NATS

# 14 Operational Efficiency - Fast Time Airspace Simulation

Issue 2

April 2015

# 14 Operational Efficiency - Fast Time Airspace Simulation. April 2015

## Contents

## *Referenced Documents*

| Number | Reference | Source |
|---|---|---|
| **1** | Taking Britain Further (Part 3, page 176) | *https://www.gov.uk/government/publications/additional-airport-capacity-heathrow-airport-north-west-runway* |
| **2** | NATS input to Module 14, Operational Efficiency: Airspace Efficiency Report | *https://www.gov.uk/government/publications/additional-airport-capacity-operational-efficiency-analysis* |
| **3** | Heathrow Airport Northern Runway Extension Updated Scheme Design 14/05/14 | *Supplied by the Airports Commission Secretariat.* |
| **4** | Gatwick Airport Ltd.'s response to the Airports Commission | *https://www.gov.uk/government/publications/additional-airport-capacity-gatwick-airport-second-runway* |
| **5** | Noise: Local Assessment | *https://www.gov.uk/government/publications/additional-airport-capacity-noise-analysis* |

# 1. Executive Summary

The objective of the assessment was to understand and test the ability of the three scheme proposals to be integrated into the London airspace system (network), identify potential breaking points from the increase in traffic on different flows and suggest any possible future mitigation. The proposals were assessed independently of each other to provide an impartial view of each. The results were highly sensitive to the traffic forecasts provided and the commercial framework within which they deliver, i.e. 2040, 'Low Cost is King', Carbon Traded. It is important to note that the findings would be different if the exercise was conducted using alternative routes or traffic samples.

None of the proposals could be delivered into the operating environment modelled (i.e. LAMP Phase 1A) as all would place unserviceable demands on the airspace and route network structures. As previously reported to the Commission (Ref 2), the London TMA would need to be substantially redesigned (post LAMP Phase 2) to enable an additional runway, wherever located, as well as the forecast growth at the other London airfields to be efficiently supported.

With the increase in demand predicted, the traffic levels in 2040 will be challenging for the airspace network, even without the addition of a new runway to the LTMA (as assessed via a 'Do Minimum' scenario). Some additional resilience could be gained through extra mixed-mode runway operations at Heathrow during the day.

NATS is constantly modernising its ATC solutions and will continue to do so, with substantial investment in airspace re-design and technological advancements. These are expected to provide substantial mitigations to the challenges that the forecast traffic levels will present to the operation, as well as enabling the efficient integration of an additional runway at either Gatwick or Heathrow.

**Heathrow Airport North West Runway**
The assessment concluded that the Heathrow Airport North West Runway scenario presented fewer challenges for the airspace network than the Do Minimum scenario, partly through growth at the main regional airfields affecting the LTMA being less pronounced.

There are issues of integrating the proposal into the low level and dense LTMA airspace; however a collaborative approach to the task, undertaken with joint responsibility by HAL, NATS, the CAA and the UK Government as well as pro-active engagement with the airport consultative committee could provide some mitigation. Similarly, inter-state collaboration with adjacent FIRs, to re-design route structures would provide mitigation for impacts observed for Sector 18.

**Heathrow Airport Northern Runway Extension**
The assessment concluded that the Heathrow Airport Northern Runway Extension scenario presented fewer challenges for the airspace network than the Do Minimum scenario, partly through growth at the main regional airfields affecting the LTMA being less pronounced. There are issues of integrating the proposal into the low level and dense LTMA airspace; however a collaborative approach to the task, undertaken with joint responsibility by HAL, NATS, the CAA and the UK Government and pro-active engagement with the airport consultative committee could provide some mitigation.

The current proposal provided limited modes of runway operation during peak hours, leading to less operational resilience. This could be redesigned; however an impact on surrounding airspace would be a trade-off.

**Gatwick Airport Second Runway**
The assessment concluded that the Do Minimum scenario presents fewer challenges for the airspace network than the proposal set out by Gatwick Airport Second Runway when using the traffic forecasts provided by the Airports Commission. Some of these impacts were directly due to the additional runway at Gatwick and airspace structure, whilst there are secondary effects due to the assumed economic impact driving growth at the main regional airfields affecting the LTMA. The LTMA and Area Control sectors around Gatwick would require significant re-development to cater for additional flows of traffic and holding stacks and / or Point Merge systems for Gatwick arrivals. Further design work affecting the SIDs, in order to allow optimised departure sequencing, as well as changes to military danger areas in the vicinity, may provide additional mitigations. The use of segregated runway modes could provide substantial mitigation due to reduce traffic complexity; however this would also reduce the overall declared runway capacities, further reducing the demand on the network in the TC South and AC Worthing sectors.

None of the proposals presented a notable impact upon surrounding airfields within the LTMA that would directly affect their growth potential.

The simulations were run with clear weather conditions and with an absence of runway closures, go-arounds or technical failures. With these assumptions the large and continuous traffic demand still resulted in prolonged stack dwell times. With conditions that are not as ideal the resilience of the system would be tested further. Whilst the system may cater for this level of demand under ideal conditions, it would be unrealistic to expect an operation this busy to be completely problem free and any issues would quickly lead to significant disruption. Service resilience could be mitigated by considering this factor when balancing sector demand, i.e. ensuring there is always an amount of spare runway capacity across LTMA airports at any one time.

# 2. Introduction

The purpose of the fast time simulation exercise was to test the ability of the three scheme proposals to be integrated into the London airspace system, to identify potential breaking points in the airspace system (network) from the increase in traffic on different flows and suggest any possible future mitigation.

Models of each proposal, together with interpretation of each proposal's detail were constructed together with a 'Do Minimum' model as a comparison scenario. Traffic during a hypothetically busy day in 2040 was used to meet the requirement to stress-test the airspace. Data generated from these models was analysed, with particular emphasis on sector occupancy metrics and the indicated net effect on the London airspace system including traffic at other London airfields.

This report examines each proposal individually and considers its impact on the network system. It does not compare the proposals against one another nor makes any recommendation as to which proposal is best as this is dependent on many additional factors, many of which remain unknown at this time. Rather, it sets out the outcomes of the analysis for each of the individual proposals for the assumptions made and constraints observed to identify and quantify potential impacts where appropriate. The findings are only applicable to the individual scenario modelled (for example, the results cannot be further interpreted to consider the impact of an additional runway at Heathrow *and* an additional runway at Gatwick due to the interdependent nature of such operations).

## 2.1. The Current Operating Environment

During busy periods, controller workload is intense and needs to be supported through a highly structured and systemised operation in order to deliver the level of traffic throughput required whilst maintaining high safety levels. This can result in environmentally inefficient flight profiles and high controller workload.

The London Terminal Control (LTC) operation has evolved through continual development to provide an operation delivering high movement rates to and from multiple major and minor airfields and is now one of the most complex and busy operational environments in the world.

Whilst there are occasions when demand is in excess or at 100% of the available capacity, scheduling regimes ensure this is not planned to occur continuously throughout the whole day. This action provides the operation with a degree of resilience so as to provide occasions in which the system can recover from periods of excess demand either planned or those that naturally arise from fluctuations in the operating environment.

To safely handle this level of traffic, there is a reliance on a high degree of tactical intervention coupled with a significant R/T (radio-telephony) workload.

