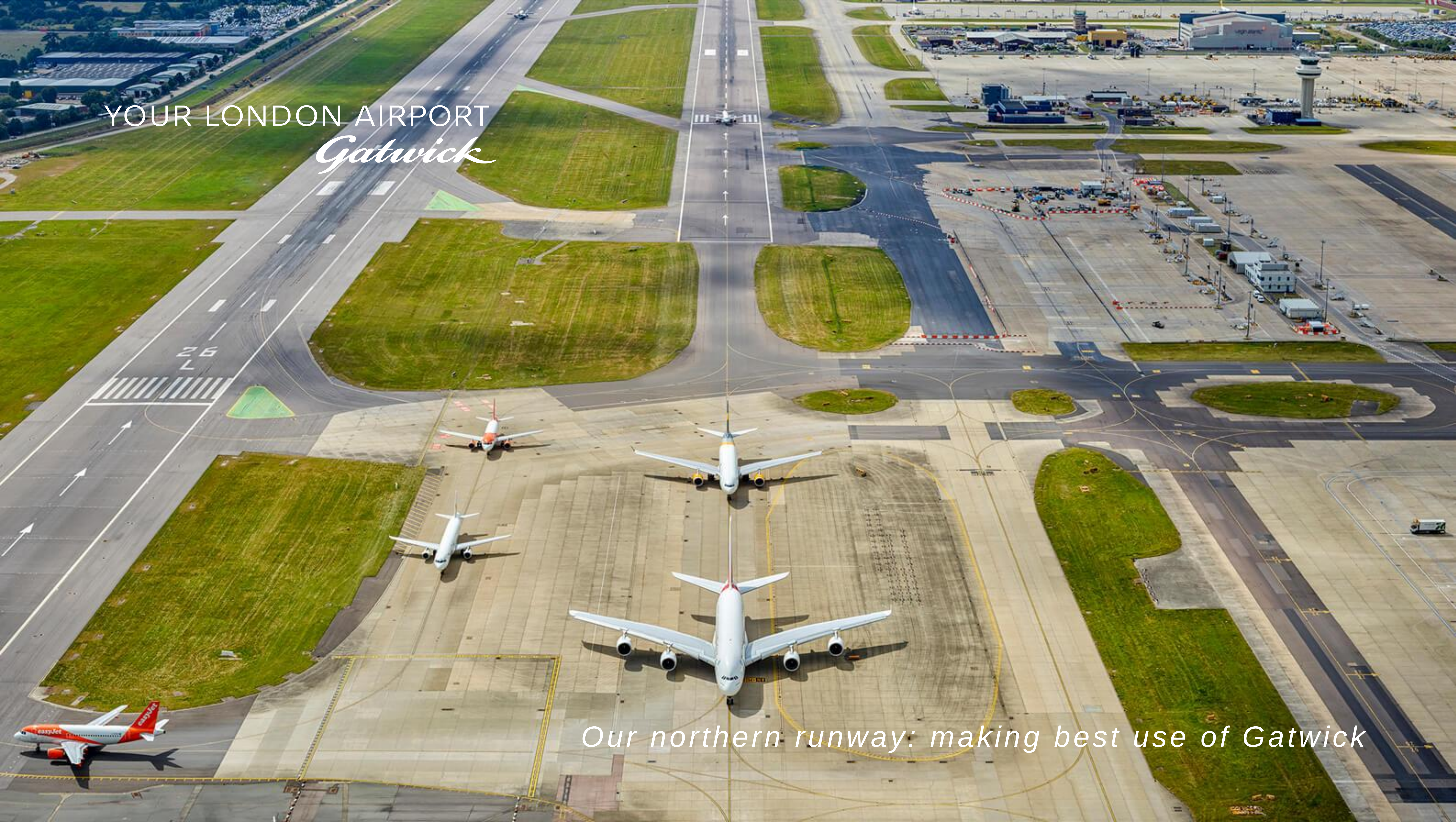

Preliminary Environmental Information Report
Appendix 12.9.1:PTAR Annex B: Strategic Modelling Report

September 2021

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1 Executive Summary

1.1 Executive Summary

1.1.1 This document, the PEIR Strategic Modelling Report is Annex B of the Preliminary Transport Assessment Report (PTAR), which is Appendix 12.9.1 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The Project proposes alteration to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations.

1.1.2 This report provides the detail around the suite of transport models that have been used to develop a sustainable surface access strategy for the future of the airport and help assess the impacts of the proposed development on the surface transport network. The report provides a summary of the rationale for the development of the transport models with full technical details of the model development being provided at the DCO stage.

1.1.3 The Gatwick Strategic Model, which is known as GHOST, (Gatwick's Holistic Overview of Strategic Transport) was developed in order for GAL to assess the impact of any potential future airport growth scenarios on the transport network.

1.1.4 There are three core model components to the GHOST model which align to the modelling structure outlined in TAG (Unit M1.1).

- The demand model – capable of reflecting changes in the distribution and mode of non-airport demand and the mode of travel for airport demand (employees and passengers).
- Assignment models – capable of establishing the likely routes taken by airport and non-airport demand and producing costs for the demand model.
- Simulation models – used for the detailed operational assessment of key pieces of infrastructure at and adjacent to the airport.

1.1.5 GHOST is made up of:

- A highway assignment model in SATURN;
- A separate rail and bus/coach model in Emme;
- A variable demand model in Emme; and
- A Gatwick Mode Choice model, known as GSAM.

1.1.6 GHOST has been developed using available model data including:

- the South East Regional Traffic Model (SERTM);
- PLANET South;
- Crawley Local Transport Model (CLTM); and
- London Highway Assignment Model (LoHAM).
- a wealth of existing data sources including but not limited to traffic count data from local authorities and WebTRIS, surveyed traffic count data, journey time data, distribution data Green Book data, timetable data, Gatwick employee survey data and CAA data.

1.1.7 All the elements of the strategic transport model have been through development, calibration and validation using the appropriate TAG guidance. The model is deemed appropriate for assessment for the PEIR and associated impacts of the development at Gatwick Airport. However, detailed model statistics are being reviewed by stakeholders and the model will be go through a series of updates in terms calibration and validation to feed into the final DCO submission.

1.1.8 The model has been developed to a June 2016 base year and considers the following year assessment years to analyse the peak construction and the operation of the airport:

- 2018 – Forecast to support environmental modelling workstreams
- 2029 – First Full Year of Operation
- 2032 – Interim Assessment Year
- 2047 – Ultimate Year

1.1.9 In term of background growth assumptions in accordance with TAG Unit M4, an uncertainty log was developed for both demand (e.g., developments) and supply (e.g. new transport infrastructure). The demand uncertainty log was used as the basis for reviewing assumptions at a fine level of spatial detail in the Area of Detailed Modelling AoDM. National Trip End Model NTEM assumptions were updated accordingly, and the most current local plan assumptions were used as the basis for the growth trajectory in each local authority district. These were further extrapolated beyond the relevant local plan period adopting the assumptions in the NTEM.

1.1.10 The forecasts prepared by GAL for the Northern Runway and Baseline Cases adopt a 'No Heathrow R3' assumption, as providing a robust assessment of local conditions. GAL will, however, keep this under review as work continues on the project.

1.1.11 Therefore, the central assessment cases for the Project are as follows:

- Gatwick future baseline with no Heathrow R3.
- Gatwick Northern Runway or with "Project", which assumes Project opens in 2029 and Heathrow R3 does not come forward.

1.1.12 Growth in passengers, employees and cargo for both cases and all assessment years has been developed by ICF and used in the modelled scenarios. Additional growth is servicing vehicles to/from the airport has been assumed alongside indirect and catalytic job growth due to the Northern Runway Project, which was provided by a third-party consultant on behalf of GAL.

1.1.13 The strategic model includes measures around the Airport Surface Access Strategy, most notably increases in forecourt and parking charges. These lead to an increase in passenger public transport mode share from around 45% prior to the Covid-19 pandemic up to 54% and 56% between 2029 and 2047. Whilst not at the 60% draft target GAL has set itself for 2030, this increase in public transport mode share for air passengers is significant and notable given the growth in passenger numbers with the Project.

1.1.14 In terms of employees, the strategic model shows that a sustainable transport mode share of 47% is achievable and this would indicate that further measures are required, in particular these could include incentives around EV uptake as well as restrictions on staff parking.

1.1.15 Even with increases in sustainable mode share, the modelling also then assumes proposed highway mitigation is in place in the 'with Project' scenarios in 2032 and 2047. Highway works are proposed as part of Project to both the South Terminal and North Terminal roundabouts, to improve capacity and mitigate against significant effects, with additional improvement works also proposed at the Longbridge Roundabout. The final designs and details of the improvement works will be subject to further road traffic assessment and detailed engagement with highway authorities, including Highways England.

Highway Network Performance Summary

1.1.16 Similar levels of growth are displayed in all four time periods for car business, commute and other trips. Between 2016 and 2047 there are 26% additional business trips, 21% additional commuting trips, and 33% additional other trips.

1.1.17 Between 2016 and 2047 airport passenger car trips are forecast to grow by 24% (an additional 1,672 daily car trips) in the Future Baseline and 50% (3,454) in the Future Baseline with Project. Employee car trips are expected to increase by 18% (300) Future Baseline and 31% (518) with Project.

1.1.18 The impact of the Project compared to the Future Baseline on the highway network across five performance areas has been assessed by considering the AADT, journey times, Volume to Capacity Ratios, and a Magnitude of Impact metric.

1.1.19 In 2029 there are increases of 2,500 vehicles a day with Project for access to Perimeter Road, associated with the relocation of trips from Gatwick South Terminal in the opening year as part of changes related to the car parking strategy.

1.1.20 In 2032 the more significant increases in demand are expected with the Project, including on the M23 north of the airport and on the M23 spur in each direction. Journey times are not notably affected between the Future Baseline and with Project scenarios, with changes across all years limited to no greater than a 1-minute increase for end-to-end journey times.

1.1.21 A few areas around the airport are flagging as having a V/C > 99 with Project which are London Road between Lowfield Heath and Gatwick Road roundabouts in 2029 and 2032 ; Airport Way westbound in 2032 and 2047; Gatwick Road northbound approach to Gatwick Road roundabout in 2032 and 2047 which have been investigated further in the VISSIM modelling. There are additionally some increases in busyness at M23 Junction 9.

1.1.22 The key areas where there are notable Magnitude of Impacts are predominantly at access/egress points to the network for airport traffic, in particular at Gatwick Road roundabout and from North Terminal Long Stay. Staff parking spaces increase change with Project to the south, with access to the network via either Gatwick Road roundabout or Lowfield Heath roundabout.

1.1.23 The increase in traffic with Project, also results in some notable changes on the M23 Junction 9 southbound offslip, particularly in AM1 and AM2, and at the M23 Junction 8 northbound offslips and southbound onslips.

1.1.24 All of these local impact areas are examined in further detail in local VISSIM microsimulation modelling, which is reported in the PTAR.

Public Transport Network Performance Summary

Rail

1.1.25 Between 2019 and 2047 station entries/exits at Gatwick Rail Station are forecast to grow by around 60% in the Future baseline and around 90% in the Future baseline with Project. A Legion simulation model of pedestrian movements through the station has been developed to test the capacity of the station to serve these expanded volumes and is reported in the PTAR.

1.1.26 Overall, the Project adds around 18,600 (+4.2%) passengers over 24 hours in 2047 of which:

- 1,350 (+1.2%) are Brighton Main (Brighton)
- 600 (+1.3%) are Arun Valley
- 550 (+3.0%) are North Downs Line (Reading)
- 100 (+2.4%) are Tonbridge Line
- 16,000 (+6.3%) are Brighton Main (London)

1.1.27 In 2029, 2032 and 2047 there are increases in both seating capacity (due to extra services) and in demand. In 2029 both Future Baseline and with Project scenarios, a similar level of crowding occurs to 2019. Although demand has increased, so has capacity, as the full Thameslink (24 tph) frequencies come into effect as well as extra peak services enabled by the Croydon Area Remodelling Scheme.

1.1.28 In 2032, capacity is unchanged from 2029, but demand growth continues, leading to slightly raised load factors in both scenarios but Purley remains the southern limit for standing into London in the AM peak.

1.1.29 By 2047, the fast services are approaching seated capacity with Gatwick Express seats being 94% occupied (in the Future Baseline) and 96% (in Future Baseline with Project); Fast Victoria 98% and 100% and Fast London Bridge 99% and 100% (Future Baseline and Future Baseline with Project respectively).

1.1.30 The volume changes on the London Underground are small in comparison to the overall volumes forecast on these links, with a maximum forecast change being 141 from Green Park on the Victoria Line. Changes of this magnitude will be unnoticeable when compared to background activity on the London Underground network.

Bus/Coach

1.1.31 This report provides a summary of changes in airport related demand on bus and coach services. The growth rates 2019 to 2047 Project are around 40% for local bus and around 140% for coach. For bus and coach services the assumption is that operators can adjust capacity to manage loadings more readily than rail services, through adjustment of frequencies as Gatwick demand grows. Coach and bus loadings are therefore not assessed against a fixed capacity plan.

Construction Scenarios

1.1.32 Two scenarios have been modelled to assess the impact of construction at two different phases of the development being delivered. These scenarios reflect:

- the airfield and airport works; and
- the effect of the highway construction.

1.1.33 The airfield construction scenario adds 33 vehicles (HGVs and LGVs) in and out an hour along the M23 Spur, and 150 construction worker vehicles in the morning peak hour. These changes are small and no significant impacts are shown by the model.

1.1.34 Highway construction has been modelled to represent the four-month period when construction work will be carried out around South and North Terminal roundabouts. This includes narrowing of lanes and lane closures in the vicinity of the terminal roundabouts. The modelling showed that the constraint on the highway network at both South and North Terminal roundabouts leads to slightly lower numbers of trips using the key routes in/out of the airport via the M25 and M23 corridors across the day.

1.1.35 Additionally, there are increases in AADT through Crawley where vehicles that would normally use the Spur use alternate routes to avoid the constraints on the Spur and terminal roundabouts which are causing congestion/delays. However, the temporary impact on junction operation is limited with the main affects being seen immediately adjacent to the airport.

Conclusion

1.1.36 In summary:

- the Project result in journey times which are not notably affected between the Future Baseline and with Project scenarios, with changes across all years limited to no greater than a 1-minute.
- There are some areas of notable Magnitude of Impacts predominantly at access/egress points to the network for airport traffic, or in close proximity to the airport which are being examined in further detail with the VISSIM model and reported in the PTAR.
- The airfield construction give rise to no significant highway impacts.
- Highway construction shows that the constraint on the highway network at both South and North Terminal roundabouts leads to slightly lower numbers of trips using the key routes in/out of the airport via the M25 and M23 corridors across the day.
- The Project will increase the number of rail passengers but based on the line loading, seated loading factor and standing capacity assessments, no significant crowding on rail services is expected as a result of the Project.
- Given the adaptability of bus and coach provision, it is not considered necessary to model crowding on bus and coach services, the assessment includes service frequency and quality as a measure of public transport amenity. Increased service frequencies provide improved amenity for non-airport users also, benefitting both local communities and businesses by improving connectivity.

2 Introduction

2.1 General

2.1.1 This document, the PEIR Strategic Modelling Report is Annex B of the Preliminary Transport Assessment Report (PTAR), which is Appendix 12.9.1 of the Preliminary Environmental Information Report (PEIR) prepared on behalf of Gatwick Airport Limited (GAL). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the proposal to make best use of Gatwick Airport's existing runways (referred to within this report as 'the Project'). The Project proposes alterations to the existing northern runway which, together with the lifting of the current restrictions on its use, would enable dual runway operations. The Project includes the development of a range of infrastructure and facilities which, with the alterations to the northern runway, would enable the airport passenger and aircraft operations to increase. Further details regarding the components of the Project can be found in the Chapter 5: Project Description of the PEIR.

2.2 Purpose of this report

2.2.1 Gatwick Airport Limited (GAL) have developed a suite of transport models to help develop a sustainable surface access strategy for the future of the airport. The models enable different travel policies at the airport to be assessed to help reduce the impact of increased Air Traffic Movements (ATMs) on the surface transport network.

2.2.2 The models were developed and refined to support GAL's Northern Runway Proposals and enable the assessment of environmental effects in line with national guidance set out in the IEMA EIA guidance and in the DfT's Transport Analysis Guidance (TAG).

2.2.3 This PEIR Strategic Modelling Report sets out the rationale for the development of the transport models, key sources of data, key assumptions and provides an assessment of the potential effects of the scenarios set out above.

2.2.4 Full technical details of the models developed, in a format akin to TAG's recommendations for a Traffic Data Collection Report, Model Validation Report and Traffic Forecasting Reports will be provided at the DCO stage and aspects of these are being discussed with the relevant stakeholders, including the DfT, Surrey County Council (SCC), West Sussex County Council (WSCC) and Highways England. It is expected that this process will continue during and after the PEIR Consultation and during which, model assumptions will be updated and further refined to reflect feedback from stakeholders.

2.3 Northern Runway Proposals

2.3.1 Gatwick Airport is served by a single runway. The airport also has a further runway, which is located north of the main runway and is only available for use when the main runway is closed. This runway is known as the 'northern runway' or the 'standby runway'. A planning condition, together with a planning agreement, has historically prevented this runway from being used at the same time as the main runway. This agreement expired in August 2019 but the planning condition remains in place.

2.3.2 The Project proposes to make alterations to the northern runway, including repositioning its centreline to the north by 12 metres which, along with the lifting of the planning condition restricting its use, would enable dual runway operations in accordance with international standards.

2.3.3 It is anticipated that by 2047 these improvements could increase airport capacity up to 80.2 million passengers per annum (mppa), compared to a maximum potential capacity based on existing facilities of 67.2 mppa within the same timescale. This represents an increase of approximately 13 mppa. Further details of the proposals are presented in the PTAR[1] Section 2.

2.4 Scenarios for assessment

2.4.1 Modelling considers the following assessment years to test and analyse the peak construction phase and the operation of the Airport without and with the Project, details regarding these scenarios are provided in section 8.

2016 Baseline Year

- The baseline year is 2016. This matches the base year of the modelling tools being used and reflects an extensive data collection exercise undertaken by GAL in that year. This includes mobile phone data capture, collected over a two-month period and comprising upwards of 2.5 million devices and 170 million events per day for the busiest days giving a wealth of information to inform transport modelling. Given construction of M23 Smart Motorways from 2018 to 2020, rail disruption in 2016 through to 2018, and now the Covid pandemic, this remains the most recent dataset.
- The baseline scenario is used to describe existing transport infrastructure and the performance of the transport network prior to expansion. In order to provide comparison with other environmental modelling workstreams a 2018 forecast was provided from the model to support these assessments.

2029 First Full Year of Operation

2.4.2 The first year of operation after opening of the Project is anticipated to be 2029, accordingly this would be the first operational year modelled and tested.

2032 Interim Assessment Year

2.4.3 An interim assessment year, by which time it is expected that all slots on the northern runway are likely to have been filled and the highway mitigation is expected to be in place. This horizon year was tested both without and with the Project.

2047 Ultimate Year

2.4.4 Reflecting a requirement under the Design Manual for Road and Bridges[2] to assess the effects of a highway project (the Northern Runway highway mitigation scheme in this context) 15 years after it has been completed. This assessment year has been tested both without and with the Project.

Construction Traffic Scenarios

2.4.5 Two construction traffic scenarios have been considered.

2.4.6 This first provides an understanding the impact of peak construction vehicle traffic on the highway network. It considers construction traffic reflecting the significant airfield and airport works, which would be completed in the mid-2020s, modelled using the 2029 baseline scenario for airport and background traffic.

[1] Appendix 12.9.1 PTAR

[2] DMRB Vol. 5, Sec. 1 (TD37/93)

2.4.7 The second scenario provides an understanding of the impact of constructing the highway mitigation. This construction scenario uses the 2029 with Project airport traffic and considers the effects associated with highway construction, such as potential traffic redistribution using strategic modelling.

Habitats Regulations Assessment (HRA)

2.4.8 Guidance produced by Natural England[3] identifies the following considerations for the assessment of air pollution impacts at ecological sites reported in an HRA: To support this assessment, an additional scenario for 2032 was required to create an alternate future baseline scenario, full details are provided in section 7.3.

2.5 Stakeholder Engagement

2.5.1 The model has been developed with input from key stakeholders such as DfT, Highways England and Local Authorities including West Sussex and Surrey councils. This was undertaken through a series of technical workshops and reviewing of specific modelling technical notes when the base model was being developed. Stakeholder engagement meetings are recorded in Table 4.2.1 of the PTAR. These workshops have been restarted in Summer 2021 to finalise the base and forecast year models for DCO submission with initial meetings held with:

- DfT;
- Highways England;
- Surrey; and
- West Sussex.

2.6 Structure of report

2.6.1 This report is set out as follows:

- Section 3 provides an outline of the **modelling framework**, the range of interventions to be tested and the requirements for the models developed.
- Section 4 sets out the **key features of the models**, this covers the general architecture of the models developed, the coverage, time periods and segmentation.
- Section 5 lists out the types of **data** that were collected and collated on behalf of developing the models.
- Section 6 describes the **model development** approach.
- Section 7 describes the range of **background forecasting assumptions** used to construct the future baseline.
- Section 8 sets out the specific **Northern Runway Proposals** in the context of strategic model assumptions.
- Section 9 provides the **future demand by mode** at the airport. These are outputs of the model forecasts for the Future Baseline and Future Baseline with Project scenarios – showing the airport passenger and employment demand at the airport using different surface transport modes of access.
- Section 10 describes the potential **highway network performance** when considering each of the assessment scenarios. This sets out the impact at different geographical scales.
- Section 11 describes the **public transport network performance** for each of the assessment scenarios covering both rail and the bus / coach networks.
- Section 12 evaluates the **construction scenarios** including airfield construction activity and the construction of highway mitigation.
- Section 13 sets out the assumptions for generating outputs from the model to support environmental assessment.
- Section 14 provides an overall summary and conclusion of the assessment.

[3] Natural England (2018), Approach to advising competent authorities on road traffic emissions and HRAs

3 Modelling framework and assessment requirements

3.1 Model uses

3.1.1 The Gatwick Strategic Model, which is known as GHOST, (Gatwick's Holistic Overview of Strategic Transport) was developed in order for GAL to assess the impact of any potential future airport growth scenarios on the transport network. It allows GAL to understand the impacts of changes in transport system capacity or performance on airport accessibility and the modes of transport used by passengers and employees.

3.1.2 The GHOST model was designed to specifically test proposals that include:

- growth in passenger numbers;
- change in flight schedules (such as the mixture of long haul and short haul flights, change in arrival and departure profiles and aircraft size) affecting passenger numbers and demographics;
- growth in staff numbers;
- changes to surface transport access and behaviour;
- responses to changes in travel cost over time; and
- surface access designs.

3.1.3 Additionally, the model is capable of including the potential impacts of:

- Committed proposals for upgrades to the wider transport system (e.g., highway junction improvements, rail service upgrades, bus frequency changes).
- Committed development proposals with the local area covering housing, employment or mixed-use development sites.
- The model is capable of providing traffic forecasts and network speed impacts that are required for environmental assessments covering noise and air quality.

3.2 Interventions to be tested

3.2.1 The previous work undertaken for the Gatwick Second Runway Airport Surface Access Strategy (R2 ASAS), in response to the Airports Commission, identified a range of potential transport schemes that could be required to support growth at Gatwick Airport. The strategic model was developed in order to be able to assess the impact of these interventions. These included:

- highway widening;
- junction improvements, including grade separation;
- signal timings / controller change;
- changes to rail and bus/coach services;
- public transport service frequency changes and speed changes;
- parking regime changes; and
- pricing / fare changes (including access charges and car parking).

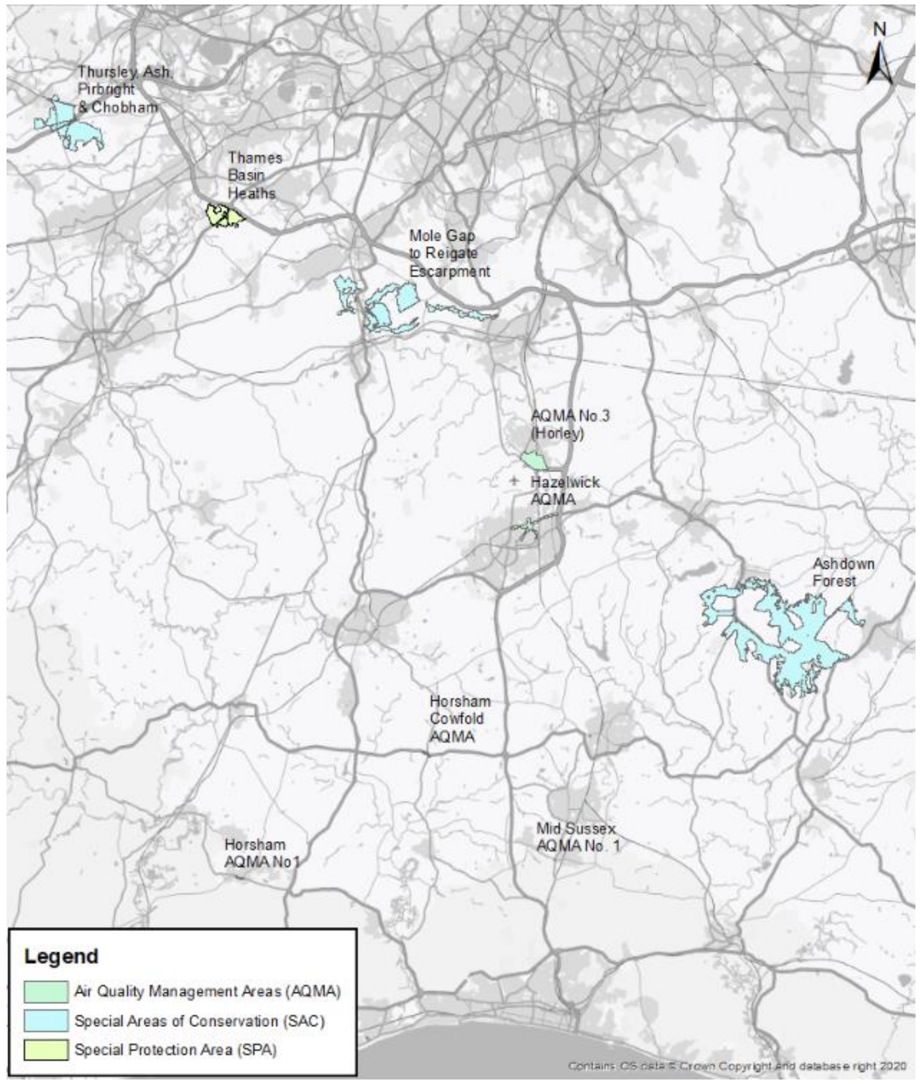
3.3 Key requirements

3.3.1 The core requirements of the GHOST model are a capability to assess the transport network affected by Gatwick Airport in order to assess the impact of future changes at the airport.

3.3.2 Considering the specifics of potential changes at the airport and the transport system serving it, the following requirements were used as the basis for developing the model:

- multi-modal capability with highway, public transport (rail and bus/coach) modes represented;
- time periods that take account of peaks at Gatwick airport and peaks on the surrounding road and rail networks, which in some cases may differ;
- separate segmentation for airport passengers and employees in order to be able to update passengers and employee numbers, their distribution, and represent the different perceptions of mode choice for each group;
- inclusion of goods traffic movements consistent with airport operations, services and airborne cargo demand;
- the highway model includes detailed junction modelling covering a suitable area, and takes account of flow metering and blocking back effects to accurately reflect delays and potential upstream effects;
- demand modelling functionality to represent the potential behavioural responses to changes in travel costs, such as changes in trip distribution and mode, for non-airport users;
- sufficient detail at the airport is included to be able to provide inputs into local more detailed simulations models that model the detailed operation of key pieces of infrastructure (e.g., capable of assessing detailed highway junction performance, or the operation of Gatwick Airport station); and
- inclusion of sufficient spatial detail and accuracy to facilitate environmental assessments for noise and air quality. Figure 1 shows the environmentally sensitive areas in the local area highlighting the potential relevance of model detail in these areas.

Figure 1: Environmentally sensitive areas near to Gatwick Airport



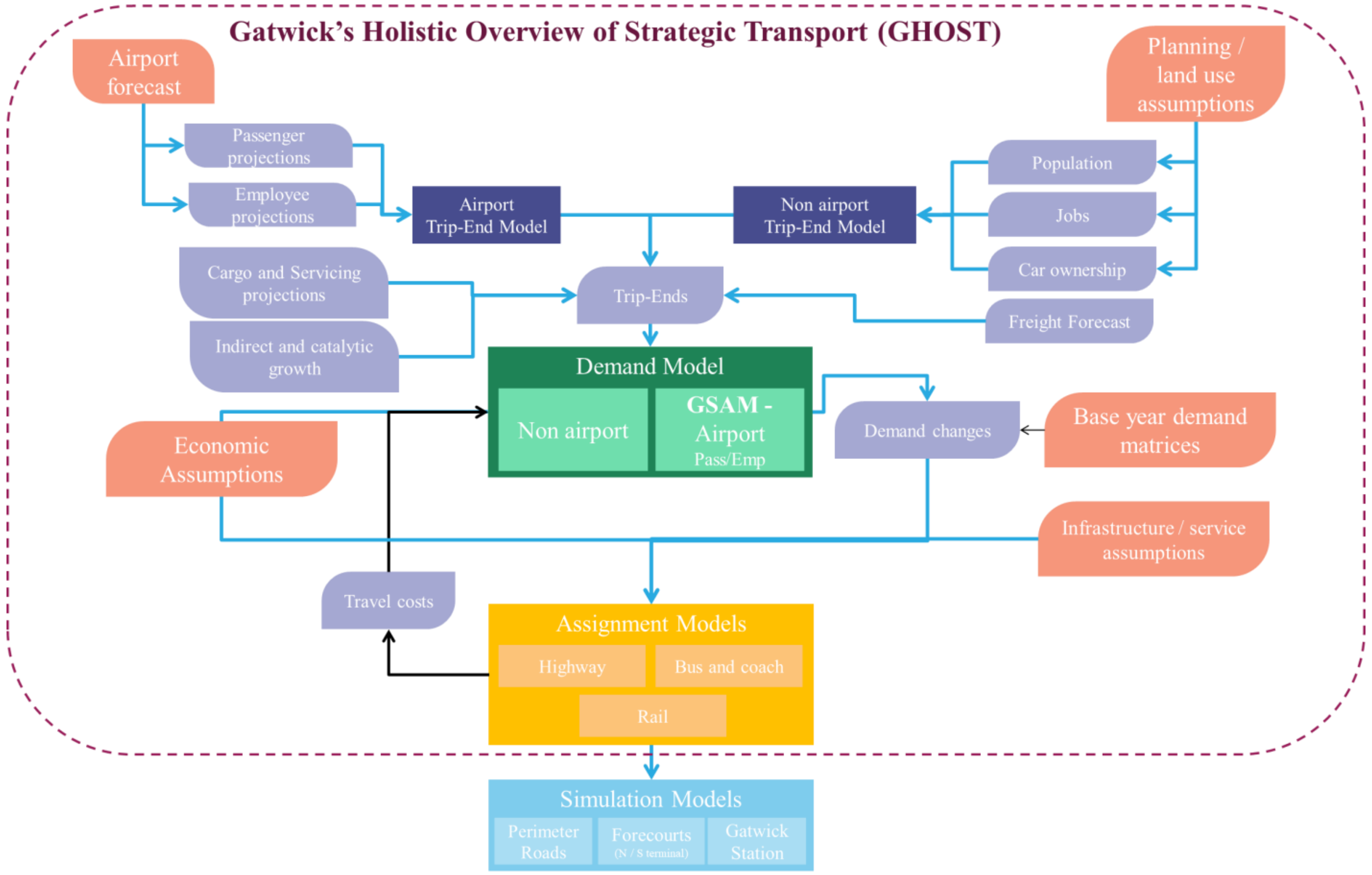
4 Key features of models

4.1 Overall modelling architecture

4.1.1 Figure 2 outlines the overall modelling structure that the GHOST Model follows. This aligns with the approach in TAG (Unit M1.1). It outlines three core model components:

- **The demand model** – capable of reflecting changes in the distribution and mode of non-airport demand and the mode of travel for airport demand (employees and passengers).
- **Assignment models** – capable of establishing the likely routes taken by airport and non-airport demand and producing costs for the demand model.
- **Simulation models** – used for the detailed operational assessment of key pieces of infrastructure at and adjacent to the airport.

Figure 2: Model Architecture



4.2 Source model overview

Use of existing models

4.2.1 The main objective of the model development is to create a suite of models that covers the requirements listed in Section 3.

4.2.2 A number of pre-existing models have provided useful source data to support the development of the GHOST model. The approach was therefore to make best use of existing model components, along with the incorporation of relevant data, to ensure the approach aligns with guidance within the DfT's TAG. The key source models are summarised below.

South East Regional Traffic Model (SERTM)

4.2.3 Highways England commissioned the development of five regional transport models in 2015, one of which covers the South East region. The South East model covers the South East England region which includes Gatwick Airport and the surrounding area with a modelled base year of March 2015.

4.2.4 These regional models were developed in order to assist in the assessment of Road Investment Strategy (RIS) schemes. The nature of the regional model means that there is no single geographic area of focus, and therefore to use the model for a local study, local area updates and recalibration/validation was required.

PLANET South (PS)

4.2.5 PLANET South (PS) is an AM peak rail model covering the south of England with a base year of 2011. PS is a member of the PLANET group of models, owned by the Department for Transport (DfT). It is focussed on national rail (TOCs); but London Underground, DLR and Croydon Tramlink services are also included to provide London access and cross London connectivity for rail trips.

Crawley Local Transport Model (CLTM)

4.2.6 The Crawley Local Transport Model (CLTM) is owned by West Sussex County Council (WSCC). The model focuses its area of detailed modelling on the town of Crawley with some extension of the simulation network coding to the north to account for trips between Crawley and both Gatwick Airport and Horley. The model version that we considered had a base year of November 2015.

4.2.7 The SATURN highway assignment model is supported by a spreadsheet-based trip-end and mode choice model in order to assess mode share in terms of public transport and active modes. This methodology means that other demand responses such as time period choice are not considered.

London Highway Assignment Model (LoHAM)

4.2.8 The London Highway Assignment Model (LoHAM) is owned by Transport for London (TfL). London is the area of focus with detailed simulation network inside the M25. At the time of developing the GHOST model TfL were creating an updated model with a base year of November 2016 which wasn't yet complete, with only the initial networks available for use during the development stage.

4.2.9 The HAM model is fed by TfL's demand model LTS with a separate public transport model, Railplan, used to assess the public transport network.

4.3 Model Platform

4.3.1 This section outlines the different software components that have been adopted to make best use of the available models in the development of the GHOST model.

Highway Assignment Model (HAM)

4.3.2 The South East region and the area around Gatwick in particular experience congestion during the peak periods. This, along with the network detail needed to assess widening and junction improvements requires a model platform that can assess these types of interventions.

4.3.3 The HAM was developed in the SATURN software, which is the most appropriate software for strategic highway modelling and is the software used by all of the source highway models. SATURN allows flow metering and blocking back to be modelled as well as achieving good convergence over large areas where detailed simulation is required for all junction types.

Public Transport Assignment Model

4.3.4 Emme was used for the public transport models. Emme is a well-established and reliable software for public transport assignment, including modelling impacts of in-vehicle crowding on passenger route choice. Both TfL and DfT have their principal rail models in Emme software (Railplan and PS respectively) and its strengths and limitations are well understood.

Variable Demand Model (for Non-Airport movements)

4.3.5 The highway and PT parts of the model are linked through a TAG aligned Variable Demand Model (VDM). Two options were considered: adapting the SERTM VDM which is coded in DfT software DIADEM; or developing an equivalent VDM in Emme scripting software for a more bespoke application.

4.3.6 Following a review, it was determined that an Emme option was preferred to allow for an improved interface between all component model parts, allowing for greater control over methodology and quality control.

Airport Demand Models

4.3.7 For consistency with other parts of the model and for efficiency (fast matrix calculations) the airport demand models were implemented in the Emme software.

4.3.8 The Gatwick Surface Access Models (GSAM) are mode choice models for travel to/from Gatwick Airport. GSAM is a key component of the strategic model; its role is to forecast how the mode choices of air passengers and airport employees change as transport supply times and costs change. It is comprised of two parts:

- an Air passenger model called GapSAM (Gatwick air passenger Surface Access Model); and
- an employee access model called GemSAM (Gatwick employee Surface Access Model).

4.4 Model Coverage and Network Structure

Highway Model Coverage

4.4.1 SERTM was used as a basis for assessing the extent of the modelled area which is shown in Figure 3. The Area of Detailed Modelling (AoDM) extends to the A27 in the south and Croydon in the North. The extent of the AoDM was determined through analysis of scale of the potential Affected Road Network (ARN) using SERTM by uplifting airport demand and reassigning to the base network to identify the ARN following the quantification method outlined in DMRB.

4.4.2 The fully modelled area includes the entire M25 and road network in London, however it should be noted that outside of the AoDM London is coded as a fixed speed network. Outside the fully modelled area the network consists of buffer links coded with fixed speeds. The buffer network covers the rest of Great Britain and provides realistic routing and journey times for trips to and from external zones. In both the fully modelled and external areas the model is not validated.

Figure 3: Highway Assignment Model Extent

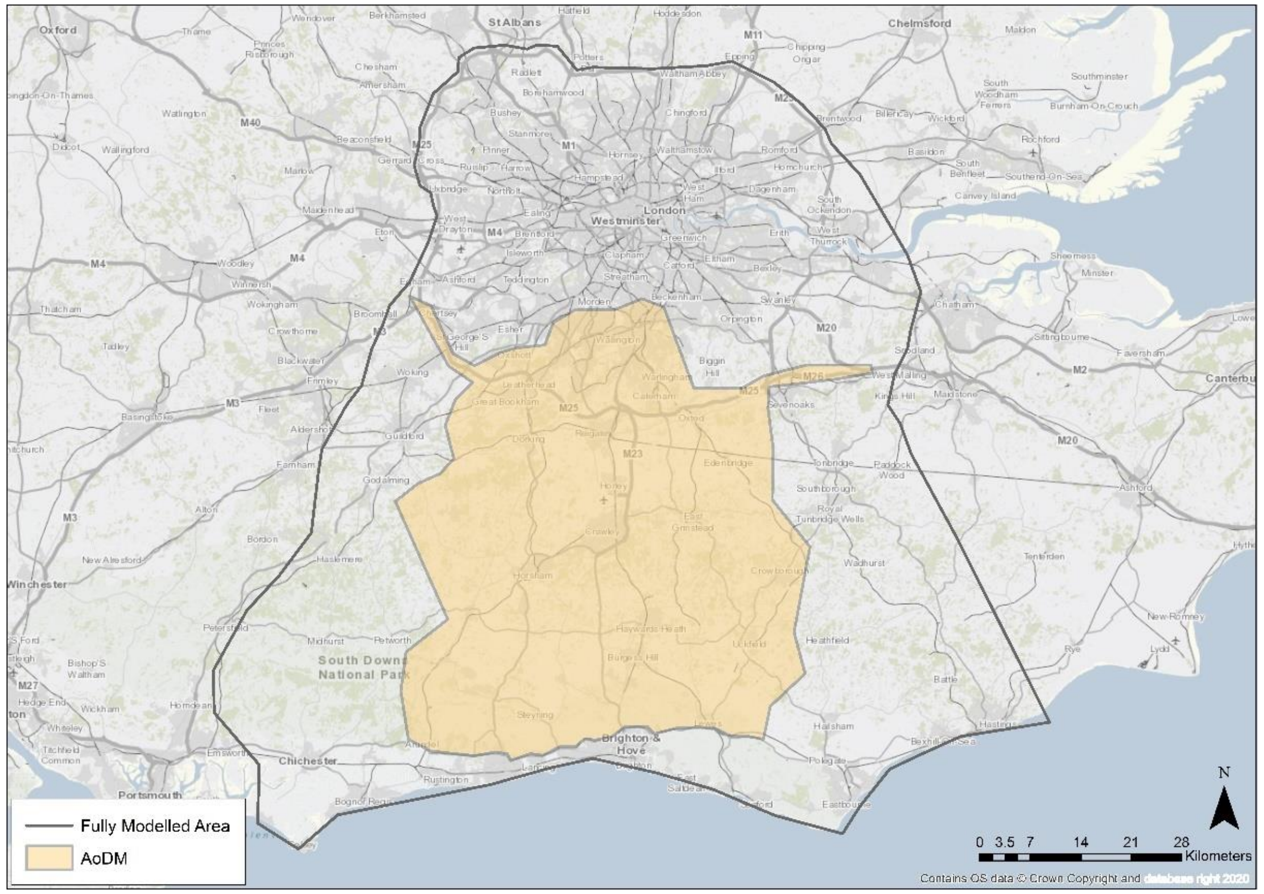


Figure 4: Rail network extent

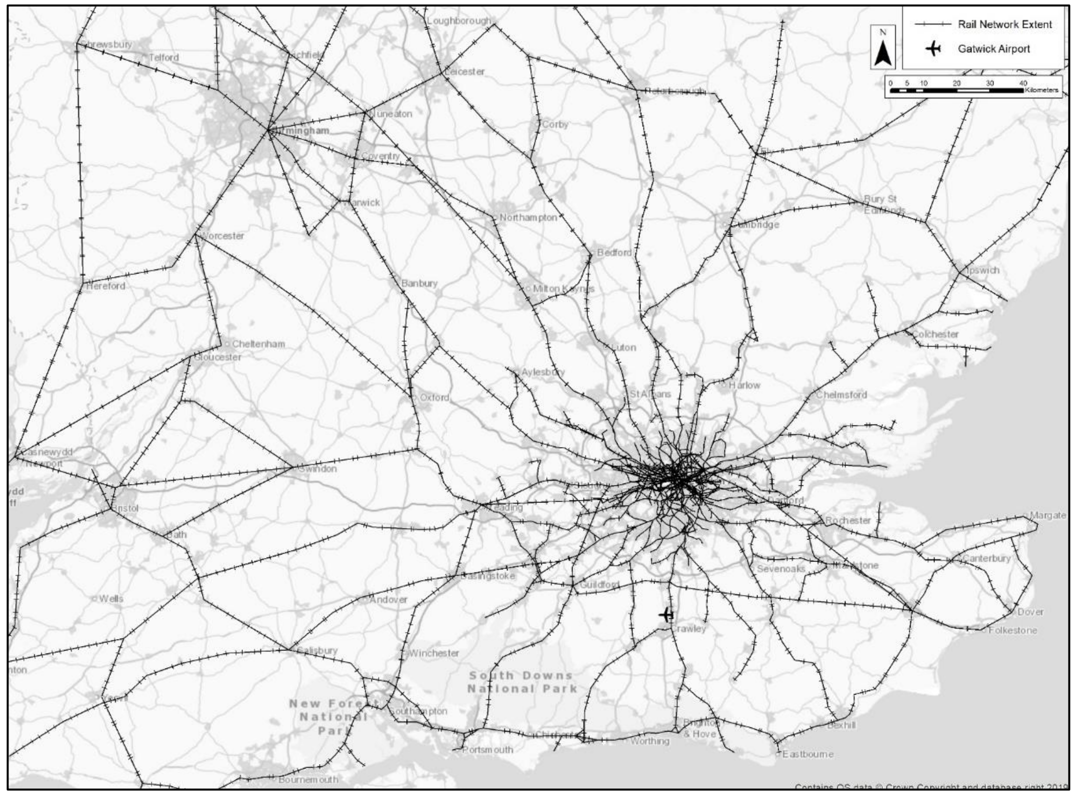
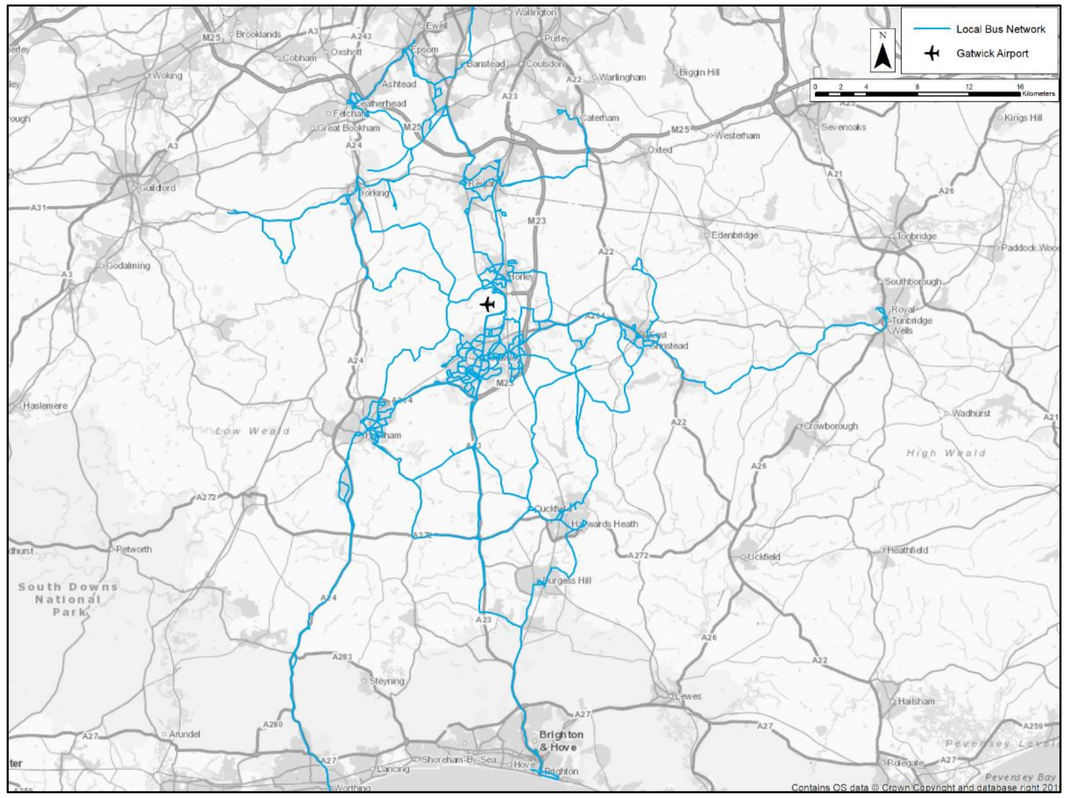


Figure 5: Local Bus Network



Public Transport Model Coverage

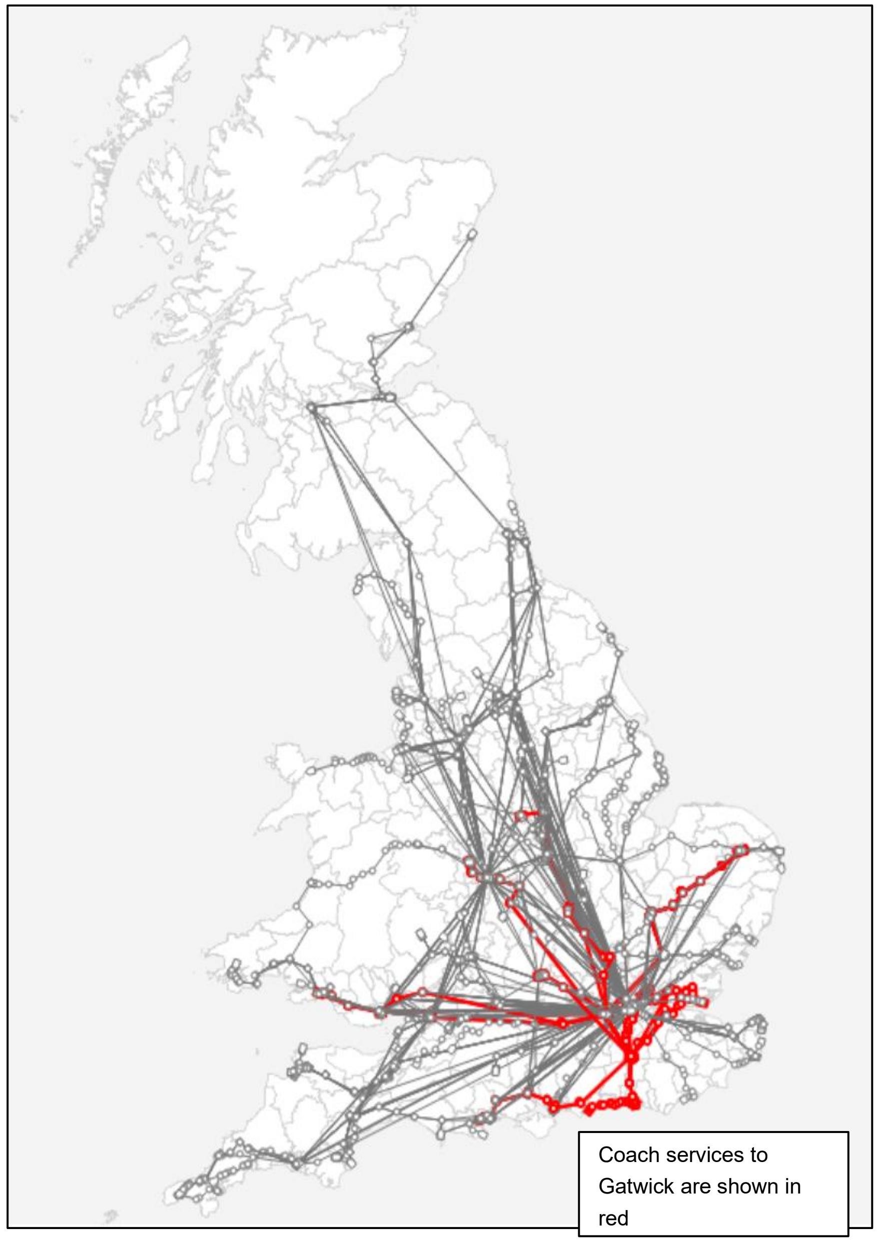
4.4.3 The extent of the public transport models for both rail and local bus and coach are shown in Figure 4 and Figure 5 and Figure 6 respectively. The rail model covers all national rail demand, stations and services in southeast England, while the bus/coach model covers demand for travel to and from Gatwick Airport only.

