the dynamic rail modelling stage of this study involved re-running TfL's LTS model to generate a background public transport demand forecast associated with the Extended Baseline scenario. This re-run was undertaken as major public transport schemes included in the Extended Baseline (for example Crossrail 2 and the Bakerloo Line southern extension) will likely induce demand on the public transport network. Assessing the impact of airport expansion using the reference case forecast (7031ref6) would therefore underestimate impacts, since this induced background demand would not be accounted for in the appraisal.

Inputs

4.4.2 The additional Extended Baseline schemes listed in Appendix B (the schemes already included in the reference case are summarised in Appendix C) were coded in Railplan in both the AM peak and Inter-peak periods and then converted into LTS format to complete the run. Many of the schemes, particularly new LUL and Overground services, had already been coded by TfL for previous assessments and this coding was supplied and then reviewed by Jacobs to assess its suitability for this study. Other schemes such as the additional 6 peak-hour train paths on the BML identified in the Sussex Route Study had to be coded specifically for this study, and assumptions on service patterns were made based on inputs from the AC stakeholders during pre-consultation; reviews of the latest NR route studies; and inputs from the Jacobs rail operations team.

4.4.3 A summary of the additional services included in the Extended Baseline, and the associated modelling assumptions, is provided in Table 4-2. In addition to the new services listed, TfL also provided updated coding for South Eastern, TSGN and First Great Western (FGW) services based on new information obtained since the reference case was developed.

Results

4.4.4 When compared with the reference case, the LTS Extended Baseline run indicated an overall increase in PT demand across the forecast day in 2031 as a result of the new services included. Figure 4-11 summarises forecast PT boardings in the AM peak period (0700-1000) in both scenarios, indicating an increase of 99,400 PT boardings across the 3-hour peak in the Extended Baseline when compared with the reference case, an increase of 1.8%. Figure 4-12 indicates that this corresponds to an additional 1.8m passenger-kms travelled on the PT network in the same time period, an increase of 2.3%.

4.4.5 The graphs also indicate that within the overall forecast uplift in PT demand, some transfer from Bus to LUL and National Rail/Tramlink services occurs. In the AM peak, National Rail/Tramlink boardings increase by 134,000, an uplift of 7.1%, while passenger-kms increase by 1.87m (3.1%). In contrast, bus boardings decrease by 4.2% and passenger-kms decrease by 7.0%.

4.4.6 In the inter-peak 6-hour period a similar pattern is evident for all PT services, with an overall uplift in total boardings of 1.8% corresponding to an uplift of 2.8% in total passenger-kms travelled in the Extended Baseline when compared with the reference case. When National Rail/Tramlink services were considered independently, the corresponding increases were 12.7% and 4.4%, indicating that the impact of the Extended Baseline enhancements on demand is more pronounced with regard to National Rail and Tramlink services in the inter-peak than it is in the AM peak.

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Table 4-2: Summary of schemes included in LTS Extended Baseline run

Scheme	Source info	Service pattern
HS2 Phase 1 and ancillary schemes	TfL	Phase 1 hybrid bill scheme (Jan 2013 service pattern[9]) and associated amendments to WCML services – LTS does not include HS2 so amendments made to service patterns to simulate demand impacts on other services – demand forecast then included in subsequent Railplan runs, sourced from Planet Framework Model (PFM)
BML schemes (Sussex Route Study)	NR (Pre-Consultation / Sussex Route Study	Option S3i assumed from Sussex Route Study[10] - extra London Victoria peak-hour train paths (3 x Haywards Heath fast, 1 x Hove fast) and extra London Bridge peak-hour train paths (1 x Eastbourne, 1 x Hove fast); all 12-car Class 377 rolling stock in peak-hour
TSGN amendments	NR (Pre-Consultation)	Current TSGN assumption but with minor amendments: extension of some train paths terminating at Gatwick to Three Bridges; Thameslink Class 700 carriage capacity assumptions amended to 55 seats and 23.3m^2 standing space; GEX rolling stock amended to match current upgrade plan (Class 387/2)
Western Rail Access (WRA)	NR (Pre-Consultation) / coded by Jacobs	Assumed to provide 4tph service calling at Reading, Twyford, Maidenhead, Slough, Heathrow T5 and Heathrow CTA
Crossrail 2	TfL	Regional option (scenario 3b) and related amendments to South West Trains services to Waterloo
DLR enhancements	TfL	Assumed 22.5tph on Stratford Bow Branch (7.5 to Lewisham, 15 to Canary Wharf); 3-car services between Stratford International and Woolwich Arsenal; additional services at 7.5tph between Stratford International and Beckton – no reference in 2050 TfL Infrastructure Plan to DLR extensions so upgrade file incorporating extensions to Bromley excluded
London Overground enhancements	TfL	8-car Class 378's on NLL/ELL/WLL/SLL in AMP; Gospel Oak-Barking Line (GOBLIN) extended to Barking Riverside; extra 2tph between Dalston Junction and New Cross Gate (AMP); extra 2tph between Stratford and Clapham Junction (AMP)
Bakerloo line southern extension	TfL	Current 'central case' assumption (pending appraisal): peak service of 27tph from Elephant and Castle along Old Kent Road (2 new stations) and then Hayes Line to Beckenham Junction and Hayes – corresponding amendments to Southeastern services into London Bridge on parallel routes
Northern Line upgrade	TfL	Full signalling upgrade; full separation (including rebuild of Camden Town station, creation of two separate lines); extension of Charing Cross branch to Battersea via Nine Elms
West Anglia infrastructure	NR (Anglia Route Study) / coding from TfL	Additional train capacity between Liverpool Street/Stratford and Stansted Airport, Cambridge, Kings Lynn, Broxbourne, and Bishops Stortford
Western Route Study Services	NR (Western Route Study)	Minor amendments: Crossrail set as 9-car service; Swansea/Bristol-via-Bath services changed from 8-car to 9-car; some rolling stock seat assumptions amended; amendments to Marlow/Windsor & Eton branch line services

[9] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244033/Updated_economic_case_for_HS2__August_2012__-_Explanation_of_the_service_patterns__January_2013_.pdf
[10] http://www.networkrail.co.uk/long-term-planning-process/south-east-route-sussex-area-route-study/ - Table 5.4 (page 105)

Figure 4-11: Forecast 2031 AMP 3-hour PT boardings – Extended Baseline v Ref Case

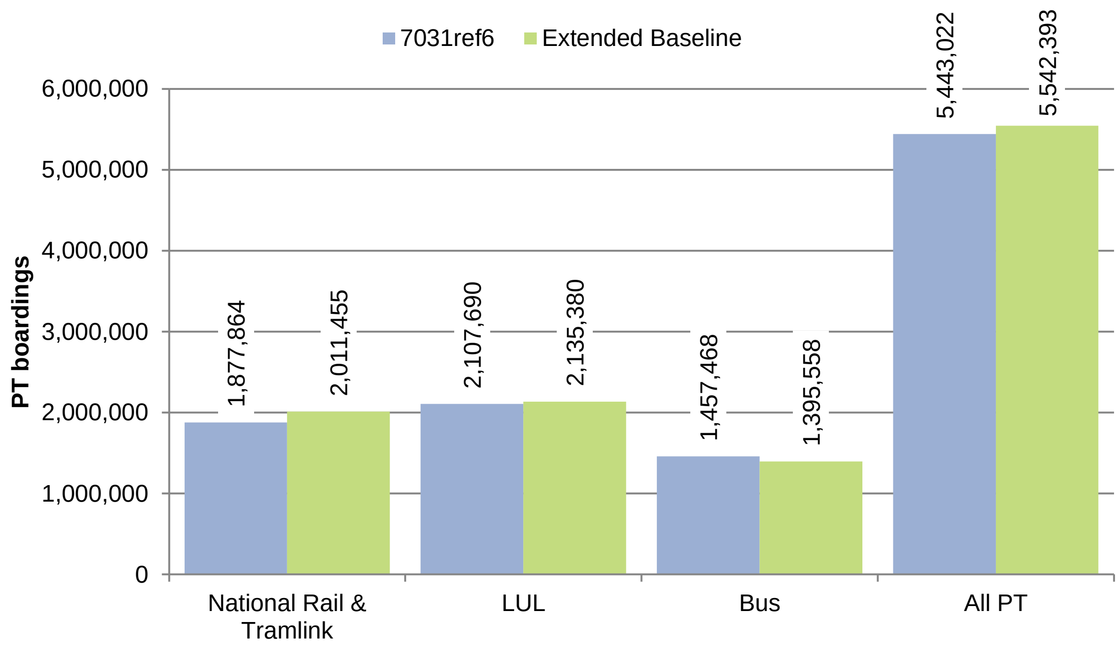
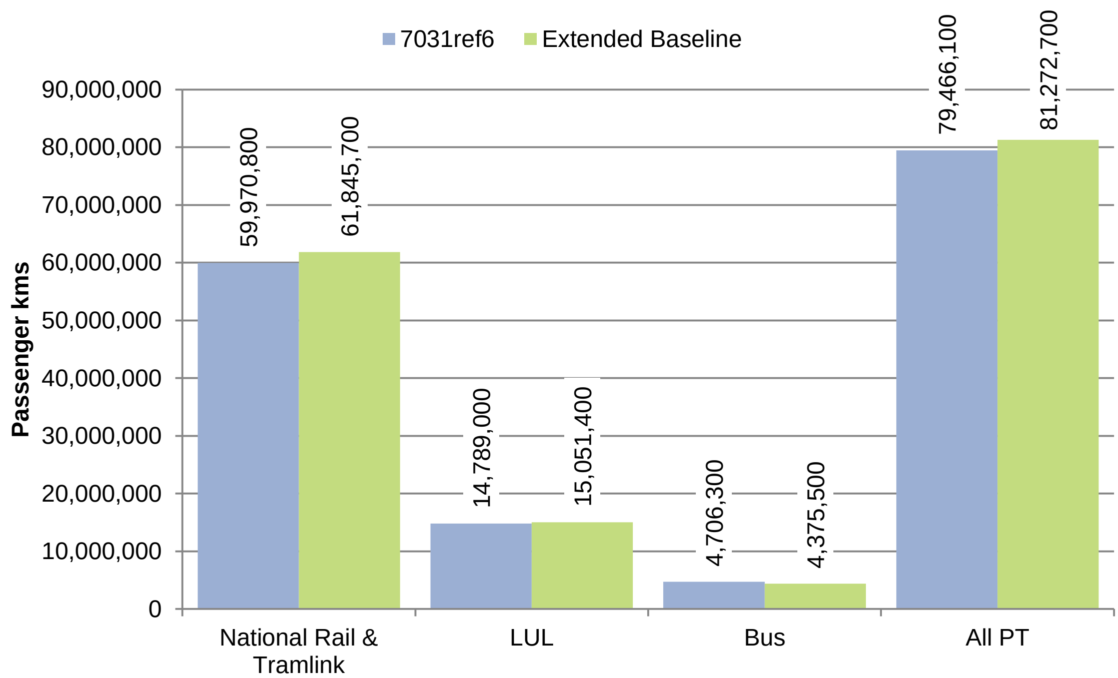


Figure 4-12: Forecast 2031 AMP 3-hour PT passenger kms – Extended Baseline v Ref Case



4.4.7 In terms of the distribution of PT demand, the impact of Extended Baseline schemes can be seen in Figure 4-13 and Figure 4-14. The plans show the % uplift in AM peak PT trip origins and destinations forecast by location in the Extended Baseline when compared with the LTS reference case. The largest % uplifts occur in areas benefitting directly from improved rail connections in the Extended Baseline, including the following locations:

- Areas in Surrey (particularly around Epsom), Kingston-upon-Thames, Merton, Hackney, Enfield and parts of Hertfordshire (around Broxbourne and Cheshunt) all benefit from Crossrail 2 stations in the regional option;

- Bromley and Lewisham benefit from the Bakerloo Line southern extension to Hayes and Beckenham Junction;
- Areas around Watford, Hemel Hempstead and St. Albans all benefit from improvements to suburban services into Euston, taking advantage of the released capacity created by the introduction of HS2.

4.4.8 The plans also indicate an increase in PT trips originating and terminating in other areas of central, north and east London to a lesser extent than those identified above, either because new services do not effect these areas to the same degree or (in the case of central London) because PT provision in the reference case is already very good so new schemes have relatively less impact on demand.

4.4.9 While PT trip destinations appear to increase in all areas, Figure 4-13 indicates that marginal reductions in PT trip origins are forecast in areas in West London and Berkshire, and also in Kent. In the case of the latter, some rail demand may be replaced by car trip origins in the Extended Baseline rail-heading onto Bakerloo Line services in Bromley. In general however, the demand reductions from these areas are marginal and probably reflect the fact that relative to the areas described above, these areas benefit less from Extended Baseline schemes. LTS indicates that the Extended Baseline schemes increase the number of rail trips on the PT network in central London, which may increase crowding and encourage a marginal shift to other modes for some trips originating in areas that do not benefit directly from the new schemes.

Figure 4-13: % change in AMP PT trip origins (Extended Baseline v Ref Case)

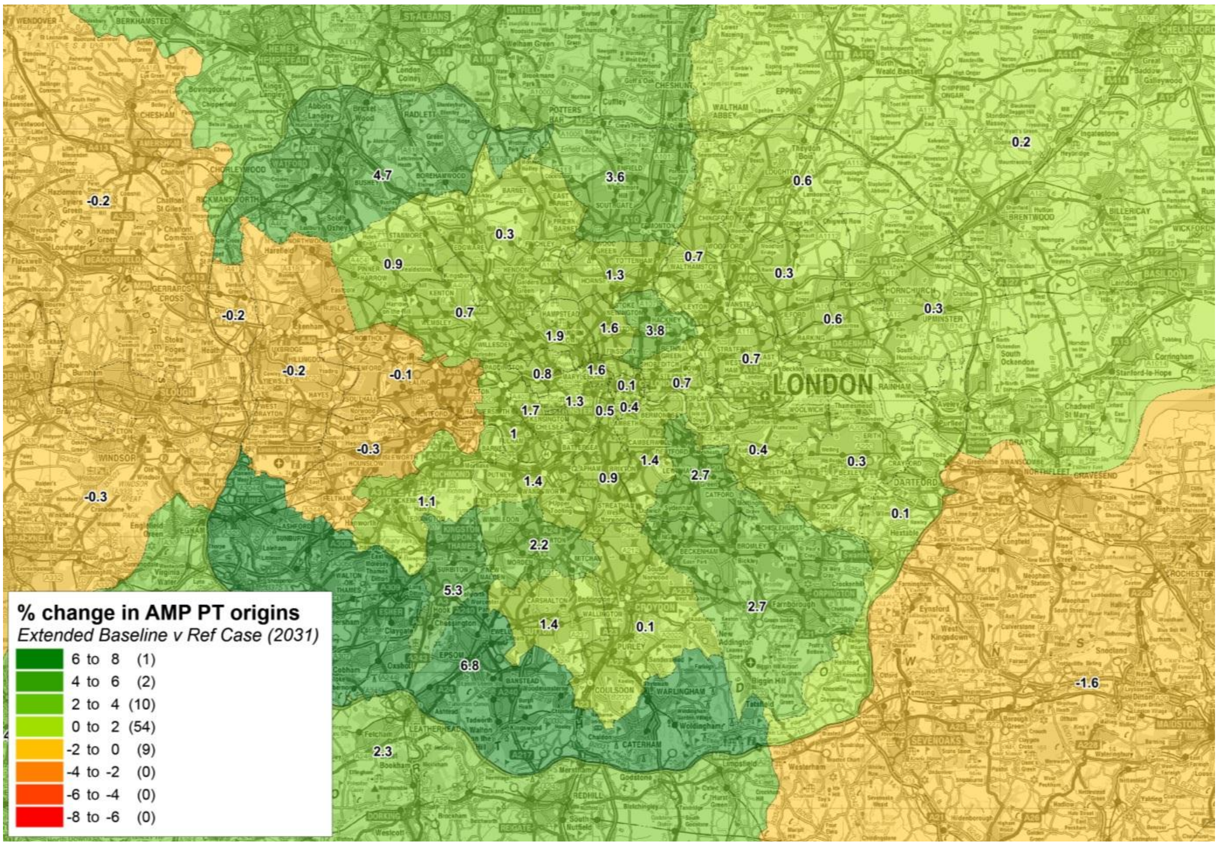
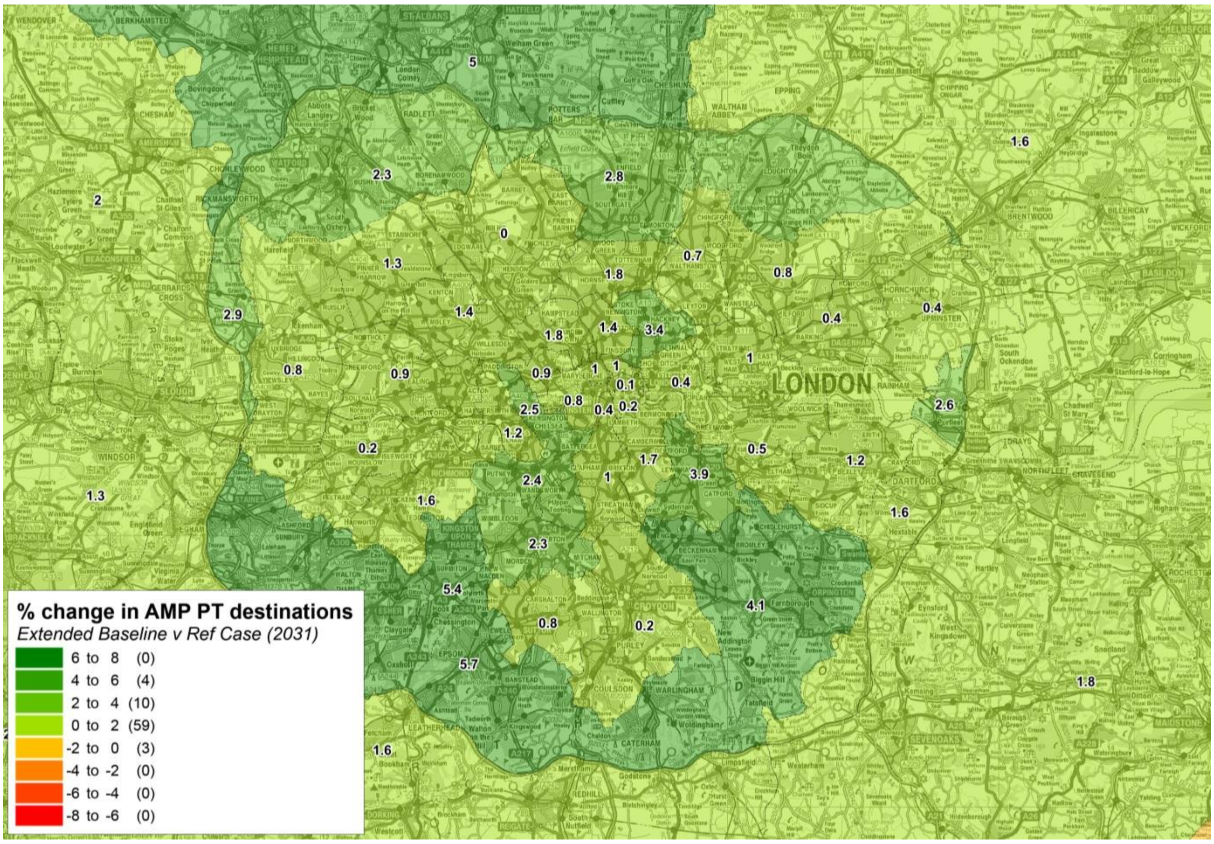


Figure 4-14: % change in AMP PT trip destinations (Extended Baseline v Ref Case)



4.5 Airport demand forecasts

4.5.1 Following the completion of the LTS Extended Baseline run, the corresponding 2031 AMP and IP demand matrices were imported back into Railplan. The forecast trip origins and destinations associated with Gatwick Airport zones were then replaced with airport-related demand forecasts derived from the enhanced spreadsheet models for two scenarios, as follows:

- Gatwick with no expansion (i.e. the airport in its current form in 2030, with one runway);
- Gatwick with the Second Runway in place.

4.5.2 Four Railplan runs were then completed, providing AMP and IP outputs for the two scenarios identified above. These are described in more detail later in this chapter.

Scenario outputs

4.5.3 The graph in Figure 4-15 summarises the total rail demand forecast to and from Gatwick in the AM peak period (0700-1000) in each of the two scenarios described above, consisting of airport passengers, employees, and rail 'meet and greet' trips – the totals illustrated on the graph relate to the core CT LCK headline numbers described in Chapter 2 and represent the airport-related demand inputs to the Railplan AMP models described later in this chapter.

4.5.4 The graph indicates a total uplift in demand of some 3,800 rail trips to and from the airport during the AMP in the Second Runway scenario when compared with the no expansion forecast – this amounts to an increase of around 37% in total rail demand between the two scenarios.

4.5.5 Figure 4-16 provides the corresponding forecasts for the IP (1000-1600), illustrating similar trends. The total increase in rail trips between the no expansion and Second Runway scenarios is around 5,300 during this time period, amounting to an uplift of around 25%.

Figure 4-15: Forecast 2030 AM peak (0700-1000) rail demand (airport passengers and employees)

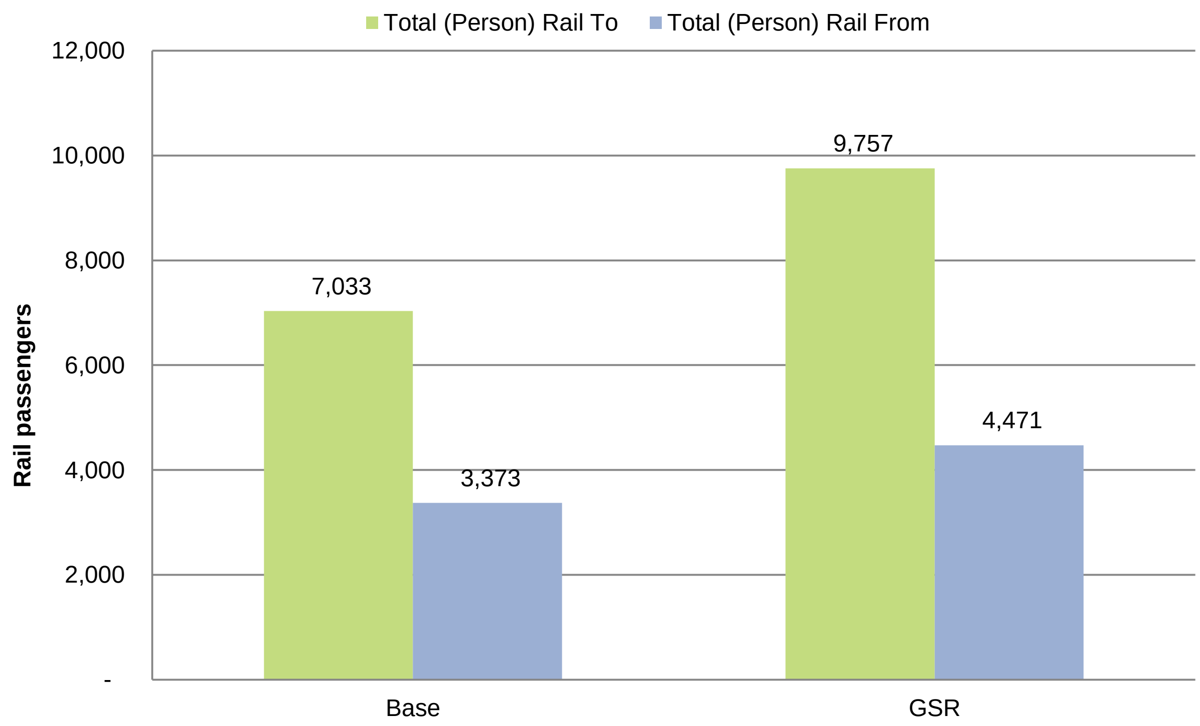
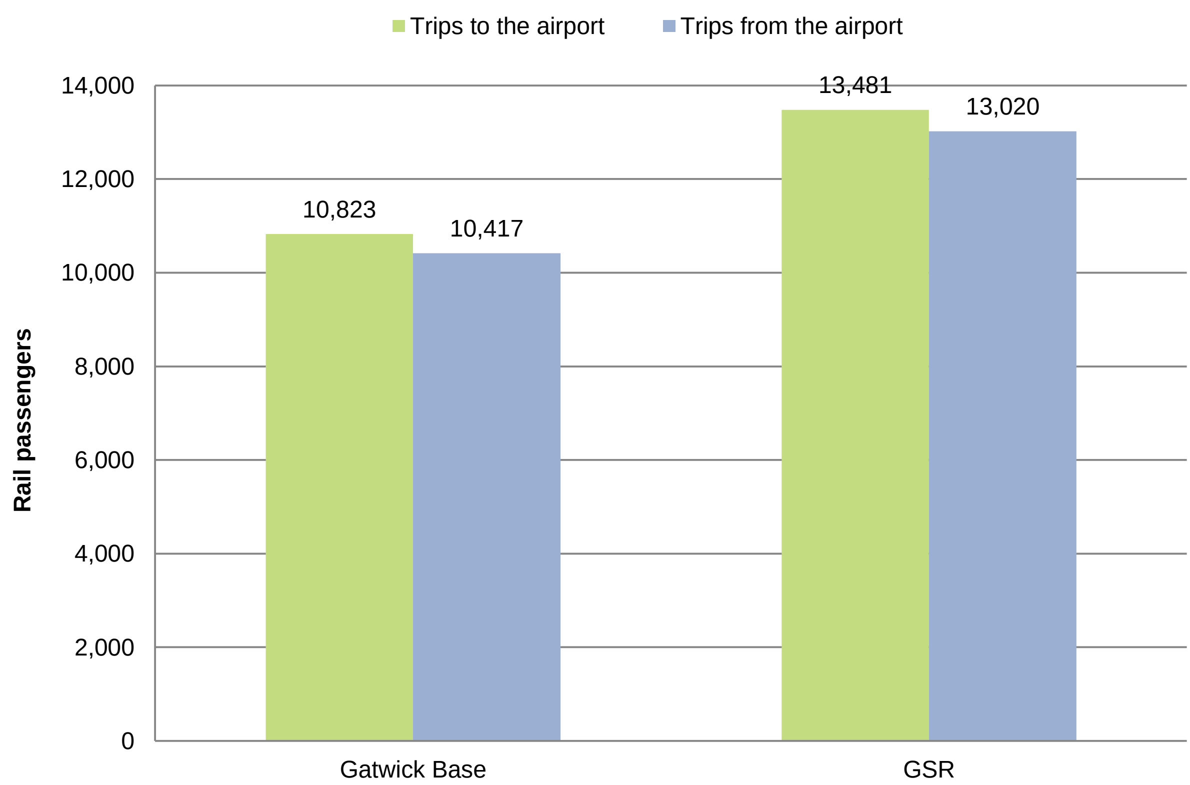


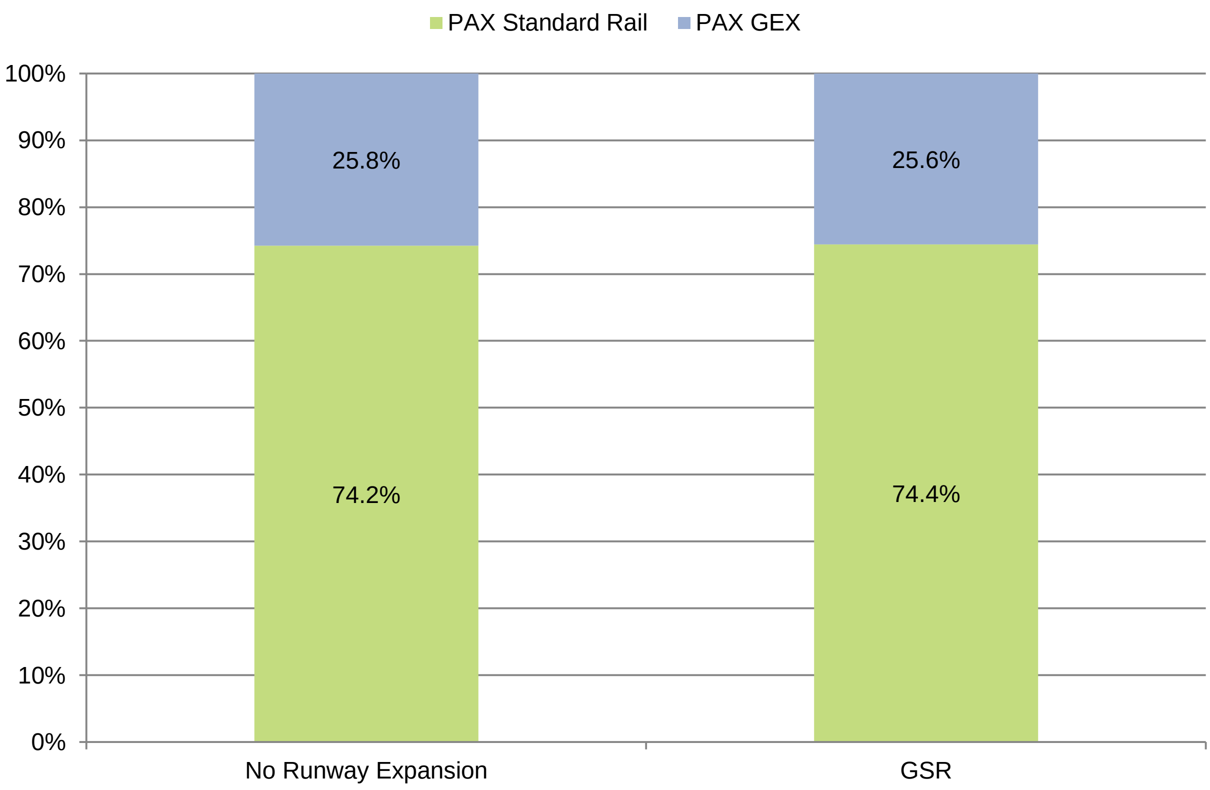
Figure 4-16: Forecast 2030 IP (1000-1600) rail demand (airport passengers and employees)



4.5.6 Figure 4-17 illustrates the total rail sub-mode share forecast to the airport in the AM peak period (0700-1000). It should be noted that the graph shows a combined rail sub-mode forecast for both airport passengers and employees, with each group assessed independently in the modelling process.

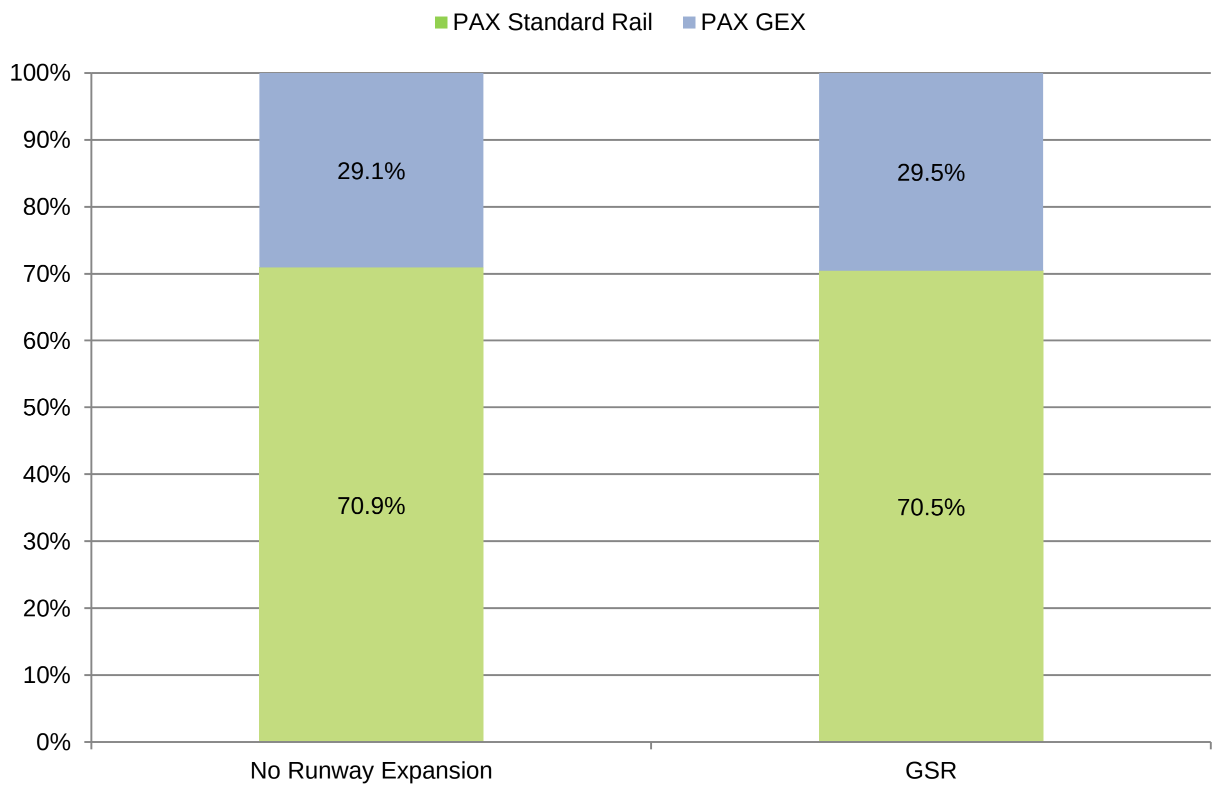
4.5.7 Passenger and employee trips to and from the airport are forecast based on hourly profiles and as a result, the combined mode share changes according to the modelled hour and the direction of travel (since employee travel is more tidal in nature, for example accounting for a greater proportion of total demand to the airport in the AMP than from the airport in the same period).

Figure 4-17: AMP (0700-1000) overall rail sub-mode share TO airport (passengers and employees)



4.5.8 Figure 4-18 illustrates the point made above, indicating how rail sub-mode share changes in the AMP for trips away from the airport. Employees make up a much smaller proportion of total demand in this direction and therefore the mode share illustrated is more reflective of airport passenger rail choices.

Figure 4-18: AMP (0700-1000) overall rail sub-mode share FROM airport (passengers and employees)



4.6 AM peak Railplan Extended Baseline runs

No runway expansion

4.6.1 The first AMP Railplan run completed was the ‘no expansion’ scenario, consisting of the Extended Baseline transport network and corresponding background demand forecast from LTS, assuming that Gatwick remains in its current form with one runway.

4.6.2 Figure 4-19 illustrates AM peak flows on the network in the vicinity of Gatwick Airport in this scenario, indicating a forecast of around 34,500 trips heading inbound to London north of Horley in the AM peak, with around 15,000 heading in the opposite direction on the same link.

4.6.3 Figure 4-20 illustrates the AM peak flows on the network north of East Croydon in the same scenario. The plan shows that the split of demand on the BML routes to Victoria and London Bridge is broadly similar, with around 44,500 travelling inbound to London on the Victoria branch north of Streatham Common and 45,400 travelling in the same direction on the London Bridge branch north of Sydenham.

Figure 4-19: 2031 Extended Baseline AM peak forecast rail demand around Gatwick (no runway expansion)

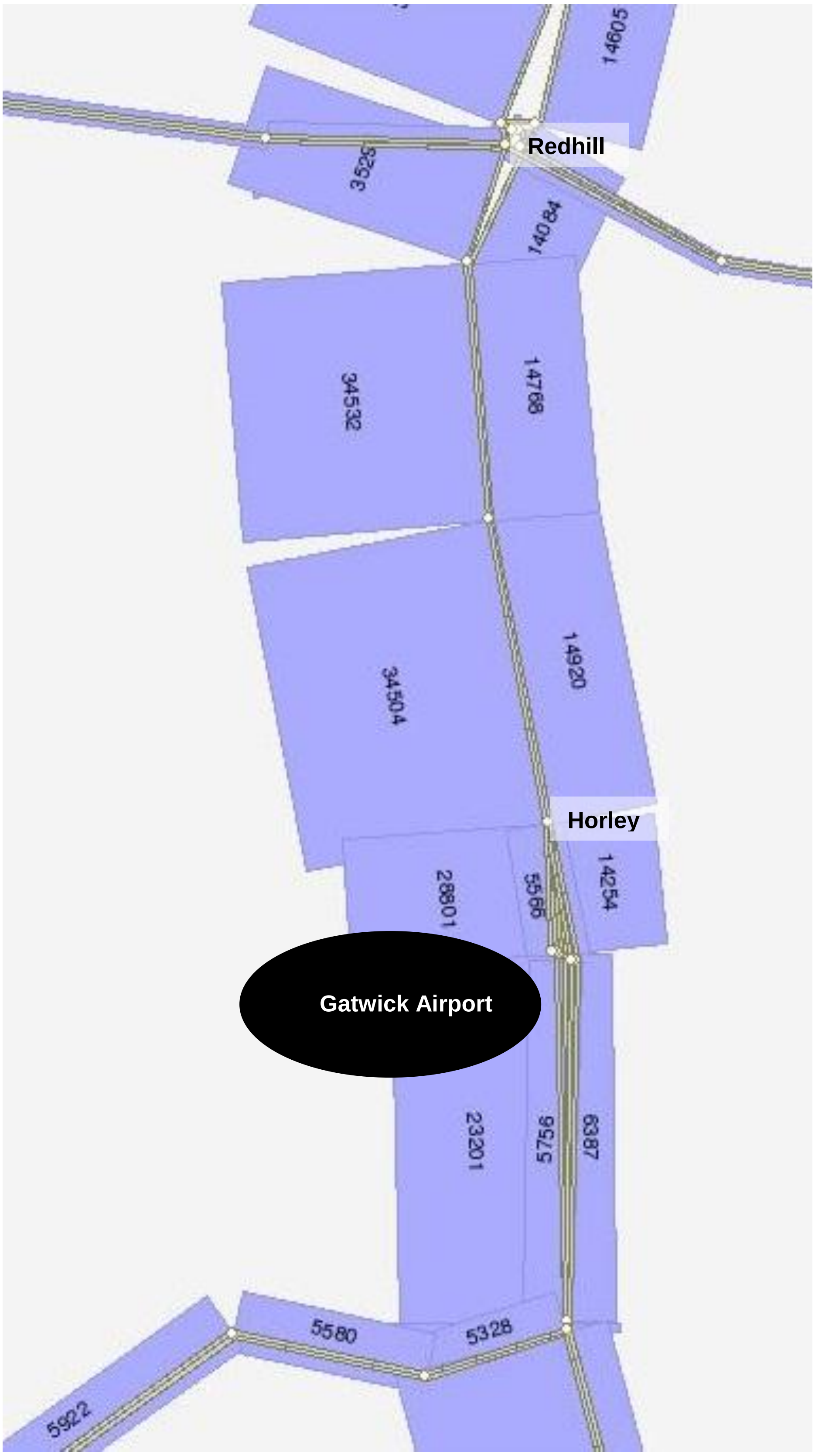
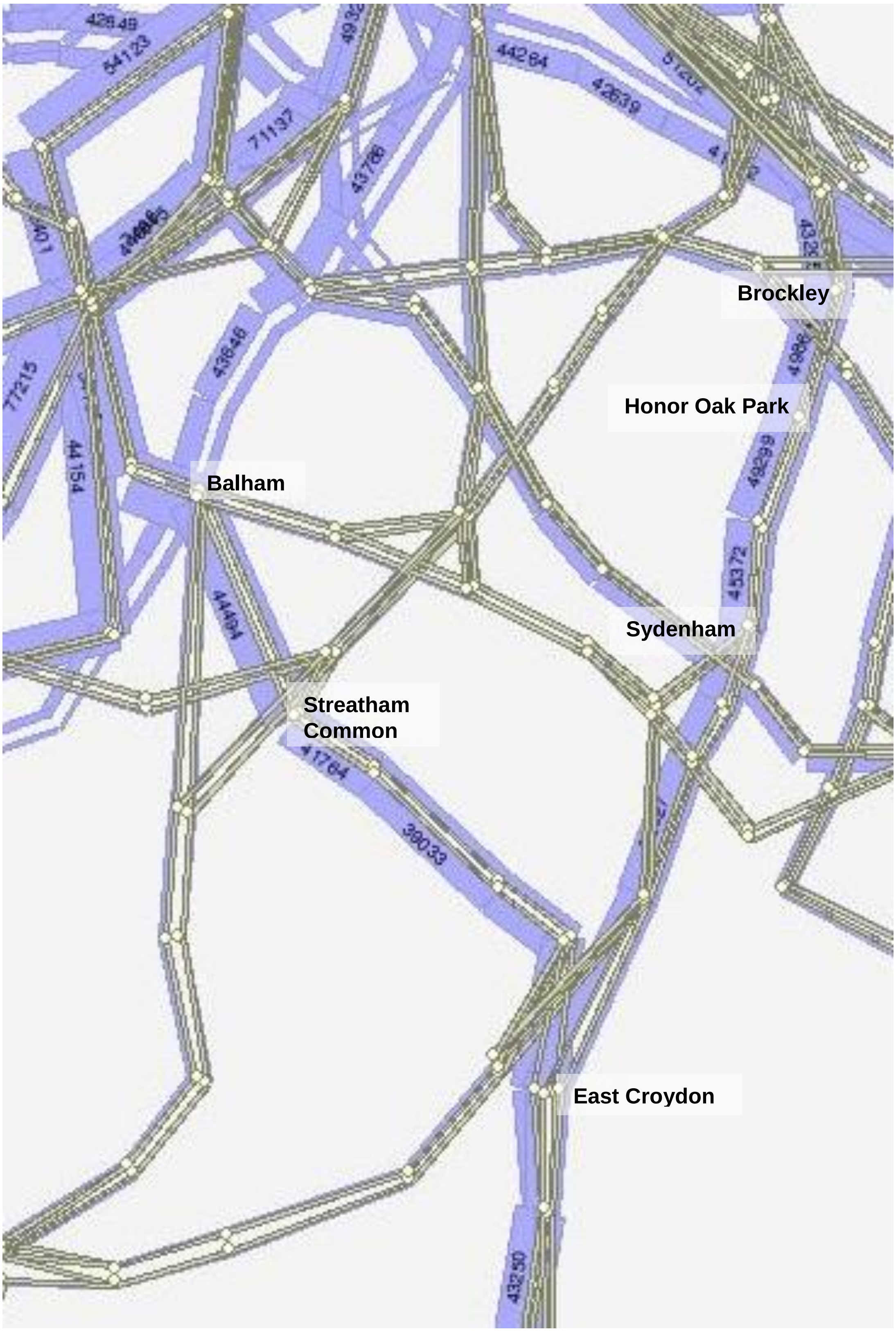


Figure 4-20: 2031 Extended Baseline AM peak forecast rail demand (no runway expansion)



4.6.4 The flows on links summarised above were compared with available seated and standing capacity on each link in the model to calculate estimates of forecast crowding on the network, measured as the average number of people standing per m^2 on trains on each link across the time period.

4.6.5 Railplan does produce full crowding plots for all National Rail services included in the model, but these outputs have not been included in this report as forecasts for each link represent aggregate estimates of crowding incorporating many different types of service (utilising different types of rolling stock), including non-airport services on the BML.

4.6.6 As a result, these outputs are not detailed enough to draw any meaningful conclusions about the crowding experienced by airport-related passengers on the network. Link-based model outputs for National Rail services have instead been disaggregated to report crowding impacts on trains directly serving the airport, split by service group (i.e. GEX and National Rail).

4.6.7 Figure 4-21 summarises the aforementioned crowding impacts on National Rail services providing direct connections to Gatwick in the AMP ‘no expansion’ scenario. The plot indicates that there are no significant crowding issues on any routes serving the station as a result of the additional capacity added to the BML by the post-2018 TSGN programme and the additional train paths released by the infrastructure schemes identified in the Sussex Route Study, which are listed in the AC’s Extended Baseline. The highest level of forecast crowding is on Thameslink services into London Bridge, with just over 1 person standing per m^2 on the approach to London Bridge. On terminating services into London Bridge, crowding reaches 0.63 people standing per m^2 and on GEX some standing is evident into Victoria, as the service attracts non-airport demand commuting from areas such as Brighton.

4.6.8 Figure 4-22 illustrates the London Underground crowding plot for the AMP ‘no expansion’ scenario. In contrast to the National Rail outputs, this plot is a standard output from Railplan and is more appropriate for this report since routes and service/rolling stock types are limited when analysed by line.

4.6.9 The Underground plot indicates that even incorporating a range of schemes to enhance capacity across the network, high crowding levels are forecast on many services by the 2030s regardless of airport expansion, including significant sections of the Northern Line (particularly the Bank branch), the Central Line to the east, and the Victoria Line north of Oxford Circus. The plot also indicates that the new Bakerloo Line southern extension is forecast to become very crowded west of Lewisham in the AMP, reaching in excess of 4 people standing per m^2.

Figure 4-21: 2031 Extended Baseline (no runway expansion) – average passengers standing per m[2] on trains serving Gatwick (AM peak hour)

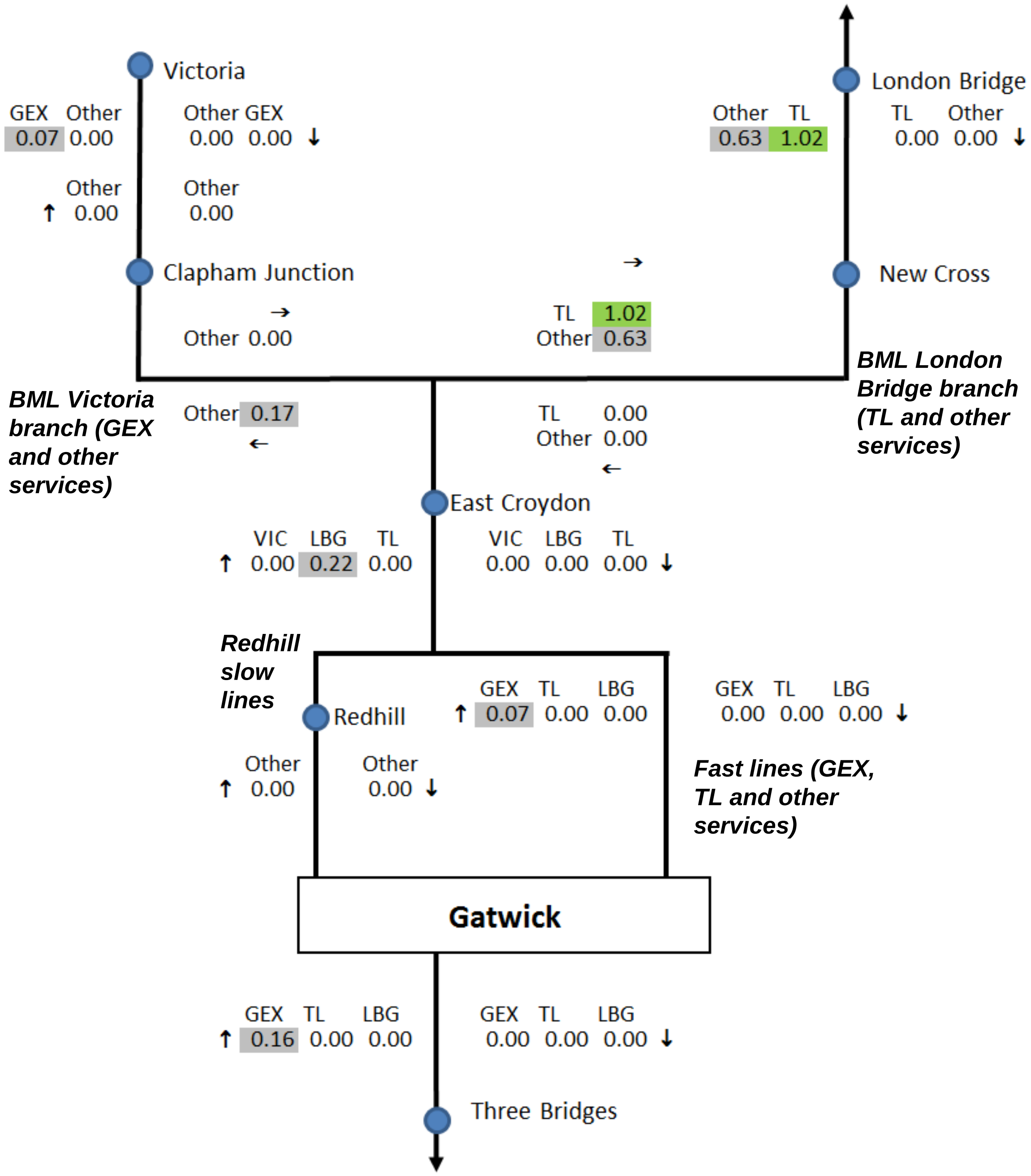
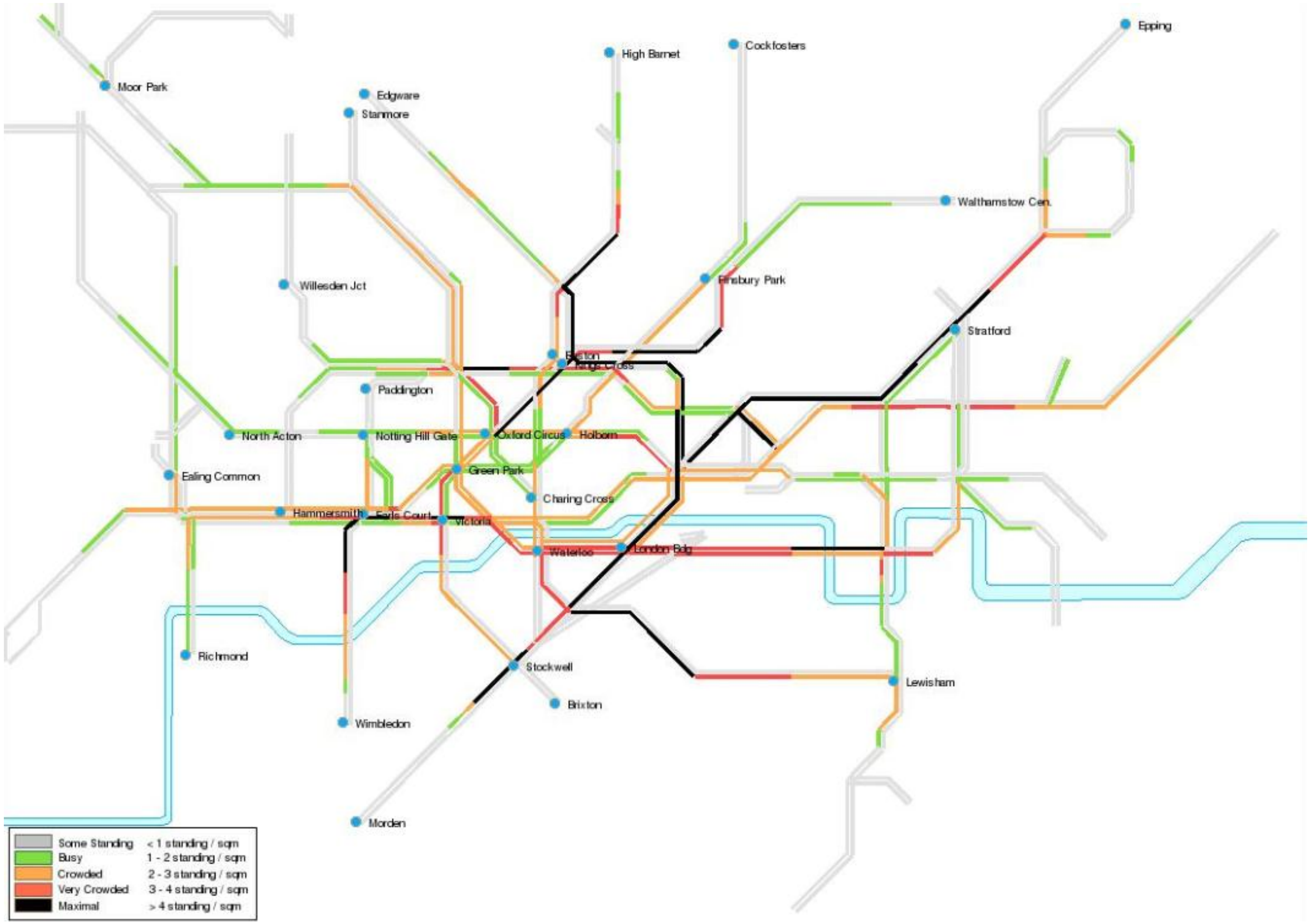


Figure 4-22: 2031 Extended Baseline LUL crowding (no runway expansion)



Second Runway

4.6.10 The second AMP Railplan run involved testing the Extended Baseline network with the additional airport rail demand associated with the Second Runway.