The current airspace design limits the initial climb of departures from LTMA (London Terminal Manoeuvring Area) airfields unless tactical interventions are used to position aircraft away from the (what are now considered to be) low level terminal holds (FL70+) and deconflict aircraft from common navigational waypoints such as BPK/CPT VOR[1]. Whilst this use of radar headings facilitates higher climb, the application of the technique is neither predictable nor always possible and adds to the high workload environment owing to high R/T workload.

This method of working is unlikely to support a significant increase in traffic.

The three general ATC functions that are carried out by LTC can be summarised as follows:

- **Transition sectors** operating between En-Route and LTMA operations. TC Midlands (4 sectors), TC Capital (2 sectors) and TC East (4 sectors, including 2 bordered by the London FIR boundary) facilitate the interface between some LTMA and London Area Control (LAC) / Prestwick Centre (PC) Sectors.

- **TC LTMA sectors** whose primary role involves tactical traffic deconfliction of arrivals and departures before transfer to approach control or transition / en-route sectors. TC LTMA sectors are divided into two groups along an east-west axis through Heathrow (TC North (6 Sectors) and TC South (6 sectors)). LTMA inbound sectors share responsibility for the holding stacks with Approach controllers.

- **Approach Control (APC)**. Heathrow (5 positions), Gatwick (3 positions), Stansted (3 positions), Thames Radar (4 positions including SVFR[2]) and Luton (2 positions).

[1] VHF Omni-directional Range- a ground-based navigation radio beacon.
[2] Special VFR (Visual Flight Rules) is a VFR flight cleared by air traffic control to operate within a control zone in meteorological conditions below visual meteorological conditions.

TC sector controllers operate both the transition and LTMA sectors. Approach Controllers operate the Approach sectors.

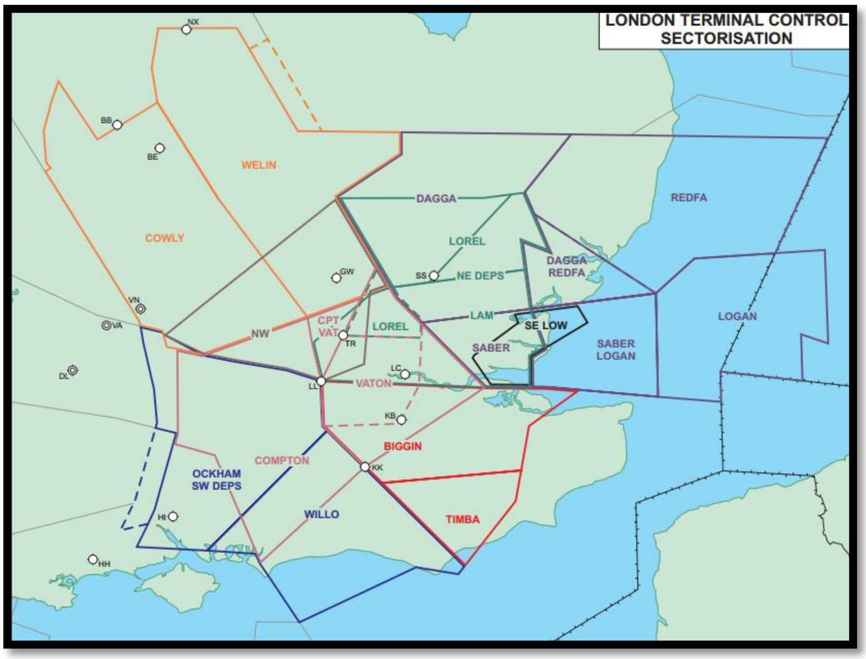



**Figure 1 - London Terminal Control Sectorisation**

## 2.2. Transition Altitude

Transition Altitude (TA) is the altitude at or below which the vertical position of an aircraft is normally controlled by reference to altitude, i.e. the vertical position of the aircraft is calculated using the pressure at Mean Sea Level (MSL). Above this, aircraft are controlled by reference to Flight Levels (FLs) i.e. the vertical position of the aircraft is calculated using a standard pressure setting. The space in between the TA and the lowest available FL is called the transition layer. The size of this layer varies depending on the pressure at MSL, as does the lowest FL which is separated by 1,000ft or more from the TA. Subsequently, there are limitations to the vertical constraints which can be placed on departure procedures, effectively only vertical restrictions given as altitudes can be written into the procedures.

The Transition Altitude within the LTMA is 6,000ft. This provides a technical constraint on the ability to deconflict multiple departure routes vertically. The CAA intends to raise the TA within the UK to 18,000ft in 2018; it is unlikely however that this will be harmonised with our neighbours which would add complexity at the boundaries that have not been considered in this report.

## 2.3. Navigation Specification

LTC Airspace is currently designed using Conventional Navigation Specification which requires aircraft to use ground-based navigational aids, such as VORs. This adds to the constraints on the operation whereby multiple routes converge on the same VORs (each of which are known by 3-letter abbreviations) such as Compton (CPT), Brookman's Park (BPK), Detling (DET), Midhurst (MID), Sam (SAM), Clacton (CLN) and Goodwood (GWC).

In the UK, Basic Area Navigation (B-RNAV or RNAV5)[3] is mandated to the base of the airway structure on all existing routes. Current CAA guidance requires all new ATS routes to be designed in line with RNAV1[4] specification which requires a higher degree of navigation accuracy resulting in concentration of aircraft on route centrelines. The requirements of the various navigation standards and capabilities are defined internationally by ICAO.

Many operators have already 'overlaid' conventional SIDs with RNAV1 routings into their avionics Flight Management Systems with the insertion of extra waypoints to improve track keeping accuracy.

## 2.4. Airspace Design and Method of Operation

Aircraft performance has improved significantly since the current airspace route and sector structure was designed and for many aircraft, their optimum climb rate is greater than current airspace design permits. Sectors have been implemented and/or developed

[3] B-RNAV or RNAV5 is an equipment specification which permits aircraft to navigate without the use of point source navigation aids. To meet the specification, aircraft track keeping accuracy must be within +/- 5 nautical miles of the route for at least 95% of the time.
[4] RNAV1 is a performance requirement of +/- 1 nautical mile for at least 95% of the time

to manage ATC workload around the main obstacles in the local airspace environment and have historically been limited to specific sector developments rather than targeting wholesale change.

## 2.5. Arriving Aircraft

Arrivals are normally presented to TC controllers from adjacent sectors from multiple directions into their sector. TC controllers dictate the order aircraft arrive at the terminal holding stacks and ensure vertical separation at the holding stacks prior to transfer of control to Approach.

Arrivals are normally directed to one of ten holding stacks, each of which is designated to a particular airfield or groups of airfield, by the appropriate tactical controller.

The use of holding stacks is a key feature of today's operation, which sees aircraft fly tiered orbital tracks when the demand on arrival runways exceeds capacity.

At Heathrow, Gatwick, Stansted and Luton, aircraft are instructed to enter the holds at the lowest available level (the lowest level in these holding stacks is usually FL70 or FL80 depending on runway orientation and atmospheric pressure) as this maximises the efficiency of the operation.

The high traffic demand at the main LTMA airfields, and the transfer mechanism used either in or approaching the stacks, places an operational reliance on the stack even when its use for delay is not required. Aircraft arriving at the holding stacks at the same or similar time can cause aircraft to hold even when there is sufficient runway capacity to accommodate 'no delay'. This can be burdened by approach airspace and/or procedure constraints (aircraft may have to be at or below a certain level before being cleared to leave the holding stack). Once holding has commenced, subsequent aircraft are then also required to hold due to the inability to clear lower aircraft off the stacks quickly enough.