4.4.4 It was deemed advantageous that the rail model should include rail demand for all London corridors given that travel to Gatwick for many movements requires cross-London travel. Therefore, full coverage of PS has been included. This covers a far wider area, including origins that have recently become directly linked to Gatwick by Thameslink, such as Stevenage, Peterborough and Cambridge.

4.4.5 The bus/coach model includes all bus services that operate to, from or within the Crawley, Horley and Gatwick area. These are operated mainly by Metrobus plus a few by Southdown. The services include those that do not serve Gatwick Airport such Route 11 (Maidenbower) and 23 (Worthing) from which a transfer at Crawley bus station would be required to reach Gatwick.

4.4.6 The bus/coach model also includes all coach services operated by Megabus and National Express nationwide, plus other coach operators operating services at Gatwick Airport.

Figure 6: Coach network (interpeak)



4.5 Model Base Year

4.5.1 The model base year is 2016. This matches the base year of the modelling tools being used and reflects an extensive data collection exercise undertaken by GAL in that year including traffic count data, mobile phone data, and an employee travel survey.

4.5.2 It corresponds with normal road conditions prior to the M23 Smart Motorway programme, which started in 2018 and completed in September 2020, and the subsequent Covid pandemic. The M23 Smart Motorway programme resulted in roadworks and associated speed limit restrictions on the major strategic route to the airport.

4.5.3 From 2016 through to 2018 there was disruption (reduced services, cancellations, short formed services) on the Southern rail network including Brighton Main Line due to reconstruction of London Bridge station and Thameslink Programme. Analysis of growth rates showed that during this period there was lower than normal growth (or even contraction) and unreliable counts. Following discussion with train operator GTR it was determined that 2016 demand in the absence of disruption would be estimated by interpolating between counts taken before and after the disruption. The resulting underlying growth rates were checked against other areas, that were not affected, and found to be similar.

4.5.4 Taking all the above into account, 2016 was determined to be the most appropriate base year for the strategic model as it would replicate more normal conditions alongside the appropriate count datasets.

4.6 Time periods and seasonality

4.6.1 Airport seasonality analysis and traffic flow analysis on both the strategic and local road network was undertaken and showed that June was considered an appropriate month for the purpose of the assessment. June is representative of a neutral month for background traffic being outside of the school holidays, while the airport flows are 18% higher than the annual average, with the airport operating its summer flight schedule.

4.6.2 In addition to analysing the seasonality profiles, counts sites on both the strategic and local road network were analysed to understand the peak flows on the highway network. The analysis concluded that in the morning peak period there were distinct peak hours on the SRN and Local Road networks, in order to assess the peak impact upon the network two separate hours therefore needed to be modelled. In the evening peak period, SRN and local road network profiles are similar and therefore an average hour is most representative of typical conditions.

4.6.3 Therefore the time period definitions for the highway model are:

- AM Peak Hour 1 – representing the peak in flows on the SRN network between 07:00 – 08:00;
- AM Peak Hour 2 – representing the distinct peak in vehicles on the network between 08:00 – 09:00;
- IP Average Hour – representing an average hour flow between 09:00 – 16:00;
- PM Average Hour – representing an average hour flow between 16:00 – 18:00; and
- Off Peak Average Hour – representing an average hour flow between 18:00 – 07:00.

4.6.4 The Variable Demand Model has the same periods as the highway model except that periods AM1 and AM2 were combined into a single AM Peak period.

4.6.5 The PT models and the Airport Demand model have the following time periods:

- AM Peak – representing the period 07:00-09:00;
- Interpeak – representing the period 09:00-16:00;
- PM Peak– representing the period 16:00-18:00;
- Off Peak 1 – representing the period 18:00-24:00;
- Off Peak 2 – representing the period 00:00-04:00;
- Off Peak 3 – representing the period 04:00-07:00;

4.6.6 Three off peak periods have been selected to reflect the three very different levels of service to/from Gatwick in the off-peak: during OP1 (evening) there is good level of service and high PT mode share; in OP2 (night) there is little demand and most rail and bus lines have no service; and OP3 (early morning) when a reduced service operates and there is low PT mode share but significant airport demand .

4.7 Segmentation

4.7.1 The following level of segmentation has been applied in the highway assignment model:

- Car – Employers' Business;
- Car – Commute;
- Car – Other;
- Car – Gatwick Airport Employees;
- Car – Gatwick Airport Passengers;
- Light Goods Vehicles (LGVs); and
- Heavy Goods Vehicles.

4.7.2 In the VDM the segments are:

- Home-based work (commute)
- Home-based employers business
- Non-home-based employers business

- Home-based other
- Non-home-based other
- LGV (fixed)
- HGV (fixed)

4.7.3 The rail assignment has been segmented by purpose as in the existing PS model: business, commute and leisure; and the bus/coach assignment will only include assignment of airport users.

4.7.4 The airport passenger and employee mode choice models have adopted a segmentation that is appropriate to airport passengers and employees. For air passengers the segmentation has the same categories used in several existing SE England airport choice models: UK-resident Business, UK-resident Leisure, UK-non-resident Business, UK-non-resident Leisure.

4.8 Assignment Methodology

Highway Assignment

4.8.1 The assignment procedure used for the highway model is an interaction between an equilibrium assignment and a junction delay calculation, distributing demand according to Wardrop's first principle of traffic equilibrium:

4.8.2 "Under equilibrium conditions traffic arranges itself in congested networks in such a way that no individual trip makers can reduce his path costs by switching routes"

4.8.3 The state of equilibrium is reached by iterating between inner and outer assignment loops. Within the inner assignment loop, alternative routes for an origin-destination pair are brought into a state of equilibrium by shifting traffic from one route to the other until the travel time is the same. The outer loop then checks whether other routes with shorter travel times can be found as a result of the current assignment. This is repeated until no routes with an equal or shorter travel time can be found.

Public Transport Assignment

4.8.4 The public transport assignment is undertaken using the assignment algorithm of the Emme software and in the case of rail, the crowding functions of PS. Separate assignments are undertaken for rail (national rail, London Underground, DLR and Croydon Tramlink) and bus (local bus and scheduled coach). Trips that use both (e.g., local bus then rail) are treated as rail trips.

4.8.5 Routing through the network depends on the items included in the generalised cost function, which are as follows:

- Access time to bus stop / rail station
- waiting time at the bus stop / rail station
- in-vehicle time
- boarding / transfer penalty
- interchange walking time
- crowding penalties (peak periods only; rail only)
- egress time from final bus stop / rail station to destination

4.8.6 This is a standard approach for modelling public transport except in the one respect that we include modelling of crowding in the peak rail assignments using the methodology inherited from the PS model. This is appropriate to modelling rail route choice and generalised costs in peak times in the London area.

4.8.7 Fares do not influence the assignment routing but are included in generalised costs for the variable demand and airport mode choice models.

4.9 Generalised Cost Formulation and Parameter Values

4.9.1 The generalised costs here relate to the highway assignment model where it refers to both the monetary (i.e., fuel cost, vehicle operating cost) and non-monetary (i.e. travelling time) costs of a journey. Parameters are input for individual user classes. Monetary values are input to SATURN as pence per kilometre and non-monetary are input as pence per minute.

4.9.2 These costs interact to affect route choice. If time is highly valued and distance is not valued at all, the quickest journey will be chosen, no matter how long the distance. Similarly, if distance is highly valued and time not at all, the shortest distance will be chosen.

4.9.3 Generalised cost values were calculated based on the latest vehicle operating costs, values of time and user class splits as outlined within TAG Unit A1.3 and based on the prevailing TAG databook. TAG databook version 1.14, released July 2020, was used as the basis for the modelling described in this report.

5 Data

5.1.1 This section focuses on the availability of data that was used to develop the components of the GHOST model. A combination of primary and secondary data sources was included in the development of the model with specific data required for each model component.

5.2 Highway related data

5.2.1 To support the development of the highway model, data was required to capture the configuration of junctions and their characteristics (e.g., signal timings), the observed journey times and delays on the network, as well as traffic volumes and the classes of vehicles using the network. All data received was reviewed and processed to develop a consistent dataset to represent June 2016 conditions. A series of seasonality adjustments were used to ensure any secondary data not occurring during June 2016 was adjusted accordingly.

Traffic count data

5.2.2 For the development of the Gatwick Highway Assignment Model (HAM) an extensive primary data collection exercise was undertaken in 2016 to aid the development a model in the local area and assist in the calibration and validation exercise. Additional count data was collected in summer 2019. A variety of secondary data sources were identified from local highway authorities, including Surrey County Council, West Sussex County Council, East Sussex County Council and Transport for London. The data collected was used to provide information on either traffic volumes or journey times. Volumetric data was also obtained from the DfT for minor and major roads.

5.2.3 In total 545 counts are used for the calibration and validation of the model and associated with screenlines/cordons or ad hoc locations used to inform specific roads. The sources are outlined in Table 5.2.1.

Table 5.2.1: Sources of count data used in calibration/validation

Source	Number of Counts
WebTRIS	127
Surrey	29
East Sussex	39
Surveyed Sites	87
West Sussex	81
TfL	191

5.2.4 Additionally, manual classified counts providing estimates of vehicle proportions at specific locations were used, these were largely sourced from DfT sites.

Volumetric Data

5.2.5 Highways England have an extensive set of permanent monitoring sites across the Strategic Road Network (SRN). These measure the volume of traffic on the network and provide continuous output. This was used to support the derivation of robust seasonality profiles and average hourly volumes at specific sites covering the A27, A23, M25 and M23. Volumetric data available via DfT for minor and major roads were also considered for this purpose.

Journey Time Data

5.2.6 Historic journey time data was sourced from INRIX, a company providing observed data from a fleet of vehicles moving across the network. This data provides an estimated road speed at different times of day based on real time GPS feeds from vehicle navigation systems and in vehicle security systems. These feeds are processed to form estimates of vehicle speeds on individual stretches of road. Data was obtained for the period 1st April 2016 to 30th June 2016.

Trip Distribution Data

5.2.7 Citi Logik (CL) were commissioned in 2016 to provide travel demand data for an area within the south east of England. In the context of GAL, a broad specification to the data was included to ensure that temporal and geographic characteristics of travel through the area could be identified.

5.2.8 The Department for Transport's National Travel Survey dataset has been obtained at End User Licence (EUL) level via the UK Data Service (dataset Study Number 5340). The dataset, obtained for the period of 2002 – 2017, provides records from a series of household surveys designed to provide regular, up-to-date data on personal travel and monitor changes in travel behaviour over time.[4] The dataset has been used to provide validation checks throughout the matrix building process, namely providing trip length distribution information.

5.2.9 In addition, Transport for London provided data from their own research on movements within and from / to greater London. This was also derived from Mobile Network Data and was used as the basis for checking the amount of demand within London and between the M23 corridor and London.

Highway Models

5.2.10 Existing HAMs were used to inform the development of the highway component of the GHOST model. These sources included:

- South East Regional Traffic Model (SERTM), owned by Highways England;
- London Highway Assignment Model (LoHAM), owned by TfL; and
- Crawley Local Transport model (CLTM), owned by West Sussex.

5.2.11 Other models such as Surrey's transport model were considered but on review were not considered appropriate for developing a model of the Gatwick area due to incompatibility of software.

5.3 Public Transport Data

5.3.1 The Rail model and bus/coach model component of the GHOST model utilises a variety of data sources and is summarised in Table 5.3.1.

[4] https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=5340

Table 5.3.1: PT Data Sources

PT Mode	Data Source	Type	Year, Coverage
Rail	Planet South model	-	2012, AM only
Rail	DfT Rail Statistics – Rai0201 / Rai0203	Services / Seats	2016 (24h), London Termini
Rail	ORR Estimates of station Usage	Demand	2012 & 2016, National Rail stations
Rail	DfT Green Book – Total Load	Total Load	2016, (All TOCs excluding GTR, by service), London Termini
Rail	DfT Green Book – Seats + total capacity / Services	Seats / Services	2016, (All TOCs excluding GTR, by service), London Termini
Rail	GTR Data – Total Load	Total Load	2012, 2019 (All GTR services), London Termini
Rail	GTR Data – Seats + total capacity / Services	Seats / Services	2016, (All GTR services), London Termini
Rail	Google Directions API	Journey Times	2019, (routes to/through London/Gatwick)
Rail	Rail Delivery Group, CIF Timetable	Services / Journey Times	2016, May
Rail	TfL Working Timetable	Services / Journey Times	2016 - 2019
Rail	Highways England South East Regional Transport Model	Demand	2015
Rail	TEMPRO	Demand	-
Rail	National Rail Travel Survey 2009	Demand	2009
Rail / Bus	Gatwick Airport Limited Employee Survey	Demand	2016
Rail	CAA Gatwick Departing Air Passenger Survey	Demand	2014 - 2018
Rail / Bus	Gatwick Airport Terminal Counts	Demand	2016
Bus/Coach	GTFS / OSM	Services / Journey Times	2019
Bus/Coach	Online timetables	Services / Journey Times	2019

Rail Data

DfT

5.3.2 Data publicly available through DfT's online rail statistics portal provides information on the number of services, seats and standing capacity in/out of London termini for 2016. This information was used to validate the rail model at a 24-hour level.

5.3.3 DfT provided access to Green Book data for use on the study. This is very detailed data providing information on train formations/capacities and average loadings crossing a cordon formed by the TfL Zone 1 boundary. This data was used to code individual service capacities and to size the matrices. The following was received:

- All TOCs except Govia Thameslink Railway (GTR) – passenger flows, services and formations for all services originating/terminating/through London termini, autumn 2016;
- GTR – passenger flows, 2012 & 2019; and
- GTR – services, seats and total capacities, 2016.

Google Directions API data

5.3.4 Journey time analysis via Google Directions API was explored. The data captured through this process provides information relating to in-vehicle travel time, transfers/interchanges, walk-time and wait time. A selection of origin-destination pairs relating to Gatwick Airport and various key London locations were analysed. The data collected through this method corresponded to July 2019. This is not aligned with the base year of the model, 2016, therefore it was necessary to assess the impact of changes in the intervening period and impacts these changes may have on travel routes and times, particularly relating to Thameslink/London Bridge disruptions in 2016.

Office of Rail and Road Statistics

5.3.5 The Office of Rail and Road provide statistics through its online portal relating to entries and exists across all national rail stations in each year. The following two sources were utilised:

- estimates-of-station-usage-2010-11; and
- estimates-of-station-usage-2016-17

RDG CIF Timetable

5.3.6 Rail Delivery Group timetable information forms the foundation for inputs relating to all National Rail services for the rail model. The extracted data pertains to the May-Dec 2016 timetable. Data comprising train origin and destination termini, departure/arrival times and stop-stop times were processed for use in the rail model for all TOCs in London and the south east.

Bus and Coach Data

5.3.7 The foundation of the bus/coach network uses a combination of GTFS[5] data and Open Street Map (OSM) for 2019.

5.3.8 To assist in the validation of the bus/coach model, online resources were used to assess the validity of modelled services and journey times. These were obtained from operator websites including Megabus, Oxford Bus Company, National Express and easyBus.

5.4 Air passenger data

5.4.1 Civil Aviation Authority (CAA) data from Gatwick air passenger surveys 2014-2018 was used to provide the database of air passenger details such as home location, mode of travel, travel purpose, parking location.

5.4.2 Gatwick Airport Limited provided counts of passengers arriving at, and departing from, Gatwick North and South terminals in 15-minute time slices. These were used in the development of weights to expand the air passenger surveys

5.5 Employee survey data

5.5.1 For the employee model, behavioural survey data was obtained from the Gatwick Employee and Employment survey that GAL undertakes periodically of all employees who work within the airport. The last one, used in this study, was taken in Spring 2016. The data captured includes job type, work start and end times (for up to three shifts), home location and travel mode.

5.5.2 There were 5,323 usable responses from a total workforce of around 23,000. GAL also provided a survey report describing findings[6].

5.5.3 Oxera provided the full breakdown of employee job categories for all employees in 2015/16 to allow for expansion of the data to the workforce total of 23,807 employees

5.6 Parking data

5.6.1 Parking locations for employees are based on those stated in the employee survey, which have been matched to model zones.

5.6.2 For passengers parking on the airport the CAA profiler data provided information on locations where passengers park. Parking locations for May to July 2016 by terminal were allocated to the North Terminal; South Terminal; and North Terminal long stay parking and weighted by airport trips to provide the proportion of passengers using North and South terminals parking in each location.

5.6.3 Passengers parking off site or using the offsite valet provision have been allocated to car parks based on the relative capacities of the off-site car parks, using information provided by GAL.

5.7 Fares

Rail

5.7.1 UK-wide rail fares to/from Gatwick (for use in GSAM) and for all movements across the UK (for use in the VDM) were obtained from RDG for 2017 with some for 2019 that were deflated to 2017 to match. These were adjusted to 2016 base year using a fare index, and then discounted to a 2010 price base using the TAG GDP Deflator.

5.7.2 The employee rail fares included the 25% discount offered by the Gatwick Travel Pass if the origin zone is within the employee discount zone. This pass offers a 25% discount for employees on Thameslink, Gatwick Express, Southern and First Great Western as far as Wokingham[7]. This scheme existed in 2016 and remains in place as of the time of writing.

[5] General Transit Feed Specification – an electronic timetable format describing the schedule of different public transport services

[6] 2016 Travel to Work Survey Report

[7] https://www.gatwickairport.com/business-community/careers/why-work-at-gatwick/staff-travel/

Bus / Coach

5.7.3 Fares on local bus services (Metrobus, Southdown PSV) and coach services (easybus, Megabus, National Express, and Oxford Airline) in 2019 were obtained from the operator websites along with the approximate distance by road, to create a relationship between fare and distance.

5.7.4 The fares for local bus services were obtained from operator websites (Metrobus operates almost all services at Gatwick) which provide the fare zones; representative stops within these zones were used to determine fares. Employees are able to buy travelcards allowing unlimited travel on the Metrobus and Southdown PSV services within the wider network that serves Gatwick Airport

Taxi

5.7.5 Taxi fares in 2019 from a sample of locations to Gatwick Airport were extracted for Uber and minicabs (https://www.minicabit.com/quotes). It is our understanding that very few people hail a black cab for a trip to the airport therefore these fares were not used in the taxi fare calculations.

Parking costs

5.7.6 For the air passengers, on-airport parking costs for durations of 1 to 9 days were obtained from the Gatwick website for long stay, valet and short stay parking at north and south terminals. Data was collected for November, early December, February, April and June to examine seasonal variation.

6 Strategic transport model development

6.1 Highway Model

6.1.1 The highway model represents vehicle movements to and from Gatwick Airport as well as other strategic and local trips on the road network.

6.1.2 Prior to the assessment of future baseline scenarios, the highway model was built to represent current traffic conditions and is referred to as the 'base model' and is representative of average weekday traffic conditions consistent with June 2016.

6.1.3 The base model is built in consideration of guidance specified within DfT's TAG Unit M3.1, May 2020[8] and is built within the software suite SATURN. The wider role of the highway model and its interaction with the demand model is to supply generalised costs for the base model and future year scenarios.

Network Development

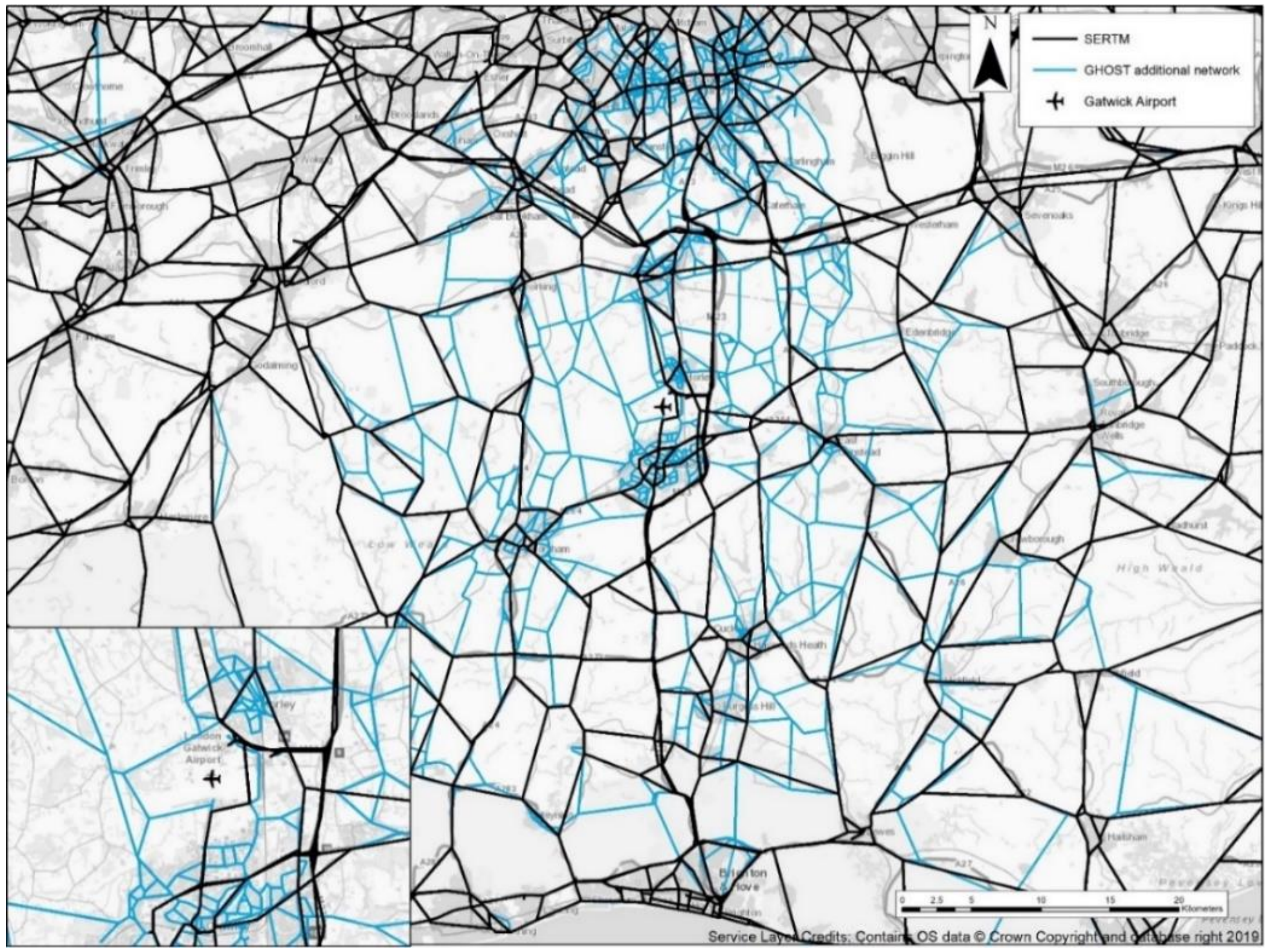
6.1.4 The highway model, known as Gatwick's Holistic Overview of Strategic Transport (GHOST) model, is principally built using the South East Regional Traffic Model (SERTM) developed by Highways England. Further network detail was incorporated through utilising the following additional models:

- Crawley Local Transport Model (CLTM); and
- The London Highway Assignment Model (LoHAM).

6.1.5 Inherited assumptions with respect to treatment of signalised junctions, detailed coding decorum and representation of tolls and network were considered in the model development process and addressed accordingly. The additional network included within the HAM model is shown in Figure 7.

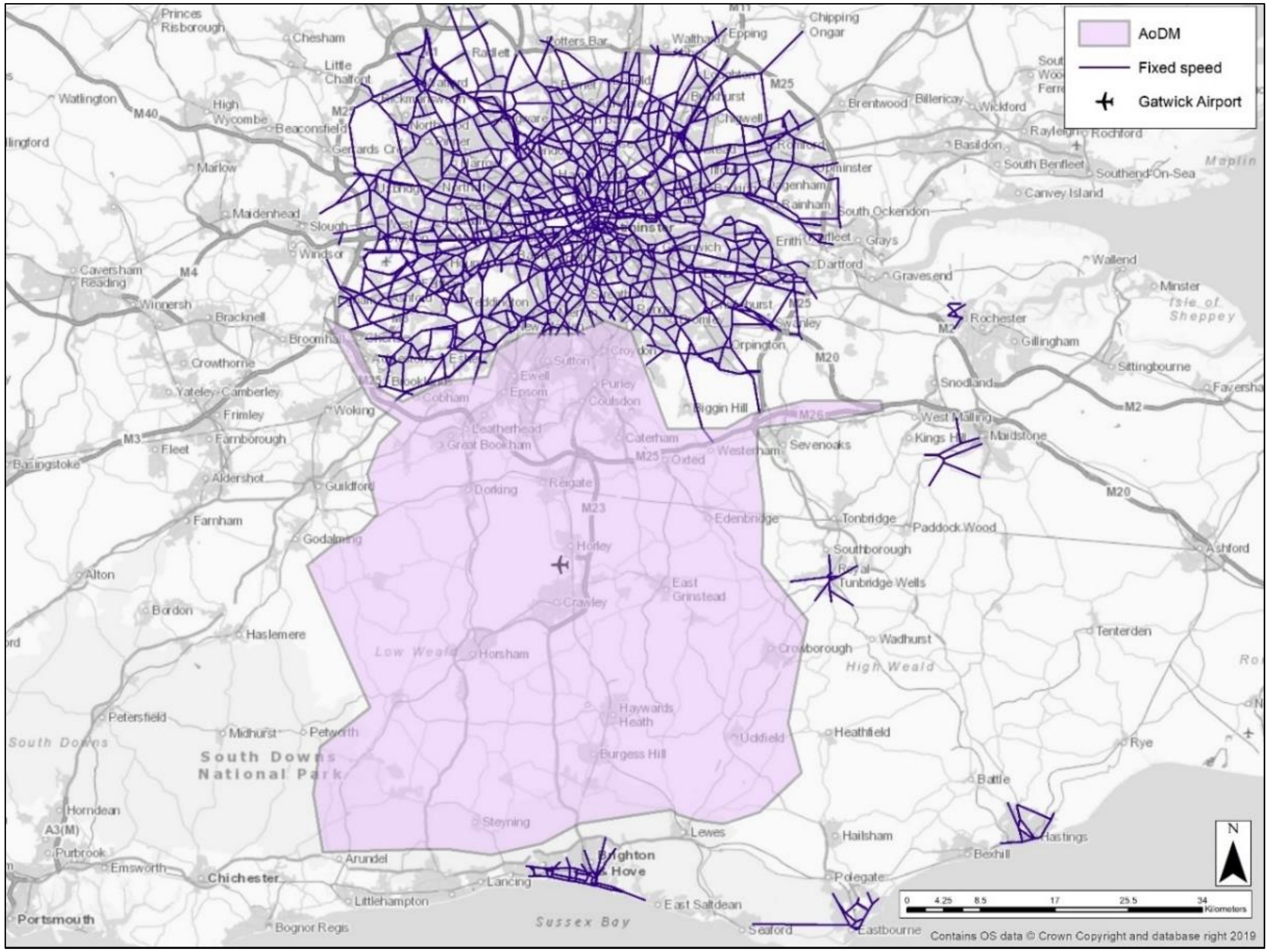
6.1.6 It should be noted due to the size of the regional models, SERTM was developed with fixed speed assumptions within urban areas to reduce the sources of model instability. To address this issue within the GHOST model, we have added in network detail into the main towns and cities that fall within our AoDM. This includes Crawley, Horsham and an area in South London. However, within the rest of the "fully modelled area" the fixed speed coding has been retained. Other areas of fixed speed coding in the fully modelled area e.g., on the south coast will retain the SERTM coding and forecast methodology. The fixed speed areas in the GHOST model are shown in Figure 8.

Figure 7: GHOST additional network



[8] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938864/tag-m3-1-highway-assignment-modelling.pdf

Figure 8: Fixed Speed Coding in GHOST



Matrix Development

6.1.7 The development of the highway model trip matrices considered the travel demand with respect to the following three regions:

- **Gatwick airport** – covering the terminals and all associated airport activity directly associated with the GAL operations;
- **local area** – the local area around the airport covering Crawley, Horley and local adjacent built-up areas; and
- **rest of model** – the remaining wider area covered by the highway model.

6.1.8 An estimate of June 2016 average weekday demand was built up progressively using the available sources of data and evaluating the strengths of each data source over each of the three geographies in order to generate prior matrices.

6.1.9 This tiered approach was required to reflect the need for increasing confidence in the quality of the travel demand estimated in the model within each region and the relative weight of analytical effort needed to build the model. Following the review of each of the sources of data, the development of base year matrices consisted of the following key steps:

- Rezoning of demand sources to common zone system
- Review of demand sources against NTS data and CAA/GAL Employee survey to check the appropriateness of the different sources. This considered trip length, purpose and time of day comparisons.
- Non airport demand was taken predominately from SERTM, with some updates derived using the CitiLogik source data where clear patterns emerged. Updates were controlled against NTS data.
- TfL distribution data was used to update the demand within London that was present in the SERTM source data.
- All airport demand (employees and passengers) was taken from the GAL employee survey data or passenger data.

Highway Performance Metrics

6.1.10 A calibration / validation process was undertaken with the aim of adjusting the model to improve the fit with observed data – including both traffic volumes and journey times. This was done in stages.

6.1.11 Network calibration was undertaken which picked up on the following reviews:

- modelled capacities verses observed traffic flows;
- investigation of large delays and very slow speeds;
- initial volume/capacity; and
- modelled shortest path routes against google maps.

6.1.12 As set out in TAG, calibration and validation screenlines and cordons were developed using the traffic count data. Following a detailed network calibration, review of routing, and adjustments to the prior matrices to improve the fit of the prior matrices, a matrix calibration process was undertaken.

6.1.13 In order to determine the success of the matrix estimation process, the modelled flows were compared to the counts. Calibration sites were reviewed on the same basis as validation sites, with the following measures used for comparison:

- the absolute differences between modelled flows and counts; and
- the GEH statistic.

6.1.14 Modelled link flows have been assessed across the calibration/validation screenlines. Table 6.1.1 show the calibration results at the screenline level while Table 6.1.2 show the performance at a link level for all vehicles combined.

Table 6.1.1: Screenline Performance

Classification	No.	AM1		AM2		IP		PM	
Criteria		5%	10%	5%	10%	5%	10%	5%	10%
Calibration	30	60%	93%	63%	90%	73%	100%	83%	97%
Validation	8	13%	75%	50%	88%	25%	75%	63%	75%

Table 6.1.2: Screenline Link Flow Validation Performance (All Vehicles)

Classification	AM1	AM2	IP	PM
Calibration	91%	92%	96%	92%
Validation	77%	80%	80%	73%

6.1.15 The summary of routes meeting the TAG guidance of modelled routes being within 15% of the observed times, for each time period, is shown in Table 6.1.3. The 33 sub-routes are considered in each direction, giving a total of 66 routes.

Table 6.1.3: Journey Time Validation Summary

Time Period	Number of Routes Passing	Percentage of Routes Passing
AM1	56	85%
AM2	48	73%
IP	63	95%
PM	56	85%

6.1.16 The model was deemed appropriate for assessment for the PEIR and associated impacts of the development at Gatwick Airport. However, detailed model statistics are being reviewed by stakeholders and the highway model will be go through a series of updates in terms calibration and validation to feed into the final DCO submission.

6.2 Rail Model

6.2.1 The role of the rail model is to produce zone-to-zone travel times and costs for the variable demand and airport mode choice models; and to assign rail trips onto services so that rail volumes may be reviewed and interpreted. In this section the development of the rail model is briefly described.

Source model

6.2.2 The DfT PS model formed the starting point for the rail assignment model. This covers national rail services across SE England and London Underground, Croydon Tramlink and Dockland Light Railway.

6.2.3 PS has a 2011 base year and represents only the AM peak. This therefore needed updating to 2016, and to reflect rail services across the day in the airport mode choice models, as a significant amount of airport access is outside the traditional peaks.

Network Development

6.2.4 PS provided the base network of nodes and links and the zoning system. The nodes and links were updated from 2011 to 2016, adding new links and stations such as Oxford Parkway, adding some existing stations that were not previously coded, and editing or completely replacing network elements requiring extra detail for the Gatwick analysis e.g., Croydon Tramlink. The single PS zone representing Crawley was split into north and south parts.

6.2.5 The 0700-1000 AM rail services coded in PS were deleted. Service coding was developed for six modelling periods (AM peak 0700-0900, Interpeak 0900-1600, PM peak 1600-1800, evening 1800-0000, night 0000-0400 and early morning 0400-0700). The services, calling points and journey times came from Network Rail CIF input for the May-Dec 2016 timetable. The train capacities (seats and standing spaces) came from DfT Green Book data for Spring 2016.

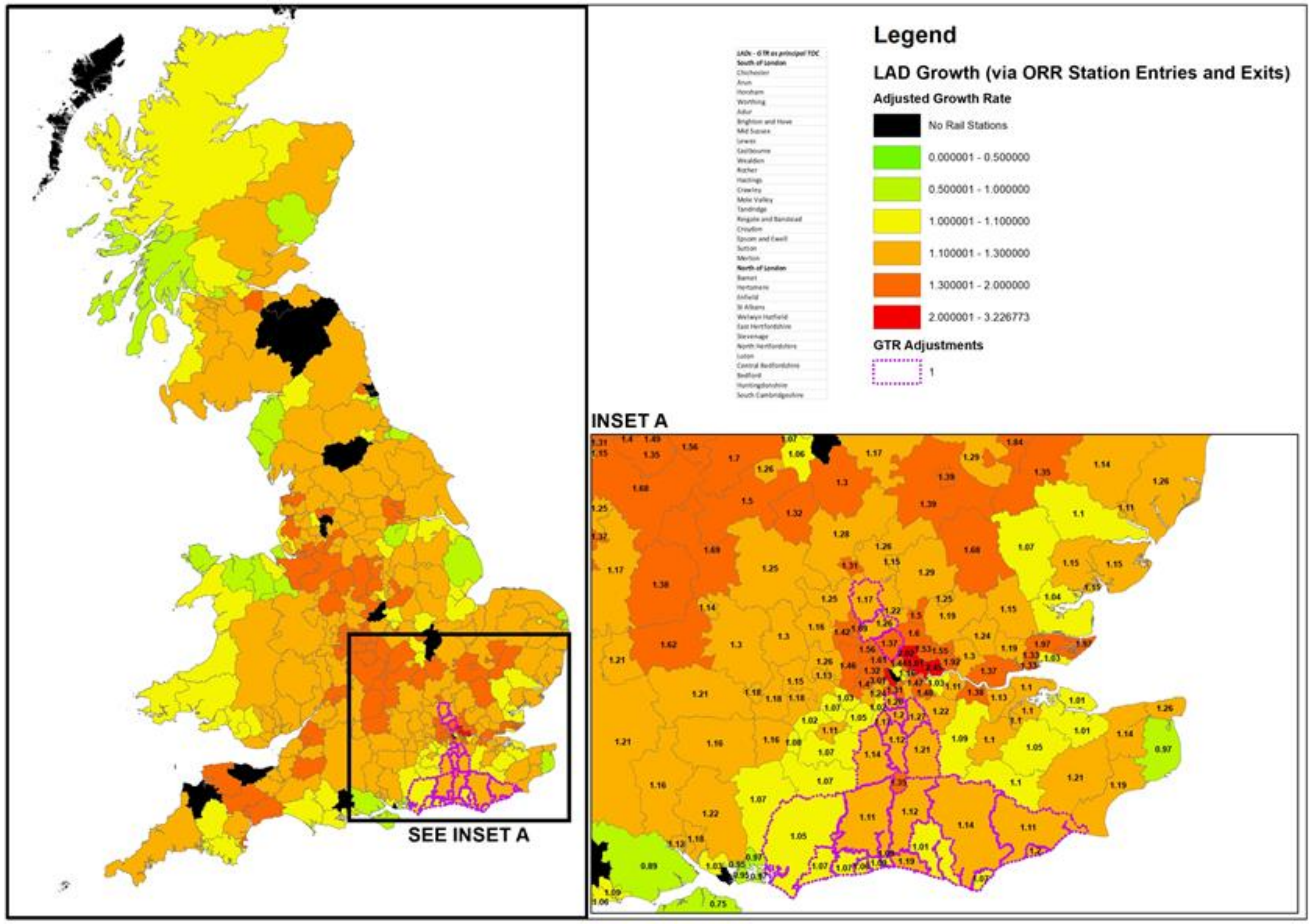
Matrix Development

6.2.6 The starting point was the PS AM Peak 2011 matrix. To expand to all periods and update from 2011 to 2016, the following steps were taken:

- Create a 2011 24hr Production-Attraction (PA) matrix by expanding the 2011 AM PA matrix using National Rail Travel Survey (NRTS) outward/return PA profiles (as used in DfT MOIRA2.2 model). These vary by purpose, time band, and flow type (e.g., to/from London).
- Apply growth to the 24hr 2011 PA matrix to create a 2016 version using growth rates derived from ORR (Office of Rail and Road) station entries and exits data for 2011 and 2016 and similar TfL data.
- In areas adversely affected by Thameslink Programme disruptions in 2016 (including the Brighton Main Line), the growth rates were obtained from an interpolation between 2012 and 2019.
- Create 2016 OD matrices for each of the six model periods by multiplying outward and return factors from the National Rail Travel Survey (NRTS) to the 24hr PAs.
- Assign to the networks.
- Refine volumes at 24-hour level and time period level using observed data at the London cordon and adjusting outward/return factors and overall 24hr volumes.

6.2.7 The demand growth from 2011 to 2016 at local authority level is shown in Figure 9. The pink outlined zones are those affected by Thameslink Programme disruption – growth for these zones was determined by interpolation between pre- and post-disruption counts.

Figure 9: 2010/11 to 2016/17 LAD Growth



Rail Performance Metrics

6.2.8 The performance of the rail model was assessed by undertaking service, journey time and line loading comparisons in line with the guidance set out in TAG Unit M3.2. Specifically, the following metrics were adopted:

- Number of National Rail services across the London cordon (TfL Zone 1 boundary);
- Number of seats on national rail services across the London cordon;
- Journey Times between selected locations;
- Passenger volumes across the London cordon;
- Passenger volumes entering/exiting at Gatwick Airport;
- Passenger volumes arriving at and departing from Gatwick Airport.

Summary of Performance

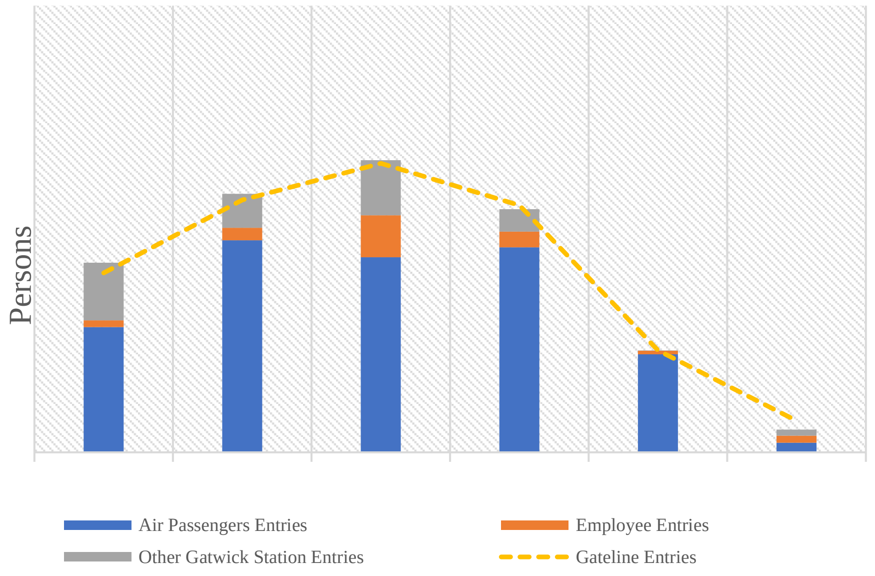
6.2.9 Validation was undertaken in sequential steps: ensuring the modelled supply (train services and capacities) and demand were realistic at 24-hour level at the London cordon, then repeating for each of the five periods (we do not include night time OP2) and then focusing attention on volumes at Gatwick Airport.

6.2.10 At 24hr level the 2-dir modelled passenger volumes are 1% above the counts for the Southern network (i.e., for GTR services crossing the London cordon at Victoria, Blackfriars and London Bridge).

6.2.11 In the individual periods, the 2-dir volumes differ from the counts by +1% (AM), 0% (IP), +4% (PM), -2% (OP1) and +6% (OP3). The coded train capacities were also checked and confirmed to be a close match to observed data.

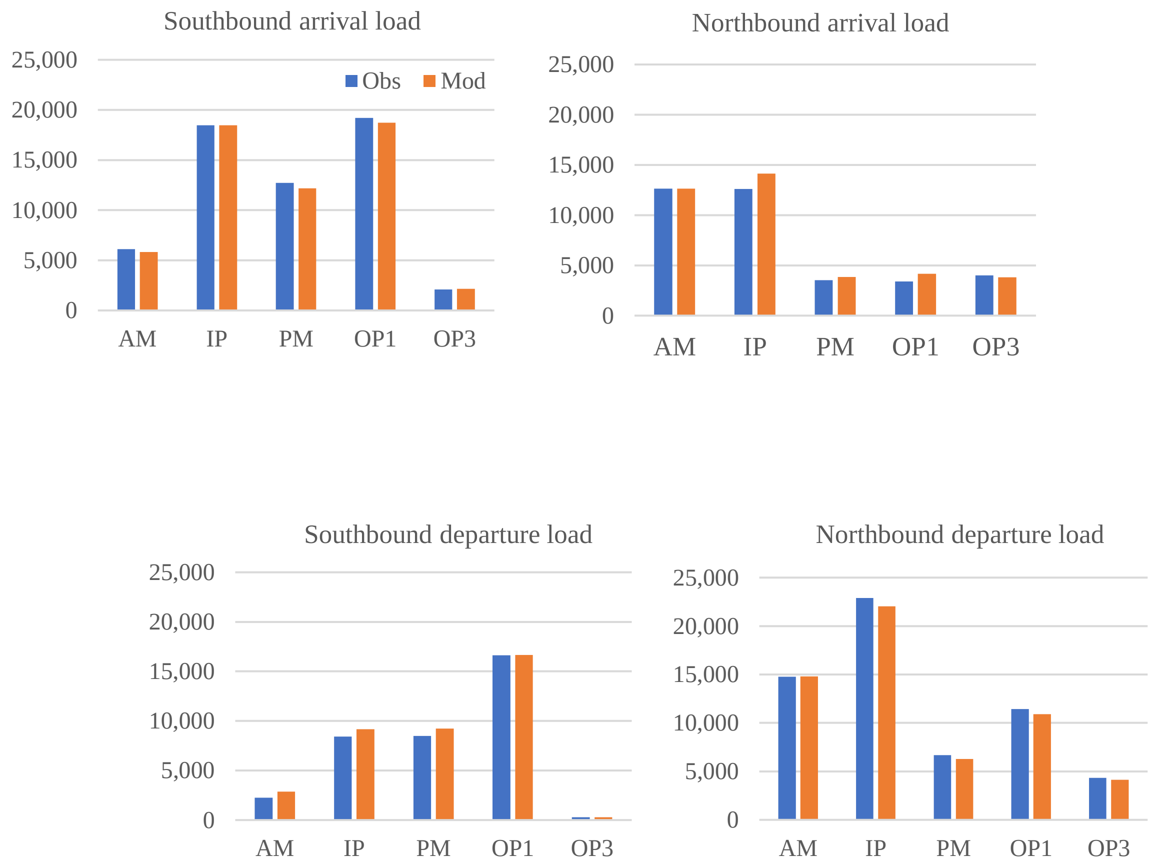
6.2.12 At Gatwick airport the modelled entries were compared against gateline data as shown in Figure 10. The numbers on the y-axis have been omitted for confidentiality reasons, but it can be seen that the match is close. The gateline data is independent, i.e., it was not used in development of the demand matrices, so this is a strong validation.