4.6.11 Figure 4-23 and Figure 4-24 summarise the forecast flow on links in the vicinity of Gatwick and on the BML north of Croydon respectively in this scenario, while Figure 4-25 and Figure 4-26 indicate the change in forecast flows when compared with the Extended Baseline ‘no expansion’ scenario. In the latter two plans, red bands indicate an increase in demand while green bands indicate a reduction, and since the transport networks and background demand estimates are similar in both scenarios, the plans effectively indicate the growth in demand on links directly as a result of Second Runway-related rail trips.

4.6.12 The plans indicate that in the Gatwick area, the Second Runway adds around 900 additional trips inbound to London, with an additional 2,000 travelling towards the airport. On the link north of Horley for example, this adds around 2.5% to total demand in the Up direction and around 13% in the Down direction, albeit to a lower base flow. In the London area, the impact of the Second Runway diminishes – on the link between Streatham Common and Balham on the Victoria branch for example, flow in the Up direction increases by around 500 trips (1.1% of total demand), while north of Sydenham on the London Bridge branch the increase is around 250 trips (0.6%). Again, in the Down direction the proportional uplift is more significant but on a significantly lower level of demand.

4.6.13 The impact on crowding on National Rail links providing direct connections to Gatwick is illustrated in Figure 4-27, while Figure 4-28 highlights the change from the ‘no expansion’ scenario. The figures indicate that even with the Second Runway in place, there are no significant crowding issues on National Rail services to and from the airport in the AM peak. The most crowded route in this scenario is Thameslink into London Bridge but this only reaches 1.05 people standing per m^2 on the approach to London Bridge, while terminating services reach 0.7. No issues are evident on Victoria services.

4.6.14 Figure 4-29 provides crowding forecasts for London Underground services in the Second Runway scenario. When compared with the Extended Baseline ‘no expansion’ forecast, there is virtually no difference in forecast crowding with the Second Runway in place. The difference plots described earlier indicate that the only noticeable changes in demand occur on the BML on services providing direct connections to the airport. Airport-related rail trips are highly dispersed in terms of secondary connections on the Underground network.

Figure 4-23: 2031 Extended Baseline AM peak forecast rail demand around Gatwick (with Second Runway)

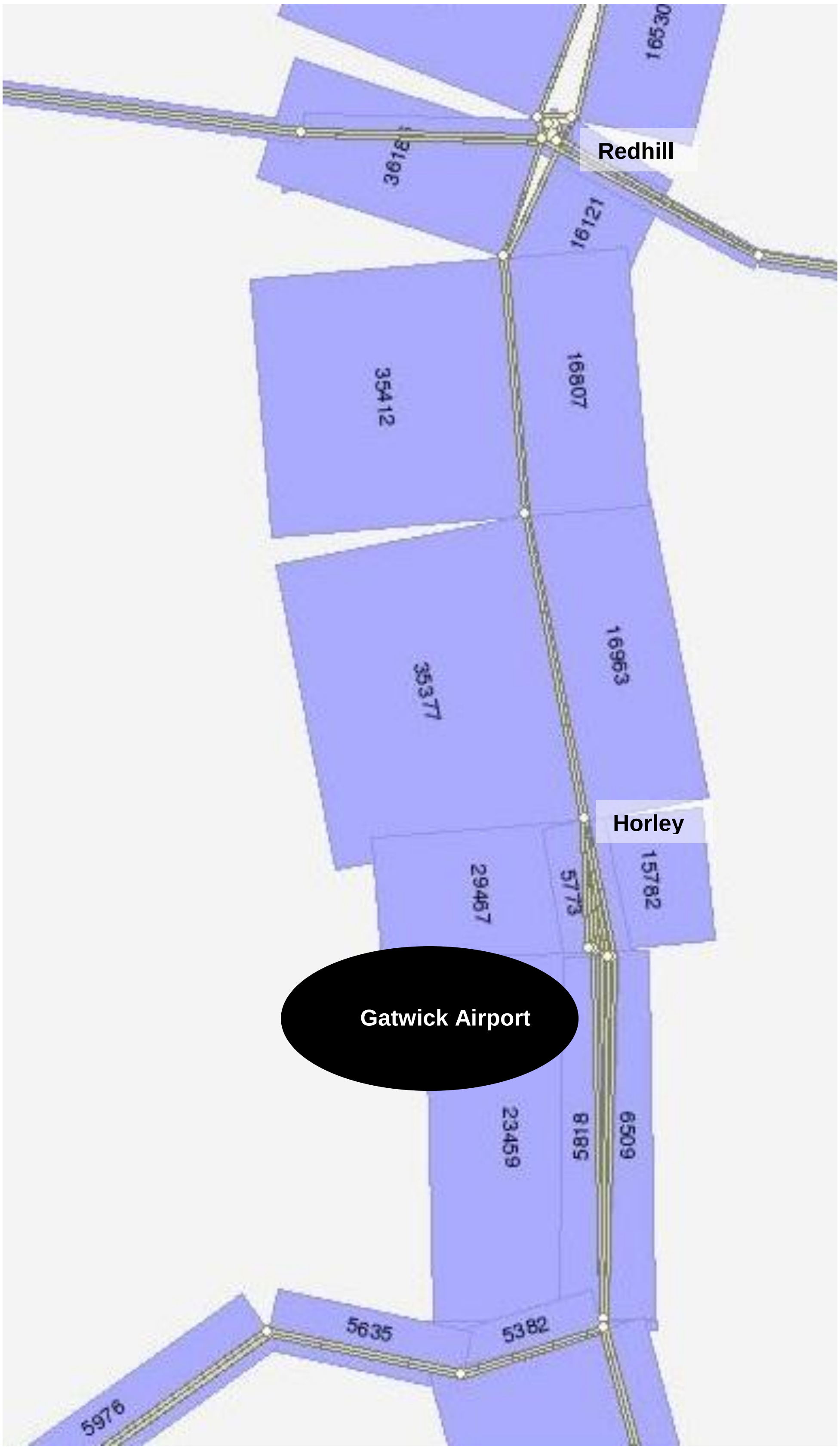


Figure 4-24: 2031 Extended Baseline AM peak forecast rail demand in South London (Second Runway)

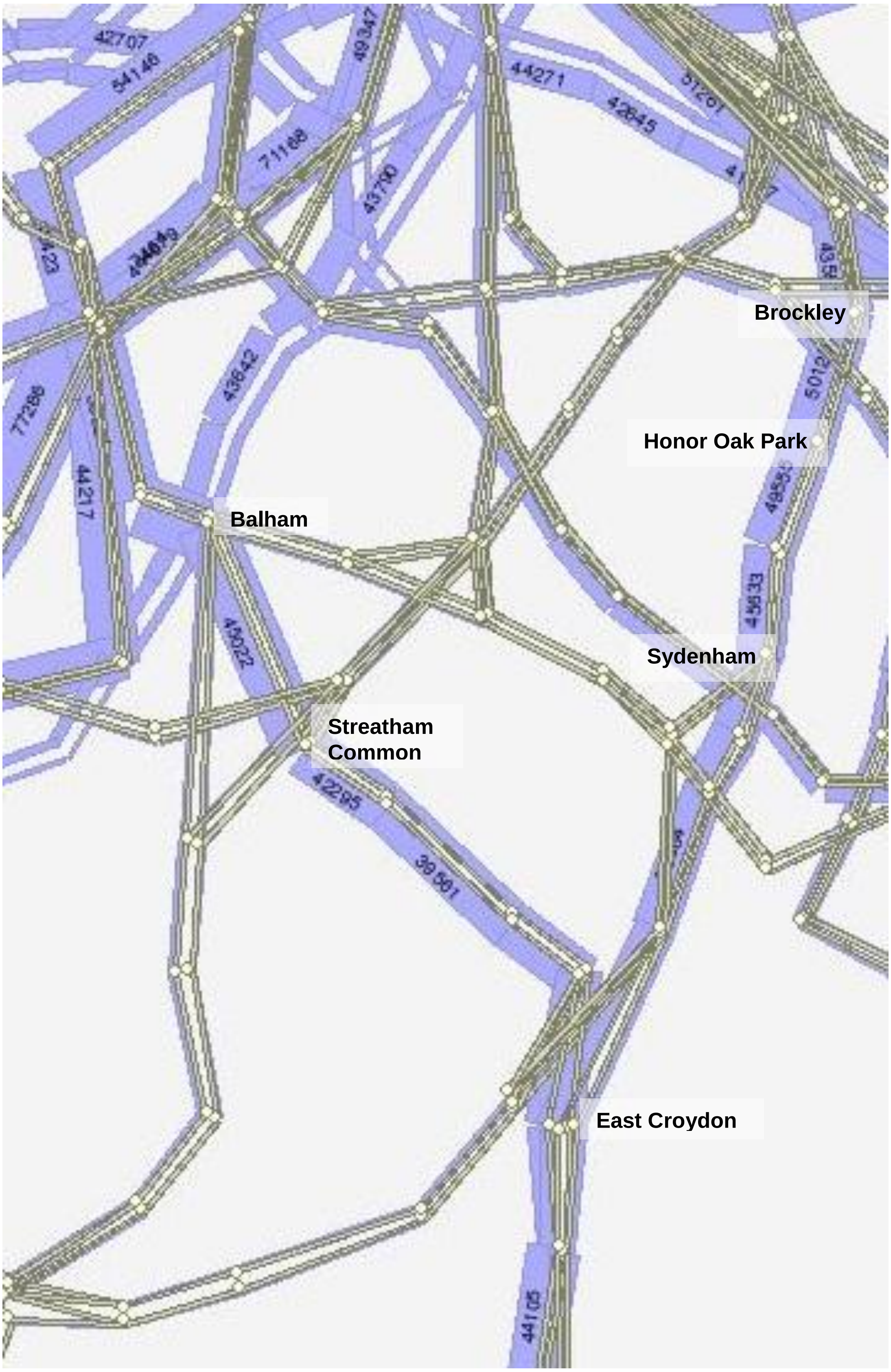


Figure 4-25: 2031 Extended Baseline change in AMP demand around Gatwick (GSR v no expansion)

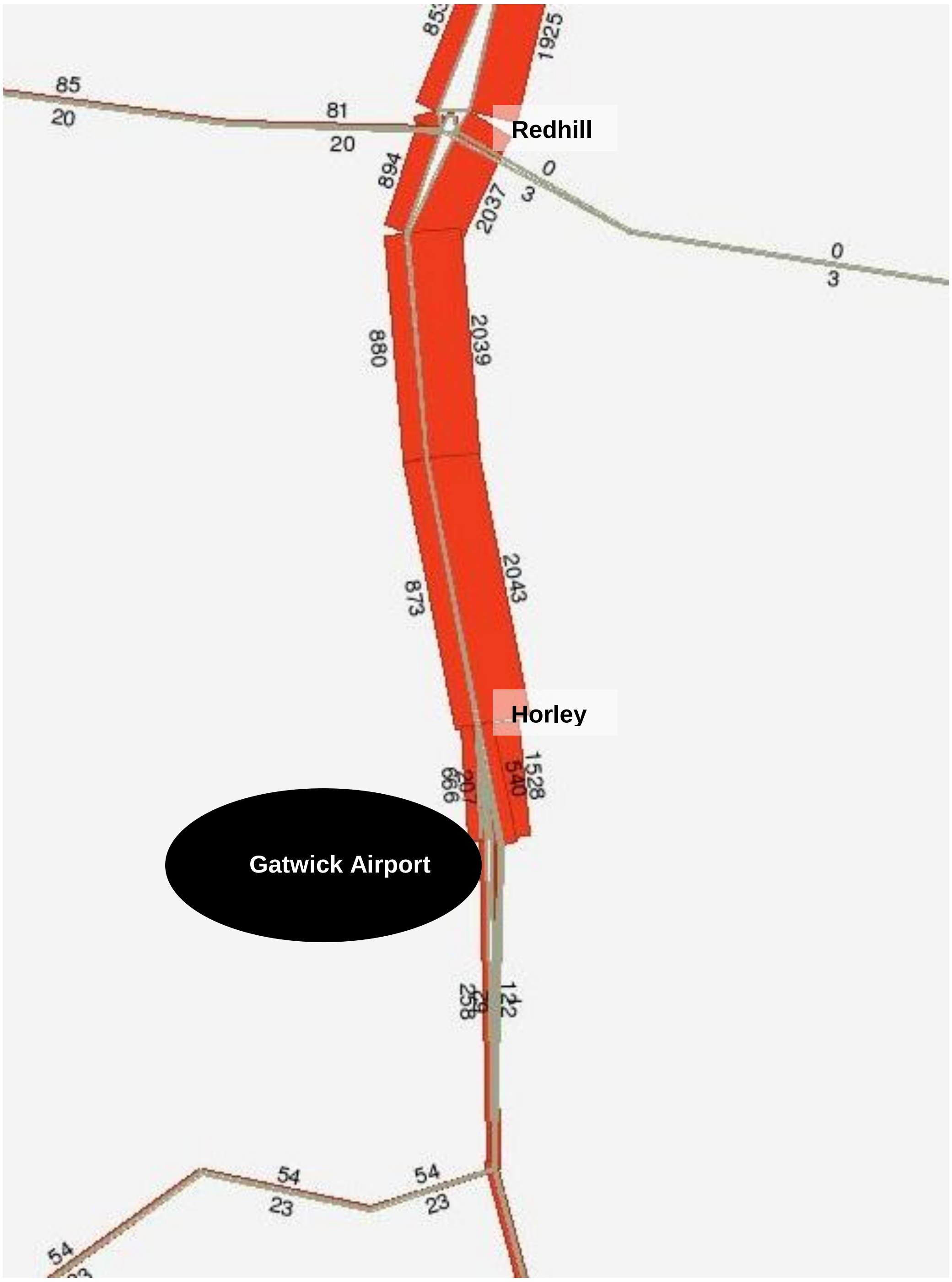


Figure 4-26: 2031 Extended Baseline change in AMP demand in South London (GSR v no expansion)

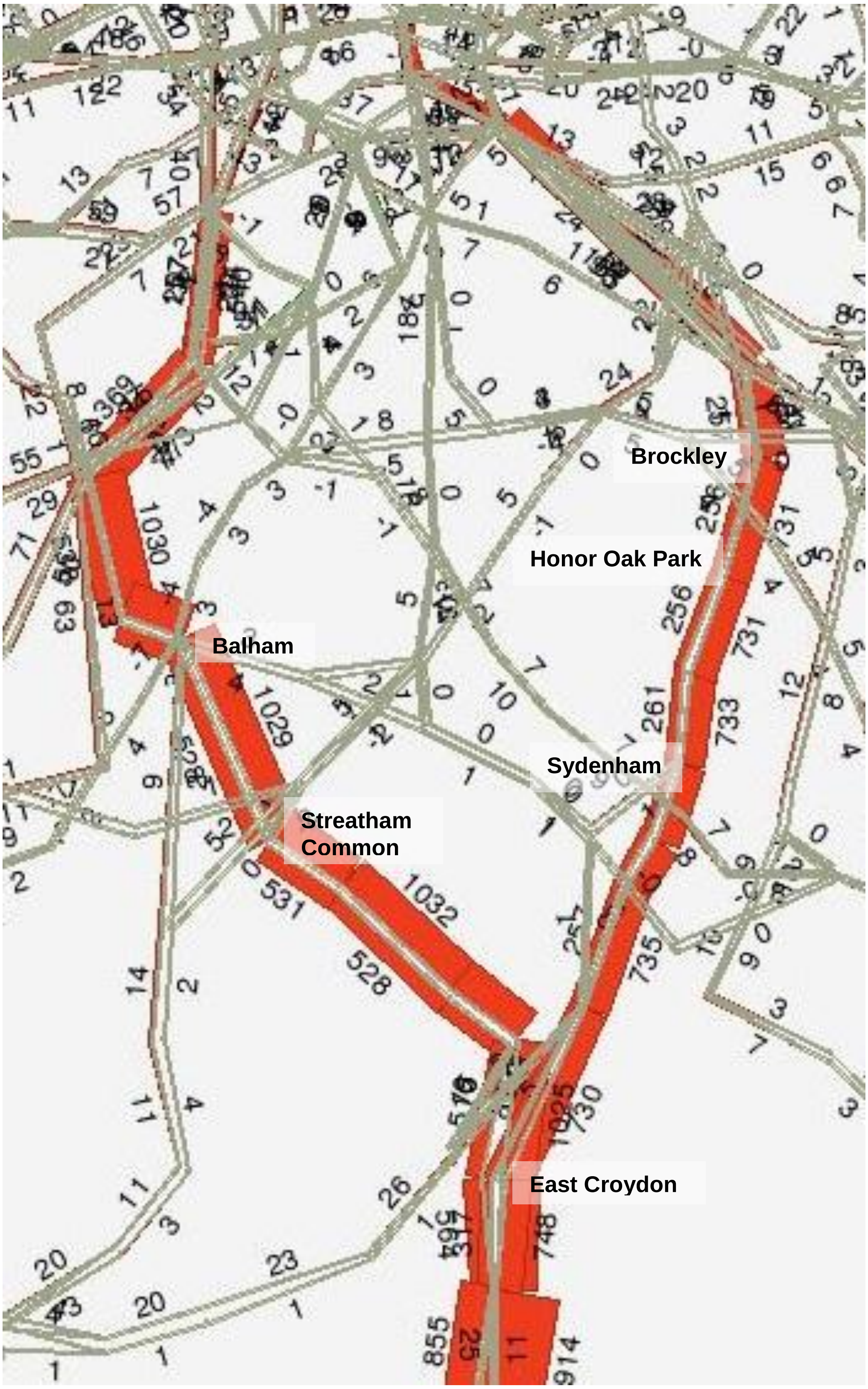


Figure 4-27: 2031 Extended Baseline (with Second Runway) – average passengers standing per m² on trains serving Gatwick (AM peak hour)

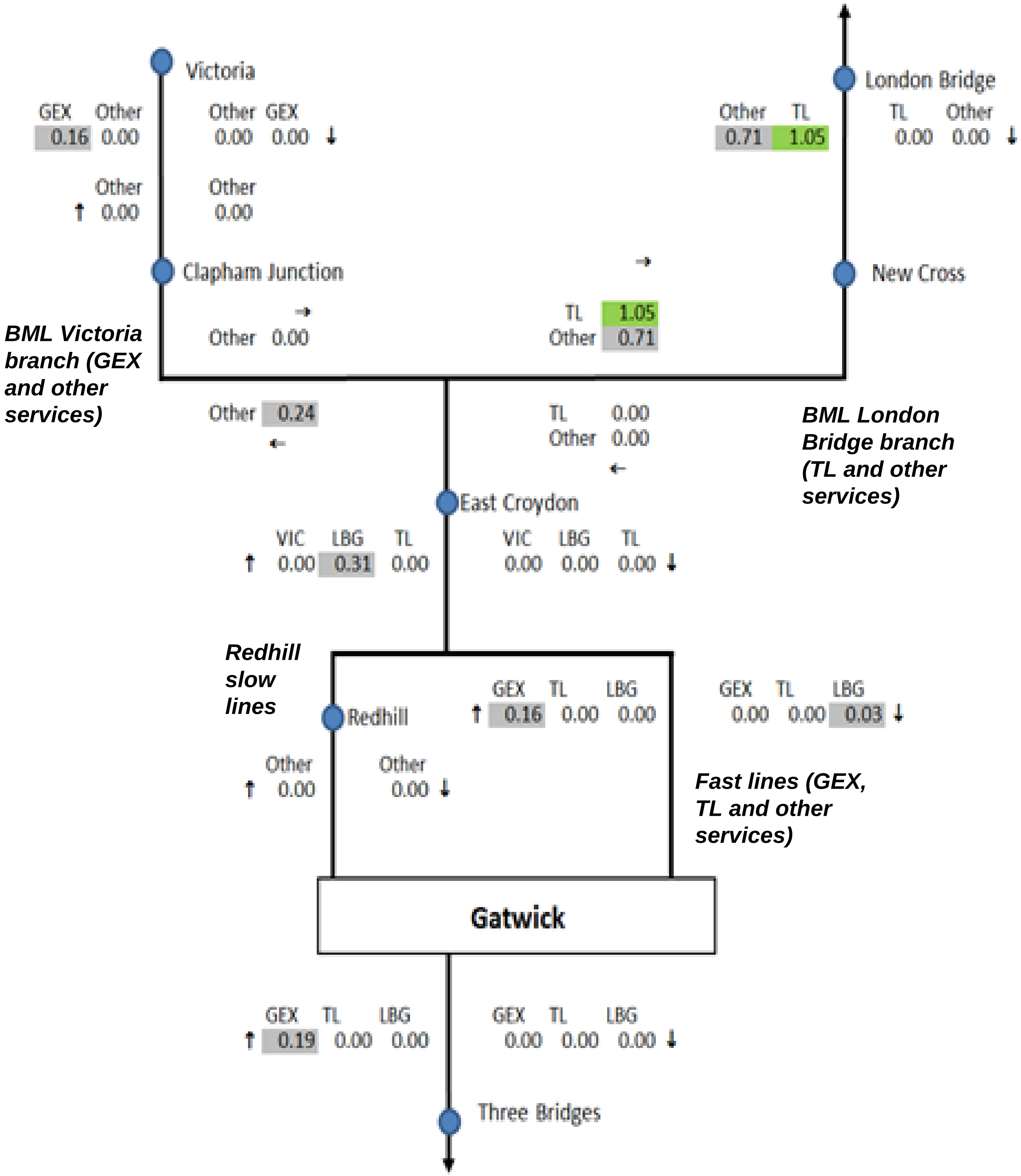


Figure 4-28: Gatwick Second Runway – change in crowding compared with 'no expansion' scenario

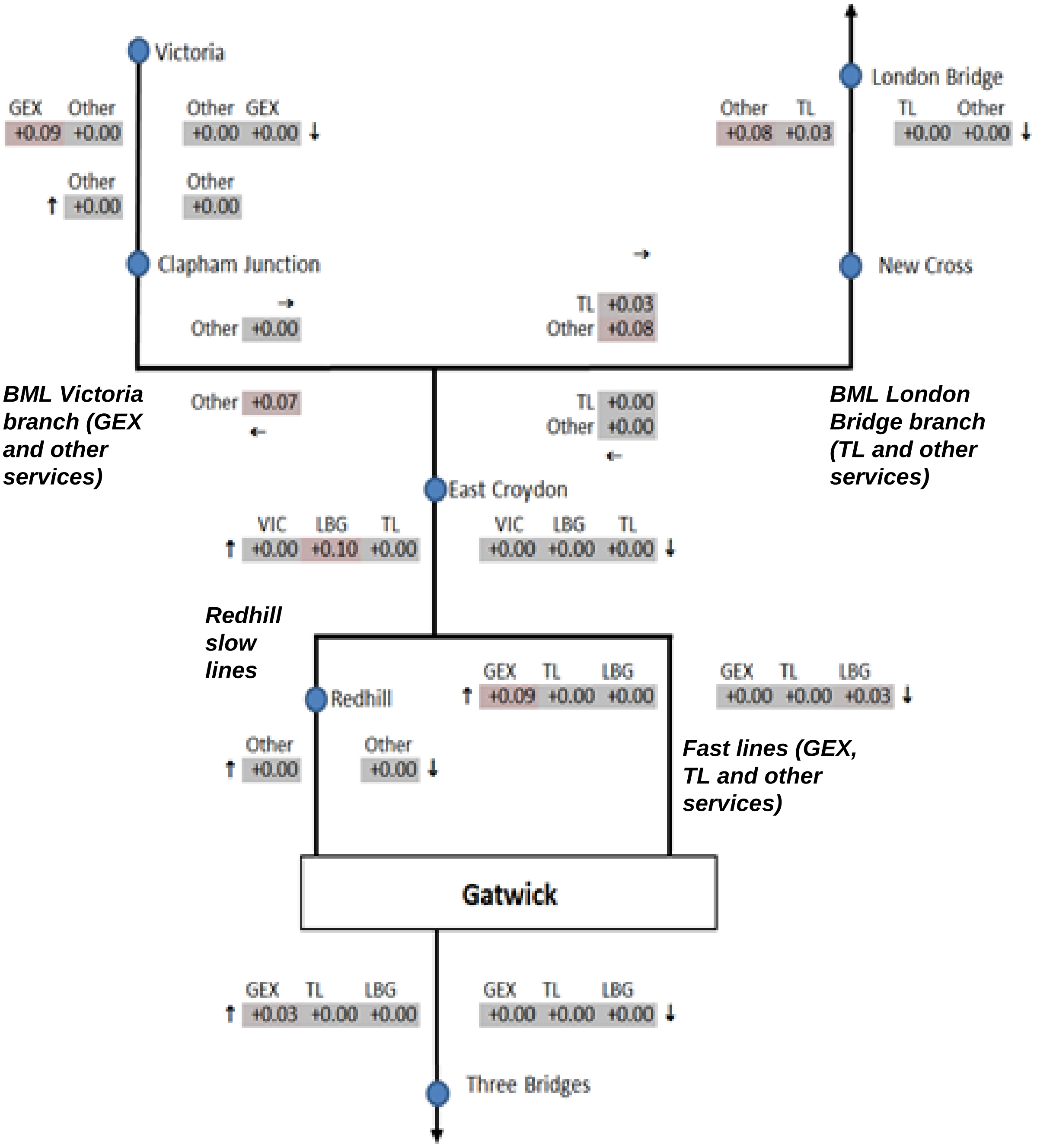
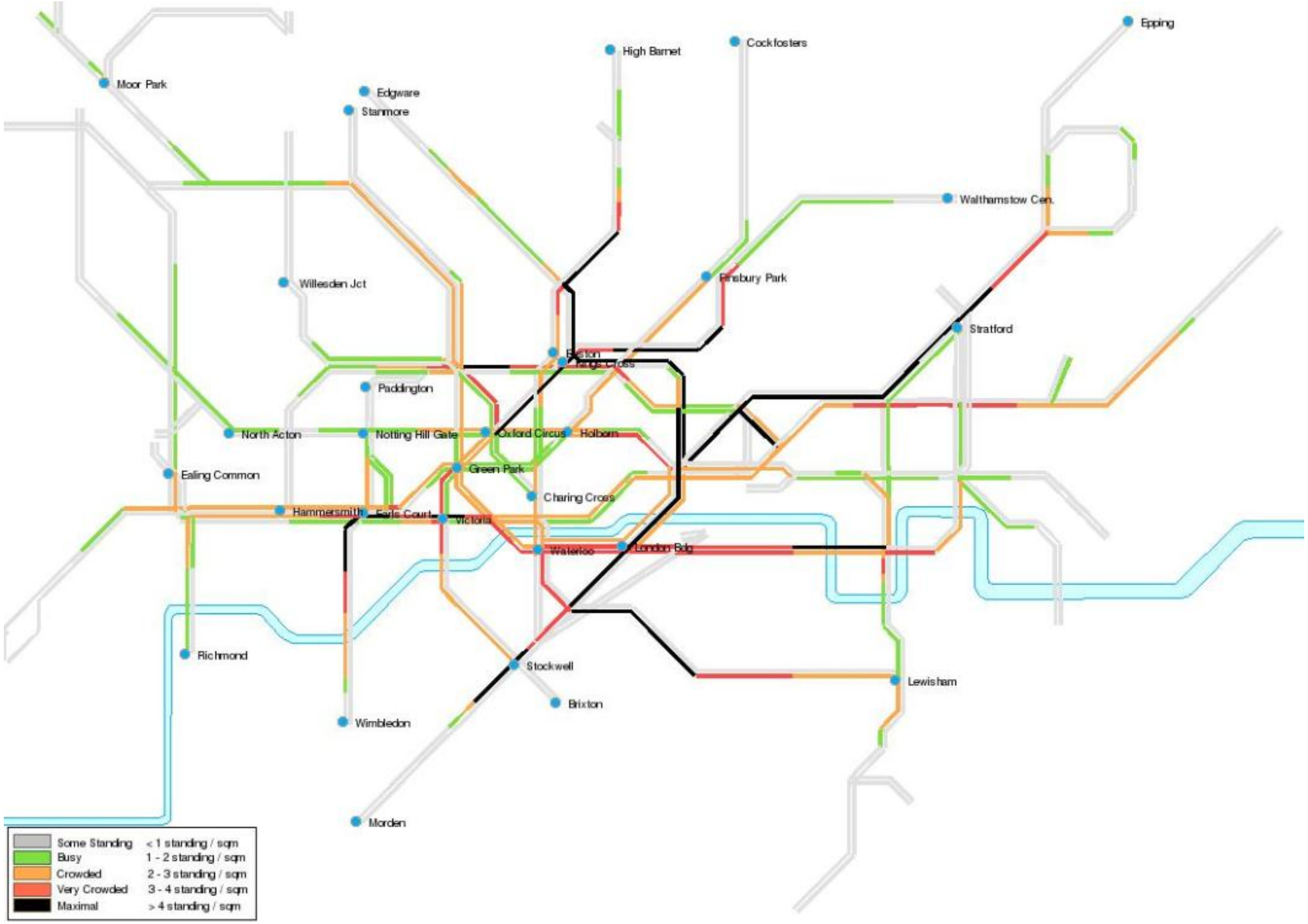


Figure 4-29: 2031 AM peak Extended Baseline LUL crowding – Gatwick Second Runway



Journey time/distance impacts

4.6.15 In addition to demand and capacity-related outputs, the Railplan model also outputs metrics related to journey time and distance across scenarios. Table 4-3 summarises the total demand and total passenger hours travelled to Gatwick zones in the AM peak in the two scenarios described above. The table indicates that overall average rail journey time decreases slightly to 135 minutes in the Second Runway scenario, compared with 137 minutes in the 'no expansion' scenario.

Table 4-3: 2031 AMP Extended Baseline journey time by rail sub-mode TO Gatwick Airport zones

Rail sub-mode	No expansion			GSR		
	Assigned demand	Passenger hours	Average time (mins)	Assigned demand	Passenger hours	Average time (mins)
National Rail	5,221	12,109	139	7,260	16,441	136
GEX	1,811	3,969	131	2,497	5,450	131
Total	**7,033**	**16,078**	**137**	**9,757**	**21,891**	**135**

4.6.16 The transport network in the two scenarios is the same, so the difference in rail journey time to the airport is related largely to the difference in airport passenger distribution. In the CT LCK scenario there is a reduction in the proportion of total surface access passenger demand to Gatwick from outside the South East of England with the Second Runway in place when compared to the scenario with no runway expansion. In the latter the proportion of trips originating outside the South East is 20.3%, decreasing to 19.2% with the Second Runway. As a result, there are likely to be fewer long-distance rail journeys undertaken in the expansion scenario, marginally reducing the average rail travel time.

4.6.17 Table 4-4 indicates that the average journey time to Gatwick is 149 minutes in the 2011 AMP model, suggesting that the rail improvements in the Core and Extended Baselines will have significantly improved rail accessibility at the airport by 2031.

Table 4-4: 2011 AMP journey time by rail sub-mode To Gatwick Airport zones

Rail sub-mode	Assigned demand	Passenger hours	Average time (mins)
Total	3,985	9,865	149

4.7 Inter-peak Railplan Extended Baseline runs

No runway expansion

4.7.1 The first IP Railplan run completed was the 'no expansion' scenario, consisting of the Extended Baseline transport network and corresponding background demand forecast from LTS, assuming that Gatwick remains in its current form with one runway. The IP period covers 6 hours between 1000 and 1600 and all results referenced in this section are for the entire period.

4.7.2 Figure 4-30 illustrates IP flows on the network in the vicinity of Gatwick Airport in this scenario, indicating a forecast of around 29,200 trips heading inbound to London north of Horley in the inter peak, with around 26,500 heading in the opposite direction on the same link.

4.7.3 Figure 4-31 illustrates the IP flows on the network north of East Croydon in the same scenario. The plan shows that the split of demand on the BML routes to Victoria and London Bridge is broadly similar, with around 30,000 travelling inbound to London on the Victoria branch north of Streatham Common and 26,000 travelling in the same direction on the London Bridge branch north of Sydenham.

Figure 4-30: 2031 Extended Baseline inter peak forecast rail demand around Gatwick (no runway expansion)

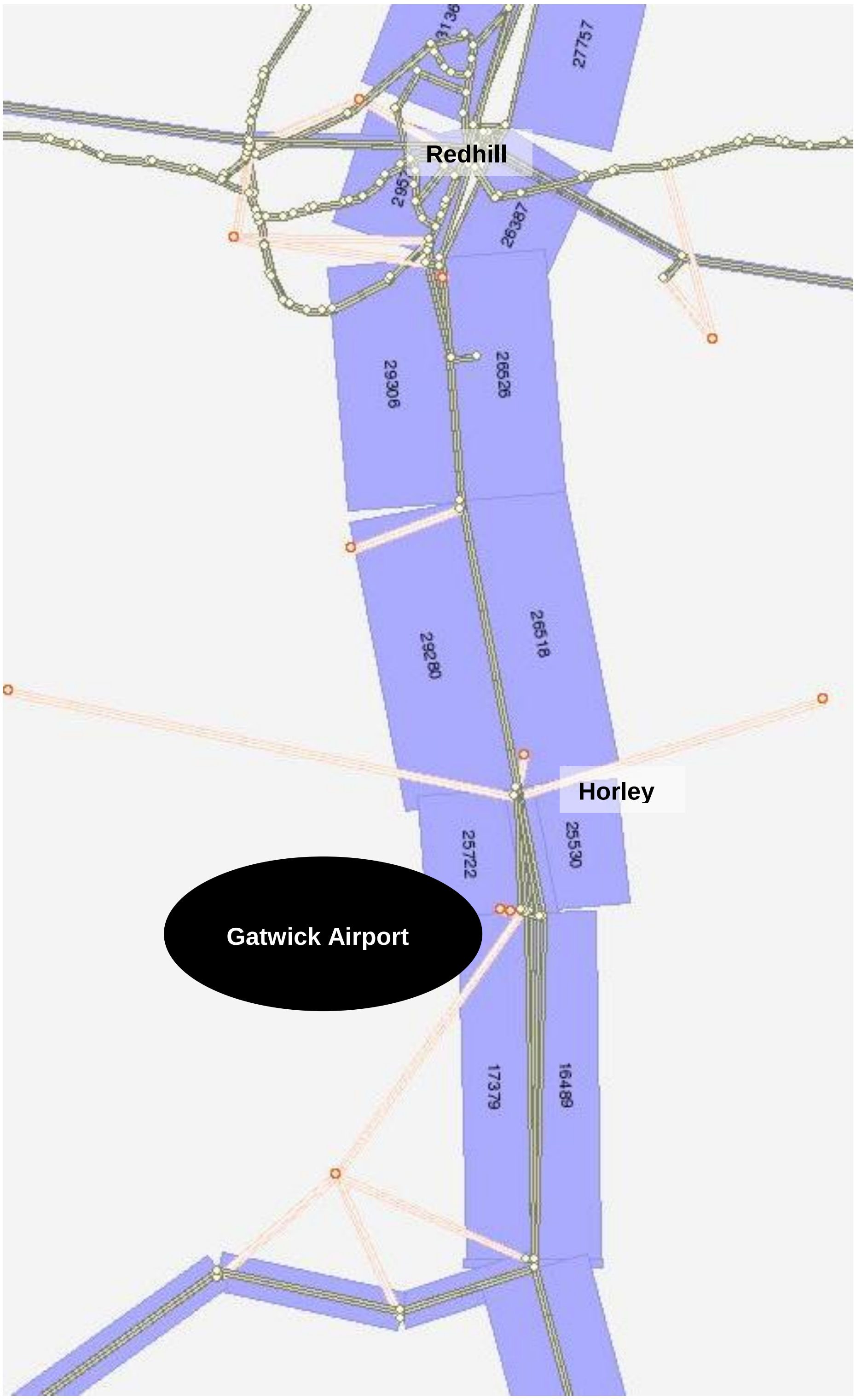
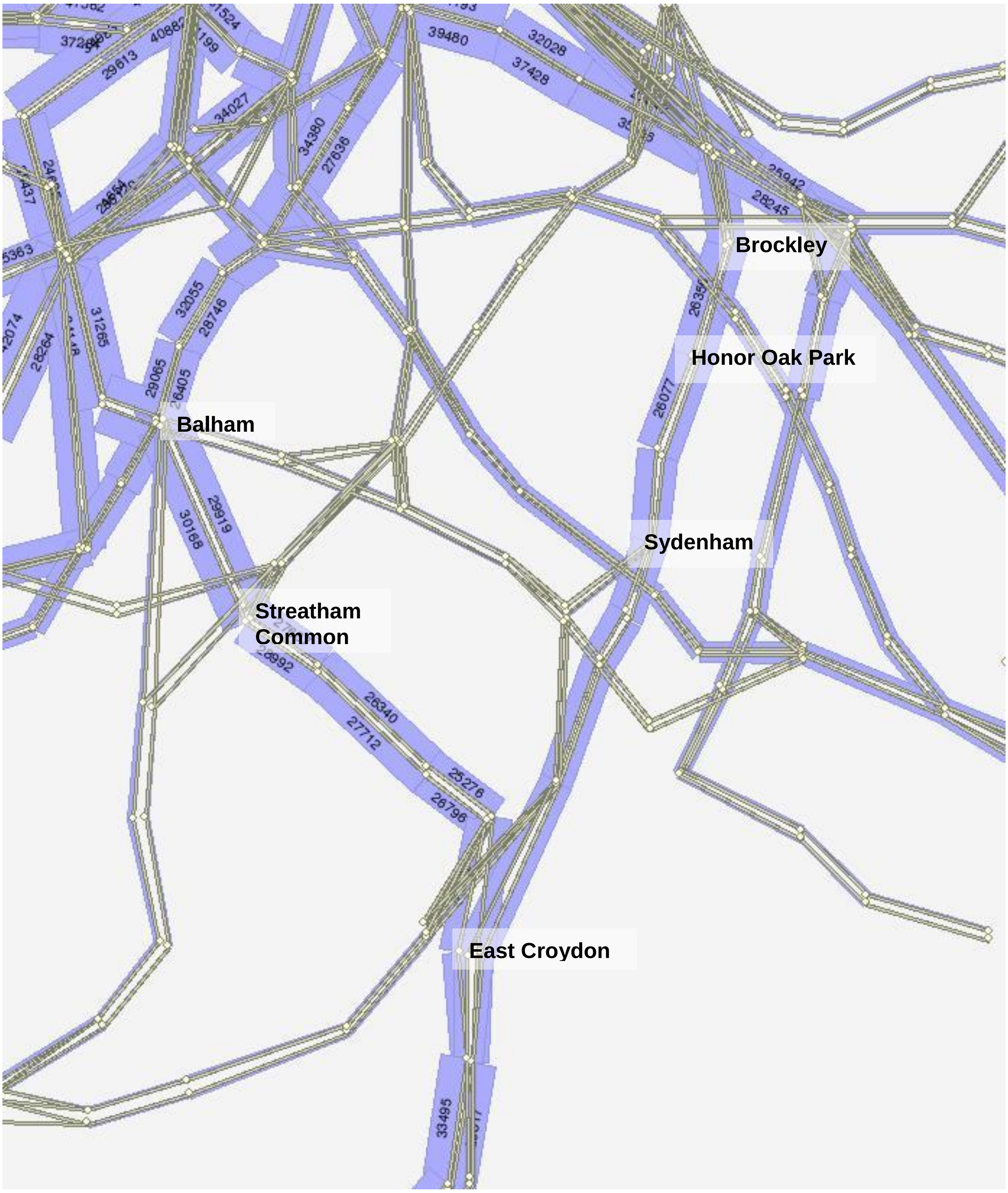


Figure 4-31: 2031 Extended Baseline inter peak forecast rail demand (no runway expansion)



4.7.4 The flows on links summarised above were compared with available seated and standing capacity on each link in the model to calculate estimates of forecast crowding on the network. As with the AM peak, link-based model outputs for National Rail services were disaggregated to report crowding impacts on trains directly serving the airport, split by service group.

4.7.5 Figure 4-32 summarises the aforementioned crowding impacts on National Rail services providing direct connections to Gatwick in the IP 'no expansion' scenario. The plot indicates that there are no crowding issues on any routes serving the airport as a result of the additional capacity added to the BML by the post-2018 TSGN programme and the additional train paths released by the infrastructure schemes identified in the Sussex Route Study, which are listed in the AC's Extended Baseline. On every link in the IP period, forecast demand is within total seated capacity.

4.7.6 Figure 4-33 illustrates the London Underground crowding plot for the IP 'no expansion' scenario. In contrast to the National Rail outputs, this plot is a standard output from Railplan and is more appropriate for this report since routes and service/rolling stock types are limited when analysed by line. This plot indicates that no crowding issues are forecast on the network in the IP period.

Figure 4-32: 2031 Extended Baseline (no runway expansion) – average passengers standing per m² on trains serving Gatwick (IP average hour)

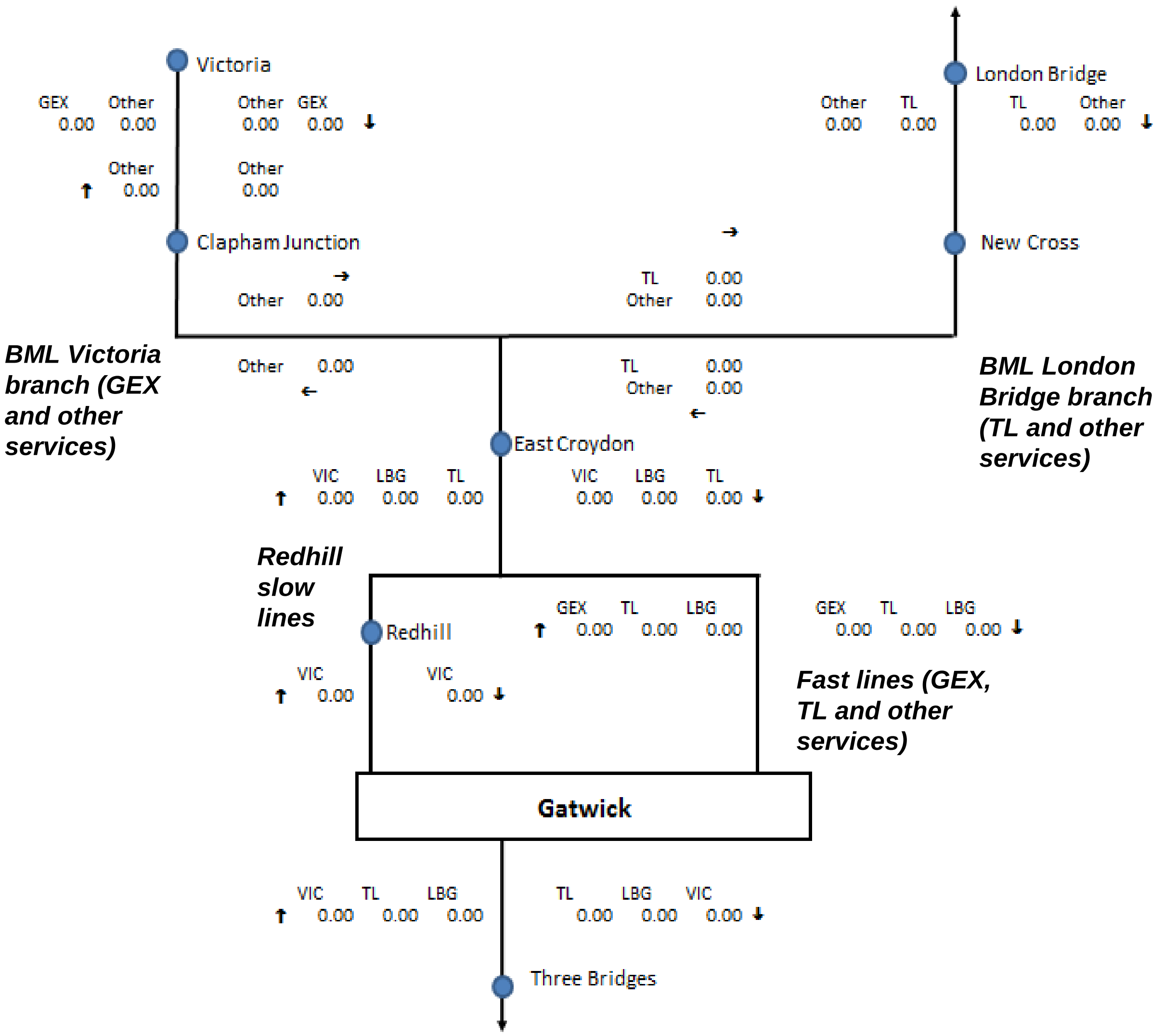
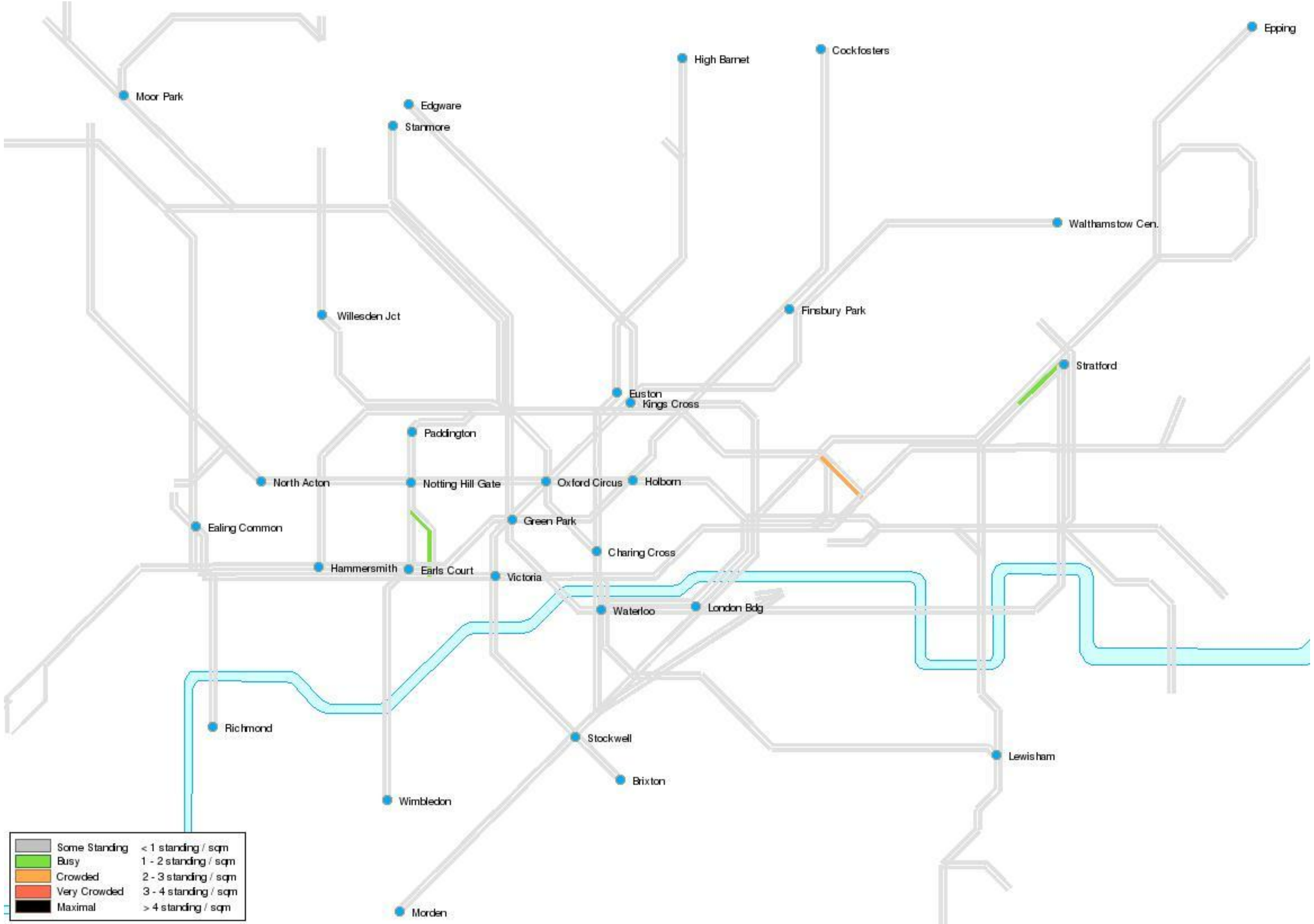


Figure 4-33: 2031 IP Extended Baseline LUL crowding (no runway expansion)



Second Runway

4.7.7 The second IP Railplan run involved testing the Extended Baseline network with the additional airport rail demand associated with the Second Runway.

4.7.8 Figure 4-34 and Figure 4-35 summarise the forecast flow on links in the vicinity of Gatwick and on the BML north of Croydon respectively in this scenario, while Figure 4-36 and Figure 4-37 indicate the change in forecast flows when compared with the Extended Baseline ‘no expansion’ scenario. In the latter two plans, red bands indicate an increase in demand while green bands indicate a reduction, and since the transport networks and background demand estimates are similar in both scenarios, the plans effectively indicate the growth in demand on links directly as a result of Second Runway-related rail trips.

4.7.9 The plans indicate that in the Gatwick area, the Second Runway adds around 2,000 additional trips inbound to London, with an additional 2,100 travelling towards the airport. On the link north of Horley for example, this adds 6.8% to total demand in the Up direction and around 7.9% in the Down direction, albeit to a lower base flow. In the London area, the impact of the Second Runway diminishes – on the link between Streatham Common and Balham on the Victoria branch for example, flow in the Up direction increases by around 1,300 trips (less than 5% of total demand), while north of Sydenham on the London Bridge branch the increase is around 450 trips (2%).

4.7.10 The impact on crowding on National Rail links providing direct connections to Gatwick is illustrated in Figure 4-38, while Figure 4-39 highlights the change from the ‘no expansion’ scenario. The figures indicate that with the Second Runway in place, there is still sufficient seated capacity to accommodate forecast demand and so there is no change in the standing passenger forecast between the scenarios.

4.7.11 Figure 4-40 provides the crowding forecast for London Underground services in the Second Runway scenario. When compared with the Extended Baseline ‘no expansion’ forecast, there is no significant difference in forecast crowding with the Second Runway in place. The difference plots described earlier indicate that the only noticeable changes in demand occur on the BML on services providing direct connections to the airport. Airport-related rail trips are highly dispersed in terms of secondary connections on the Underground network.