The terminal holding stacks are located close to the airfield enabling Approach controllers to manage traffic efficiently enough to maintain runway capacity during peak times and accommodate requests for variable spacing at short notice from the Tower controller. However, the proximity of these holding stacks to the airfield is the primary reason for departures being vertically constrained.

On being cleared to leave the holding stacks, Approach controllers are required to issue heading instructions (vector) all aircraft into a radar vectoring pattern to establish a sequence for landing. All aircraft require vectors onto the ILS[5] for landing. TC Approach controllers provide an efficient operation delivering high movement rates to single or dual runway operations. To deliver this level of traffic, there is a reliance on a near continuous R/T workload. Section 2.8 'London Airspace Management Programme (LAMP)' details NATS' plans to re-design the London TMA which will include use of more systemised approach techniques which use linear holding such as 'Point-Merge' and 'Tromboning'[6].

### 2.5.1. Missed Approach Procedures

Instances of 'go-arounds' managed through Missed Approach procedures may be more complex than those that currently exist in current operations at both Heathrow and Gatwick. Missed Approach Procedures that do not result in a less resilient operation being provided will need to be developed; these are the responsibility of the airfield operator supported by the airfield air traffic control service provider. Should an increase in instances of Missed Approaches occur, then resilience of the LTMA operation will be tested as traffic aborting landings will need to be deconflicted with other arriving/departing traffic in the vicinity of the airfields and then re-integrated into the arrival stream.

To achieve the peak rates asserted, assurance of many aspects of the future operation will be required, including the development of robust Missed Approach procedures to support both individual and multiple go-around situations.

## 2.6. Continuous Descent Approaches (CDA)

Continuous Descent Approaches (CDAs) provide the most fuel efficient descent profile for aircraft. LTC Approach controllers are to provide a CDA from 6000ft wherever the airspace structure and traffic situation allows. Unfortunately, airspace limitations currently limit CDAs into Stansted Rwy 04, Gatwick Rwy 08, London City and Luton.

## 2.7. Departing Aircraft

Departures from Heathrow, Gatwick, Stansted and Luton are initially restricted to 6000ft or below (co-incident with the LTMA Transition Altitude) on the standard departure routes (SIDs) to remain below traffic in the holding stacks or on the initial/ intermediate approach. Once the departure is clear of the inbound conflicting aircraft the pilots are issued further clearances dependant on prevailing traffic conditions and agreements with adjacent sectors. For example, aircraft following the current DVR SIDs from Heathrow Rwy 27 are regularly unable to be climbed above 6000ft until 50nm after departure.

[5] Instrument Landing System. A ground-based instrument approach system that provides precision lateral and vertical guidance to an aircraft approaching and landing on a runway

[6] Point Merge and Tromboning are systems by which the aircraft fly in a queue to land via an extended flight path instead of holding in a race-track pattern.

Heathrow departures all climb continuously to 6000ft. Departures from adjacent airfields climb to lower, intermediate levels underneath Heathrow SIDs, often containing step-climbs i.e. aircraft are required to level off for periods during their climb rather than benefit from a continuous climb profile.

SIDs from Heathrow, Gatwick, Stansted, Luton and London City are all separated from each other for the initial portion of their route. However, tactical intervention is ultimately required by controllers to ensure separation against the other SIDs, routes, Radar Manoeuvring Areas (RMAs), sectors and also in order to present the aircraft to the next sector in the manner required.

When above the Noise Preferential Route (NPR), controllers have the flexibility to vector aircraft off their SID in order to facilitate climb earlier than would be possible if left to follow the SID profile. This is common practice and is indeed what TC controllers are trained to do until their workload becomes too high, at which point aircraft are left to follow the SID. However, as detailed above, aircraft cannot be left on all SID routes for their entirety due to other traffic interactions therefore even during busy periods, tactical intervention is needed.

## 2.8. London Airspace Management Programme (LAMP)

The London Airspace Management Programme (LAMP) has been established to provide a complete re-design of the London TMA to provide more efficient operations to all the airfields in a manner which reflects progressive advances in aircraft capabilities (both avionics and performance) and addresses forecast future demand based on existing infrastructure. This requires a raised Transition Altitude, hence the CAA's intention to progress with this in 2018.

The LAMP will re-design the airspace and allied route structure within the London TMA to increase capacity and service delivery efficiency, whilst improving safety and reducing environmental inefficiencies. More efficient arrival and departure routes supporting all five London airports will be developed, supported by changes to abutting airspace in the en-route operation delivered by London Area Control and supporting changes to the airspace providing the Farnborough and Solent[7] operations.

**The LAMP is being progressed on the existing ground infrastructure:** an additional runway will require further changes to the route structures to ensure safe and efficient services are delivered. The LAMP is planned to complete by the end of 2020 and extensive further design work will be required before a new runway can be integrated into the complex LTMA airspace structure.

As the LAMP is still in development **this assessment assumes that only the LAMP Phase 1A has been successfully implemented**[8] and this configuration provides the baseline on which the three proposals have been integrated and modelled. LAMP Phase 1A primarily affects arrival and departure routes into and out of London City, Southend and Biggin Hill with some changes to Luton, Northolt and Stansted departure routes and Gatwick arrival routes in order to facilitate the LAMP Phase 1A implementation. Therefore this assessment is based on the constraints detailed above namely the current location of holding stacks and the limitation of a 6000ft Transition Altitude within all UK FIRs.

### 2.8.1. LAMP Timescales and Phases

LAMP Phase 1A includes airspace surrounding London City, Southend and Biggin Hill airfields and is scheduled for delivery in Winter 2015/16.

The remaining elements of the LAMP are scheduled for delivery during Phase 2 between 2018-2020. The degree of LAMP Phase 2 success is dependent upon *inter alia,* political will and Government policies to inform the debate on noise for airspace redesign.

## 2.9. Post LAMP Operating Environment

NATS is constantly modernising its ATC solutions and will continue to do so, with substantial investment in airspace re-design and technological advancements. NATS has embarked on programmes to re-develop and modernise its LTMA structures through large scale PBN re-design between now and 2020. It has also embarked on an intensive period of system upgrades to replace its core operating systems in collaboration with European Partners which will lay solid foundation for the introduction of SESAR ideologies. ATM is moving away from tactical ATC control to an era of deconflicted aircraft trajectories allowing ATM and aircraft systems to burden the load of aircraft separation. This will allow Air Traffic Controllers to handle more flights at any one time as their role moves from an intensive tactical task to a monitoring task. It is this modernisation of ATM that will allow NATS to cater for future demand whilst keeping operating costs to levels acceptable to its stakeholders.

Future technological and airspace developments will improve both the capacity and efficiency of the London TMA, enabling NATS to support the future traffic levels expected over the period when the additional runway will become operational and thereafter.

[7] Comprising Bournemouth and Southampton airports.
[8] Implementation date December 2015

NATS operations, including those that support the London TMA, will continually evolve as advances in technology bring opportunities to provide safer and more efficient services. The advanced concepts being validated by SESAR[9] will enable a variety of new tools and applications to be used, the key ones being:

#### 2.9.1. Trajectory Based Operations

The key change from today's concept is that a safe, efficient and continuous 'trajectory' will be negotiated between the aircraft and all ATC service providers, and once agreed, ground and airborne systems will monitor the aircraft's compliance and notify deviations for resolution. The operation will thus be more predictable, systemised and strategic than the current operation, which is far more tactical and characterised by controller intervention.