Figure 10: Gatwick airport station entries, 2016



6.2.13 The passenger volumes on arrival at and on departure from Gatwick Airport station are also a reasonably close match as shown in Figure 11.

Figure 11: Loads on arrival at / departure from Gatwick Airport Station



These summary performance statistics indicate that the model estimates passenger volumes that are a good match to count data and that capacity and crowding conditions are a reasonable reflection of reality.

6.3 Bus/Coach Model

6.3.1 In the absence of any suitable source model that could be built upon, a bus/coach model was developed from scratch with the same base year and time periods as for rail. Coach services are mostly used by Gatwick air passengers and bus services by Gatwick employees.

6.3.2 The role of the bus/coach model is to produce zone-to-zone times and costs for the airport mode choice models; and to assign bus/coach trips onto services so that volumes may be reviewed and interpreted. In this section the development of the bus/coach model is briefly described.

Network development

Coach Network

6.3.3 There is a limited coach network serving Gatwick. Some locations such as London Victoria and Oxford have excellent coach links to Gatwick throughout the day, but most towns and cities are either not directly connected to Gatwick or there is a low frequency service. From these places coach passengers going to/from Gatwick may need to change coaches at Victoria coach station or Heathrow Airport.

6.3.4 To ensure that the bus/coach model identifies realistic routes and generalised costs for those with direct and indirect access to Gatwick Airport, the complete (GB-wide) coach networks operated by National Express and Megabus were coded. In addition, any other coach operators that serve Gatwick Airport, eg, Oxford Bus Company. The data source was GTFS.

Bus Network

6.3.5 The local bus network serving Gatwick is provided by Metrobus, supplemented by a few services from other operators e.g., Southdown. All bus services that call at Gatwick or within the built-up areas of Horley and Crawley have been included in the model. This ensures that all local areas are connected to Gatwick by bus either directly or with interchange, generally at Crawley bus station.

6.3.6 GTFS data for the bus services were obtained to build a bus network at stop-to-stop level which was then overlaid onto the road networks to obtain the network shown in Figure 5.

Matrix development

6.3.7 Bus and coach demand matrices have been developed for airport passengers and airport employees using data from the expanded CAA passenger survey and GAL employment surveys respectively.

6.3.8 Operators were approached for patronage data but for reasons of commercial confidentiality this was not possible, and it was not possible to undertake a survey. Therefore, the bus/coach matrices are partial. This limits our ability to comment on capacity, however it is reasonable to assume that if/when demand exceeds capacity then operators would respond with higher frequencies or larger vehicles.

Bus/Coach Performance Metrics

6.3.9 The following metrics were adopted for validation for bus/coach:

- Number of coach services at Gatwick;
- Number of local bus services
- Journey times
- Passengers boarding local bus services at Gatwick Airport

6.3.10 The validation indicated that modelled bus and coach routes, frequencies and journey times are in close accordance with observed data.

6.3.11 As the demand matrices are partial (they exclude non-airport demand) the full validation of demand was not possible.

6.3.12 Bus boarding counts provided by Metrobus at North Terminal (where the vast majority of bus passengers should be air passengers or airport employees) showed a good match in each time period. At South Terminal there are a lot of non-airport bus passengers interchanging between rail and bus; the model includes only the airport trips, the boarding counts suggest that airport trips make up about half of all bus passengers boarding at ST.

6.4 Variable Demand Model

Development approach

6.4.1 The Variable Demand Model (VDM) was developed to forecast demand and find equilibrium between the demand and supply. The VDM was developed in EMME v4.4.2 with highway assignment undertaken in SATURN.

6.4.2 The model hierarchy follows the relevant guidance in TAG with choices applied incrementally, as opposed to absolutely. This incremental nature accounts for cost changes between the base and the forecast scenarios using a pivot point approach that is similar to the VDMs in the Highways England RTM e.g., SERTM.

6.4.3 In accordance with TAG guidance, the model hierarchy is as follows:

- Mode choice – car and rail (lowest sensitivity).
- Destination choice
- Route choice - undertaken for the highway model in SATURN (highest sensitivity).

6.4.4 TAG also refers to macro time period choice as the lowest sensitivity response (lower than mode choice). In our experience inclusion of this stage makes little difference to results but does extend run times. For this reason, it was excluded.

6.4.5 Destination choice is singly constrained for Business and Other trips, and doubly constrained for Commute trips. The destination choice logit parameters are as shown in Table 6.4.1. These are the median values from TAG Unit M2 Table 5.1.

Table 6.4.1: Destination choice parameters

Segment	Car	Rail	Constraint
HBEB	0.067	0.036	Production
HBW	0.065	0.033	Production and Attraction
HBO	0.090	0.036	Production
NHBEB	0.081	0.042	Origin
NHBO	0.077	0.033	Origin

6.4.6 The mode choice logit parameters are shown in Table 6.4.2. These are the median values from TAG Unit M2 Table 5.2.

Table 6.4.2: Mode choice parameters

Segment	Theta
HBEB	0.45
HBW	0.68
HBO	0.53
NHBEB	0.73
NHBO	0.81

6.4.7 The generalised costs used in the model were taken from TAG Data Book (July 2020 v1.14 -sensitivity test). The values of time (VoT) and vehicle operating costs (VOC) are shown in Table 6.4.3.

Table 6.4.3: Generalised Costs

	2016	2018	2029	2032	2047
Car Business VoT (pence per hour)	1,839.41	1,876.83	2,067.88	2,156,86	2,650.64
Car Commute VoT (pence per hour)	1,222.18	1,247.04	1,373.98	1,433.10	1,761.19
Car Other VoT (pence per hour)	876.04	893.86	984.84	1,027.22	1,262.39
Car Business VOC (pence per km)	12.27	12.68	10.91	10.13	8.39
Car Commute VOC (pence per km)	5.77	6.29	5.23	4.75	3.55
Car Other VOC (pence per km)	5.77	6.29	5.23	4.75	3.55
Rail Business VoT (pence per hour)	2,640.64	2,694.36	2,968.63	3,096.36	3,805.23
Rail Business VoT (pence per hour)	1,071.91	1,093.72	1,205.05	1,256.90	1,544.65
Rail Business VoT (pence per hour)	489.25	499.20	550.02	573.69	705.03

6.4.8 The base demand was assigned on an origin/destination basis and, for highway, calibrated in SATURN using matrix estimation. The VDM considers home based demand and non-home-based demand separately, the former modelled as productions and attractions and the latter modelled as origins and destinations. Conversion of the home-based trips from PAs to ODs results in discrepancies between the validated base demand and the VDM base reference demand. To overcome this, as is standard practice, a set of factors referred to as fitting on factors (FOFs) were calculated. These FOFs are applied on each iteration before assigning the demand to correct the differences.

6.4.9 Outbound and return factors define the proportion of home-based trips going out and returning in each time period. This is necessary to assign the demand and find equilibrium between demand and supply. These factors were calculated from the mobile phone data.

6.4.10 There are differences between the time period definitions in the highway, rail and variable demand models. This is shown in Table 6.4.4. Distribution and mode choice calculations are undertaken at the VDM time period level, and subsequently split where necessary for assignment using the ratio of demand in each sub time period in the base model.

Table 6.4.4: VDM time periods

Time period	Highway	Rail	VDM
AM	AM1: 07:00 – 08:00 AM2: 08:00 – 09:00	AM: 07:00 - 09:00	AM: 07:00 – 09:00
IP	IP: 09:00 – 16:00	IP: 09:00 – 16:00	IP: 09:00 – 16:00
PM	PM: 16:00 – 18:00	PM: 16:00 – 18:00	PM: 16:00 – 18:00
OP	OP: 18:00 – 07:00	OP1: 18:00 - 00:00 OP2: 00:00 - 04:00 OP3: 04:00 - 07:00	OP: 18:00 – 07:00

6.4.11 The VDM calculates demand for persons. The highway model assigns Passenger Car Units (PCUs); therefore occupancy factors are required to convert between persons and PCUs. For Business and Commute trips, these are imported from Highways England's SERTM and are listed in Table 6.4.5.

Table 6.4.5: Car occupancy factors

Segment	Occupancy factor
HBEB	1.11
HBW	1.1
NHBEB	1.18

6.4.12 The occupancy factors for Other trips are calculated based on trip distance. The parameters are dependent on the location of the origin zone. The parameters are shown in Table 6.4.6.

Table 6.4.6: Other occupancy factor parameters

Segment parameter	Urban	Rural	London
HBO a	0.00113	0.00113	0.00113
HBO b	0.524	0.482	0.549
NHBO a	0.00108	0.00108	0.00108
NHBO b	0.418	0.418	0.497

6.4.13 The rail assignment model is not iterated in VDM. Forecast time and fare skims are read in for each scenario and are assumed to stay fixed. The rail time and fare skims have been rezoned from PS zoning to GHOST zoning, splitting based on population and jobs.

6.4.14 Choices predicted by multinomial logit models depend on the difference in generalised costs between two alternatives. This can result in overly sensitive to cost changes for longer distance trips. As recommended in TAG Unit M2.1, cost damping is applied in the model as a function of distance. The cost damping parameters were imported from SERTM, shown in Table 6.4.7.

Table 6.4.7: Cost damping parameters

	k	α	d_c	d_0	η
Car Business	30	0.5	10	99.5	0.387
Car Commute	30	0.5	10	30.5	0.248
Car Other	30	0.5	10	31.2	0.315
Rail Business	30	0.5	10	165.5	0.435
Rail Commute	30	0.5	10	30.5	0.248
Rail Other	30	0.5	10	31.2	0.315

6.4.15 LGV and HGV and segments are fixed, they are not subject to destination choice or mode choice.

6.4.16 Gatwick Airport employee and passenger demand is modelled by the Gatwick Mode Choice Model (GSAM). This is integrated into the VDM and run on each iteration of the VDM. The Gatwick Airport employee and passenger demand is assigned to the highway model on each iteration of the VDM. GSAM is discussed in further detail in section 6.5.

Realism testing

6.4.17 Three realism tests were undertaken for the base model:

- A fuel cost realism test by increasing the highway fuel costs by 20% in both the variable demand model and the highway assignment model;
- a public transport fare realism test by increasing PT fares by 20% in the variable demand model; and
- a car journey time realism test by increasing journey time skims by 20% in the variable demand model.

6.4.18 The model meets the TAG criteria set out in Unit M4 section 6.4 and Unit M2 for all three realism tests as shown in Table 6.4.8. The responses are sensible and the model is considered suitability for forecasting.

Table 6.4.8: Realism Test Summary

Test	TAG Criteria	Model
Car Fuel Cost	-0.25 to -0.35	-0.35 ✓
Public Transport Fare	-0.2 to -0.9	-0.28 ✓
Car Journey Time	No greater than -2.0	-1.13 ✓

6.5 Gatwick Mode Choice Model

Development approach

6.5.1 The Gatwick Mode Choice Model (GSAM) was developed to calculate the changes in mode choice for airport passengers and employees. GSAM was applied as an incremental logit model, in a similar manner to the main VDM.

6.5.2 The process followed for specifying, estimating, and validating GSAM is summarised as follows.

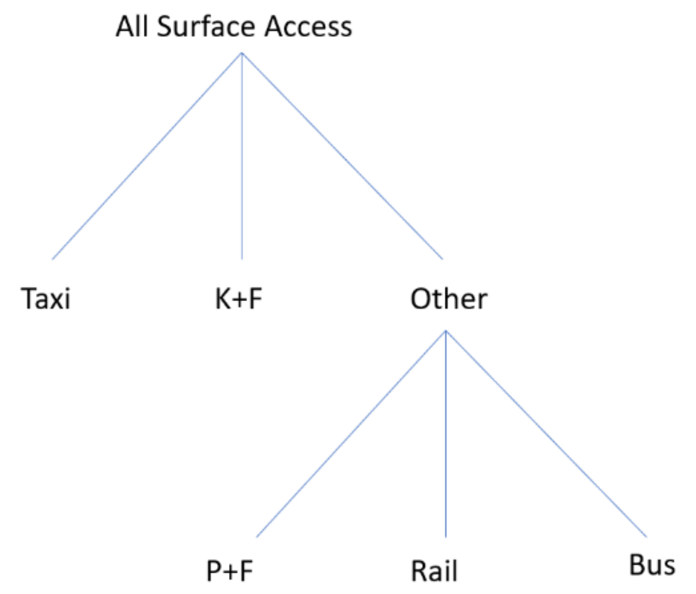
- Behavioural data for the period around / including the model base year 2016 was developed – databases were provided by GAL from the CAA rolling survey of departing airport passengers, and from the most recent periodic employee travel survey (Spring 2016).
- a database of transport times and costs from the highway, rail and bus models and other sources such as rail fares databases, taxi rates etc was developed and joined to the behavioural data.
- scripts to estimate models using Biogeme (v3.2.6) were developed.
- utility functions defined.
- model parameters estimated for a multinomial logit model.
- A range of models were tested, each assessed, to consider the overall fit; significance; magnitudes and signs of the parameters; key ratios e.g., the value of time; and other sensibility and reasonableness tests.
- utility functions were varied and relevant corrections / transformations applied to inputs. This process was repeated to estimate different models, testing a range of alternative utility functions.
- When no further improvements were found, alternative hierarchies (nesting structures) for improved model fit and plausibility were tested.
- the final models were run on the survey database to check that observed mode shares could be replicated with reasonable accuracy.
- the final models were then implemented in the GSAM application and base realism tests were undertaken to check sensitivities (elasticities).
- elasticities were compared against benchmarks from other models and DfT guidance.
- an expert reviewer was engaged to advise on the suitability of the approach and assist in the finalisation

6.5.3 To best align with the other model components, data inputs for the estimations have been undertaken at a time period level (AM, IP, PM, OP1, OP2, OP3), representing a single trip. For the employee model, GemSAM, this is the average of the two directions and for the passenger model, GapSAM, this is half the round-trip cost.

Model Hierarchy

6.5.4 A two-level model hierarchy produced the most statistically significant structure for air passengers, as shown in Figure 12, with the nesting parameters (theta values). The structure implies more sensitivity to switching within the lower nest (Park and Fly, Bus, Rail).

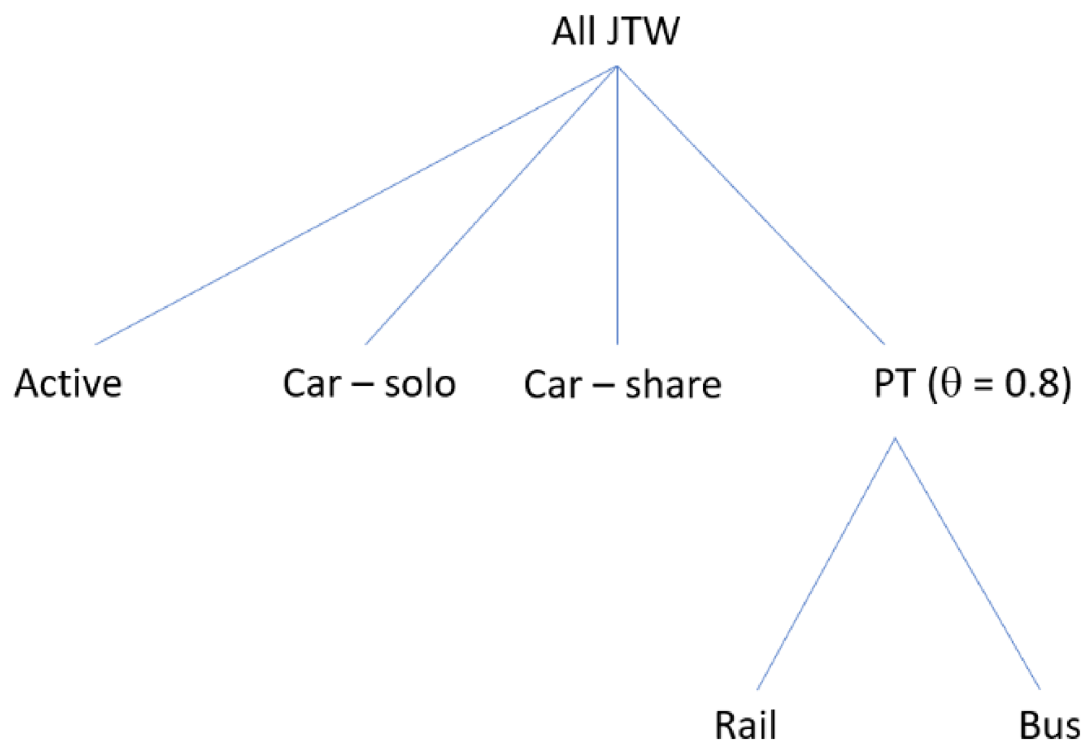
Figure 12: GapSAM (Air Passenger) model nesting



	Run	Theta
UKB	V1	0.62
NUKB	T2	0.57
UKL	T3	0.69
NUKL	T4	0.68

6.5.5 For airport employees, the best model fit was nesting of the public transport modes as shown in Figure 13.

Figure 13: GemSAM (Airport employee) model hierarchy



6.5.6 For UK Leisure, the model fit was significantly improved when out of pocket costs for car and taxi (fuel cost, taxi fare, parking fee) were shared among the vehicle occupants; for the other segments the fit was not improved. Therefore, sharing of fuel cost, taxi fare and parking fee has been accepted for UKL and rejected for other segments. There is no information in the survey data of whether costs are in fact shared or not. We have assumed that fuel costs are shared for the car share option for airport employees.

6.5.7 For employees, the costs for the 'car share' option are split among the car occupants.

Realism testing

6.5.8 A wide range of base realism tests were undertaken to test the sensitivity of the model and to benchmark elasticities against existing models of airport access choice (notably LASAM). The elasticities were found to be in reasonably ranges. The estimation of the models and elasticities were submitted for external expert review.

7 Background Forecasting assumptions

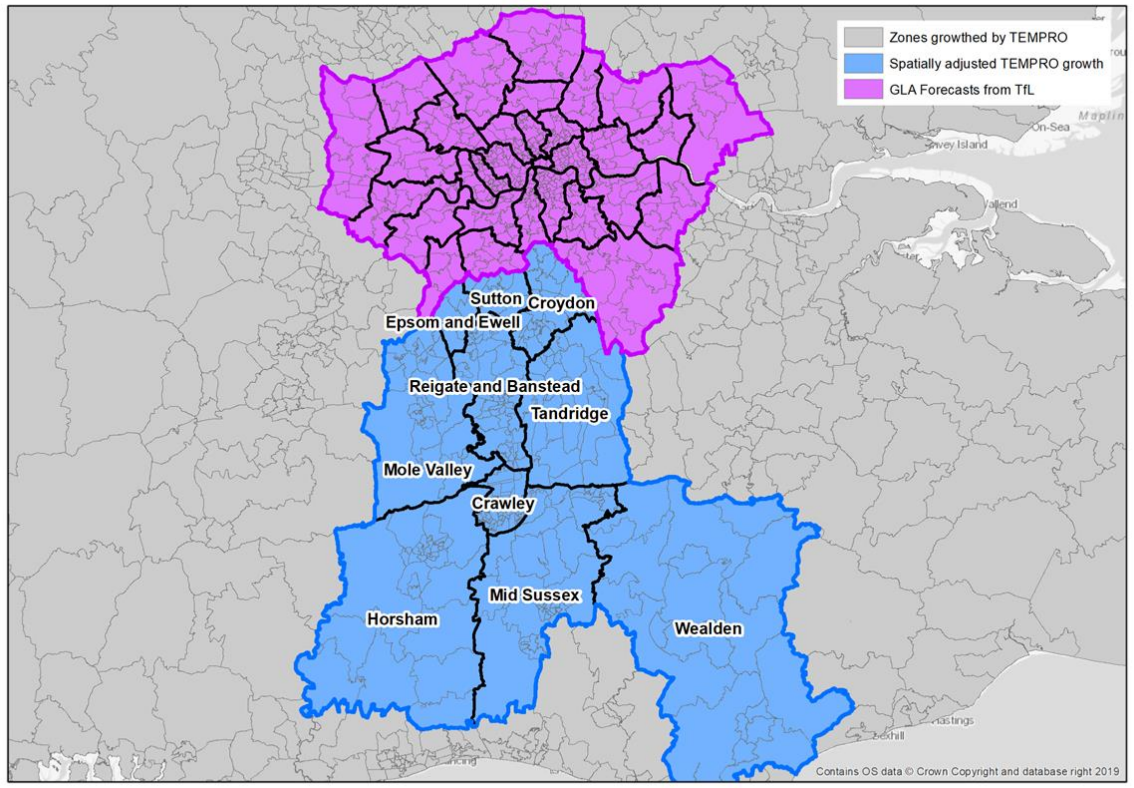
7.1 Uncertainty log

Background

7.1.1 In accordance with TAG Unit M4, an uncertainty log was developed for both demand (e.g., new developments) and supply (e.g. new transport infrastructure) that could impact the future performance of the transport system. The objective of this, is to review the likelihood of specific proposals coming forward based on their current planning / funding status and use this as the basis for selecting a set of assumptions for the Future Baseline.

7.1.2 The approach undertaken has been to review the assumptions for authorities that sit within the AoDM alongside national bodies such as Network Rail (and Train Operating Companies), Highways England, and relevant bus / coach operators. Specific Local Authority districts were contacted for specific information around committed and planned development as shown in blue in Figure 14. In addition, Transport for London's assumptions for population and employment growth in Greater London were also reviewed, such that growth in the Greater London Area align with TfL's LTS 7.1 model and GLAs projections from 2015/6 (see the purple area). Note specific detailed assumptions were made for the London Boroughs of Sutton, Croydon and Epsom and Ewell as these formed part of the area of detailed modelling.

Figure 14: Coverage area of uncertainty log



7.1.3 For ease of cross reference, Table 7.1.1 provides an extract from TAG Unit M4 in relation to the classification of uncertainty. This is the framework applied in the subsequent sections.

Table 7.1.1: Classification of future inputs (taken from TAG Unit M4)

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

Demand uncertainty - development data

7.1.4 The demand uncertainty log was populated using information from multiple planning documents in conjunction with council planning portals, mainly:

- Local Plan Development
- Strategic Housing Land Availability Assessment
- Annual Monitoring Report
- Housing/Employment Land Trajectory

7.1.5 Table 7.1.2 outlines the local plan assumptions used as the basis for the assessment.

Table 7.1.2: Local Plans

Local Authority	Source	Plan Period
Mid Sussex	District Plan 2014 - 2031	2014 - 2031
Reigate and Banstead	Reigate and Banstead Local Plan: Core Strategy	2012 - 2027
Wealden	Adopted Core Strategy	2013 - 2027
Mole Valley	Core Strategy	2009 - 2026
Epsom and Ewell	Core Strategy 2007	2006 - 2026
Crawley	Local Plan	2015 - 2030
Tandridge	Local Plan 2033 Proposed Version (under examination	2013 - 2033
Horsham	Horsham District Planning Framework 2015 - 2031 (excluding South Downs National Park)	2015 - 2031
Sevenoaks	New Local Plan	2015-2035
Wealden	Adopted Core Strategy	2013-2027
Brighton & Hove	City Plan Part One 2016	2010-2030

7.1.6 The data for each district was summarised and checked with data held by each LA to help verify the assumptions. Larger scale development, where specific new access requirements were likely were identified through the application of a specific set of criteria as shown in Table 7.1.3. Developments identified using this approach were modelled in detail through new zoning and specific access arrangements updated.

Table 7.1.3: Inclusion Criteria

Land use	Criteria
C3 - Dwellings	100
B1 - Office development (m^2)	1,200
B2 - Industrial Estate (m^2)	1,500
B8 - Warehousing (m^2)	5,000
Other	Major Developments

7.1.7 The uncertainty log identifies the likelihood of each development taking place as near certain, more than likely, reasonably foreseeable, hypothetical.

7.1.8 Assumptions of alternating commercial land-use size to number of full-time employees and build out rates across the future years were inferred based on planning documents and existing information of similar sites if no such data was available.

7.1.9 Major developments with the greatest number of housing units or employment opportunities collated in the uncertainty log are listed in Table 7.1.4. The full list of developments scoped in are included in Appendix A.

Table 7.1.4: Major Developments Identified in Uncertainty Log

Index	Location	Local Authority	Fully Built Year
37-41	Burgess Hill Northern Arc Land North and North West of Burgess Hill Between Bedelands Nature Reserve in The East and Goddard's Green Waste Water Treatment Works In The West	Mid Sussex	2035
156-160	Land West of Bewbush (Kilnwood Vale)	Horsham	2029
171-177	Land North of Horsham, Strategic Site, Holbrook Park and Chennells Brook, North Horsham	Horsham	2035
195-200	Horley North West Sector 'Land at Meath Green', Horley	Reigate and Banstead	2023
432-436	Whitgift Shopping Centre and Surrounding Land Croydon	Croydon	2028
289	Land west of Uckfield - Site SD1	Wealden	2029
375-377	1-5 Lansdowne Road and Voyager House, 30-32 Wellesley Road	Croydon	2025
19-21	Thales, Gatwick Road	Crawley	2029 (parcel 1&2) parcel 3 under construction
9	Land at London Road and Fleming Way (Elekta)	Crawley	2021
185	Nowhurst Business Park Guildford Road Broadbridge Heath, Slinfold	Horsham	2023
380-384	Land Adjoining East Croydon Station, bounded by George Street (Including 1-5 Station Approach), Dingwall Road, (Including The Warehouse Theatre), Lansdowne Road and Including Land to The North of Lansdowne Road, Croydon	Croydon	2025
485-487	Land Bounded by George St, Park Lane, Barclay Road, And Main London To Brighton Railway Line	Croydon	2026
485-487, 509	Forge Wood Neighbourhood	Crawley	2030
163-165	Land west of Horsham	Horsham	2026
503	Northwood Park, Gatwick Road, Northgate, Crawley	Crawley	2023

Supply uncertainty - transport scheme data

7.1.10 The supply side uncertainty log was completed for each relevant mode of transport used within the model.

7.1.11 For highway schemes, data was collated from the following sources:

- SERTM Future Year transport schemes from Highways England
- Crawley Local Transport Model uncertainty log of infrastructure schemes
- Highway network improvements provided by WSCC
- Development-related transport mitigation identified through review of planning applications
- Local Plan Schemes
- Infrastructure Delivery Plans

7.1.12 The schemes were cross checked against the Highways England road schemes website, information provided by LA/consultancies and available public information. The major Road Investment Strategy (RIS) schemes were captured as well as other strategic schemes in the study area. Table 7.1.5 lists the major highway schemes and full list can be found in the Addendum.

Table 7.1.5: Major Highway schemes

Index	Scheme Name	Scheme Promoter	Opening Year
13	M23 Junctions 8-10: Smart Motorways	Highways England	Spring 2020
86	M23 Junction 9, north bound slip road - Carriageway widening	Crawley	Before 2026 (assumed)
87	M23 Junction 10 - Junction improvements, Signal, carriageway widening	Crawley	Before 2026 (assumed)
24	M25 Junction 10-16 Smart Motorway	Highways England	2023
32	M25 J8 Improvement Scheme	Highways England	Dec-2020
153	M25 South West Quadrant	Highways England	2023
31	Lower Thames Crossing - new link	Highways England	Before 2029 (assumed)
5	A2 Bean & Ebbsfleet Junction Improvement Scheme	Highways England	2022-2023
22	A27 East of Lewes	Highways England	Jan-2022
62	A22 Corridor - M25 Junction 6 improvements	Tandridge	Before 2029 (assumed)
97	Burgess Hill Northern Arc Land - Highways (A2300), bridges	West Sussex	Before 2029 (assumed)
90	Radford Road approach to Gatwick Road	Crawley	Before 2026 (assumed)

7.1.13 The future year rail schemes included in all future years (unless otherwise stated) are:

- Crossrail
- Network Rail schemes
  - North Downs Line increase from 2 trains per hr (tph) to 3 tph (increase from 1 tph to 2 tph at Gatwick) with 1 tph extended from Reading to Oxford in 2047 only
  - Thameslink ultimate frequency 24 trains/hr
  - Croydon Area Remodelling Scheme enabling extra peak train paths
- London Underground schemes
  - Northern Line extension to Battersea Power Station
  - Jubilee Line enhancements
  - Victoria Line upgrade
  - Piccadilly Line upgrade
  - Subsurface full upgrade
  - LUL new vehicles
  - London Overground schemes
  - East London Line upgrades
  - Gospel Oak – Barking upgrades
- Dockland Light Railway and Croydon Tram schemes
  - DLR Rolling Stock Replacement Programme
  - Croydon Tram timetable change

7.1.14 HS2 was not coded as this would not have a significant impact on access to Gatwick as it and is outside the modelled area (first stop Birmingham).

7.1.15 Similar to the demand side uncertainty log, design stages and details given in the planning documents for development-related schemes were used to inform the uncertainty categories.

7.1.16 Those schemes meeting the near certain or more than likely criteria were coded into the relevant future model networks.

7.2 Demand forecasting approach

7.2.1 The methodology set out in TAG Unit M4 was used to produce demand forecasts for each of the model years.

7.2.2 The DfT's TEMPRO programme (V7.2) was used to source the National Trip End Model assumptions (NTEM). This sets out national travel demand growth for each local authority area based on a set of planning assumptions covering employment and housing projections. The demand uncertainty log was used as the basis for reviewing these assumptions at a fine level of spatial detail in the AoDM. NTEM assumptions were updated accordingly, and the most current local plan assumptions were used as the basis for the growth trajectory in each local authority district. These were further extrapolated beyond the relevant local plan period adopting the assumptions in the NTEM.

7.2.3 The growth in travel demand was calculated for each modelled demand segment, mode and car availability combination based on this update of population and employment projects by factoring the standard TEMPRO forecasts, accordingly, as recommended in the guidance.

7.2.4 In London, data from TfL was adopted to modify the assumptions in London for growth in travel demand. This involved the updated of population and employment forecasts for the London Boroughs outside of the AoDM.

7.2.5 Goods vehicle growth rates were taken from Road Traffic Forecast 2018 (RTF18) Scenario 1. The traffic growth factors (in vehicle miles) at regional level were applied to the 2016 base goods vehicle demand. Goods vehicle forecasting at Gatwick airport was undertaken using passenger and cargo forecasts. This is detailed in Section 8.4.

7.2.6 For each of the major development sites identified above in Table 7.1.4, specific trip generation assumptions were developed based on data sourced from transport assessments. These were adjusted where necessary to cover the full series of time periods modelled. These developments were removed from the growth adjustment process set out above. Specific trip distribution assumptions were made for each development zone based on the likely characteristics of the development and considering adjacent zones of similar characteristics.

7.2.7 The distribution of Heathrow Airport demand was taken from SERTM – this was based on data from the DfT on an R2 only scenario, with demand projections based on 2014 DfT forecasts. This demand was updated using the latest available public demand forecasts for Heathrow which assumed by 2047, a total of 92 mppa. Specific time period assumptions were derived by comparing base Heathrow assumptions with observed counts on the M4 Spur, and T5 slip roads on the M25.

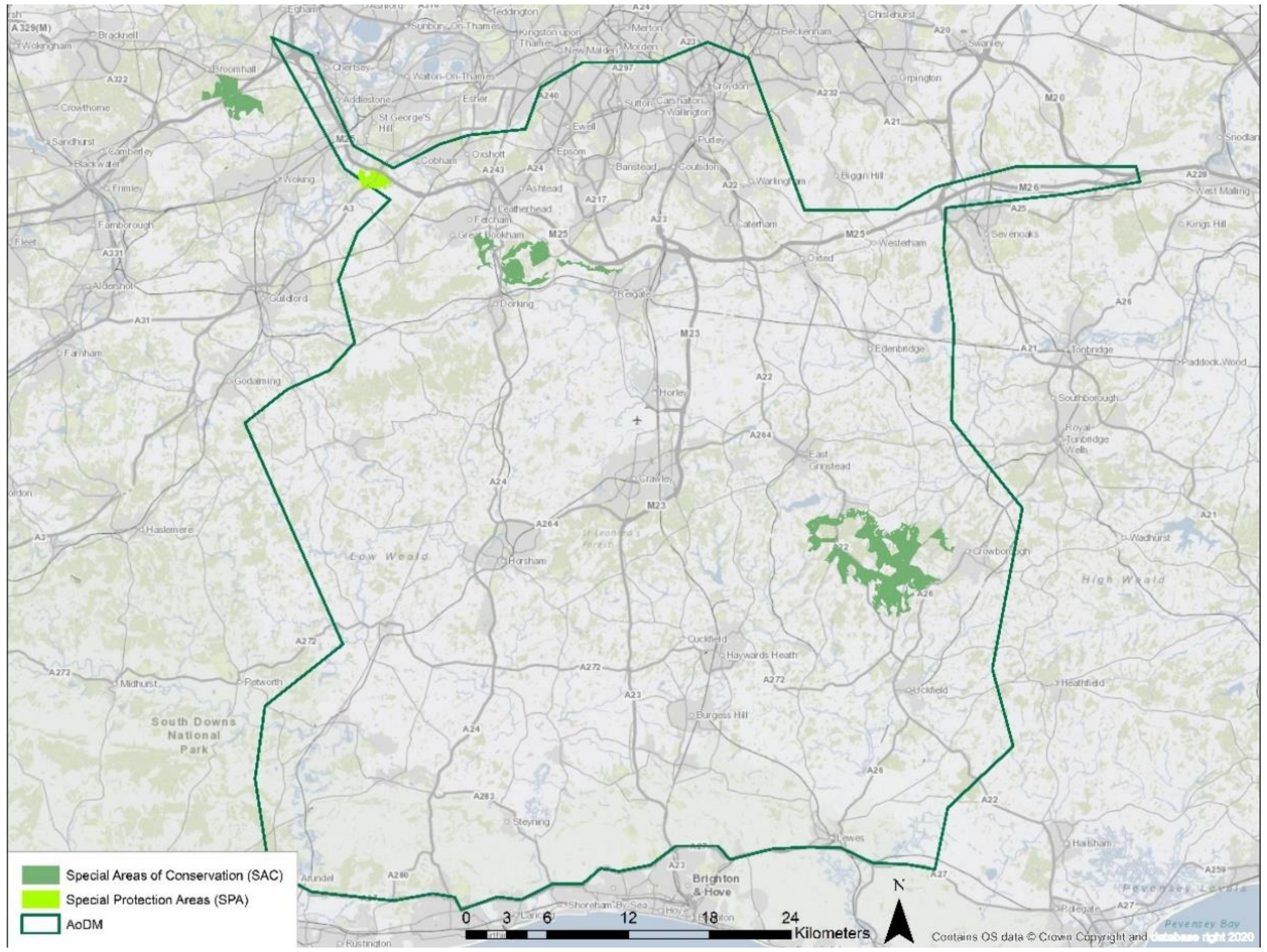
7.3 HRA

7.3.1 Habitats Regulations Assessment (HRA) was carried out for the 2032 forecast year. This assessment covers the following sites:

- Ashdown Forest Special Are of Conservation (SAC) and Special Protection Areas (SPA).
- Mole Gap to Reigate Escarpment SAC.
- Thames Basin Heaths SPA.
- Thursley, Ash, Pirbright & Chobham SAC.

7.3.2 These are shown in Figure 15. These sites were chosen based on the distance from the highway network, emissions, and presence and location of qualifying features.

Figure 15: SACs and SPA



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7.3.3 The HRA needs to include an assessment of air pollution changes from the Project alone, but also the project acting in combination with other projects/plans in the area. The assessment scenarios for the HRA were carried out for 2032 and are as follows:

- Future baseline scenario without any committed developments/plans;
- Future baseline scenario with growth to account for committed developments and plans (which is the scenario known as Future Baseline); and
- With Project scenario, which includes future growth from committed developments/plans and the contribution of the Project (the scenario known as With Project).

7.3.4 A comparison between scenarios C and B will provide the impact of the Project alone, while a comparison between scenarios C and A will provide the impact of the Project in combination with other committed developments/plans in the area.

7.3.5 To support this assessment, an additional scenario for 2032 was required to create an alternate future baseline scenario without any committed development plans which has been called HRA.

7.3.6 Based on the Natural England Guidance[9] the following approach was used:

- Apply growth to the 2016 base demand up until 2021
- Apply business as usual growth (i.e., without the Project) at the airport up until 2032.
- Exclude all committed developments, plans and other projects for local authorities within 10km of each ecological site.

[9] Natural England (2018), Approach to advising competent authorities on road traffic emissions and HRAs

7.3.7 The local authorities within 10km of each site are shown in Table 7.3.1.

Table 7.3.1: Local authorities within 10km of sites

Ashdown Forest SAC/SPA	Mole Gap to Reigate Escarpment SAC	Thames Basin Heaths SPA	Thursley, Ash, Pirbright & Chobham SAC
Lewes	Elmbridge	Windsor and Maidenhead	Windsor and Maidenhead
Wealden	Epsom and Ewell	Bracknell Forest	Bracknell Forest
Sevenoaks	Guildford	Elmbridge	Elmbridge
Tunbridge Wells	Mole Valley	Epsom and Ewell	Guildford
Tandridge	Reigate and Banstead	Guildford	Runnymede
Crawley	Tandridge	Mole Valley	Spelthorne
Mid Sussex	Woking	Runnymede	Surrey Heath
	Crawley	Spelthorne	Woking
	Kingston upon Thames	Surrey Heath	
	Sutton	Woking	
		Kingston upon Thames	

7.4 Indirect and catalytic employment growth

7.4.1 Indirect and catalytic employment numbers have been generated by a third-party consultant on behalf of GAL and are included in the 'Economic Impact Report'. The output of this work has been included in the strategic model in the With Project scenarios as shown in Table 7.4.1.

Table 7.4.1: Indirect and Catalytic Employment Growth included in With Project Scenarios

Employment Growth	Area	2029	2032	2047
Indirect	Diamond	400	1,300	1,300
	C to C LEP	600	2,100	2,100
	5 Authorities	1,300	3,900	3,900
	UK Total	1,800	5,600	5,600
Catalytic	Diamond	2,400	7,300	6,200
	C to C LEP	4,100	12,500	10,700
	5 Authorities	4,200	12,500	10,700

7.5 Background highway demand forecasts

7.5.1 The resulting highway demand for the AM1, AM2, IP and PM periods for the future baseline scenario is shown in Table 7.5.1, Table 7.5.2, Table 7.5.3 and Table 7.5.4 respectively.

Table 7.5.1: AM1 background highway demand (future baseline)

	Demand (PCUs)				Growth		
	2016	2029	2032	2047	2029	2032	2047
Business	528,982	589,323	599,781	662,108	1.11	1.13	1.25
Commute	2,214,469	2,427,253	2,463,116	2,674,164	1.10	1.11	1.21
Other	2,186,537	2,537,708	2,604,865	2,914869	1.16	1.19	1.33
LGV	891,376	1,059,730	1,100,783	1,301,686	1.19	1.23	1.46
HGV	379,048	383,702	387,354	410,096	1.01	1.02	1.08
Employees	1,134	1,305	1,326	1,413	1.15	1.17	1.25
Passengers	3,552	5,290	5,478	5,934	1.49	1.54	1.67
Total	**6,205,097**	**7,004,310**	**7,162,702**	**7,970,270**	**1.13**	**1.15**	**1.28**

Table 7.5.2: AM2 background highway demand (future baseline)

	Demand (PCUs)				Growth		
	2016	2029	2032	2047	2029	2032	2047
Business	578,955	645,250	656,732	725,010	1.11	1.13	1.25
Commute	2,431,620	2,665,996	2,705,454	2,937,347	1.10	1.11	1.21
Other	2,397,485	2,784,047	2,857,827	3,197,920	1.16	1.19	1.33
LGV	681,378	810,185	841,573	995,146	1.19	1.24	1.46
HGV	383,900	388,628	392,330	415,376	1.01	1.02	1.08
Employees	1,102	1,258	1,279	1,364	1.14	1.16	1.24
Passengers	3,521	5,119	5,249	5,535	1.45	1.49	1.57
Total	**6,477,961**	**7,300,483**	**7,460,444**	**8,277,698**	**1.13**	**1.15**	**1.28**

Table 7.5.3: IP background highway demand (future baseline)

	Demand (PCUs)				Growth		
	2016	2029	2032	2047	2029	2032	2047
Business	470,283	522,932	532,187	586,449	1.11	1.13	1.25
Commute	953,445	1,046,188	1,061,937	1,154,408	1.10	1.11	1.21
Other	2,924,688	3,390,014	3,478,632	3,890,563	1.16	1.19	1.33
LGV	897,917	1,067,365	1,108,702	1,311,041	1.19	1.23	1.46
HGV	519,646	525,467	530,332	560,842	1.01	1.02	1.08
Employees	685	788	801	851	1.15	1.17	1.24
Passengers	3,727	4,817	4,886	5,150	1.29	1.31	1.38
Total	**5,770,391**	**6,557,570**	**6,717,477**	**7,509,303**	**1.14**	**1.16**	**1.30**

Table 7.5.4: PM background highway demand (future baseline)

	Demand (PCUs)				Growth		
	2016	2029	2032	2047	2029	2032	2047
Business	573,659	640,085	651,653	720,062	1.12	1.14	1.26
Commute	2,129,734	2,335,505	2,370,702	2,578,556	1.10	1.11	1.21
Other	3,131,681	3,635,897	3,732,227	4,177,546	1.16	1.19	1.33
LGV	877,947	1,043,560	1,083,967	1,281,761	1.19	1.23	1.46
HGV	357,542	361,517	364,875	385,900	1.01	1.02	1.08
Employees	952	1,098	1,115	1,189	1.15	1.17	1.25
Passengers	3,332	4,452	4,500	4,931	1.34	1.35	1.48
Total	7,074,846	8,022,115	8,209,039	9,149,944	1.13	1.16	1.29

7.5.2 All four time periods display similar levels of growth in car business, commute and other trips. Between 2016 and 2047 there are 26% additional business trips, 21% additional commuting trips, and 33% extra other trips.

7.5.3 The background growth for LGV and HGV trips is consistent across all time periods. LGV trips grow by 46% between 2016 and 2047, while HGV trips grow by 8% over the same period.

7.5.4 The IP period has slightly higher background growth overall compared the other periods, experiencing an increase of 30% between 2016 and 2047 compared to 28% for AM1 and AM2, and 29% for the PM period.

7.5.5 There is significant growth in Gatwick employee numbers, particularly in the AM1 and AM2 periods where it exceeds 50% in 2047. Highway passenger trips grow by approximately 25% by 2047, and this is consistent across the model time periods.

7.6 Impact of the Covid Pandemic on travel demand

7.6.1 At the time of writing, there is a lot of speculation relating to the impact of the Covid-19 pandemic on long term trends associated with mobility. This includes discussions around the extent of changes in flexible working conditions offered in certain employment sectors, and the sustained impact on commuting and business-related travel. Due to this level of uncertainty, no specific account has been made in the forecasting of background travel demand to reflect any specific long-term trends. We would in general consider these impacts to result in a downside to travel demand making the assessments undertaken in this report conservative. These assumptions will be revisited in the run up to DCO submission as more information and advice is published around how to approach this.

8 Northern Runway Proposals

8.1 Context

8.1.1 As explained in the PTAR there are two major outside influences that will affect the predicted growth in demand at Gatwick Airport these are:

- the Covid-19 pandemic; and
- development of Runway 3 at Heathrow.

8.1.2 The influence of these are explained further in the PTAR, however in summary while the Covid-19 has had a severe impact on the global aviation industry it is expected that through the mid-2020s overall demand for air travel will recover to previous levels and then continue to grow.

8.1.3 Similarly, the development of Runway 3 at Heathrow remains in doubt due to both legal challenges and Heathrow themselves currently stopping work on the development proposal. Even if HAHL do restart the consenting process, it is considered unlikely that R3 could be operational much before the early/mid-2030s. Given the continuing uncertainty surrounding Heathrow R3, careful consideration has been given to the most robust assumption to be made in the traffic forecasts and environmental studies for Gatwick about Heathrow R3. It has been decided that the most robust assumption to adopt, at least for the purpose of preparing the PEIR, is to assume that a third runway does not come forward at Heathrow.

8.1.4 This approach provides a conservative assessment of environmental impacts of the Project. This is because if Heathrow R3 was to come forward, traffic levels at Gatwick would likely decline in the period immediately following the opening of R3, meaning that the environmental impacts of the Project, such as noise, traffic and emissions, would be lower in the 2032 assessment year. By not including Heathrow R3, the 2032 assessment is therefore more conservative. It should be noted that, by 2047, there would be little difference between demand at Gatwick with or without Heathrow R3 and accordingly this scenario would be unchanged irrespective of developments at Heathrow.

8.1.5 The forecasts prepared by GAL for the Northern Runway and Baseline Cases therefore adopt a 'No Heathrow R3' assumption. GAL will, however, keep this under review as work continues on the Project.

8.1.6 The central assessment cases for the Project are therefore as follows:

- Gatwick future baseline with no Heathrow R3.
- Gatwick Northern Runway or "with Project", which assumes Project opens in 2029 and Heathrow R3 does not come forward.