Figure 4-34: 2031 Extended Baseline IP forecast rail demand around Gatwick (with Second Runway)

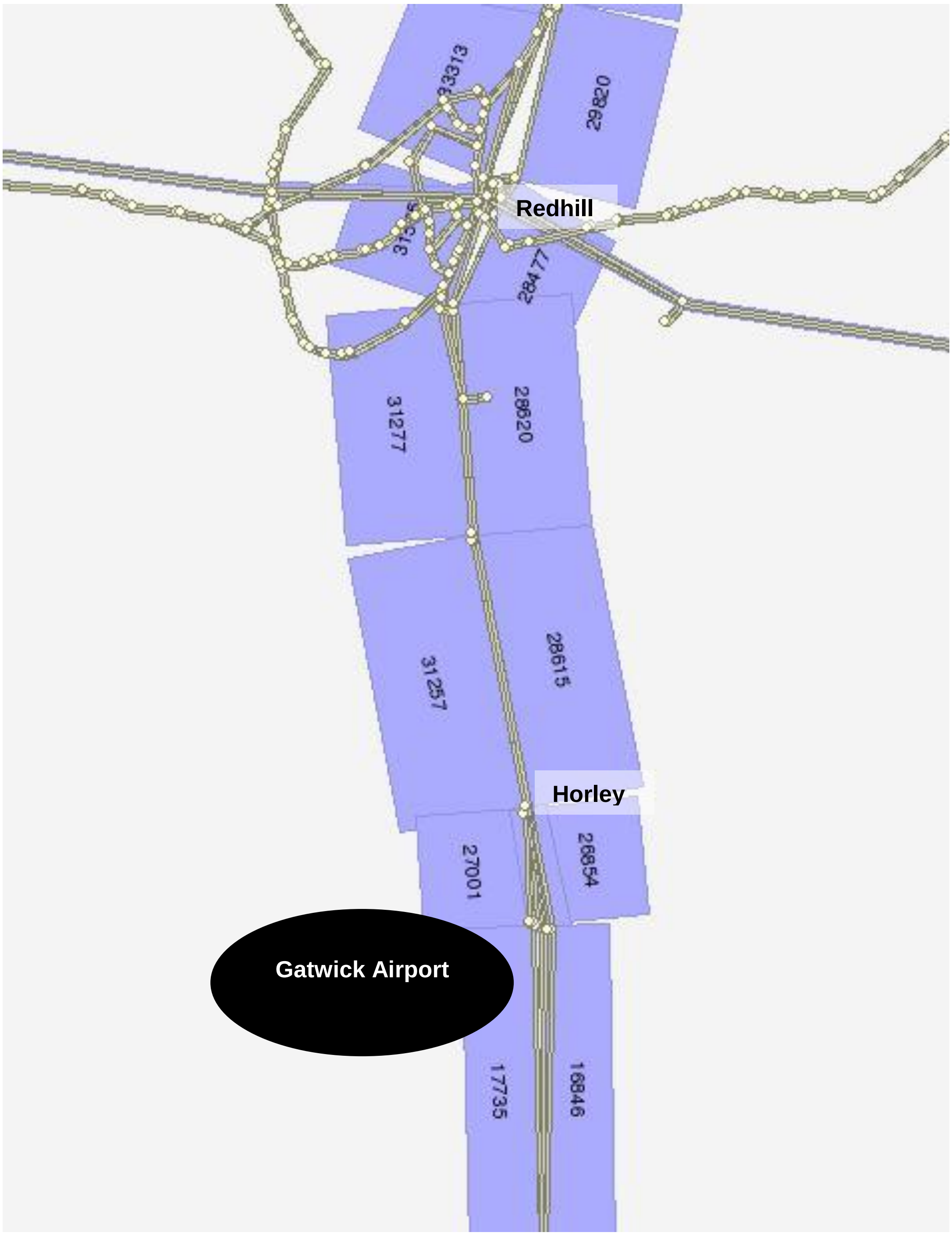


Figure 4-35: 2031 Extended Baseline IP forecast rail demand in South London (Second Runway)

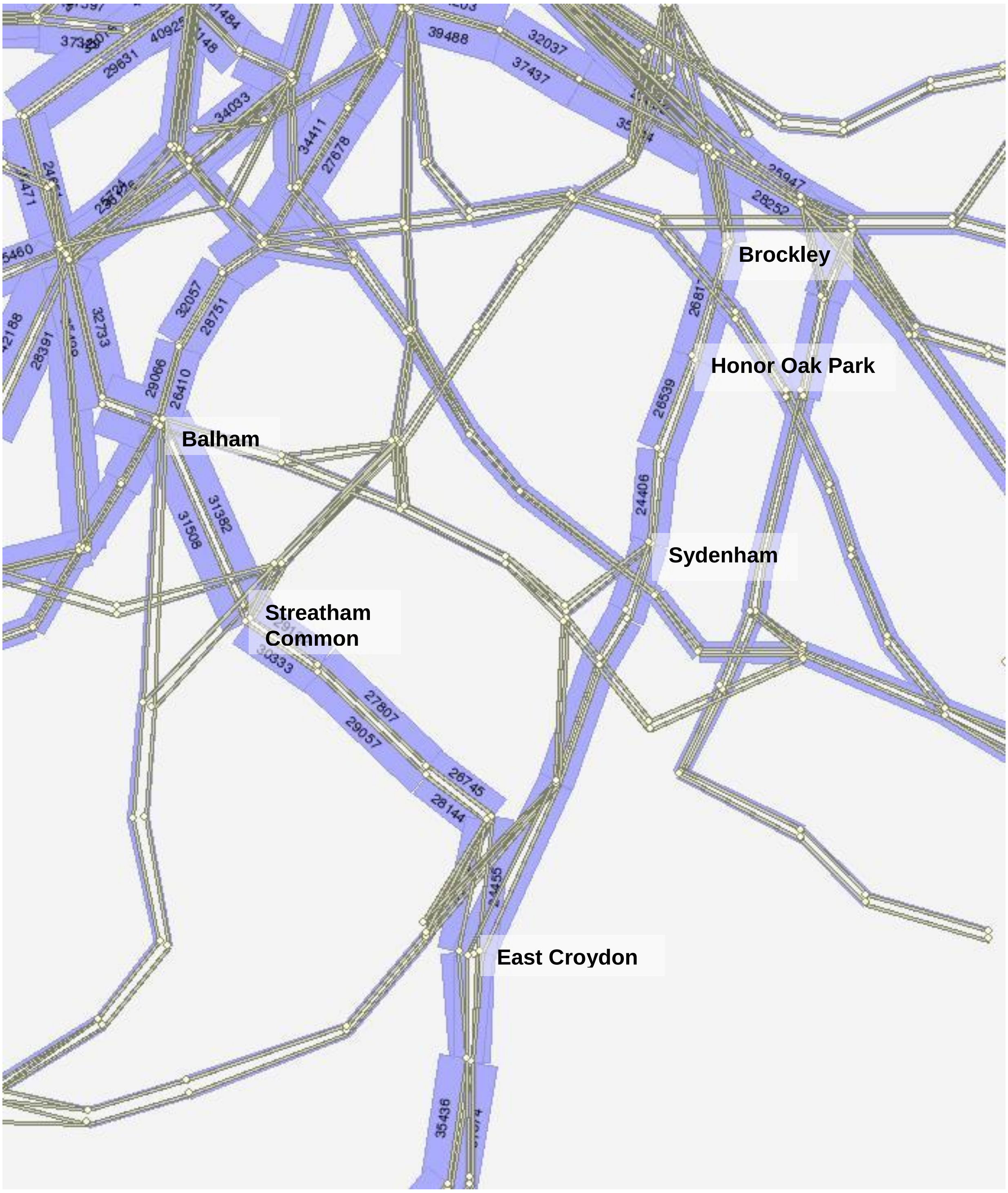


Figure 4-36: 2031 Extended Baseline change in IP demand around Gatwick (GSR v no expansion)

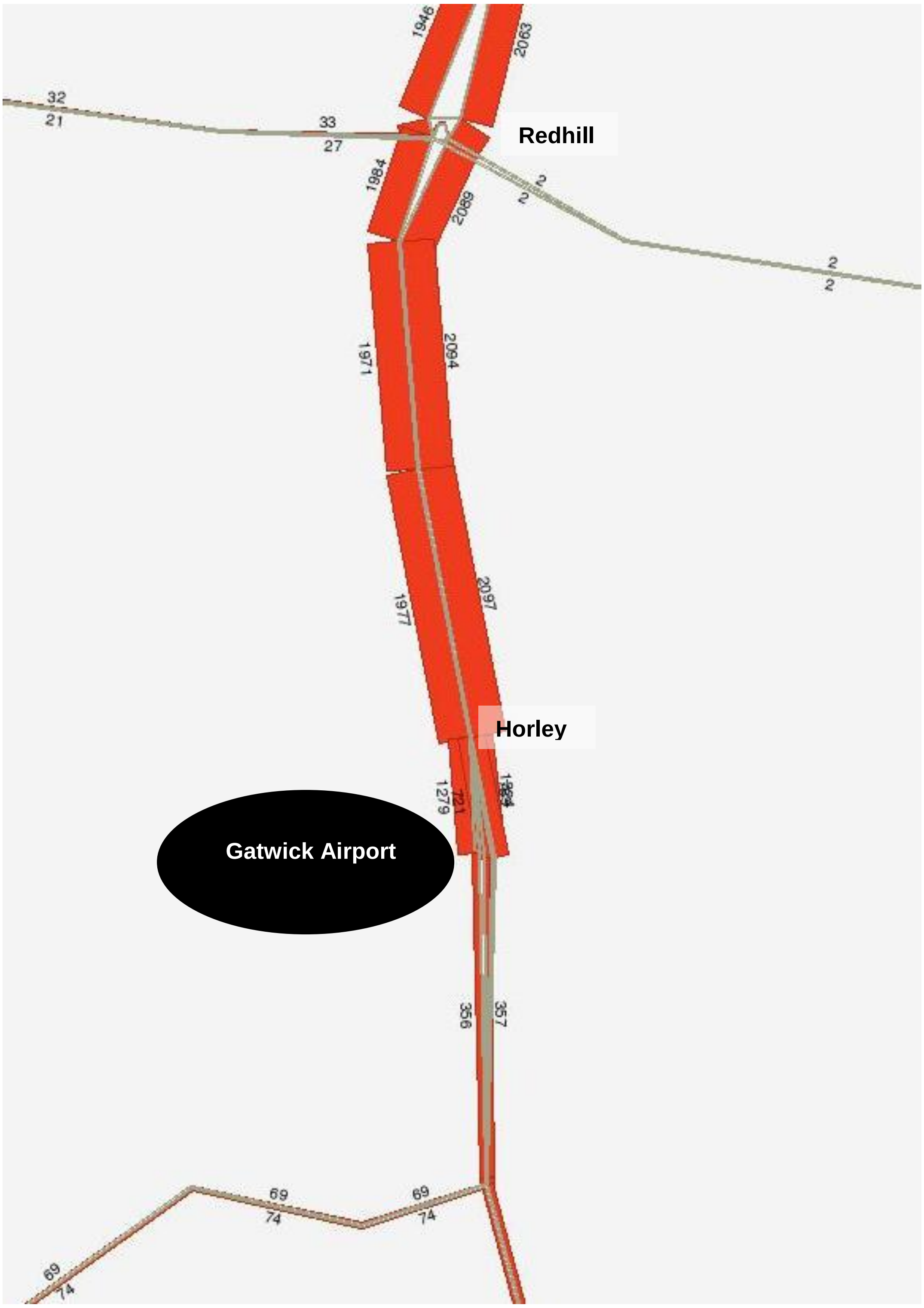


Figure 4-37: 2031 Extended Baseline change in IP demand in South London (GSR v no expansion)

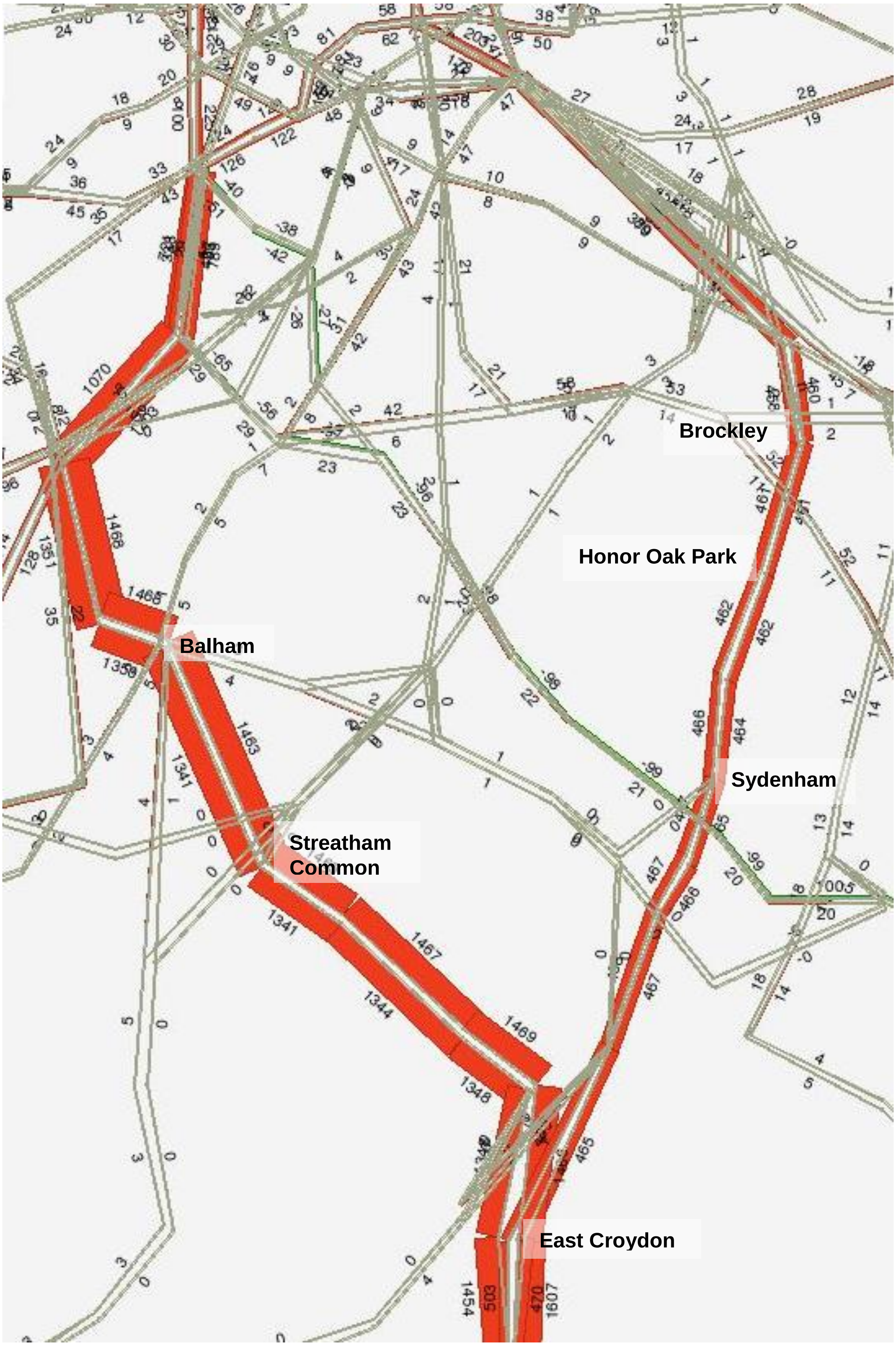


Figure 4-38: 2031 Extended Baseline (with Second Runway) – average passengers standing per m² on trains serving Gatwick (IP average hour)

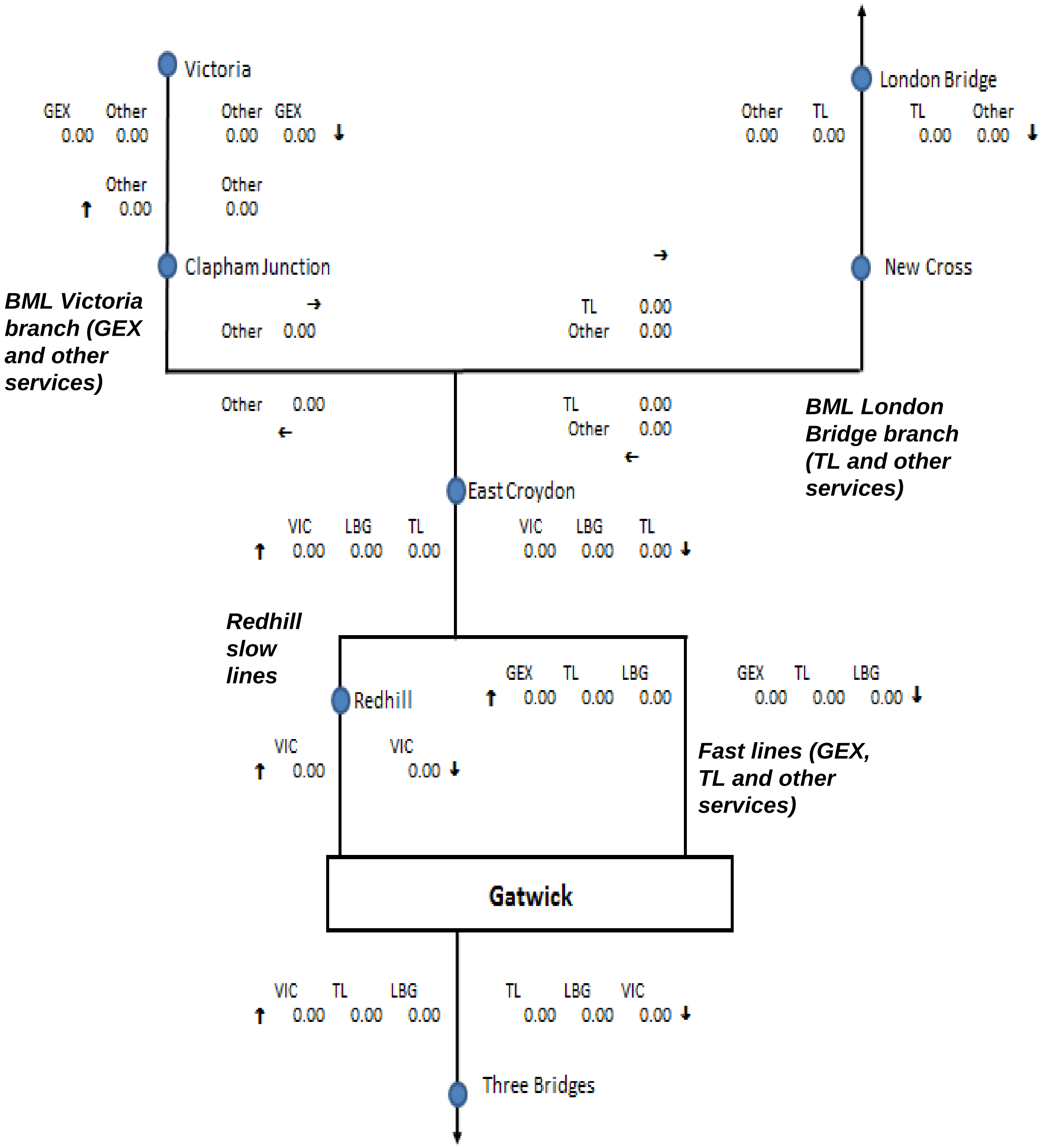


Figure 4-39: Gatwick Second Runway – change in crowding compared with 'no expansion' scenario

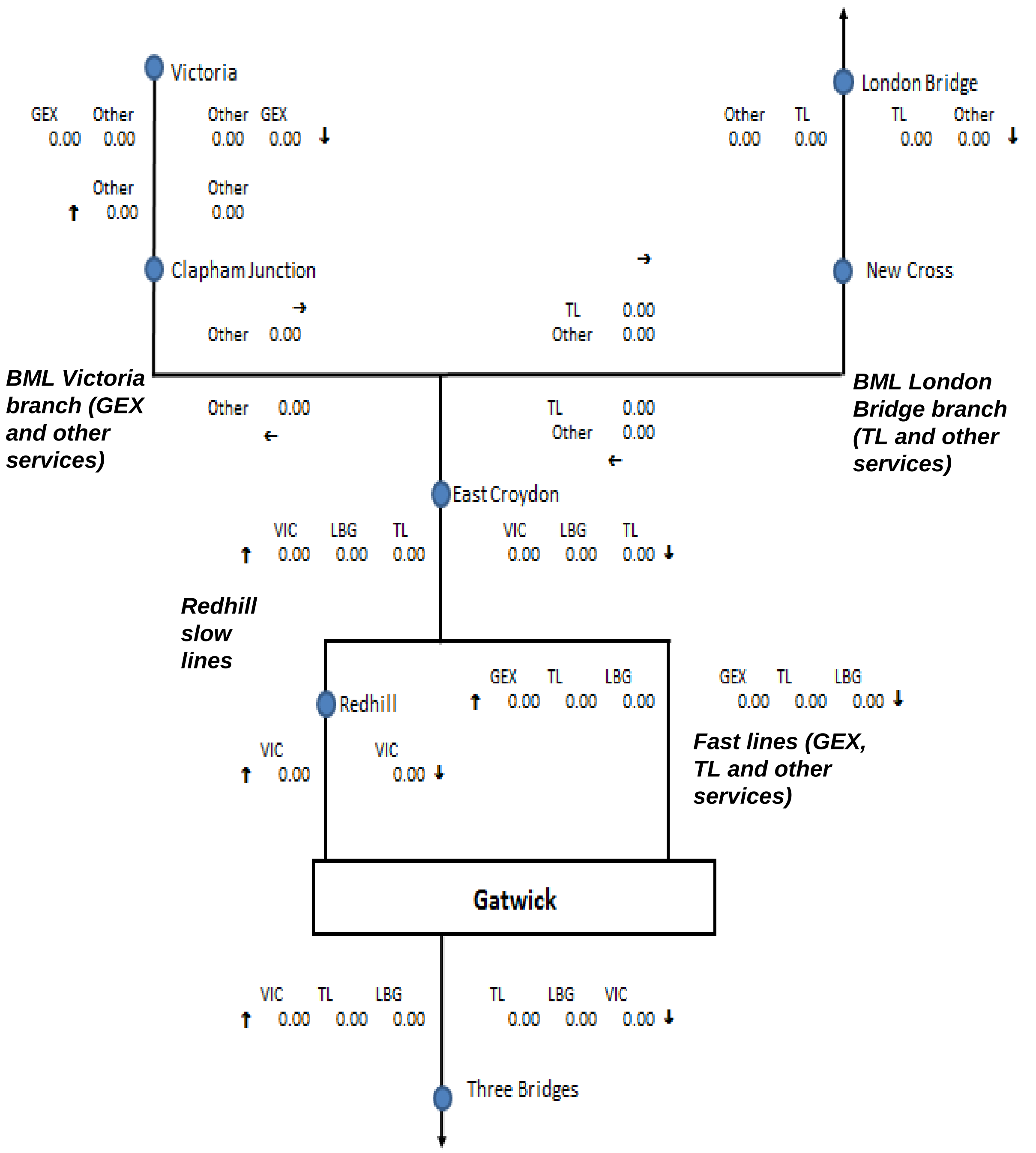
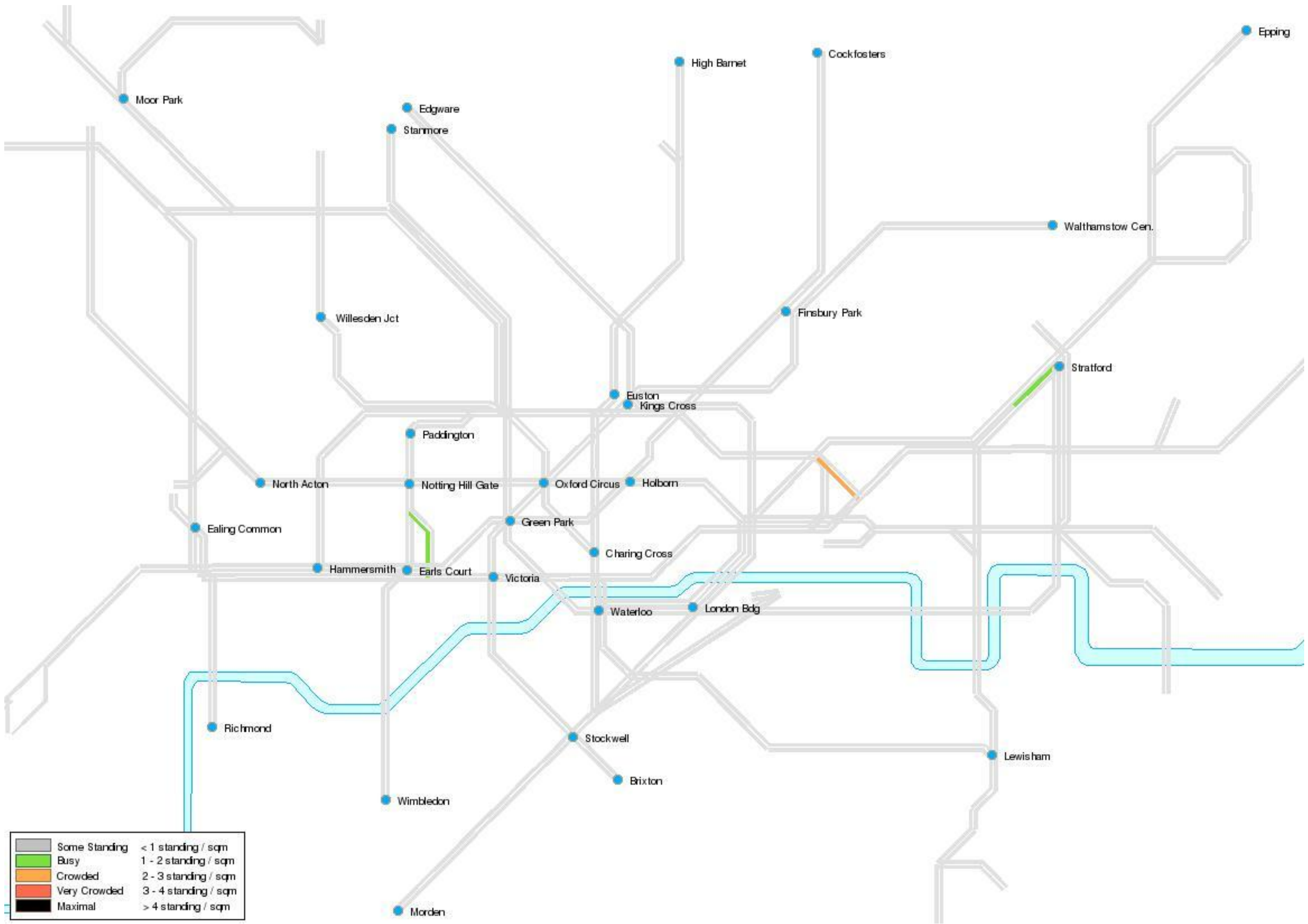


Figure 4-40: 2031 IP Extended Baseline LUL crowding – Gatwick Second Runway



4.8 Summary of rail modelling conclusions

4.8.1 In terms of the AM peak period (0700-1000), the following key conclusions can be drawn from the analysis summarised in this chapter in terms of the impacts on the rail network:

- The Second Runway does not impact on the tube network as demand to/from the airport making secondary connections via the tube is widely dispersed;
- The Second Runway does increase forecast crowding on the BML but not to significant levels – in the expansion scenario, average AM peak hour crowding on Thameslink services is forecast to reach 1.05 people standing per m^2 on the approach to London Bridge while terminating services reach 0.7 people standing per m^2 – there are no significant crowding issues on the branch to Victoria as a result of the additional train paths ear-marked in the Sussex Route Study;
- The Second Runway changes rail journey times to the airport very little, and the change that is evident is largely related to the assumptions regarding passenger distribution contained in NAPAM for the CT LCK growth scenarios with and without the Second Runway in place.

4.8.2 In the IP period (1000-1600) there is very little evidence of crowding anywhere on the network in either the 'no expansion' or the Second Runway scenarios.

5. Dynamic highway assessment

5.1 Overview

South London Highway Assignment Model

5.1.1 Dynamic highway modelling of road surface access to Gatwick Airport has been undertaken to assess the impact of increased airport related traffic on the strategic and local road network surrounding the airport. A dynamic modelling approach has been adopted in order to capture the effect of network capacity constraints on vehicle route choice and to help identify locations where additional strategic road capacity is a requirement to support the second runway proposals.

5.1.2 Highway modelling has been undertaken using SATURN software. SATURN is an industry standard modelling package, widely used to inform the design and appraisal of highway projects within the United Kingdom and internationally. The existing TfL SATURN South London Highway Assignment Model (SoLHAM) was provided to Jacobs by TfL for use on this project.

5.1.3 SoLHAM is one of five SATURN models developed by TfL that together cover the whole of Greater London. Each model covers the whole of London, but differs in the area coded as "simulation", defined as detailed junction coding of traffic signals, roundabouts and priority junctions. The highway network detail within SoLHAM is illustrated to the left in Figure 5-1.

5.1.4 For further details regarding the SoLHAM model, please contact TfL[11].

Gatwick model extension

5.1.5 Gatwick lies outside the simulation area of SoLHAM and it has been necessary to convert the level of network detail around the airport from buffer to simulation coding in order to accurately model traffic impacts resulting from a second runway. The extended network is shown to the right in Figure 5-1.

5.1.6 Model zones have also been disaggregated throughout the study area.

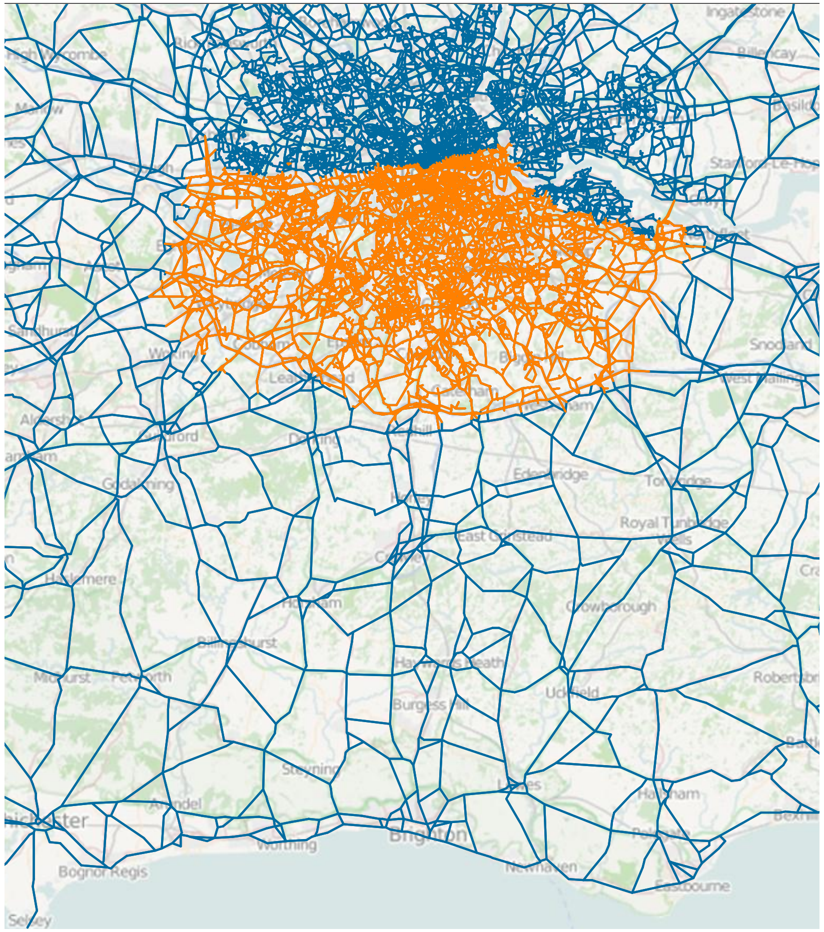
5.1.7 In order to better reflect local traffic movements, it has been necessary to infill trips between the new local zones. Matrices from the West Sussex SATURN Highway Model, provided by West Sussex County Council (WSCC), have been used in the derivation of these trips. Base year Gatwick Airport demands from Jacobs Gatwick Airport Demand Model (as described in Chapter 3) have also been included. Matrices have then been matrix estimated as part of a local recalibration of the base model, taking care to freeze the cells to / from Gatwick.

5.1.8 The highway modelling component of the Gatwick Second Runway appraisal followed the process illustrated in Figure 5-2.

[11] https://www.tfl.gov.uk/

Figure 5-1: Base SoLHAM simulation network / Gatwick Airport Model simulation network

SoLHAM simulation extent



Gatwick Airport Model simulation extent

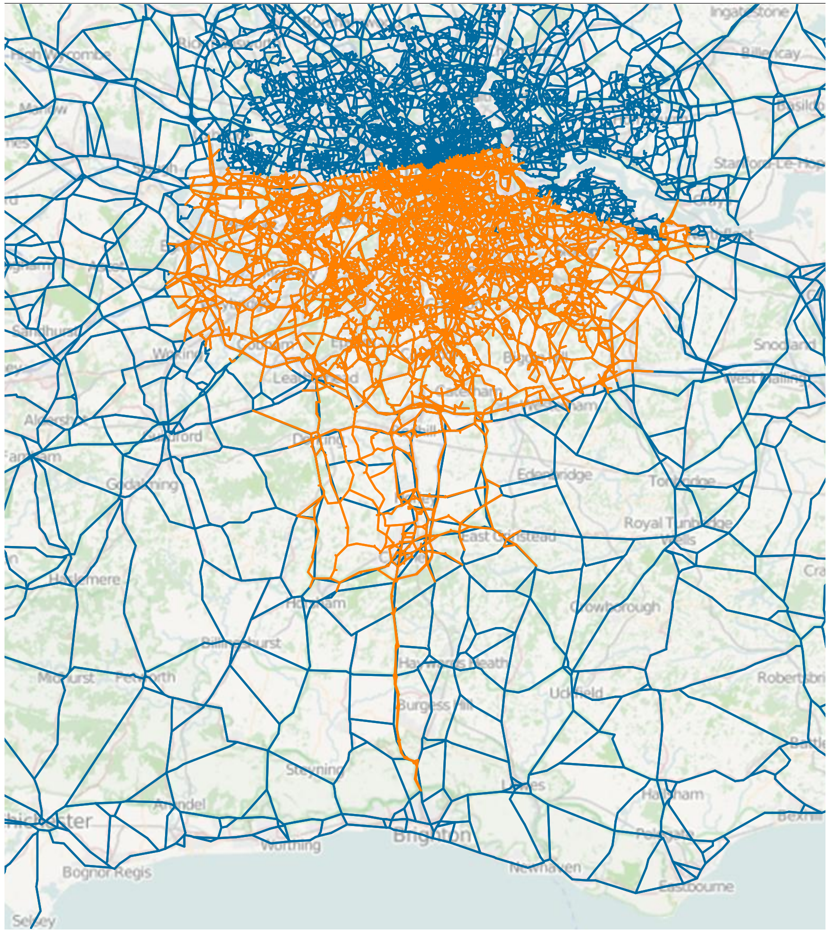
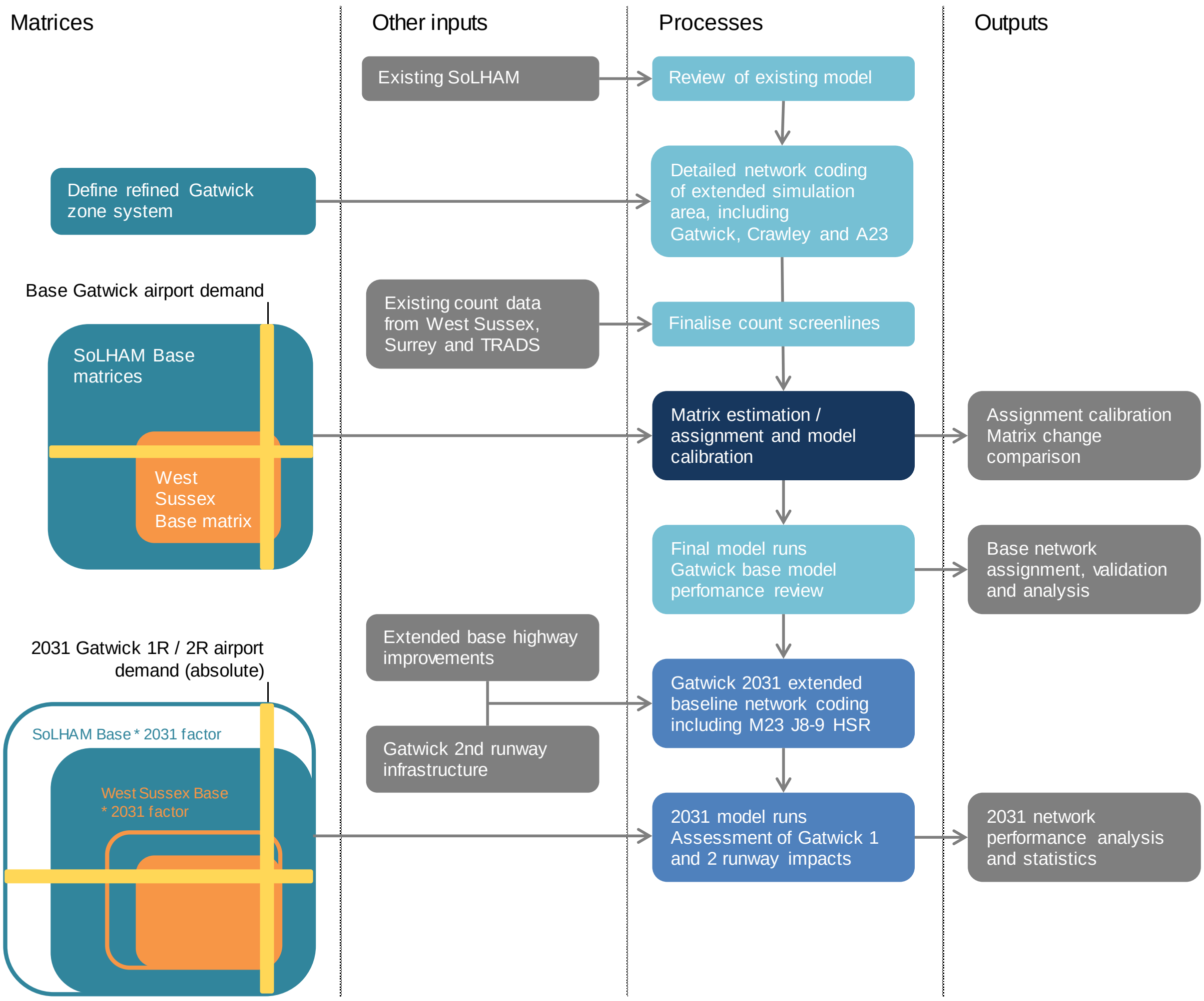


Figure 5-2: Dynamic highway model development process



5.1.9 To maintain consistency with the original SoLHAM, a 2009 base year has been retained. Model time periods and demand segmentation are also unaltered.

5.1.10 There are three time periods:

- AM 08:00 - 09:00
- inter peak average hour 10:00 – 16:00, and
- PM 17:00 - 18:00

5.1.11 Traffic demand is segmented into five user classes, each with an individual demand matrix:

1. Car (with an origin or destination or both in London)
2. Car (external to London)
3. Taxi (hackney)
4. Light Good Vehicles (LGV)
5. Other Good Vehicles (OGV)

5.2 Base model development

Model scope

5.2.1 A two-level study area has been adopted for the dynamic highway assessment of Gatwick airport. The outer area incorporating all major strategic routes to Gatwick, bounded by the following key roads:

- The M25 east;
- The M25 west;
- The A23 south of Crawley

5.2.2 The inner area covers an area centred on Gatwick and focusses on access to and from the Airport. This area incorporates the following key roads, as illustrated in Figure 5-4:

- The M23 spur from the airport to Junction 9a and 9;
- The M23 Junction 8 to 10; and
- The A23 and local access

Figure 5-3: Study area – Outer area

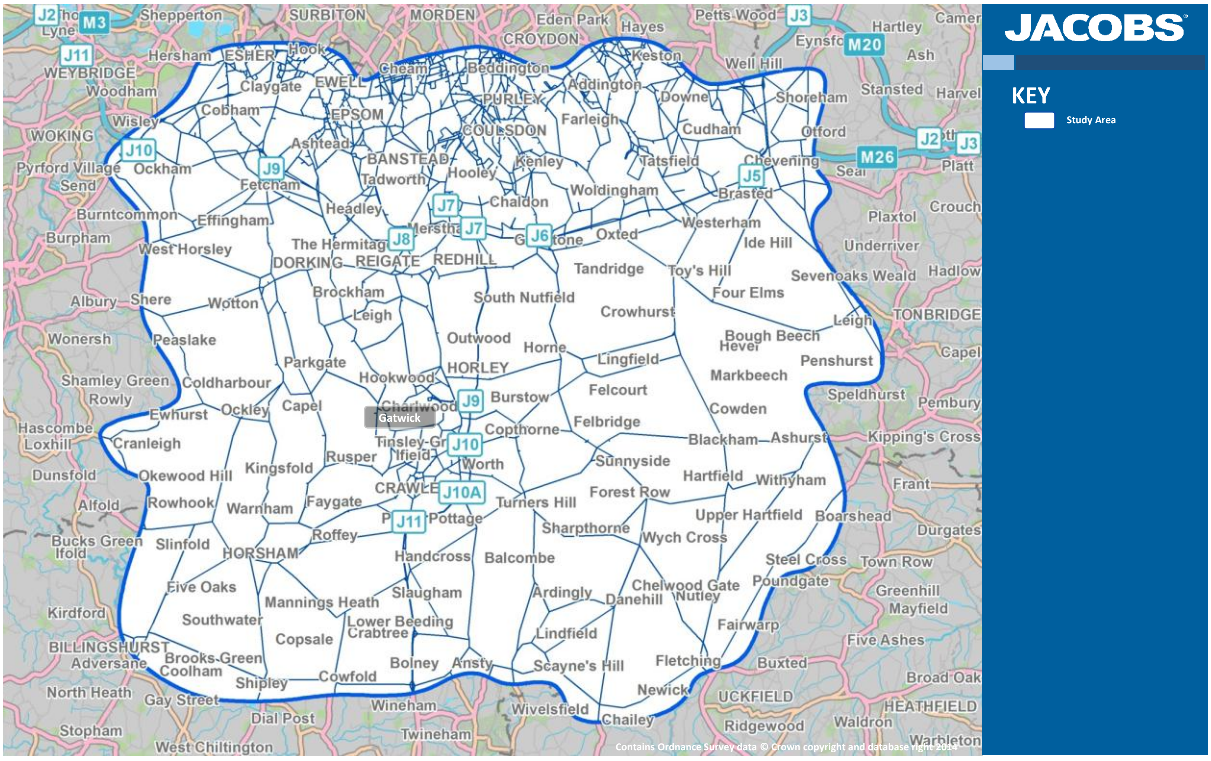


Figure 5-4: Study area – Inner area

Existing model audit

5.2.3 An audit of the existing base SoLHAM network coding was undertaken. Checks included:

- Roads: directionality, user class bans, free flow speed, delay, length, capacity; and
- Junctions: Numbers of entry lanes, junction type, turn allocations and saturation flows.

5.2.4 The model base audit revealed no critical issues in regards to route choice on the M25 and arterial routes to and from London. Nevertheless, it was clear that the model network and zone system and were insufficiently detailed outside of the M25 area to accurately appraise the impact of future traffic demand to and from Gatwick.

Gatwick network and zone system enhancement

5.2.5 An extended SoLHAM simulation area was identified and included an area bounded by (and including) the M25, A22, A24 and A264. Within this, all A class and significant B and minor roads likely to be used as routes to / from Gatwick have been included. In addition, the A23 corridor was coded as simulation from the A27 north of Brighton to the M23 junction with the M25.

5.2.6 New links have been coded from GIS data. Speed limits and carriageway standards have defined appropriate / speed flow relationships. Where possible, existing SoLHAM speed / flow curves have been used. New curves have been applied in a small number of locations – to model minor C class roads and to model 50mph speed limits on Balcombe Road, Crawley and the A25 between Dorking and Redhill.

5.2.7 All model nodes within the simulation area have been coded as detailed junctions. General layouts, the number of lanes and lane allocations have been derived from appropriate mapping sources.

5.2.8 Traffic signal timings have been obtained from the DfT (M23 Junctions) and West Sussex County

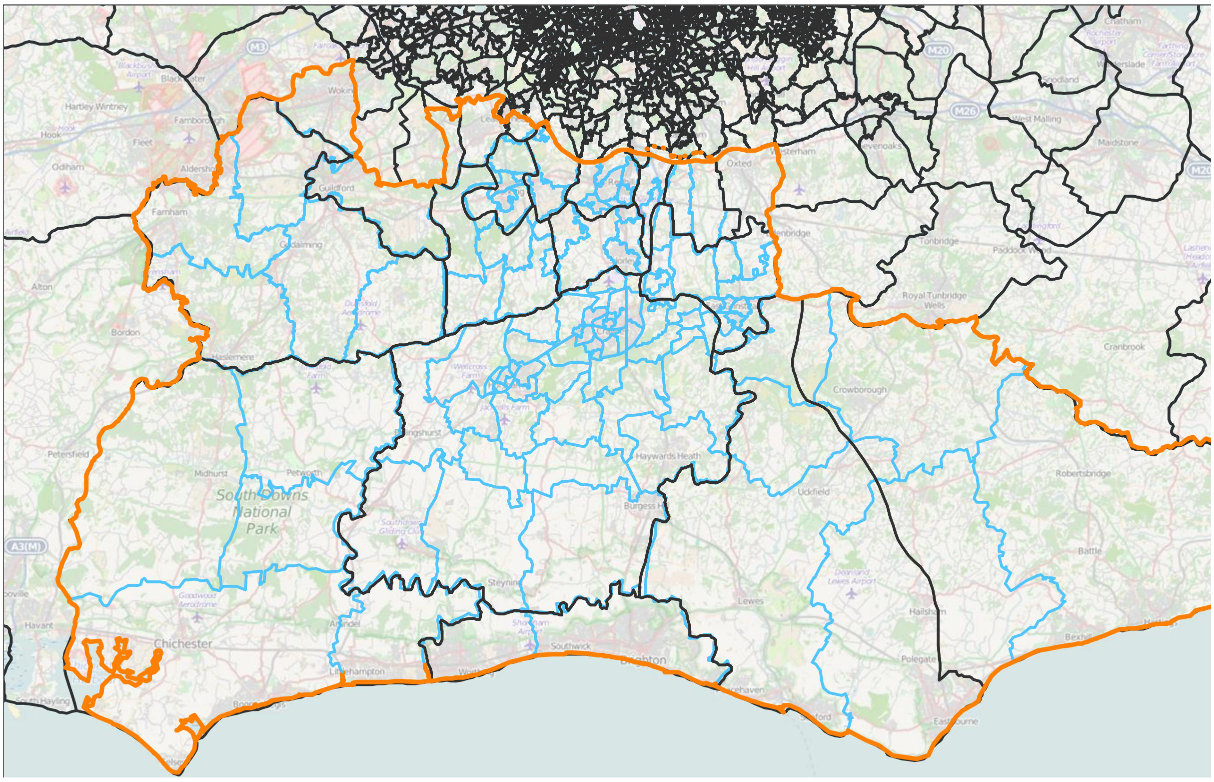
Council (from the West Sussex SATURN Highway Model).

5.2.9 Signalised, roundabout and give-way junction saturation flows, for each approach and movement, have been based on standard TfL values. These are comprehensive and include capacities for a wide range of layouts. Their application is consistent with junction coding elsewhere across SoLHAM.

Matrix development

5.2.10 A disaggregated zone system has been developed in order to better reflect local traffic movements within the study area. The area of this disaggregation is shown in orange in Figure 5-5 below. New zones are shown in blue in and numbered 99001 to 99116. Elsewhere, zones are unchanged and remain consistent with SoLHAM.

Figure 5-5: Gatwick Airport Model Zone System (disaggregated from SoLHAM zones)



5.2.11 Corresponding 2009 Gatwick model matrices have been created as outlined below.

5.2.12 While SoLHAM demands form the basis of the revised matrices, it has been necessary to infill trips between new local zones using other data. The existing West Sussex SATURN Highway Model was identified as a suitable source of data with which to infill this demand. The methodology to derive the various matrix segments was as follows:

- Trips wholly external to the study area were derived from SoLHAM. **(E to E)**
- Trips with an external origin and internal destination or internal origin and external destination were disaggregated from SoLHAM to Gatwick zones based on census data. **(E to I and I to E)**
- Trips with both an origin and destination inside the study area, and poorly represented in SoLHAM, were derived from the West Sussex Highway Model. **(I to I)**
- Trips to/from Gatwick airport were imported from the Jacobs Gatwick Airport Demand Model (as described in Chapter 3), replacing airport-related trips within the SoLHAM and WSCC models.(**airport-related trips)**

5.2.13 The WSCC Model only covers the morning period. An evening period matrix has been derived from the reverse of the morning peak. An inter-peak matrix has been derived by averaging the trip patterns of the combined morning and evening matrices and factoring trip totals to inter peak counts.

Matrix estimation

5.2.14 A process of matrix estimation (ME) has been undertaken to improve the quality of model calibration within the area of interest. With ME, Initial matrices are assigned to the network and the process adjusts these in such a way that when assigned to the network, the link flows' better match observed values.

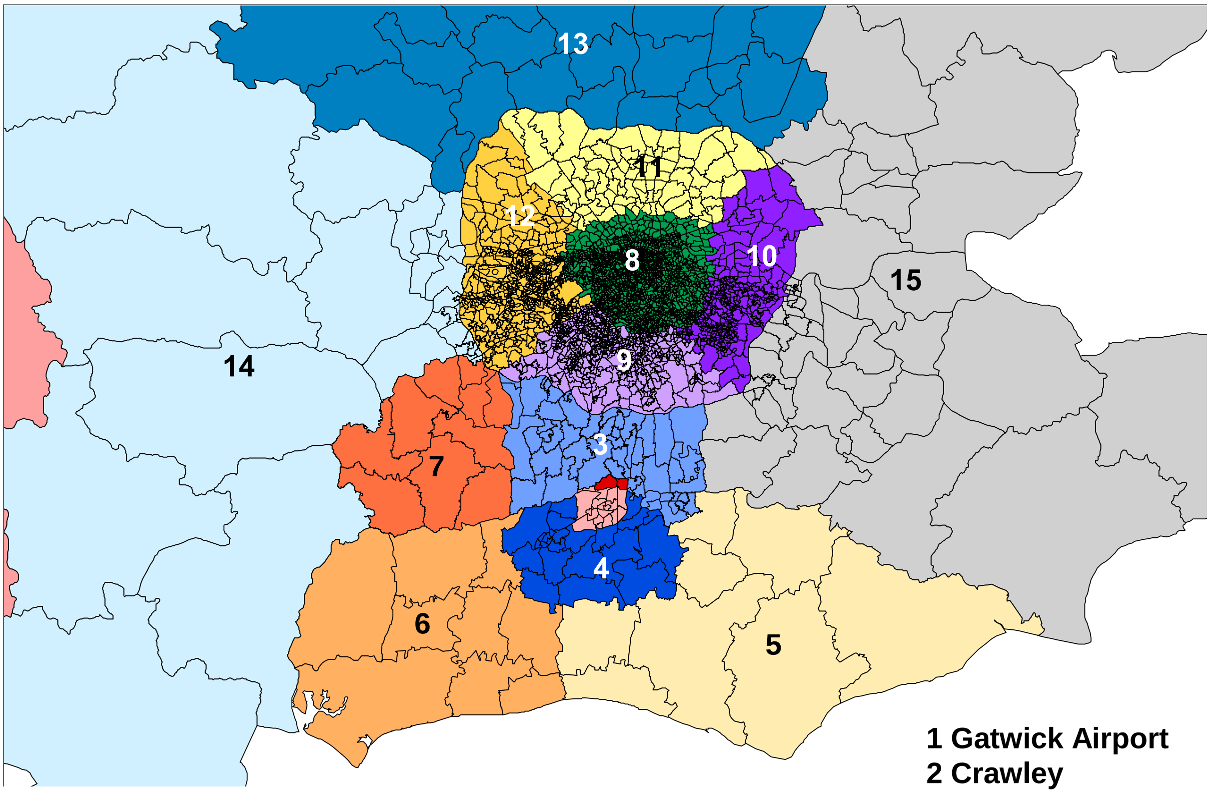
5.2.15 Care was taken not to distort the matrix and an analysis of matrix changes, resulting from the estimation process, has been undertaken. This is based on a Sector system, given in Table 5-1 and illustrated in Figure 5.6.

5.2.16 As noted above, demand to and from Gatwick Airport (Sector 1) has been derived from a separate Jacobs demand model and so has been frozen during the estimation process.