The trajectory will be the flight path that sets out the most fuel efficient route for that aircraft within the airspace framework. It will define, in 4 dimensions (horizontally, vertically and in time), the cruise-to-cruise aspect of the flight (including arrival and departure aspects of the operation).

The trajectory that is delivered will be as close as possible to that which is required to minimise the cost of the flight. It will be established by considering many factors, including: the desired trajectory provided by the operator of the flight; interactions with the desired trajectories of all other flights; and operational conditions that may exist as the trajectory is followed (such as weather conditions; unexpected closure of airspace; and other factors that cannot be strategically managed). Controllers will be supported by a suite of tools and applications that continually monitor the aircraft's adherence to its trajectory and warn if a deviation outside tolerable limits is expected or has been detected.

#### 2.9.2. Performance Based Navigation

Advanced avionic navigation capabilities enable aircraft to adhere to flight paths to a far greater accuracy than previously possible. Operations based on Performance Based Navigation (PBN) capabilities form a cornerstone of the CAA's Future Airspace Strategy (FAS) as they provide the opportunity to concentrate and route traffic away from major populations and fly more predictable departure paths. The establishment and use of routes which are 'deconflicted by design' and the ability of aircraft to reliably and accurately navigate them is a key goal of the safe and effective operation of airfields within the London TMA.

A European Mandate in 2024 requires a higher specification of PBN accuracy for certain airfields and the European Aviation Safety Agency (EASA) has recently muted its intent to introduce this more widely from 2018 onwards.

It should be noted that concentrating noise using PBN creates its own problems where there are no areas of low density population and concentration of noise in low density areas is more noticeable due to lower background noise.

#### 2.9.3. Time Based Separation

This concept will result in separation between aircraft on final approach being based on time as opposed to distance, thereby sustaining the landing rate during strong headwind conditions. TBS is operational at Heathrow airport and in the timeframe being considered by this report will be operational at Gatwick airport.

#### 2.9.4. Queue Management

NATS continues to develop its Arrival Manager (AMAN) system to provide controllers with more accurate information about aircraft arrival time at the holding stack entry points, with the intent to revise the speed of the aircraft (within acceptable limits) to reduce or even avoid the need for airborne stack holding, termed Linear Holding.

[9] Single European Skies ATM Research http://www.sesarju.eu/

# 3. The Three Scheme Proposals

There are various levels of detail associated with the designs for each proposal, each with little recognition of the effect on other traffic flows within the LTMA.

The proposals included indicative routes for departures in all directions off each runway, but do not include detail on how the proposed routes were expected to interact with each other, i.e. which SIDs would be active in which configuration and what the departure separations would be required for aircraft departing from the same runway following different SIDs. Therefore, it was necessary to use ATCO expertise to formulate working assumptions on route availability and departure separations in the operating modes modelled. These assumptions are documented later in this section.

The indicative routes supplied were produced for the purpose of assessing the operational viability of each scheme proposal and in order to undertake the fast-time simulation modelling. These designs were for illustrative purposes only and were not to be interpreted as representative of the location of future flight paths, should a particular proposal be recommended and ultimately granted Government approval. It was also noted that finalising the routes of future flight paths would be a matter for detailed design in future years prior to runway opening.

- For the Heathrow Airport North West Runway proposal, the airport operator supplied indicative flight path designs covering a range of operating modes – as per Annex 4, 'NATS input to Module 14, Operational Efficiency' (Ref 2).
- For the Heathrow Airport Northern Runway Extension proposal, indicative flight path designs were constructed by the Commission in conjunction with expert advisers – as per Annex 5, 'NATS input to Module 14, Operational Efficiency' (Ref 2).
- For the Gatwick Airport Second Runway proposal, indicative flight path designs were constructed by the Commission in conjunction with expert advisers – as per Annex 3, 'NATS input to Module 14, Operational Efficiency' (Ref 2).

In order to treat each proposal without bias there was no attempt to re-design any low-level routes or the wider network in order to accommodate the proposals. The proposed routes were then attached into the wider network as in the LAMP Phase 1A airspace. Some of the proposed routes were assessed as not feasible in the LAMP Phase 1A airspace design and so were not modelled. Those routes are also detailed later in this section.

As this report is focussed on the impact on the airspace network, achieved runway throughput was not of principal concern for the modelling. However in order to feed a realistic traffic demand into the airspace network, the runway demand for each of the proposed concepts was cross-checked to ensure it did not exceed the hourly movement limits specified. Where the grown traffic had exceeded these limits the traffic was moved into periods where this limit had not been reached.

The achieved runway throughput rates were checked to ensure they did not exceed the reference rates, however these did not take into account any airfield surface constraints (e.g. location of stands and terminals), the impact on potential loss of runway throughput due to the requirement to safely integrate missed approaches, environmental impacts such as loss of CDA, track mileage extensions and any revised airspace design or changes to the method of operation required to enable the ability to safely service these arrival and departure rates.

The complexities of the airspace proposals and the forecast demand meant that delays would be incurred leading to differences between demand and achieved runway throughput. Owing to the issues this caused, principally excessive stack holding, some arriving aircraft were removed from the simulation upon reaching the initial approach fix; such traffic was still considered to have arrived. Traffic at this stage in their journey (i.e. past the initial approach fix) was considered outside of the sectors and thus this behaviour did not directly affect the sector throughput figures. This will have had some impact upon departure rates for mixed-mode runways, however owing to the high departure demand and this demand being partially responsible for some of the arrival delay, this will not have contributed to significant changes in demand throughput.

The runway throughput rates used as a reference from each of the scheme proposals were;

- Heathrow Airport North West Runway: 128/Hr
- Heathrow Airport Northern Runway Extension: 130/Hr
- Gatwick Airport Second Runway: 98/Hr

This report does not support or refute the ability for the runway configurations to deliver the peak movement rates claimed by each proposal. The numbers proposed above are credible when considered for individual airfields but the complexities of the proposals combined with the limitations of the dense LTMA environment will make providing a safe and efficient solution extremely challenging.

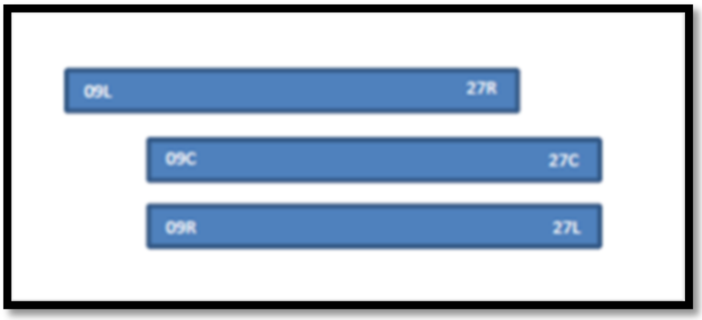
As the scheme proposals do not consider missed approaches it is possible that when approved procedures have been developed to safely integrated go-around flights back in to the arrival stream, they **could** limit these peak rates.

The results and observations discussed in this paper are based on each of the proposals being superficially 'integrated' into the LAMP Phase 1A airspace network which is subject to many of the current constraints experienced in the LTMA today, such as the location of the Heathrow stacks, procedurally conflicting routes and a 6000ft TA. A complete re-design such as the further planned LAMP Phase 2 airspace changes would provide over-arching mitigation together with further extensive airspace re-design and technological enhancements to cater for new routes and the associated increase in movements.