Assessment Years

8.1.7 In respect of each of these two cases, forecasts have been prepared for three primary assessment years – 2029, 2032 and 2047:

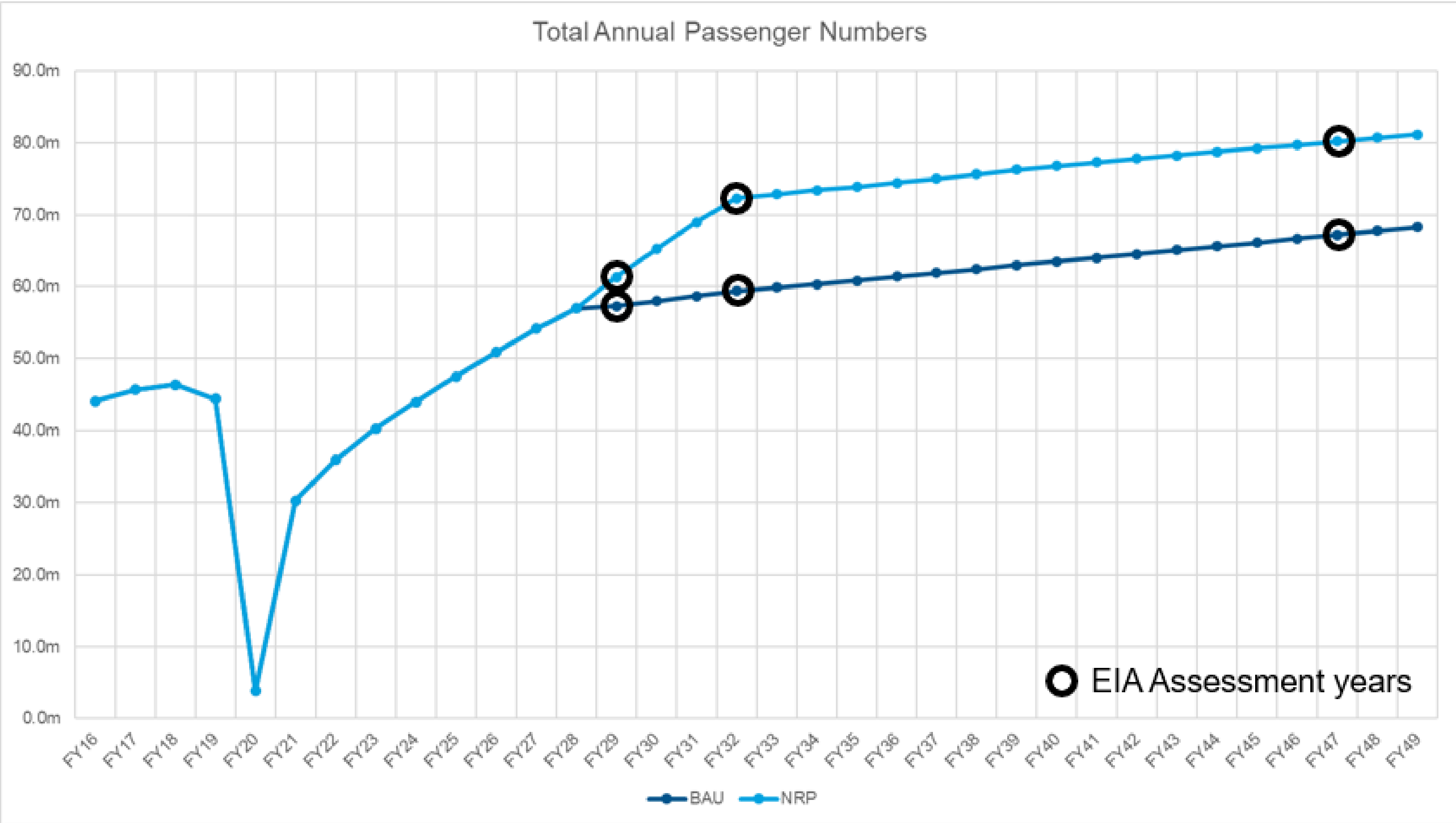
- 2029: represents the first full year of opening of the proposed Northern Runway Project.
- 2032: an interim assessment year, by which time highway mitigation is expected to have been completed and which represents a year in which environmental effects are likely to be higher than 2029.
- 2047: reflects a design year to assess the effects of a project 15 years after it has been completed.

8.2 Passenger growth

8.2.1 Annual demand for the assessment years are shown in Figure 16. Between 2024 and 2025, demand at the Airport is forecast to return to pre-Covid levels and, by 2029, annual demand is estimated to be 57.3mppa in the future baseline. Opening of the Northern Runway generates additional traffic, with airlines taking advantage of the released slots, such that 2029 demand with the Project is 4 mppa higher than the future baseline, at 61.3mppa.

8.2.2 With the Project, there then follows a three-year period of rapid growth to 2032, by which time demand at the Airport has grown to 72.3mppa with the Northern Runway as compared to 59.4mppa in the future baseline. Demand then levels off in line with future baseline and grows incrementally with all slots filled and any additional growth coming from higher load factors or larger aircraft. It is anticipated that by 2047, the Project could increase airport capacity up to 80.2 mppa, compared to a maximum potential capacity based on existing facilities of 67.2 mppa within the same timescale. This represents an increase of approximately 13 mppa.

Figure 16: Airside demand for Future Baseline and with Project Scenarios (No Heathrow R3)



8.2.3 These ICF forecasts provide a breakdown of hourly passenger arrivals and departures by terminal, residency, purpose and haul for each of the scenarios. For the purposes of this assessment the Busy Day forecasts have been used, these represent the third Friday in August.

8.2.4 The demand growth is the growth from a June 2016 weekday, to the forecast year third Friday in August. The third Friday in August 2016 had 14% higher passenger demand than the average June weekday, as such this approach to the forecast growth represents a robust scenario with higher airport demand levels than might otherwise be expected.

8.2.5 Table 8.2.1 shows the number of days and weekdays in each of 2016, 2017, 2018 and averaged that had higher volumes of passengers compared to the third Friday in August for that year. In 2016 19 weekdays had higher volumes than the third Friday in August; 2017 and 2018 had significantly fewer days where this was the case.

Table 8.2.1: Total number of days with higher passenger demand than the third Friday in August

	2016	2017	2018	Average
All days	33	3	2	7
Weekdays	19	1	0	2

8.2.6 The demand inputs are built in the same way as the base model with the hourly scheduled departures and the arrivals profiled out into exit times. The processed demand is then compared with the base demand inputs to provide growth factors by residency and purpose (UK Business, UK Leisure, Non-UK Business, Non-UK Leisure) for North and South terminals.

8.2.7 The ICF forecast additionally provides the proportion of expected transfers for each scenario, these are adjusted in each scenario to account for the volume of passengers with a surface access trip at Gatwick.

8.2.8 The demand inputs along with the forecast return factors and AM1 / AM2 highway demand split are inputs to GSAM.

8.2.9 The growth in passengers in terms of airside and landside demand across the day is shown in Figure 17 and Figure 18 respectively. In order to calculate landside demand, a 'lead' time before departure and a 'lag' time after flight arrival is assumed. These were based on survey data of passengers checking in and leaving the airport with variation in lead times based on short or long-haul flights.

8.2.10 The future baseline growth scenario to 2032 is around 15% higher across the day when compared to 2018. By 2047 demand is around 25% higher than in 2018. Demand in the Project scenario is 40% to 50% higher across the day when compared to 2018.

8.2.11 The landside profiles (Figure 18) show the overlaps with background traffic peaks so the potential impact on congestion is greater at these times of the day, specifically 06:00 to 09:00 and 16:00 to 19:00. High inter-peak demand may also affect resilience and network recovery.

Figure 17: Airside demand for 2018, Baseline and with Project

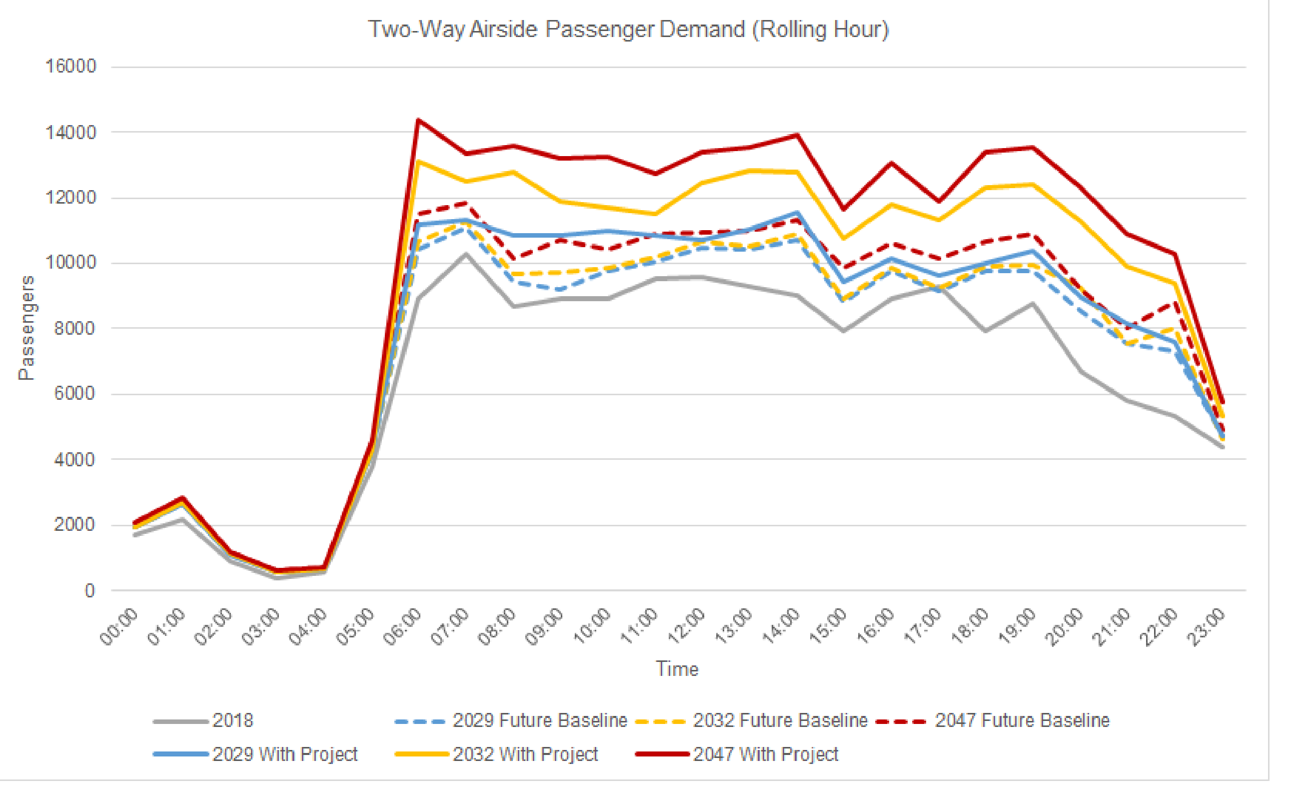
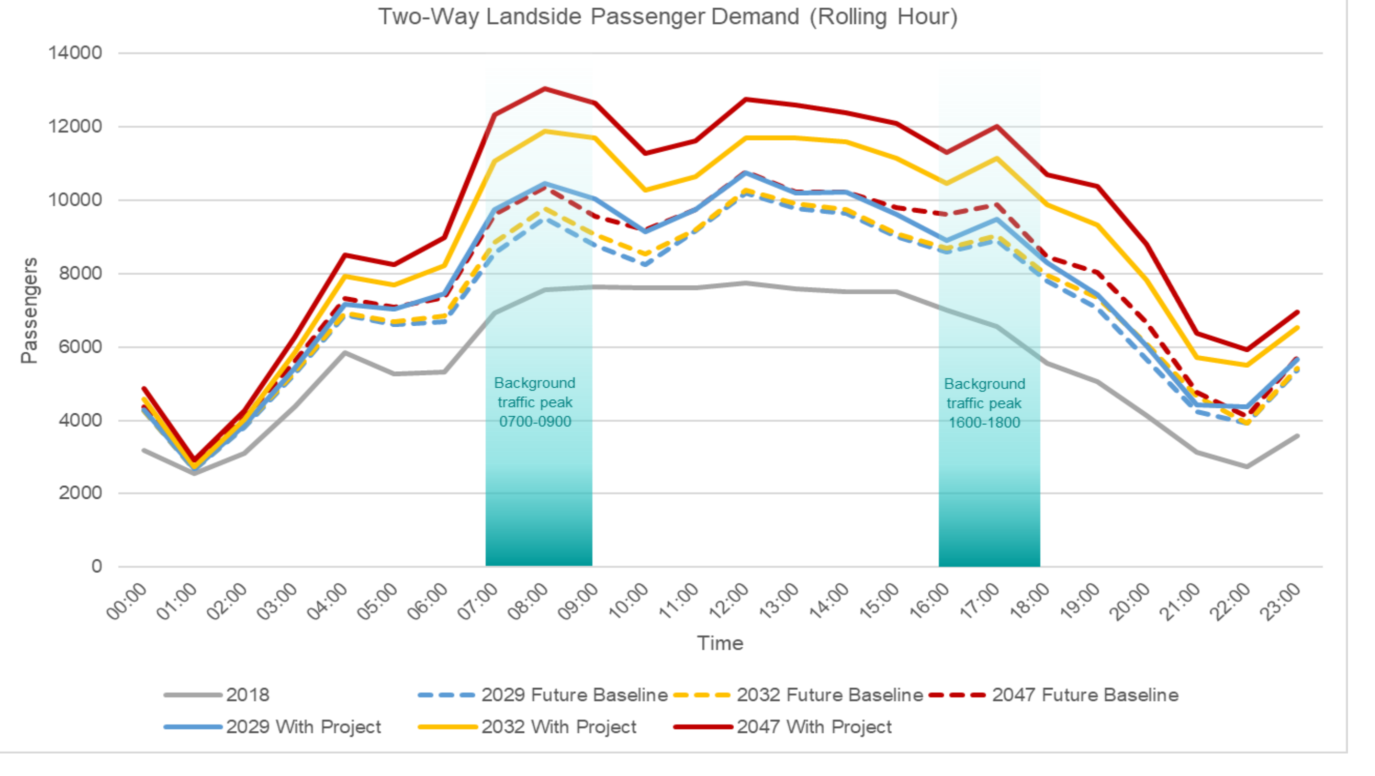


Figure 18: Landside demand for 2018, Future Baseline and Project Scenarios



8.3 Employment growth

8.3.1 The ICF Employment model provides employee numbers by job role for each scenario and forecast year for both the Future Baseline and Project scenarios without a third runway at Heathrow. The total employees for each year are shown in Table 8.3.1. The forecasts indicate that on-airport employees will increase progressively and will reach approximately 29,700 by 2047 for the future baseline scenario and approximately 32,800 by 2047 for the Project scenario, a difference of 3,100 employees.

Table 8.3.1: Gatwick employee forecasts (on-airport employee only)

Year	Future Baseline	With Project
2016	23,807	
2029	27,609	28,596
2032	28,074	31,247
2047	29,721	32,822

8.3.2 These totals are compared to the Oxera employee numbers to create growth factors by role. **Table 8.4.1** presents the growth factors from 2016 for the Future Baseline and with Project scenarios for 2029, 2032 and 2047.

8.3.3 Growth factors are applied during the data expansion process to create demand for each scenario and year. This processed demand is then compared to the base demand to produce growth factors by shift and non-shift workers and feed into GSAM.

8.3.4 Outbound and return factors for shift and non-shift workers are also fed into GSAM from this process.

8.3.5 Splits for AM1 and AM2 to and from the airport are calculated based on the hourly trip profiles in the demand build process and also fed into GSAM for producing assignable demand at the end of each loop of the demand model.

8.4 Cargo and Goods Vehicles

8.4.1 In 2017/18, Gatwick handled just over 102,000 tonnes of cargo. Gatwick's cargo volumes are forecast to grow to just over 290,000 tonnes by 2047 in the future baseline and just under 350,000 tonnes in the With Project scenario.

8.4.2 Forecast growth in cargo volumes is driven by an increasing proportion and volume of flights to long haul markets where cargo volumes are typically strong. To serve these markets the forecasts anticipate a greater proportion of wide-body aircraft with cargo capacities in line with or greater than today's fleet. The forecast growth in cargo numbers is shown in Table 8.4.2.

Table 8.4.1: Growth factors from 2016

	2029 Project	2032 Project	2047 Project	2029 Future Baseline	2032 Future Baseline	2047 Future Baseline
Air Cabin Crew	1.27	1.42	1.52	1.22	1.25	1.35
Management Professional – Airport / Airline	1.16	1.24	1.30	1.13	1.14	1.20
Apron Ramp Cargo Baggage etc.	1.07	1.13	1.13	1.05	1.05	1.06
Catering Cleaning and Housekeeping	1.34	1.52	1.64	1.27	1.30	1.43
Customs Immigration Police and Fire Staff	1.36	1.55	1.68	1.29	1.33	1.45
Management/Professional – Other and IT	1.10	1.16	1.19	1.08	1.09	1.13
Maintenance Trades Staff and Other Skilled	1.22	1.33	1.40	1.17	1.19	1.27
Passenger Services Sales and Clerical Staff	1.08	1.12	1.15	1.06	1.07	1.10
Pilots/ATC/Flight operations	1.11	1.20	1.21	1.07	1.08	1.10
Security Passenger Search Security Access	1.25	1.38	1.47	1.20	1.23	1.32

Table 8.4.2: Cargo Growth Forecast (tonnes)

Year	Baseline	With Project
2016	76,800	
2018	157,475	
2029	227,705	250,816
2032	234,969	304,626
2047	290,499	348,430

8.4.3 Goods vehicles for cargo are not the only ones accessing/exiting the airport as both light and heavy goods vehicles are required to service the airport and aeroplanes themselves. Therefore, there were two assumptions applied to goods vehicles at the airport in order to increase the numbers to/from the airport. These were:

- **Cargo** – trips accessing the zone in the highway model representing the cargo terminal were increased by a growth factor between 2016 and the scenario being modelled. For example, the growth factor used for 2047 with Project was 4.54. representing an increase from 76,800 tonnes to 348,430 tonnes.
- **Servicing** – for any other goods vehicle trips using the Gatwick zones not related to the cargo terminal, these have been increased in line with the passenger per annum increase for each of the scenarios. The growth factors used for these vehicles is shown in Table 8.4.3.

Table 8.4.3: Growth in Gatwick goods vehicles servicing the airport

Year	Baseline	With Project
2029	1.4	1.5
2032	1.46	1.77
2047	1.65	1.97

8.5 Surface Access strategy

8.5.1 Draft actions and targets for the Airport Surface Access Strategy have been included within the PTAR. The final strategy in the application for development consent will be prepared in conjunction with Gatwick's Airport Transport Forum and in accordance with the Aviation Policy Framework guidance.

8.5.2 Gatwick intends to put forward a robust strategy which enhances Gatwick as a regional transport hub through improvements to rail, bus, and sustainable transport with challenging but achievable mode share targets established towards a lower carbon future.

8.5.3 In alignment with the ASAS, the Travel Plan will focus on specific interventions related to staff travel in particular. The Travel Plan will seek to promote sustainable and healthier modes of transport for staff and reduce travel to work by single occupancy car.

Targets

8.5.4 The Project ASAS and Travel Plan will be developed to deliver the growth associated with the northern runway safely and sustainably.

8.5.5 Headline targets proposed in this PTAR are as follows.

- Achieve 60% sustainable transport mode share, including active travel and public transport, for airport passengers by 2030 under the scrutiny of the Transport Forum Steering Group.
- Demonstrate clear progress towards reaching a rail mode share aspiration of 50% by 2030.
- Achieve 60% of staff journeys to work by sustainable modes (public transport, active travel modes and group travel provided by individual employers for their staff, referred to as 'company transport') and including other sustainable travel initiatives such as low emission travel initiatives for those who choose to travel by car by 2040.
- Achieve a year-on-year increase in bus use by staff and passengers and demonstrate measurable value for money from Passenger Transport Levy funding.
- In proportion with the public transport mode share targets set above, to deliver:
  - A reduction in air passenger "Kiss and Fly" car journeys;
  - A reduction in single occupancy car journeys by staff and an increase staff car journeys by registered car share users.
  - A reduction in staff car parking spaces in line with a shift to more sustainable modes.

8.5.6 The measures included in the strategic model lead to an increase in passenger public transport mode share from around 45% prior to the Covid-19 pandemic up to 54% and 56% between 2029 and 2047. Whilst not at the 60% target set for 2030, this increase in public transport mode share for air passengers is significant and notable given the growth in passenger numbers with the Project.

8.5.7 The annual average represents a public transport mode share of 48% to 50% on the peak summer day, owing to the seasonal variation, comprising 42% to 43% rail and 6% to 7% bus and coach.

8.5.8 Accordingly, it is considered likely that Gatwick can achieve a 45% rail mode share by 2030 in line with its ASAS target. Additional routes and higher frequencies will be explored for bus and coach prior to the application for development consent.

8.5.9 In terms of employees, the strategic model shows that a sustainable transport mode share of 47% is achievable and this would indicate that further measures are required, in particular these could include incentives around EV uptake as well as restrictions on staff parking

8.5.10 Further actions which could lead to an increase in sustainable mode share across passengers and employees and are set out in the PTAR.

Parking and forecourt charges

8.5.11 A forecourt access minimum charge of £5 was introduced in 2021 to reduce emissions as part of GAL's Decade of Change and Sustainability targets. It is assumed that this will rise in future years as demand grows to manage the forecourt efficiently. In 2029 the forecourt charge is assumed to rise to £9.50 (in 2021 money) and to £11.50 in 2032 and 2047.

8.5.12 Charges for use of both GAL managed and off-site car parks are assumed to rise by 30% in real terms from 2016 Base to 2029 and by 40% to 2032 and 2047.

8.5.13 In the Base, the off-airport car parks are estimated to be 80% on the modelled day. In future years no new capacity is assumed and an upper limit on off-airport car park occupancy is set at 95%. Excess demand above this limit is switched to on-airport car parks.

8.5.14 Onsite forecast parking assumptions are based on the Gatwick with Project Car Parking in Chapter 5: Project Description of the PEIR for Quarter 2. This provides the location and type of car parks in each of the forecast years, for the model these have been allocated to model zones. Car rental provision on and offsite is assumed to have the same level of provision and that operations can change in order to accommodate growth. It is assumed that the car rental location remains the same as for the 2016 base model.

8.5.15 Staff car parking provision in Car Park M is expected to become a new multi-story car park for passengers, with parking provision for staff moving across to Car Park H in the Future Baseline scenarios, and Car Parks X&V in the With Project scenario with the additional closure of Car Park Y to staff.

8.5.16 In the Future Baseline scenarios, passenger onsite parking provision is expected to increase through the opening of the multi-story car park where Car Park M currently is, along with additional spaces provided by the Robotics parking in the Self-Park South. In addition to these, with the Project in 2029 additional spaces at the north terminal self-parking and short stay in Car Park J will be completed along with an additional 5,800 spaces in the Pentagon. Additional spaces in the North Terminal self-parking will be available in 2032 and some in Car Park Y with the remaining spaces in Car Park Y available by 2047. Table 8.5.1 summarises the total onsite parking provision for staff and park and fly in each of the scenarios.

Table 8.5.1: On-site parking provision

	Staff spaces	Park and Fly	Valet
2019	6,090	26,804	13,807
2029 Future Baseline	6,090	33,554	13,807
2032 Future Baseline	6,090	33,554	13,807
2047 Future Baseline	6,090	33,554	13,807
2029 Project	6,041	42,514	13,807
2032 Project	6,041	49,103	13,807
2047 Project	6,041	52,103	13,807

8.5.17 Parking location changes between the Future Baseline and Project scenarios for each year are shown in Figure 19 to Figure 21, these show the difference compared to the Future Baseline rather than the incremental change year on year.

Figure 19: Changes in parking assumptions from Future Baseline to With Project, 2029

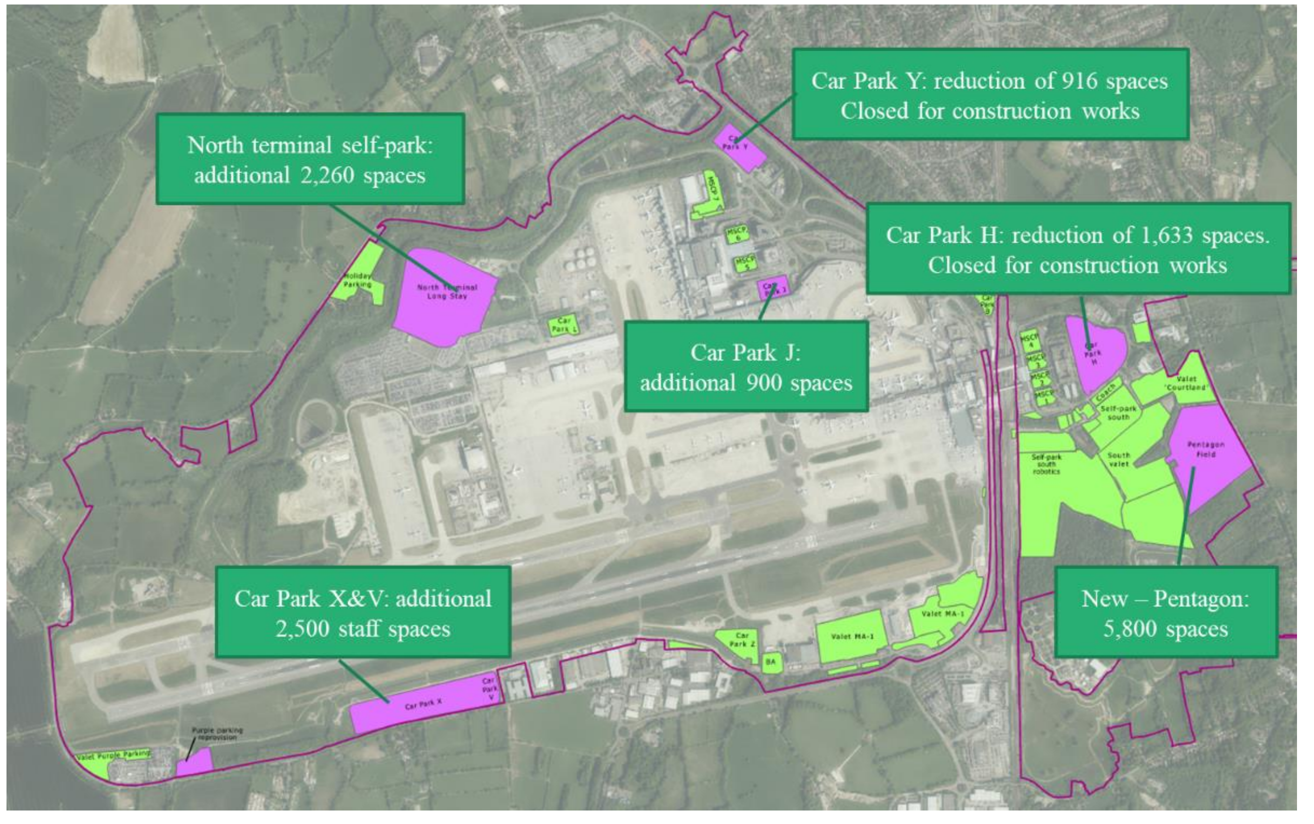


Figure 20: Changes in parking assumptions from Future Baseline to With Project , 2032

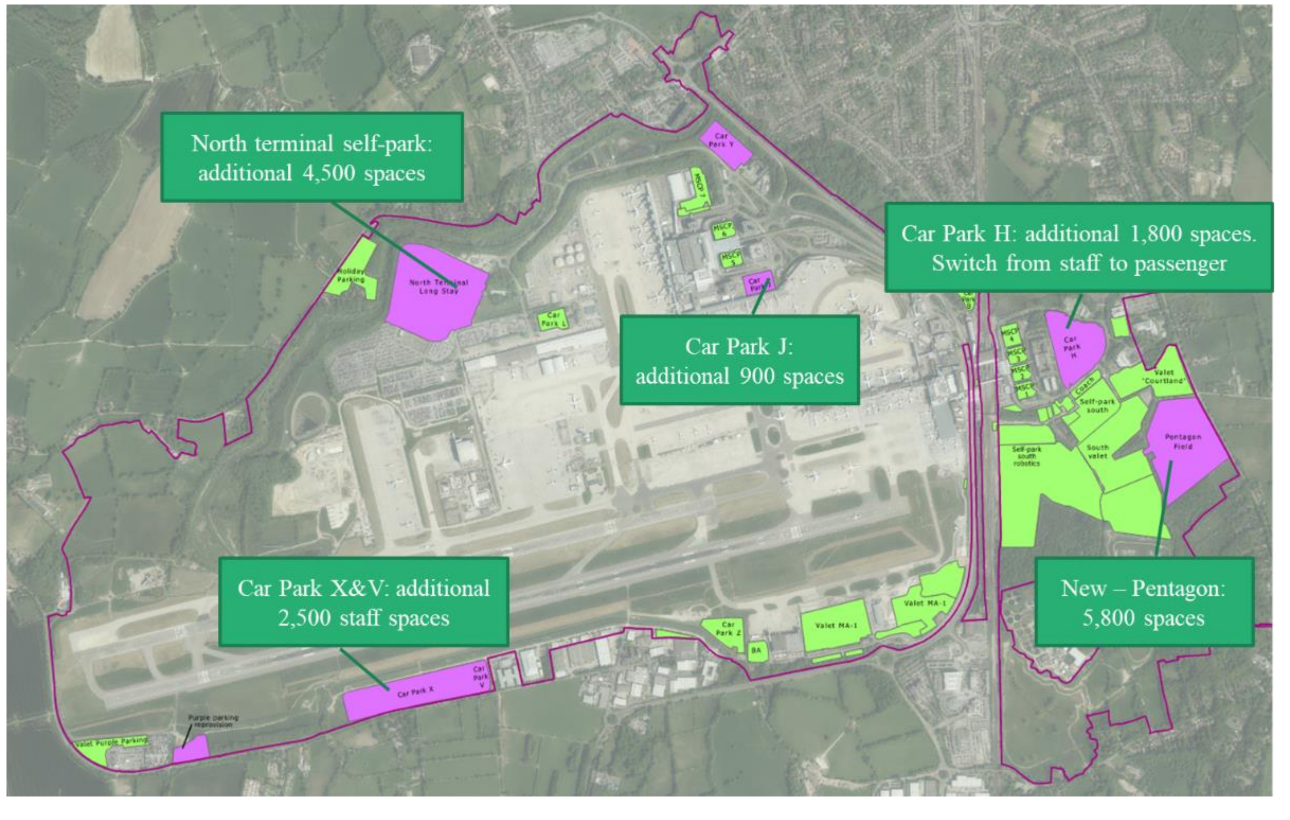
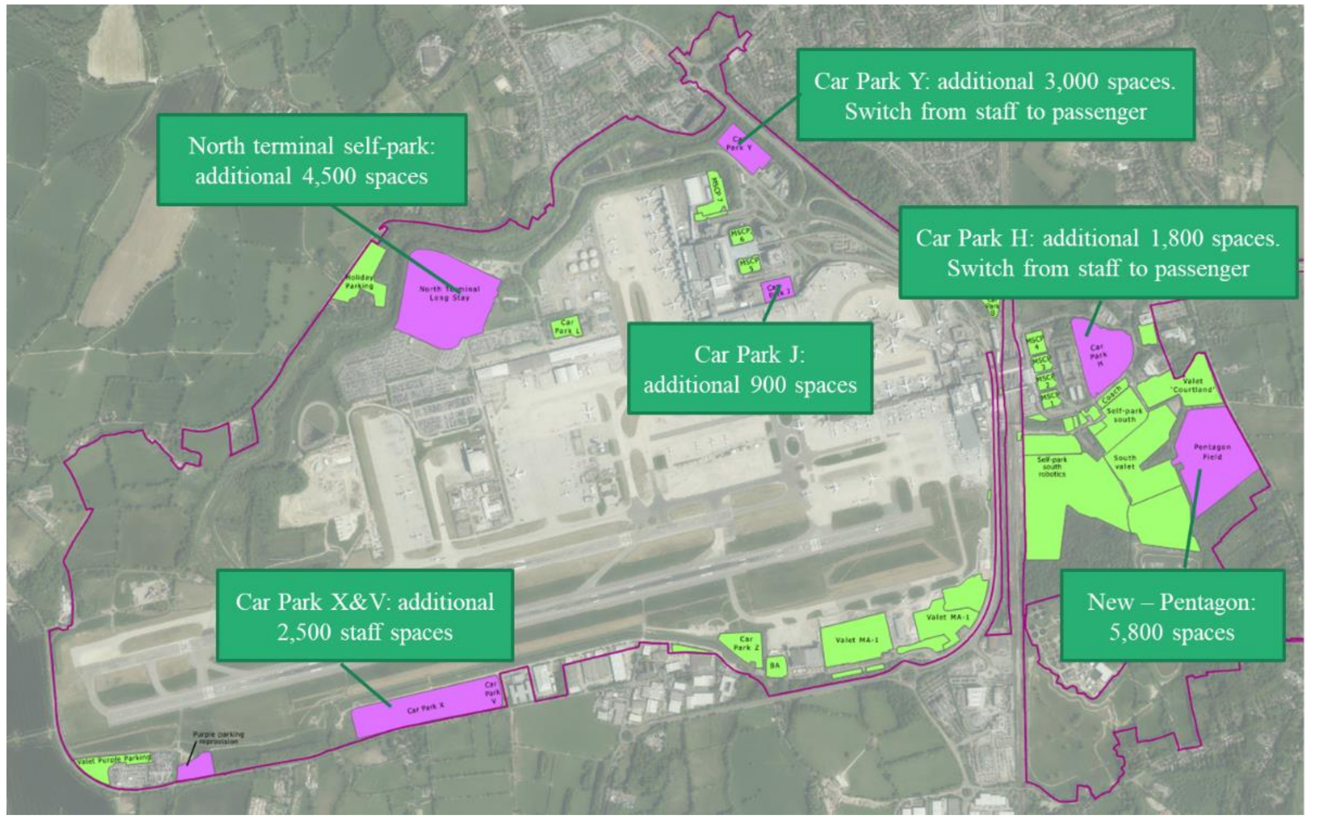


Figure 21: Changes in parking assumptions from Future Baseline to With Project , 2047



8.5.18 Offsite park and fly and valet are assumed to retain the same distribution and to be 80% occupied in 2016 with this increasing to a cap of 95% occupation of capacity for the forecast scenarios.

8.5.19 These assumptions were used to inform the surface access strategy for modelling the Project scenarios.

8.6 Proposed Mitigation

8.6.1 In order to accommodate the proposed increase in passenger numbers, and taking into account other known and planned developments in the area and expected access and mode share changes, highway works are proposed as part of Project. These are to both the South Terminal and North Terminal roundabouts, to improve capacity and mitigate against significant effects, with additional improvement works also proposed at the Longbridge Roundabout.

8.6.2 The final designs and details of the improvement works will be subject to further road traffic assessment and detailed engagement with highway authorities, including Highways England.

South Terminal Junction Improvements

8.6.3 The South Terminal roundabout (also known as the Welcome Roundabout) is the sole entry point into the South Terminal area and for local airport-related roads, including the terminal forecourt, long stay car parks and commercial premises. It is served by the M23 Gatwick Spur to the east (leading from the M23 Junction 9) and Airport Way from the west (leading from North Terminal roundabout). The majority of Gatwick traffic accesses the airport from the M23 and traffic for both the North Terminal and South Terminal passes through this roundabout.

8.6.4 The M23 Gatwick Spur has recently undergone an upgrade as part of the Highways England M23 Smart Motorway Project, completed in 2020. The hard shoulder of the westbound carriageway will become a permanent running lane, providing a total of three lanes approaching the airport. Further local improvements, involving signalisation and minor widening of entries/exits, are proposed in the absence of the Project.

8.6.5 In order to cater for additional road traffic demand associated with the Project, it is proposed that a significant improvement scheme will be required at the South Terminal roundabout. Details of the highway design are being developed and for the purpose of PEIR, it is assumed that grade separation of the roundabout is required. The highway scheme being considered for the South Terminal roundabout for PEIR involves the following.

- A new flyover taking through traffic from the M23 Gatwick Spur to Airport Way over the top of the existing roundabout to remove this traffic from the roundabout.
- The flyover will likely be around 8 metres above the existing ground level allowing for Highways England's safety and design standards.
- To deliver the grade separated solution, slip roads are required and these can be provided on public highway land to the north and GAL land to the south of the existing roundabout.
- Bridging structures are needed for the flyover at the roundabout. The existing structures either side of South Terminal roundabout (where the M23 Gatwick Spur crosses B2036 Balcombe Road, and where Airport Way crosses the Brighton-London main line railway) may require widening and strengthening or replacement.
- This scale of improvement would not preclude further enhancement relevant to serving any planned development north of the roundabout, should that be brought forward.

North Terminal Junction Improvements

8.6.6 The North Terminal roundabout is the entry point to the North Terminal and local access roads, including the north and east perimeter roads. The existing layout consists of a circular five-arm at-grade roundabout to the north east of the North Terminal, to the south west of the A23. There is currently no direct entry to the roundabout southbound from Horley and no direct exit from the roundabout on to the A23 southbound towards Crawley.

8.6.7 Local improvements are proposed in the absence of the Project, including some widening and signalling to provide additional capacity in the future baseline.

8.6.8 In order to cater for additional road traffic demand associated with the Project, together with traffic growth that is expected to arise as a result of background growth and other developments, it is assumed that a significant improvement scheme will be required at North Terminal roundabout. As for the South Terminal junction improvements, any improvement scheme will be subject to detailed assessment work and discussion with Highways England and the local highway authorities.

8.6.9 For the purposes of the PEIR, the highway scheme being considered for the North Terminal roundabout involves the following.

- An elevated flyover to carry traffic between Airport Way (from South Terminal and the M23) and the A23 towards Horley. This removes through traffic from the roundabout.
- The elevated links are likely to be approximately 8 metres above the roundabout to provide the required clearances as stipulated by Highways England's safety and design standards.
- The grade separation solution would include additional slip roads, in particular to provide connections between Airport Way, the A23 London Road and access to the airport. Not all movements are currently catered for at North Terminal Roundabout (e.g., from the airport to the A23 southbound) and the aim is to include as many movements as practicable in order to improve the flow of traffic.
- The configuration of roads beneath the flyover will mean providing specific signal-controlled routings which allow traffic to move directly between Airport Way, A23, Longbridge Way and the terminal forecourt.
- Options exist to accommodate all works within the existing highway boundary, or to take additional land from Riverside Garden Park by the A23 to provide alternative arrangements to meet design standards. These are subject to further design and approval by Highways England and alternative options are being explored to avoid additional land requirements.

Longbridge Roundabout

8.6.10 The existing Longbridge roundabout is where the A23 London Road meets Povey Cross Road, A217 and A23 Brighton Road. There is a dedicated left turn slip from Brighton Road to London Road. Signal controlled pedestrian crossings are provided on all four arms.

8.6.11 Preliminary modelling work shows that that the existing Longbridge roundabout would require works to improve capacity with the Project and to provide better integration with improvements at the North Terminal roundabout.

8.6.12 The proposed solution is to substantially improve the roundabout and provide full width running lanes throughout the junction, replacing the sub-standard narrow lanes that currently exist. These lanes create a capacity restriction due to goods vehicles needing to straddle two lanes for certain manoeuvres. The new roundabout would have a slightly larger inscribed diameter and would extend further west and north to accommodate wider circulating lanes, additional pedestrian crossing facilities and improved capacity on exit and entry lanes, particularly for the A23 arm to and from Horley.

9 Future demand by mode

9.1 Airport passengers

Future Baseline

9.1.1 Table 9.1.1 and Figure 22 show the modelled number of two-way trips made during a June weekday for airport passengers by mode, for the future baseline scenarios. The total demand grows by 36% from 2016 to 2029 and 48% to 2047 from 2016 levels.

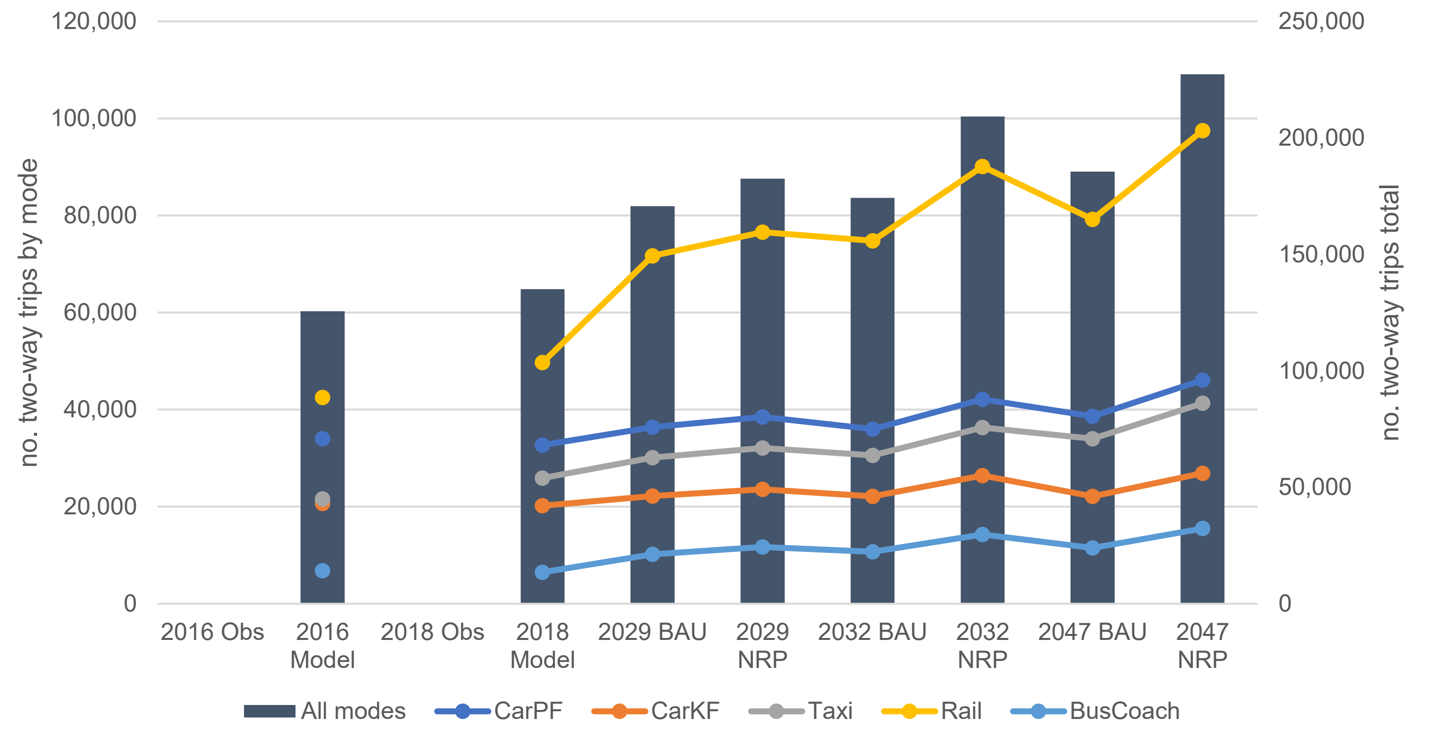
9.1.2 The amount of demand by each mode follows an increasing trend but with different rates. Around 40% of the total number of trips made across the modelled years is by rail, with a large increase of 87% in 2047 compared to the base year (from 42,500 to 79,200). Taxi usage by airport passengers increases by 39% in 2029 and 57% in 2047 from 2016. There are also small increases in trips by car, both parking at the airport and pick-up / drop-off and bus and coach.

Table 9.1.1: Airport Passenger Demand Future Baseline

Two-way trips, weekday, June	2016	2018/2019	2029	2032	2047
CarPF	34,000	32,700	36,400	36,000	38,600
Share (%)	*(27.1%)*	*(24.2%)*	*(21.3%)*	*(20.7%)*	*(20.8%)*
CarKF	20,700	20,200	22,200	22,100	22,100
Share (%)	*(16.5%)*	*(15.0%)*	*(13.0%)*	*(12.7%)*	*(11.9%)*
Taxi	21,600	25,900	30,100	30,600	34,000
Share (%)	*(17.2%)*	*(19.2%)*	*(17.6%)*	*(17.6%)*	*(18.3%)*
Rail	42,500	49,700	71,700	74,800	79,200
Share (%)	*(33.8%)*	*(36.8%)*	*(42.0%)*	*(42.9%)*	*(42.7%)*
BusCoach	6,800	6,500	10,200	10,700	11,500
Share (%)	*(5.4%)*	*(4.8%)*	*(6.0%)*	*(6.2%)*	*(6.2%)*
All modes	125,600	135,000	170,600	174,200	185,400
Share (%)	*(100.0%)*	*(100.0%)*	*(100.0%)*	*(100.0%)*	*(100.0%)*

'CarPF': Car Park and Fly
'CarKF': Car "Kiss and Fly" (pick-up and drop-off)

Figure 22: Airport Passenger Demand Future Baseline



9.1.3 Table 9.1.2 summarises the number of modelled car trips made by airport passengers from 2016 to 2047 in future baseline scenarios. Included modes are car parking and fly, car pick-up and drop-off, and taxis. The total number of trips increases by 16.3% in 2029, stays level until 2032 then increases by 24.1% in 2047.

Table 9.1.2: Total Number of Car Trips Made by Airport Passenger Future Baseline

Two-way trips, weekday, June	2016	2018/2019	2029	2032	2047
All car trips	76,300	78,800	88,700	88,700	94,700
	(60.8%)	*(58.4%)*	*(52.0%)*	*(50.9%)*	*(51.1%)*
Increase from 2016		2,500	12,400	12,400	18,400
% increase from 2016		3.3%	16.3%	16.3%	24.1%

9.1.4 Table 9.1.3 summarises the number of modelled sustainable mode trips made by airport passengers from 2016 to 2047 in future baseline scenarios. Included modes are rail, bus, coach, active and car share. The total number of trips increases by 36.6% in 2029, stays level until 2032 then increases by 24.1% in 2047.

Table 9.1.3: Total Number of Sustainable Mode Trips made by Airport Passenger Future Baseline

Two-way trips, weekday, June	2016	2018/2019	2029 BAU	2032 BAU	2047 BAU
All sustainable mode trips	132,400	141,500	180,800	184,900	196,900
	(39.2%)	*(41.6%)*	*(48.0%)*	*(49.1%)*	*(48.9%)*
Increase from 2016		9,100	48,400	52,500	64,500
% increase from 2016		6.9%	36.6%	39.7%	48.7%

Future Baseline with Project

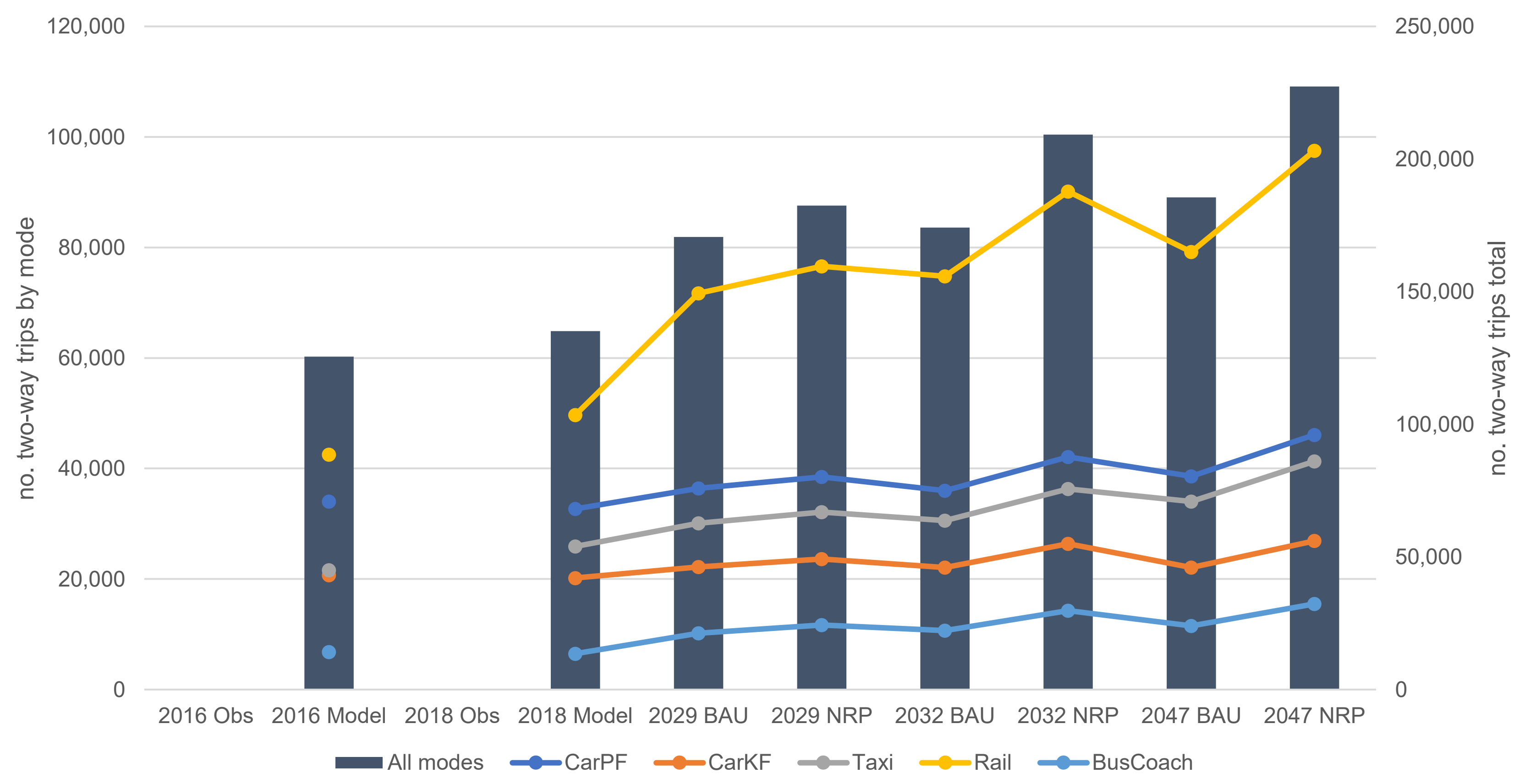
9.1.5 Table 9.1.4 and Figure 23 show the modelled number of two-way trips made during a June weekday for airport passengers by mode, for the future baseline with Project scenarios. The total demand increases by 45% in 2029 and 81% in 2047 from the base year, which is around 33% more growth by 2047 in surface access demand than that in the 2047 future baseline scenario.