Table 5-1: Sector system

Sector	Name	Sector	Name
1	Gatwick	11	London East
2	Crawley	12	London North
3	North West of Crawley	13	London West
4	North East of Crawley	14	Hertfordshire / north of London
5	South of Crawley	15	West
6	Brighton / Hove	16	East
7	Worthing / Chichester	17	Midlands
8	Woking / Guildford	18	South West
9	Central London	19	Wales
10	London East	20	North / Scotland

Figure 5.6: Sector system



5.2.17 Comparisons of the pre and post matrix estimation changes are summarised in Tables 5-2 to 5-4, using the "GEH statistic". An R-squared analysis comparing original and post matrix estimation values is illustrated in Figures 5-7 to 5-9.

5.2.18 A key aim through the estimation process was to freeze the trips to/from Gatwick and to further limit matrix change outside the study area (Sectors 8 – 20) so that existing SoLHAM demand remained virtually unchanged. This has been achieved in the morning peak, as shown in Table 5-2. Major matrix changes occur only within the area of disaggregation from the WSCC model (Sectors 2-7).

5.2.19 Inter-peak and PM post-estimation matrices follow a similar pattern (Tables 5-3 and 5-4) with all major changes lying within Sectors 2-7 derived from the WSCC model. As previously noted, infill data from the WSCC was only available for AM peak. Consequently the scale of matrix change is larger in the evening peak, and to a lesser extent in the Inter-peak.

5.2.20 R-squared analysis is presented for Sectors 2 to 7 only. To include all other sectors would mask the scale of change, giving an unrealistically good result. Nevertheless, the R-squared values are still very good with all values above 0.9.

5.2.21 In summary, the matrix estimation process was carefully controlled to mainly influence the part of the prior matrix derived from the WSCC model. This was achieved, and the process did not alter these I-I trips significantly.

Table 5-2: AM pre and post matrix estimation comparison

GEH	Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Gatwick	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crawley	2	0.0	0.0	9.2	2.2	4.9	2.5	2.9	2.6	10.5	2.1	0.9	2.2	1.4	1.6	0.6	0.8	0.6	0.2	1.1	0.3
North of Crawley	3	0.0	8.4	0.0	1.6	2.1	1.2	2.4	1.0	3.7	2.5	0.3	0.2	1.2	0.8	5.6	0.2	1.4	0.0	0.3	0.0
South of Crawley	4	0.0	6.3	7.6	0.0	5.1	0.8	0.2	1.4	2.8	2.1	0.7	1.6	1.2	0.9	2.4	0.6	0.3	0.1	0.7	0.2
Brighton / Hove	5	0.0	15.0	4.5	2.7	0.0	0.2	2.4	4.0	0.5	2.4	1.9	3.3	2.2	1.7	0.3	2.0	0.1	0.8	7.7	1.4
Worthing / Chichester	6	0.0	10.9	2.3	5.1	0.2	0.0	0.2	4.3	3.9	2.4	2.1	3.2	1.5	0.2	3.3	1.1	0.0	0.0	0.9	0.3
Woking / Guildford	7	0.0	2.0	4.6	0.1	4.0	0.0	0.0	0.3	0.9	1.8	0.1	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0
Central London	8	0.0	0.1	0.7	0.1	1.4	3.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
London North	9	0.0	1.3	2.5	0.5	5.2	4.4	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
London East	10	0.0	0.6	2.1	0.2	3.4	3.4	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
London South	11	0.0	0.1	0.3	0.0	1.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
London West	12	0.0	0.5	0.1	0.3	2.4	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Home Counties	13	0.0	0.2	0.4	0.1	2.9	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East	14	0.0	0.8	0.7	0.3	2.6	0.3	0.0	0.1	0.2	0.8	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0
West	15	0.0	2.5	3.1	0.3	1.7	3.5	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Midlands	16	0.0	0.3	0.3	0.3	4.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South West	17	0.0	0.2	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wales	18	0.0	0.2	0.3	0.3	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North	19	0.0	0.0	0.1	0.0	3.2	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scotland	20	0.0	0.0	0.0	0.0	5.2	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Trips to / from Gatwick Airport fixed during matrix estimation
ME changes focused on Sectors 2-7 (WSCC model)
Minimal changes to Sectors 8-20 (from SoLHAM)

Figure 5.7: AM pre and post ME sector R^2 analysis

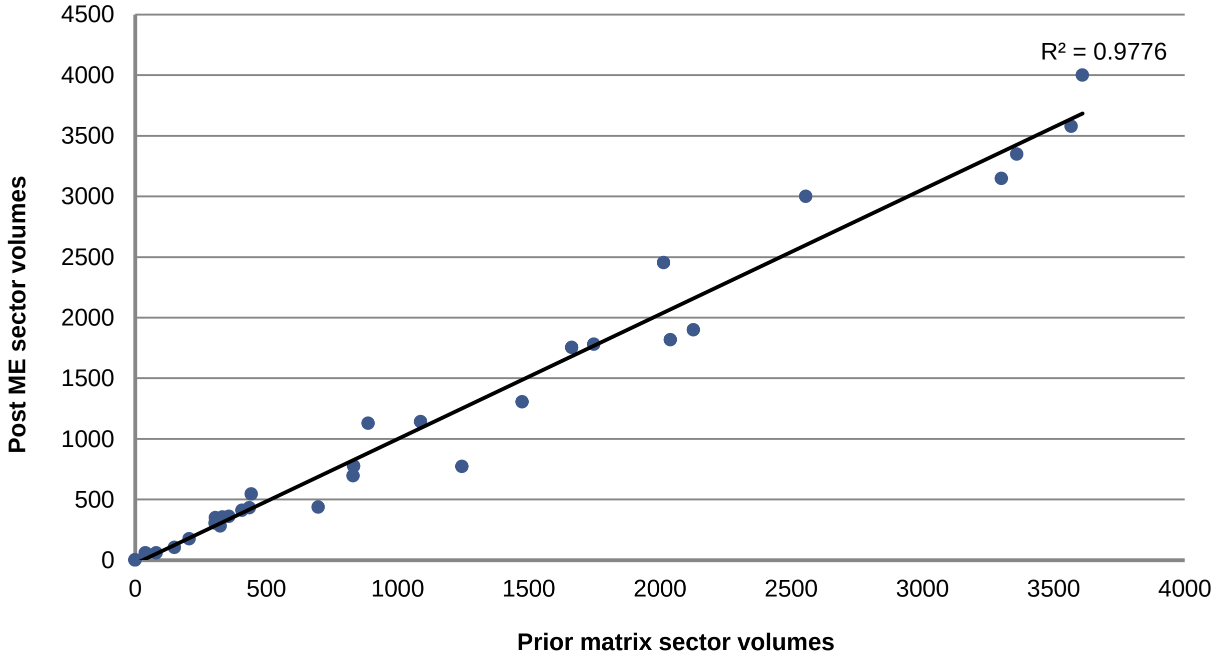


Table 5-3: IP pre and post matrix estimation comparison

GEH	Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Gatwick	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crawley	2	0.0	0.0	6.5	1.1	6.6	3.1	0.7	0.3	1.2	0.2	0.0	0.1	0.3	0.2	1.1	0.2	0.0	0.1	0.1	0.1
North of Crawley	3	0.0	10.0	0.0	3.5	6.0	0.8	0.0	0.6	1.2	4.1	0.3	0.0	0.1	0.3	1.7	0.1	0.0	0.0	0.1	0.1
South of Crawley	4	0.0	2.0	3.0	0.0	3.2	0.7	0.0	0.2	0.5	0.2	0.1	0.1	0.0	0.1	0.9	0.1	0.1	0.1	0.1	0.1
Brighton / Hove	5	0.0	8.8	9.5	3.2	0.0	0.1	3.4	2.6	4.0	1.6	1.5	1.6	2.7	0.8	1.3	0.6	0.4	1.0	0.4	1.3
Worthing / Chichester	6	0.0	6.7	1.2	3.9	0.1	0.0	0.3	5.6	4.4	3.1	2.0	3.6	1.9	0.3	4.2	0.8	0.0	0.0	1.3	0.4
Woking / Guildford	7	0.0	1.0	0.6	0.1	2.8	0.0	0.0	0.1	0.5	0.9	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0
Central London	8	0.0	0.3	3.1	0.5	2.0	2.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
London North	9	0.0	1.8	2.3	1.0	4.0	2.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
London East	10	0.0	0.3	3.6	0.0	1.5	2.8	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
London South	11	0.0	0.1	0.5	0.1	0.2	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
London West	12	0.0	0.4	0.1	0.6	0.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Home Counties	13	0.0	0.4	0.7	0.4	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East	14	0.0	0.1	0.2	0.4	1.5	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
West	15	0.0	1.3	3.8	0.5	0.8	3.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Midlands	16	0.0	0.5	0.6	0.5	3.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South West	17	0.0	0.8	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wales	18	0.0	0.0	0.1	0.1	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North	19	0.0	0.1	0.0	0.3	0.4	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scotland	20	0.0	0.0	0.0	0.1	1.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Trips to / from Gatwick Airport fixed during matrix estimation
ME changes focused on Sectors 2-7 (WSCC model)
Minimal changes to Sectors 8-20 (from SoLHAM)

Figure 5.8: IP pre and post ME sector R^2 analysis

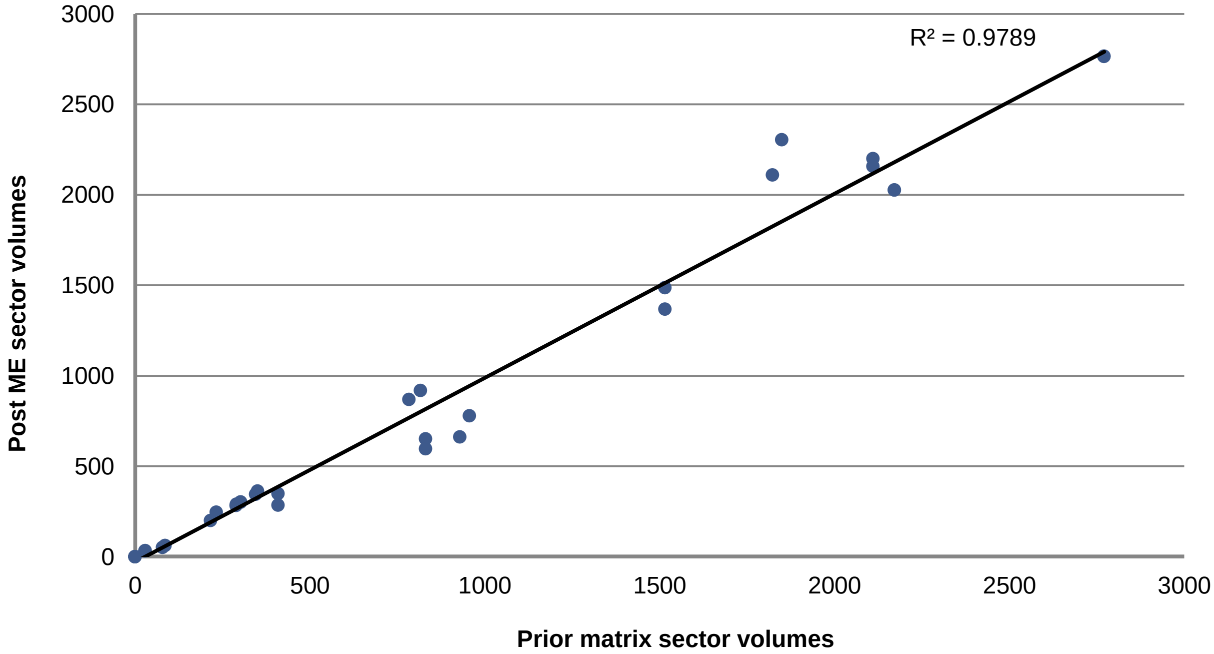
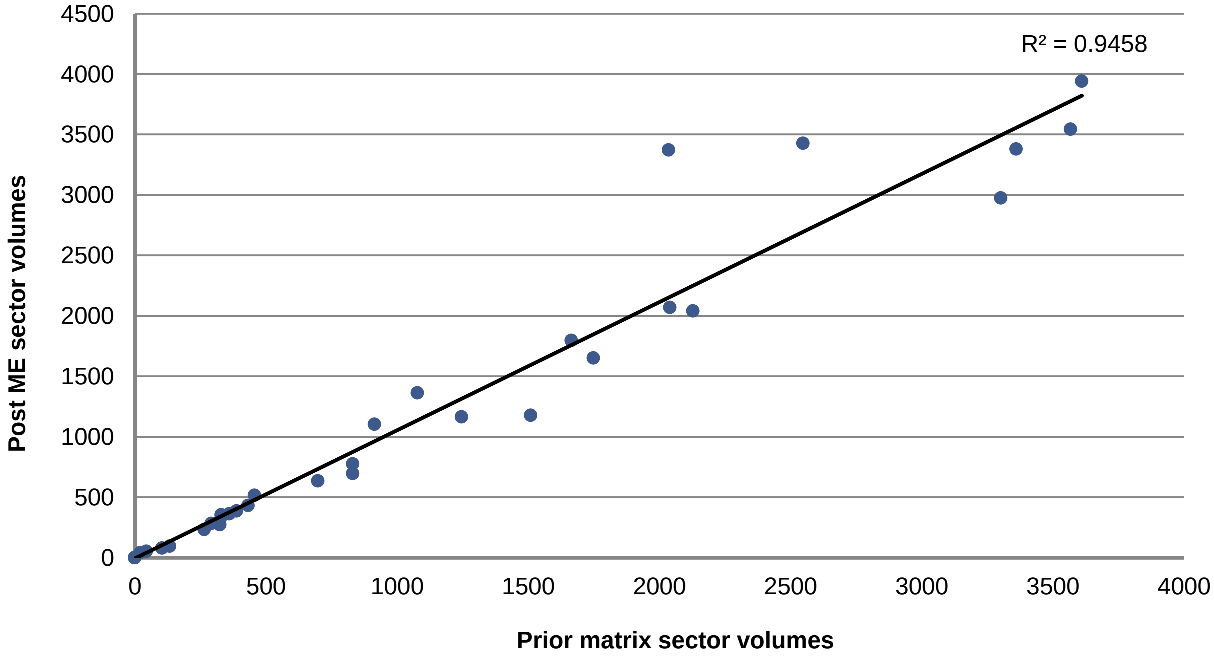


Table 5-4: PM pre and post-matrix estimation comparison

GEH	Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Gatwick	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crawley	2	0.0	0.0	16.1	5.4	2.3	2.3	1.6	0.4	2.7	0.3	0.3	0.9	0.6	0.7	3.3	0.7	0.4	0.2	0.7	0.5
North of Crawley	3	0.0	25.7	0.0	6.0	9.0	1.9	2.7	0.9	1.2	1.6	0.4	0.1	0.4	1.2	1.7	1.0	0.0	0.0	0.1	0.1
South of Crawley	4	0.0	3.2	8.2	0.0	5.8	0.7	0.2	1.4	1.6	0.4	0.5	0.9	0.7	0.7	2.7	0.5	0.3	0.1	0.6	0.3
Brighton / Hove	5	0.0	4.8	1.9	1.9	0.0	0.4	3.5	5.2	6.0	2.1	2.9	3.2	3.5	1.4	0.8	2.9	0.4	0.7	4.2	2.1
Worthing / Chichester	6	0.0	2.9	1.4	2.3	0.4	0.0	0.4	8.1	8.7	3.2	3.8	5.8	2.7	0.2	2.9	1.0	0.0	0.0	2.0	0.8
Woking / Guildford	7	0.0	3.8	0.7	0.0	2.5	0.0	0.0	0.3	1.2	1.9	0.2	0.0	0.1	0.0	3.3	0.0	0.0	0.0	0.0	0.0
Central London	8	0.0	1.2	1.8	0.1	3.5	1.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
London North	9	0.0	9.0	3.8	0.2	5.1	2.1	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
London East	10	0.0	0.4	3.8	0.2	2.2	2.2	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
London South	11	0.0	0.8	0.9	0.0	1.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
London West	12	0.0	6.4	0.4	0.9	3.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Home Counties	13	0.0	3.6	1.3	0.0	1.2	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East	14	0.0	9.0	0.6	0.0	2.3	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
West	15	0.0	0.7	6.4	0.6	1.1	1.9	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Midlands	16	0.0	3.6	0.4	0.1	3.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South West	17	0.0	1.3	0.8	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wales	18	0.0	0.9	0.4	0.5	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North	19	0.0	5.3	0.2	0.2	3.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scotland	20	0.0	1.8	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Trips to / from Gatwick Airport fixed during matrix estimation
ME changes focused on Sectors 2-7 (WSCC model)
Minimal changes to Sectors 8-20 (from SoLHAM)

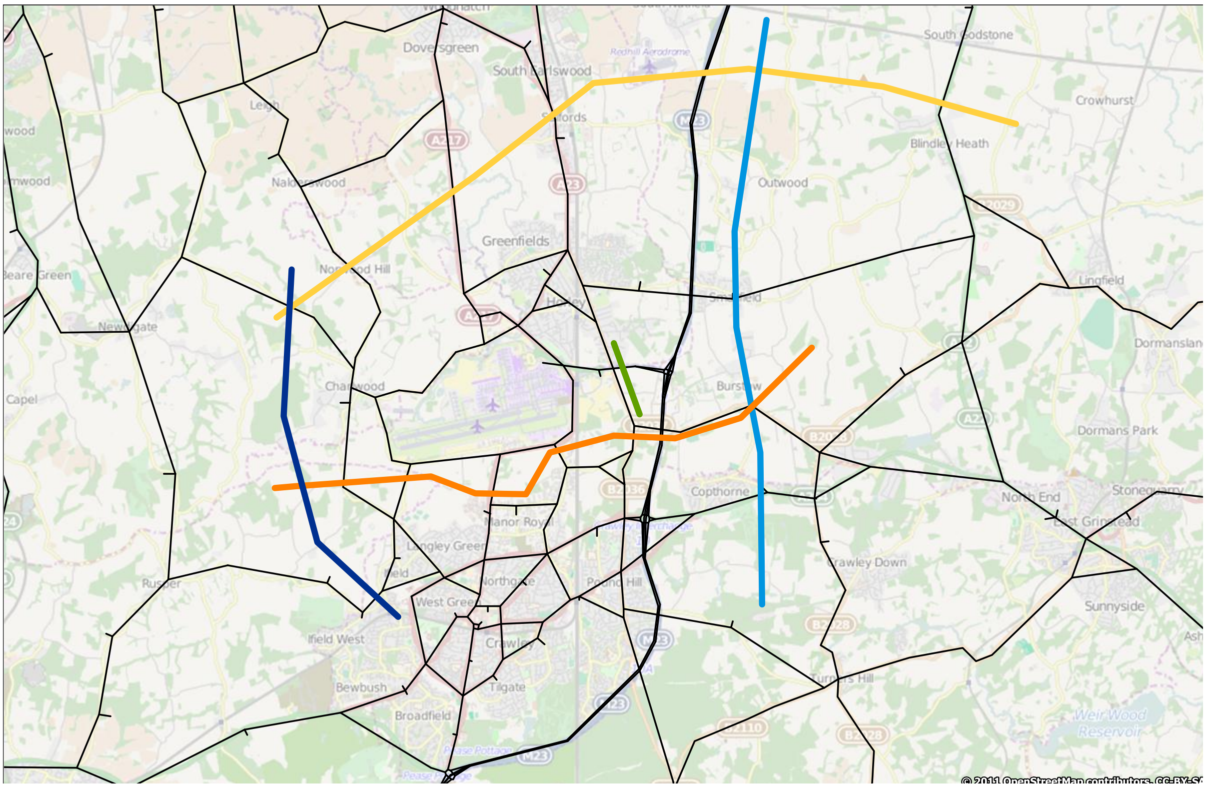
Figure 5.9: PM pre and post-ME sector R^2 analysis



Model calibration

5.2.22 The Gatwick Airport Base Model has been calibrated across a series of screenlines, as indicated in Figure 5-10. These form a watertight coverage of trips to / from Gatwick Airport in all directions.

Figure 5-10: Calibration screenlines



5.2.23 Model screenline performance statistics have been compared against validation criteria outlined in WebTAG unit M3.1, Highway Assignment Modelling (DfT, 2014). Key statistics for each model time period are presented in Tables 5-5 to 5-7. Calibration by individual link and screenline is summarised in in Tables 5-8 to 5-10.

5.2.24 In the AM peak, six out of eight screenlines are within WebTAG criteria. Similarly, 82% of links meet a GEH<5 criteria with 89% meeting a more relaxed criteria of 8.

5.2.25 In the inter-peak, all screens are within WebTAG; individual link calibration is good with 89% of links meeting a GEH<5 and 100% meeting a criteria of 8.

5.2.26 While only five out of eight screenlines exceed WebTAG acceptance criteria in the evening peak, all major screenlines pass. Some 82% of links meet a GEH<5 criteria with 95% meeting a more relaxed criteria of 8.

5.2.27 Whilst the validation does not meet the stringent WebTAG criteria across all screenlines and all links, the validation does meet the criteria across the screenlines (Gatwick North, Gatwick South and M23 Spur) and the individual links (M23, A23) that most Gatwick-bound traffic will be using.

Table 5-5: AM peak statistics

Criteria	Achieved	Guideline aspiration
Link flow GEH < 5[12]	82%	85%
Link flow GEH < 8	92%	-
Link flow within WebTAG criteria[13]	79%	85%
Screenline[14] flow difference < 5%	75%	85%
Journey time routes – time difference < 15 %	100%	85%

Table 5-6: Inter peak statistics

Criteria	Achieved	Guideline aspiration
Link flow GEH < 5	89%	85%
Link flow GEH < 8	100%	-
Link flow within WebTAG criteria	100%	85%
Screenline flow difference < 5%	88%	85%
Journey time routes – time difference < 15 %	-	85%

Table 5-7: PM peak statistics

Criteria	Achieved	Guideline aspiration
Link flow GEH < 5	82%	85%
Link flow GEH < 8	95%	-
Link flow within WebTAG criteria	87%	85%
Screenline flow difference < 5%	63%	85%
Journey time routes – time difference < 15 %	50%	85%

[12] The GEH statistic is a measure of fit incorporating both relative and absolute errors. Refer TAG Unit M3.1 section 3.2.7
[13] Refer TAG Unit M3.1 Table 2
[14] A screenline is a collection of traffic counts which together provide a measure of total traffic flow across a defined boundary

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Table 5-8: AM calibration statistics

Location	Car / taxi	LGV	HGV	Observed	Car	LGV	HGV	Modelled	Diff	% diff	GEH	% diff	GEH
Gatwick north screenline – northbound													
Blanks Lane	121	10	16	147	153	25	4	182	35	24%	2.7	✓	✓
Norwood Hill Rd	389	45	28	462	260	27	8	295	-167	-36%	8.6	✗	✗
A217	364	52	20	436	391	47	45	482	46	11%	2.2	✓	✓
A23	831	133	58	1022	791	130	52	974	-48	-5%	1.5	✓	✓
M23, J8-9	3122	513	702	4337	3317	520	726	4563	226	5%	3.4	✓	✓
A22	408	63	43	514	441	85	44	570	57	11%	2.4	✓	✓
Total screenline	**5235**	**816**	**867**	**6918**				**7066**	**148**	**2%**	**1.8**	✓	
Gatwick north screenline – southbound													
Blanks Lane	199	11	24	234	354	27	1	382	148	63%	8.4	✗	✗
Norwood Hill Rd	477	40	22	539	168	29	7	204	-335	-62%	17.4	✗	✗
A217	597	80	18	695	665	77	53	794	99	14%	3.6	✓	✓
A23	599	107	46	752	701	106	46	853	101	13%	3.6	✓	✓
M23, J8-9	3452	567	775	4794	3521	429	706	4655	-139	-3%	2.0	✓	✓
A22	432	56	27	515	341	31	27	399	-116	-22%	5.4	✗	✓
Total screenline	**5756**	**862**	**911**	**7530**				**7289**	**-241**	**-3%**	**2.8**	✓	
Gatwick south screenline – northbound													
Charlwood Rd	216	28	17	260	223	17	8	248	-12	-5%	0.8	✓	✓
Bonnetts Lane	361	26	4	391	231	4	14	248	-143	-37%	8.0	✗	✓
A23 Fleming Way	703	81	47	830	661	81	39	781	-49	-6%	1.7	✓	✓
Gatwick Rd	622	72	41	735	566	80	12	657	-78	-11%	2.9	✓	✓
B2036 Balcombe Rd	568	101	44	713	682	91	53	826	113	16%	4.1	✗	✓
M23, J9-10	3569	587	802	4958	3824	625	740	5189	231	5%	3.2	✓	✓
B2037	666	66	46	778	675	80	37	792	14	2%	0.5	✓	✓
Total screenline	**6704**	**961**	**1000**	**8405**				**8494**	**89**	**1%**	**1.0**	✓	
Gatwick south screenline – southbound													
Charlwood Rd	123	16	5	145	132	17	4	153	9	6%	0.7	✓	✓
Bonnetts Lane	76	8	2	85	68	7	3	78	-7	-9%	0.8	✓	✓
A23 Fleming Way	1012	81	69	1161	1020	76	70	1166	5	0%	0.2	✓	✓
Gatwick Rd	627	50	42	719	592	77	48	718	-2	0%	0.1	✓	✓
B2036 Balcombe Rd	736	105	46	887	802	103	36	941	54	6%	1.8	✓	✓
M23, J9-10	2615	430	587	3633	2711	456	708	3875	243	7%	4.0	✓	✓
B2037	411	31	16	458	459	46	6	511	53	12%	2.4	✓	✓
Total screenline	**5599**	**722**	**767**	**6943**				**7289**	**346**	**5%**	**4.1**	✓	
Gatwick east screenline – eastbound													
Smallfield Rd	243	37	6	286	179	15	16	209	-77	-27%	4.9	✓	✓
B2037	301	31	16	348	459	46	6	511	163	47%	7.9	✗	✓
A264 Copthorne Common Rd	1010	173	90	1272	889	194	89	1173	-100	-8%	2.8	✓	✓
Total screenline	**1554**	**241**	**112**	**1906**				**1894**	**-13**	**-1%**	**0.3**	✓	
Gatwick east screenline – westbound													
Smallfield Rd	259	24	16	299	331	21	29	382	83	28%	4.5	✓	✓
B2037	666	66	46	778	675	80	37	792	14	2%	0.5	✓	✓
A264 Copthorne Common Rd	1224	244	127	1594	1219	191	94	1504	-90	-6%	2.3	✓	✓
Total screenline	**2149**	**334**	**189**	**2671**				**2679**	**7**	**0%**	**0.1**	✓	
Gatwick west screenline – eastbound													
Blanks Lane	199	21	24	244	354	27	1	382	138	57%	7.8	✗	✓
Rusper Rd	579	77	25	682	550	65	27	642	-40	-6%	1.5	✓	✓
Total screenline	**778**	**98**	**49**	**926**				**1024**	**98**	**11%**	**3.1**	✗	
Gatwick west screenline – westbound													
Blanks Lane	121	10	16	147	153	25	4	182	35	24%	2.7	✓	✓
Rusper Rd	175	23	14	212	170	23	14	207	-5	-2%	0.3	✓	✓
Total screenline	**296**	**33**	**30**	**359**				**389**	**30**	**8%**	**1.6**	✗	
M23 Spur													
Eastbound	1287	125	42	1454	1215	68	5	1324	-130	-9%	3.5	✓	✓
Westbound	2418	218	126	2762	2524	151	20	2695	-67	-2%	1.3	✓	✓

Table 5-9: IP calibration statistics

Location	Car / taxi	LGV	HGV	Observed	Car	LGV	HGV	Modelled	Diff	% diff	GEH	% diff	GEH
Gatwick north screenline - northbound													
Blanks Lane	57	9	8	74	84	12	1	97	23	31%	2.51	✓	✓
Norwood Hill Rd	144	23	9	175	73	20	6	98	-77	-44%	6.59	✓	✓
A217	280	55	19	354	333	48	29	411	57	16%	2.94	✓	✓
A23	637	116	62	815	639	117	62	817	2	0%	0.06	✓	✓
M23, J8-9	2297	523	833	3653	2403	479	845	3727	74	2%	1.22	✓	✓
A22	334	57	32	424	335	57	54	446	22	5%	1.07	✓	✓
Total screenline	**3749**	**783**	**962**	**5494**				**5596**	**102**	**2%**	**1.37**	✓	
Gatwick north screenline – southbound													
Blanks Lane	54	8	9	71	63	7	1	70	-1	-1%	0.10	✓	✓
Norwood Hill Rd	163	25	13	200	155	25	3	182	-18	-9%	1.28	✓	✓
A217	268	43	24	335	267	46	39	352	18	5%	0.95	✓	✓
A23	634	132	56	821	654	132	56	842	21	3%	0.71	✓	✓
M23, J8-9	2256	514	817	3587	2327	481	832	3640	53	1%	0.89	✓	✓
A22	331	61	38	430	332	61	38	431	2	0%	0.08	✓	✓
Total screenline	**3706**	**782**	**956**	**5444**				**5518**	**74**	**1%**	**1.01**	✓	
Gatwick south screenline – northbound													
Charlwood Rd	80	15	9	104	132	24	6	162	57	55%	4.98	✓	✓
Bonnetts Lane	93	13	1	107	42	4	4	51	-56	-52%	6.29	✓	✓
A23 Fleming Way	566	66	40	672	567	63	34	664	-9	-1%	0.34	✓	✓
Gatwick Rd	451	53	32	536	412	62	29	503	-32	-6%	1.42	✓	✓
B2036 Balcombe Rd	384	80	34	498	426	67	43	535	38	8%	1.66	✓	✓
M23, J9-10	2014	459	730	3203	2113	462	851	3426	223	7%	3.88	✓	✓
B2037	213	45	28	286	272	58	9	339	53	18%	2.97	✓	✓
Total screenline	**3803**	**730**	**873**	**5302**				**5519**	**217**	**4%**	**2.95**	✓	
Gatwick south screenline – southbound													
Charlwood Rd	90	18	13	120	159	24	5	188	68	56%	5.44	✓	✓
Bonnetts Lane	117	13	1	131	47	7	9	64	-67	-51%	6.80	✓	✓
A23 Fleming Way	595	66	43	704	618	66	42	726	22	3%	0.82	✓	✓
Gatwick Rd	403	45	29	477	380	53	45	478	2	0%	0.08	✓	✓
B2036 Balcombe Rd	382	69	37	488	414	61	17	492	4	1%	0.17	✓	✓
M23, J9-10	2052	467	743	3263	2093	462	835	3389	127	4%	2.19	✓	✓
B2037	258	44	36	338	291	52	16	359	21	6%	1.14	✓	✓
Total screenline	**3897**	**721**	**902**	**5400**				**5508**	**108**	**2%**	**1.47**	✓	
Gatwick east screenline – eastbound													
Smallfield Rd	126	24	15	165	68	15	33	117	-49	-30%	4.11	✓	✓
B2037	258	44	36	338	291	52	16	359	21	6%	1.14	✓	✓
A264 Copthorne Common Rd	909	155	81	1145	910	155	83	1148	3	0%	0.09	✓	✓
Total screenline	**1293**	**223**	**132**	**1649**				**1624**	**-24**	**-1%**	**0.61**	✓	
Gatwick east screenline – westbound													
Smallfield Rd	119	25	11	155	79	12	29	120	-34	-22%	2.94	✓	✓
B2037	213	45	28	286	272	58	9	339	53	18%	2.97	✓	✓
A264 Copthorne Common Rd	961	164	86	1211	943	164	86	1193	-18	-1%	0.51	✓	✓
Total screenline	**1293**	**234**	**125**	**1652**				**1652**	**0**	**0%**	**0.01**	✓	
Gatwick west screenline – eastbound													
Blanks Lane	54	8	9	71	63	7	1	70	-1	-1%	0.10	✓	✓
Rusper Rd	200	39	28	267	205	39	28	272	6	2%	0.35	✓	✓
Total screenline	**254**	**47**	**37**	**338**				**343**	**5**	**1%**	**0.26**	✓	
Gatwick west screenline – westbound													
Blanks Lane	57	9	8	74	84	12	1	97	23	31%	2.51	✓	✓
Rusper Rd	211	41	22	274	212	41	25	278	4	1%	0.21	✓	✓
Total screenline	**268**	**50**	**30**	**348**				**375**	**27**	**8%**	**1.40**	✗	
M23 Spur													
Eastbound	1276	115	66	1458	1291	112	3	1405	-52	-4%	1.39	✓	✓
Westbound	1261	114	66	1440	1235	114	6	1356	-85	-6%	2.26	✓	✓

Table 5-10: PM calibration statistics

Location	Car / taxi	LGV	HGV	Observed	Car	LGV	HGV	Modelled	Diff	% diff	GEH	% diff	GEH
Gatwick north screenline - northbound													
Blanks Lane	140	14	8	162	199	23	0	223	61	37%	4.4	✓	✓
Norwood Hill Rd	384	21	10	415	237	4	1	242	-173	-42%	9.6	✗	✗
A217	648	64	4	716	665	66	20	751	35	5%	1.3	✓	✓
A23	749	98	16	863	811	144	16	971	108	12%	3.6	✓	✓
M23, J8-9	2758	445	413	3617	3010	403	398	3812	195	5%	3.2	✓	✓
A22	482	34	29	545	453	35	30	517	-28	-5%	1.2	✓	✓
Total screenline	**5161**	**676**	**481**	**6318**				**6515**	**197**	**3%**	**2.5**	✓	
Gatwick north screenline – southbound													
Blanks Lane	107	21	6	134	161	8	0	169	35	26%	2.9	✓	✓
Norwood Hill Rd	359	58	8	425	322	32	1	355	-70	-17%	3.6	✓	✓
A217	398	48	2	448	360	83	14	457	9	2%	0.4	✓	✓
A23	829	88	24	941	837	109	24	971	30	3%	1.0	✓	✓
M23, J8-9	3302	532	494	4328	3345	509	504	4358	30	1%	0.5	✓	✓
A22	469	43	18	530	659	47	18	724	194	37%	7.7	✗	✓
Total screenline	**5464**	**790**	**552**	**6806**				**7034**	**228**	**3%**	**2.7**	✓	
Gatwick south screenline – northbound													
Charlwood Rd	123	5	2	130	156	6	1	163	34	26%	2.8	✓	✓
Bonnetts Lane	107	14	3	123	92	18	1	111	-12	-10%	1.1	✓	✓
A23 Fleming Way	1229	67	32	1328	1345	109	32	1486	159	12%	4.2	✓	✓
Gatwick Rd	871	51	25	947	791	73	24	888	-59	-6%	2.0	✓	✓
B2036 Balcombe Rd	925	98	27	1050	889	73	22	984	-66	-6%	2.1	✓	✓
M23, J9-10	2355	380	353	3087	2436	388	388	3211	124	4%	2.2	✓	✓
B2037	389	82	10	481	487	113	14	614	133	28%	5.7	✗	✓
Total screenline	**5999**	**696**	**451**	**7016**				**7294**	**278**	**4%**	**3.3**	✓	
Gatwick south screenline - southbound													
Charlwood Rd	258	24	17	299	325	27	13	365	66	22%	3.6	✓	✓
Bonnetts Lane	534	30	4	568	305	26	8	340	-228	-40%	10.7	✗	✗
A23 Fleming Way	829	62	22	914	782	58	22	862	-51	-6%	1.7	✓	✓
Gatwick Rd	503	38	14	554	477	47	23	547	-8	-1%	0.3	✓	✓
B2036 Balcombe Rd	761	100	16	876	687	105	5	797	-80	-9%	2.8	✓	✓
M23, J9-10	3507	565	525	4597	3835	577	544	4957	359	8%	5.2	✓	✓
B2037	685	54	14	753	684	81	22	787	34	5%	1.2	✓	✓
Total screenline	**7078**	**872**	**611**	**8262**				**8289**	**27**	**0%**	**0.3**	✓	
Gatwick east screenline – eastbound													
Smallfield Rd	289	40	14	343	223	23	3	248	-95	-28%	5.5	✓	✓
B2037	685	54	14	753	684	81	22	787	34	5%	1.2	✓	✓
A264 Copthorne Common Rd	1484	254	132	1870	1355	202	127	1684	-186	-10%	4.4	✓	✓
Total screenline	**2458**	**348**	**160**	**2966**				**2719**	**-247**	**-8%**	**4.6**	✗	
Gatwick east screenline – westbound													
Smallfield Rd	236	48	10	294	174	34	8	216	-78	-27%	4.9	✓	✓
B2037	389	82	10	481	487	113	14	614	133	28%	5.7	✗	✓
A264 Copthorne Common Rd	1151	197	102	1450	1097	170	102	1369	-81	-6%	2.2	✓	✓
Total screenline	**1776**	**327**	**122**	**2225**				**2199**	**-26**	**-1%**	**0.6**	✓	
Gatwick west screenline – eastbound													
Blanks Lane	107	21	6	134	161	8	0	169	35	26%	2.9	✓	✓
Rusper Rd	277	26	18	321	294	28	18	340	19	6%	1.1	✓	✓
Total screenline	**384**	**47**	**24**	**455**				**509**	**54**	**12%**	**2.5**	✗	
Gatwick west screenline – westbound													
Blanks Lane	140	14	8	162	199	23	0	223	61	37%	4.4	✓	✓
Rusper Rd	530	19	10	560	521	17	10	548	-11	-2%	0.5	✓	✓
Total screenline	**670**	**33**	**18**	**722**				**771**	**49**	**7%**	**1.8**	✗	
M23 Spur													
Eastbound	1876	169	98	2143	2123	143	56	2322	179	8%	3.8	✓	✓
Westbound	1103	103	60	1266	1079	60	20	1159	-107	-8%	3.1	✓	✓

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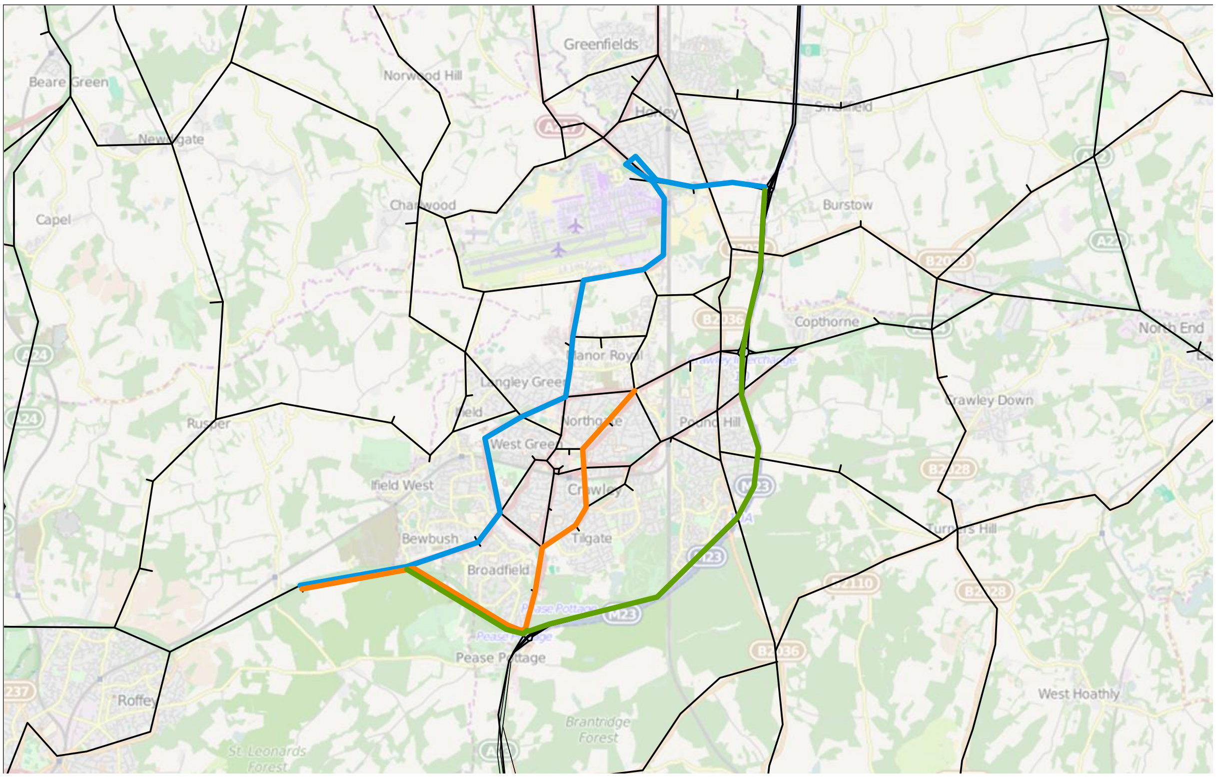
Journey time validation

5.2.28 It has not been possible to undertake new journey time surveys within the timescale available for this study. Instead, modelled times have been compared against limited existing data, collected as part of an update of West Sussex County Council's Crawley Model (a sub-model of the wider West Sussex Model discussed previously).

5.2.29 Observed data is historic (2006) and available for the AM and PM peaks only. Although six runs were undertaken in each peak and direction, data was collected across three hours of a peak, rather than the modelled peak hour.

Figure 5-11: Journey time routes



5.2.30 WebTAG states that journey times should be within 15% of observations. Modelled times have been compared with mean observed values in Table 5-11 below.

5.2.31 In the morning period, all three north and three southbound modelled times are within 10% of observed values. Results of the evening peak comparisons are weaker and only Route 3 meets WebTAG guidance both north and southbound.

5.2.32 Nevertheless, given the limitation in age and statistical accuracy of the observed data, the journey time analysis illustrates that modelled journey times reflect, to a sufficient level of accuracy, actual road traffic conditions and travel times.

Table 5.11: Observed / modelled journey time difference (minutes)

Route	Modelled	Observed	Difference	% diff	Modelled	Observed	Difference	% diff
AM	Northbound				Southbound			
1	20.0	19.5	0.6	-3%	13.9	13.7	0.1	-1%
2	19.1	18.2	0.9	-5%	13.0	14.4	-1.4	10%
3	12.1	11.8	0.3	-2%	9.6	10.7	-1.1	10%
PM	Northbound				Southbound			
1	13.5	16.2	-2.7	17%	20.7	18.6	2.1	-11%
2	13.4	17.0	-3.5	21%	13.1	16.5	-3.4	21%
3	8.2	9.4	-1.2	12%	10.5	11.1	-0.6	6%

Summary

5.2.33 Matrix estimation has resulted in significant changes to matrices only within the internal study area. Across the existing SoLHAM area, demand is almost unchanged as a result of the local recalibration around Gatwick. Trips to/from Gatwick were frozen in the matrix estimation process.

5.2.34 Model performance summary statistics show that the model replicates observed key screenline flows (Gatwick North, Gatwick South and M23 Spur) and strategic road link flows (M23, A23 and A24) likely to be used by the majority of trips to/from Gatwick within acceptable limits.

5.2.35 Available observed journey time data is historic and not statistically significant. Nevertheless, it provides a useful comparison between actual and modelled times. AM observed / modelled difference are within WebTAG criteria. PM peak values are less good but meet the guidance on the critical M23 corridor.

5.2.36 On the basis of the above results and statistics, it is considered that the Gatwick Airport Model is a reasonable basis to test the impact of an additional runway at Gatwick.

5.3 Forecast year (2030) demand

Background growth

5.3.1 SoLHAM traffic forecasts were provided to Jacobs by TfL for both 2021 and 2031. Similarly, a 2031 matrix (AM peak only) was provided for the West Sussex County Council SATURN model.

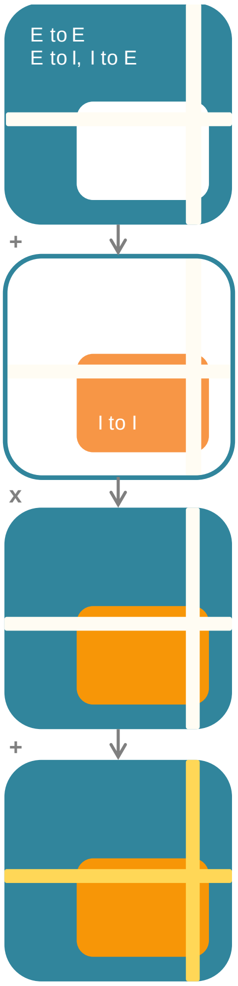
5.3.2 Based on the uncertainty surrounding growth to 2031, it was assumed that no further adjustment would need to be made to adjust the non-airport traffic to a common year of 2030 and as such all further reference to traffic forecasts will be to 2030.

5.3.3 As the base matrices had previously been matrix estimated, it was not possible to use the above matrices directly. Instead, it was necessary to apply growth factors to derive 2030 demand.

5.3.4 Consistent with the base, trips with an origin or destination or both external to the study area (E to E, E to I, I to E) have been factored using SoLHAM growth factors. Trips wholly within the study area have been factored using factors from the West Sussex Model. For each model, growth factors have been derived by dividing 2031 by 2009 matrices. The appropriate sections of each factored matrix have then combined to produce a single matrix of 2009 to 2031 growth factors.

5.3.5 A summary of the future year matrix process is outlined in Figure 5-12.

Figure 5-12: Future year matrix building process



Stage 1
E to E, E to I and I to E trips
Factor Aij = 2031 SoLHAM / 2009 SoLHAM demand
I to I and Gatwick Airport demand = 0

Stage 2
I to I trips
Factor Bij = 2031 WSCC / 2009 WSCC model demand
E to E, E to I, I to E and Gatwick Airport demand = 0

Stage 3
2031 demand = (Factor Aij + Factor Bij) * 2009 demand

Stage 4
2031 airport trips added as absolute values

Airport growth

5.3.6 Calculation of car and taxi demand to Gatwick airport was based on the headline assumptions for annual passenger volume and number of employees, as described in Chapter 3.

5.3.7 From the passenger and employee headline assumptions, final hourly demand is computed though a series of steps taking into account yearly to average day proportion, daily arrival and departure profiles, employee shift times and the number of empty return trips. A summary of the steps to derive hourly vehicular trips is listed below:

- Employees are assumed to have no empty returns and not to use taxis - so to calculate employee car trips, total person trips were divided by the headline car occupancy rate;
- Passenger vehicle trips are split by sub-mode share (for private car and for taxi) – this is done using the observed sub-mode share split by district. The resulting values for person private car and person taxi trips are then divided by the respective mode shares to calculate a base vehicle trip value private cars and taxis;
- Base vehicle trips in each direction "empty trips" (i.e. vehicle trips caused by pickups, drop offs etc.) are then added. To calculate the empty trips, the total number of trips by type *in the opposite direction* were divided by observed empty return rate (for each type) by district; and
- For each vehicle type, the empty return value was added to the base value to calculate a total number of car journeys by type. These were added together to calculate a total car journey value for each zone.

5.3.8 Background demand in SATURN varies by time of day, and so different inputs were created to allow the dynamic model to be run for different time periods. Observed data was used to calculate a value (as a percentage) of the total trips per day (by group) of employee trips to and from the airport, and passengers to and from the airport, for the following time periods:

- AM Peak – 0800 to 0900
- Inter Peak – 1000 to 1600 (1 hour average of the 6 hour period)
- PM Peak – 1700 to 1800.

5.3.9 Total hourly demand then feeds into the distribution and mode share models (as described in section 3), producing the final car and taxi demand for each model period, as shown in Table 5-12.

Table 5-12: 2031 Gatwick car and taxi travel demand by time period (veh/hr)

Scenario	To Airport			From Airport		
	AM	IP	PM	AM	IP	PM
1 runway (extended baseline)	2462	1364	1031	1276	1439	1704
2 runways	3635	1773	1417	1718	1907	2549

5.3.10 Referring to good vehicles, Gatwick is not represented as a unique zone in SoLHAM and the West Sussex SATURN model is not disaggregated by vehicle class and so there is insufficient model information to identify current good vehicle demand or a trip distribution. There are also very few HGV's to or from Gatwick in the morning or evening peaks. Consequently, applying a factoring process to the available data sources would not be appropriate.

5.3.11 It should be noted that forecast peak hour LGV / HGV numbers are very low. From Appendix A6 Table 14.1 of the "A Second Runway for Gatwick Report", Arup, 2014, only 30 LGV / HGV trips are forecast to support cargo operations in the peak hour in 2050. While there are additional logistics to support airport operations, much of this is outside of the peak.

5.3.12 Given the limited availability of data and the low number of goods vehicles forecast, goods vehicle traffic to / from Gatwick has been subsumed within the total vehicle flows and has not been separately modelled.

5.3.13 Future demand within Gatwick has been disaggregated to each terminal based on information given in Appendix 6, Tables 8.4 and 8.5 of the "Gatwick Surface Access Strategy".

5.3.14 With the Extended Baseline scenario, in 2030, it is forecast that the split between north and south terminals / perimeter parking will be 44% / 56% respectively. With a Second Runway, travel demand has been disaggregated as follows:

- North Terminal 27%
- South terminal 35%
- New terminal 12%
- Long stay parking 26%[15]

5.3.15 A visualisation of Baseline and Second Runway travel demand within Gatwick, across all time periods, is shown in Figure 5-13 and 5-14 respectively.