Instances of 'go-arounds' managed through Missed Approach procedures may be more complex than those that currently exist in current operations at both Heathrow and Gatwick. Missed Approach Procedures that do not result in a less resilient operation being provided will need to be developed; these are the responsibility of the airfield operator supported by the airfield air traffic control service provider. Should an increase in instances of Missed Approaches occur, then resilience of the LTMA operation will be tested as traffic aborting landings will need to be deconflicted with other arriving/departing traffic in the vicinity of the airfields and then re-integrated into the arrival stream.

To achieve the peak rates asserted, assurance of many aspects of the future operation will be required, including the development of robust Missed Approach procedures to support both individual and multiple go-around situations.

## 3.1. Heathrow Airport North West Runway proposal




As required by the Airports Commission Secretariat, the mode of operation for the three runways which presents the most difficulty from an ATC perspective was identified[10] and modelled. This was 'Mode 2 Period 2 – Minimising New' for both Westerly and Easterly runway operations as detailed in 'Taking Britain Further' (Ref 1) Part 3, page 176, due to the proximity of departure traffic on immediately adjacent runways.

It was assumed that all runways at Heathrow operated independently.

As illustrated in Table 1 below, this mode of operation consists of mixed-mode (DL in the table below) on the new northern runway (09L/27R), Departures from the centre runway (27C/09C) and Arrivals onto the southern runway (27L/09R).

| Assumption | Mode 1 | Mode 2 | Mode 3 | Mode 4 |
|---|---|---|---|---|
| Northerly Runway | DL | DL | L | D |
| Centre Runway | L | D | D | L |
| Southern Runway | D | L | DL | DL |
| D = Departing, L = Landing, DL = Departing and Landing | | | | |

Table 1 - Modes of Runway Operation[11]

### 3.1.1. Departures

'Taking Britain Further' (Ref 1) Volume 1, 3.5.1.3 states:

"*We have assumed a principle of Terminal Arrivals and Compass Departures to allocate the schedule to runways. Compass Departures mean that aircraft depart from the runway most suited to their flight direction – i.e. northbound flights depart from the northernmost departure runway. This avoids departures routes crossing each other and also supports the principle of providing periods of relief for communities close to the runway ends. The alternative, Terminal Departures, means aircraft departing from the runway closest to the terminal at which they are parked. If a Terminal Departures approach were used, sometimes a northbound departure would depart from the south runway, and a southbound departure from the north runway. In this case, the departure rate would fall significantly to allow aircraft to cross in the air safely after take-off.*"

Therefore, the routes provided by the Heathrow Airport North West Runway proposal which were conducive to the principal of compass departures were modelled. Any which were contrary to this principal in the chosen mode of operation of the runways were reviewed with consideration given to the LAMP Phase 1A airspace configuration. Routes considered unfeasible due to the crossing of traffic flows without adequate space to provide minimum separation were discarded. This had the desirable consequence of metering departure traffic into the LTMA sectors.

Figure 2 and Figure 3 are taken from Annex 4, 'NATS input to Module 14, Operational Efficiency' (Ref 2) as provided by the airport operator.

[10] Ref (2), NATS input to Module 14, Operational Efficiency.
[11] Ref (1), Taking Britain Further (Part 3, page 176)

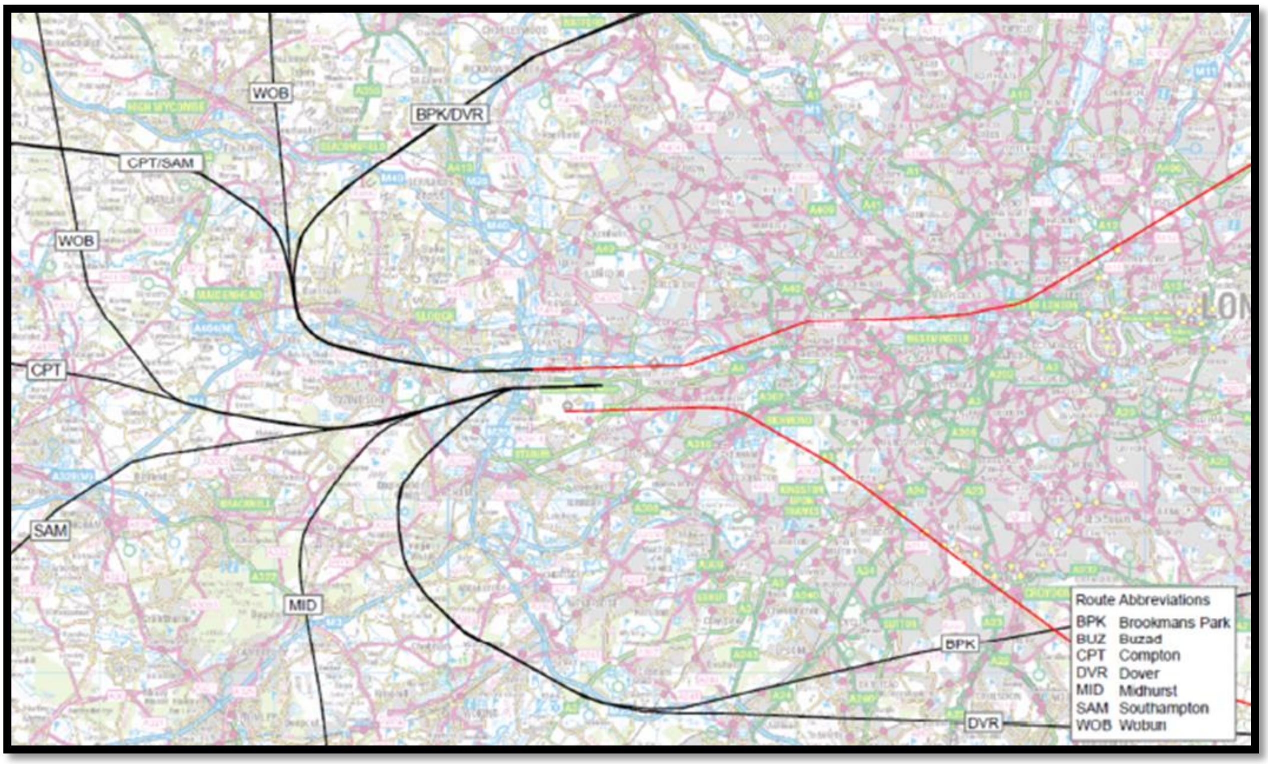



Figure 2 – Heathrow Airport North West Runway: Indicative Arrival and Departure Paths during Westerly Runway Operations[12]