9.1.6 There are greater increases by mode in with Project scenarios. The mode split proportions are similar to that of future baseline scenarios in respect of each modelled year.

Table 9.1.4: Airport Passenger Demand Future Baseline with Project

Two-way trips, weekday, June	2016	2018/2019	2029	2032	2047
CarPF	34,000	32,700	38,500	42,100	46,100
Share (%)	*(27.1%)*	*(24.2%)*	*(21.1%)*	*(20.1%)*	*(20.3%)*
CarKF	20,700	20,200	23,600	26,400	26,900
Share (%)	*(16.5%)*	*(15.0%)*	*(13.0%)*	*(12.6%)*	*(11.8%)*
Taxi	21,600	25,900	32,100	36,300	41,300
Share (%)	*(17.2%)*	*(19.2%)*	*(17.6%)*	*(17.4%)*	*(18.2%)*
Rail	42,500	49,700	76,600	90,100	97,500
Share (%)	*(33.8%)*	*(36.8%)*	*(41.9%)*	*(43.1%)*	*(42.9%)*
BusCoach	6,800	6,500	11,700	14,300	15,500
Share (%)	*(5.4%)*	*(4.8%)*	*(6.4%)*	*(6.8%)*	*(6.8%)*
All modes	125,600	135,000	182,500	209,200	227,300
Share (%)	*(100.0%)*	*(100.0%)*	*(100.0%)*	*(100.0%)*	*(100.0%)*

Figure 23: Airport Passenger Demand Future Baseline with Project



9.1.7 Table 9.1.5 shows the total number of car trips made by airport passenger from 2016 to 2047 in future baseline with Project scenarios. The increase in car trips by 2047 in the future baseline with Project scenario compared with the future baseline scenario.

Table 9.1.5: Total Number of Car Trips Made by Airport Passenger Future Baseline with Project

Two-way trips, weekday, June	2016	2018/2019	2029	2032	2047
All car trips	76,300	78,800	94,200	104,800	114,300
	(60.8%)	(58.4%)	(51.7%)	(50.1%)	(50.3%)
Increase from 2016		2,500	17,900	28,500	38,000
% increase from 2016		3.3%	23.5%	37.4%	49.8%

9.1.8 Table 9.1.6 summarises the number of modelled sustainable mode trips made by airport passengers from 2016 to 2047 in future baseline scenarios. The total number of trips increases by 46.7% in 2029, and almost double in 2047.

Table 9.1.6: Total Number of Sustainable Mode Trips made by Airport Passenger Future Baseline with Project

Two-way trips, weekday, June	2016	2018/2019	2029 BAU	2032 BAU	2047 BAU
All sustainable mode trips	132,400	141,500	194,200	223,500	242,800
	(39.2%)	*(41.6%)*	*(48.3%)*	*(49.9%)*	*(49.7%)*
Increase from 2016		9,100	61,800	91,100	110,400
% increase from 2016		6.9%	46.7%	68.8%	83.4%

9.2 Airport Employees

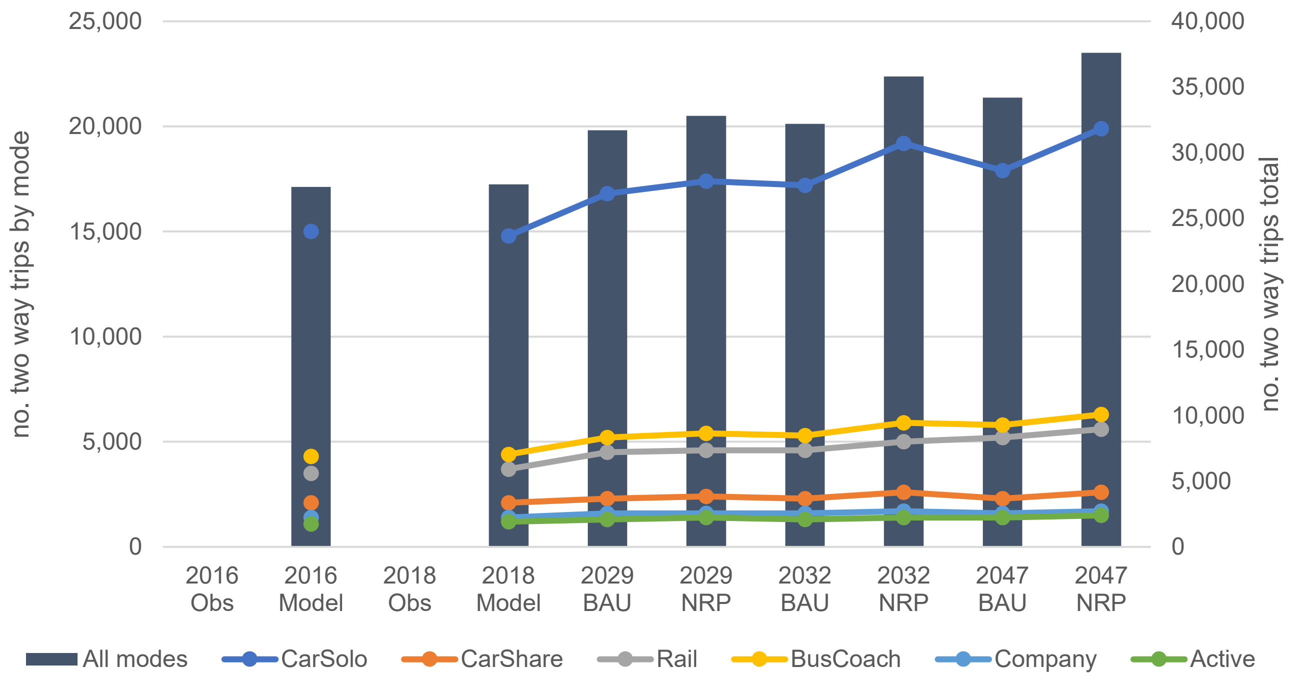
9.2.1 Table 9.2.1 and Figure 24 show the modelled number of employee two-way trips during a June weekday, by mode and in future baseline scenarios.

9.2.2 More than 50% of the total demand is made by solo car driving trips across the modelled years. There is a slight drop in 2018 but this increases back up in the future years. The number of trips by public transport increases slightly by around 4,000 from the base year to 2047, half of which are rail trips and the other half are bus or coach. The active travel, company shuttle service and car share demands show minor growth from 2016 to 2029 and then steady at that level through to 2047.

Table 9.2.1: Airport Employee Demand Future Baseline

Two-way trips, weekday, June	2016	2018/2019	2029	2032	2047
CarSolo	15,000	14,800	16,800	17,200	17,900
Share (%)	*(54.7%)*	*(53.7%)*	*(53.1%)*	*(53.3%)*	*(52.3%)*
CarShare	2,100	2,100	2,300	2,300	2,300
Share (%)	*(7.6%)*	*(7.5%)*	*(7.2%)*	*(7.2%)*	*(6.8%)*
Rail	3,500	3,700	4,500	4,600	5,200
Share (%)	*(12.8%)*	*(13.5%)*	*(14.1%)*	*(14.3%)*	*(15.2%)*
BusCoach	4,300	4,400	5,200	5,300	5,800
Share (%)	*(15.7%)*	*(16.0%)*	*(16.5%)*	*(16.3%)*	*(17.0%)*
Company	1,400	1,400	1,600	1,600	1,600
Share (%)	*(5.1%)*	*(5.1%)*	*(4.9%)*	*(4.8%)*	*(4.7%)*
Active	1,100	1,200	1,300	1,300	1,400
Share (%)	*(4.2%)*	*(4.2%)*	*(4.1%)*	*(4.1%)*	*(4.1%)*
All modes	26,300	26,400	30,400	31,000	32,800
Share (%)	*(100.0%)*	*(100.0%)*	*(100.0%)*	*(100.0%)*	*(100.0%)*

Figure 24: Airport Employee Demand Future Baseline



9.2.3 Table 9.2.2 summarises the numbers of modelled car trips made by airport employees from 2016 to 2047 in future baseline scenarios, which sums the 'CarSolo', 'CarShare' and 'Company' trips. The total number of trips increases steadily to 17.8% in 2047.

Table 9.2.2: Total Number of Car Trips Made by Airport Employees Future Baseline

Two-way trips, weekday, June	2016	2018/2019	2029	2032	2047
All car trips	18,500	18,300	20,700	21,100	21,800
	(67.4%)	*(66.3%)*	*(65.3%)*	*(65.3%)*	*(63.8%)*
Increase from 2016		-200	2,200	2,600	3,300
% increase from 2016		-1.1%	11.9%	14.1%	17.8%

9.2.4 Table 9.2.3 summarises the numbers of modelled sustainable mode trips made by airport employees from 2016 to 2047 in future baseline scenarios, which sums all trips of modes analysed apart from 'CarSolo'. The total number of trips increases steadily to 31.5% in 2047.

Table 9.2.3: Total Number of Sustainable Mode Trips Made by Airport Employees Future Baseline

Two-way trips, weekday, June	2016	2018/2019	2029	2032	2047
All sustainable mode trips	12,400	12,800	14,900	15,100	16,300
	(45.3%)	*(46.3%)*	*(46.9%)*	*(46.7%)*	*(47.7%)*
Increase from 2016		400	2,500	2,700	3,900
% increase from 2016		3.2%	20.2%	21.8%	31.5%

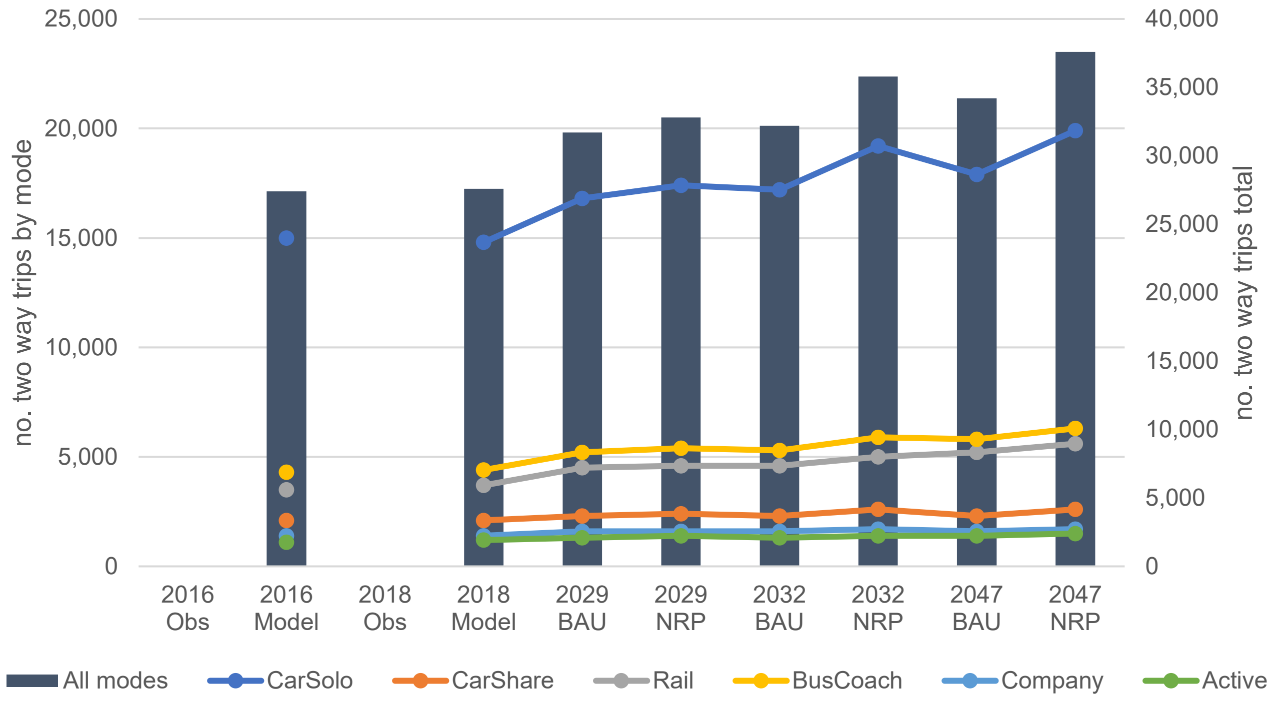
9.2.5 Table 9.2.4 and Figure 25 show the modelled number of two-way trips during a June weekday, made by airport employees by mode in future baseline with Project scenarios. The total demand increases by 4% in 2029 and 8% in 2047 compared to that in 2016.

9.2.6 It also shows greater demand increase by public transport from 2029 to 2047. The mode split proportions are similar to that of baseline scenarios in respect of each modelled year.

Table 9.2.4: Airport Employee Demand Future Baseline with Project

Two-way trips, weekday, June	2016	2018/2019	2029	2032	2047
CarSolo	15,000	14,800	17,400	19,200	19,900
Share (%)	*(54.7%)*	*(53.7%)*	*(53.1%)*	*(53.7%)*	*(52.9%)*
CarShare	2,100	2,100	2,400	2,600	2,600
Share (%)	*(7.6%)*	*(7.5%)*	*(7.2%)*	*(7.2%)*	*(6.9%)*
Rail	3,500	3,700	4,600	5,000	5,600
Share (%)	*(12.8%)*	*(13.5%)*	*(14.1%)*	*(13.9%)*	*(14.8%)*
BusCoach	4,300	4,400	5,400	5,900	6,300
Share (%)	*(15.7%)*	*(16.0%)*	*(16.6%)*	*(16.4%)*	*(16.8%)*
Company	1,400	1,400	1,600	1,700	1,700
Share (%)	*(5.1%)*	*(5.1%)*	*(4.9%)*	*(4.8%)*	*(4.6%)*
Active	1,100	1,200	1,400	1,400	1,500
Share (%)	*(4.2%)*	*(4.2%)*	*(4.1%)*	*(4.0%)*	*(3.9%)*
All modes	26,300	26,400	31,400	34,400	36,100
Share (%)	*(100.0%)*	*(100.0%)*	*(100.0%)*	*(100.0%)*	*(100.0%)*

Figure 25: Airport Employee Demand Future Baseline with Project



9.2.7 Table 9.2.5 shows the total number of car trips made by airport employees from 2016 to 2047 in future baseline with Project scenarios. The number of car trips increases by 27% in 2032 and 30.8% in 2047, with significantly higher growth rate between 2016 and 2029 than the rate in baseline scenarios.

Table 9.2.5: Total Number of Car Trips Made by Airport Employees Future Baseline with Project

Two-way trips, weekday, June	2016	2018/2019	2029	2032	2047
All car trips	18,500	18,300	21,400	23,500	24,200
	(67.4%)	*(66.3%)*	*(65.2%)*	*(65.7%)*	*(64.5%)*
Increase from 2016		-200	2,900	5,000	5,700
% increase from 2016		-1.1%	15.7%	27.0%	30.8%

9.2.8 Table 9.2.6 shows the total number of sustainable mode trips made by airport employees from 2016 to 2047 in future baseline with Project scenarios. The total number increases by 24.2% in 2029 and 42.7% in 2047.

Table 9.2.6: Total Number of Sustainable Mode Trips Made by Airport Employees Future Baseline with Project

Two-way trips, weekday, June	2016	2018/2019	2029	2032	2047
All sustainable mode trips	12,400	12,800	15,400	16,600	17,700
	(45.3%)	*(46.3%)*	*(46.9%)*	*(46.3%)*	*(47.1%)*
Increase from 2016		400	3,000	4,200	5,300
% increase from 2016		3.2%	24.2%	33.9%	42.7%

10 Highway Network Performance

10.1 Assessment approach

10.1.1 The following section details the performance of the highway model in relation to the Future Baseline and Future Baseline with Project respectively. This covers the three assessment years of 2029, 2032 and 2047.

10.1.2 The performance of the highway model is assessed by considering the changes in network operation for each assessment year between the Future Baseline and With Project scenarios. The assessment considers five performance areas presented in Figure 26 and consists of:

- Strategic Road Network (SRN): M25 (J5 to J10), M23, A23 & A27 (Lewes to Arundel);
- Performance Area A: Gatwick Airport, Crawley and Horley;
- Performance Area B: M25 to A272;
- Performance Area C: Inter-London; and
- Performance Area D: A272 – A27

10.1.3 To this end, the following network characteristics are explored in the analysis:

10.1.4 **Annual Average Daily Traffic (AADT)** – presented in vehicle units and represents the annual average daily volume of traffic expanded from the four individual modelled time periods. Summarised across all Performance Areas.

10.1.5 **Journey Times** – expressed as end-to-end travel times on key routes across the AoDM. These include the Strategic Route Network (SRN), routes in the vicinity of Gatwick Airport, the periphery of Crawley and other key distributor roads. The routes analysed capture trips to/from Gatwick Airport as well as other key strategic movements on the network. Presented for SRN, Performance Areas A, B and D.

10.1.6 **Volume to Capacity (V/C)** – ratios expressing the total traffic volume utilising a link with respect to its total available capacity, this is a common metric used to assess the level of congestion. Modelled values are presented to capture the worst performing links (i.e. the maximum across all time periods). V/C is segmented in to three key operational categories presented in Table 43 and is considered for SRN & Performance Areas A-D.

Table 10.1.1: Volume / Capacity Operational Categories

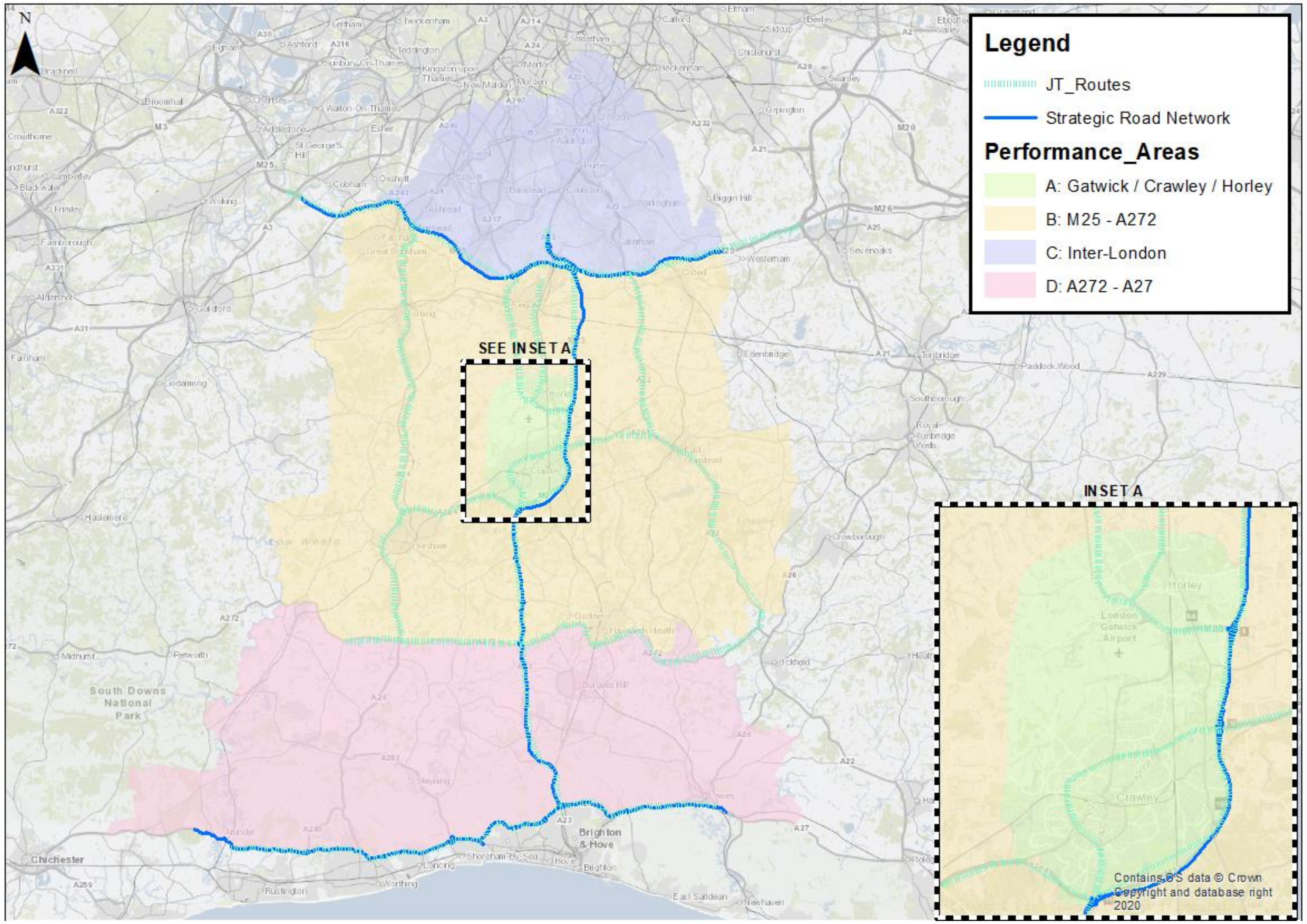
Category	V/C Definition
-	V/C < 50%
Green	50% < V/C < 85%
Amber	85% < V/C < 99%
Red	V\C > 100%

10.1.7 **Magnitude of Impact (Links / Nodes)** – Changes between link and node V/C metrics between the Future Baseline and With Project scenarios are categorised into Low, Medium and High and is presented for Performance Areas A-D. The categories are based on a combination of changes in V/C referred to as congestion indicators as well as the V/C standard in the With Project scenario. For example, an instance of V/C changing by >10% with a corresponding V/C of <85% in the With Project scenario is deemed 'Negligible', however if the V/C standard is 92-99% in this context the change would be classified as 'High'. An overview of the parameters enforced as part of the categorisation process is presented in Table 10.1.2.

Table 10.1.2: Magnitude of Impacts Grid

Criteria		Magnitude of impacts			
		Not significant	Minor	Moderate	Major
		<85%	85 - 92%	92 - 99%	99% or more
<2% change in Congestion Indicator	Very Low	Negligible	Negligible	Negligible	Negligible
2-5% change in Congestion Indicator	Low	Negligible	Low	Low	Medium
Between 5-10% change in Congestion Indicator	Medium	Negligible	Low	Medium	High
>10% change in Congestion Indicator	High	Negligible	Medium	High	High

Figure 26: Highway Model Performance Area



10.2 Actual Flow by time period

10.2.1 This section discusses the growth in hourly traffic volumes within the study area between modelled years for the base and Future Baseline scenarios to provide an understanding of the change in background traffic without the Project.

10.2.2 Increases in traffic flow are represented by variable band widths in shade of yellow to dark red, with decreases in blue to green. There are some sections of road where the network is not completely consistent between the two scenarios, where this is the case the total traffic volume for the later year is shown instead (shades of purple), this along with the bandwidths either side should indicate the change in volume in this area. Small changes in flow of between -50 and 50 are shown as grey links, to more clearly present where there are greater changes in modelled flows.

2016 to 2029 Future Baseline

10.2.3 The modelled flow difference between 2016 and the 2029 Future Baseline for AM1 is presented in Figure 27 to Figure 30 for AM1, AM2, IP and PM respectively

10.2.4 Between 2029 Future Baseline and 2016, the largest hourly increases in traffic volumes are seen on the M25 (particularly between Junction 7 and Junction 10) and M23 north of Junction 9. These areas align with where there are network improvements built between 2016 and 2029 on both the M23 and M25.

10.2.5 On the M25 these increases are between 500 and 2,500 vehicles in each direction in AM1, AM2 and PM, the AM2 in particular has increases of up to 2,500 on all sections of this part of the M25. An increase of 1,000-2,500 in both directions is expected on the M23 north of Junction 9 in all time periods except the IP where an increase of 500-1,000 vehicles is expected. These are likely to be as a result of the M25 South West Quadrant (and M25 J10-16 additionally increasing capacity on this side of the M25) and M23 Junction 8-10 Smart Motorway improvements.

10.2.6 There is some re-routing indicated by the reductions in traffic in the south west of London, in addition to re-routing from Horsham Road / A23 / A2011 onto the M23 around Crawley.

10.2.7 In the immediate vicinity of the airport, there are increases of 200-500 vehicles on Airport Way and the A23 London Road in all time periods, with 500-1,000 westbound on Airport Way in the PM.

Figure 27: Traffic flow change 2016 base year to 2029 Future Baseline, AM1

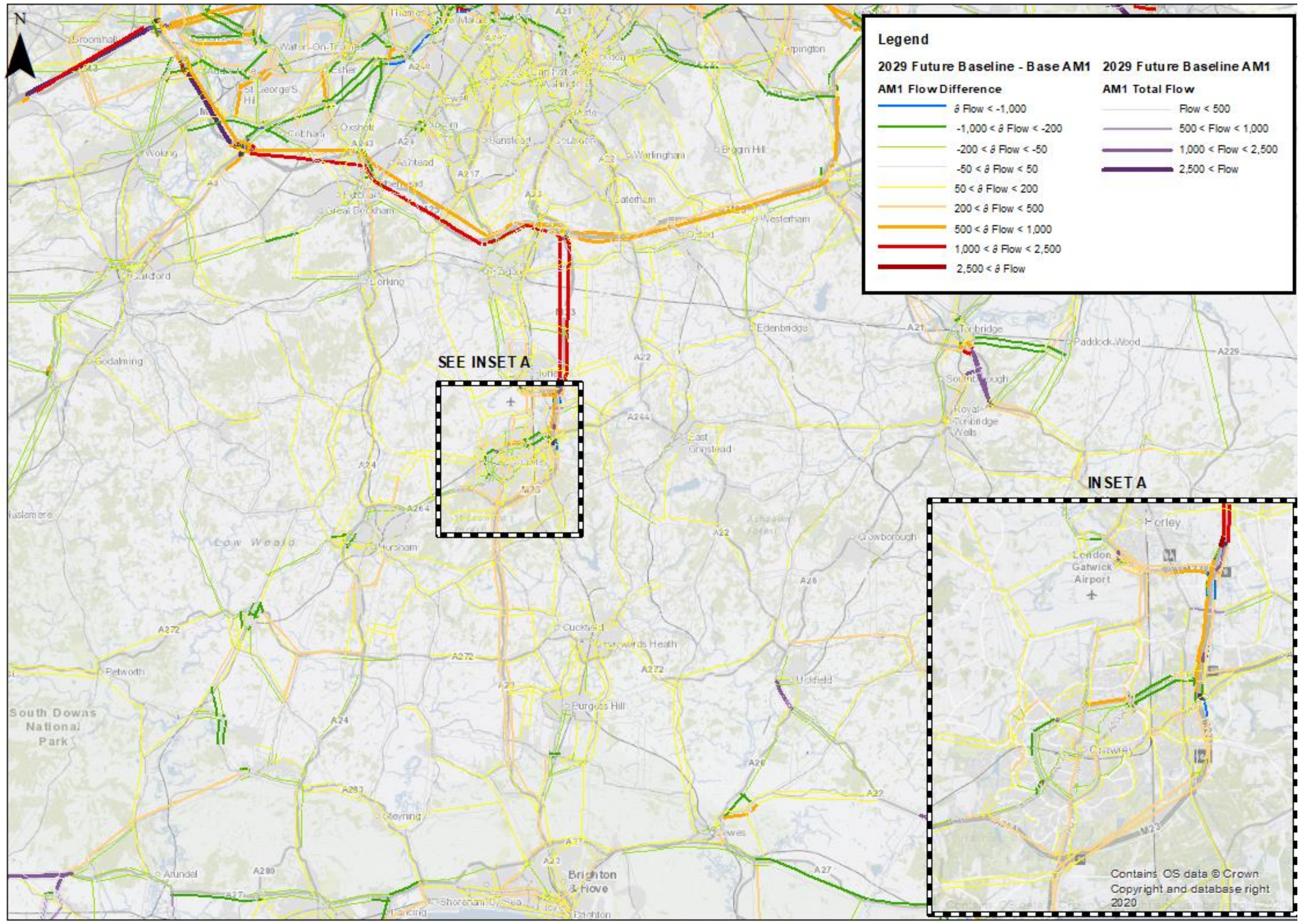


Figure 28: Traffic flow change 2016 base year to 2029 Future Baseline, AM2

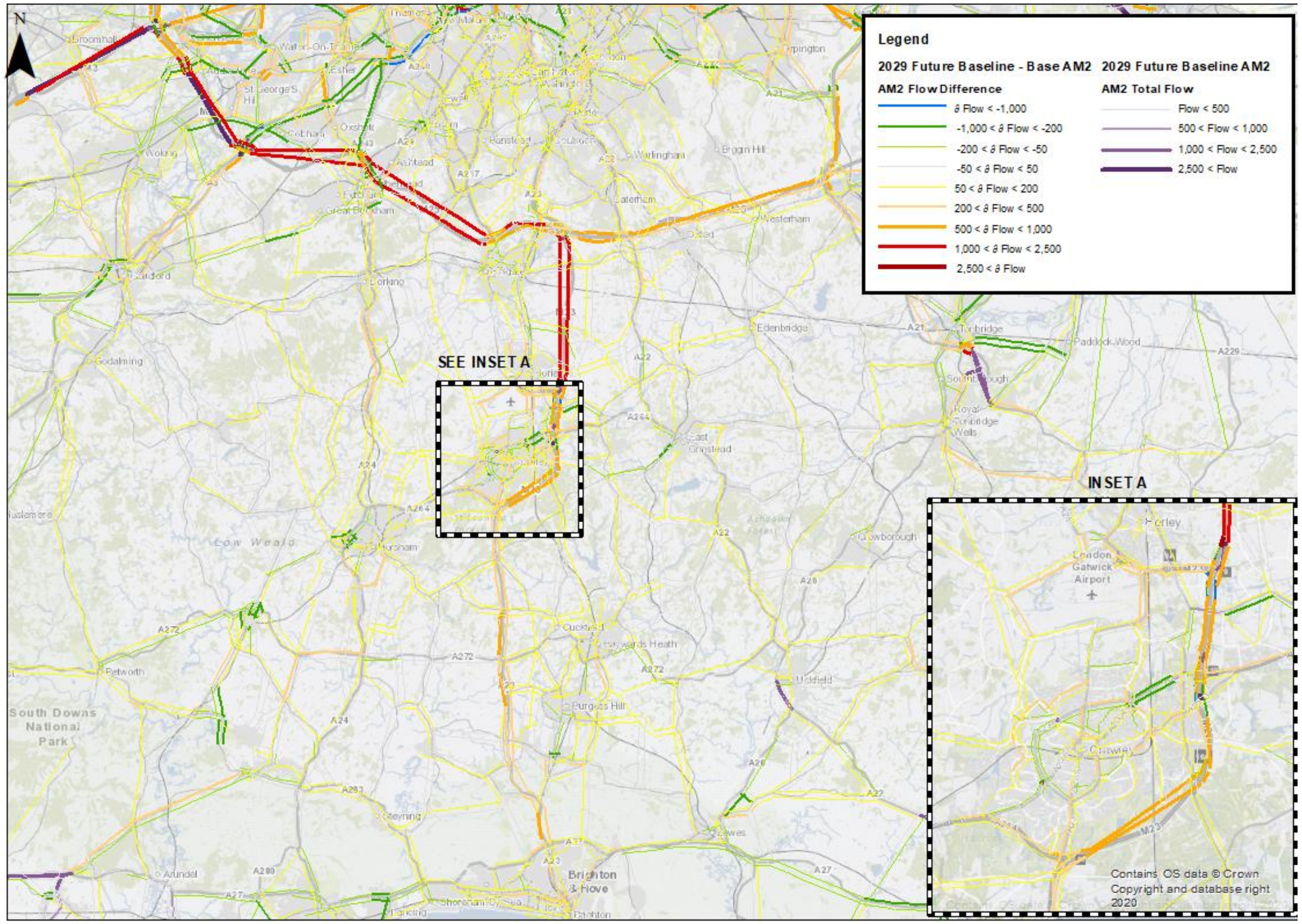


Figure 29: Traffic flow change 2016 base year to 2029 Future Baseline, IP

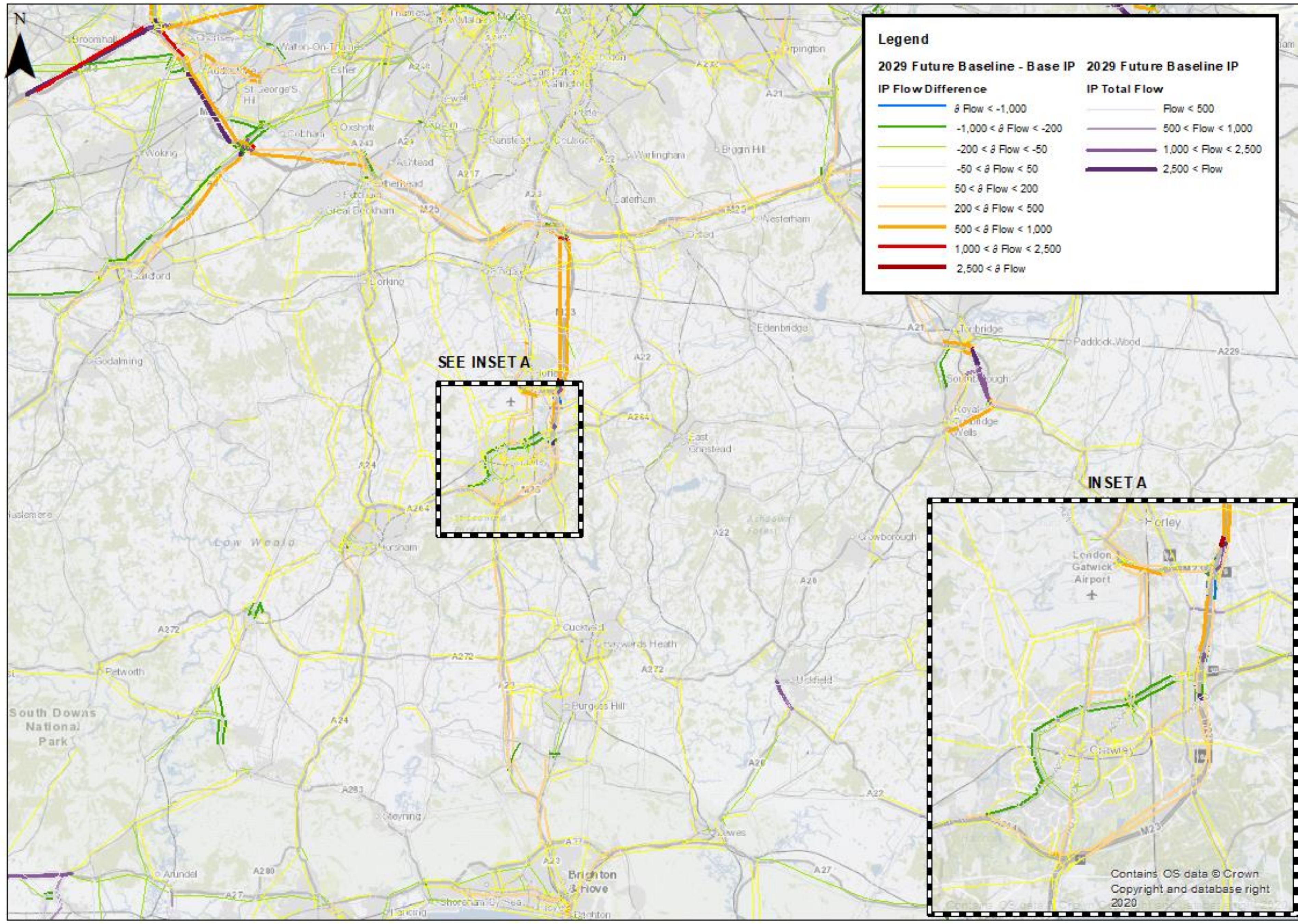
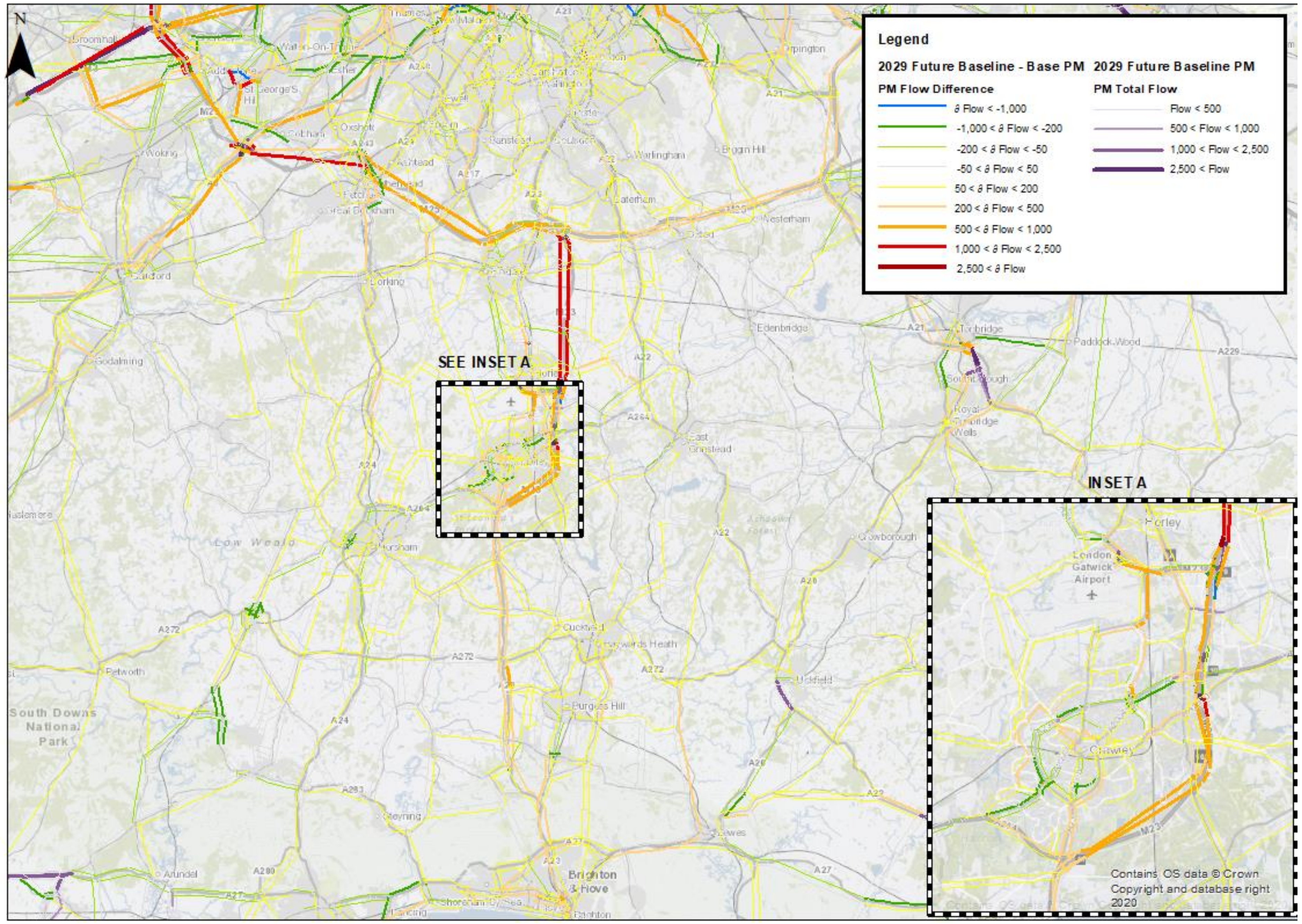


Figure 30: Traffic flow change 2016 base year to 2029 Future Baseline, PM



2029 to 2032 Future Baseline

10.2.8 Figure 31 to Figure 34 show the change in traffic volumes between 2029 and 2032 Future Baseline scenarios for AM1, AM2, IP and PM respectively. There are no additional changes to the networks, or supply assumptions, as such the changes are related to background growth changes.

10.2.9 These show that flow changes are generally on motorways and major A roads, the largest of these being increases of between 200 and 500 in each direction on the M23 north of Junction 11 and on the M25.

10.2.10 In the immediate vicinity of the airport, there are increases of between 50 and 200 vehicles between the M23 and North Terminal in AM1 and PM, and on A23 London Road to the east of the airport in AM1 and AM2.