[15] CAA 2012 Gatwick data

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Figure 5-13: Extended Baseline (1 runway)

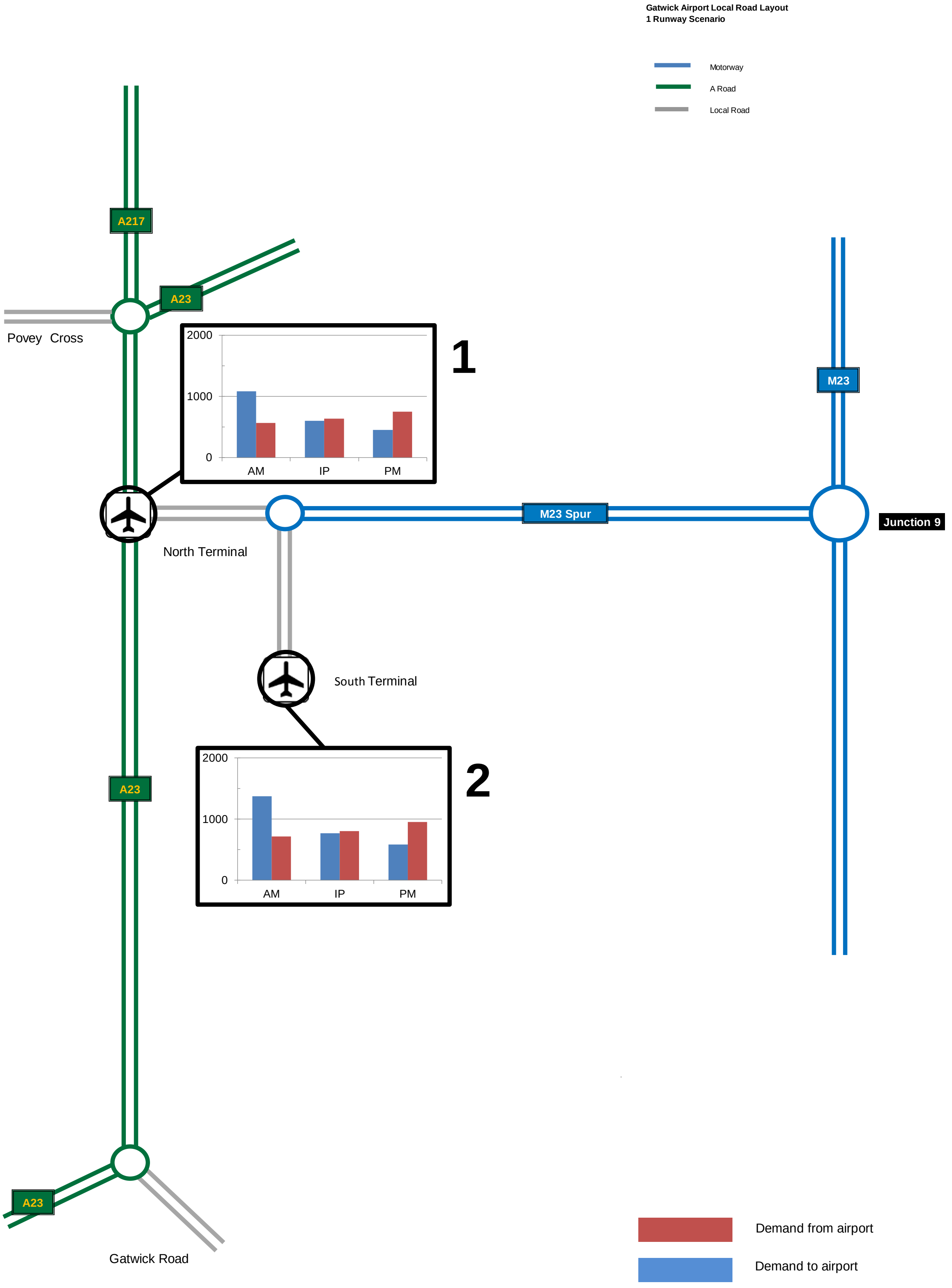
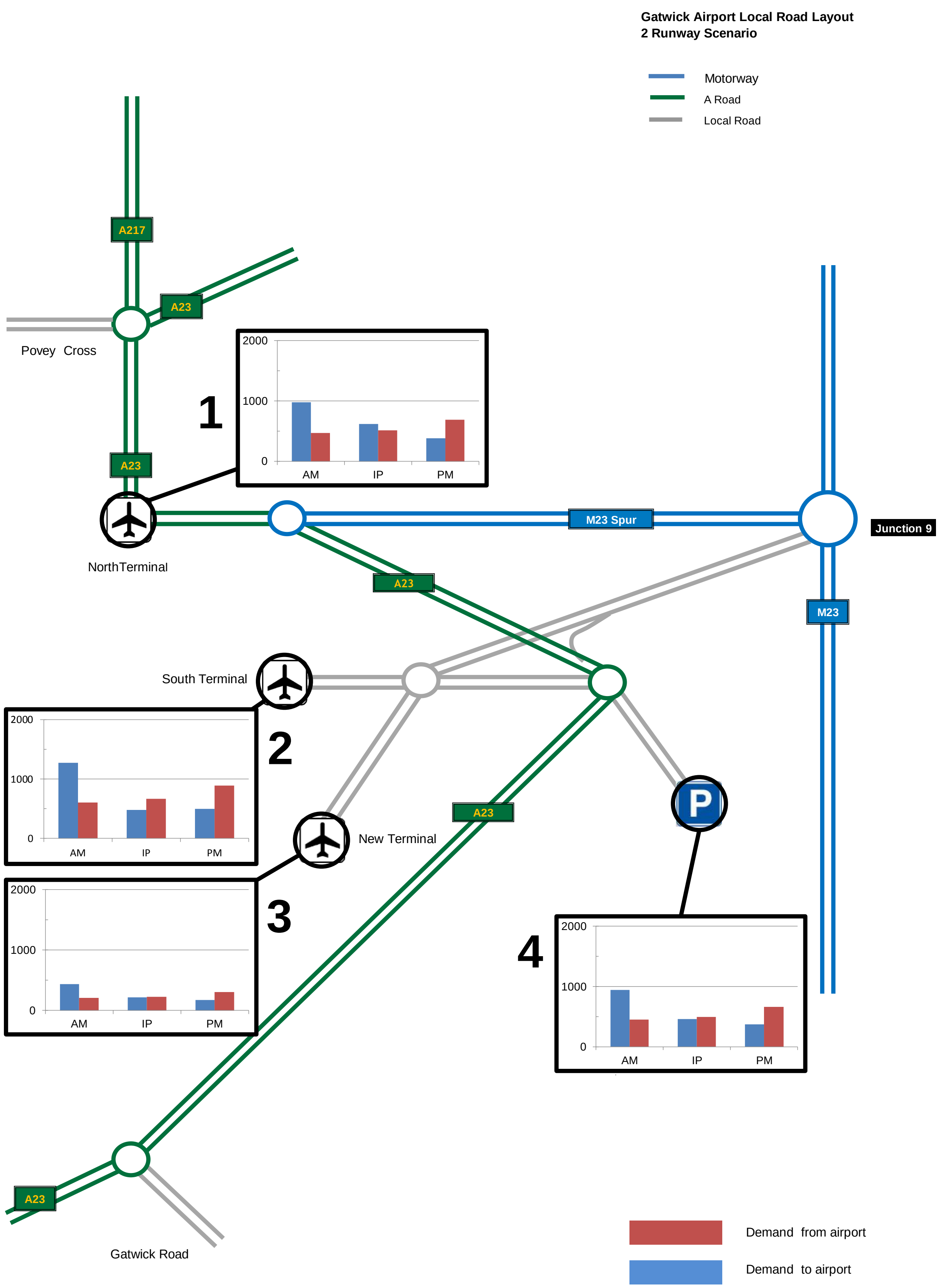


Figure 5-14: 2 runways



5.4 Definition of highway assignment model terms

5.4.1 Before the SoLHAM model outputs are described in detail, it is useful to define a number of highway assignment model terms. These are as follows:

- *Demand flows*. Demand flow is the total unconstrained volume of traffic wanting to travel through a particular location; representing total desire for road travel at the location.
- *Actual flows*. Actual flow represents the volume of traffic determined by detailed simulation taking into account real world metering of traffic through intersection capacity constraints and subsequent bottlenecks and queueing of traffic. It represents the volume of traffic feasibly able to travel through a location. A large difference between demand and actual flow would indicate a large desire for travel unable to be met by the road network traffic capacity.
- *Queued flows*. Queued flow represents the amount of traffic demand unable to reach its intended destination at the end of the traffic assignment due to an upstream source of delay, such a traffic signals or a congested motorway ramp.
- *Volume over capacity (V/C) ratios.* Drawing from a large body of empirical research, the theoretical traffic capacity per lane for a particular stretch of road can be estimated based on the standard of design, speed limit and a number of additional environmental considerations. The capacities within the SoLHAM model are derived from TfL's coding manual, which take into account such criteria. Volume over Capacity (V/C) is a ratio representing the degree of saturation of a particular stretch of road, with values closer to 0 representing free flow conditions and values approaching or greater than 1 indicating high levels of congestion. Observations on many roads shows that delay rises steeply at v/c ratios of above 0.85, and that severe delays occurs at v/c ratios of above 1.00. Two v/c ratios can be output from the model: the *demand flow/capacity ratio*, which compares the unconstrained flow against the link capacity and the *actual flow/capacity ratio*, which compares the traffic flow feasibly able to get through the link against the link capacity
- *Select link analysis*[16] *(SLA)*. A select link analysis is a useful modelling tool, which identifies the "paths" of all trips using a particular link. Thus, for example, a SLA on the access roads to Gatwick Airport will identify not only the origins and destinations of trips using that link, but the routing of those trips. Thus it is a powerful analysis tool.

5.5 Extended baseline assessment – 1 runway (2030)

Extended baseline network

5.5.1 The Extended Baseline (EB) highway network comprises of the existing road network; committed and funded improvement schemes and a set of Extended Baseline schemes. At the time of writing, none of these schemes are committed or funded, but are judged highly likely to be required and in place by 2030 to accommodate forecast demand on the UK highway network, regardless of any airport expansion.

5.5.2 A full list of the schemes defined in the Extended Baseline is included in Appendix B. The following highway schemes around Gatwick Airport have been included in the Extended Baseline Network:

- M23 junction 8 to 10 smart motorway (all lane running);
- M25 junction 23 to 27 smart motorway (all lane running);
- M25 junction 5 to 7 smart motorway (all lane running);
- M3 junction 2 to 4a smart motorway (all lane running); and
- M4 junction 3 to 12 smart motorway (all lane running).

[16] Select link analysis provides insight into vehicle routing to and from a particular location by summing volumes along the travel route for all trips passing through the location.

5.5.3 An initial review of network performance highlighted localised capacity issues at the M23 / M25 interchange.

5.5.4 In order to obtain benefit from the adjacent smart motorway proposals on the M23 Junction 8 to 10 and M25 Junction 5 to 7, it seems highly probable that modest capacity improvements will be implemented at the interchange to support these schemes. Localised capacity increases have therefore been included in the extended baseline. Without exception, these are associated with enhancing weaving capacity on the slips which is required to support the additional lanes of the smart motorway schemes.

5.5.5 No additional lanes or structures have been assumed other than those already required as part of the smart motorway proposals.

Assignment and review of performance

5.5.6 A detailed review of the Extended Baseline model performance has been undertaken to ensure the forecast year traffic assignment produces reasonable results and is a suitable point of reference for assessment of impacts arising from the Gatwick Second Runway project. This review covered all the modelling aspects defined in Section 5.4.1 above.

5.5.7 The full set of figures is contained in a separate document entitled “Supplementary Figures Report”. In total there are 168 figures, covering six model outputs, by two model areas (local road network and full study area) and three time periods (AM peak, Inter-peak and PM peak).

5.5.8 The supplementary figures relating to the Extended Baseline assessment are defined below.

- Demand traffic flows on the local road network within the immediate vicinity of Gatwick (Figs 1,4,7);
- Actual traffic flows on the local road network within the immediate vicinity of Gatwick (Figs 10,13 16);
- Demand traffic flows on the strategic road network surrounding Gatwick (Figs 19,22,25);
- Actual traffic flows on the strategic road network surrounding Gatwick (Figs 28,31,34);
- Demand flow v/c ratios on the strategic road network surrounding Gatwick (Figs 37, 40, 43);
- Actual flow v/c ratios on the strategic road network surrounding Gatwick (Figs 46, 49 52);
- SLA routing of traffic traveling to/from Gatwick North Terminal (Figs 55, 58, 61, 64, 67, 70);
- SLA routing of traffic travelling to/from Gatwick South Terminal (Figs 73, 76, 79, 82, 85, 88);
- SLA queued flow of traffic traveling to/from Gatwick North Terminal (Figs 103, 106, 109, 112, 115, 118);
- SLA queued flow of traffic travelling to/from Gatwick South Terminal (Figs 121, 124, 127, 130, 133, 136);

5.5.9 Figures 5-15 to 5-18 below present the peak hour actual traffic flows as well as select link analyses of traffic to the Gatwick North and South terminals in the AM peak hour.

Figure 5-15: AM extended baseline flows

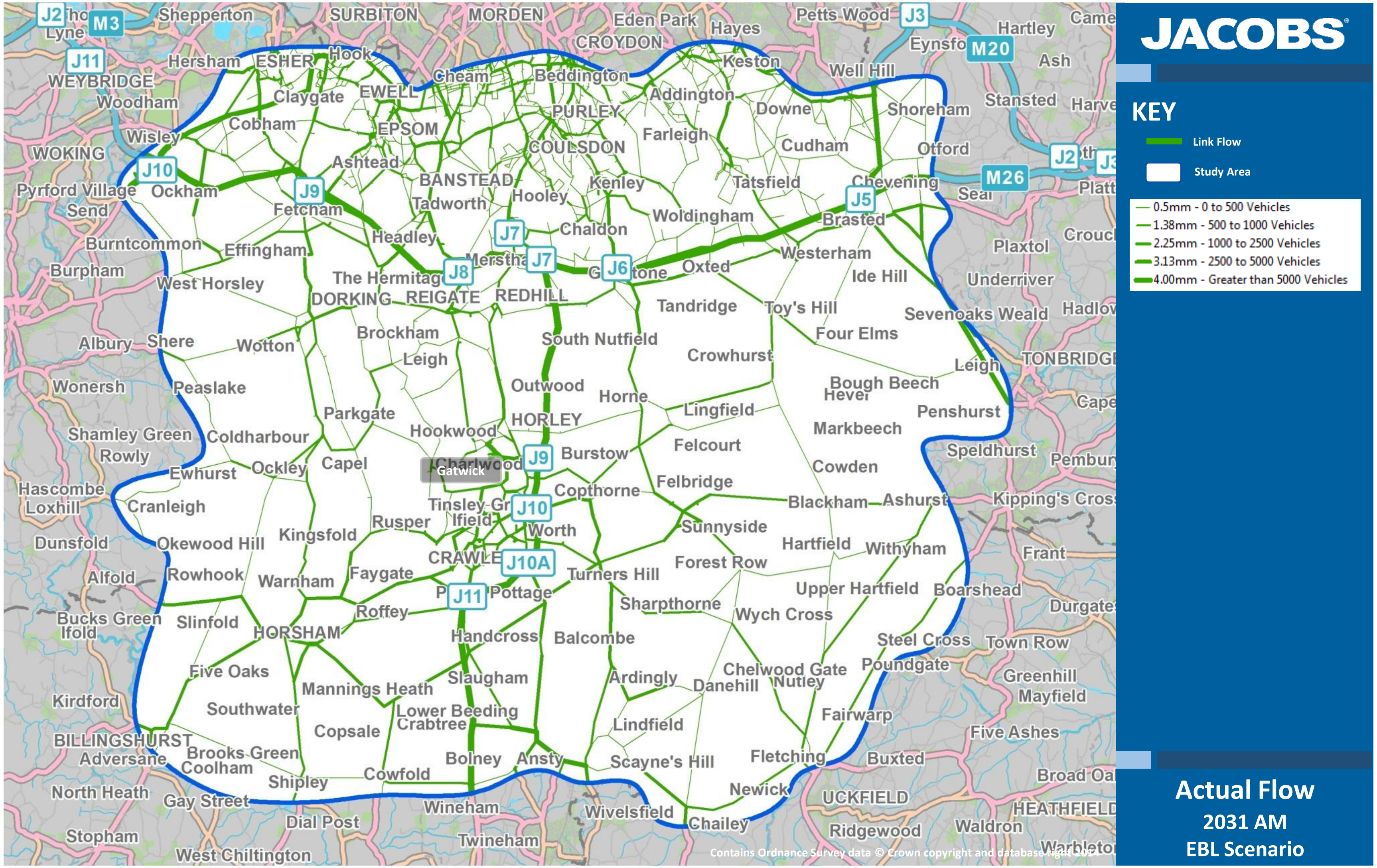


Figure 5-16: PM extended baseline flows

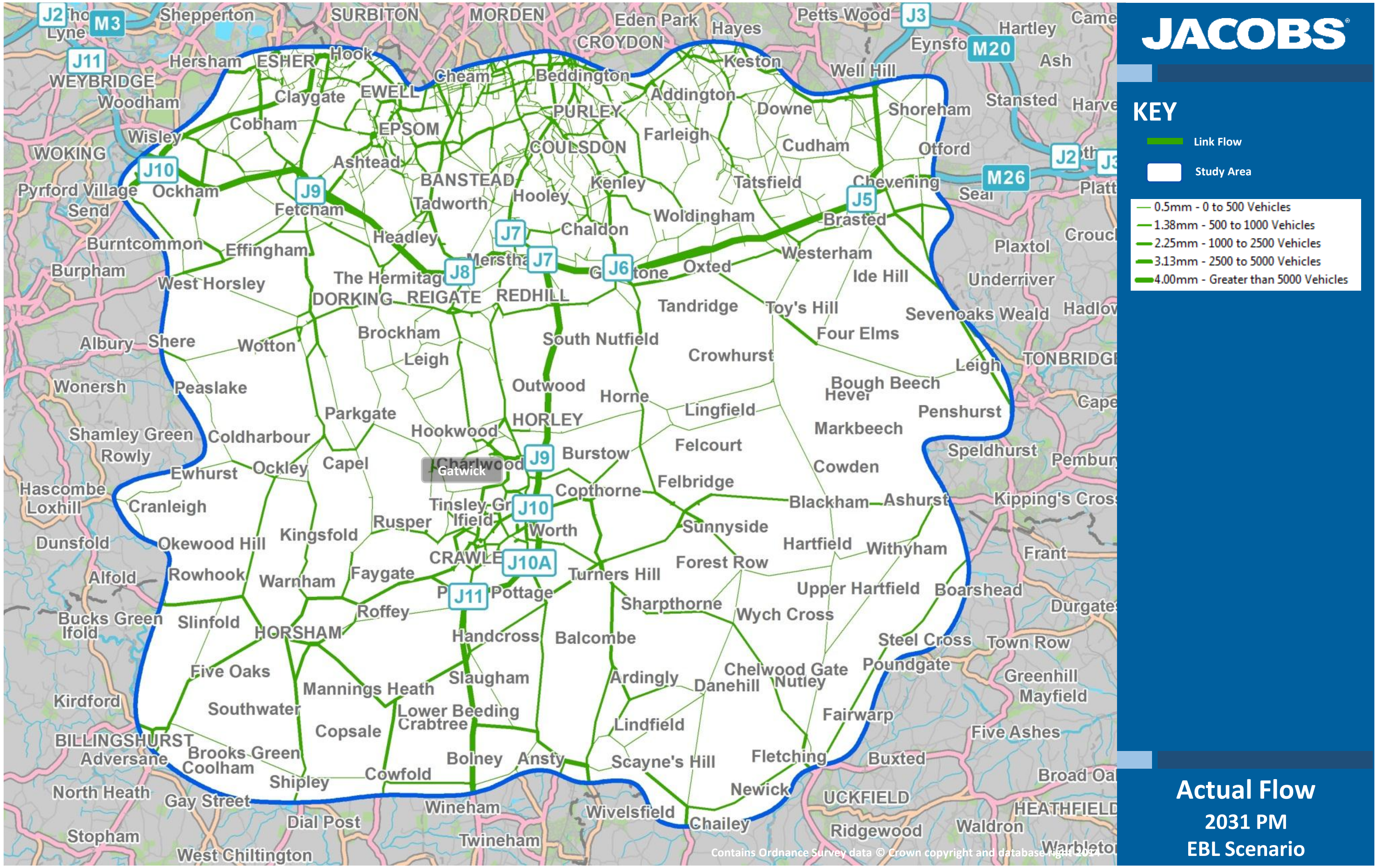


Figure 5-17: AM select link Inbound to North Terminal

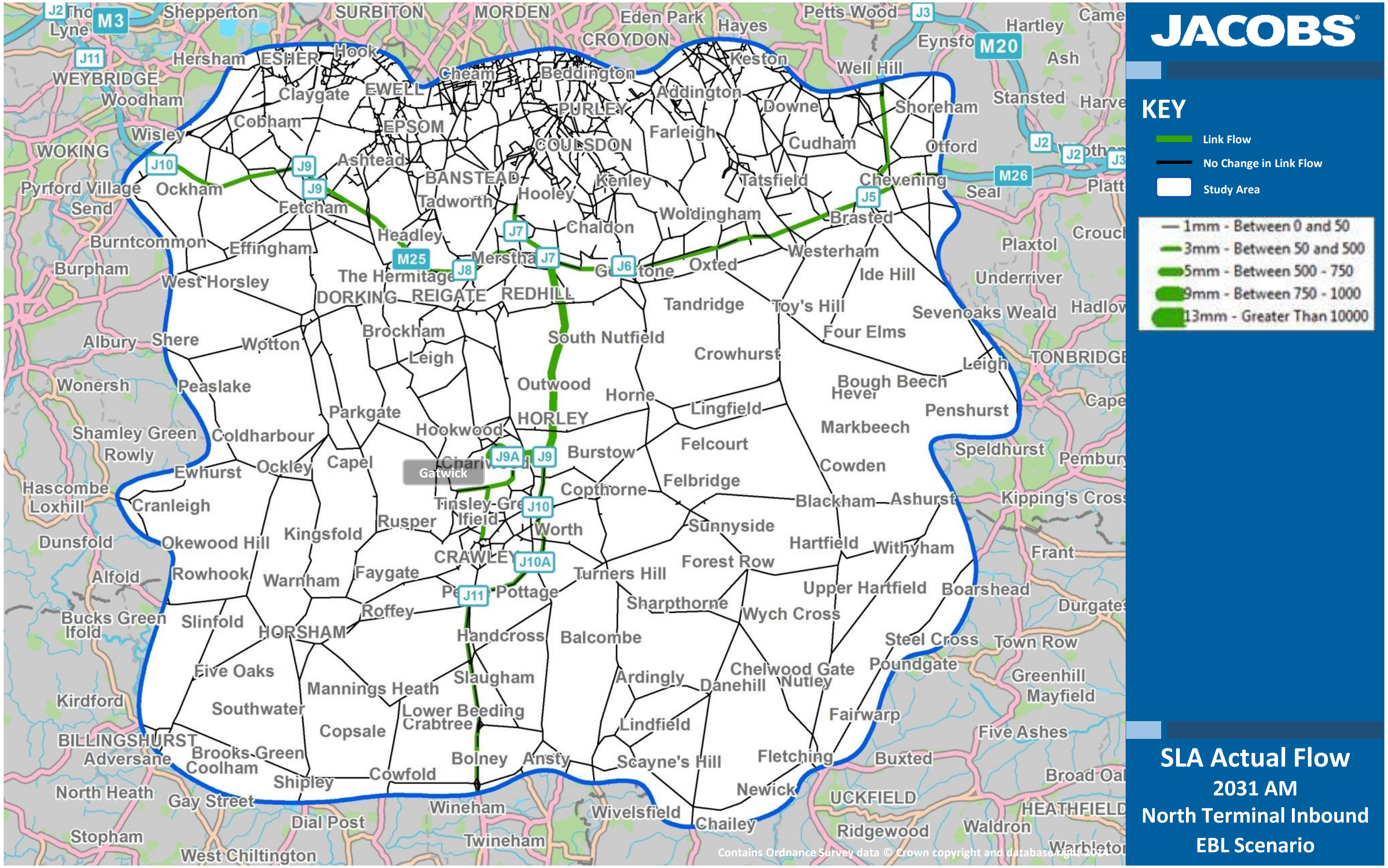
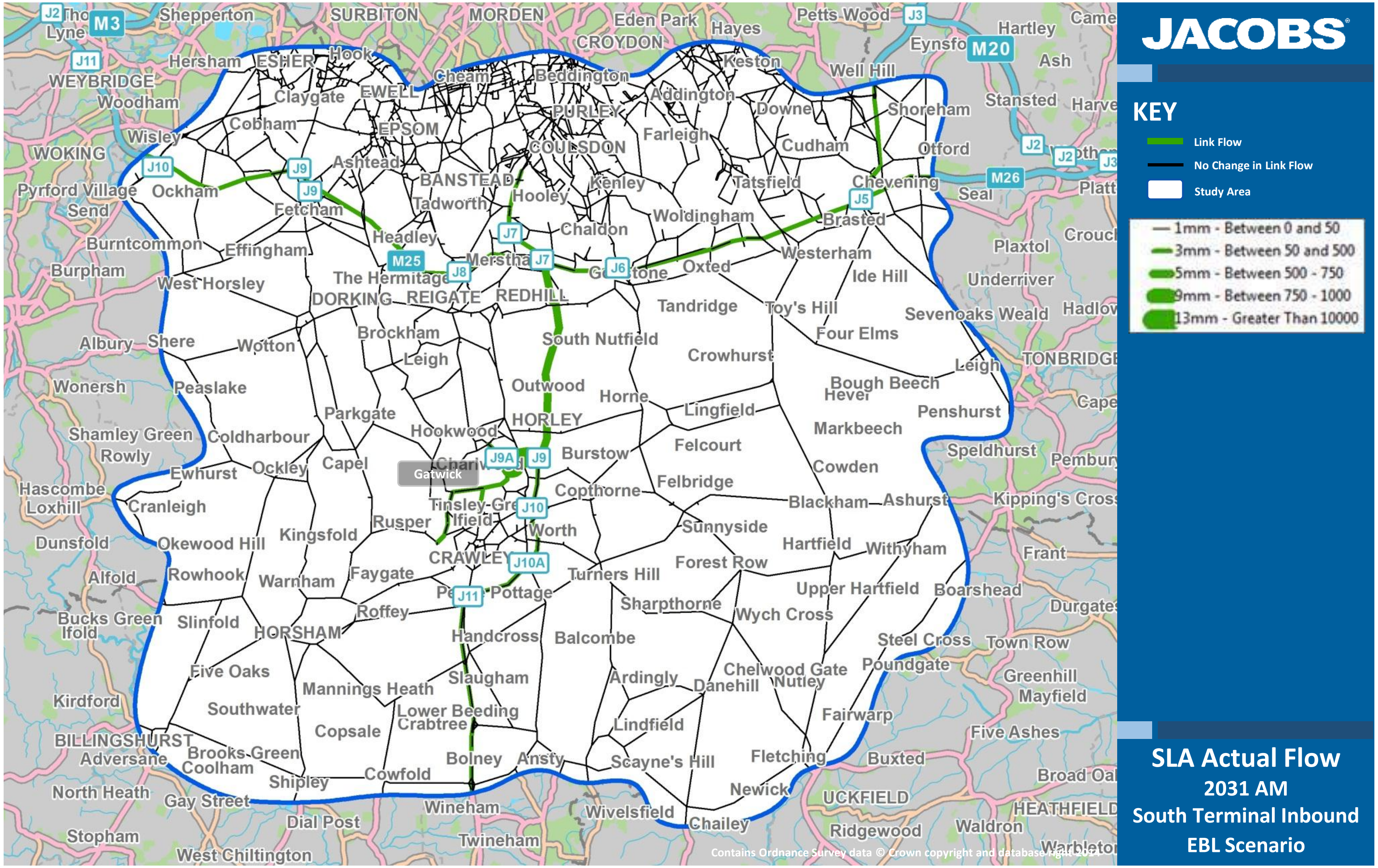


Figure 5-18: AM select link inbound to South Terminal



5.5.10 A summary of our analysis of these figures is as follows:

- Traffic volumes in the vicinity of Gatwick are concentrated on the Motorway (M23 Spur, M23, M25), and A road (A23, A264) network. The M25 and M23 form major parts of the London strategic road network, and as such, should be expected to carry large volumes of traffic. The A23 north and south and A264 are important local routes providing access to / from Crawley and surrounding towns.
- The SLA figures show that traffic to / from Gatwick North and South Terminals is generally using the strategic road network. Traffic is arriving from the west and east via the M25 and M23 and traffic from the south via the A23 / M23. Local traffic is also generated from Crawley and Horsham. This route choice behaviour is in line with expectations and represents the appropriate choice for each direction of travel. Plots show that route choice for vehicles leaving Gatwick largely mirror travels to the Airport.

5.5.11 In summary, a review of the Extended Baseline performance shows that the model is producing results that are reasonable in relation to the capacity and connectivity of the road network surrounding Gatwick. Large traffic volumes and areas of high congestions are shown to be confined to the strategic road network, while travel to and from the airport follows a logical route for all directions of travel.

5.5.12 Based on the outcomes of this review, it is considered that the Extended Baseline model provides a suitable point of reference for assessment of the Gatwick Second Runway proposal.

5.6 Gatwick second runway assessment (2030)

Additional airport capacity improvements

5.6.1 The Gatwick Airport Second Runway highway network incorporates the highway access concept design proposed by Gatwick Airport Limited together with all Extended Baseline Improvements and the M25 / M23 interchange enhancements, described above. Key changes proposed as part of the airport expansion include:

- doubling the capacity of the M23 Junction 9 including slip road widening and a new grade separated flyover;
- the M23 between Junction 9 and 9a increased from two lanes in each direction to four lanes and five lanes in the eastbound and westbound directions respectively;
- Airport Way increased from two lanes in each direction to four (including constructing a new bridge over the railway lines);
- the A23 realigned to the east of the airport and provided as a dual carriageway with two lanes in each direction, and
- a new high capacity interchange for the A23 with direct access to and from airport parking facilities.

Proposed highway access improvements are illustrated conceptually in Figure 5-19.

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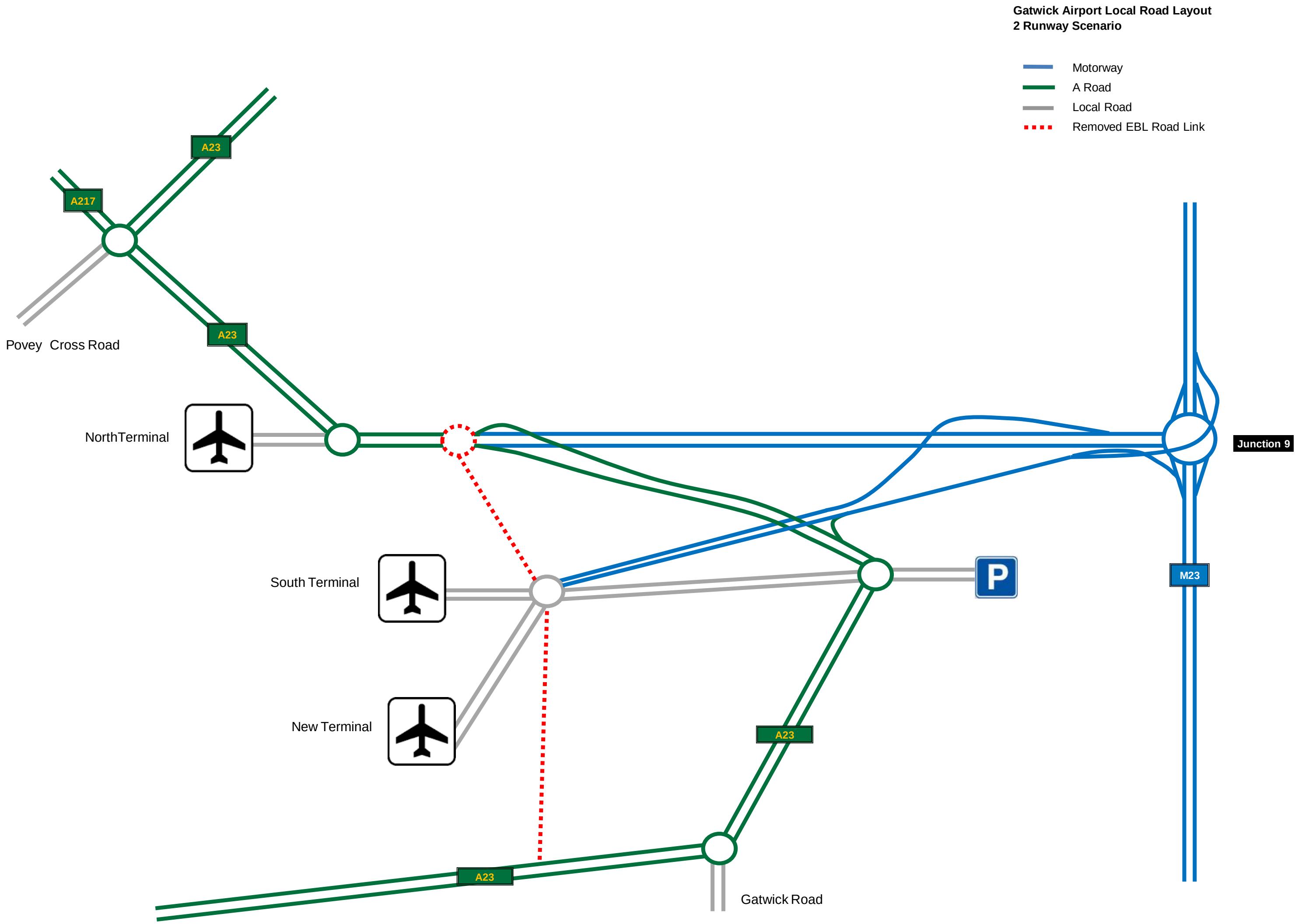
Figure 5-19: Local road network improvements



Assignment and review of performance

5.6.2 A detailed review of the Gatwick Airport Second Runway model performance has been undertaken to ensure the assignment produces reasonable results reflecting the intent of the projects highway access concept design. This review covered the same key results assessed as part of the Extended Baseline model review.

5.6.3 The figures (contained in the Supplementary Figures Report) relating to the additional runway assessment are defined below.

- Demand traffic flows on the local road network within the immediate vicinity of Gatwick (Figs 2,5,8);
- Actual traffic flows on the local road network within the immediate vicinity of Gatwick (Figs 11,14 17);
- Demand traffic flows on the strategic road network surrounding Gatwick (Figs 20,23,26);
- Actual traffic flows on the strategic road network surrounding Gatwick (Figs 29,32,35);
- Demand flow v/c ratios on the strategic road network surrounding Gatwick (Figs 38, 41, 44);
- Actual flow v/c ratios on the strategic road network surrounding Gatwick (Figs 47, 50 53);
- SLA routing of traffic traveling to/from Gatwick North Terminal (Figs 56, 59, 62, 65, 68, 71);
- SLA routing of traffic travelling to/from Gatwick South Terminal (Figs 74, 77, 80, 83, 86, 89);
- SLA routing of traffic travelling to/from Gatwick New Terminal (Figs 91, 92, 93, 94, 95, 96);
- SLA routing of traffic travelling to/from Gatwick Long Stay Parking (Figs 97, 98, 99, 100, 101, 102);
- SLA queued flow of traffic traveling to/from Gatwick North Terminal (Figs 104, 107, 110, 113, 116, 119);
- SLA queued flow of traffic travelling to/from Gatwick South Terminal (Figs 122, 125, 128, 131, 134, 137);
- SLA queued flow of traffic traveling to/from Gatwick New Terminal (Figs 139, 140, 141, 142, 143, 144);
- SLA queued flow of traffic travelling to/from Gatwick Long Stay Parking (Figs 145, 146, 147, 148, 149, 150)

5.6.4 Figures 5-20 to 5-25 below present the peak hour actual traffic flows as well as select link analyses of traffic to Gatwick North, South and New Terminals and Long Stay parking in the AM peak hour.

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Figure 5-20: AM peak hour Gatwick Second runway flows

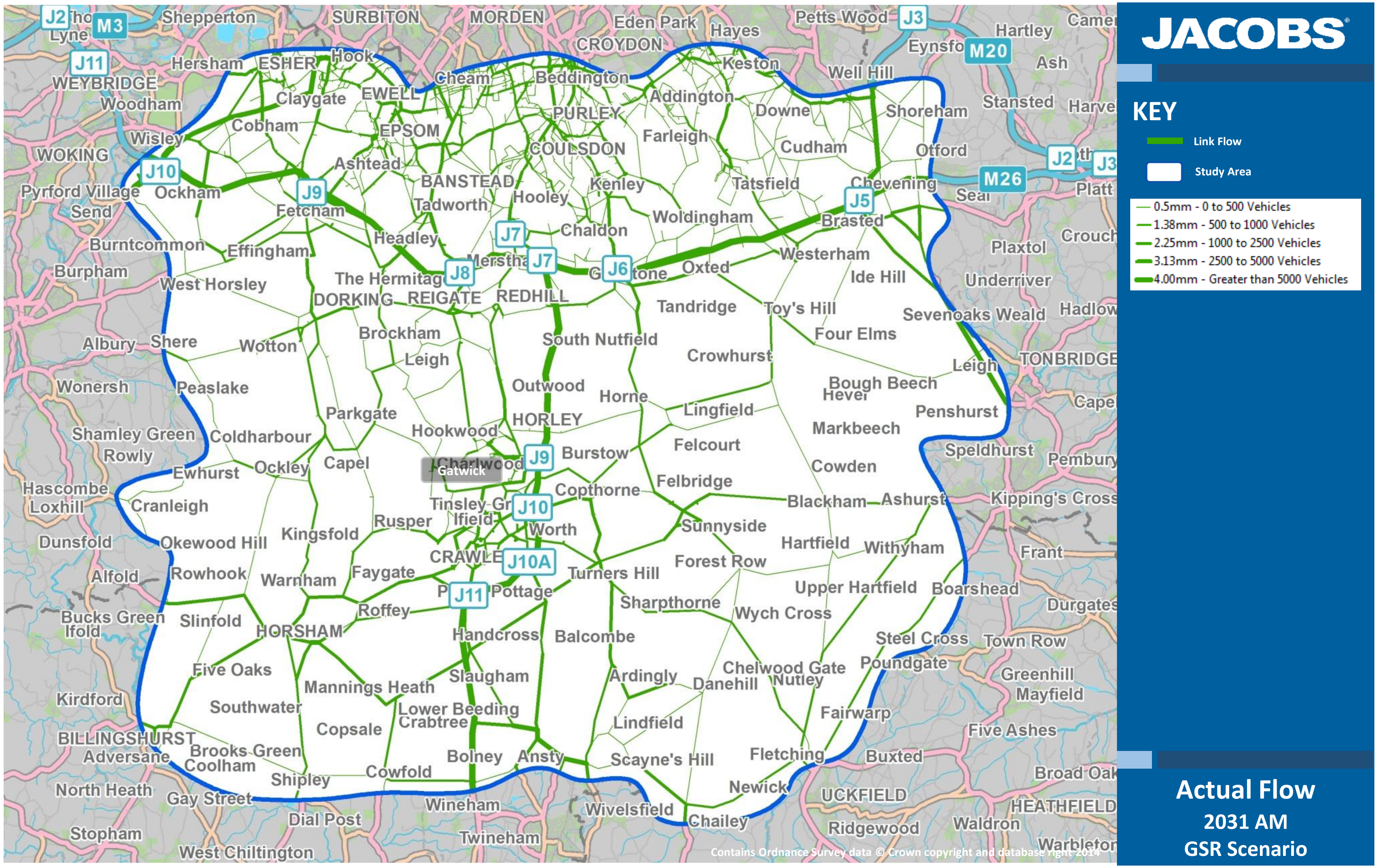

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Figure 5-21: PM peak hour Gatwick Second runway flows

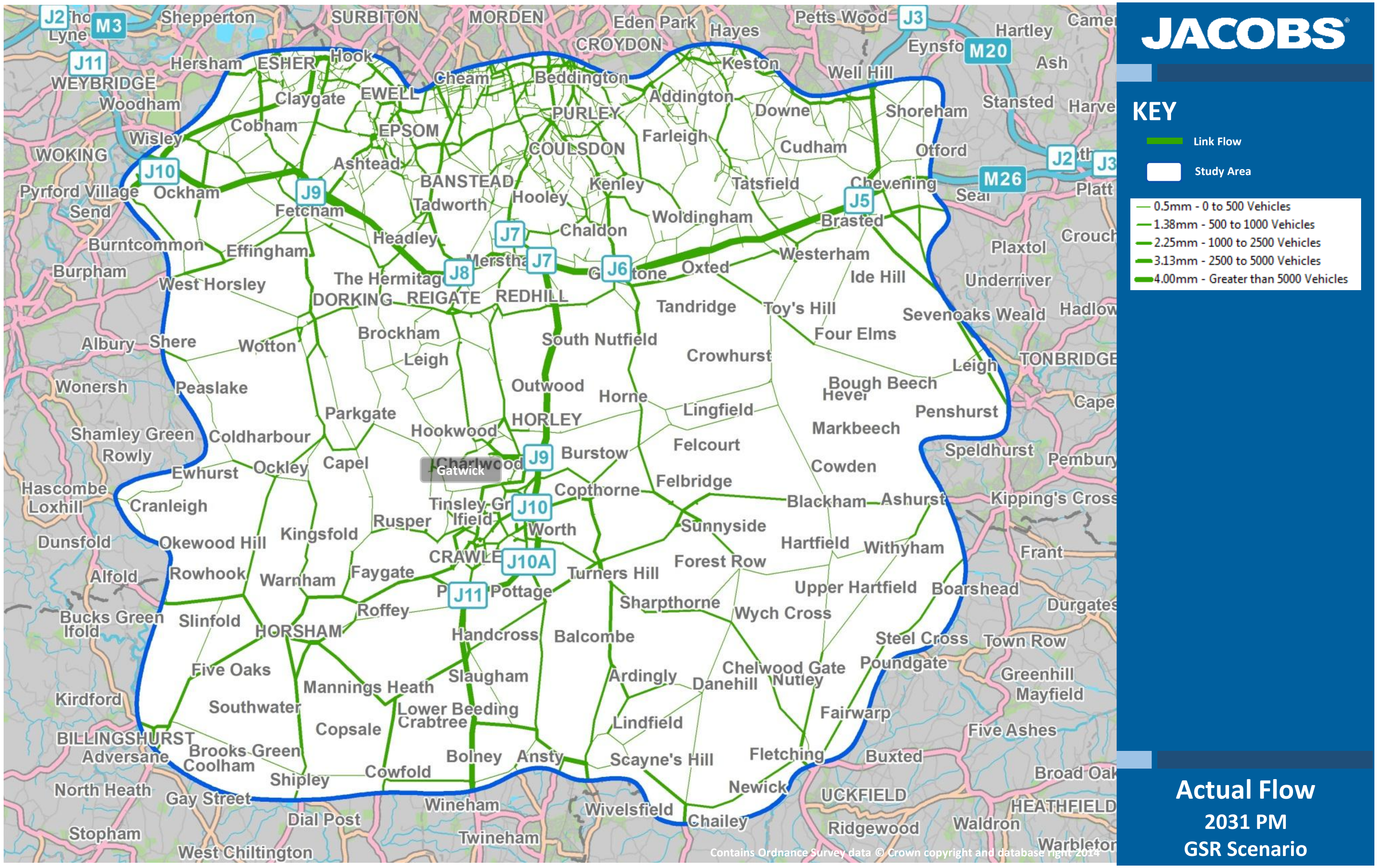

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Figure 5-22: AM select link inbound to North Terminal

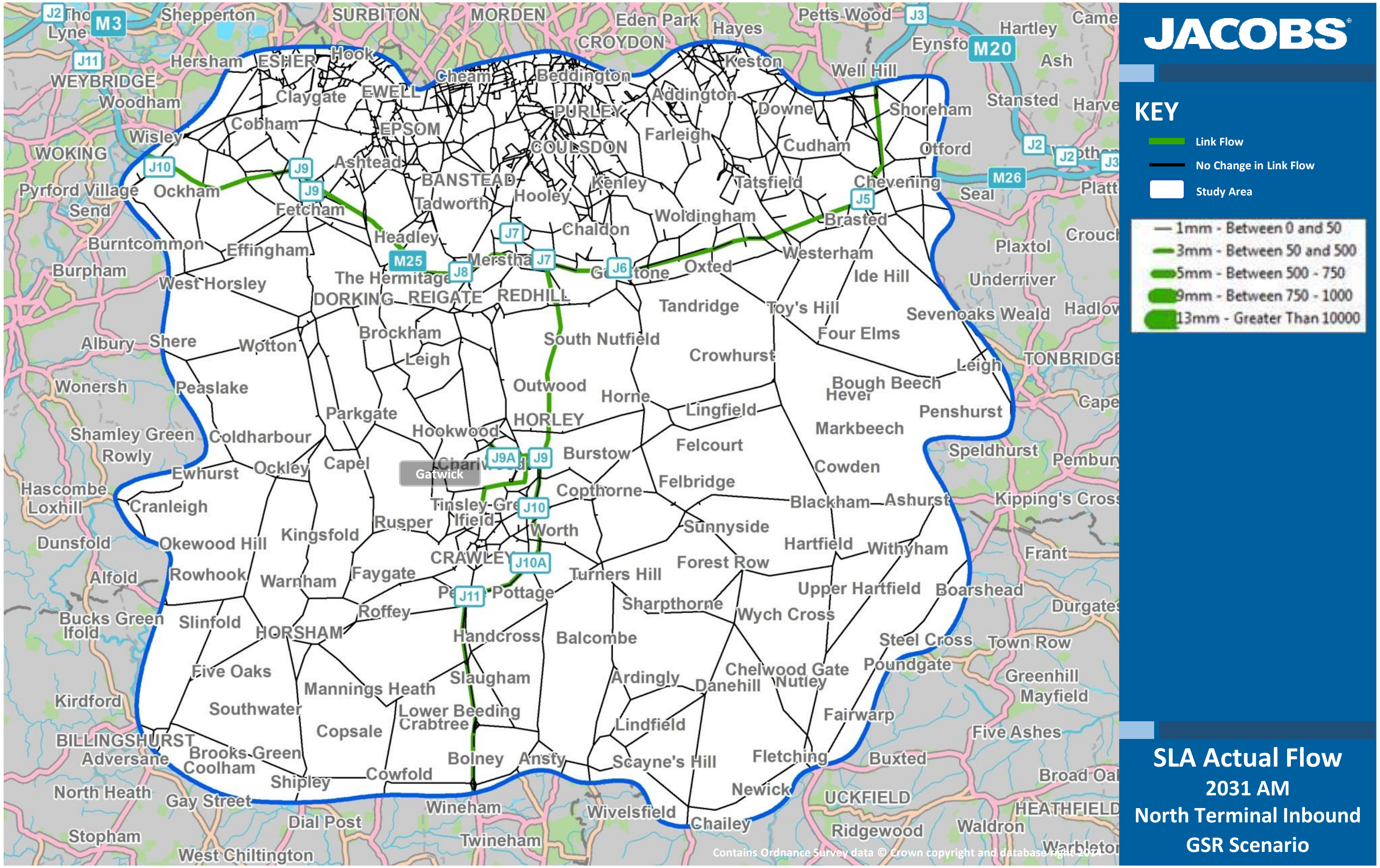


Figure 5-23: AM select link inbound to South Terminal

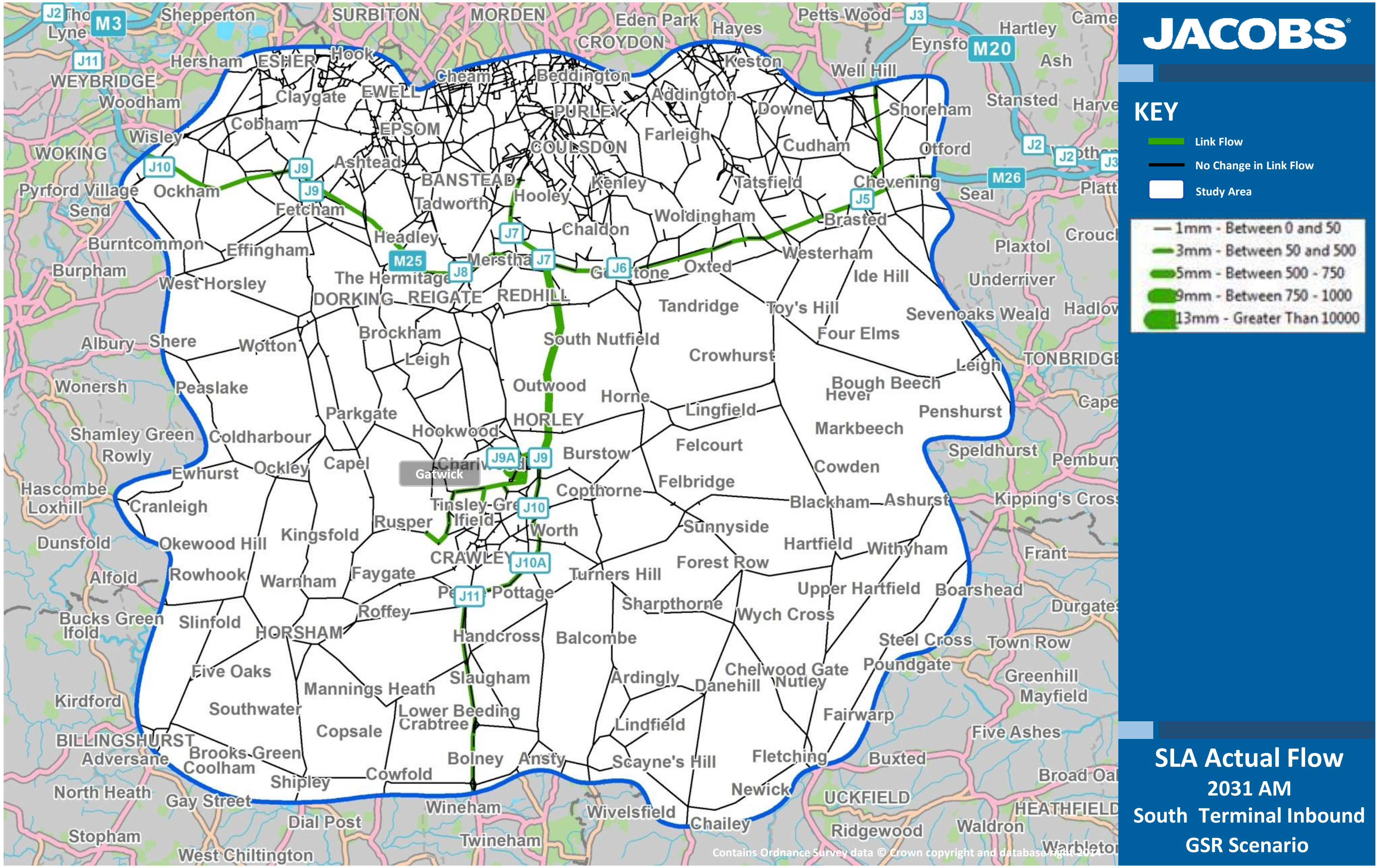


Figure 5-24: AM select link inbound to New Terminal

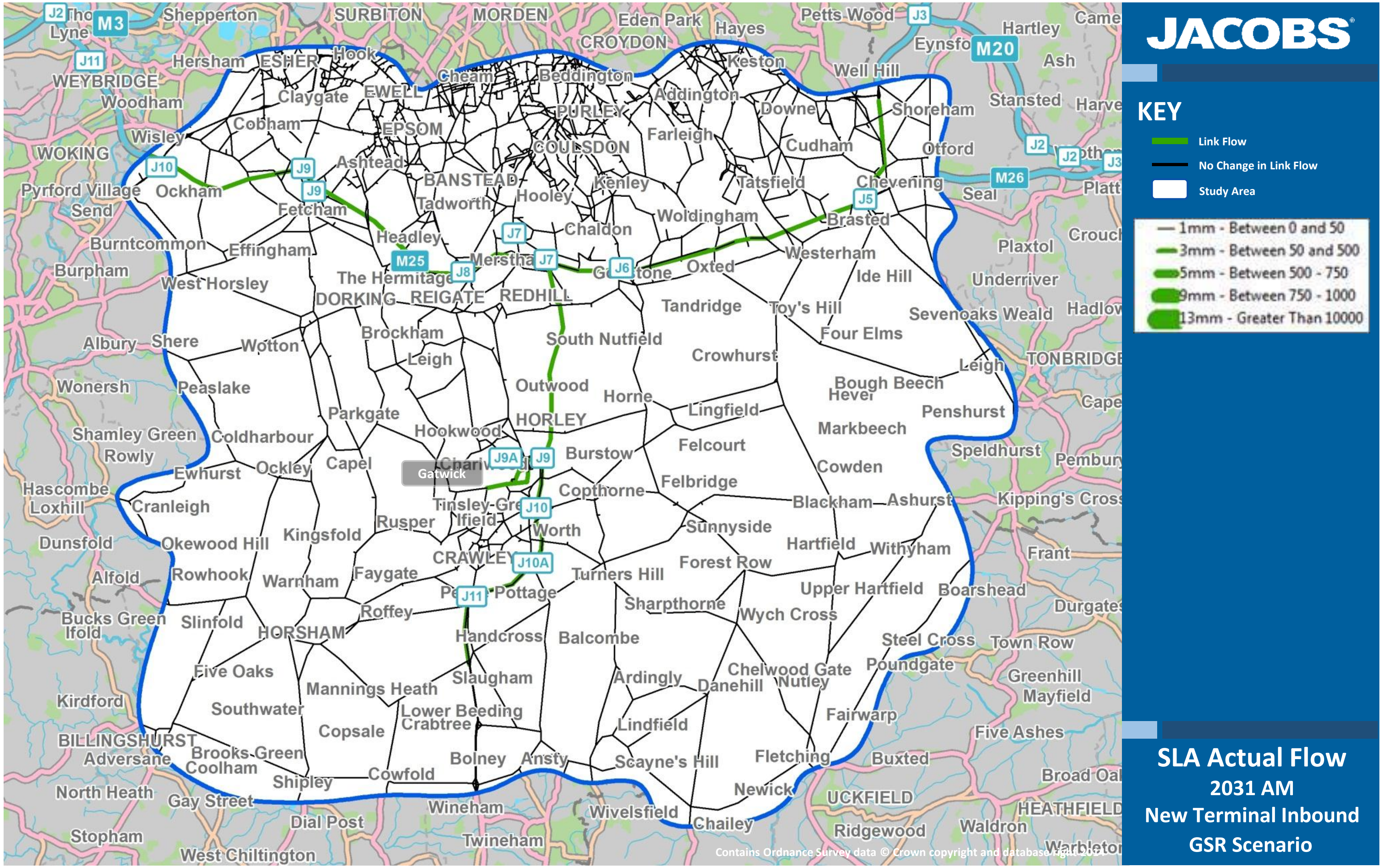
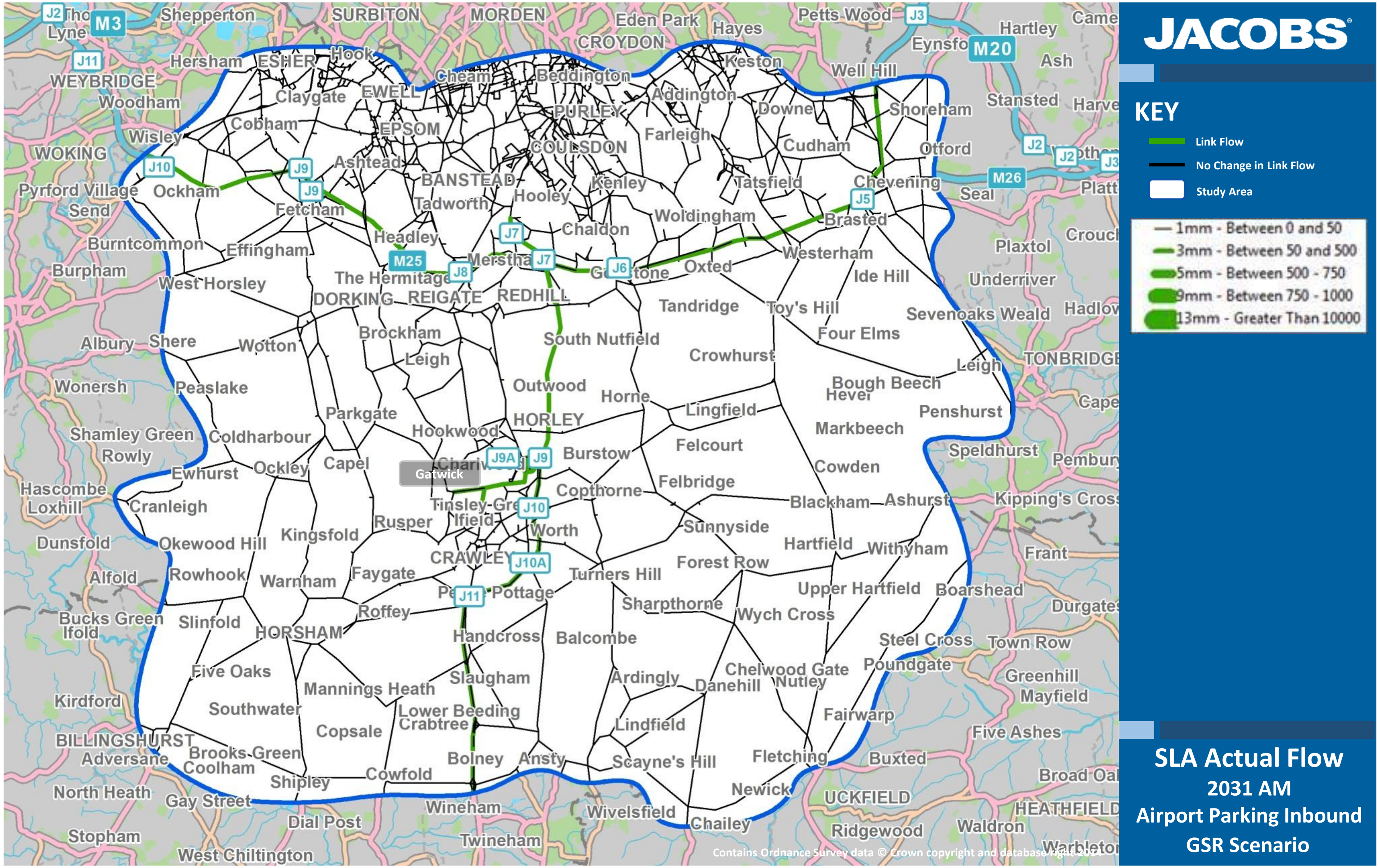


Figure 5-25: AM select link inbound to Long Stay parking



5.6.5 A summary of our analysis of these figures is as follows:

- Traffic volumes in the vicinity of Gatwick are concentrated on the Motorway (M23 Spur, M23, M25), and A road (A23, A264) network.
- A second runway at Gatwick will not substantially alter the strategic road network for trips not relating to the airport. As such, it is expected that at a strategic level, the concentrations of traffic will broadly reflect what is forecast in the Extended Baseline model.
- V/C ratio figures largely reflect the Extended Baseline model results.
- The SLA figures for the North, South, New Terminals and Long Stay parking all highlight that the primary access route continues to be the M23 spur and that the wider distribution of traffic is unchanged from the Extended Baseline.