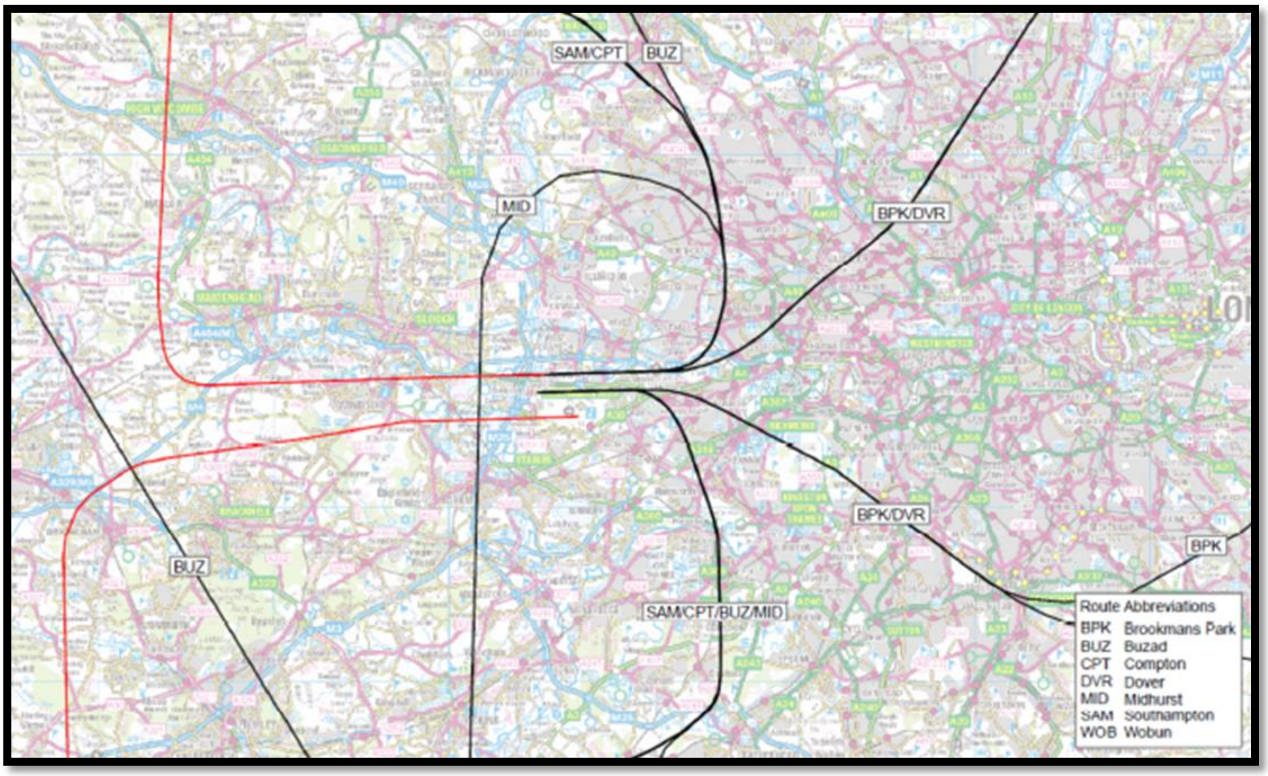



Figure 3 – Heathrow Airport North West Runway: Indicative Arrival and Departure Paths during Easterly Runway Operations[12]

From this information the SIDS were grouped as shown in Figure 4 for Westerly runway operations and Figure 5 for Easterly runway operations where the same colour indicates the same initial SID routing. This is significant as successive departures on the same initial routing require a minimum 2 minute departure interval between them which is detrimental to runway throughput. Where the SID name has been struck through, these routes have not been modelled as they do not constitute compass departures. The exceptions were DVR departures to the North East and CPT departures to the North West with a

[12] Crown Copyright and Database Rights 2014. Annex 4, 'NATS input to Module 14, Operational Efficiency' (Ref 2)

slight alteration applied to the latter as these were judged to be viable options in the modelled airspace. The necessary SID departure gaps assumed are detailed in Table 2 to Table 14.

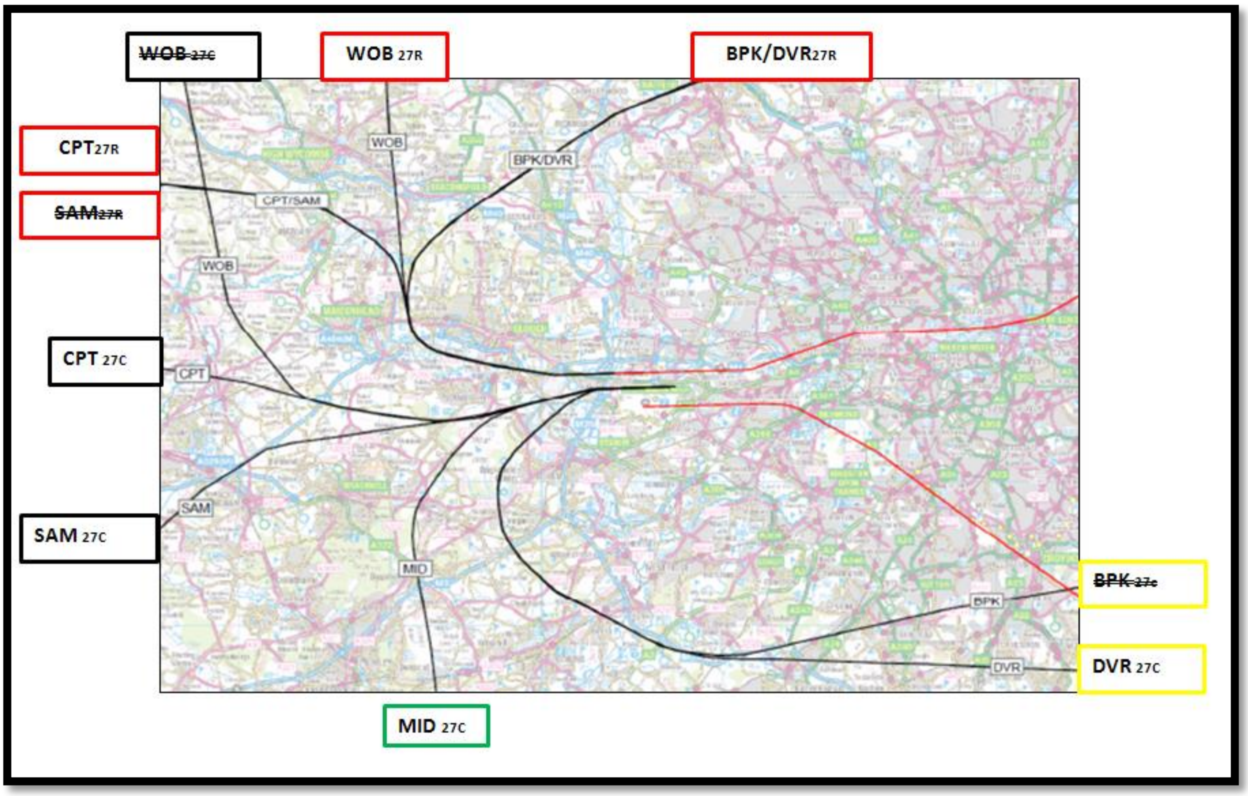



Figure 4 – Heathrow Airport North West Runway: Departure Path Assumptions during Westerly Runway Operations[13]

Figure 3 indicates that the 27C MID departure should follow the same initial routing as the CPT/SAM departures from the same runway. However, for this study, the MID departure routing was modelled as if on a separate NPR to the CPT and SAM SID group in order to reduce the minimum departure interval between the MID SID and the other departure groups to one minute. This was deemed necessary to avoid an excessively restrictive and unworkable reduction in runway capacity. Therefore, there is an assumption that the route could be re-designed to follow a suitably separated NPR.