Figure 31: Traffic flow change 2029 to 2032 Future Baseline, AM1

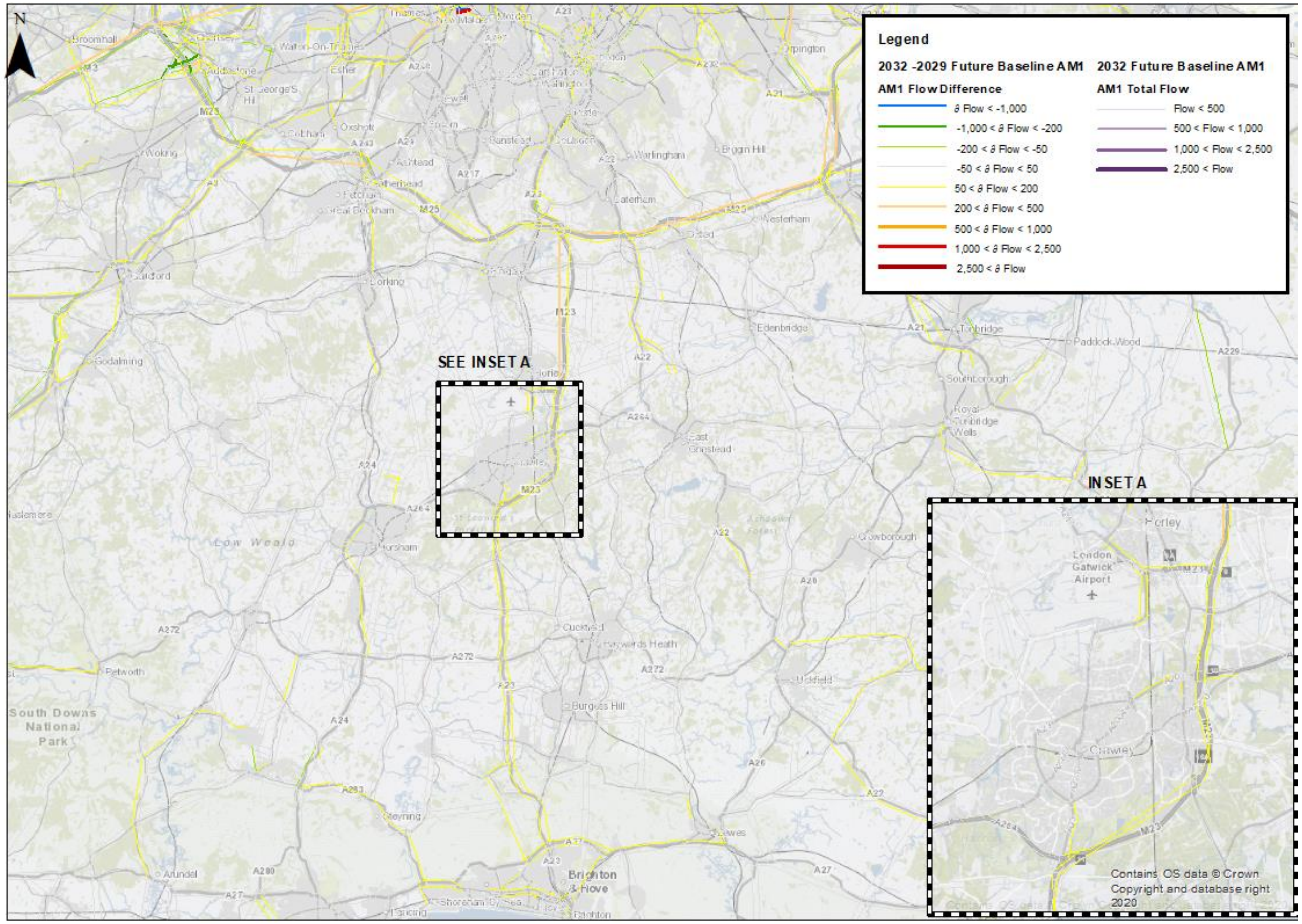


Figure 32: Traffic flow change 2029 to 2032 Future Baseline, AM2

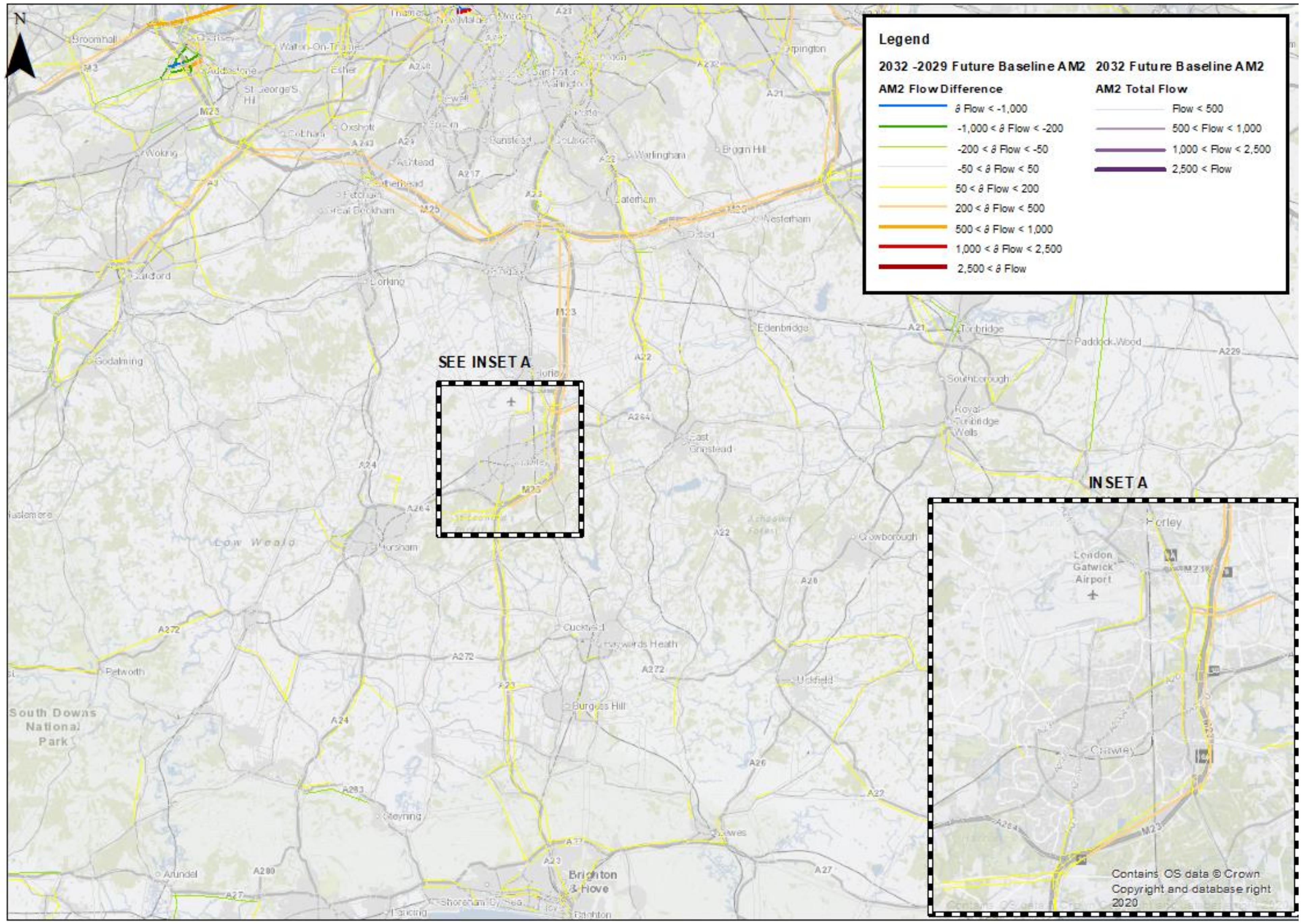


Figure 33: Traffic flow change 2029 to 2032 Future Baseline, IP

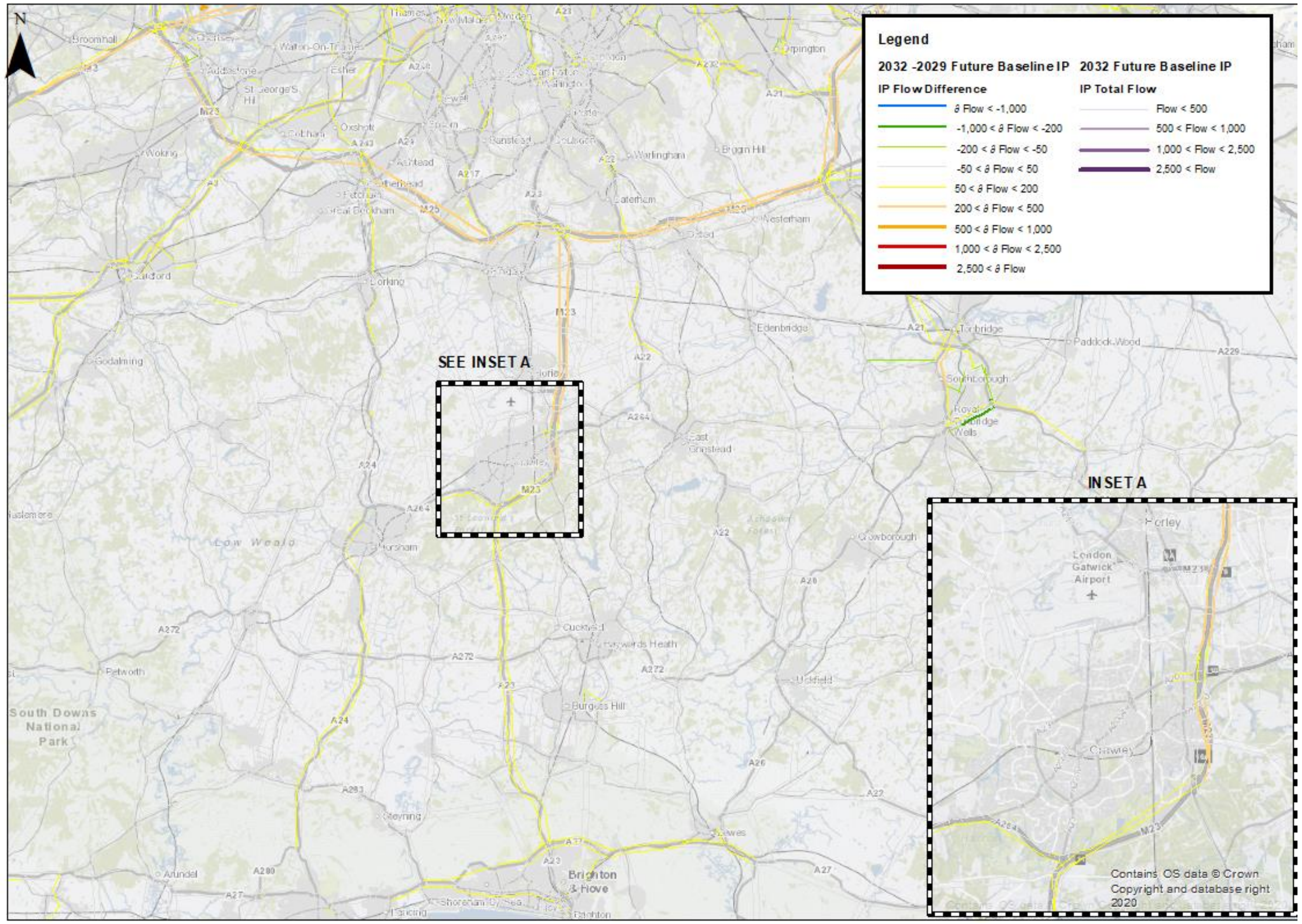
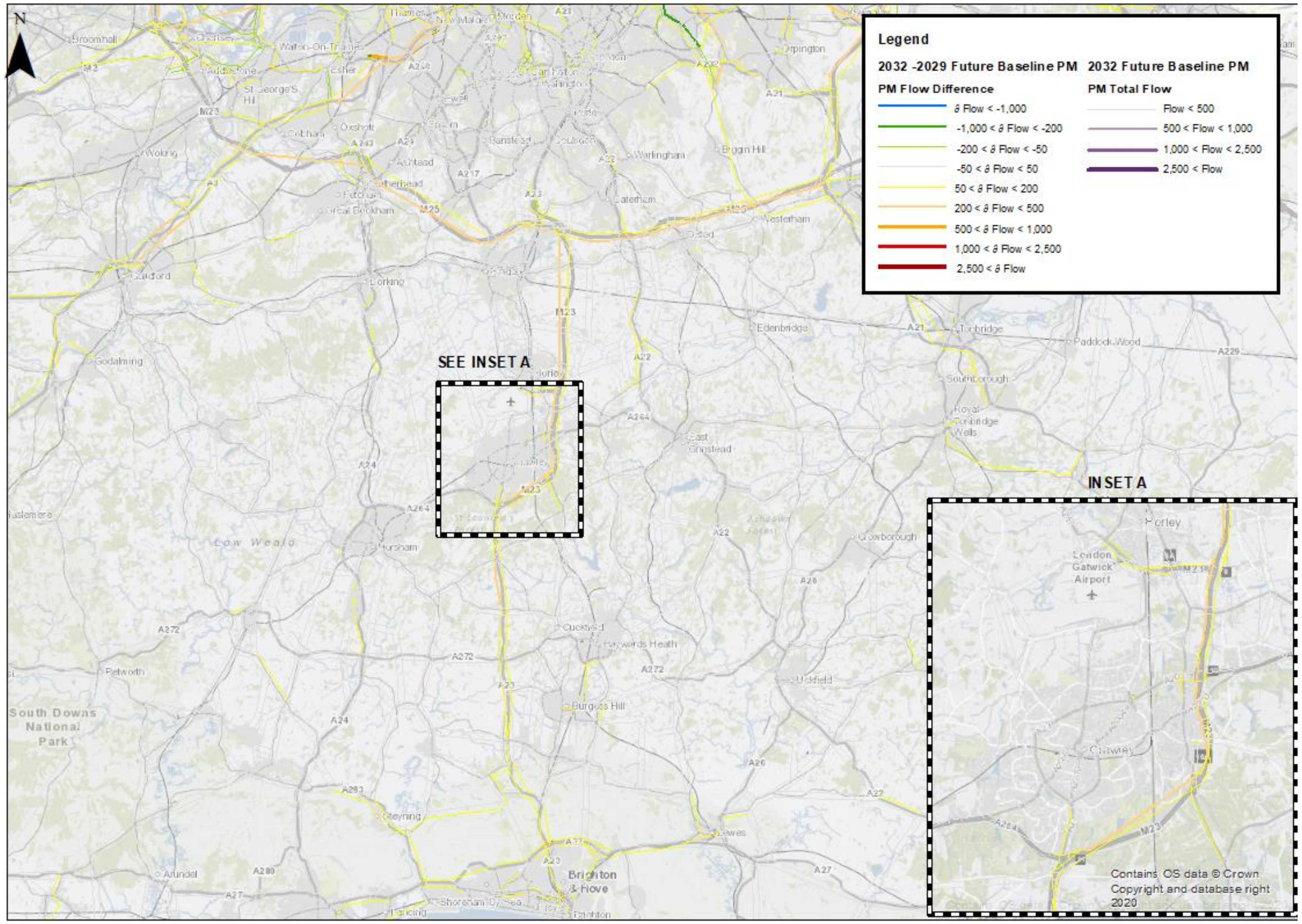


Figure 34: Traffic flow change 2029 to 2032 Future Baseline, PM



2032 to 2047 Future Baseline

10.2.11 Figure 35 to Figure 38 show the change in traffic volume between 2032 and 2047 for AM1, AM2, IP and PM respectively. These show increases of 500-1,000 on the M25 to the east of M25 Junction 7 in all time periods, and on the A3 and M3 into London. Changes in traffic volumes to the north of Horsham are related to the North of Horsham development.

10.2.12 In the immediate vicinity of the airport, traffic volumes are expected to increase between 50 and 200 vehicles.

Figure 35: Traffic flow change 2032 to 2047 Future Baseline, AM1

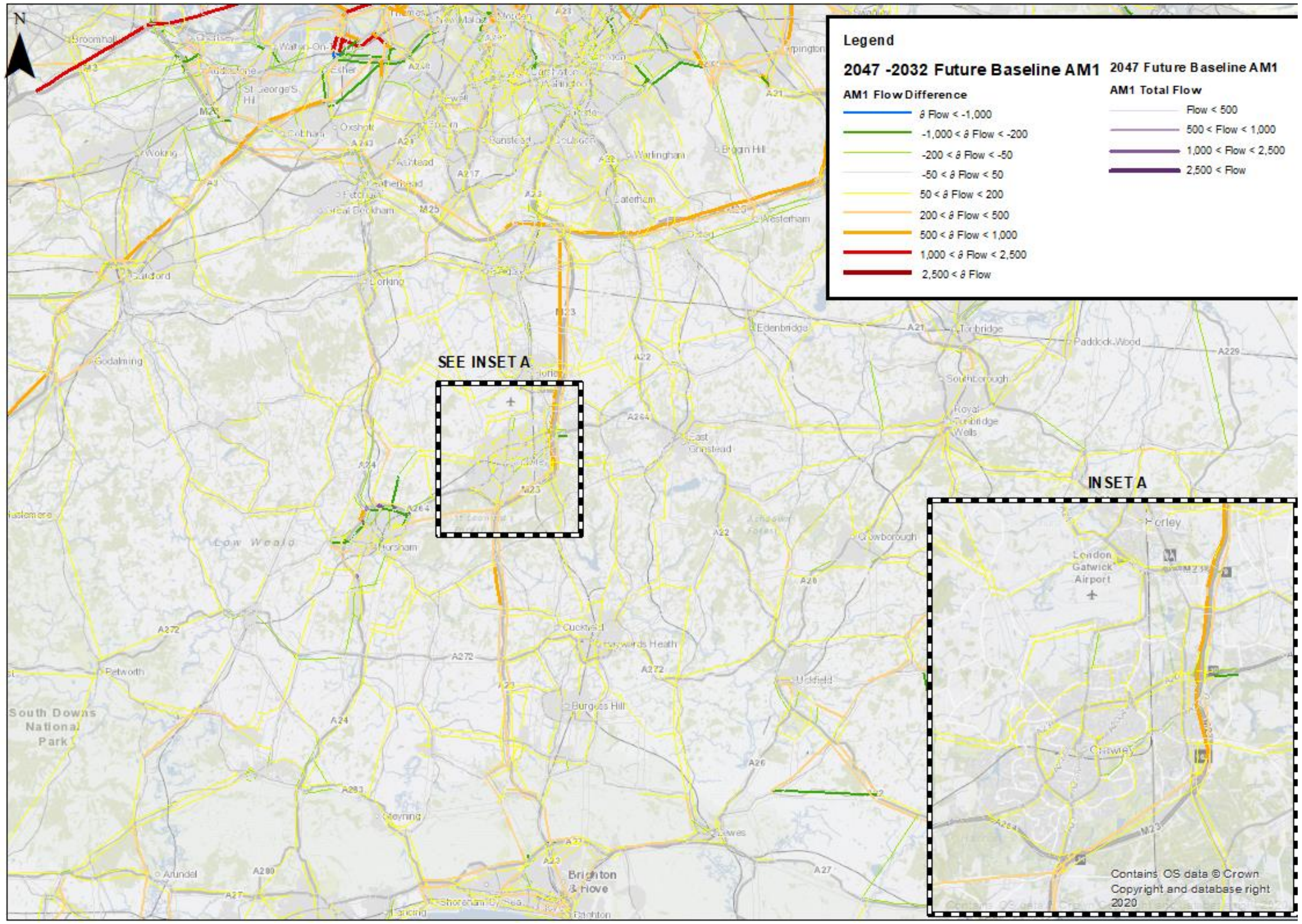


Figure 36: Traffic flow change 2032 to 2047 Future Baseline, AM2

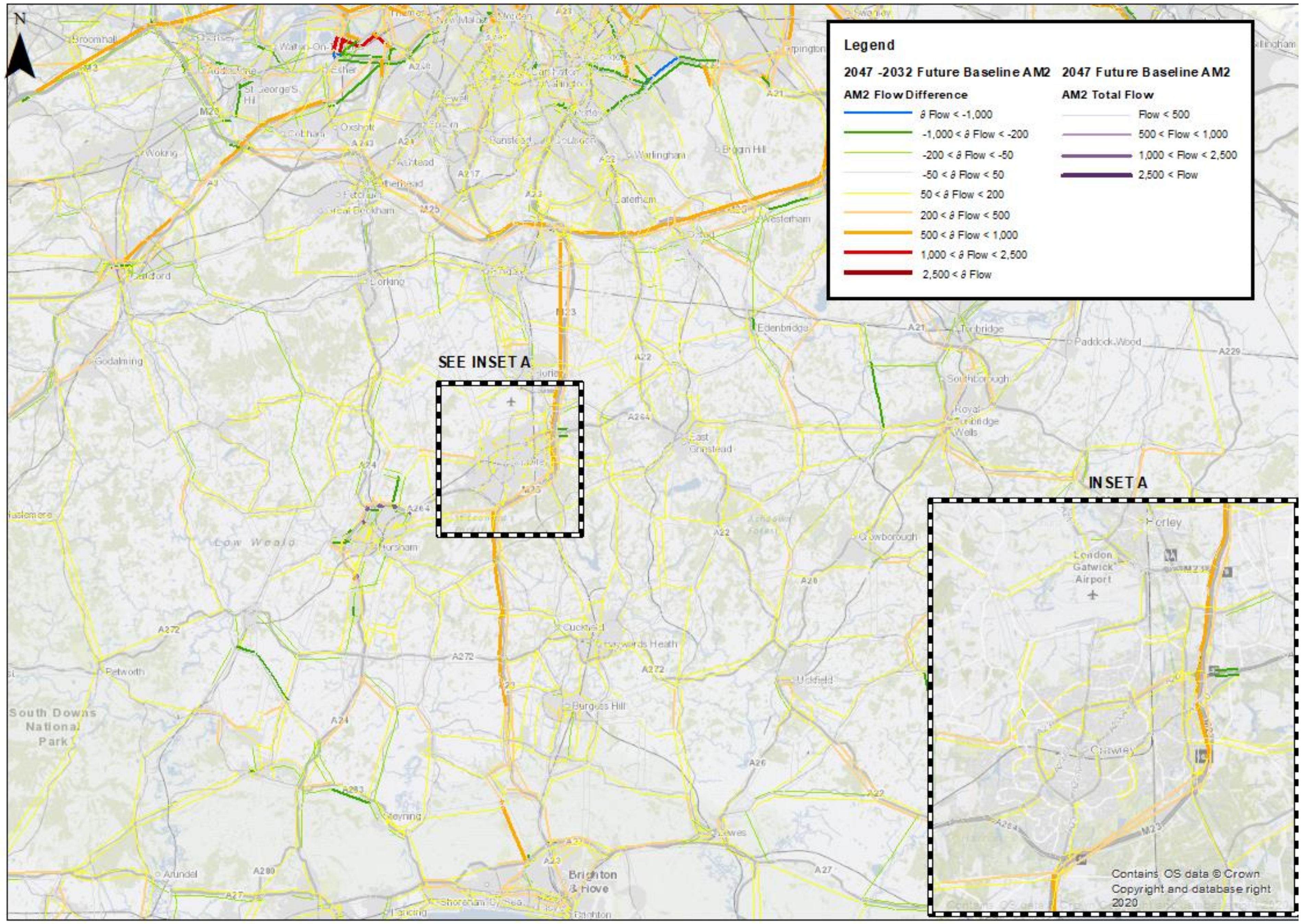


Figure 37: Traffic flow change 2032 to 2047 Future Baseline, IP

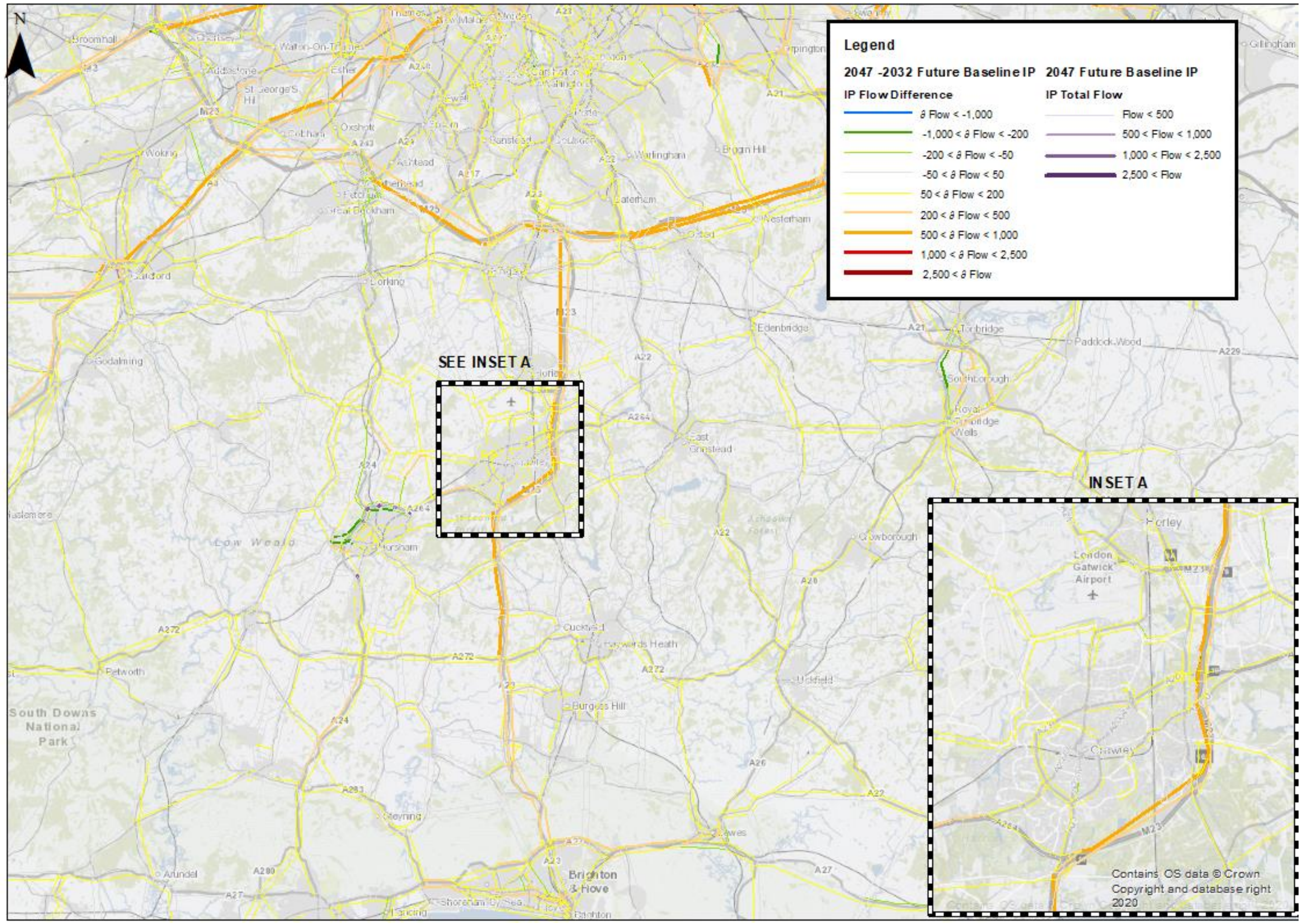
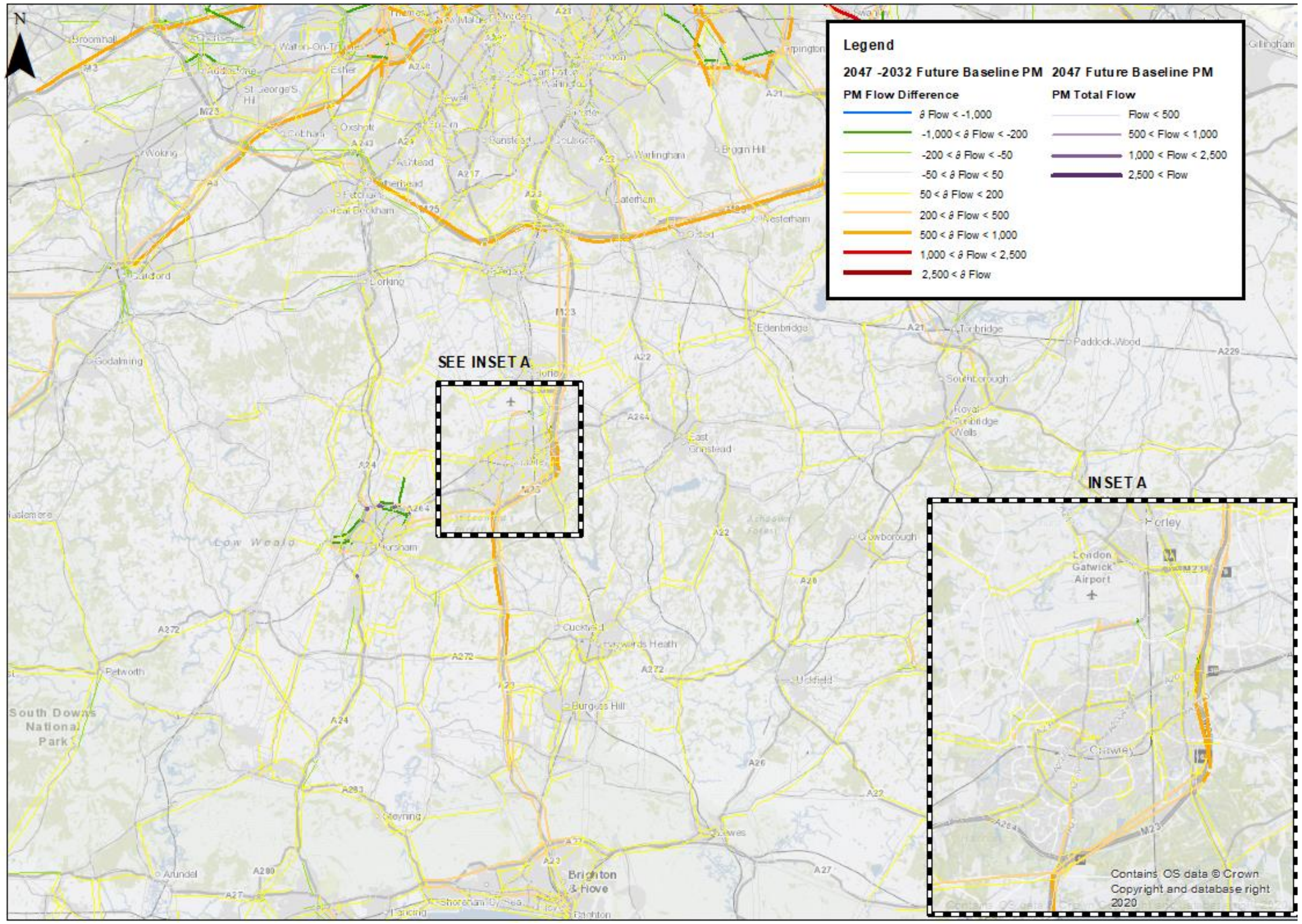


Figure 38: Traffic flow change 2032 to 2047 Future Baseline, PM



10.3 Annual Average Daily Traffic

10.3.1 Modelled traffic volumes extracted for the four modelled time periods are combined and expanded to represent Average Annual Daily Traffic (AADT) volumes. These averages represent (Monday-Sunday) traffic volumes at 24-hour levels. Details underpinning the process of calculating these are provided further in section 13.

10.3.2 Comparisons across the three assessment years, considering the differences between the Future Baseline and With Project scenario, are presented in Figure 39 - Figure 41 for all modelled links respective to the aforementioned performance areas. The purpose of this analysis is to demonstrate the characteristics of changes in traffic volume, henceforth denoted as ∆AADT and distinguishes which corridors are affected and the nature in which the highway model responds in the With Project scenario.

10.3.3 Banding for ∆AADT are defined in consideration of guidance from the Design Manual for Road and Bridges, HA 207/07[10] (see section 3.12). Guidance thresholds are presented as two-way flows whereas modelled values are represented as one-way links. Link changes with ∆AADT greater than 1,000 vehicle units draw attention to links with noteworthy differences. Links with an ∆AADT of between 0 and 100 vehicles per day are deemed as small changes and are otherwise presented as grey links. Subsequent banding is introduced to segment the largest changes between 1,000 and 2,500; between 2,500 and 5,000; between 5,000 and 10,000 and finally, changes in excess of 10,000 vehicles per day. This latter band tends to apply to the surface access points on the network rather than the wider network itself.

2029 Assessment

10.3.4 Results for the 2029 assessment year identify differences for ∆AADT > 2,500 vehicles per day only in relation to access to Perimeter Road South. This is associated with relocation of employee trips from Gatwick South Terminal in the opening year and is evidenced within Inset A of Figure 39.

10.3.5 The key corridor effected between the scenarios for the band 1,000 < ∆AADT < 2,500 is the M23 (both directions) between J9 to the M23 J8/M25 J7. The remaining changes for links in the band 0 < ∆AADT < 1,000 are predominantly on the M25 east and west of junction 7 to M25 J5 and J10 respectively and the A217 corridor from the M23 spur to M25 J8 as well as the periphery of Crawley.

2032 Assessment

10.3.6 Assessment year 2032 illustrates similar patterns to those described for assessment year 2029 with the following key differences:

- M23 corridor northbound/southbound as well as access to the airport along the spur showing changes related to 5,000 < ∆AADT < 10,000;
- M23 northbound between junction 11 and junction 9 increases to 1,000 < ∆AADT < 2,500;
- M25 east / west of junction 7 show tidal changes on links approaching the airport of 1,000 < ∆AADT < 2,500;
- M25 eastbound/westbound J9 to J10 show changes of 1,000 < ∆AADT < 2,500;
- Additional links captured for 0 < ∆AADT < 1,000 related to the A23 and A24.
- There are some reductions in traffic volumes at Longbridge roundabout with Project as access from Gatwick North Terminal to the M23 is improved. In the Future Baseline scenario, some vehicles exit Gatwick North Terminal roundabout, U-turn at Longbridge roundabout and then access the M23 via the off slip from London Road instead of using Airport Way. There are also some reductions in demand between Reigate and Crawley in the With Project scenario during the IP, which results in a slight decrease in AADT southbound towards Longbridge roundabout.

2047 Assessment

10.3.7 Assessment year 2047 changes do not present any additional noteworthy differences compared with the other assessment years.

10.3.8 The following sections discuss the extent to which the highway network can adequately satisfy these changes without detriment to operational performance and by categorising the magnitude of impact.

[10] https://www.standardsforhighways.co.uk/dmrb/search/10191621-07df-44a3-892e-c1d5c7a28d90

Figure 39: 2029 AADT Delta, With Project (-) Future Baseline

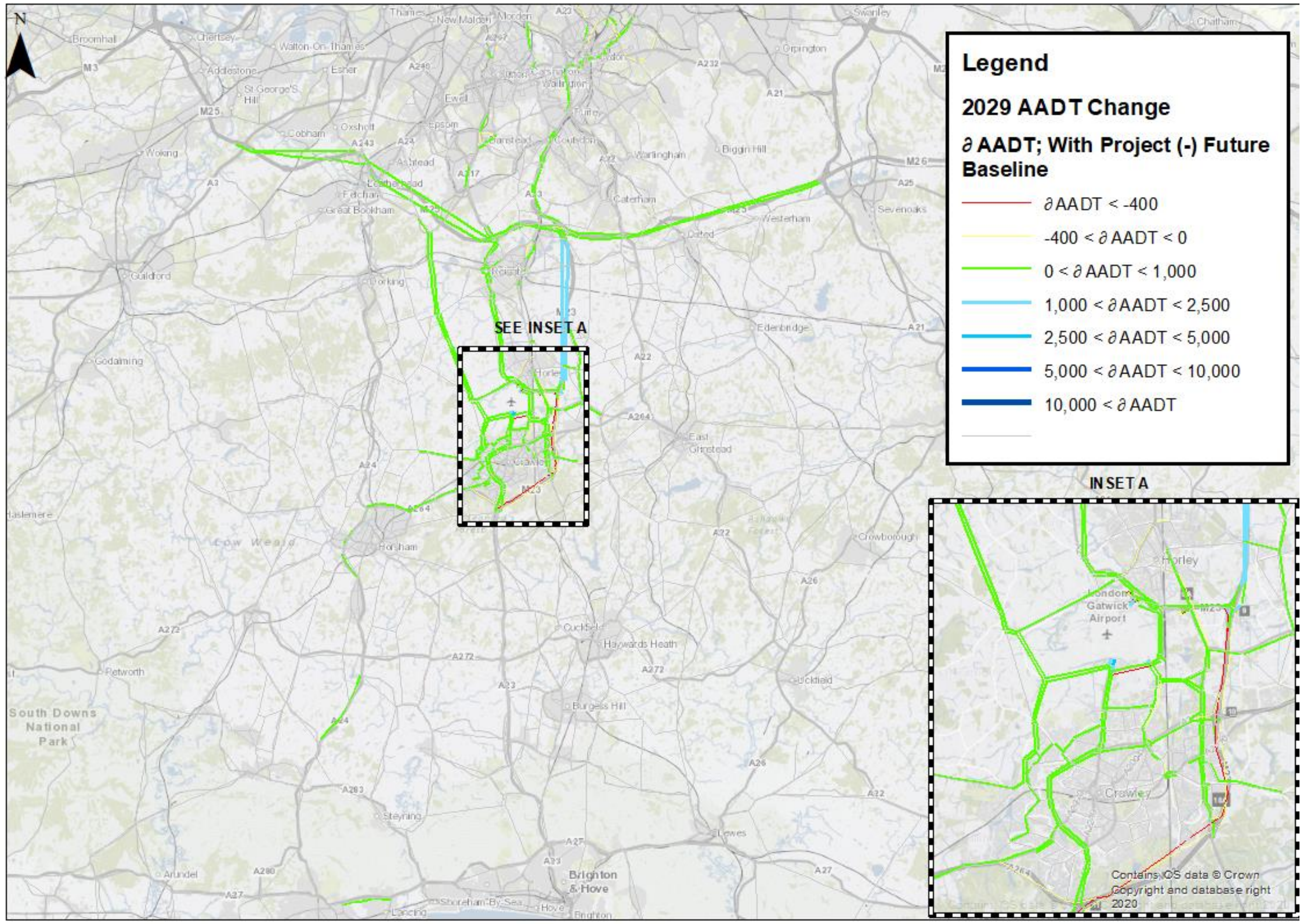


Figure 40: 2032 AADT Delta, With Project (-) Future Baseline

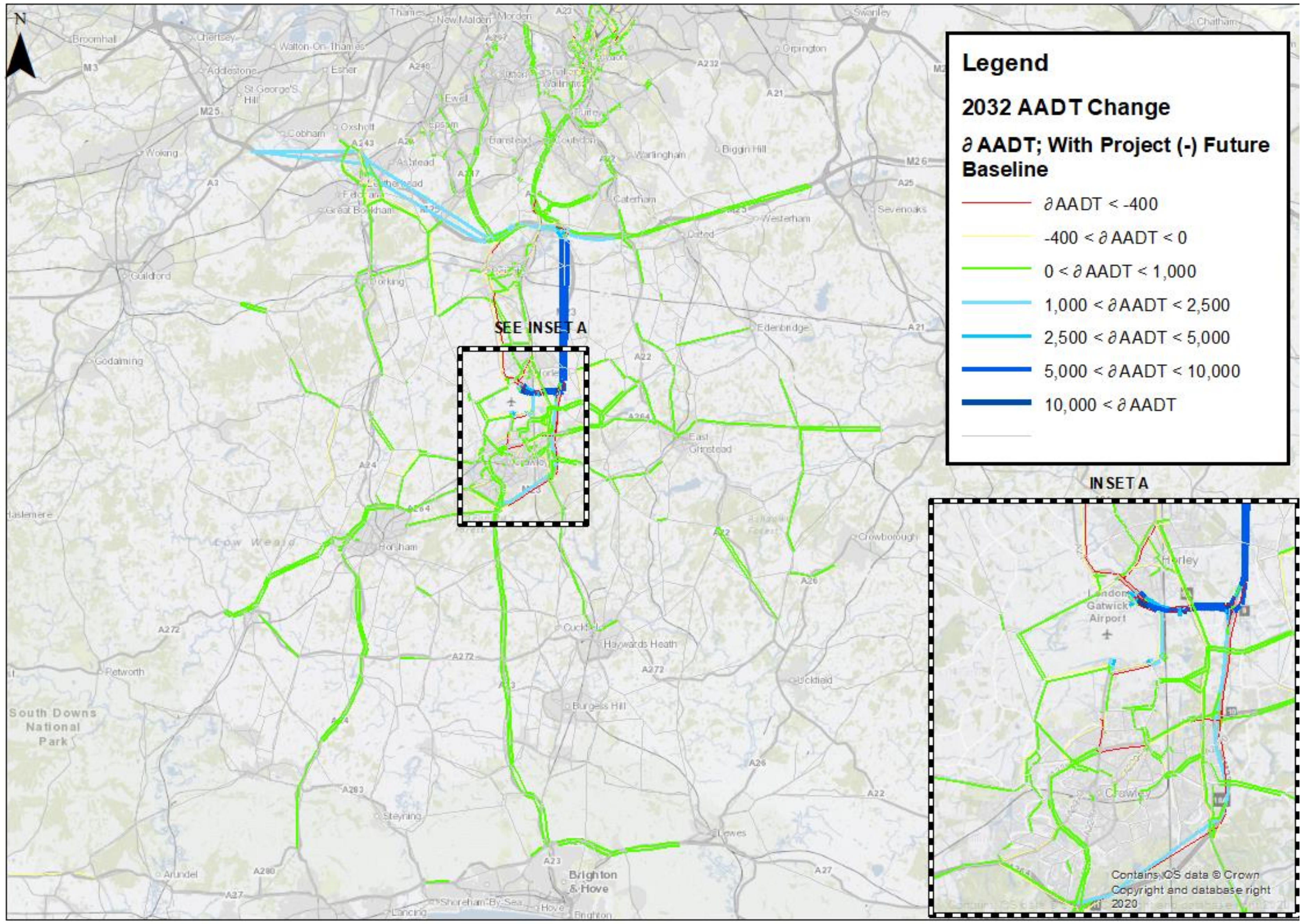
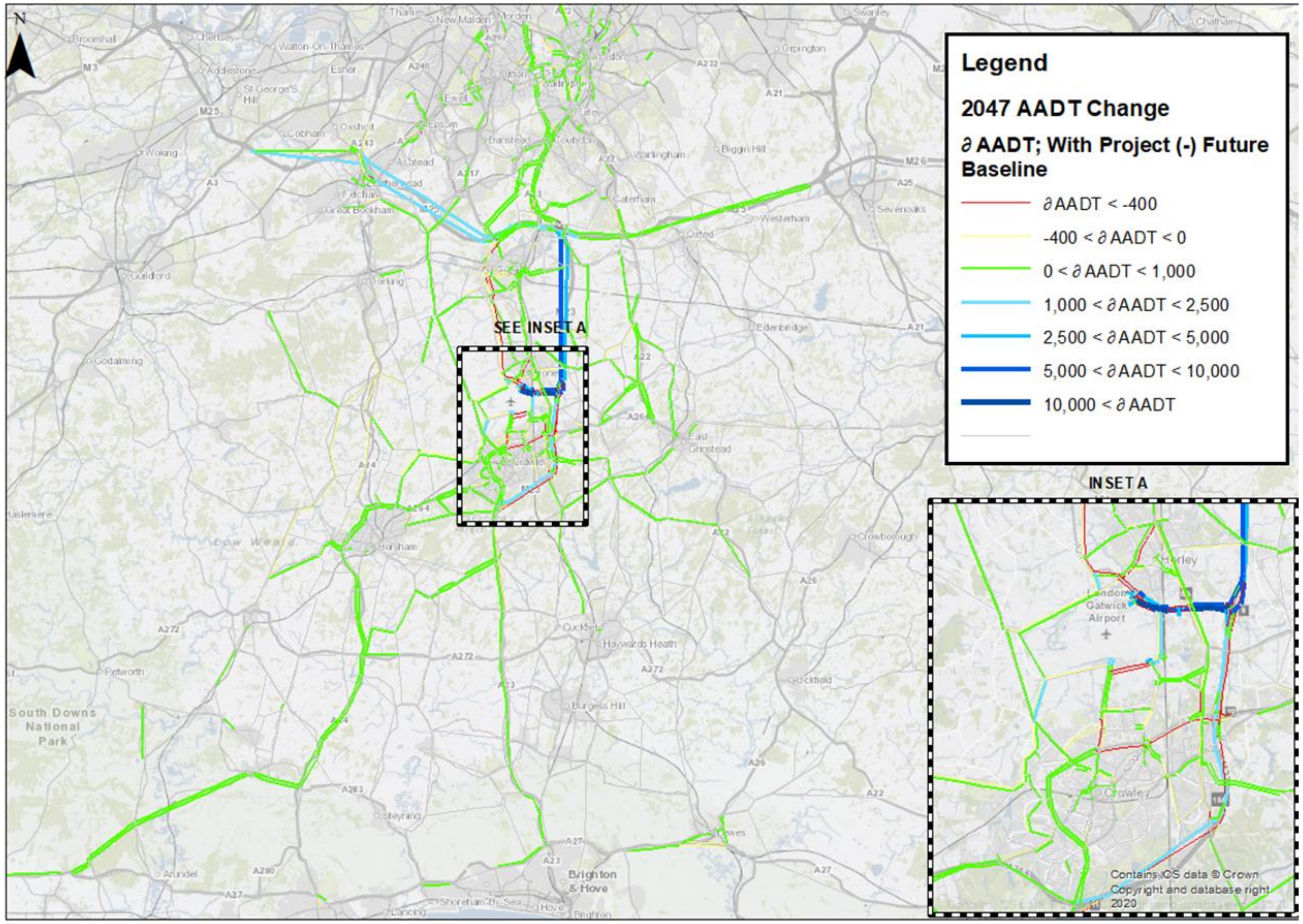


Figure 41: 2047 AADT Delta, With Project (-) Future Baseline



10.4 Strategic Road Network

Journey Times

10.4.1 Journey times routes have been assessed for the strategic road network (SRN) including the following:

- M25 from J5 to J10, westbound and eastbound;
- M23 northbound and southbound;
- A23 northbound and southbound; and
- A27 from Lewes to Arundel westbound and eastbound.

2029 Assessment

10.4.2 Modelled journey times extracted for these routes demonstrate that the travel times along these sections of the SRN are not notably affected between the Future Baseline and With Project Scenario in 2029. These are summarised in Figure 42.

2032 Assessment

10.4.3 The response between the Future Baseline and With Project scenario for 2032 show some small changes in end-to-end journey times and are presented in Figure 43. The A27 eastbound/westbound as well as the M25 in the AM1 period show changes of circa 1 minute.

2047 Assessment

10.4.4 Similar responses are evident in the modelled journey times for 2047 as with 2032 and are presented in Figure 44.

10.4.5 On balance, there are no notable changes in journey times with respect to the SRN between the Future Baseline and With Project scenarios.

Figure 42: Highway Journey Times - Primary SRN, 2029

Figure 43: Highway Journey Times - Primary SRN, 2032

Figure 44: Highway Journey Times - Primary SRN, 2047

Operational Performance - Volume / Capacity ratios

10.4.6 Modelled Volume / Capacity ratios were extracted for each of the four modelled time periods. The maximum value across all time periods was selected to identify the highest value modelled and this is presented in Figure 45 to Figure 50.

10.4.7 The modelling suggests that there are no occurrences of SRN links that have changed operational categories between the Future Baseline and With Project scenario across all assessment years.