5.6.6 Our review of the Gatwick Airport Second Runway performance shows that the model is producing results which are reasonable in relation to the capacity and connectivity of the revised road network. Large strategic traffic volumes are shown to be concentrated on the strategic road network in a similar pattern to the Extended Baseline model. Travel to and from Gatwick follows a logical route for all directions of travel under the revised access arrangements.

5.6.7 Based on the outcomes of this review, it is considered that the Second Runway model provides results which reflect the changes in travel behaviour which would be expected under the proposed scheme.

5.7 Comparative appraisal between the Extended Baseline and Gatwick Airport 2 Runway Options

5.7.1 The figures contained in the Supplementary Figures Report relating to a comparison between the Extended Baseline and the Gatwick Airport Second Runway Assessment are defined below.

- Demand traffic flows on the local road network within the immediate vicinity of Gatwick (Figs 3,6,9);
- Actual traffic flows on the local road network within the immediate vicinity of Gatwick (Figs 12,15 18);
- Demand traffic flows on the strategic road network surrounding Gatwick (Figs 21,24,27);
- Actual traffic flows on the strategic road network surrounding Gatwick (Figs 30,33,36);
- Demand flow v/c ratios on the strategic road network surrounding Gatwick (Figs 39, 42, 45);
- Actual flow v/c ratios on the strategic road network surrounding Gatwick (Figs 48, 51 54);
- SLA routing of traffic traveling to/from Gatwick North Terminal (Figs 57, 60, 63, 66, 69, 72);
- SLA routing of traffic travelling to/from Gatwick South Terminal (Figs 75, 78, 81, 84, 87, 90);
- SLA queued flow of traffic traveling to/from Gatwick North Terminal (Figs 105, 108, 111, 114, 117, 120);
- SLA queued flow of traffic travelling to/from Gatwick South Terminal (Figs 123, 126, 129, 132, 135, 138);

5.7.2 Our comparative assessment of the impact of the Gatwick Airport Second Runway on traffic levels is addressed under the following headings: Airport Demand; Strategic Road Network and Capacity Constraints.

Airport demand

5.7.3 With both 1 runway and 2 runway scenarios there is a small amount of queued traffic in the network unable to reach its final destination at Gatwick. This is to be expected and occurs where traffic is delayed due to local congestion on either the urban, interurban or strategic road network.

5.7.4 Comparing the Extended Baseline and the 2 Runway scenarios, in the AM peak, the proportion of airport passengers not able to reach the airport within the assignment period remains constant at 7%.

5.7.5 This is illustrated in the queue difference plots, which show similar levels of queued flow, indicating the addition of a second runway at Gatwick does not increase congestion on the adjacent road network.

5.7.6 It should be note that, in practice, the passengers represented by the queued flow are likely to be aware of the congestion issues and travel time required to get to the airport during the peak periods and are likely schedule their departure time accordingly. The impact of this being will be increased peak spreading[17] on surrounding roads.

Strategic road network

5.7.7 Figures 5-21 and 5-22 illustrate Gatwick Second Runway strategic model flows. As with extended base, traffic is largely confined to the M23 / A23 and M25 corridors.

5.7.8 A comparison of Gatwick 2 Runway versus Extended Baseline (1 Runway) flows has been undertaken. Difference plots showing 2 – 1 runway traffic flows are given in Figures 5-26 to 5-28 for the AM, IP and PM peaks respectively.

5.7.9 Green bandwidths indicate a flow increase resulting from the second runway, blue bandwidths indicate a decrease. In reviewing these diagrams it should be noted that SATURN only compares links which are in *both* the Extended Baseline and 2 Runway options. As a number of links have been recoded to represent the expanded airport, changes in flow within and adjacent to the airport are not illustrated.

5.7.10 The Figures clearly illustrate the distribution of increased demand with the majority of traffic travelling to and from the north via the M23 and M25. There is a predominant increase flow southbound in the morning peak and northbound in the evening. Strategic traffic routes via the M25 with comparatively little increase in traffic inside the M25 area.

5.7.11 South of Junction 11 on the M23, northbound in the AM peak, there is a modest increase in traffic, with a reverse flow observed in the evening.

5.7.12 As noted previously, road improvements to support the Second Runway proposal include a new elevated slip southbound from the M23 to westbound on the M23 Spur together with associated widening of the M23 Spur itself. A consequence of this is to improve connectivity to the north of Crawley. Traffic which previously used Junction 10 (and which is at capacity in 2030), now accesses the A23 via the improved Junction 9.

5.7.13 Figure 5-26, clearly shows the resulting reduction in traffic on the M23 southbound, and increase in traffic on the A23 around the perimeter of the airport.

5.7.14 There is also a minor increase in traffic using the A22 and on the local roads to the West of Crawley.

[17] Peak spreading refers to the phenomenon of AM and PM peak traffic periods increasing in duration over time. This is typically due to travel demand during the peak periods exceeding available road capacity, leading to a proportion of travellers scheduling their trips to occur either side of the peak.

Figure 5-26: 2030 AM difference in traffic volumes, 2 runways – 1 runway comparison

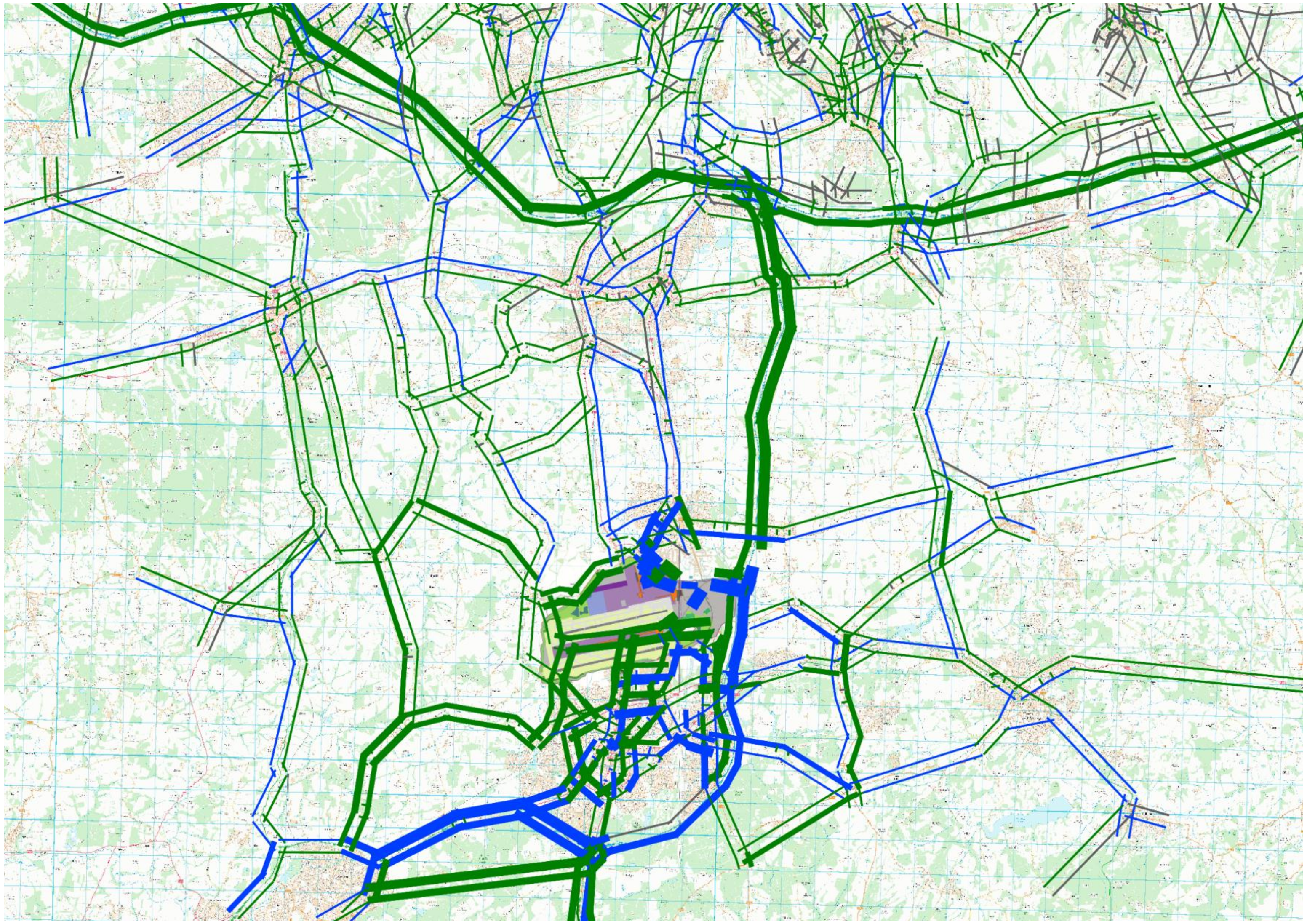


Figure 5-27: 2030 IP difference in traffic volumes, 2 runways – 1 runway comparison

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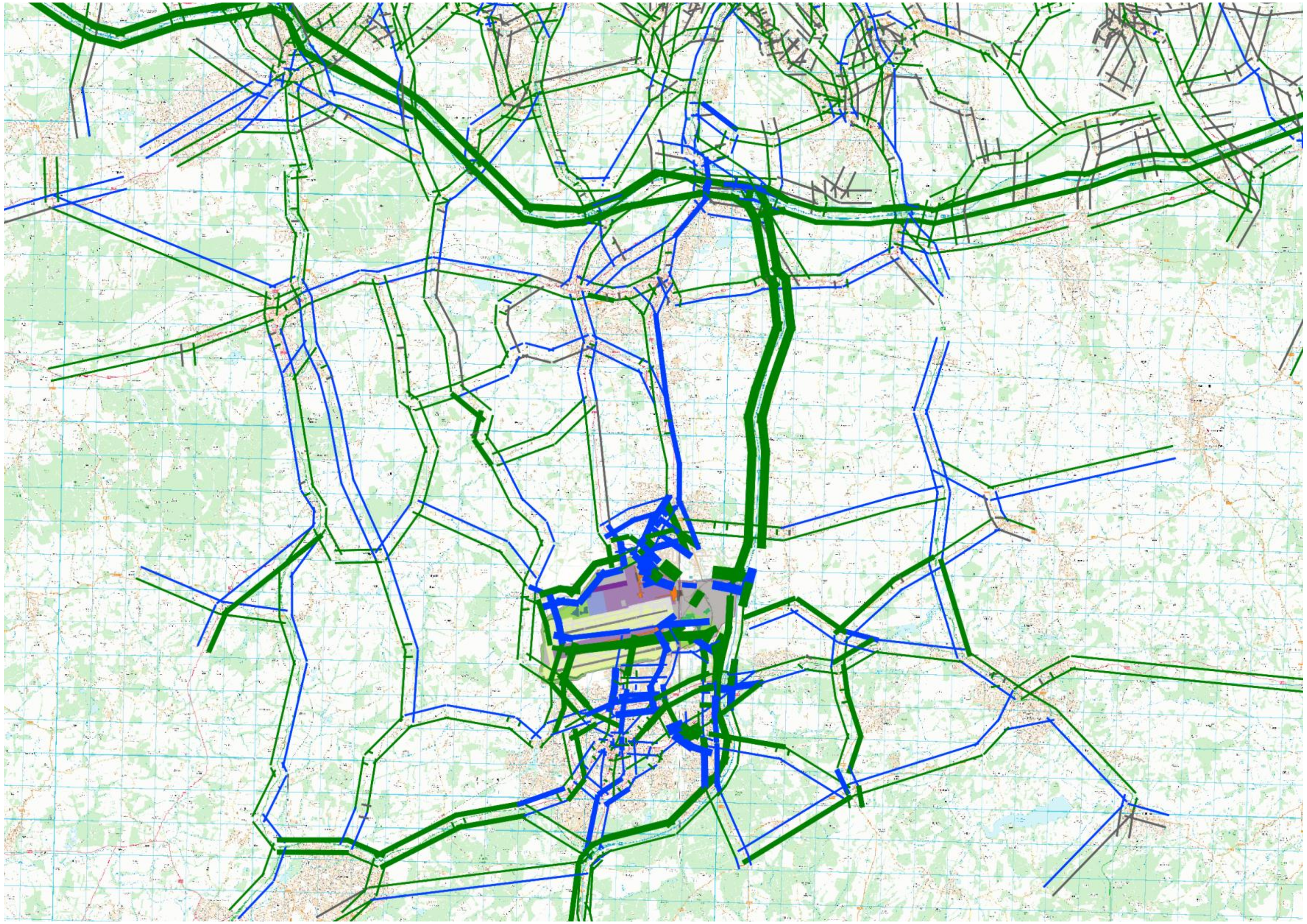
Figure 5-28: 2030 PM difference in traffic volumes, 2 runways – 1 runway comparison



Capacity constraints

5.7.15 Volume / capacity plots are presented in Figures 5-28 to 5-30 for the AM, IP and PM periods. Links over capacity in the extended baseline (1 runway) scenario are highlighted in blue; links which exceed capacity as a result of the second runway scheme are highlighted in red.

5.7.16 Generally, the figures illustrate that the strategic network is within capacity and the traffic generated by a second runway at Gatwick can be accommodated.

5.7.17 In all periods, the A23 / M23 and M25 sections within the area of interest are within capacity. The Gatwick Second Runway traffic does not result in any further strategic links exceeding capacity.

5.7.18 A number of local links, particularly within and around Crawley, are shown to be over-capacity in both the Extended Baseline and Gatwick Second Runway scenarios in 2030. Many of these are as a result of capacity constraints at junctions and an ongoing programme of minor road improvements and traffic signal optimisation will help alleviate issues.

5.7.19 A full analysis of the volume / capacity analysis (separately for demand and actual flows) for the all strategic links within the study area in the Extended Baseline and Gatwick Second Runway scenarios is presented for all model periods in the tables in the Supplementary Figures Report. As well as defining the V/C ratios on each link, the number of Gatwick Airport-bound trips on each link is also tabled, enabling the determination as to whether the increase in V/C is due to additional traffic to/from the Gatwick.

5.7.20 From this full analysis, two sets of summary tables have been extracted for inclusion in this report. The first set of summary tables (presented in Tables 5-13, 5-14 and 5-15) identify those links that are predicted to be overcapacity (defined as having a V/C ratio of over 1.00) in the Extended Baseline, and which are predicted to have higher V/C ratios in the Gatwick Second Runway scenario, i.e. additional Gatwick demand is increasing delays on an already overcapacity link.

5.7.21 The second set of summary tables (presented in Tables 5-16, 5-17 and 5-18 in this report for the AM, IP and PM peak periods respectively) identify those links that are predicted to be less than full capacity (defined as having a v/c of over 1.00) in the Extended Baseline, but overcapacity in the Gatwick Second Runway scenario, i.e. additional airport traffic is causing the links to go overcapacity, increasing delays on an already overcapacity link. While reading these tables, the following should be noted that:

- the location of these links is not identical across the AM and PM peak periods due to the tidal nature of roads surrounding the Gatwick Area;
- our criteria for selecting over capacity links includes the definition that the number of additional airport trips must be greater than 50 vehicles / hour on each individual link. For cases where additional airport demand amounts to less than 50 vehicles / hour, it is considered that the impacts directly attributable to the airport scheme are more negligible and, hence, these links have not been selected for analysis.

The tables show the link V/C ratio under both the Extended Baseline and Second Runway scheme, the difference in traffic demand between the schemes and the year which the link is predicted to go over capacity without additional runway capacity. This prediction gives an indication of how far airport expansion will bring forward the point where links are reaching capacity.

Figure 5-28: 2030 AM over capacity locations (expansion only capacity exceedances in red)

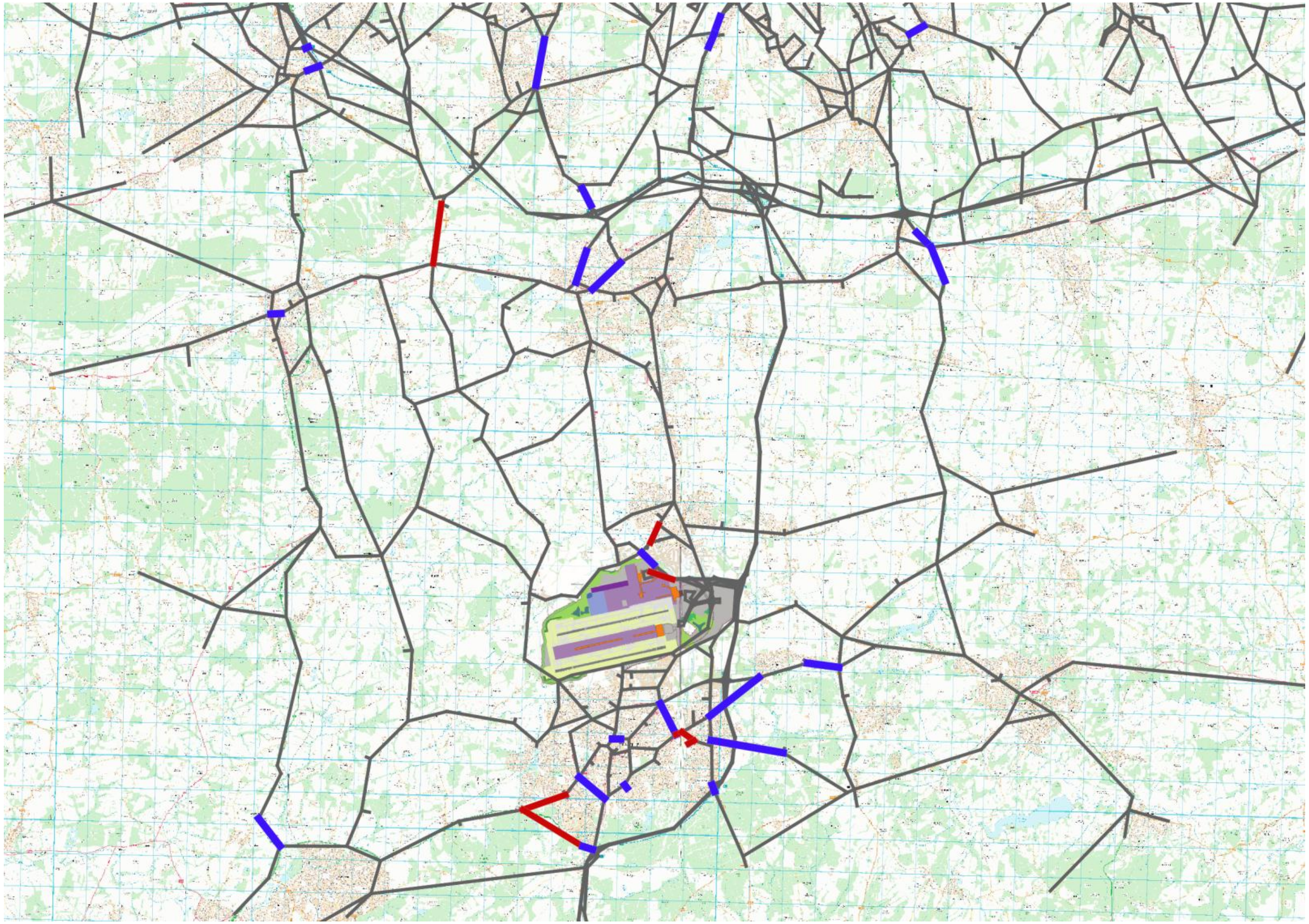


Figure 5-29: 2030 IP over capacity locations (expansion only capacity exceedances in red)

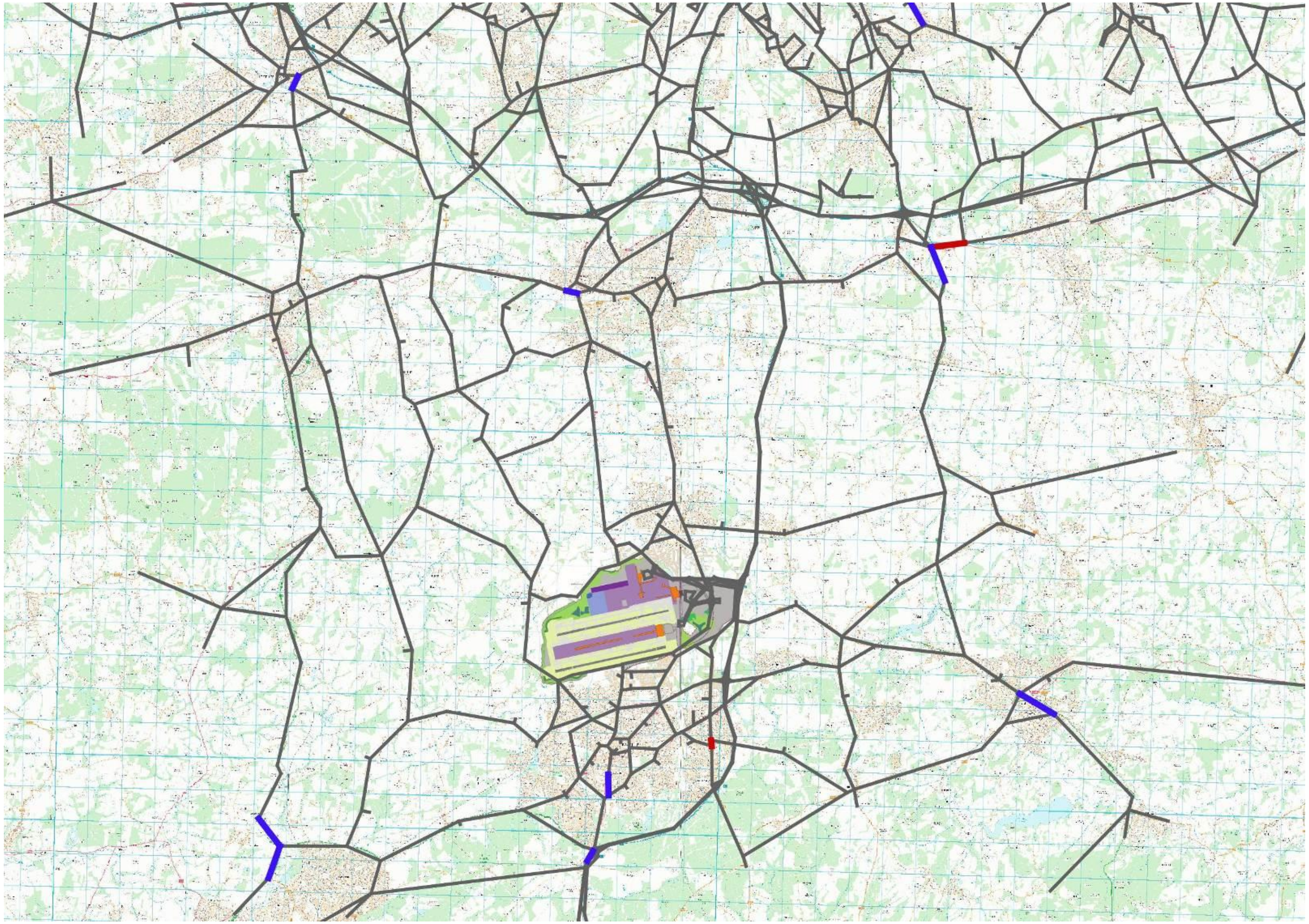


Figure 5-30: 2030 PM over capacity locations (expansion only capacity exceedances in red)

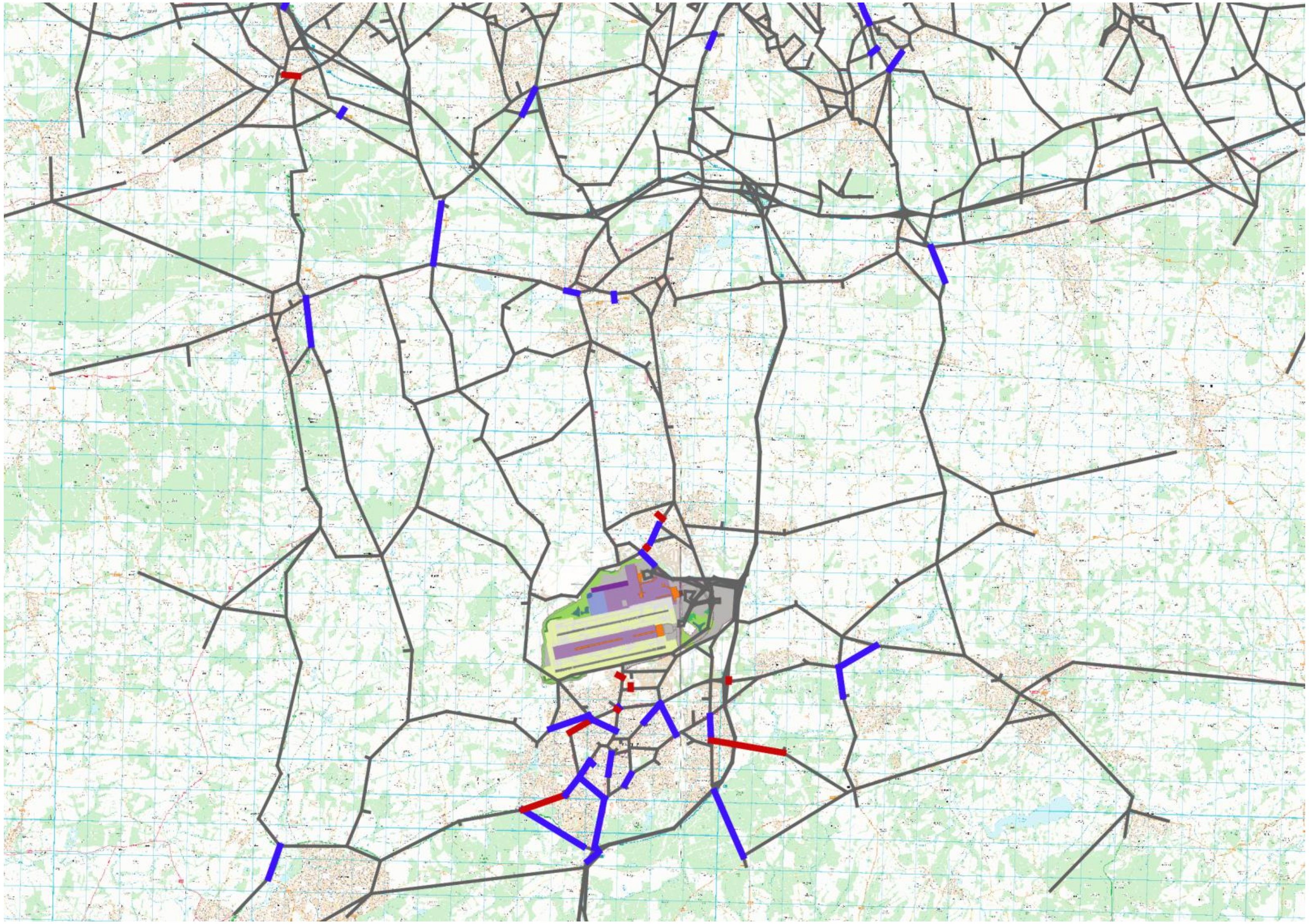


Table 5-13: AM worsened overcapacity locations

	2031 Forecast Year			
Location	**Extended Baseline V/C**	**GSR V/C**	**Demand Change**	**Year V>C Without Airport Expansion**
M25, Northbound to M25 Junction with M3	103.92	104.27	29	2015
M25, Southbound from M25 Junction with M3	100.11	101.19	90	2032
A282, Southbound towards M25 / A2 Junction	100.25	100.63	21	2032
A282, Southbound at Dartford Crossing	102.93	103.71	52	2029
Charlwood Road, Eastbound	100.43	115.86	53	2032
A23 / A2011 Roundabout, Crawley - Circulating	105.97	108.39	49	2013

Table 5-14: IP worsened overcapacity locations

	2031 Forecast Year			
Location	**Extended Baseline V/C**	**GSR V/C**	**Demand Change**	**Year V>C Without Airport Expansion**
None				

Table 5-15: PM worsened overcapacity locations

	2031 Forecast Year			
Location	**Extended Baseline V/C**	**GSR V/C**	**Demand Change**	**Year V>C Without Airport Expansion**
M25, Southbound from M25 Junction with M3	107.86	108.18	26	2024
M25, Southbound Through M25 J11	101.38	102.02	44	2031
A23 London Road, Approaching Roundabout with A2011 Crawley Avenue, Southbound	107.16	109.29	-51	2022

Table 5-16: AM new overcapacity locations

	2031 Forecast Year			
Location	**Extended Baseline V/C**	**GSR V/C**	**Demand Change**	**Year V>C Without Airport Expansion**
A23, Westbound towards Gatwick Road Roundabout	80.84	102.91	445	Expansion Only
Bonnetts Lane, Crawley, Northbound	79.65	100.37	97	2045
A23 Crawley Avenue, Southbound to A220 Roundabout	94.29	101.10	144	Expansion Only
A23 / A2011 Roundabout, Crawley - Circulating	81.99	108.40	-38	Expansion Only

Table 5-17: IP new overcapacity locations

	2031 Forecast Year			
Location	**Extended Baseline V/C**	**GSR V/C**	**Demand Change**	**Year V>C Without Airport Expansion**
None				

Table 5-18: PM new overcapacity locations

	2031 Forecast Year			
Location	**Extended Baseline V/C**	**GSR V/C**	**Demand Change**	**Year V>C Without Airport Expansion**
None				

5.7.22 Consistent with the methodology adopted in our pre-consultation analysis, Tables 5-13, 5-14 and 5-15 highlight those links which are predicted to be over-capacity in the Extended Baseline scenario with general background traffic growth. The responsibility to address these issues rests with the DfT.

5.7.23 In comparison, the second set of tables (Tables 5-16, 5-17 and 5-18) identify links that are predicted to go over-capacity due to the additional traffic from the Gatwick Second Runway scenario and the responsibility to address these issues should rest with the scheme developer.

5.7.24 While options to relieve capacity restraint include strategic and local road widening, policy levers can help reduce car-based airport demand. Levers within the control of Gatwick Airport include airport car park pricing and airport congestion charging. National policy levers may also have an impact - e.g. national congestion charging and policies to encourage home working. Further discussion is required on these options.

5.8 Conclusions

5.8.1 The construction of the Gatwick Second Runway is predicted to result in an additional number of car/taxi trips of 1,200 trips/hr to Gatwick in the AM peak direction, 450 trips/hr to/from Gatwick in the Inter-peak and 850 trips from Gatwick in the PM peak direction. These additional trips will further increase the levels of over-capacity on the links specified in the paragraph above. Furthermore, 7% of the car demand to Gatwick Airport is predicted to be queued on the network in both the Extended Baseline and Gatwick Second Runway options.

5.8.2 A significant upgrading of the A23 / M23 corridor has removed the majority of capacity constraints on the corridor. Most recently, the Handcross to Warninglid improvement scheme has been completed, providing a significant increase in capacity, south of Crawley.

5.8.3 Included within both the Extended Baseline and 2 Runway scenarios are the M23 Junction 8 to 10 and M25 Junction 23 to 27 smart motorway schemes. When delivered, these schemes will provide a further increase in capacity on key strategic routes to the north of Gatwick Airport.

5.8.4 A key potential constraint is the M23 / M25 intersection. In undertaking our analysis we have assumed that targeted capacity improvements will be undertaken on the slip roads, commensurate with the adjacent smart motorway schemes. Local capacity increases have therefore been included in the extended baseline. Without exception, these are associated with enhancing weaving capacity which is required to support the additional lanes of the smart motorway schemes. No additional lanes or structures have been assumed other than those already required as part of the smart motorway proposals.

5.8.5 As a result of the above interventions, the M23 can largely cope with the forecast additional traffic resulting from the Gatwick Second Runway proposal. Smart motorway schemes provide additional capacity on the M25 and, as a consequence, worsened over-capacity locations are generally a significant distance from the airport (and include the constrained Dartford Crossing).

5.8.6 A number links already over-capacity in 2030 are predicted to get worse with a Gatwick Second Runway. Consistent with the methodology adopted in our pre-consultation analysis, as these links are predicted to be over-capacity in the Extended Baseline scenario with general background traffic growth, the responsibility to address these issues rests with the DfT.

5.8.7 Tables 5-16 to 5-18 highlight those links which are predicted to go over-capacity solely due to additional traffic generated by a second runway. Responsibility for addressing these issues should rest with Gatwick Airport Limited.

5.8.8 Of these locations, the A23 / Gatwick Road roundabout constraint will likely be removed as part of the realignment of the A23 required to support the airport expansion. Charlwood Rd eastbound also exceeds capacity and may require mitigation.

5.8.9 In assessing the impact of the Gatwick Airport Second Runway proposal, it should be noted that there are policy levers within the control of Gatwick Airport which could help reduce car-based airport traffic (e.g. airport car park pricing or airport congestion charging). National policy levers may also have an impact - e.g. national congestion charging and policies to encourage home working. Further discussion is required on these options.

6. Summary and conclusions

6.1 Background

6.1.1 The AC was established in 2012 by the UK Government to examine the need for additional UK airport capacity and to recommend how any additional capacity requirements can be met in the short, medium and long-term. A Final Report is due to be submitted to the UK Government by the summer of 2015, assessing the environmental, economic and social costs and benefits of various solutions to increase airport capacity, considering operational, commercial and technical viability.

6.1.2 The AC published an Interim Report in December 2013 that short-listed three options to address the UK's long-term aviation connectivity and capacity needs, two focussed on expanding Heathrow Airport and one on expanding Gatwick. The short-listed options were then subsequently further developed and appraised during a pre-consultation assessment, which was published for consultation on the 11th November 2014.

6.1.3 The pre-consultation assessment with respect to surface access constituted a static appraisal using spreadsheet-based demand-forecasting models, which were developed primarily to assess the surface transport capacity implications of each expansion option. Following feedback from the AC's surface access stakeholders (the DfT, the HA, NR, and TfL), further assessment of the surface access implications of the three expansion options was undertaken during the consultation period, which ended on the 3rd February 2015.

6.2 Post-consultation study scope

6.2.1 During the consultation period, Jacobs were commissioned to undertake the aforementioned further surface access assessment of the short-listed expansion options. This post-consultation assessment had three key aims:

6.2.2 This report describes the additional work undertaken in the assessment of a Second Runway at Gatwick Airport. The key aims of the post-consultation analysis were as follows:

- To undertake further sensitivity-testing of the pre-consultation models to determine the impact of key variables on airport-related surface access demand, notably incorporating trip distribution forecasts from the DfT's NAPAM;
- To provide a more detailed dynamic assessment of the capacity and level-of-service implications of airport expansion associated with each short-listed option;
- To provide traffic forecasts compatible with the requirements of the air quality assessment that will be undertaken as a part of a separate environmental work-stream - the data requirements for this work-stream are summarised in 6.7.2.

6.2.3 The ultimate aim was to provide further guidance to the AC on the feasibility of, and likely surface transport issues associated with each short-listed expansion option, with reference to three objectives set out in the AC's Appraisal Framework as follows:

- **Objective 1** – to maximise the number of passengers and workforce accessing the airport via sustainable modes of transport;
- **Objective 2** – to accommodate the needs of other users of transport networks, such as commuters, intercity travellers and freight; and
- **Objective 3** – to enable access to the airport from a wide catchment area.

6.3 Methodology overview

6.3.1 The post-consultation surface access assessment was divided into three work-streams, summarised as follows:

- Enhanced distribution/mode-share modelling - this involved enhancements to the spreadsheet models developed during pre-consultation analysis - the air passenger and on-airport employee surface access forecasts arising from the enhanced models provided inputs for the following two work-streams;
- Dynamic rail modelling - rail surface access forecasts from the enhanced spreadsheet models were input into the Railplan model (version 7, supplied by TfL) to assess the dynamic impacts of increasing airport-related rail trips on network performance in London and the South-East of England;
- Dynamic highway modelling - highway surface access forecasts from the same spreadsheet models were also input into an adapted version of TfL's SoLHAM to assess the dynamic impacts of increasing airport-related road trips on network performance in London and the South-East – SoLHAM was chosen as a starting point as it is a detailed network-based highway capacity model of South London, which was validated to a 2009 base year and is used by TfL to assess road schemes in South London.

6.3.2 SoLHAM required adapting for the purposes of this study since the model 'simulation' area (the area where signal junctions are coded in detail) only extended as far south as the M25. As a result, a separate West Sussex County Council SATURN model was referenced to improve network detail and refine the zone system in the area around Gatwick Airport.

6.3.3 The forecast year of assessment was 2030 and a range of time periods were modelled in accordance with the requirements of the dynamic modelling work-streams. For the highway modelling, an AM and a PM peak-hour was required along with an average Inter Peak (IP) hour. For the Railplan modelling, 3-hour AMP and 6-hour IP periods were modelled.

6.3.4 The assessment was undertaken with reference to a Core and an Extended Transport Baseline, which together listed transport infrastructure and services expected or likely to be in place by 2030 regardless of any airport expansion that may be delivered in the UK. Details of the schemes included in these baselines are provided in Appendix B – the Core Baseline only included those schemes that were fully committed and funded when the pre-consultation assessment commenced. The primary focus of all the analysis was on the Extended Baseline as by 2030 it was judged very likely that further enhancements to the UK transport network would have been delivered above and beyond the works that were fully committed.

6.3.5 Constructing an appropriate Extended Baseline for a 2030 assessment involved making significant assumptions about the likely state of the transport network by that time, and this was a central factor in the decision not to extend the scope of the surface access assessment to include later years. There is currently a high degree of uncertainty surrounding some of the included schemes, not just in terms of their delivery but also their final form and characteristics, which in some cases are continually evolving as development work is progressed.

6.4 Airport expansion scenarios

6.4.1 The highest AC scenario for Gatwick Second Runway in terms of airport passengers in 2030 was the CT LCK scenario. The passenger forecasts for this scenario included a total of 43.7mppa using the airport with one runway in 2030, increasing to a total of 72.0mppa with the Second Runway in place in the same year. The proportion of those passengers that were interlining was forecast to rise from 3.7% with one runway up to 26.2% with the Second Runway in place.

6.4.2 In terms of employment, the AC produced two forecasts for Gatwick in 2030 expressed as ratios of ppa per employee – a low productivity scenario assuming a year-on-year increase of 0.5% in the ppa/employee ratio from a base 2011 figure, and a high productivity scenario assuming an increase of 2.25%. The mid-point between the two amounted to a ratio of 1,802ppa/employee – when applied to the CT LCK passenger scenario described above, this resulted in a forecast of 24,256 employees at the airport with one runway rising to 39,959 with the Second Runway in place.

6.4.3 The passenger and employee figures described above were identified as the core scenario for the post-consultation assessment, and associated demand forecasts from the spreadsheet model were assessed using Railplan and the adapted SoLHAM.

6.4.4 In addition, airport-related demand forecasts were also produced for two other scenarios for comparative purposes, as follows:

- AC CC AoN scenario – 41.1mppa (5.0% interlining) and 22,793 employees with one runway, rising to 45.6mppa (6.3% interlining) and 25,298 employees with the Second Runway (also assuming the mid-point employee ratio described above);
- GAL submission – 46.0mppa (8.0% interlining) and 24,430 employees with one runway, rising to 65.0mppa (8.0% interlining) and 29,685 employees with the Second Runway (with the employee numbers sourced directly from the submission rather than calculated using a ratio).

6.4.5 Sensitivity tests were undertaken for these other two scenarios in the spreadsheet-based distribution and mode choice models, but not in the network-based Railplan and adapted SoLHAM models.

6.5 Distribution and mode share modelling enhancements

6.5.1 In addition to amending the spreadsheet model to include the revised airport mppa and employment inputs and to produce forecasts for a range of time periods according to the requirements of the dynamic modelling work-streams, a number of other post-consultation enhancements were made:

- for the two AC scenarios, the pre-consultation passenger surface access distribution assumptions (developed based on the CAA passenger survey data) were replaced with outputs corresponding to each scenario from the DfT’s NAPAM. The CAA-based approach was retained in the test using the GAL submission forecasts of passengers and employees;
- employee mode split assumptions were applied at district level to account for the different travel options likely to be available to employees in 2030 based on their home location. For pre-consultation work, a single headline mode split was applied to all employees regardless of their home location.

6.5.2 All other inputs to the post-consultation model were retained from the previous analysis and the impact of the changes in the model can be summarised in terms of three elements: trip distribution; mode share and vehicle and rail trip demand.

6.5.3 In terms of trip distribution, the adoption of the NAPAM trip distributions in place of the CAA survey-based trip distribution made very little difference, both at a sector level and at a key district level. For example, with the Second Runway in place, the proportion of trips to/from Greater London was 46.3% in the GAL submission scenario (with distribution assumed to be based on the CAA data), 45.8% in the core CT LCK scenario and 44.8% in the CC AoN scenario. Similarly, the proportion of trips coming to/from Westminster was 7.9% in the GAL submission scenario, 9.1% in the CT LCK scenario, and 8.1% in the CC AoN scenario.

6.5.4 In terms of mode choice, there are only slight variations in passenger mode share between the different scenarios and expansion options, with the rail mode share predicted to be 44.3% in the GAL submission test, increasing slightly to 44.6% in the CT LCK scenario with the Second Runway in place.

6.5.5 Given the similarities in the distribution and mode share forecasts across the core and alternative scenarios, the difference in total demand is largely driven by the difference in headline passenger and employee growth forecasts and interlining ratios associated with each scenario. As is to be expected, forecast airport demand is higher in all scenarios with the Second Runway in place. The greatest demand for passengers occurs in the GAL submission test while the CT LCK scenario produces the greatest demand for employees.

6.5.6 In response to comments from the stakeholders and the AC surface access expert panel during pre-consultation, we also undertook a number of sensitivity tests, as follows:

- Changing the Value of Times (VoT) used to calculate Generalised Cost for business and leisure passengers travelling to and from the airport – requested by the DfT;
- Changing the methodology for calculating base year mode share using the CAA passenger survey data – requested by the DfT;
- The impact of rail pricing on demand – requested by the AC surface access expert panel.

6.5.7 Changing the VoTs in the model impacted on both main mode and rail sub-mode share for passengers. In broad terms, as VoT increases, so does the attractiveness of time-saving vis-a-vis other costs (i.e. rail fares, car operating costs) in the model. Two sensitivity tests were undertaken using 2012 and 2030 VoTs from the SERAS model – in both cases, business VoT was higher than in the core CT LCK test but leisure VoT was lower.

6.5.8 In terms of rail sub-mode share, the main impact of the tests was to increase the premium GEX share among business passengers and reduce it among leisure passengers in line with the changes in VoT summarised above. At a headline mode share level, the impact of changing VoT was less significant since the relative attractiveness of car, rail and bus/coach by location is more variable than the difference between premium and standard rail options. Business mode share changed very little, while for leisure passengers there was a small but noticeable increase in the bus/coach mode share in the 2012 SERAS test, as the lowest VoT for leisure passengers was applied in this test.

6.5.9 When combined, the increases in business VoT and the decreases in leisure VoT balanced each other out to some extent. The overall impact on headline mode share was an increase in the bus/coach mode share from 10.1% in the core CT LCK scenario to 11.7% in the SERAS 2012 test. Car and rail mode share were within 1.5% of the CT LCK scenario in both tests.

6.5.10 The second set of tests related to the interpretation of the 2012 CAA passenger survey data, to which the model was calibrated. During pre-consultation, the DfT requested that tests were undertaken to understand the potential impacts related to the use of final rather than primary mode, and the use of representative districts for remote regions. To facilitate these tests, the DfT provided summaries of primary mode share by district calculated from CAA passenger survey databases for multiple years up to 2012, incorporating a weighted-average mode share from remote regions. Two sensitivity tests were subsequently undertaken, one using the revised 2012 CAA database and another using a composite database for all years between 2006 and 2012.

6.5.11 The main impact of the two tests on headline passenger mode share when compared with the core CT LCK scenario was a reduction in bus/coach mode share, from 10.1% in the core CT LCK scenario to 7.0% in the 2006-12 test and 9.8% in the 2012 test. This suggested that bus is currently more commonly used as a final non-primary mode, for example as part of a rail-air service or a shuttle service from nearby hotels. Overall 2030 forecast PT mode share was lowest in the 2006-12 test at 47.2%, compared with 54.7% in the 2012 test, suggesting a shift away from car over the period between 2006 and 2012.

6.5.12 The AC's surface access expert panel also requested a sensitivity test for the impact of reducing the fare of premium rail services to provide more effective rail capacity and relieve crowding on standard price rail services. In the case of the Gatwick Second Runway option, the test was carried out on the core CT LCK scenario model with the fare of GEX reduced to match standard services to and from Victoria. The impact of this reduction in GEX fare was, as would be expected, to increase overall rail mode share marginally as passengers are attracted from other modes.

6.5.13 Reducing GEX fare had a more pronounced impact on rail sub-mode choice. Among business passengers, GEX sub-mode share increased from 40.2% in the core CT LCK scenario to 46.1% with GEX operating with a standard fare. For leisure passengers GEX sub-mode share increased from 27.6% to 36.8%.

6.6 Dynamic rail assessment

6.6.1 The dynamic rail modelling work-stream was undertaken using TfL's Railplan model, which is a strategic public transport model coded in Emme software that covers London and its surrounding area. Railplan Version 7 has recently been developed to represent baseline conditions in 2011, and TfL also provided a Railplan 7 forecast run for 2031 based on the '7031ref6' low car growth scenario, which is the central case currently used by TfL to test public transport scheme impacts.

6.6.2 This 2031 reference case is based on a forecast population of 9,839,366 and 5,265,000 jobs in the Greater London Authority (GLA) area in 2031. Assumptions are also made about the extent of the transport network in London and the South East in this year – these are summarised in Appendix C.

6.6.3 A review of the LTS '7031ref6' inputs was undertaken to identify the schemes in the AC's Core and Extended Baselines (summarised in Appendix B) that were not included, and to highlight any differences in assumptions between '7031ref6' and the Core/Extended Baselines for schemes that were included. Adjustments were then made to service patterns and rolling stock characteristics on key rail corridors in and around Gatwick to reflect information provided by the AC's stakeholders during pre-consultation and recent published updates.

6.6.4 A new LTS 2031 'Extended Baseline' run was then undertaken to account for any induced demand impacts related to the changes in service provision associated with the Extended Baseline schemes. The results of the run when compared with the 2031 reference case indicated an increase in total National Rail/Tramlink boardings of 134,000 across the 3-hour AM peak for the whole model, an uplift of 7.1%, while passenger-kms increased by 1.87m (3.1%) in the same period.

6.6.5 In terms of the distribution of demand, the LTS Extended Baseline run indicated that forecast uplifts in PT demand when compared with the reference case correlated closely with the geography of transport improvements included in the Extended Baseline. The largest % uplifts occurred in areas in Surrey, Kingston-upon-Thames, Merton, Hackney, Enfield and parts of Hertfordshire (as a result of the Crossrail 2 regional option); Bromley and Lewisham (as a result of the Bakerloo Line southern extension); and areas around Watford, Hemel Hempstead and St. Albans (as a result of improved suburban services into Euston, taking advantage of the released capacity created by the introduction of HS2).