Table 2 and Table 3 show the minimum departure intervals assumed necessary for successive departures from runways 27R and 27C respectively (during Westerly runway operations) in the Heathrow Airport North West proposal for the mode of operation modelled. These values were applied to the airspace models used in the relevant fast time simulation scenario, together with application of the minimum separation requirements for aircraft speed groups.

| Leading Aircraft SID | BPK | CPT | DVR | WOB |
|---|---|---|---|---|
| Subsequent Aircraft SID | | | | |
| BPK | 2 min | 2 min | 2 min | 2 min |
| CPT | 2 min | 2 min | 2 min | 2 min |
| DVR | 2 min | 2 min | 2 min | 2 min |
| WOB | 2 min | 2 min | 2 min | 2 min |

Table 2 - Minimum Time-Based Separation for Successive Departures from Heathrow; Runway 27R

| Leading Aircraft SID | CPT | DVR | MID | SAM |
|---|---|---|---|---|
| Subsequent Aircraft SID | | | | |
| CPT | 2 min | 1 min | 1 min | 2 min |
| DVR | 1 min | 2 min | 1 min | 1 min |
| MID | 1 min | 1 min | 2 min | 1 min |
| SAM | 2 min | 1 min | 1 min | 2 min |

Table 3 - Minimum Time-Based Separation for Successive Departures from Heathrow; Runway 27C

[13] Crown Copyright and Database Rights 2014. Reproduced with data from Annex 4, 'NATS input to Module 14, Operational Efficiency' (Ref 2)

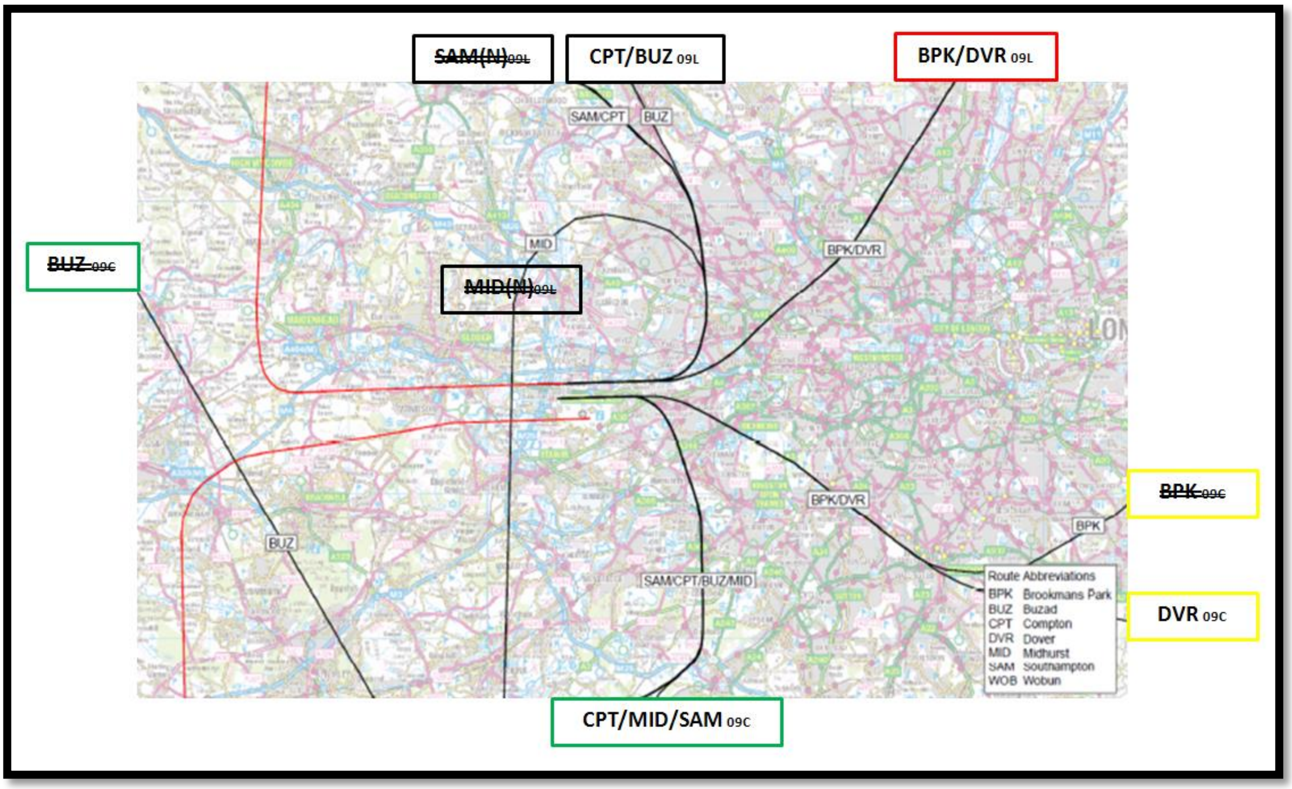



Figure 5 - Heathrow Airport North West Runway: Departure Path Assumptions during Easterly Runway Operations[14]

Table 4 and Table 5 show the departure intervals necessary for successive departures from runways 09L and 09C respectively (during Easterly runway operations), in the Heathrow Airport North West proposal for the mode of operation modelled.

| Leading Aircraft SID | CPT | BPK | BUZ | DVR |
|---|---|---|---|---|
| Subsequent Aircraft SID | | | | |
| CPT | 2 min | 1 min | 2 min | 1 min |
| BPK | 1 min | 2 min | 1 min | 2 min |
| BUZ | 2 min | 1 min | 2 min | 1 min |
| DVR | 1 min | 2 min | 1 min | 2 min |

Table 4 - Minimum Time-Based Separation for Successive Departures from Heathrow; Runway 09L

| Leading Aircraft SID | CPT | DVR | MID | SAM |
|---|---|---|---|---|
| Subsequent Aircraft SID | | | | |
| CPT | 2 min | 1 min | 2 min | 2 min |
| DVR | 1 min | 2 min | 1 min | 1 min |
| MID | 2 min | 1 min | 2 min | 2 min |
| SAM | 2 min | 1 min | 2 min | 2 min |

Table 5 - Minimum Time-Based Separation for Successive Departures from Heathrow; Runway 09C

The assumptions made in this report are consistent between the Gatwick Airport Second Runway and the Heathrow Airport Northern Runway Extension proposals. However, owing to the difference in geographical location and number of runways involved it is not possible to apply exactly the same assumptions to the Heathrow Airport North West Runway proposal.

The Heathrow Airport North West Runway proposal involved traffic departing from 09L using the CPT North West SID and depicted taking excessive track mileage to the north via BUZAD. This was deemed unfeasible due to conflicting traffic flows in the subsequent region; it was instead assumed such traffic would turn west prior to BUZAD.

Figure 6 and Figure 7 illustrate the departure routes as modelled.