Figure 45: Maximum V/C - 2029, Future Baseline – SRN

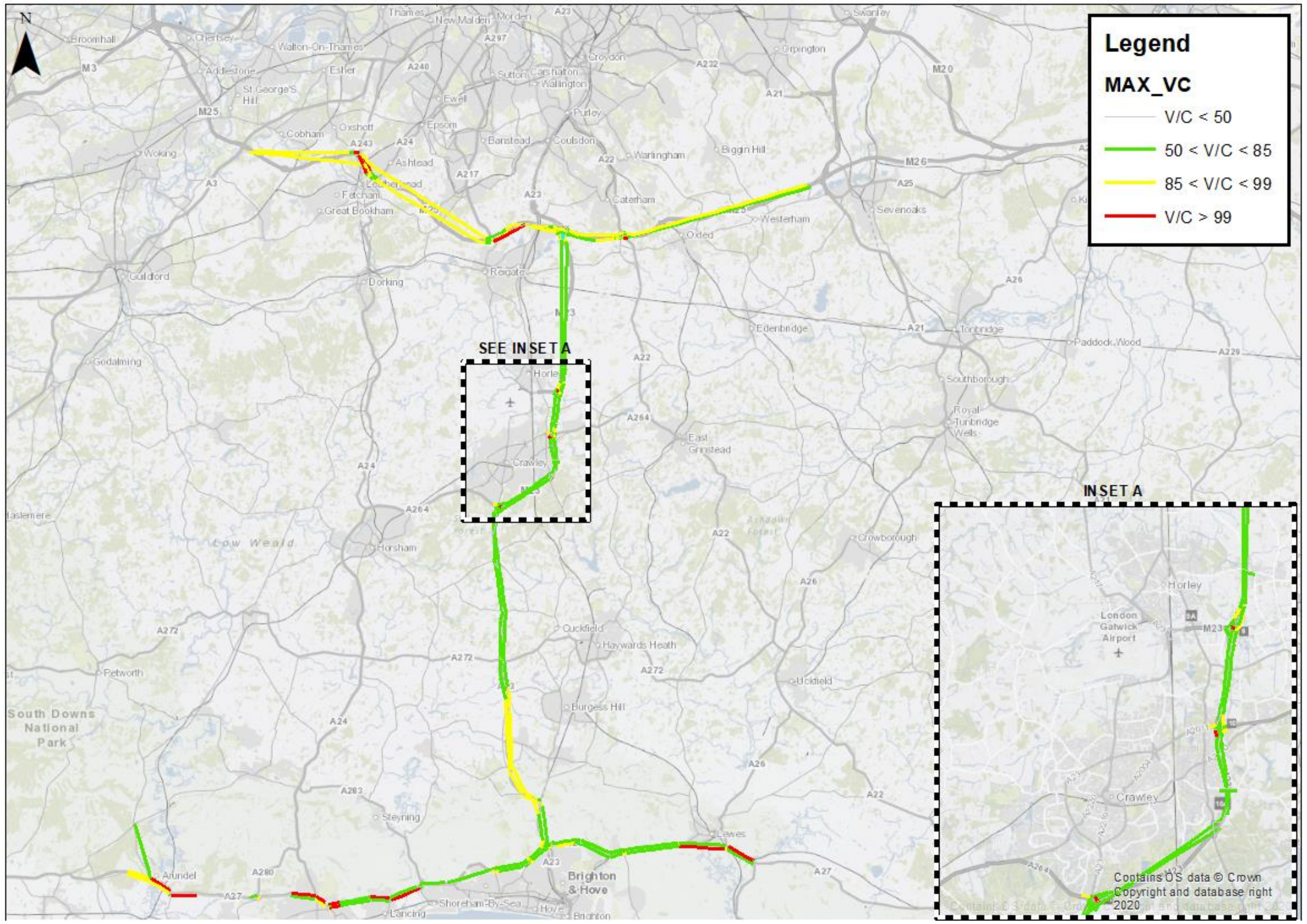


Figure 46: Maximum V/C - 2029, Future Baseline with Project - SRN

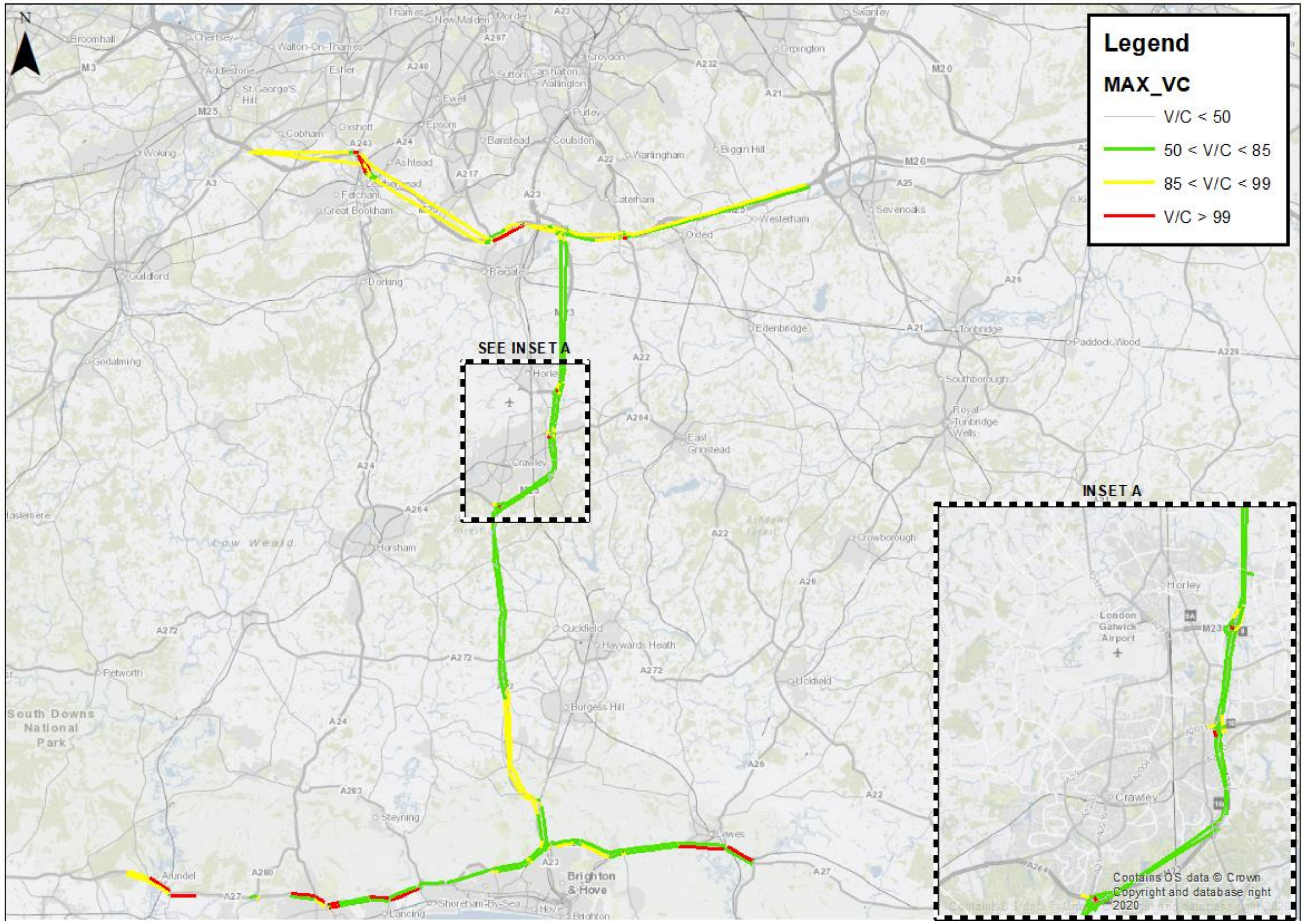


Figure 47: Maximum V/C - 2032, Future Baseline - SRN

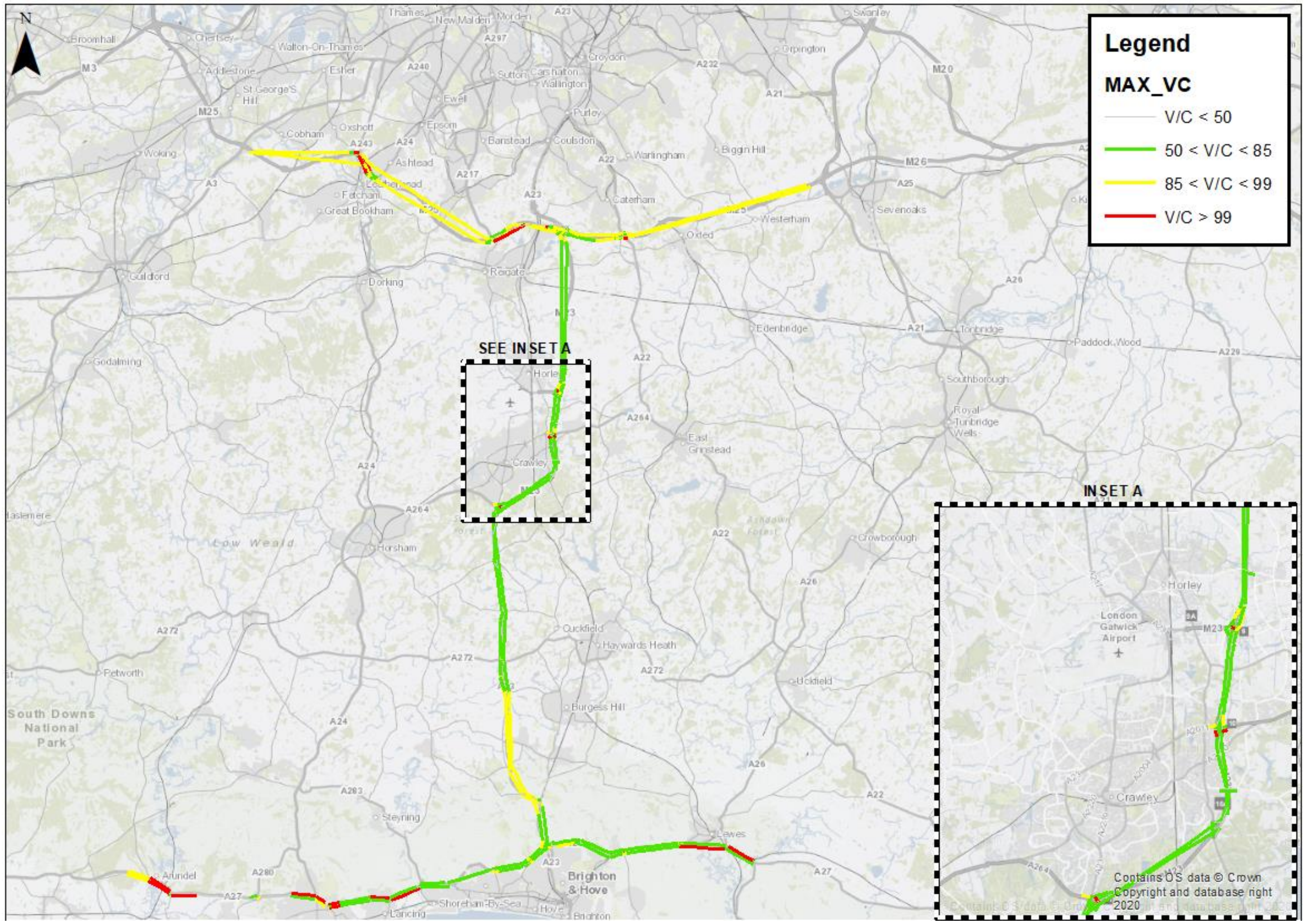


Figure 48: Maximum V/C - 2032, Future Baseline with Project - SRN

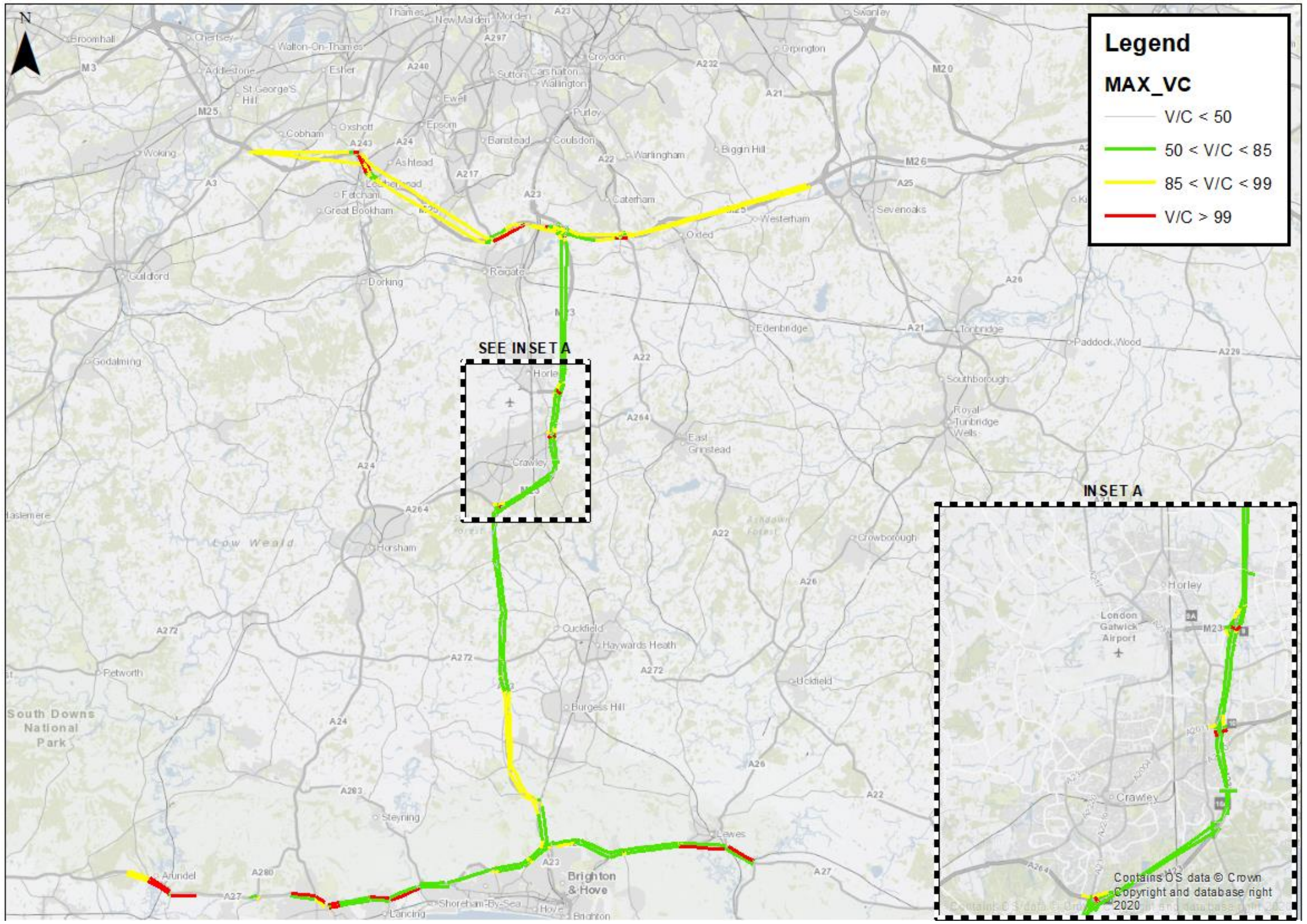


Figure 49: Maximum V/C - 2047, Future Baseline - SRN

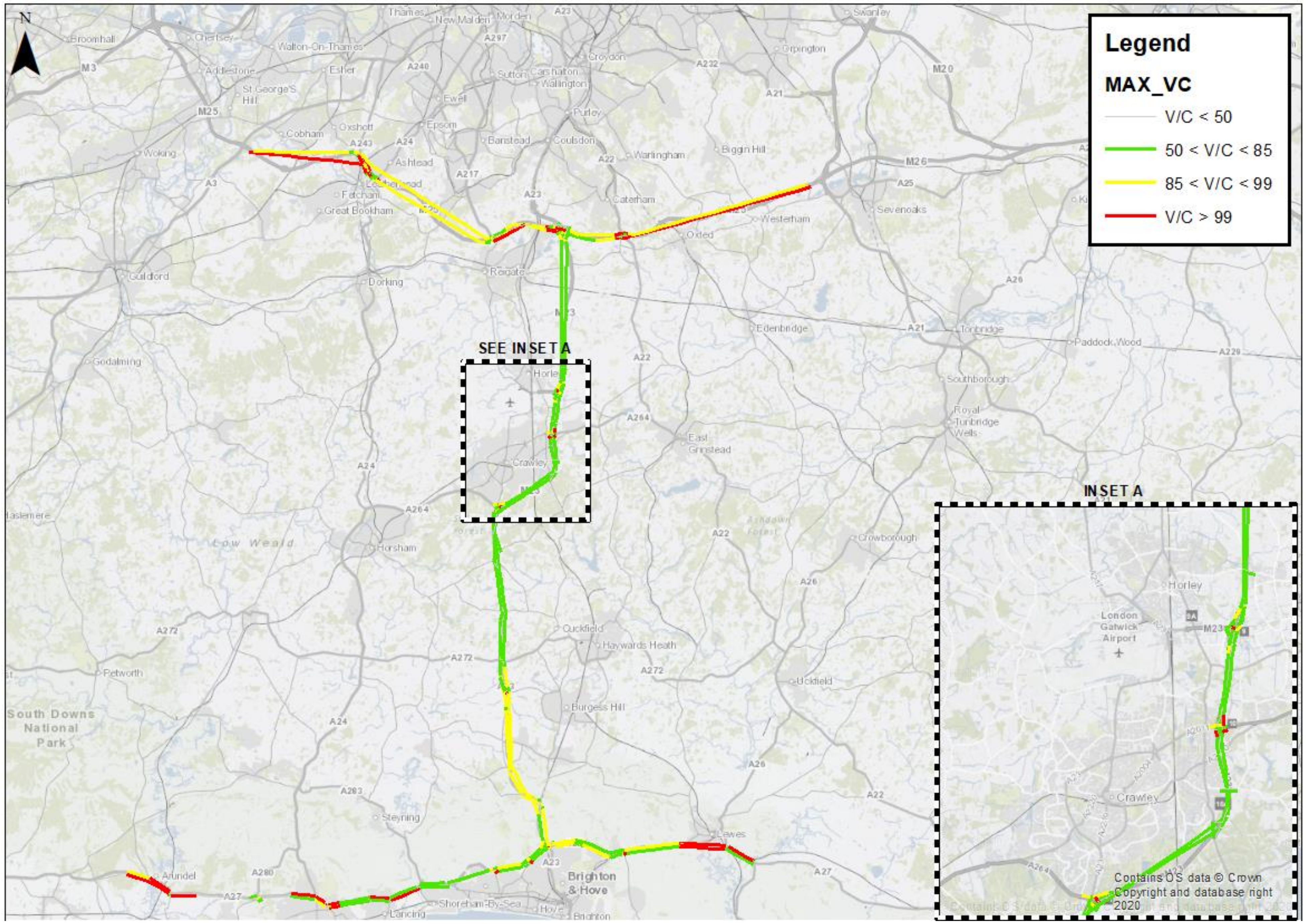
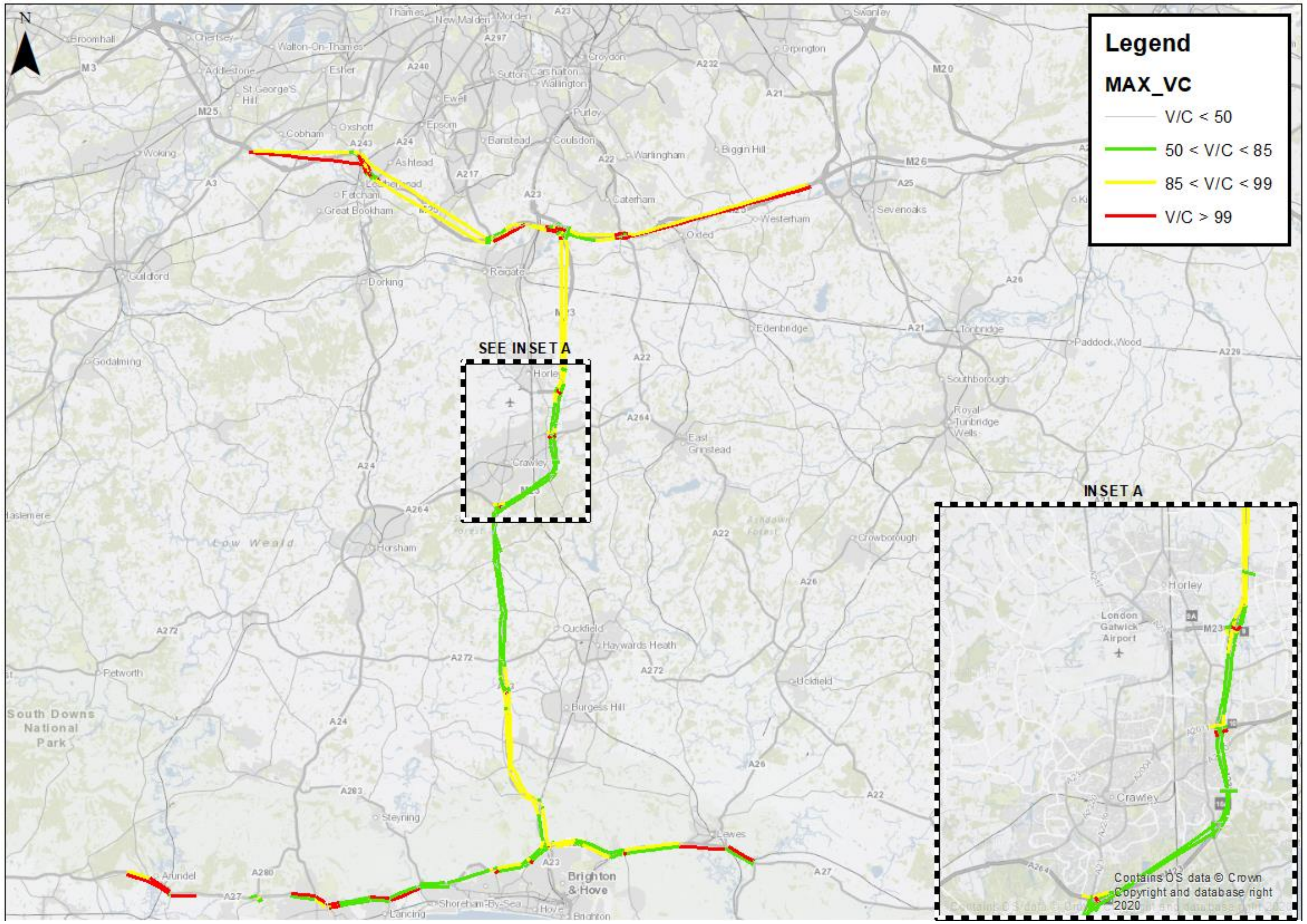


Figure 50: Maximum V/C - 2047, Future Baseline with Project – SRN



10.5 Performance Area A

Journey Times

10.5.1 Journey times routes covering the local road network include the following routes:

- A23 from Longbridge Roundabout to A23 (south of M25, nr Merstham), northbound and southbound; and
- A217 from M23 Spur via A217 to M25 J8, northbound and southbound.

2029 Assessment

10.5.2 Modelled journey times extracted for 2029, 2032 and 2047 are illustrated in Figure 51 to Figure 53. The comparisons between the Future Baseline and With Project scenarios show slight differences of up to 1 minute but no instances of end-to-end journey times being notably worsened between the scenarios.

2032 Assessment

10.5.3 Similar to 2029 there are no notable changes between the Future Baseline and Future Baseline with Project in 2032.

2047 Assessment

10.5.4 On balance, there are no notable changes in journey times with respect to the Performance Area A between the Future Baseline and With Project scenario.

Figure 51: Highway Journey Times – Performance Area A, 2029

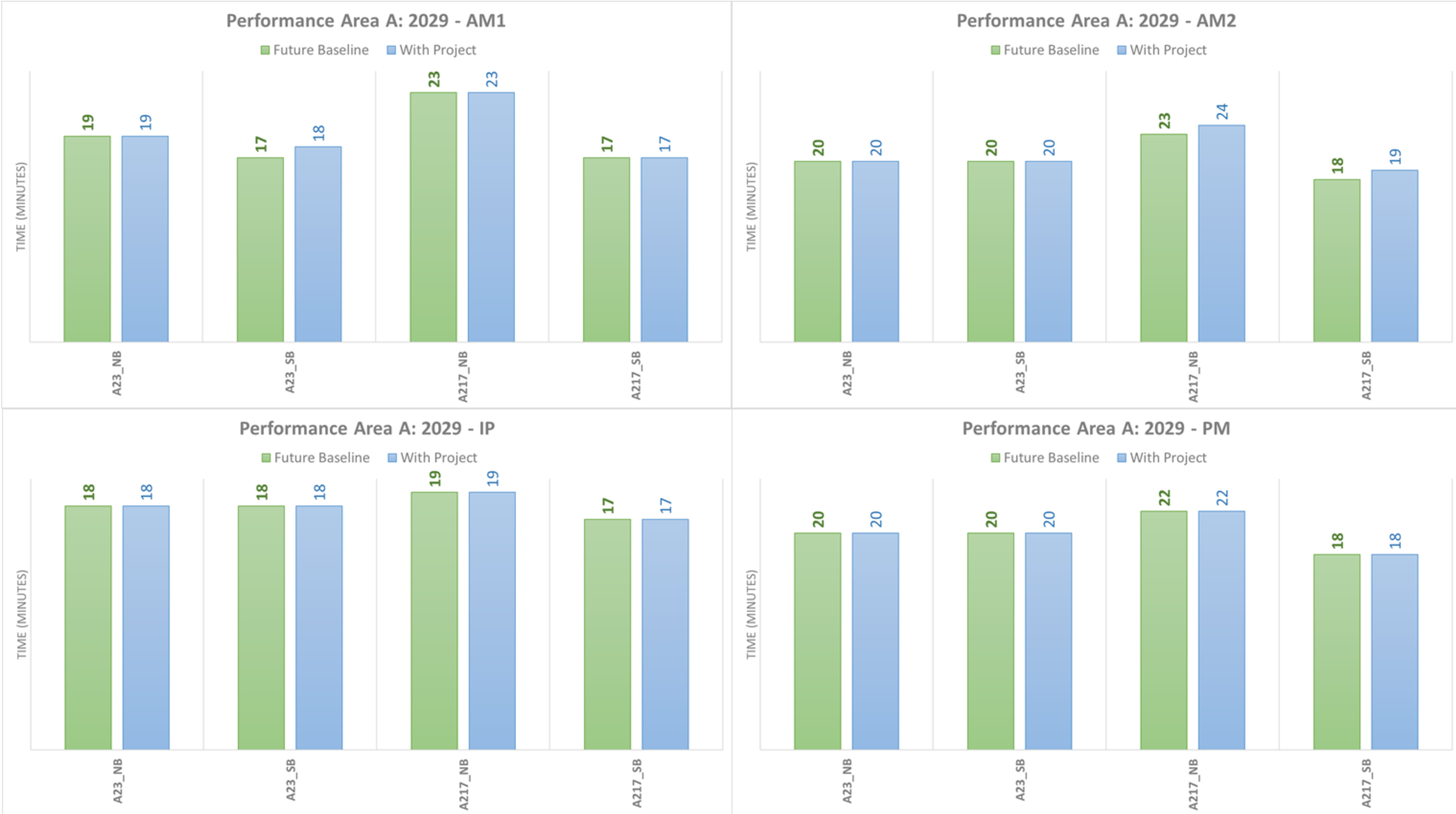


Figure 52: Highway Journey Times - Performance Area A, 2032

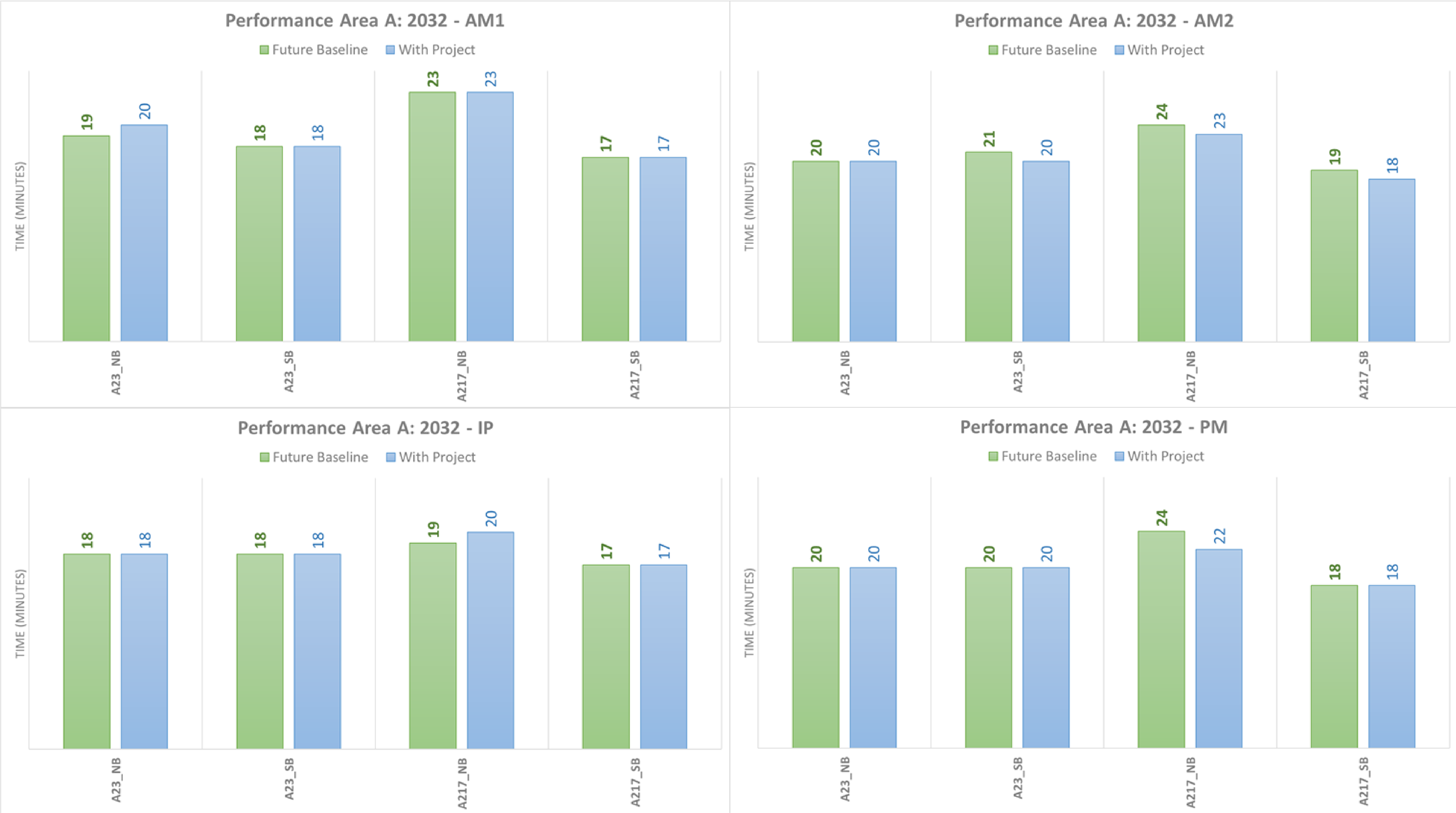
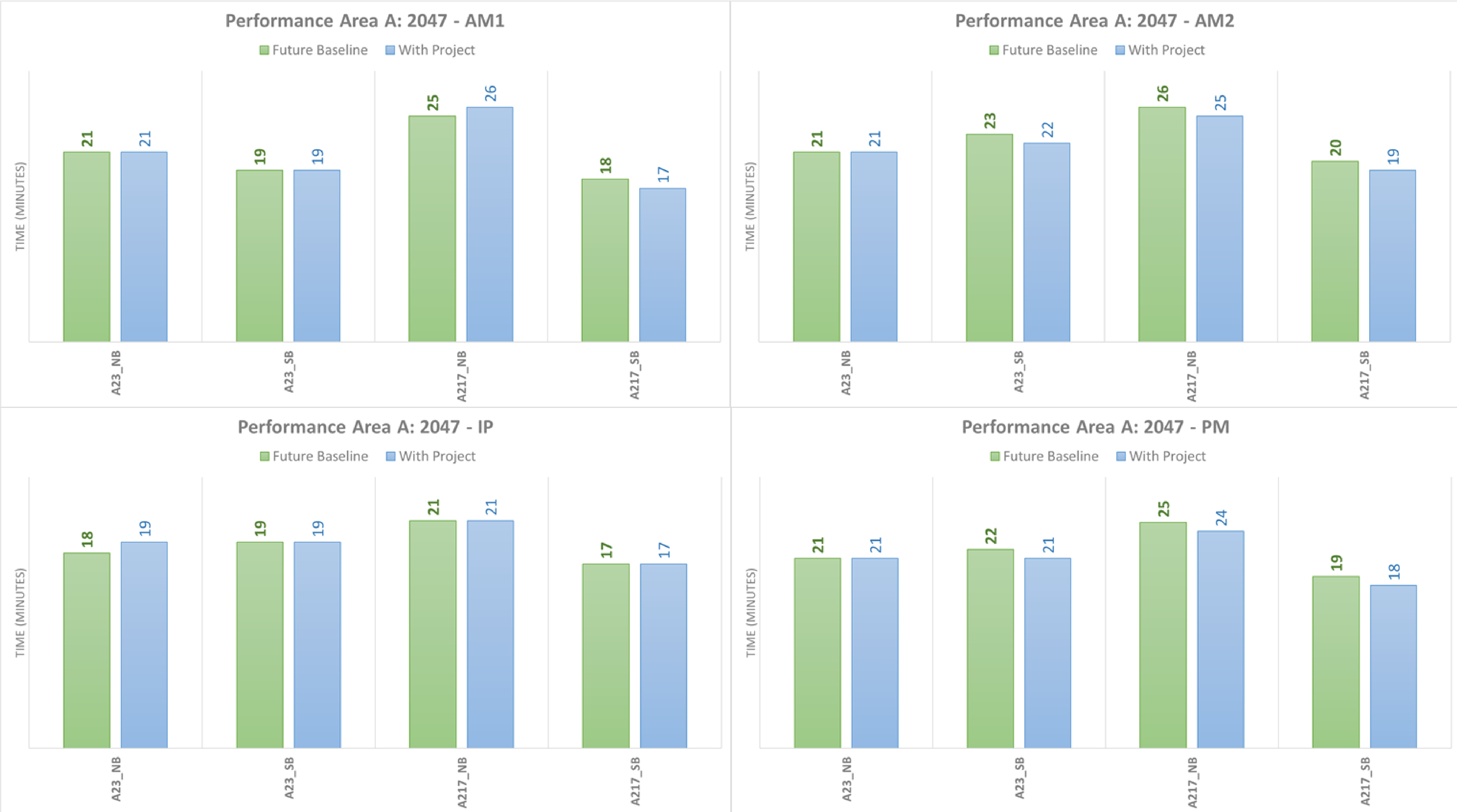


Figure 53: Highway Journey Times – Performance Area A, 2047



Operational Performance - Volume / Capacity ratios

10.5.5 Modelled Volume / Capacity ratios were extracted for each of the four modelled time periods. The maximum value across all time periods was selected to identify the highest value modelled and this is presented in Figure 57 to Figure 62.

10.5.6 The modelling suggests that there are some instances of relevant links that have changed operational categories between the Future Baseline and With Project scenario across all assessment years.

10.5.7 For 2029, there are notable changes in the approach arms to Gatwick Road roundabout, specifically the western arm. Note, in 2047 this change in operational performance does not occur.

10.5.8 Both Gatwick Road roundabout and Lowfield Heath roundabout experience some capacity issues With Project. This is because the capacity of staff parking wills double at this location in With Project compared to the Future Baseline, providing additional demand accessing the network via these roundabouts. There is some switching in which route is used, which affects the operational performance of both junctions and London Road in between. However, the operation of these junctions will be looked at in more detail in the VISSIM model.

10.5.9 2032 indicates that the M23 J9 off-slip for access towards the airport changes from yellow (85%<V/C<99%) to red (V/C > 99%) highlighting the increased conflict in movements between the circulatory and offslip at the roundabout. Additionally in 2032 and 2047 Future Baseline With Project a link on airport way flags as >99%, however as with the operation of Junction 9 these will be specifically looked at operationally in the VISSIM model.

10.5.10 Aside from the instances mentioned, the changes between scenarios across all assessment years show no other changes in links that were operating within capacity (V/C<100%) and links over capacity (V/C > 100%). Further analysis is undertaken to contextualise these impacts by categorisation with respect to magnitude of impacts.

Magnitude of Impact

10.5.11 In accordance with the criteria specified in section 10.1, the following section elaborates on instances of 'High', 'Medium' and 'Low' impacts for each assessment year. The graphics consider data for all time periods. The view extent relating to Performance Area A has been centred around the airport as no links/nodes outside of the vicinity of Gatwick Airport within Performance Area A have been flagged using these criteria.

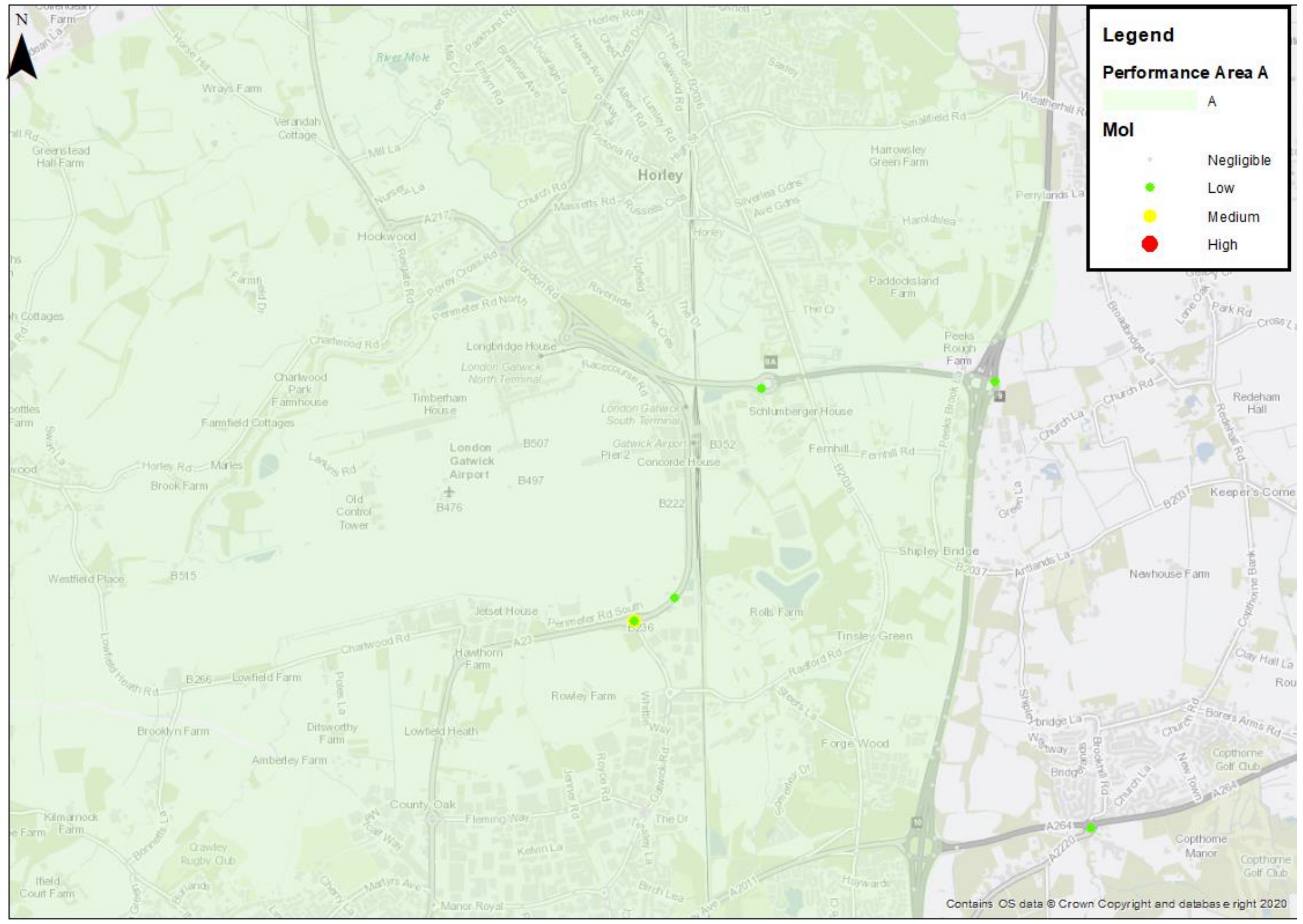
2029

10.5.12 When considering 2029, the only instance of 'Medium' impact relates to the Gatwick Road roundabout junction for both in the PM period. This change is predominantly driven by increase in the volume of southbound trips accessing the Gatwick car park zone to the north and turning right via the eastern arm of the junction denoted in Figure 54.

Table 10.5.1: Magnitude of Impacts: Performance Area A, 2029 Nodes

2029	Performance Area A - Nodes			
MoI	AM1	AM2	IP	PM
Negligible	279	220	154	172
Low	4	3	1	0
Medium	0	0	0	1
High	0	0	0	0

Figure 54: Magnitude of Impacts: Performance Area A, 2029 Nodes



2032

10.5.13 The 2032 assessment year impacts are summarised in Table 10.5.2. The table outlines that there is a maximum of one 'High' magnitude impact and one 'Medium' across all modelled periods. Figure 55 outlines all occurrences across all peaks. The highway mitigation introduced in the vicinity of the airport has positively contributed to the mitigation of the 'Low' impact at South Terminal Roundabout recognised in 2029.

10.5.14 The 'High' impact occurrence of Gatwick Road roundabout for the PM period relates to the issue described in the 2029 assessment year and is being investigated further in the VISSIM modelling.

Table 10.5.2: Magnitude of Impacts: Performance Area A, 2032 Nodes

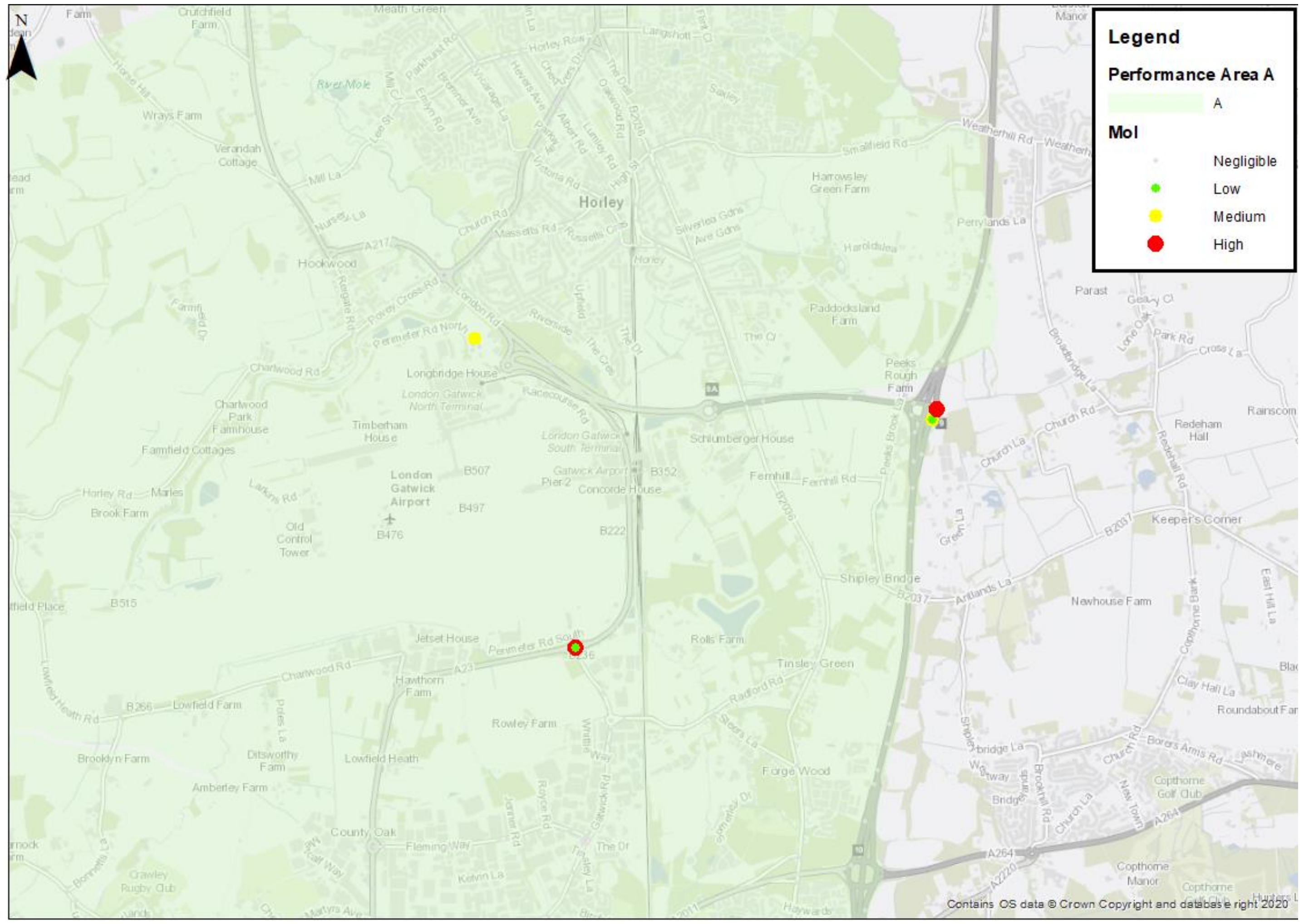
2032	Performance Area A - Nodes			
MoI	AM1	AM2	IP	PM
Negligible	243	185	211	252
Low	2	0	1	0
Medium	1	1	0	0
High	1	1	0	1

10.5.15 The AM1 and AM2 'High' instance relates to the M23 J9 southbound off-slip / circulatory and is associated with additional demand accessing the airport and the operation of this is being looked at in the VISSIM modelling to improve the circulation of traffic at the junction. The differences between the scenarios are presented in Table 10.5.3, whereby AP denotes airport related trips. The 'Medium' occurrence relates to access via North Terminal in the AM1 period. The PM 'High' instance occurs at Gatwick Roundabout and as explained above the operation of this roundabout will be looked at further in the VISSIM model.

Table 10.5.3: M23 J9 Off-slip, 2032 Differences (Total Vehicles)

Period	With Project		Future Baseline		With Project (-) Future Baseline	
	Total	AP	Total	AP	Total	AP
AM1	2,767	2,416	2,334	2,006	433	410
AM2	2,575	2,291	2,168	1,959	407	332

Figure 55: Magnitude of Impacts: Performance Area A, 2032 Nodes



2047

10.5.16 The 2047 assessment year impacts are summarised in Table 10.5.4. The table outlines that there is a maximum of two 'High' impact and two 'Medium' instances across all modelled periods. Figure 56 outlines all occurrences across all peaks. Similar to 2032, the proposed highway mitigation shows that there is no impact on the M23 Spur and Airport Way in the With Project scenario.

10.5.17 The additional 'High' impact occurrence introduced in 2047 is due to additional volume incurred on the North Terminal access described in 2032.

Table 10.5.4: Magnitude of Impacts: Performance Area A, 2047 Nodes

2047	Performance Area A - Nodes			
MoI	AM1	AM2	IP	PM
Negligible	235	209	190	228
Low	2	3	1	3
Medium	2	1	1	0
High	2	1	0	1

10.5.18 The additional 'Medium' impact relates to the M23 J9 circulatory and follows from the issue described for traffic volumes accessing via the M23 J9 southbound off-slip.