6.6.6 Airport-related demand forecasts from the resultant LTS runs were then removed from the matrices and replaced with the forecasts derived for the core scenario enhanced spreadsheet model. The Railplan Extended Baseline model was then run with associated background and airport-related demand for a range of scenarios, including the airport in its current form and with the Second Runway included.

6.6.7 The following key conclusions can be drawn from the Railplan analysis (of the AM peak period 0700-1000) in terms of the impact on the rail network:

- The Second Runway does not impact on the tube network as demand to/from the airport making secondary connections via the tube is widely dispersed;
- The Second Runway does increase forecast crowding on the BML but not to significant levels - in the expansion scenario, average AM peak hour crowding on Thameslink services is forecast to reach 1.5 people standing per m^2 on the approach to London Bridge while terminating services reach 1.4 people standing per m^2 - there are no significant crowding issues on the branch to Victoria as a result of the additional train paths ear-marked in the Sussex Route Study;
- The Second Runway changes rail journey times to the airport very little, and the change that is evident is largely related to the assumptions regarding passenger distribution contained in NAPAM for the CT LCK growth scenarios with and without the Second Runway in place.

6.6.8 In the IP period (1000-1600) there is very little evidence of crowding anywhere on the network in either the 'no expansion' or the Second Runway scenarios.

6.7 Dynamic highway assessment

Use of SoLHAM

6.7.1 Highway modelling of road surface access to Gatwick Airport has been undertaken to assess the impact of increased airport related traffic on the strategic and local road network. A network-based dynamic modelling approach has been adopted in order to capture the effect of capacity constraints on vehicle route choice.

6.7.2 All highway modelling has been completed using the SATURN software package. SATURN is an industry standard modelling package, widely used to inform the design and appraisal of highway projects both within the United Kingdom and internationally. The existing TfL South London Highway Assignment Model was provided to Jacobs by TfL for use on this project.

6.7.3 SoLHAM is one of five SATURN models developed by TfL which together cover the whole of greater London. Each model covers the whole of London, but differs in the area coded as “simulation”, defined as detailed junction coding of traffic signals, roundabouts and priority junctions.

6.7.4 Gatwick lies outside the simulation area of SoLHAM and it has been necessary to convert the level of network detail around the airport from buffer to simulation coding in order to accurately model traffic impacts resulting from a second runway. Model zones have also been disaggregated to better reflect local travel demand.

SoLHAM model calibration and validation

6.7.5 Model performance summary statistics show that the model replicates observed key screenline flows (Gatwick North, Gatwick South and M23 Spur) and strategic road link flows (M23, A23 and A24) likely to be used by the majority of trips to/from Gatwick within acceptable limits.

6.7.6 Matrix estimation has resulted in significant changes to matrices only within the study area. Across the existing SoLHAM area, demand is almost unchanged as a result of the local recalibration around Gatwick.

6.7.7 Available journey time data is historic and not statistically significant. Nevertheless, it provides a useful comparison between actual and modelled times. AM observed / modelled difference are within WebTAG criteria. PM peak values are less good but meet the guidance on the critical M23 corridor.

6.7.8 On the above basis it is considered that the Gatwick Airport Model is a reasonable basis to test the impact of an additional runway at Gatwick.

Forecast year demand

6.7.9 SoLHAM traffic forecasts were provided to Jacobs by TfL for both 2021 and 2031. Similarly, a 2031 matrix (AM peak only) was provided for the West Sussex County Council SATURN model.

6.7.10 Based on the uncertainty surrounding growth to 2031, it was assumed that no further adjustment would need to be made to adjust the non-airport traffic to a common year of 2030 and as such all further reference to traffic forecasts will be to 2030.

6.7.11 As the base matrices had previously been matrix estimated, it was not possible to use the above matrices directly. Instead, it was necessary to apply growth factors to derive 2030 demand.

6.7.12 Calculation of car and taxi demand to Gatwick airport was based on the headline assumptions for annual passenger volume and number of employees, following the methodology described in Chapter 3.

6.7.13 Given the limited availability of data and the low number of goods vehicles forecast, goods vehicle traffic to / from Gatwick has been subsumed within the total vehicle flows and has not been separately modelled.

Model runs

6.7.14 The SoLHAM model was run for the following two scenarios:

- 2030 Extended Baseline; and
- 2030 Gatwick Second Runway

6.7.1 In both cases, a detailed review of the model outputs was undertaken to ensure the forecast year traffic assignment produces reasonable results. In summary, this review has shown that the model produces results that are considered reasonable in relation to the capacity and connectivity of the road network surrounding Gatwick. Large traffic volumes and areas of congestion are generally confined to the strategic road network and trips to and from airport follow logical routes.

Conclusions

6.7.2 The construction of the Gatwick Second Runway is predicted to result in an **additional** number of car/taxi trips of 1,200 trips/hr to Gatwick in the AM peak direction, 450 trips/hr to/from Gatwick in the Inter-peak and 850 trips from Gatwick in the PM peak direction. These additional trips will further increase the levels of over-capacity on the links specified in the paragraph above. Furthermore, 7% of the car demand to Gatwick Airport is predicted to be queued on the network in both the Extended Baseline and Gatwick Second Runway options.

6.7.3 A significant upgrading of the A23 / M23 corridor has removed the majority of capacity constraints on the corridor. Most recently, the Handcross to Warninglid improvement scheme has been completed, providing a significant increase in capacity, south of Crawley.

6.7.4 Included within both the Extended Baseline and 2 Runway scenarios are the M23 Junction 8 to 10 and M25 Junction 23 to 27 smart motorway schemes. When delivered, these schemes will provide a further increase in capacity on key strategic routes to the north of Gatwick Airport.

6.7.5 A key potential constraint is the M23 / M25 intersection. In undertaking our analysis we have assumed that targeted capacity improvements will be undertaken on the slip roads, commensurate with the adjacent smart motorway schemes. Local capacity increases have therefore been included in the extended baseline. Without exception, these are associated with enhancing weaving capacity which is required to support the additional lanes of the smart motorway schemes. No additional lanes or structures have been assumed other than those already required as part of the smart motorway proposals.

6.7.6 As a result of the above interventions, the M23 can largely cope with the forecast additional traffic resulting from the Gatwick Second Runway proposal. Smart motorway schemes provide additional capacity on the M25 and, as a consequence, worsened over-capacity locations are generally a significant distance from the airport (and include the constrained Dartford Crossing).

6.7.7 A number links already over-capacity in 2030 are predicted to get worse with a Gatwick Second Runway. Consistent with the methodology adopted in our pre-consultation analysis, as these links are predicted to be over-capacity in the Extended Baseline scenario with general background traffic growth, the responsibility to address these issues rests with the DfT.

6.7.8 Tables 6-1 to 6-3 highlight those links which are predicted to go over-capacity solely due to additional traffic generated by a second runway. Responsibility for addressing these issues should rest with Gatwick Airport Limited.

6.7.9 Of these locations, the A23 / Gatwick Road roundabout constraint will likely be removed as part of the realignment of the A23 required to support the airport expansion. Other locations require only local minor mitigation.

6.7.10 In assessing the impact of the Gatwick Airport Second Runway proposal, it should be noted that there are policy levers within the control of Gatwick Airport which could help reduce car-based airport traffic (e.g. airport car park pricing or airport congestion charging). National policy levers may also have an impact - e.g. national congestion charging and policies to encourage home working. Further discussion is required on these options.

Table 6-1: AM key capacity impact locations

Location	Extended Baseline V/C	GSR V/C
A23, Westbound towards Gatwick Road Roundabout	80.84	102.91
Bonnetts Lane, Crawley, Northbound	79.65	100.37
A23 Crawley Avenue, Southbound to A220 Roundabout	94.29	101.10
A23 / A2011 Roundabout, Crawley - Circulating	81.99	108.40

Table 6-2: IP key capacity impact locations

Location	Extended Baseline V/C	GSR V/C
None		

Table 6-3: PM key capacity impact locations

Location	Extended Baseline V/C	GSR V/C
None		

Appendix A. Environmental requirements / specification

Data Format
Please return the traffic data in the spreadsheet templates provided so that pre-prepared tools the team have in place can be used efficiently.

Traffic model link data for Base, DM and DS to be provided in spatially referenced format, i.e. real-world GIS Shapefile or ESRI Shapefile (ArcGIS v9.1.3), using the OS British National Grid 1936 projection.

Please can the Base and DM shapefiles be supplied as early as possible to allow real-worlding of the anticipated study area network. This can be commenced prior to provision of finalised traffic data, as long as the network is not expected to change.

All links should contain IDs that are unique across all scenarios. The Link IDs should be formed based on the from and to node: A_B

If changes in Link IDs between model scenarios can be minimised, this helps speed Environment team model building. Links which change ID between Base/DM/DS to be clearly identified with their corresponding new ID. New links should be added to the bottom of the database with no data in the Base/DM scenario.

AQ: Directional traffic data for each link to be included in this spreadsheet template, with a corresponding link ID.
Noise: For dual carriageways, motorways and other multi-lane highways, traffic data needs to be provided separately for each carriageway, for example a northbound flow and southbound flow separately. For two way, single carriageway roads, total (two way) traffic flow data is required instead.

A detailed plan of proposed scheme real-world road network in ArcGIS v9.1.3 or Autocad DXF version 12 format.

Study Area
See notes in Study Area worksheet. ***<u>These can be critical to programme.</u>***

Traffic Data Comments
AQ: The time periods to be used for the AQ assessments are based on the forthcoming DMRB AQ guidance.

Traffic data should represent the average conditions over the period covered by the following AADT period:
- AADT24: 00:00 - 23:00 (24 hrs)

Traffic data should represent the **<u>average conditions over the period</u>** covered by the following weekday hours (i.e. not a 1 hour traffic model peak period output):
- AAWT24: 00:00 - 23:00 (24 hrs)
- AM: 07:00 - 10:00 (3 hrs)
- IP: 10:00 - 16:00 (6 hrs)
- PM: 16:00 - 19:00 (3 hrs)
- OP: 19:00 - 07:00 (12 hrs)

Therefore: AAWT24 = AM*3+IP*6+PM*3+OP*12

If Weekend traffic data is required, then the traffic team should discuss what time periods are considered to be representative. A technical note explaining the deriviation of the data should also be supplied.

HDV is defined as vehicles greater than 3.5 tonnes gross (OGV1, OGV2, PSV – COBA Classifications)

The AQ team require link average speeds, including trip delays.

Please confirm what speeds have been provided. It is assumed that queue length data is not validated or available.

Noise: With the introduction of a night-time assessment in the latest DMRB guidance, there are now 3 options as to the traffic data required. It is recognised that data may not be available for these options, and the templates are set to the Intermediate Option. The traffic team should discuss what parameters will be available with the Noise team at project inception for input to the ASR.

Preferred Option:
The preference is for hourly AAWT flows for the full 24-hour period to enable accurate predictions of daytime and night-time noise levels. Hourly % Heavy Vehicles and Vehicle Speeds also required for this method.

Intermediate Option:
Requires AAWT flows, % Heavy Vehicles and Vehicle Speeds for the following periods:
- 06:00 to 24:00 (18-hours)
- 07:00 to 19:00 (12 hours daytime)
- 19:00 to 23:00 (4 hours evening)
- 23:00 to 07:00 (8 hours night-time)

Least Favoured Option:
Daytime 18-hour AAWT flows for the period (06:00 to 24:00) can be used as a minimum. A correction factor can be applied to generate estimated night-time noise levels. Roads will need to be classified as “Motorways” (where traffic flows are relatively uniform throughout the day, evening and night-time periods), or “Non-Motorways” (where traffic flows reduce significantly overnight). % Heavy Vehicles and Vehicle Speeds also required.

% Heavy Vehicles - Heavy vehicles are defined as those with an unladen weight of greater than 3.5 tonnes.

Vehicle Speeds - Where traffic models have been used to provide hourly flows, they should also be used to estimate hourly traffic speeds. Where traffic models have been used to provide 18-hour AAWT flows, the inter-peak flow group should be used as a proxy for the daytime and night-time periods, providing the speeds are appropriate for the link. In some situations, it may be possible to use observed speeds if the measurements are robust.

Road Surfacing Type - For new road schemes or road improvement schemes, a low noise road surfacing will often be specified. Furthermore, for many motorways, low noise road surfacing may already be in use, or planned for installation in the near future. Details of the road surfacing to be assumed for the various roads within the noise model should be provided separately for the Do Minimum Opening Year, Do Something Design Year, Do Minimum Design Year and Do Something Design Year.

It should be noted that traffic data is to be presented as the total number of vehicles for each road link and not passenger car units (PCUs).

Traffic Validation Information

The air quality team also needs to understand how the traffic model has performed, and where model performance is poor for both total flow and HDVs. HDVs represent over half of total vehicle emissions and therefore whilst total flow model performance may be good for a particular link, poor HDV performance on that link can lead to poor air quality model performance.

The air quality team therefore requires the traffic validation results at each traffic count site inside the detailed traffic model area. This can be critical to the interpretation of the air quality model results, and also allows us to understand areas of weakness in the assessment which could be highlighted or challenged.

The Base worksheet has fields for identifying traffic model performance on a traffic period basis for total flow, HDV and speed. Where validation has been undertaken please identify the difference between modelled and monitored values for each link and time period. Please feel free to edit this section of the spreadsheet if necessary, or to provide this information in a GIS format, if that is more convenient.

Scenarios

Please provide traffic data for the following scenarios and years:
Base year
DM (opening & design years)
DS (opening and design years)

Please can the traffic team **confirm the Assessment Base and Opening Years as early as possible** so that the AQ team can collect relevant baseline information. In some cases it maybe necessary to adjust the base year to allow AQ model verification against existing AQ monitoring data.

Micro-Sim Outputs <<If relevant for projects>>
The model links to be provided should be agreed with the AQ & Noise teams to avoid too many very short links being supplied.

Micro-sim models can remove vehicles from the model at junctions between nodes where delays are occuring. If this occurs at a different rate between DM & DS scenarios this could alter the conclusions of the Environment assessments.

Please flag locations where vehicles are removed by the micro-sim model, and quantify the number per scenario.

Study Area

The air quality study area will be defined primarily by the AQ Scoping criteria specified in DMRB HA207/07. These are change between DM and DS scenarios:

+/-1,000 vehicles AADT24, or +/-500 in AQMAs
+/-200 HDVs AADT24
+/-10kph average daily speed
+/-20kph peak hour speed

This can lead to a study area many junctions beyond the scheme extents.

Please review whether the traffic model coverage is sufficient to meet these criteria.

In some cases it may be necessary to extend the study area to cover additional areas of risk, or to allow AQ model verification against existing AQ monitoring locations.

Please provide a diagram showing the boundary of the detailed model area, beyond which would be considered buffer modelling.

Appendix B. Core and extended baselines

B.1 Core Baseline

B.1.1 Rail infrastructure (excluding high speed)

In addition to the existing network and services, the rail Core Baseline will include all of the schemes identified in the Network Rail (NR) Control Period 5 (2014-19) Enhancement Delivery Plan, with the exception of Western Rail Access to Heathrow, which does not yet have a fully secured funding package. This is available online at http://www.networkrail.co.uk/publications/delivery-plans/control-period-5/cp5-delivery-plan/.

Elements of relevance to proposals may include (but not be limited to):

- Crossrail;
- Reading Area Station redevelopment;
- Thameslink programme;
- ERTMS in-cab signalling roll-out;
- East Coast Main Line capacity enhancements;
- West Anglia Main Line enhancements;
- Great Eastern Main Line capacity enhancement (Bow Junction);
- East Kent re-signalling;
- Redhill Station additional platform;
- London Victoria Station capacity improvements;
- London Waterloo Station capacity improvements;
- Great Western Main Line electrification;
- Intercity Express Programme roll-out;
- Thames Valley branch line enhancements;
- Oxford Corridor capacity improvements;
- Swindon to Kemble redoubling; and
- Birmingham Gateway development.

Scheme promoters are encouraged to consult the Enhancement Delivery Plan for the full details and delivery timescales for schemes.

B.1.2 Rail services (excluding high speed)

The Department for Transport (DfT) is responsible for the design and procurement of new and replacement rail franchises on the national rail network for which it is the franchising authority. The DfT is in the process of tendering a number of rail franchises, details of the rail franchise schedule can be found at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/301976/rail-franchise-schedule.pdf. This includes information on the timing and scope of competitions for future franchises. Each individual franchise has its own specific requirements and addresses a particular set of challenges and so the requirements set out in each franchise competition are tailored to meet the needs of the areas they serve. The DfT has moved towards more output-based specifications to give greater flexibility to bidders while recognising the need for Government to protect essential service levels for all passengers. Details of the Department's activities during each of the stages of a franchise competition can be found at https://www.gov.uk/government/publications/franchise-competition-process-guide.

In developing the baseline the Commission will assume that service levels will be broadly similar as they are today unless an infrastructure scheme or introduction of new rolling stock triggers a change. Details of the investment programme for 2014-19 can be found at http://www.networkrail.co.uk/publications/delivery-plans/control-period-5/cp5-delivery-plan/.

The Commission will monitor the results of current franchise competitions and, when the outcomes of these competitions become known, will discuss the implications of the franchise with scheme promoters. The Commission recognises that dialogue on this issue will need to continue after the receipt of revised scheme proposals.

The outcome of the competition for the Thameslink, Southern and Great Northern franchise is clearly of particular relevance to scheme promoters and understanding and discussing the components of this will be a priority for the Commission.

B.1.3 Rail – High Speed

In respect of the High Speed 1 link and the Channel Tunnel, the Commission will assume for its baseline no fundamental changes to infrastructure or services, though it will use existing demand forecasts for both passenger and freight traffic to inform its baseline for capacity utilisation.

In respect of the High Speed 2 link, the Commission has noted that the “Phase 1” route between London Euston and Birmingham and the “Phase 2” route from Birmingham to Manchester and Leeds represents stated Government policy and has cross-party support. The Commission has, therefore, decided to include these elements of the scheme in its Core Baseline. The Commission has also noted, however, the Secretary of State for Transport’s statement that he will delay a decision on whether to proceed with a spur from HS2 to Heathrow Airport until after the Airports Commission’s Final Report. This spur will not, therefore, form part of the Core Baseline.

For an overview of the HS2 programme, scheme promoters are encouraged to consult the following documents:

- https://www.gov.uk/government/publications/hs2-strategic-case
- https://www.gov.uk/government/publications/high-speed-rail-investing-in-britains-future-phase-two-the-route-to-leeds-manchester-and-beyond

The Commission has also noted that the recent review by Sir David Higgins made a number of recommendations regarding the delivery of HS2. On the basis of this, the Government has already taken the decision not to proceed with a link between HS2 and HS1. This link will not, therefore, form part of either baseline. It is possible that the Government may suggest further changes to the timing and phasing of the HS2 delivery programme on the basis of Sir David’s report; the Commission will monitor developments and incorporate any material changes into the baseline. Sir David’s report is available at: http://assets.hs2.org.uk/sites/default/files/inserts/Higgins%20Report%20-%20HS2%20Plus.pdf.

B.1.4 London Underground, London Overground and Docklands Light Railway

The Commission has taken advice from TfL on the status of various forthcoming enhancements to the London Underground, Overground and DLR networks. On the basis of information provided, the Commission will include the following schemes in the Core Baseline:

- London Underground Subsurface upgrade – Signalling and rolling stock replacement, complete by 2018;
- Croxley link – Metropolitan line link to Watford Junction, planned to complete by 2021;
- Northern line upgrade – planned to complete by 2020;

- Victoria line upgrade – planned increase in service frequency to 36tph;
- Piccadilly line upgrade – planned for completion by 2026;
- Bakerloo line upgrade – planned for completion by 2031;
- Central line upgrade – planned for completion by 2031;
- London Underground station redevelopments – e.g. Bank and Victoria;
- Waterloo & City Line Upgrade – Planned for completion by 2031;
- London Overground extension of class 378s to 5 car – deployed by end 2015;
- Gospel Oak to Barking electrification – complete by 2019;
- DLR 3-car upgrade Poplar to Stratford – complete by 2026; and
- DLR Inter-peak service enhancements (base service plan A) – due September 2014.

B.1.5 Strategic roads network

Following discussions with the Highways Agency (HA), the Commission's view is that the following schemes should be included in the Core Baseline:

- M23 Junction 8 to 10 "smart motorway" (all lanes running) – subject to value for money and deliverability assessment;
- M25 Junction 23 to 27 "smart motorway" (all lanes running) – complete by 2015;
- M25 Junction 5 to 6/7 "smart motorway" (all lanes running) – complete by 2014; and
- M3 Junction 2 to 4a "smart motorway" (all lanes running) – complete by 2016.

B.2 Extended Baseline

B.2.1 Rail infrastructure (excluding high speed)

The Commission has held discussions with NR, the DfT and other parties with an interest in the process regarding rail schemes which are likely – but not certain – to be funded in the coming years to meet growth in background demand regardless of decisions on airport expansion. These include:

- Western Rail Access to Heathrow: which forms part of the Control Period 5 settlement (meaning it is highly likely to progress) but does not yet have a fully agreed funding package. Should the funding package be secured, this scheme would become part of the Core Baseline.
- Gatwick Airport Station redevelopment: recommended as part of the Commission's interim report. Discussions are ongoing between Government, NR and the airport regarding the nature and scale of the redevelopment.
- Proposed capacity enhancements to the Brighton Main Line: Currently under development and may potentially be identified for funding as part of the CP6 (2019-2024) programme. Components include:
  - Windmill Bridge Junction area re-modelling (new flyover for Up London Bridge Fast line, new flyover carrying the Down London Bridge Fast over the Wallington and Victoria Slow lines, reusing the current dive under for realigned Up London Bridge Slow services removes path conflicts of current flat junction, new 6th track between East Croydon and Windmill Bridge);
  - East Croydon Station remodelling and additional platforms
  - Selhurst Spurs lengthened to provide 12-car signal standing – removes current conflicts
  - Stoats Nest Junction grade separated junction for Up Redhill trains to join the Up Fast line
  - London Victoria re-designation of platform 8 and new access from platform 9 approach

  - Clapham Junction area alterations to allow for additional train paths (no feasibility work yet undertaken)
  - Keymer Junction – third track to enable Up Lewes train to join main line whilst an Up train is passing and enables the Brighton Main Line to remain open when the junction is unusable.
- Potential outcomes of the Wessex, Sussex and East Sussex route studies: which will inform the future development of infrastructure and services on those routes.
- London Victoria: further redevelopment beyond 2019, subject to business case.
- Clapham Junction: further redevelopment beyond 2019, subject to business case.
- Crossrail 2 – subject to significant further specification and assessment.

B.2.2 Rail Services (excluding high speed)

As with the development of the Core Baseline, the Commission will monitor progress on the DfT's refranchising programme. Where the outcomes of franchise competitions are not known, but the Invitation to Tender gives clear indications regarding the probable contents of the franchise, these will be incorporated into the Extended Baseline.

B.2.3 High Speed Rail

The Government has deferred a decision regarding a spur from HS2 to Heathrow Airport until after the Airports Commission publishes its final report. This spur will, therefore, be placed within the Extended Baseline. The Commission notes, however, that the need to progress the HS2 hybrid bill through Parliament may result in changes in Government policy in this area and will keep any such developments under review, in respect of the relationship of the spur to the baselines.

B.2.4 London Underground, London Overground and Docklands Light Railway

The Commission has taken advice from TfL on the status of various forthcoming enhancements to the London Underground, Overground and DLR networks. On the basis of information provided, the Commission will include the following schemes in the Extended Baseline:

- Jubilee line upgrade: increase to 34tph, requires additional stock;
- Northern line extension to Battersea: subject to TWA approval, potentially open in 2020;
- Northern line full separation: potentially by 2026;
- Bakerloo line southern extension: aspirational only at present;
- London Overground additional 2 tph all day between Clapham Junction and Stratford via West / North London Lines – planned for 2019, but dependant on additional rolling stock;
- London Overground additional 2tph on East London Line – dependant on additional rolling stock;
- London Overground Gospel Oak to Barking extended to Barking Riverside – possible by 2021;
- London Overground 6- and 8-car operation on East, North and West London Lines – possible in 2020s / 2030s;
- DLR new franchise service plan – by 2016/17;
- North route double tracking Phase 2 – requires additional rolling stock;
- DLR Royal Rocks initial capacity enhancements – requires additional rolling stock;
- DLR full 3-car operation – requires additional rolling stock;
- DLR extension to Catford – aspirational only at present; and
- DLR extension to Bromley – aspirational only at present.

B.2.5 Strategic Roads

Following discussions with the HA, the Commission's view is that the following schemes should be included in the Extended Baseline:

- M4 Junction 3 to 12 "smart motorway" (all lanes running) – subject to value for money and deliverability assessment;
- Lower Thames Crossing – work progressing, but no decision yet as to nature of any option that might proceed.

Appendix C. LTS '7031ref6' infrastructure assumptions

C.1 Public Transport

Schemes added to 2011 Base Network		
Exact Rail/UG schemes not known - as provided by Railplan 2031 Coding - LTS RP7 Ref Cases etc LTS 29-Jan-2014.xlsx		
LTS scheme/assumption summary		**Year**
HS2 Schemes		
HS2_AMDS_2026_ES_v3		
HS2_AMDS_2026_GWML_v2		
HS2_AMDS_2026_OV_v3		
HS2_AMDS_2026_SO		
HS2_AMDS_2026_XR_v2		
Bus		
4% global increase in bus frequency over B7.0 2011	2031bus	2021
National Rail		
Chiltern Evergreen 3 Phase 1		2016
Chiltern Evergreen 3 Phase 2		2016
HLOS1 - West Anglia Services		2016
HLOS1 - South West Trains Services		2016
HLOS1 - London Bridge		2016
HLOS1 - Victoria		2016
HS1 Enhancement		2016
London Midland Project 110 (Full)		2016
Thameslink KO1.1 - Through Services		2016
West Coat Pendolino Lengthening (35x11car, 21x9car)		2016
New Lea Bridge Station		2016
Extend all class 378's to 5 car		2016
Devolution - West Anglia Inners		2016
London Overground SLC3 - East London Line Phase 2b to Clapham Jn		2016
Chiltern Speed Adjustment (Metropolitan)		2021
Crossrail 1 (Abbey Wood / Shenfield - Heathrow / Maidenhead)		2021
Thameslink KO2 - Blackfriars Services		2021
Thameslink KO2 - Cannon St Services		2021
Thameslink KO2 - Charing Cross Services		2021
Thameslink KO2 - GN Moorgate Suburban Services		2021
Thameslink KO2 - GN Kings Cross Suburban Services		2021
Thameslink KO2 - London Bridge Services		2021
Thameslink KO2 - Through Services		2021
Thameslink KO2 - Victoria (SE) Services		2021
Thameslink KO2 - Victoria (South Central) Services		2021
Paddington GWML Suburban Electrification		2021
Paddington GWML Long Distance Electrification		2021
HLOS2 - East West Rail (Aylesbury - Milton Keynes, Oxford - Bedford)		2021
HLOS2 - West London Line		2021
HLOS2 - Lea Valley mainline		2021
HLOS2 - Main Line		2021

HLOS2 - Whole TOC		2021
HLOS2 - Whole TOC		2021
HLOS2 - Sydenham route		2021
HLOS2 - Brighton main line (BML)		2021
HLOS2 - Main Line		2021
HLOS2 - Main suburban		2021
HLOS2 - Windsor Lines		2021
HLOS2 - Main Line		2021
HLOS2 - Main Line and Aylesbury route		2021
HLOS2 - London Midland		2021
HLOS2 - Main Line		2021
HLOS2 - Main Line and Hertford Loop		2021
West Anglia Upgrade		2021
Gospel Oak - Barking Electrification and longer (4 car) trains		2021
London Overground Speed Adjustment (Watford DC - Bakerloo)		2026
LUL		
Full Upgrade inc new NGT stock	Bakerloo Line	2031
Full Upgrade inc new NGT stock	Central Line	2031
36 tph Jubilee line	Jubilee Line	2021
Croxley Link	Metropolitan line	2016
PPP Upgrade - phase 1 (signalling upgrades)	Northern Line	2016
PPP Upgrade - phase 2 (revised service patterns)	Northern Line	2021
Northern Line Extension to Battersea	Northern Line	2021
Full Upgrade inc new NGT stock	Piccadilly Line	2026
Phase 1 - New Stock	Subsurface	2016
Phase 2 - Full upgrade	Subsurface	2021
33 tph in operation 2012, potential to increase to 36	Victoria Line	2016
New stock in line with Deep Tube upgrade and enhanced frequency (30 tph peaks)	Waterloo & City	2031
DLR		
Poplar - Stratford 3 car upgrade		2016
IP Service Enhancement		2016
North Route Double Tracking Phase 1 (Base Service Plan B)		2016
TRAM		
Therapia Lane 2012		2016
Wimbledon higher frequency		2016

C.2 Highway schemes

Schemes added to 2011 Base Network	
Highway Scheme Name	**LTS Scheme No.**
A3 Hindhead Improvement	70007
Tottenham Hale Gyratory	70012
Dartford Toll Plaza Removal	70013
M25 Widening to Dual 4 J29-30	3601
HAM FY Schemes	
A205 Brownhill Rd / St Mildreds Rd Torridon Rd to Helder Grove	
A24 Balham High Road Northbound bus lane	
A24 Balham High Road/ Tooting Bec Road	
A41 Cricklewood Lane / Hendon Way - right Turning	
ASLs at junction A10 High Road, Broad Lane, West Green Road	
NEW/H/5/005 Modifications to Traffic Movements at the Junction of the A1020 and Jenkins Lane	
Old Oak Common Lane / A40 Westway	
Route 38 - Bloomsbury Way	
Strand outside Courts of Justice	
A4 Sutton Court Road	
Acton Town Centre Enhancement Scheme	
Cycle Superhighways Route 5 - Kennington Lane / Durham Road Scheme	
Fulham Palace Rd / Talgarth Rd slip road (Route 220, Phase 2)	
Greenwich Reach	
Greenwich Town Centre Pedestrianisation Scheme	
Lea Bridge Road Regeneration Scheme (Formal Sub)	
Portman Square-Phase 2	
Southall Broadway Boulevard	
Stonecutter Street Closure - Road Danger Reduction Scheme	
Strand-Aldwych-Lancaster Place	
Bloomsbury Way (bus priority)	
Bounds Green environmental and safety schemes (A406)	
Brent cross at North Circular junction with A5, M1, A41 Hendon way, as well as further local improvements	
Elephant and Castle	
Euston Circus	
Exhibition Rd	
Henley Corner environmental and safety schemes (A406)	
Kender Street and Besson Street A2/A202	
Kender Street Triangle	
Piccadilly 2-way	
Russell Square	
Sydenham Road Area Based Scheme A212	
Tottenham Hale gyratory (Made Two-way)	
Wimbledon Town Centre (Destination Wimbledon)	

Appendix D. Customer experience

D.1 Methodology

The following diagrams aim to visually depict the surface access experience between Gatwick Airport and a range of locations in the UK by road and rail in 2030 with the Second Runway in place.

The locations were selected with reference to the DfT's 2030 NAPAM forecast distribution for Gatwick Second Runway in the Carbon-Traded Low Cost is King scenario. The top 5 surface access trip generating districts within London and the top 5 districts outside of London (including one district outside of South East England) were identified. Districts within 10km of the airport were excluded from the analysis due to the wide range of potential journey options from different parts of large districts in close proximity to the airport, for example Mid Sussex.

The direction of travel depicted (i.e. to or from the airport) represents the worst case travel conditions forecast in the AM peak period in 2030, and the routes reflect the lowest modelled Generalised Cost trip, which attracts the largest number of travellers.

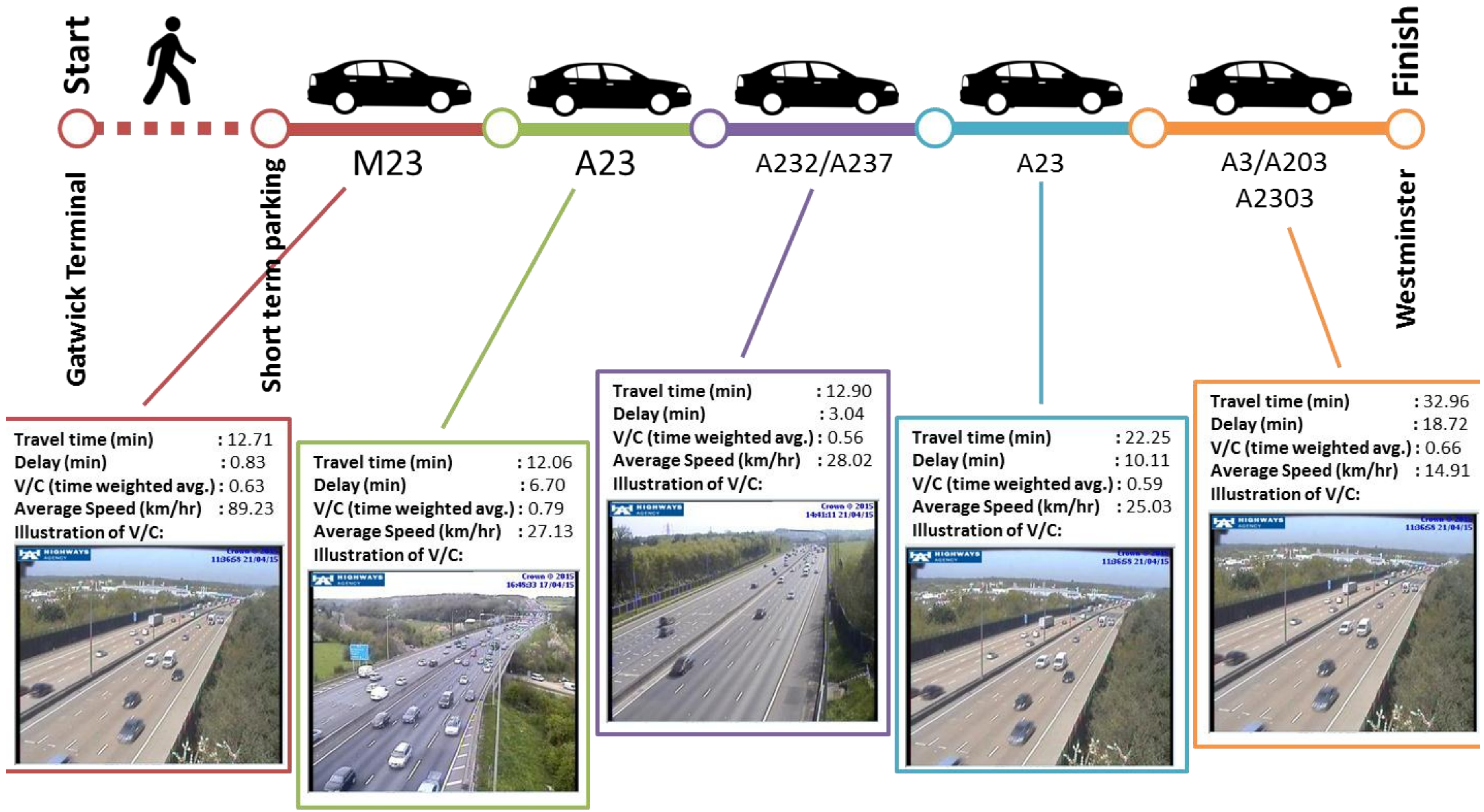
Within London the following districts were identified from the NAPAM outputs:

- Westminster;
- Kensington and Chelsea;
- Wandsworth;
- Lambeth;
- City of London.

Outside of London the following districts were identified:

- Brighton and Hove;
- Guildford;
- Reading;
- Maidstone;
- Cambridge.

D.2 AM peak Gatwick Second Runway road experience



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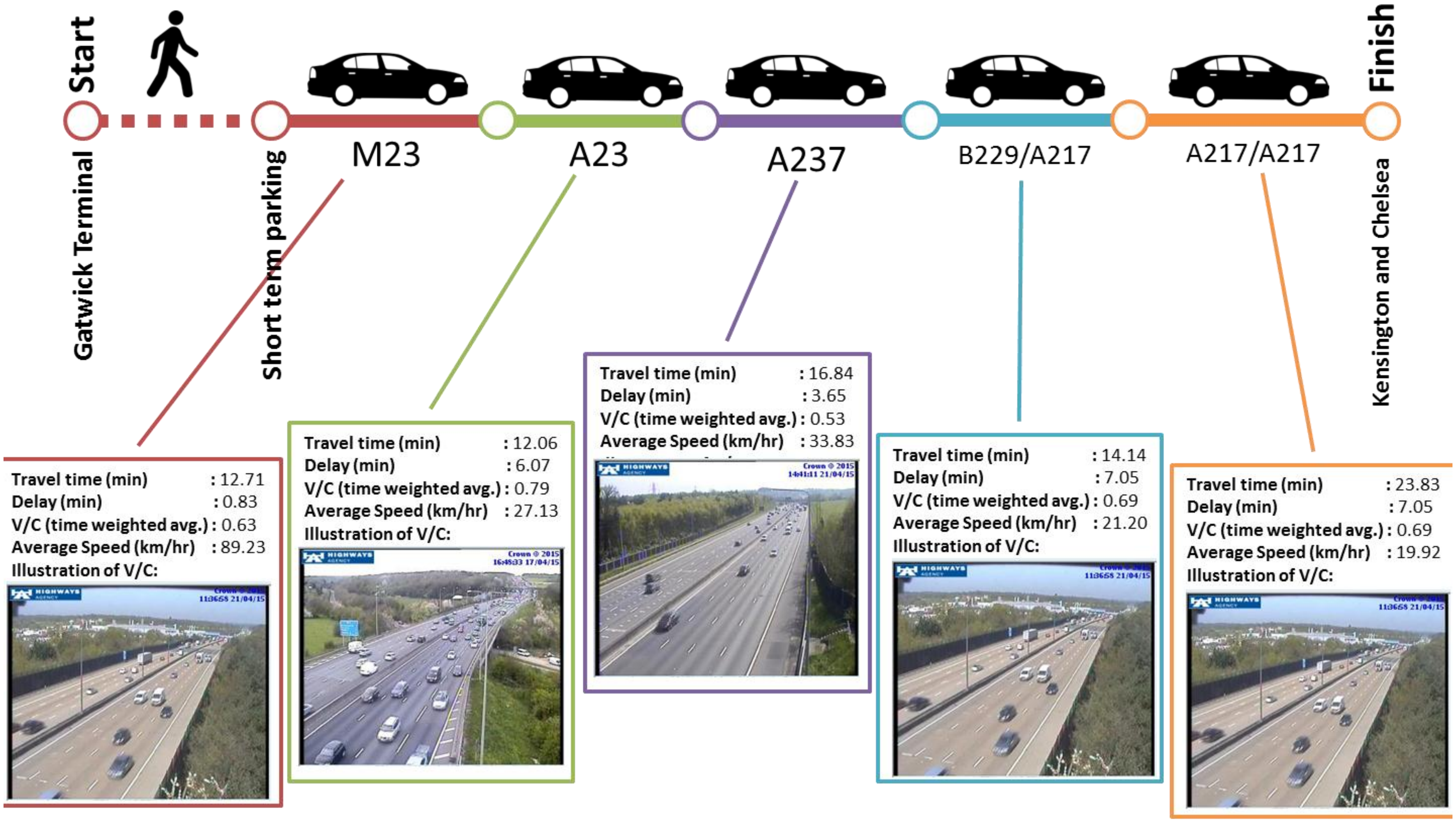
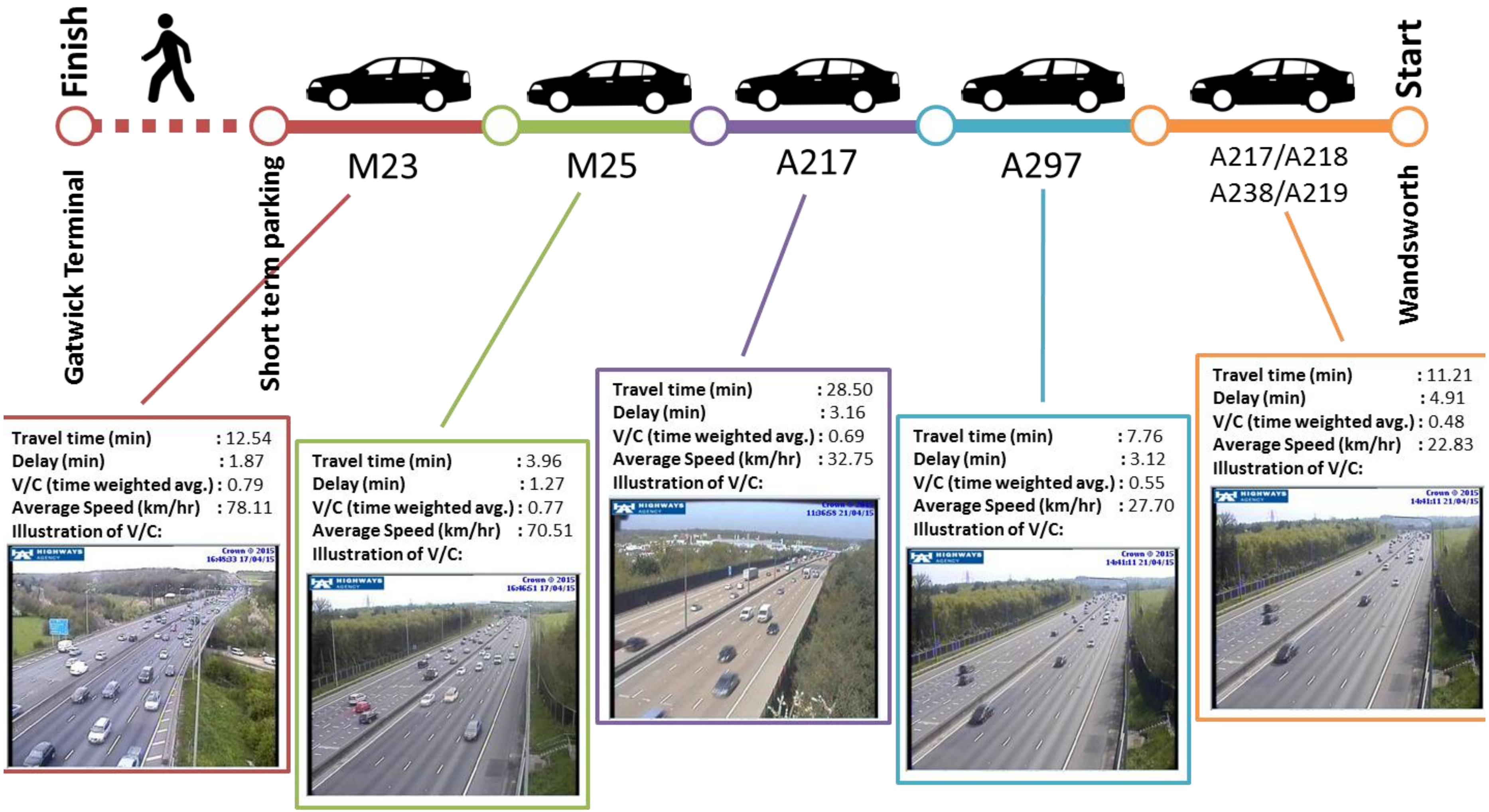
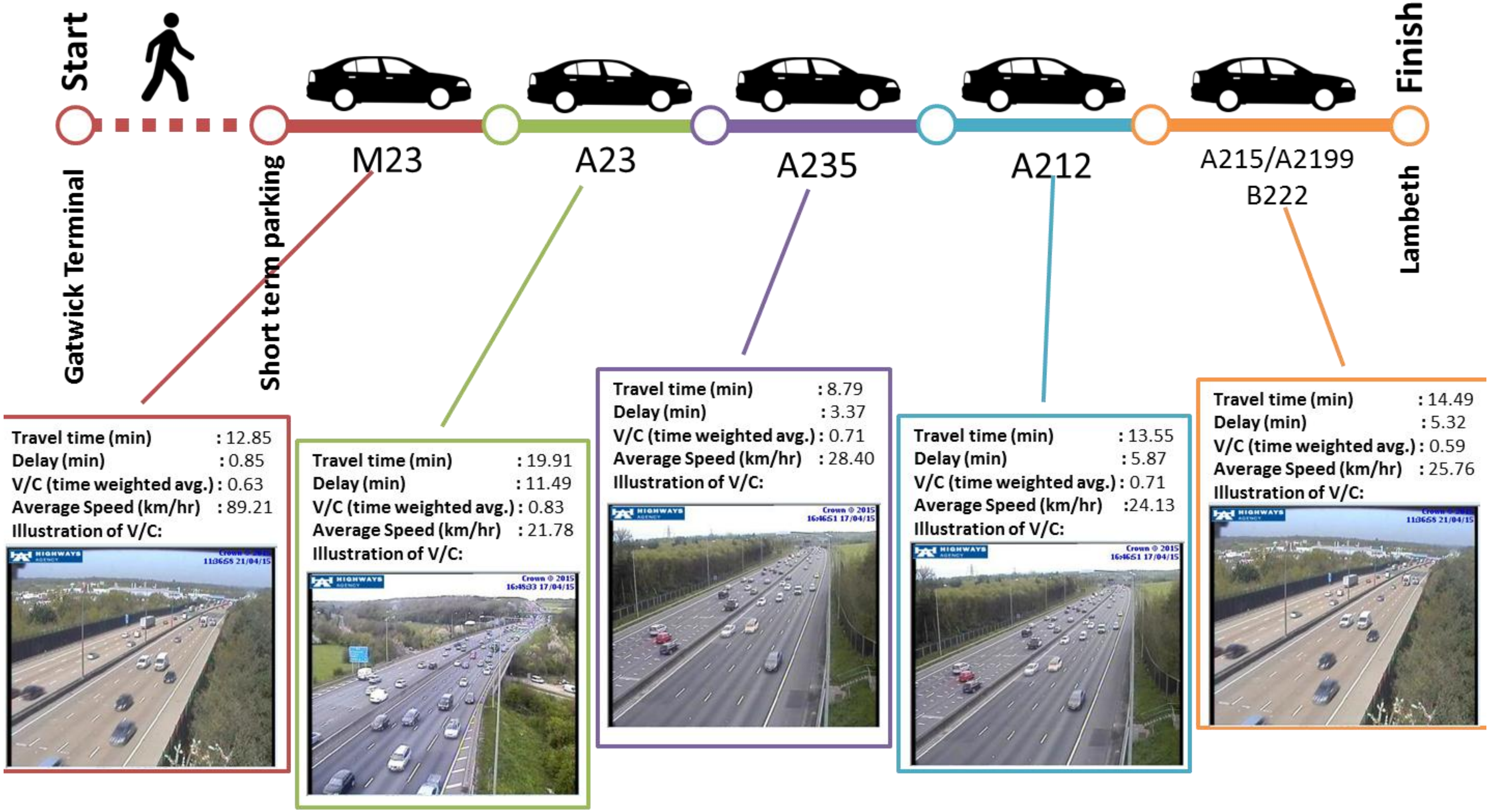

Start
Gatwick Terminal
Short term parking
M23
A23
A237
B229/A217
A217/A217
Finish
Kensington and Chelsea
Travel time (min) : 12.71
Delay (min) : 0.83
V/C (time weighted avg.) : 0.63
Average Speed (km/hr) : 89.23
Illustration of V/C:
Travel time (min) : 12.06
Delay (min) : 6.07
V/C (time weighted avg.) : 0.79
Average Speed (km/hr) : 27.13
Illustration of V/C:
Travel time (min) : 16.84
Delay (min) : 3.65
V/C (time weighted avg.) : 0.53
Average Speed (km/hr) : 33.83
Travel time (min) : 14.14
Delay (min) : 7.05
V/C (time weighted avg.) : 0.69
Average Speed (km/hr) : 21.20
Illustration of V/C:
Travel time (min) : 23.83
Delay (min) : 7.05
V/C (time weighted avg.) : 0.69
Average Speed (km/hr) : 19.92
Illustration of V/C:

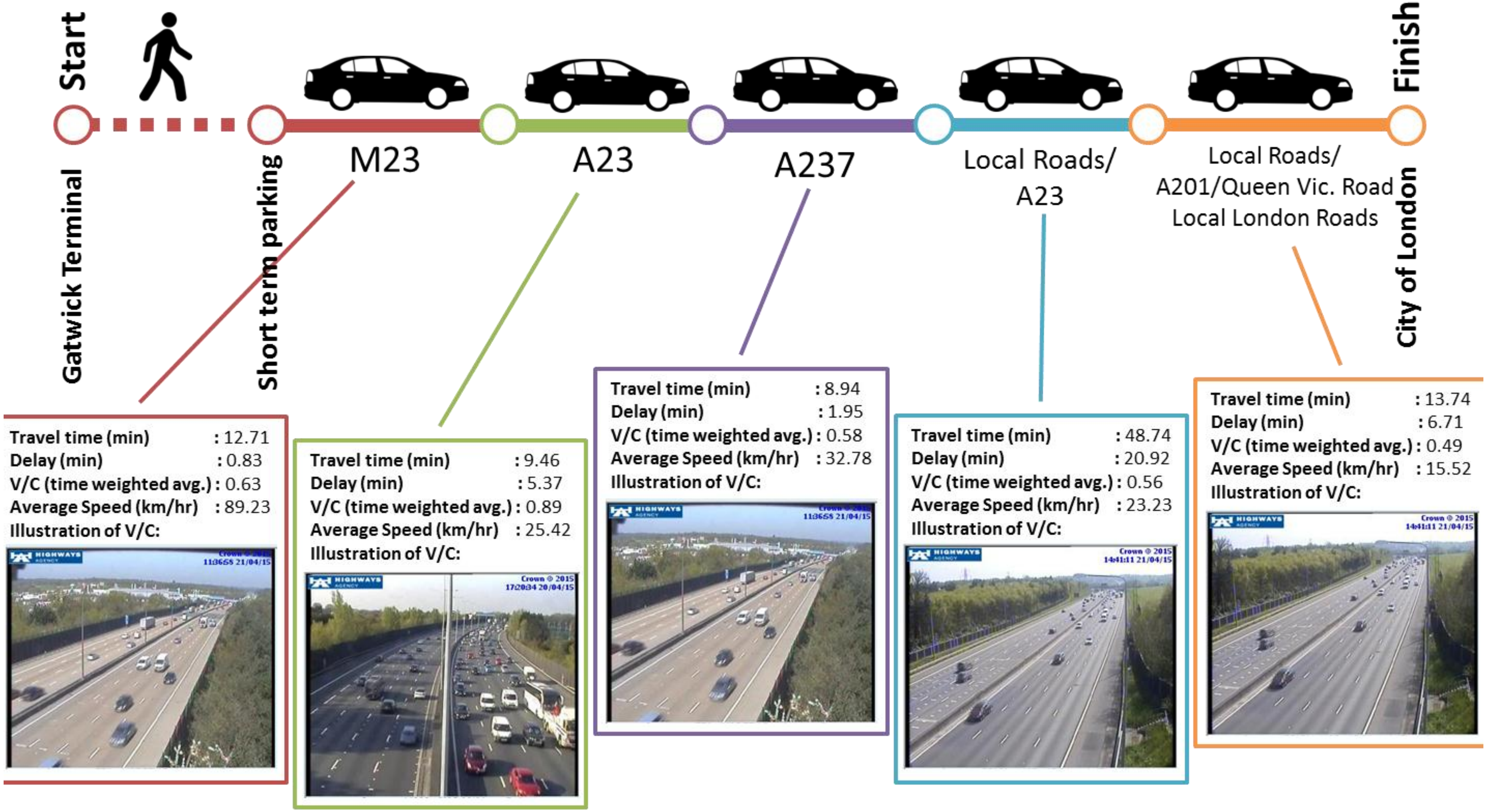
JACOBS

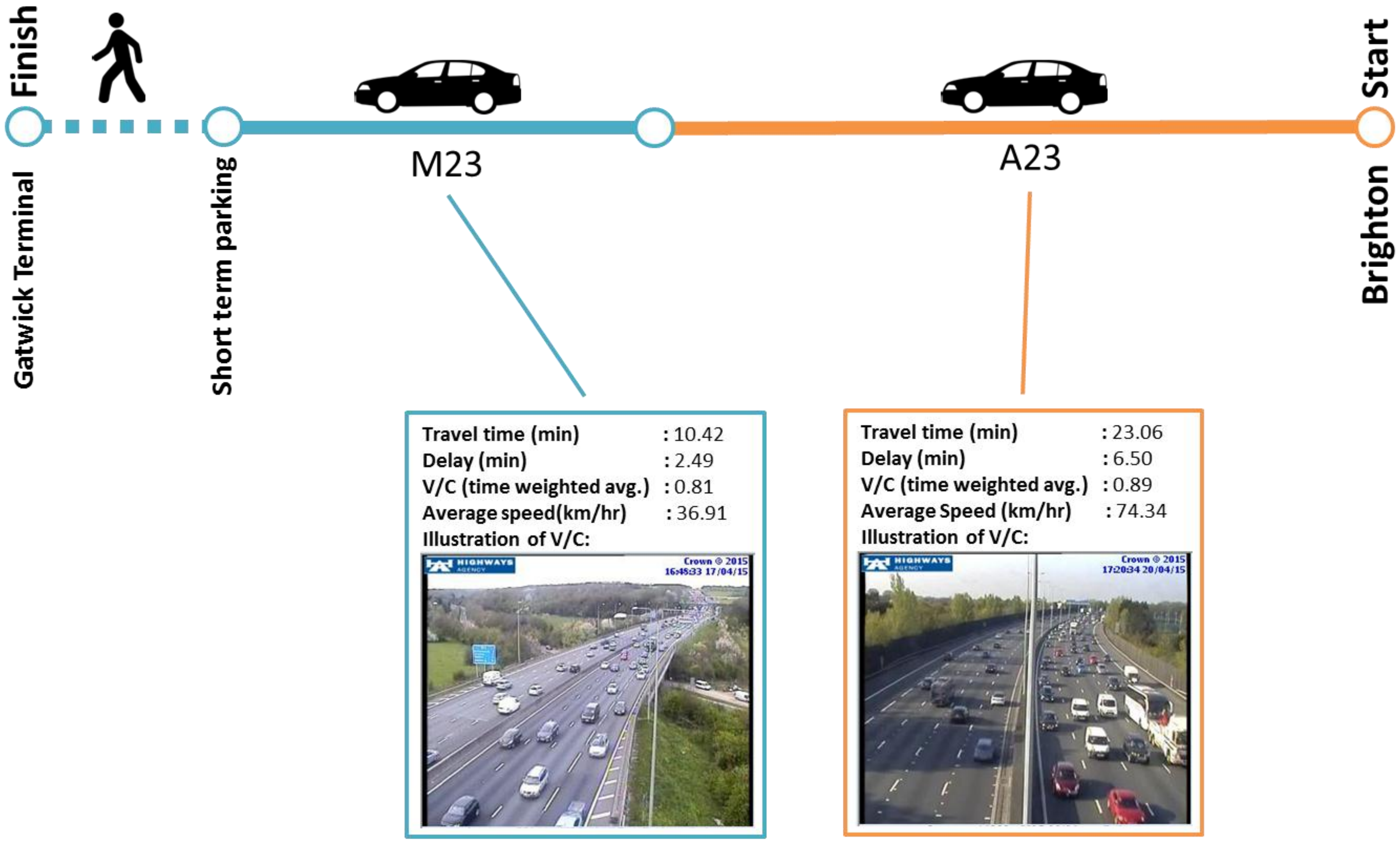

Finish
Gatwick Terminal
Short term parking
M23
M25
A217
A297
A217/A218
A238/A219
Start
Wandsworth
Travel time (min) : 12.54
Delay (min) : 1.87
V/C (time weighted avg.) : 0.79
Average Speed (km/hr) : 78.11
Illustration of V/C:
Travel time (min) : 3.96
Delay (min) : 1.27
V/C (time weighted avg.) : 0.77
Average Speed (km/hr) : 70.51
Illustration of V/C:
Travel time (min) : 28.50
Delay (min) : 3.16
V/C (time weighted avg.) : 0.69
Average Speed (km/hr) : 32.75
Illustration of V/C:
Travel time (min) : 7.76
Delay (min) : 3.12
V/C (time weighted avg.) : 0.55
Average Speed (km/hr) : 27.70
Illustration of V/C:
Travel time (min) : 11.21
Delay (min) : 4.91
V/C (time weighted avg.) : 0.48
Average Speed (km/hr) : 22.83
Illustration of V/C:

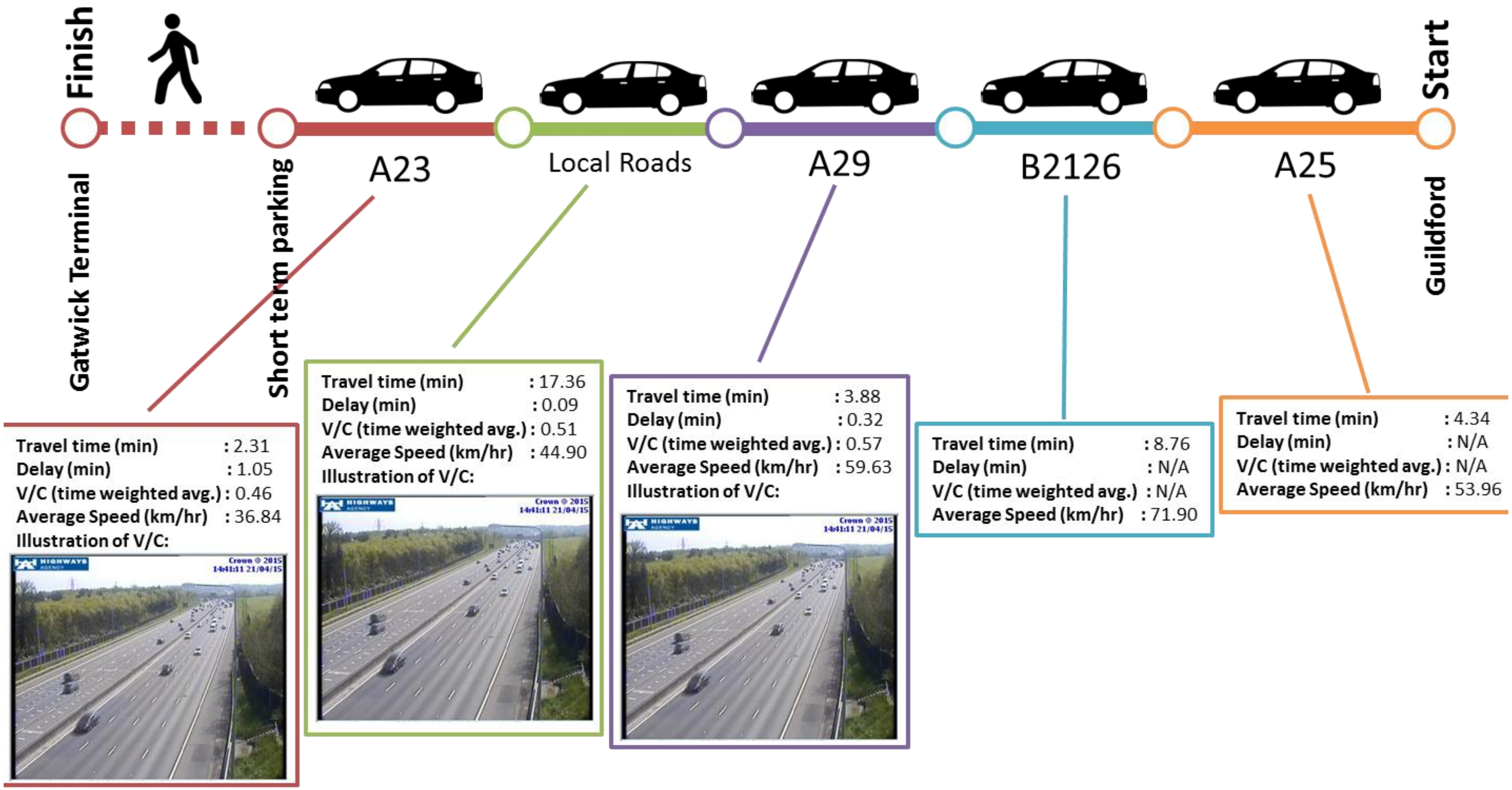
JACOBS


Start
Gatwick Terminal
Short term parking
M23
A23
A235
A212
A215/A2199
B222
Finish
Lambeth
Travel time (min) : 12.85
Delay (min) : 0.85
V/C (time weighted avg.) : 0.63
Average Speed (km/hr) : 89.21
Illustration of V/C:
Travel time (min) : 19.91
Delay (min) : 11.49
V/C (time weighted avg.) : 0.83
Average Speed (km/hr) : 21.78
Illustration of V/C:
Travel time (min) : 8.79
Delay (min) : 3.37
V/C (time weighted avg.) : 0.71
Average Speed (km/hr) : 28.40
Illustration of V/C:
Travel time (min) : 13.55
Delay (min) : 5.87
V/C (time weighted avg.) : 0.71
Average Speed (km/hr) :24.13
Illustration of V/C:
Travel time (min) : 14.49
Delay (min) : 5.32
V/C (time weighted avg.) : 0.59
Average Speed (km/hr) : 25.76
Illustration of V/C:

JACOBS

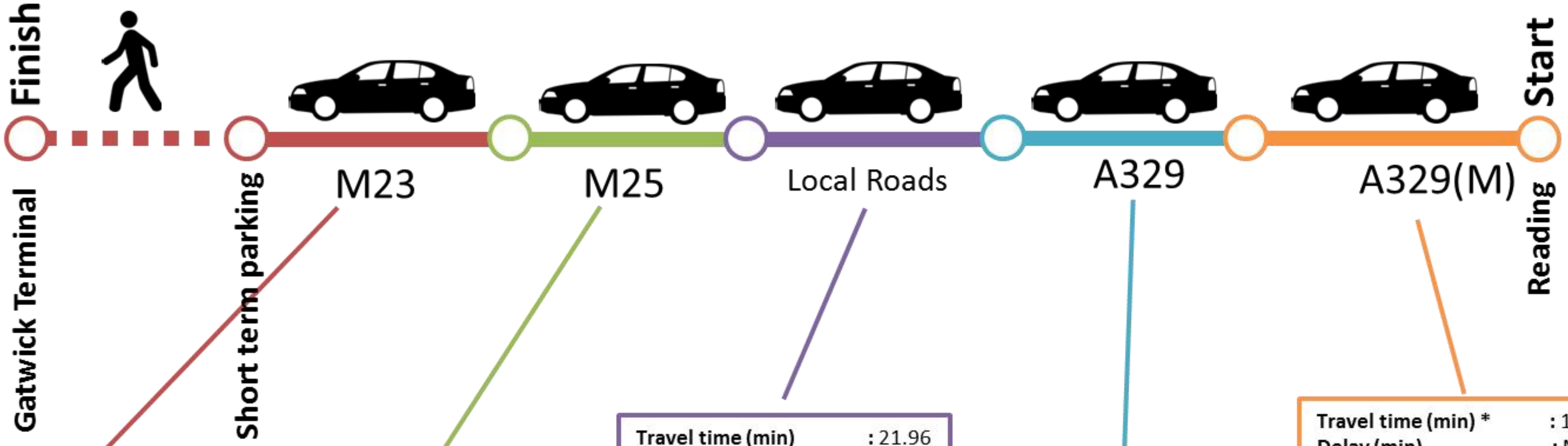

Start
Finish
Gatwick Terminal
Short term parking
M23
A23
A237
Local Roads/
A23
Local Roads/
A201/Queen Vic. Road
Local London Roads
City of London
Travel time (min) : 12.71
Delay (min) : 0.83
V/C (time weighted avg.) : 0.63
Average Speed (km/hr) : 89.23
Illustration of V/C:
Travel time (min) : 9.46
Delay (min) : 5.37
V/C (time weighted avg.) : 0.89
Average Speed (km/hr) : 25.42
Illustration of V/C:
Travel time (min) : 8.94
Delay (min) : 1.95
V/C (time weighted avg.) : 0.58
Average Speed (km/hr) : 32.78
Illustration of V/C:
Travel time (min) : 48.74
Delay (min) : 20.92
V/C (time weighted avg.) : 0.56
Average Speed (km/hr) : 23.23
Illustration of V/C:
Travel time (min) : 13.74
Delay (min) : 6.71
V/C (time weighted avg.) : 0.49
Average Speed (km/hr) : 15.52
Illustration of V/C:


Finish
Gatwick Terminal
Short term parking
M23
A23
Start
Brighton
Travel time (min) : 10.42
Delay (min) : 2.49
V/C (time weighted avg.) : 0.81
Average speed(km/hr) : 36.91
Illustration of V/C:
Travel time (min) : 23.06
Delay (min) : 6.50
V/C (time weighted avg.) : 0.89
Average Speed (km/hr) : 74.34
Illustration of V/C:



* Note: Trip segment outside detailed simulation area of highway model, as such, detailed travel statistics not available. Additionally, travel time and speed results may be unreliable

JACOBS



Travel time (min) : 12.54
Delay (min) : 1.87
V/C (time weighted avg.) : 0.79
Average Speed (km/hr) : 78.11
Illustration of V/C:

Travel time (min) : 23.59
Delay (min) : 5.84
V/C (time weighted avg.) : 0.80
Average Speed (km/hr) : 84.86
Illustration of V/C:

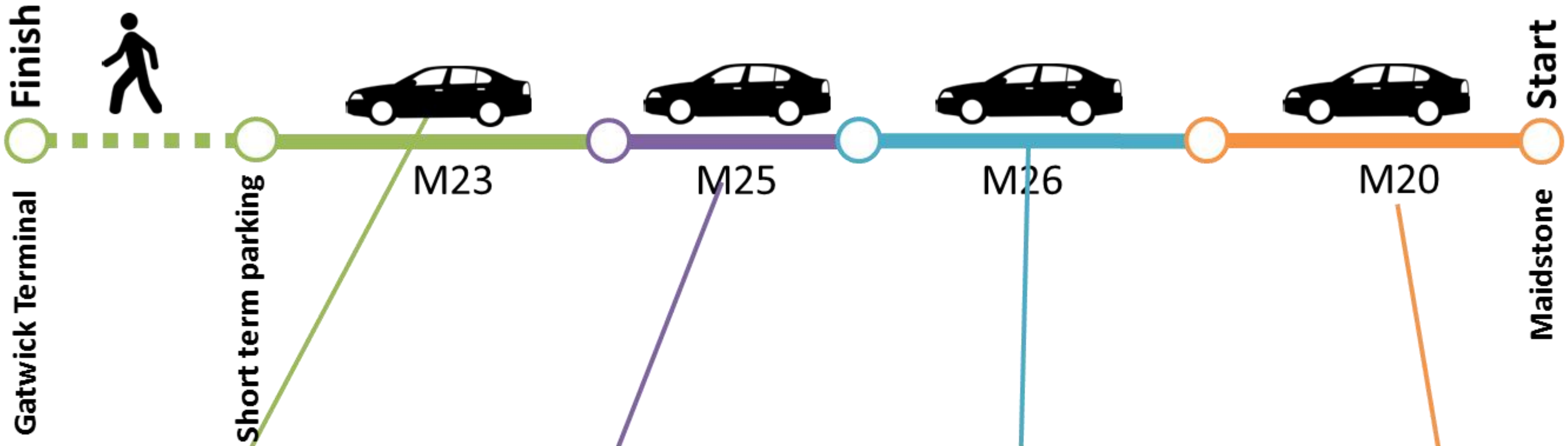
Travel time (min) : 21.96
Delay (min) : 3.53
V/C (time weighted avg.) : 0.63
Average Speed (km/hr) : 50.98
Illustration of V/C:

Travel time (min) * : 11.87
Delay (min) : N/A
V/C (time weighted avg.) : N/A
Average Speed (km/hr) : 48.04

Travel time (min) * : 18.57
Delay (min) : N/A
V/C (time weighted avg.) : N/A
Average Speed (km/hr) : 45.26

* Note: Trip segment outside detailed simulation area of highway model, as such, detailed travel statistics not available. Additionally, travel time and speed results may be unreliable

JACOBS



M23

Travel time (min) : 12.07
Delay (min) : 1.77
V/C (time weighted avg.) : 0.77
Average Speed (km/hr) : 78.17
Illustration of V/C:

M25

Travel time (min) : 16.47
Delay (min) : 3.93
V/C (time weighted avg.) : 0.86
Average Speed (km/hr) : 70.47
Illustration of V/C:

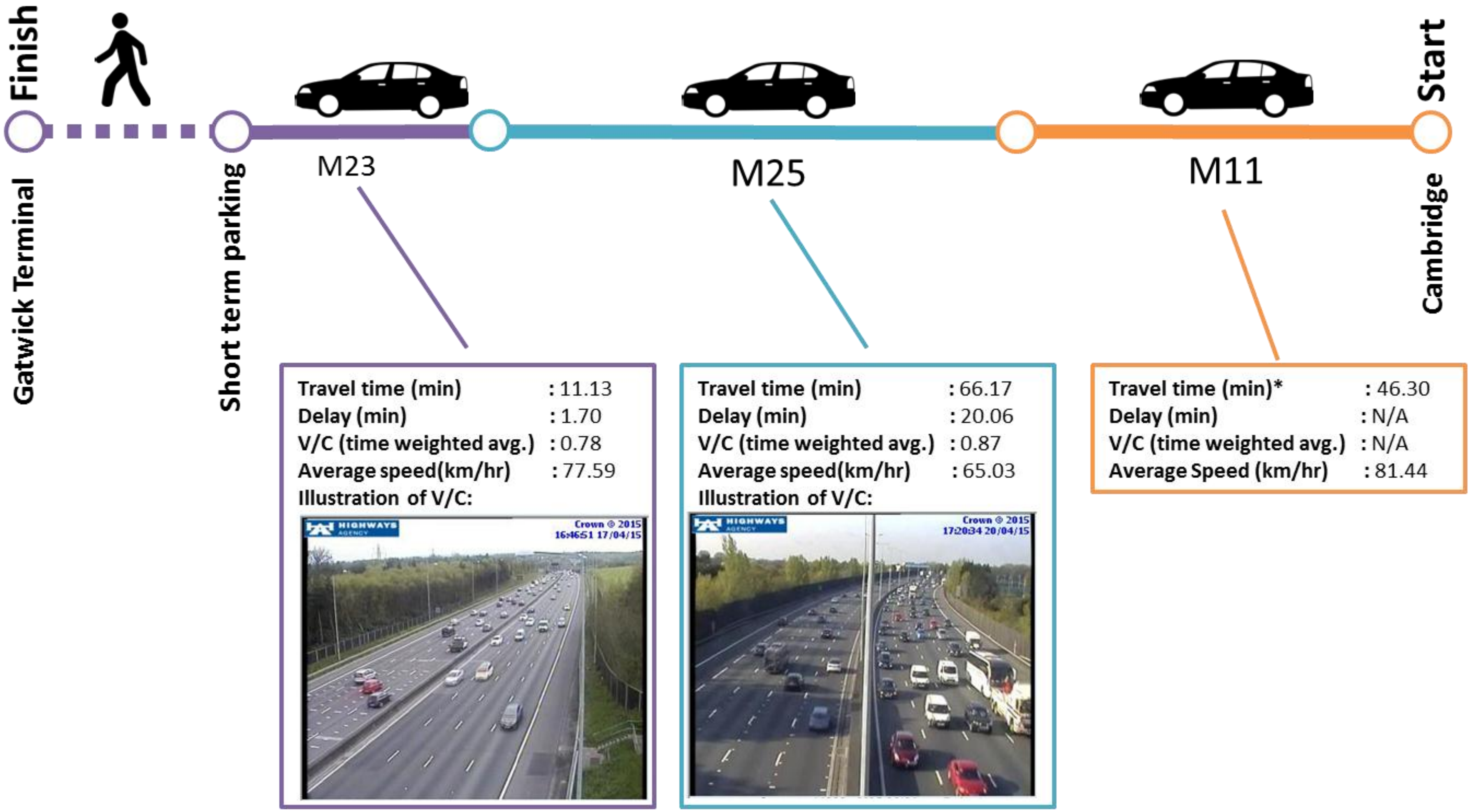
M26

Travel time (min) : 10.27
Delay (min) : 1.40
V/C (time weighted avg.) : 0.82
Average Speed (km/hr) : 77.76
Illustration of V/C:

M20

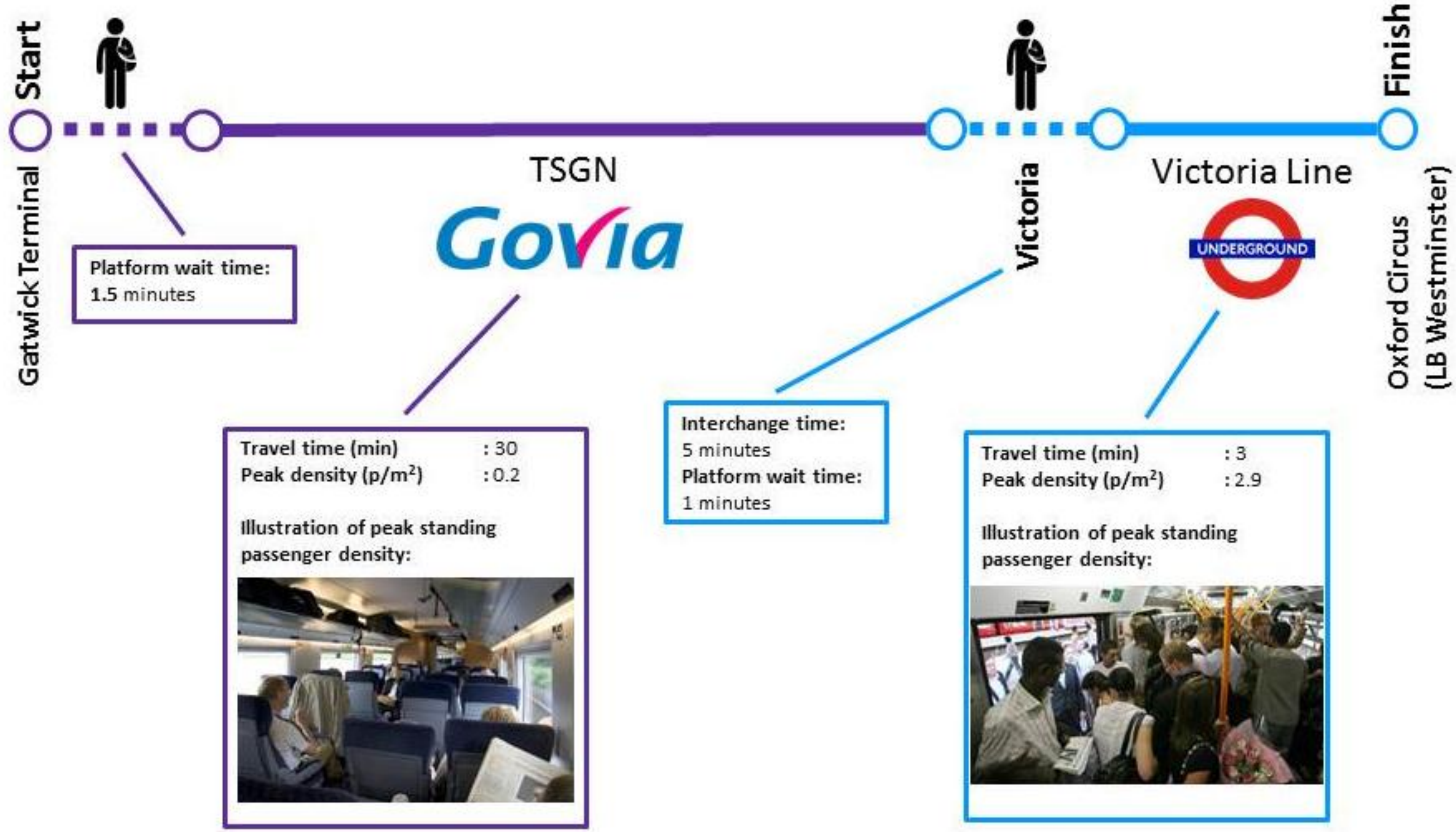
Travel time (min)* : 16.22
Delay (min) : N/A
V/C (time weighted avg.) : N/A
Average Speed (km/hr) : 25.21

* Note: Trip segment outside detailed simulation area of highway model, as such, detailed travel statistics not available. Additionally, travel time and speed results may be unreliable

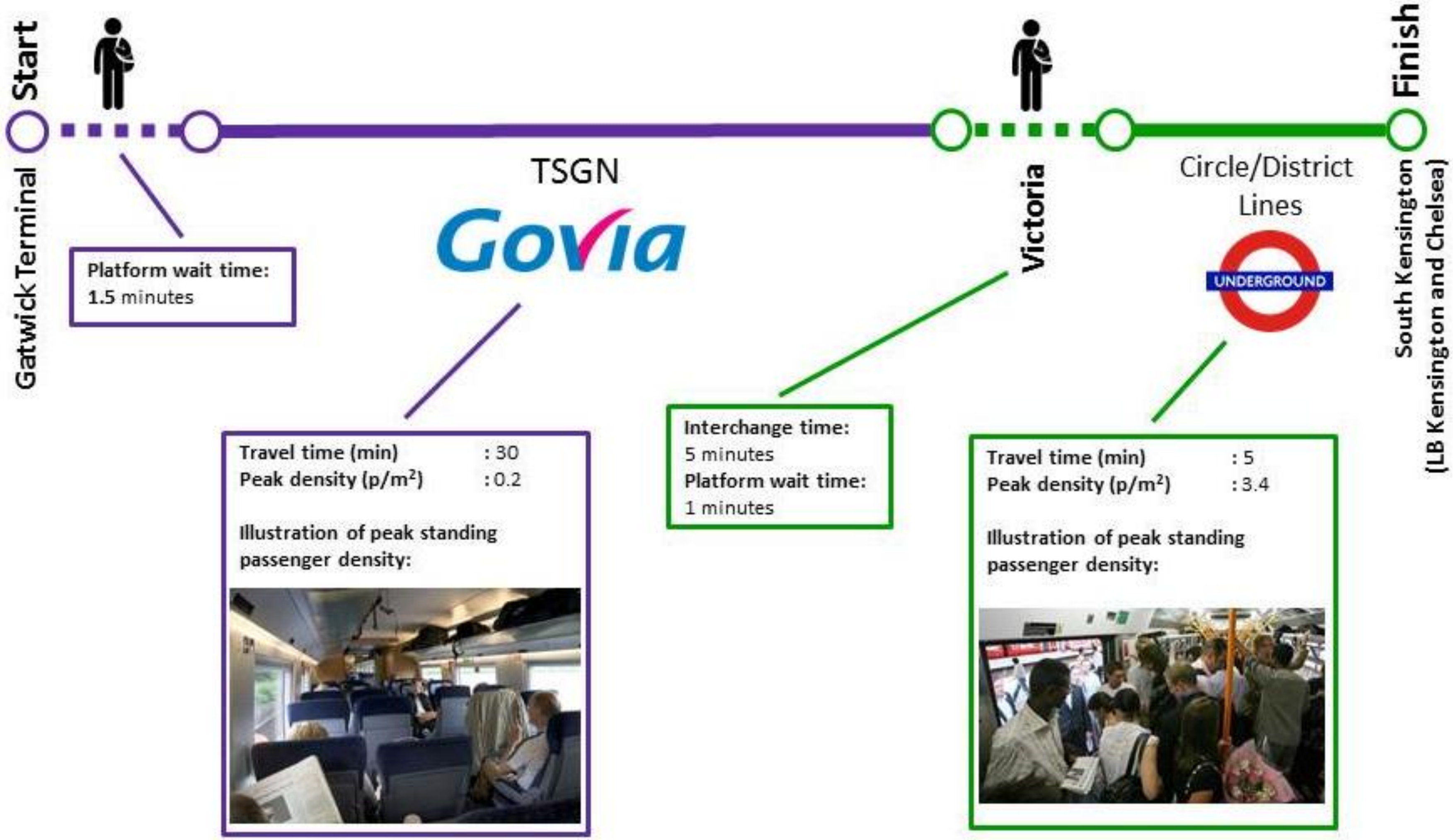


* Note: Trip segment outside detailed simulation area of highway model, as such, detailed travel statistics not available. Additionally, travel time and speed results may be unreliable

D.3 AM peak Gatwick Second Runway rail experience

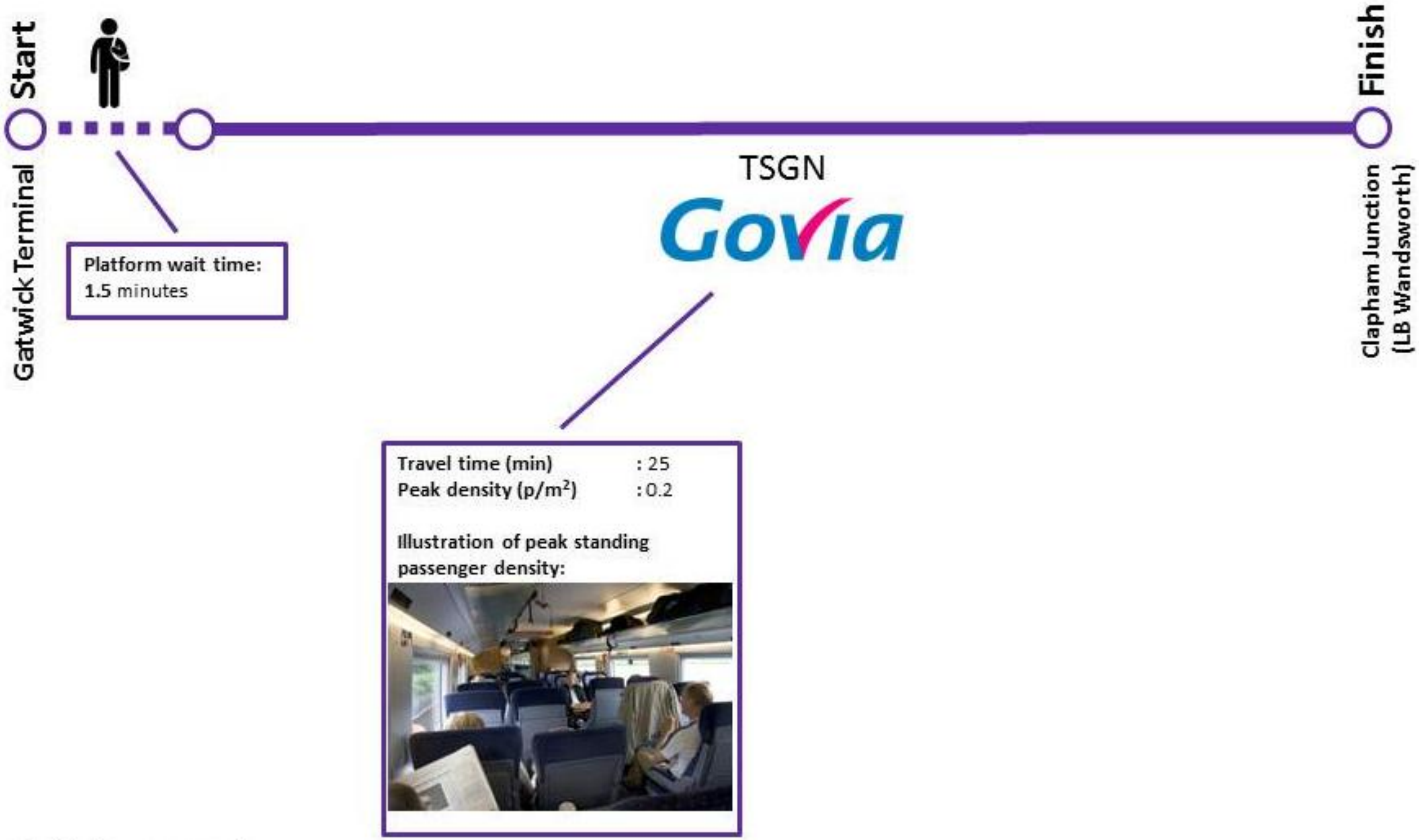


p/m^2 = number of standing passengers per m^2

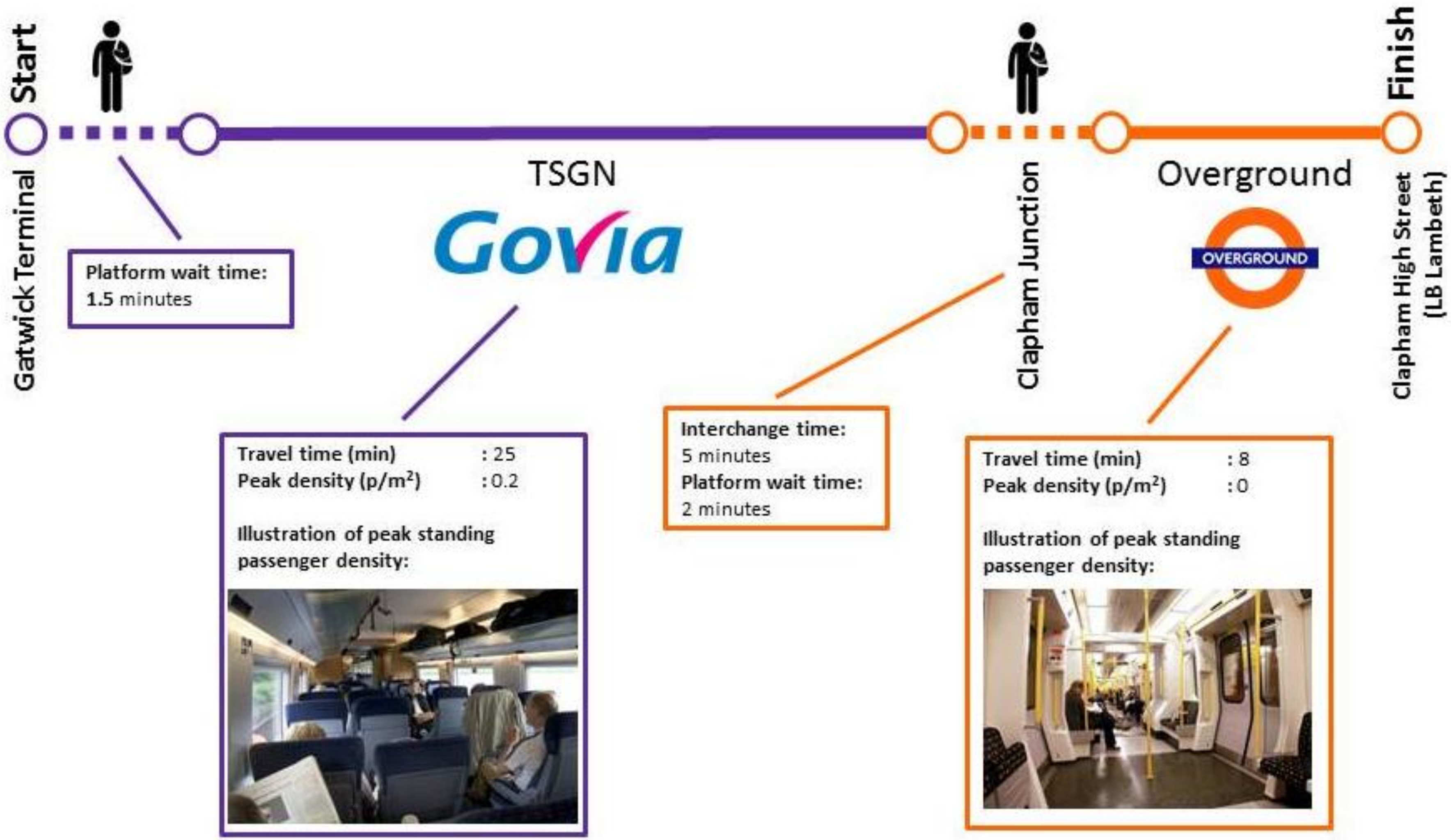


p/m² = number of standing passengers per m²

JACOBS

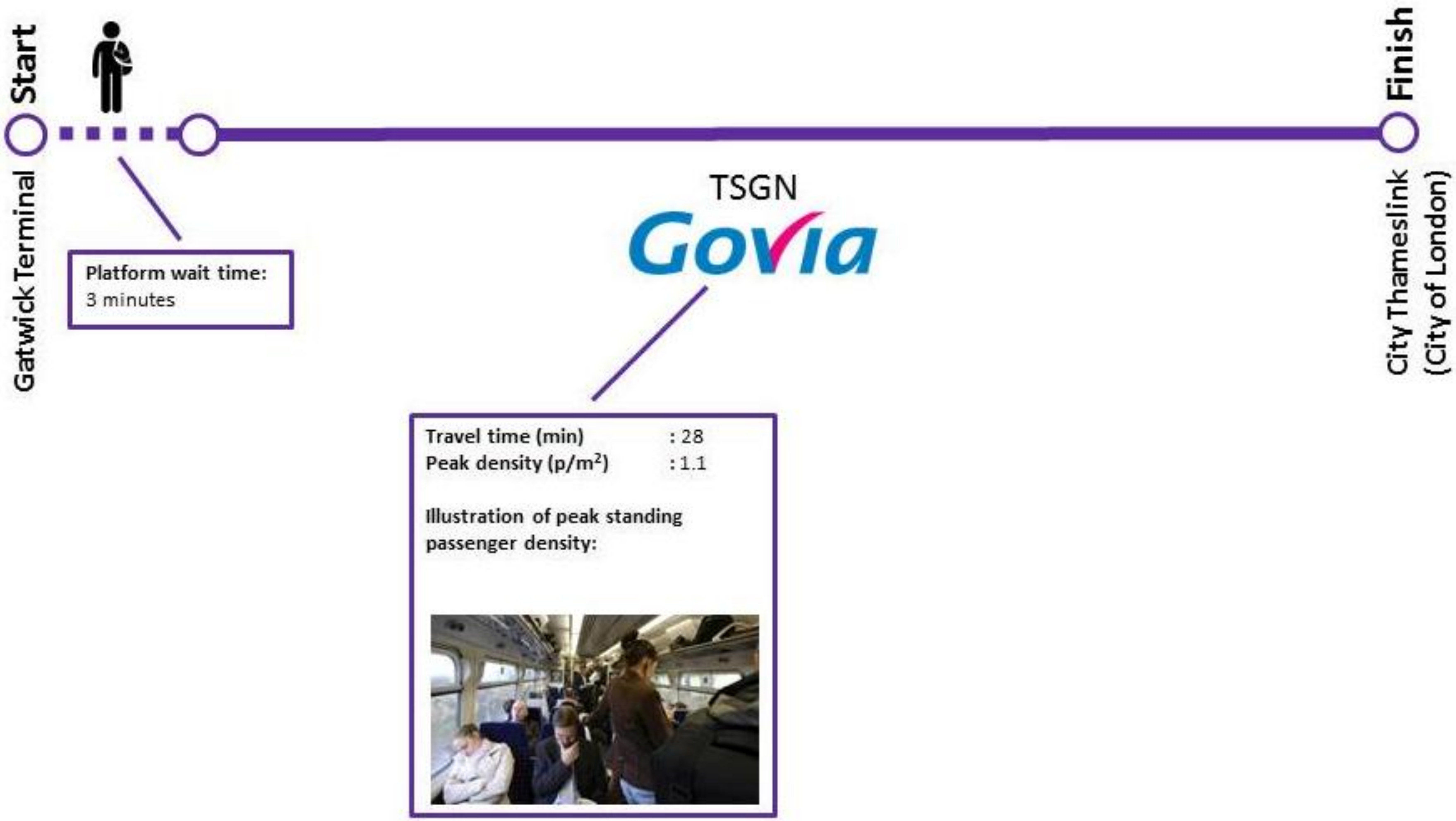


p/m² = number of standing passengers per m²



p/m² = number of standing passengers per m²

JACOBS



p/m² = number of standing passengers per m²

JACOBS

Start

Brighton

Platform wait time:
4 minutes

TSGN

Govia

Finish

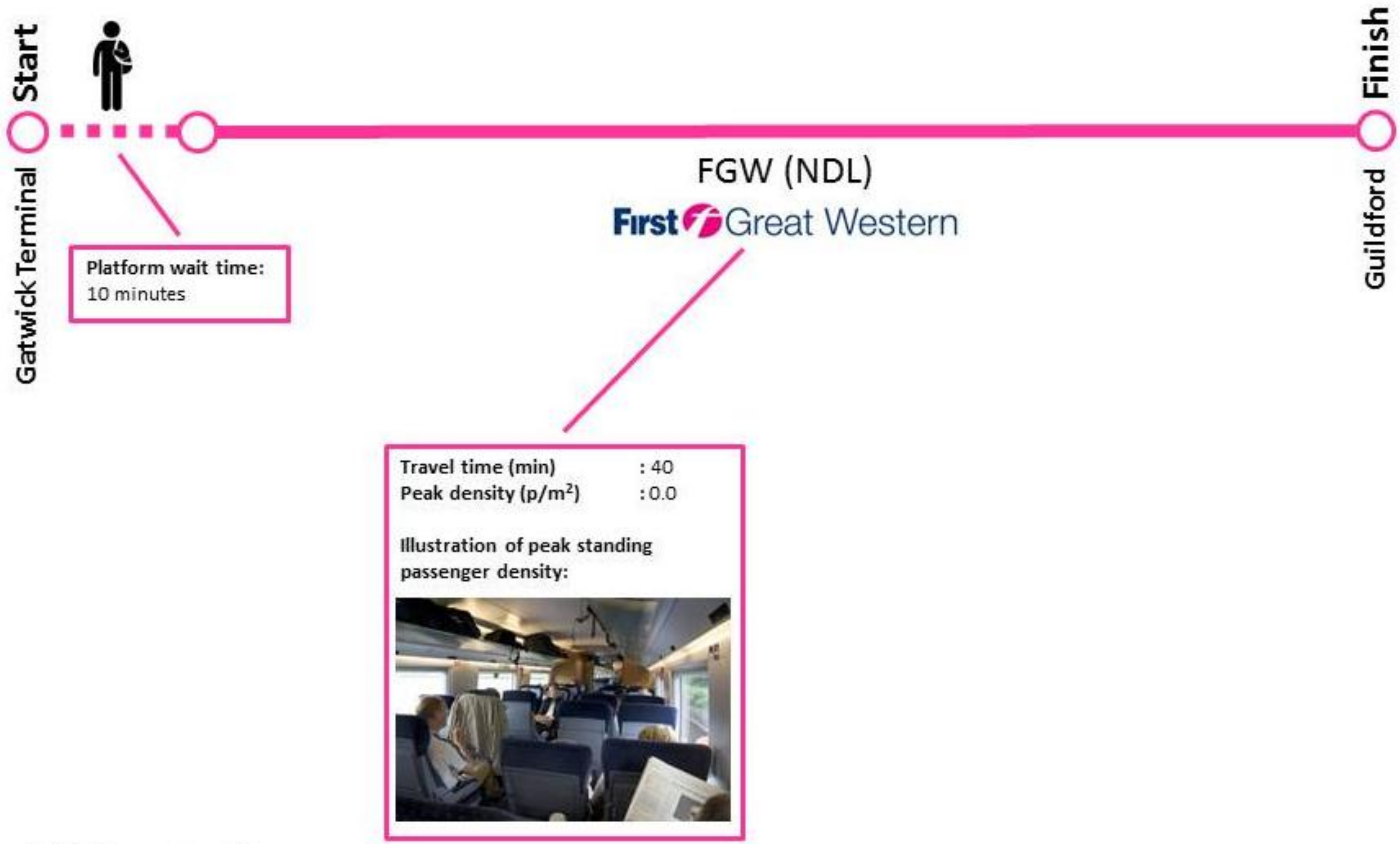
Gatwick Terminal

Travel time (min) : 28
Peak density (p/m²) : 0.0

Illustration of peak standing passenger density:

p/m² = number of standing passengers per m²

JACOBS



p/m² = number of standing passengers per m²

JACOBS

Start

Gatwick Terminal

Platform wait time:
10 minutes

FGW (NDL)

First Great Western

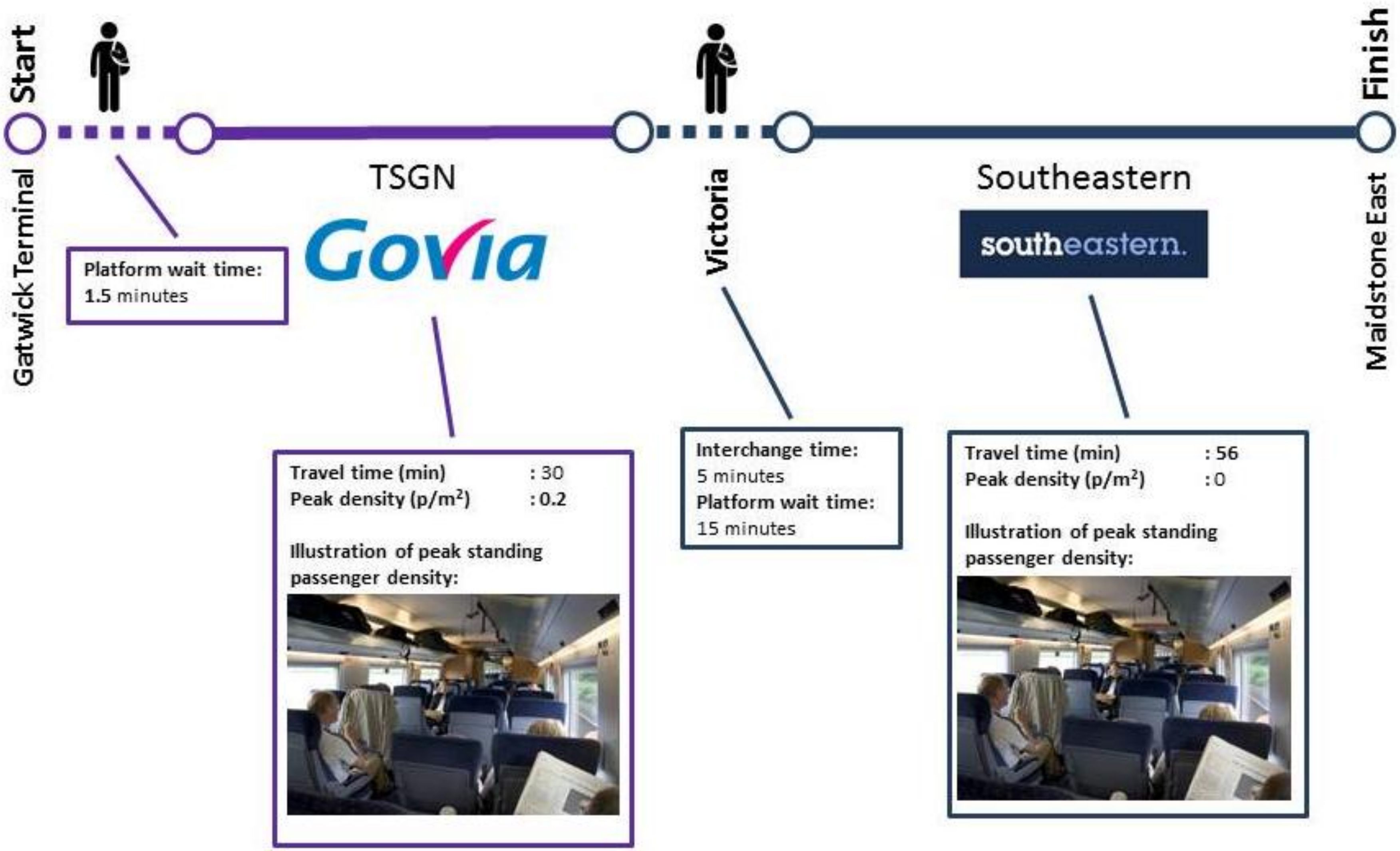
Finish

Reading

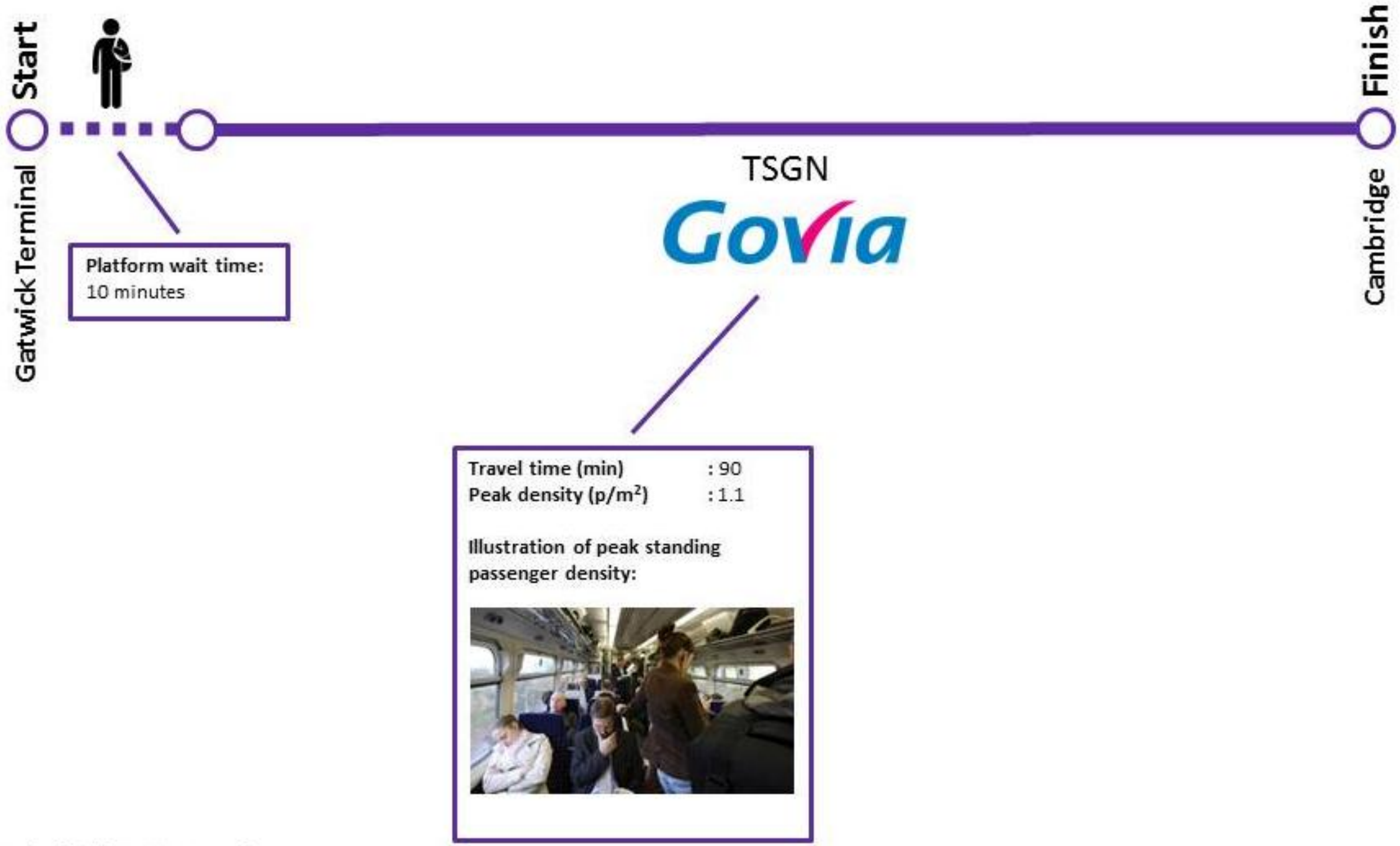
Travel time (min) : 76
Peak density (p/m^2) : 0.0

Illustration of peak standing passenger density:

p/m^2 = number of standing passengers per m^2



p/m^2 = number of standing passengers per m^2



p/m² = number of standing passengers per m²