Figure 56: Magnitude of Impacts: Performance Area A, 2047 Nodes

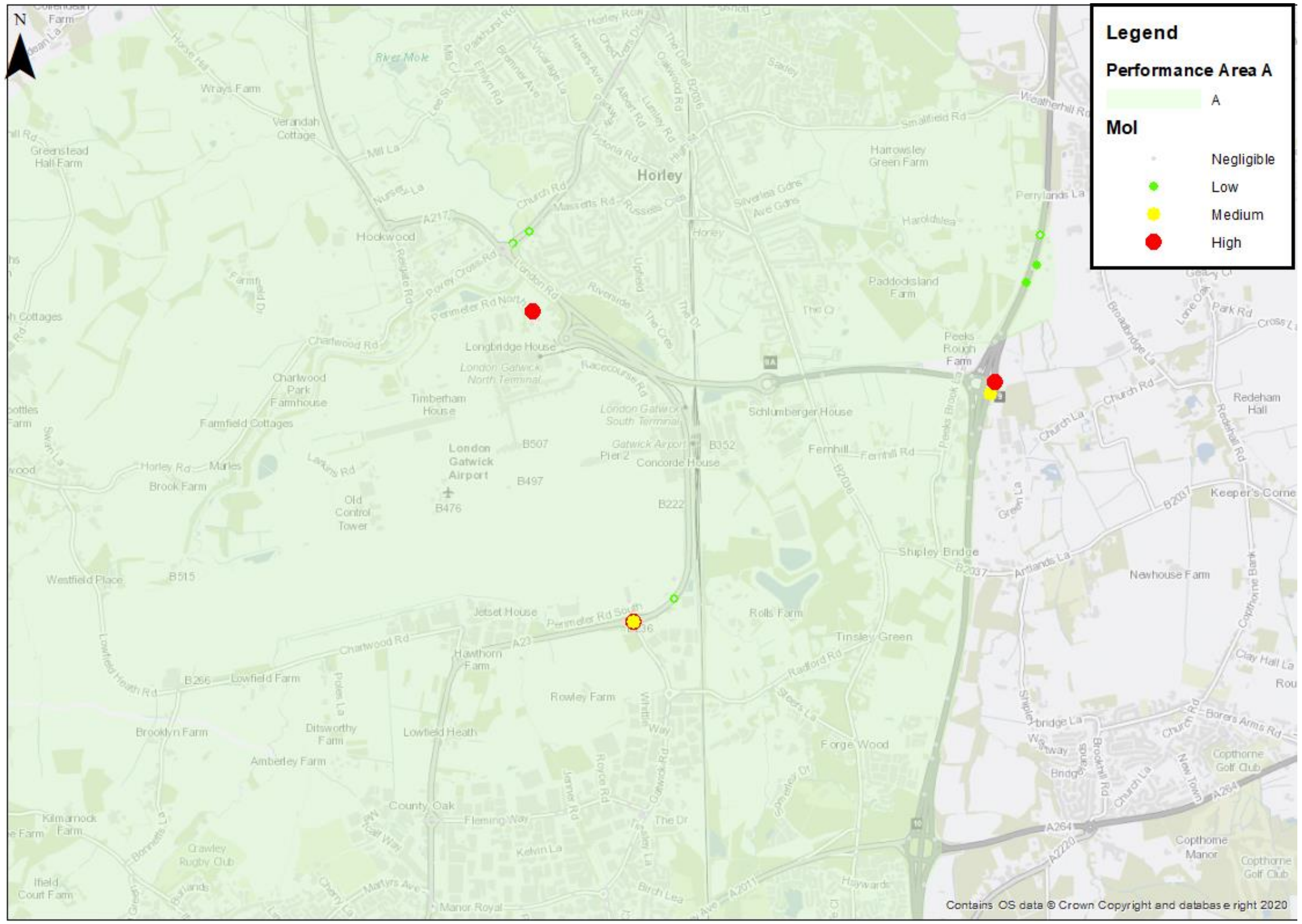


Figure 57: Maximum V/C - 2029, Future Baseline – Performance Area A

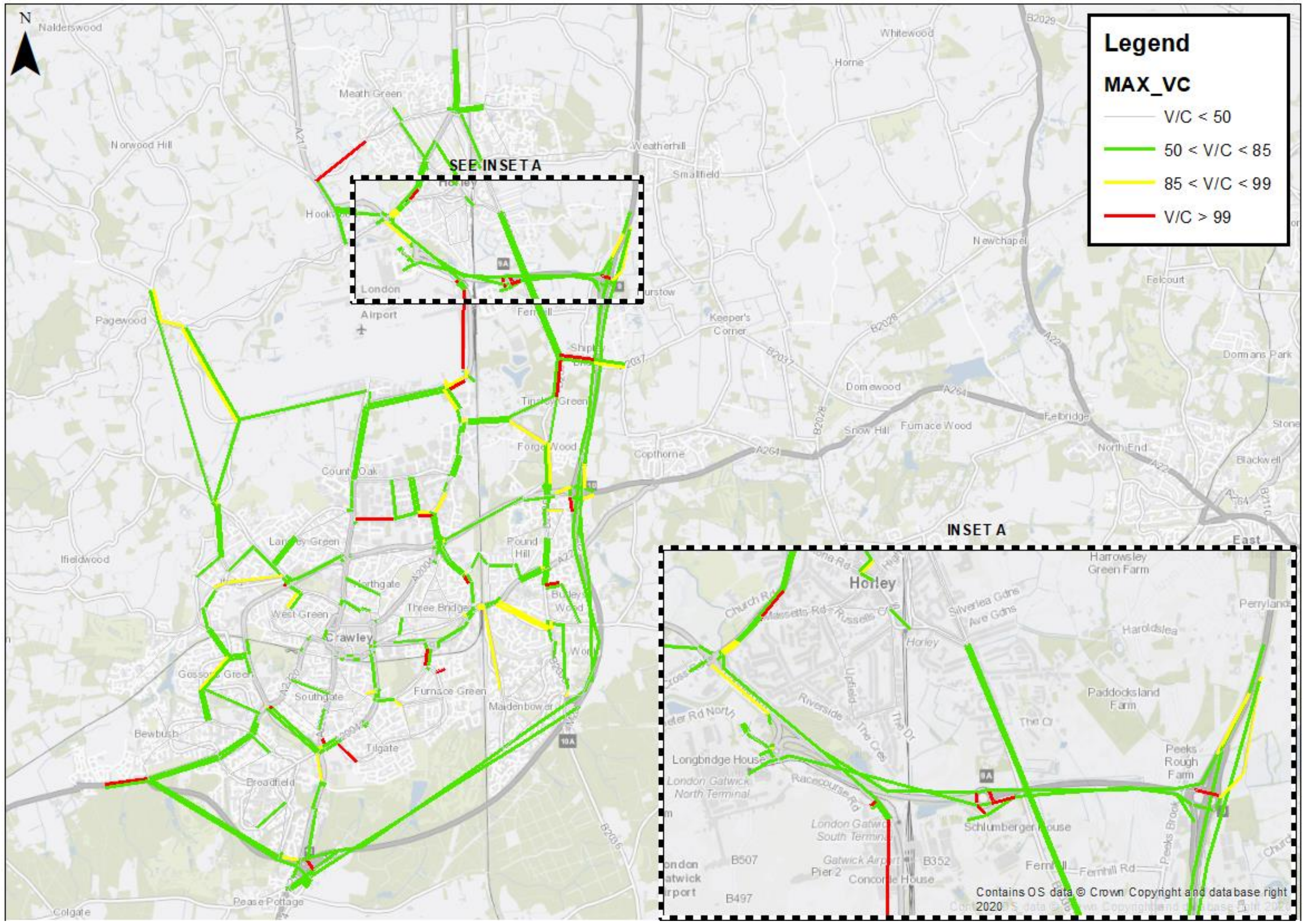


Figure 58: Maximum V/C - 2029, With Project – Performance Area A

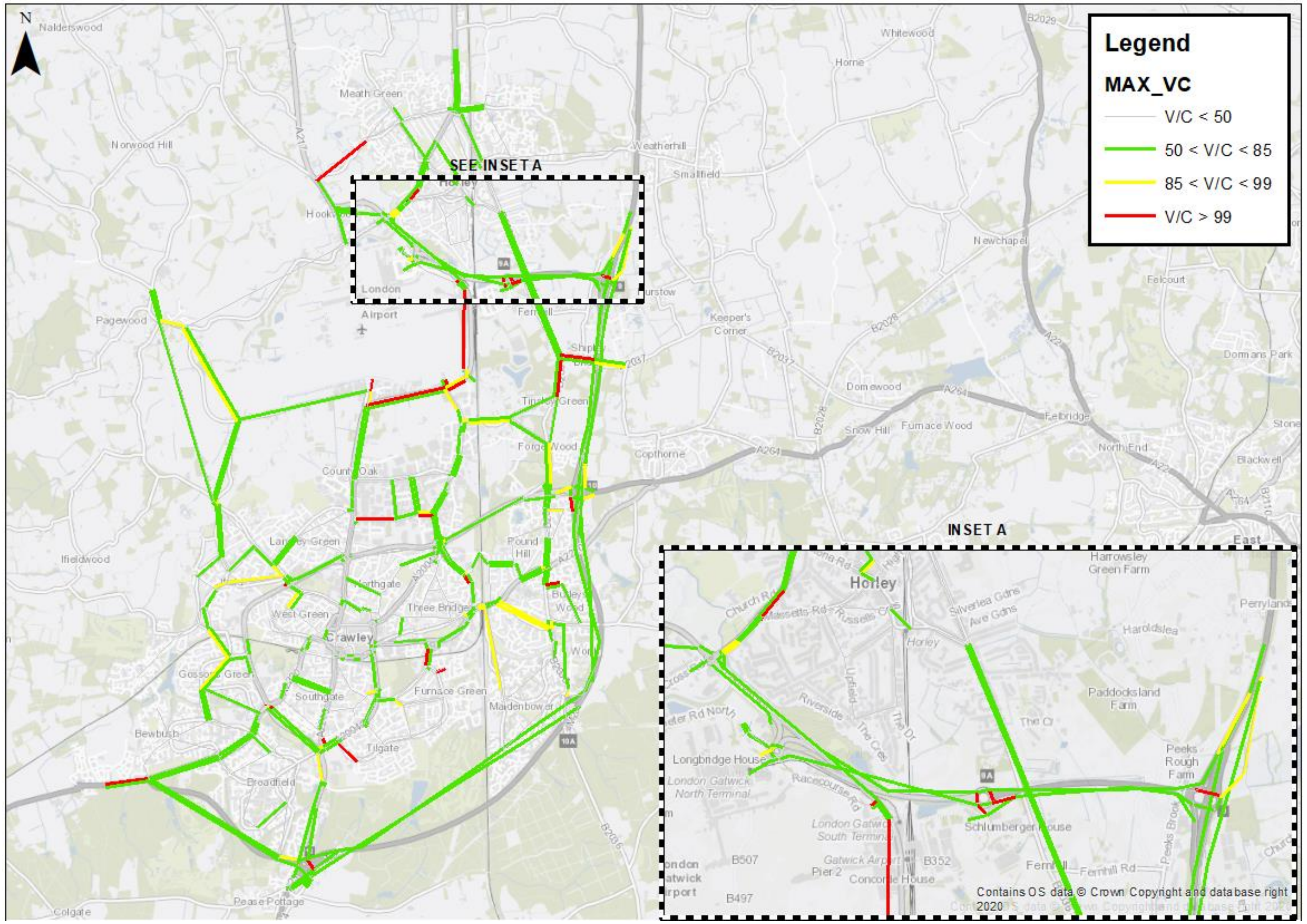


Figure 59: Maximum V/C - 2032, Future Baseline - Performance Area A

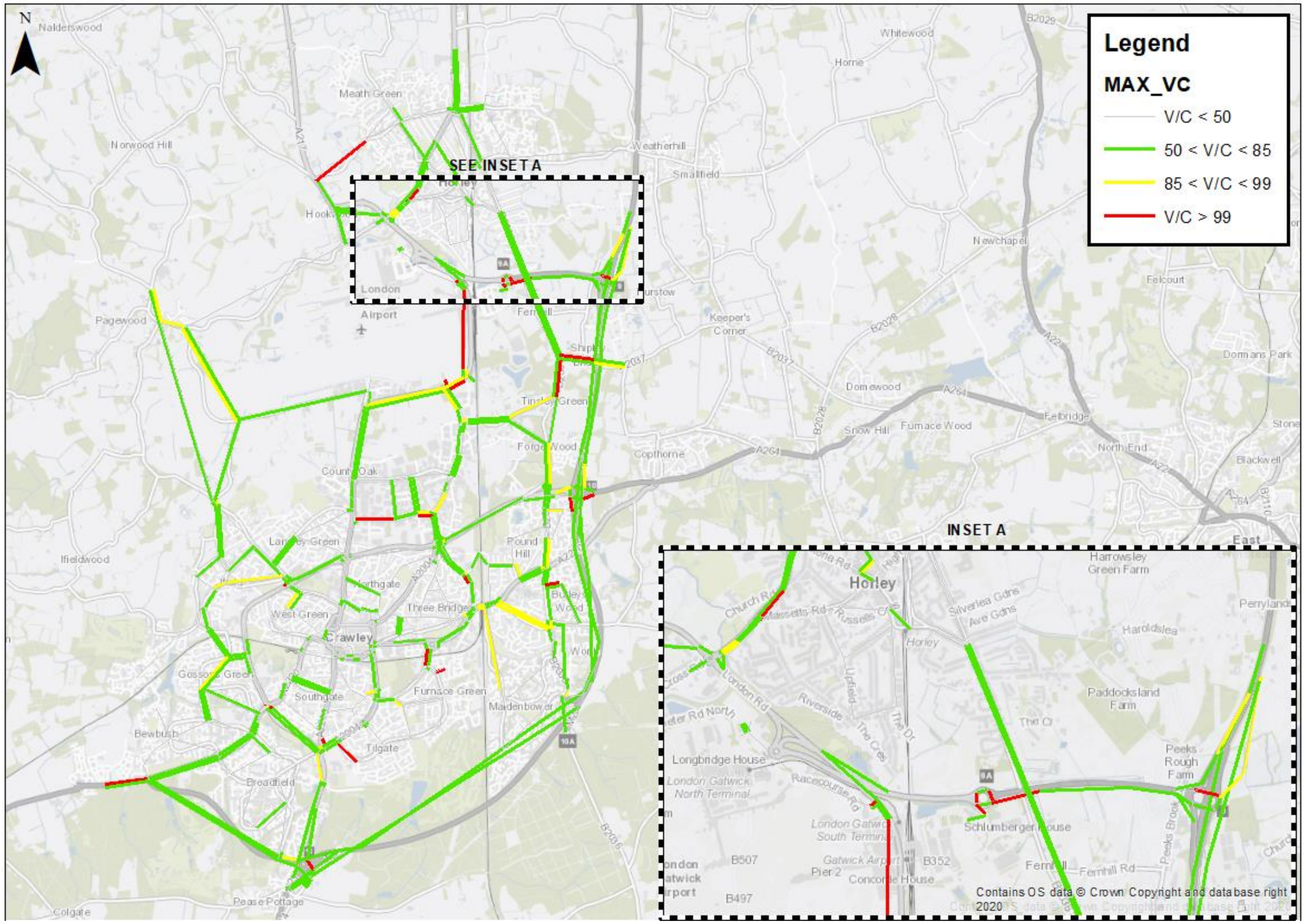


Figure 60: Maximum V/C - 2032, With Project - Performance Area A

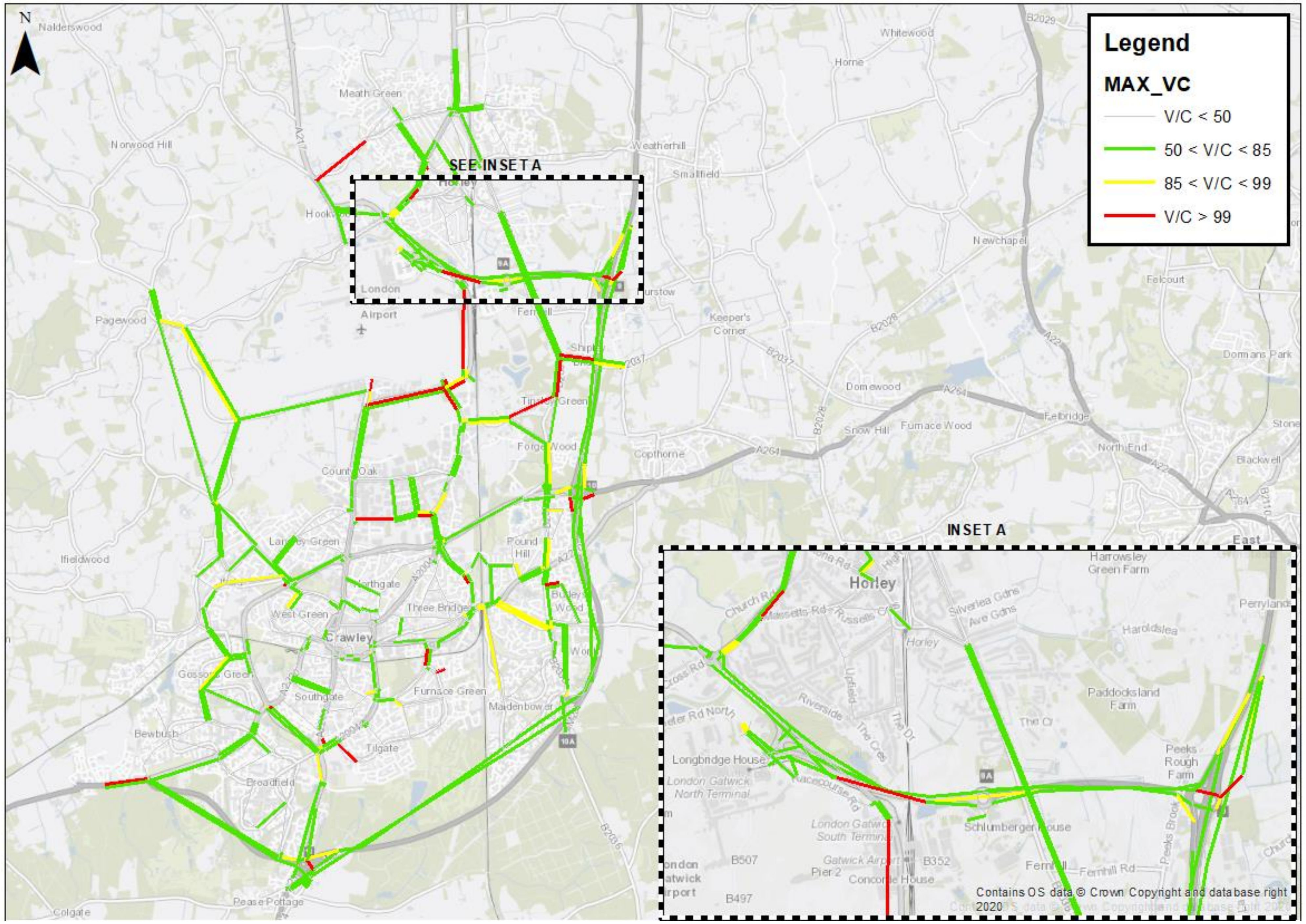


Figure 61: Maximum V/C - 2047, Future Baseline - Performance Area A

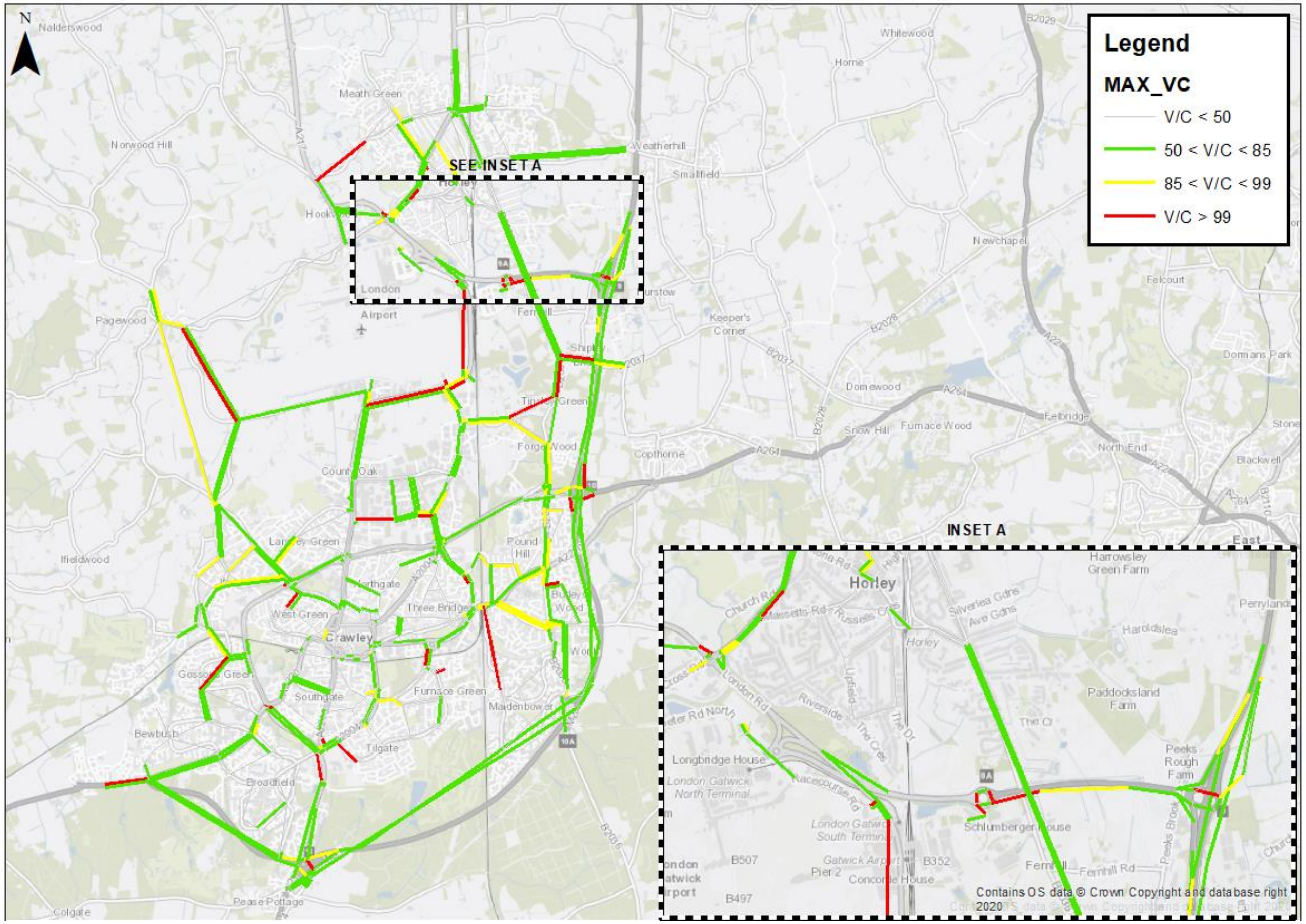
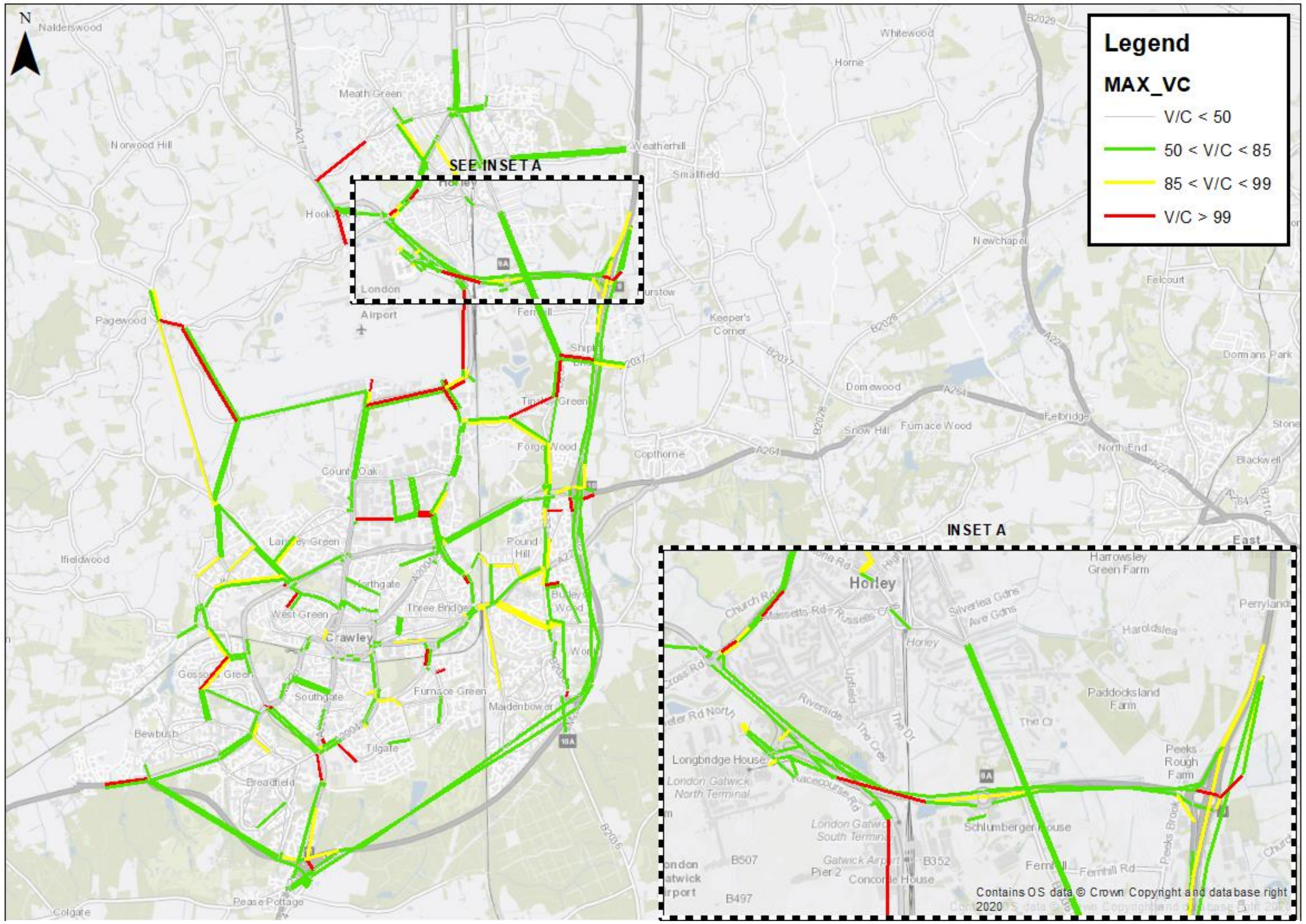


Figure 62: Maximum V/C - 2047, With Project - Performance Area A



10.6 Performance Area B

Journey Times

10.6.1 Journey times routes covering the strategic road network include the following:

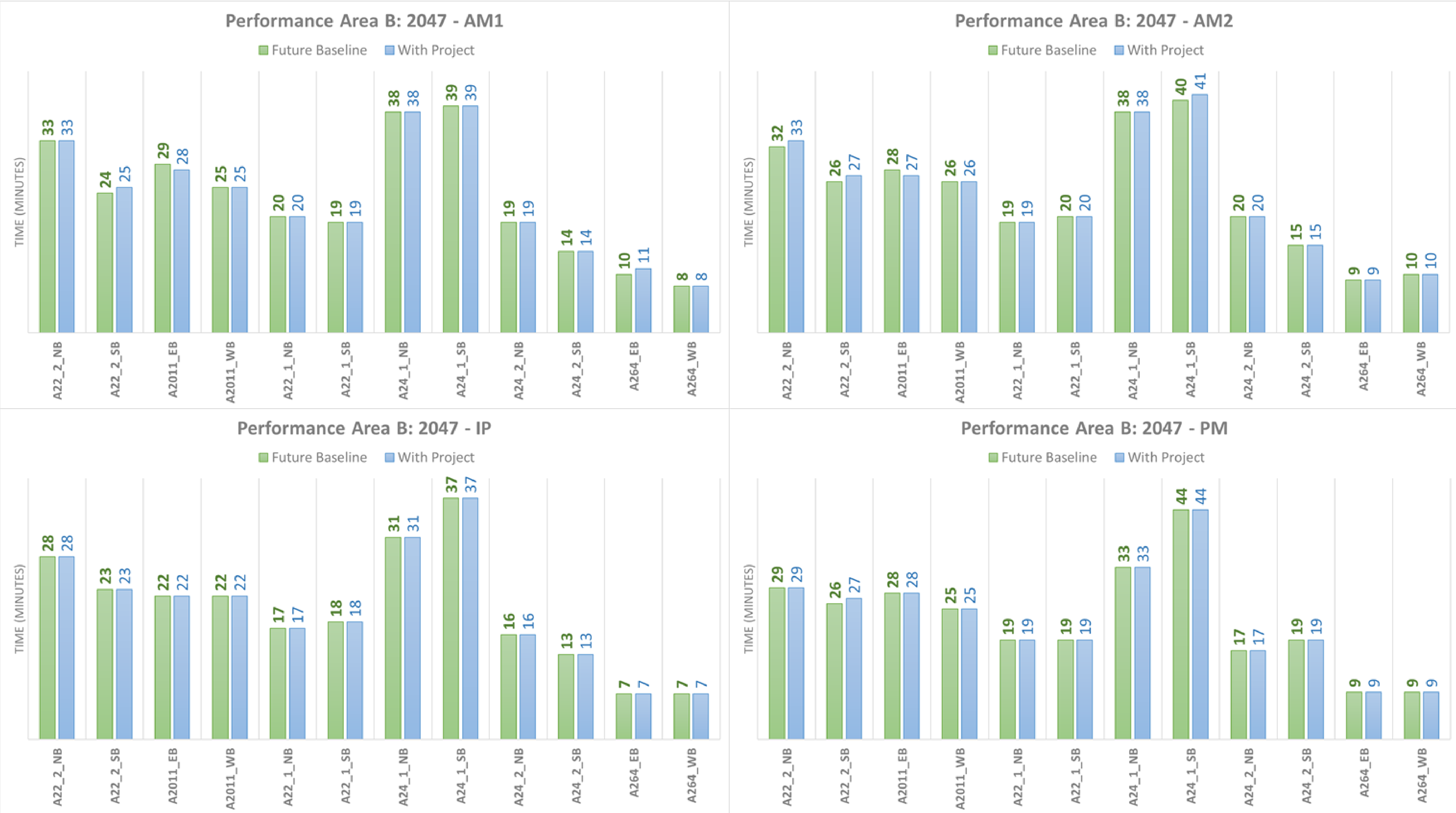
- A22 [1] from M25 J6 to East Grinstead, Southbound and northbound;
- A22 [2] from East Grinstead to Maresfield, southbound and northbound;
- A2011 from M23 J11 to East Grinstead via Crawley, eastbound and westbound;
- A24 [1] from near M25 J9 (Leatherhead) to north Horsham, southbound and northbound;
- A24 [2] from north Horsham to A272/A24 near West Grinstead, southbound and westbound; and
- A264 from north Horsham to M23 J11, eastbound and westbound.

10.6.2 Modelled journey times extracted for these routes summarised in Figure 63 - Figure 65 demonstrate that no routes are notably impacted between the Future Baseline and With Project Scenario in 2029, 2032 and 2047. There are no instances of journey times exceeding changes greater than one minute. The modelled journey times evidence that although these corridors are affected in the With Project scenario, summarised in AADT terms referenced in Figure 39 - Figure 41, there are no significant impacts in end-to-end journey times in comparison to the Future Baseline.

Figure 63: Highway Journey Times – Performance Area B, 2029

Figure 64: Highway Journey Times - Performance Area B, 2032

Figure 65: Highway Journey Times – Performance Area B, 2047



Operational Performance - Volume / Capacity ratios

10.6.3 Modelled Volume / Capacity ratios were extracted for each of the four modelled time periods. The maximum value across all time periods was selected to identify the highest value modelled and this is presented in Figure 69 to Figure 74.

10.6.4 For 2029, the modelled data demonstrates that the vast majority of links do not change operational categories with the exception of one instance on Horsham Road northbound with a category shift of yellow (85%<V/C<99%) to red (V/C > 99%). The Future Baseline scenario is associated with a V/C of 97% in the AM1 period whereas in the With Project scenario the V/C the corresponding value is 100%. The associated change is a result of 15 additional vehicles. 2032 and 2047 exhibit similar patterns in terms of changes in operation categories. Further analysis is undertaken to contextualise these impacts by categorisation with respect to magnitude of impacts.

Magnitude of Impact

10.6.5 In accordance with the criteria specified in section 9.1, the following section elaborates on instances of ‘High’ and ‘Medium’ and impacts for each assessment year. An overview of ‘Low’, ‘Medium’ and ‘High’ impacts is presented in Figure 66 to Figure 68. The graphics consider data for all periods respective to Performance Area B.

2029

10.6.6 When considering 2029, there are no instances of ‘Medium’ or ‘High’ magnitude impacts and is presented in Table 10.6.1.

Table 10.6.1: Magnitude of Impacts: Performance Area B, 2029 Nodes

2029	Performance Area B - Nodes			
MoI	AM1	AM2	IP	PM
Negligible	225	134	124	64
Low	2	3	0	0
Medium	0	0	0	0
High	0	0	0	0

Figure 66: Magnitude of Impacts: Performance Area B, 2029 Nodes

2032

10.6.7 The 2032 assessment year impacts are summarised in Table 10.6.2. The table outlines that there are a maximum of two 'Medium' magnitude impacts across all modelled periods. Figure 67 illustrates all occurrences across for all peaks.

10.6.8 The 'Medium' instances relate to the M25 westbound near junction 6 and the M25 SB off-slip on to the M23 southbound for the AM1 and AM2 period. The incident flagged near junction 6 is due to the V/C increasing from 99% to 101% in the With Project scenario. The M25 southbound off-slip instance has V/C of 87% and 94% in the Future Baseline and With Project scenarios respectively and although is flagged as a 'Medium' impact link still operates within the same operation capacity of 85%<V/C<99%.

Table 10.6.2: Magnitude of Impacts: Performance Area B, 2032 Nodes

2032	Performance Area B - Nodes			
MoI	AM1	AM2	IP	PM
Negligible	380	309	335	320
Low	5	6	2	5
Medium	2	2	0	0
High	0	0	0	0

Figure 67: Magnitude of Impacts: Performance Area B, 2032 Nodes

2047

10.6.9 The 2047 assessment year impacts are summarised in Table 10.6.3. The table outlines that are no 'High' magnitude impact instances and a maximum of two 'Medium' magnitude impact instances are recognised across all modelled periods. Figure 68 outlines all occurrences across all peaks. These occur at the M23 J8 on the northbound off-slip at in AM1 and PM and southbound on slip in AM2.

Table 10.6.3: Magnitude of Impacts: Performance Area B, 2047 Nodes

2047	Performance Area B - Nodes			
MoI	AM1	AM2	IP	PM
Negligible	348	252	278	202
Low	4	5	4	4
Medium	1	2	0	1
High	0	0	0	0

Figure 68: Magnitude of Impacts: Performance Area B, 2047 Nodes

Figure 69: Maximum V/C - 2029, Future Baseline – Performance Area B

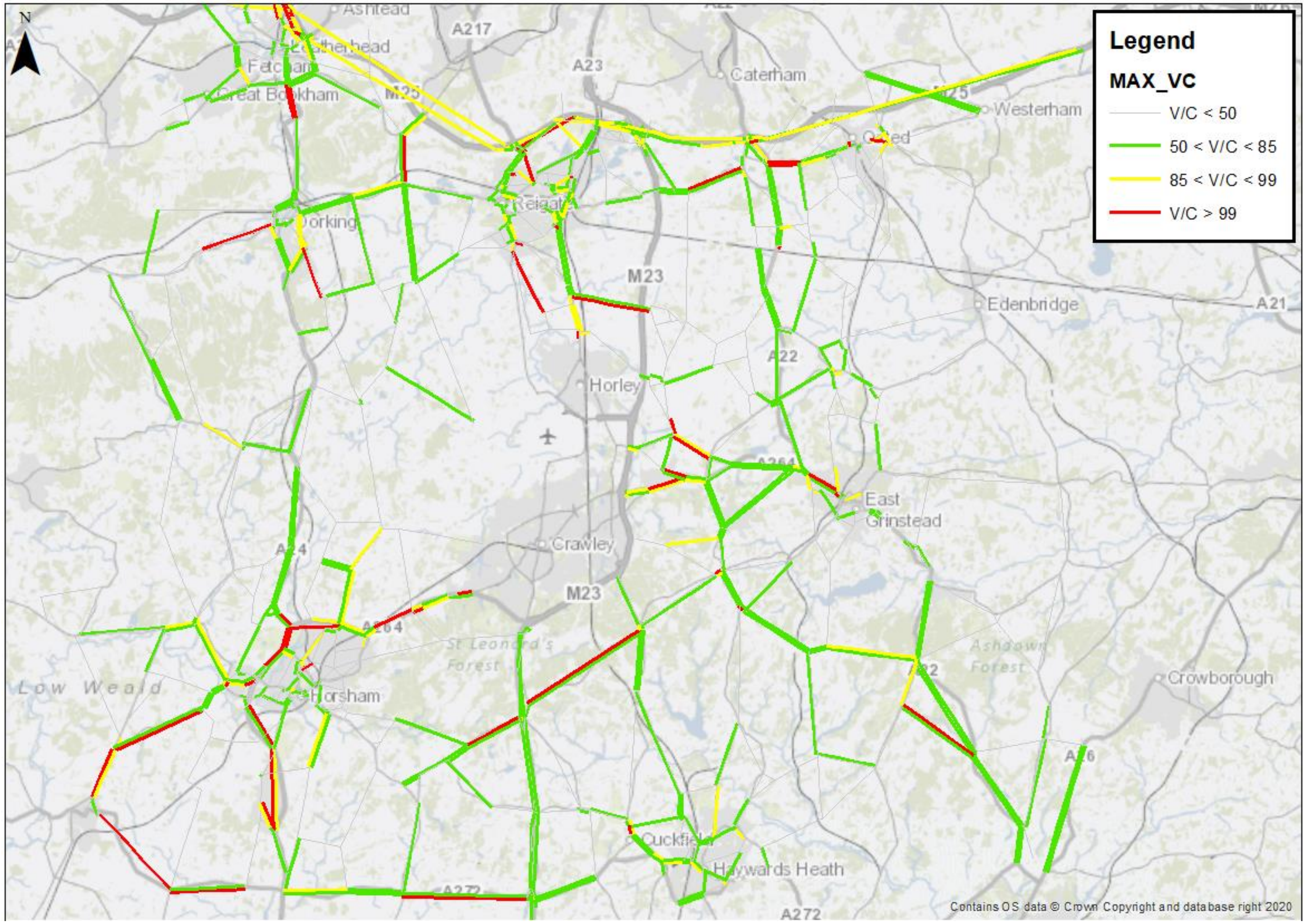


Figure 70: Maximum V/C - 2029, With Project – Performance Area B

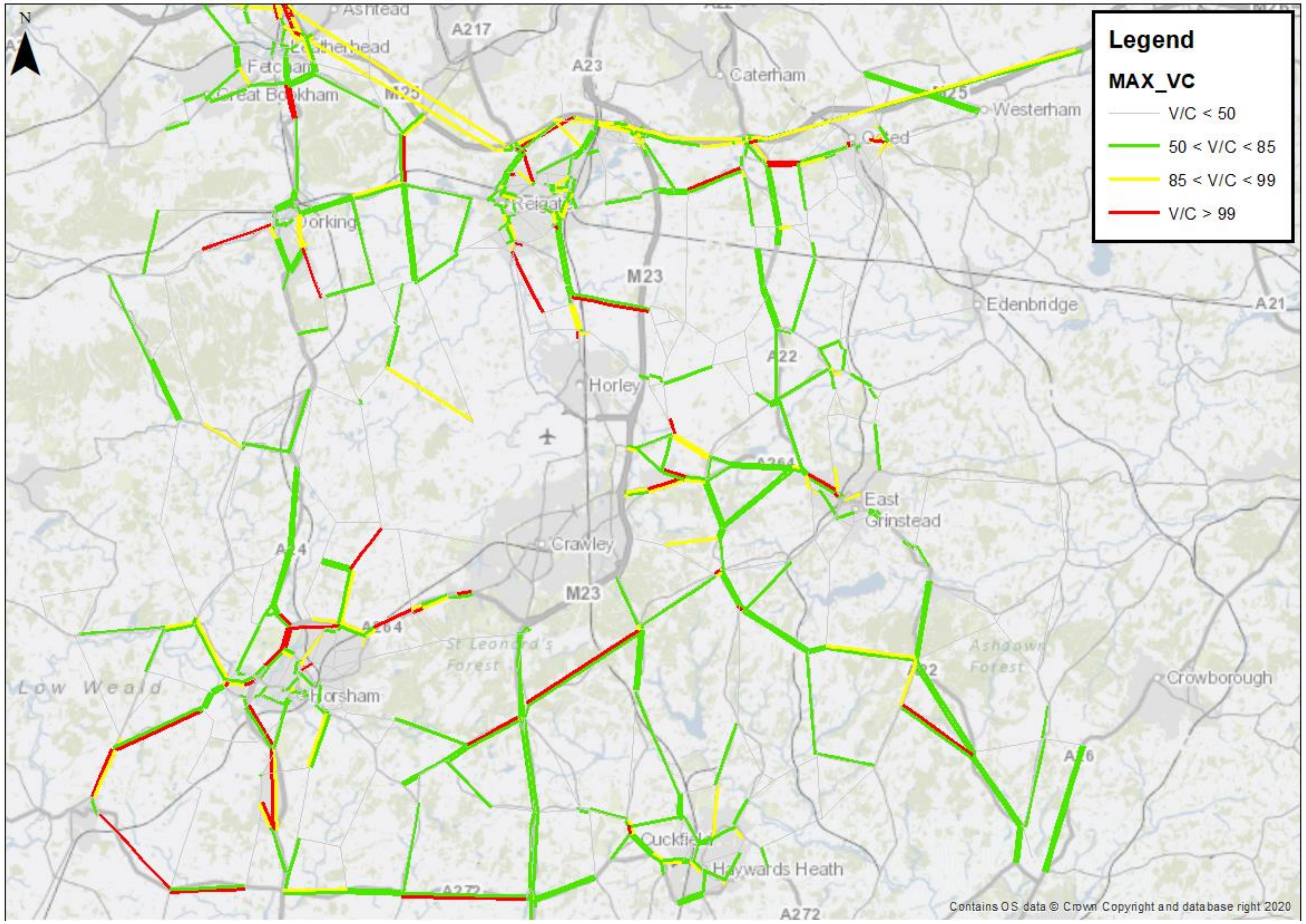


Figure 71: Maximum V/C - 2032, Future Baseline - Performance Area B

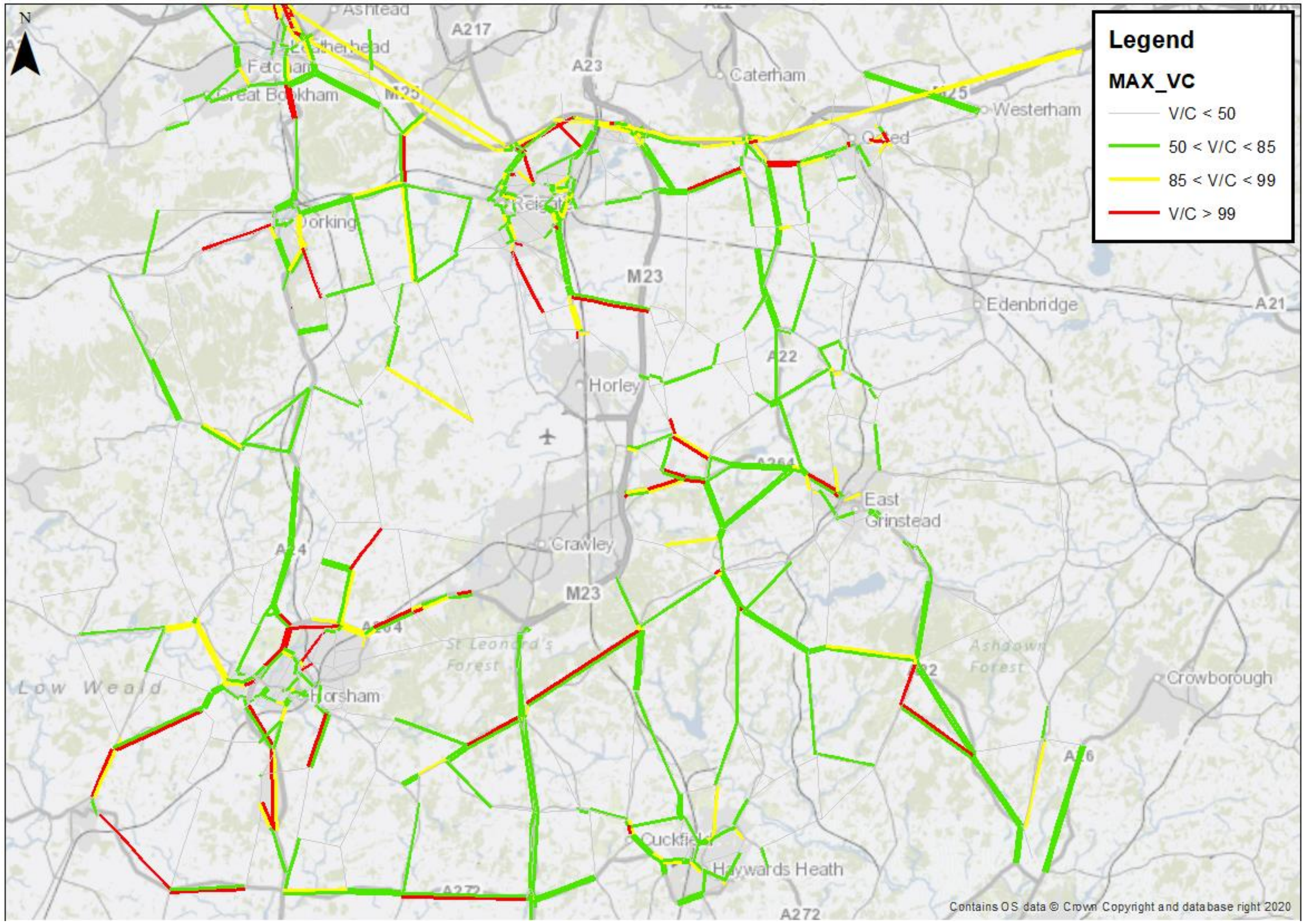


Figure 72: Maximum V/C - 2032, With Project - Performance Area B

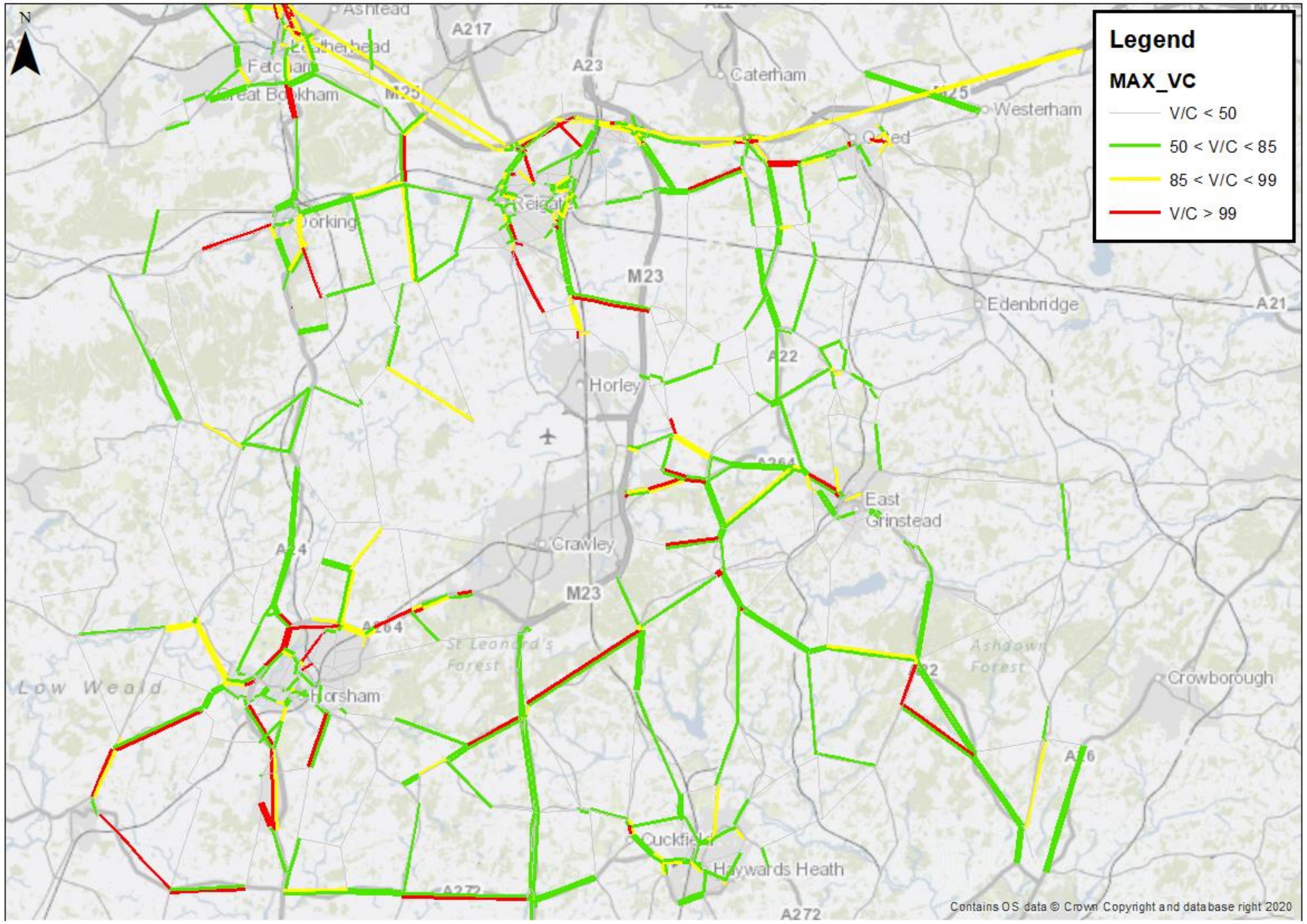


Figure 73: Maximum V/C - 2047, Future Baseline - Performance Area B