[14] Crown Copyright and Database Rights 2014. Reproduced with data from Annex 4, 'NATS input to Module 14, Operational Efficiency' (Ref 2)

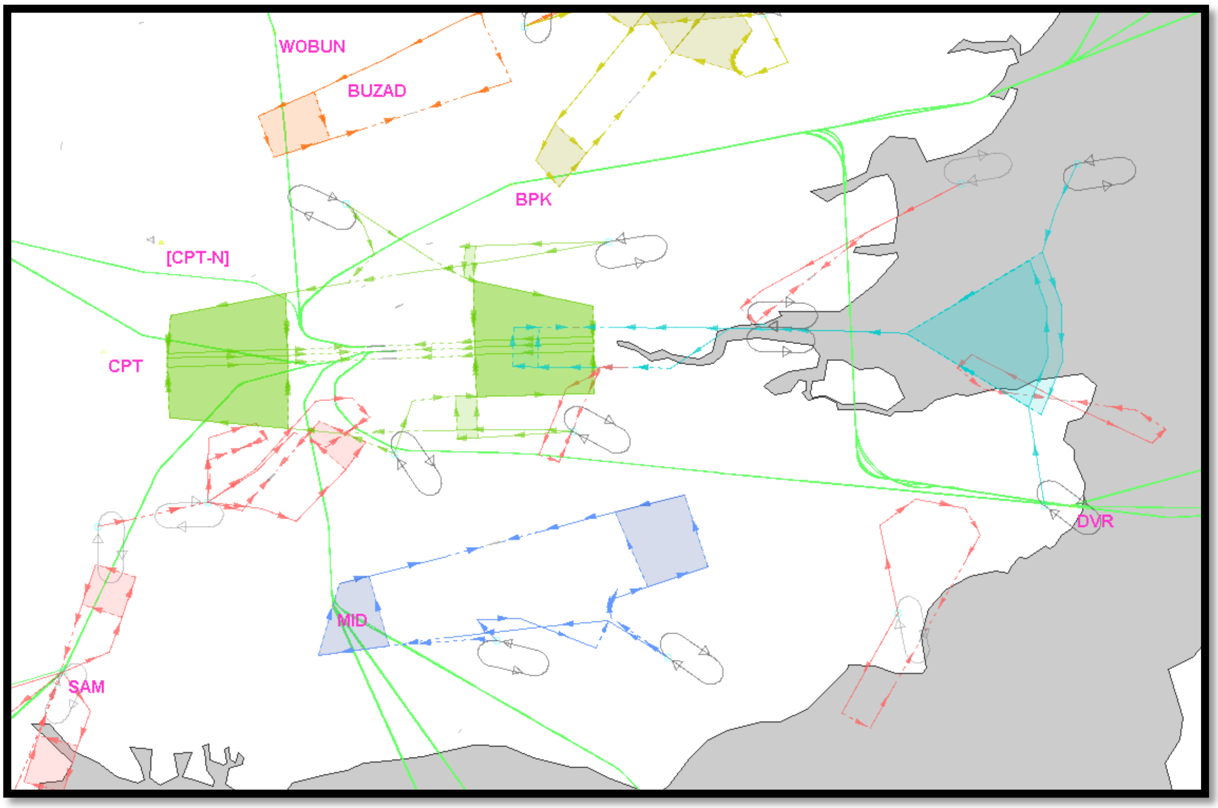



Figure 6 - Heathrow Airport North West Runway: Heathrow Departure Routes as Modelled (Westerly Runway Operations)

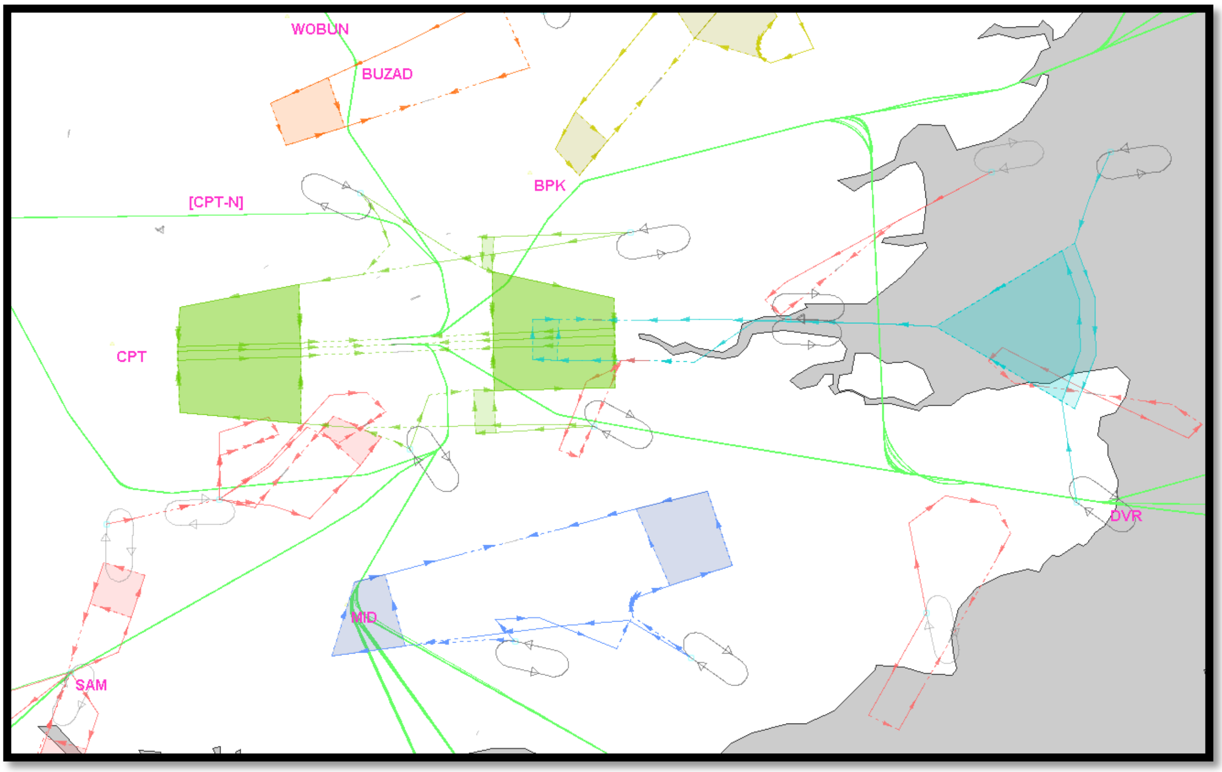



Figure 7 - Heathrow Airport North West Runway: Heathrow Departure Routes as Modelled (Easterly Runway Operations)

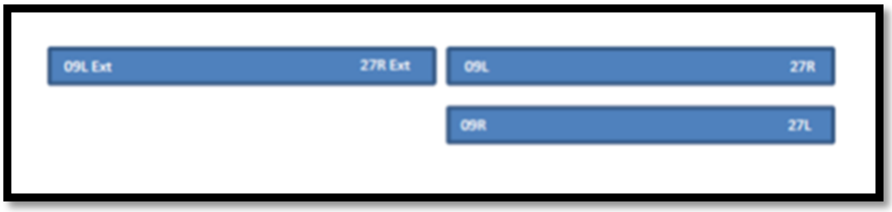
### 3.1.1. Arrivals

'Taking Britain Further' (Ref 1) Volume 1, 3.5.1.3 assumes that '*...curved approaches are able to deliver the same capacity as 'straight in' approaches*'.

There is currently no evidence to support this claim but past Real Time Simulations (un-related to this work) have shown that it has not been possible to maintain the landing rates required at Heathrow using fixed arrival routes without vectoring onto an ILS or RNAV approach. A theoretical solution may be that this vectoring could happen at tangents to the final approach with the latter stages being on a curved path. However, the effects of wind on aircraft at different stages as they progress along these curved paths are not understood and therefore NATS cannot support nor refute the claim. If further work was unable to validate use of curved approaches during peak hours there would be a reduction in runway capacity.

Therefore, for the purposes of this analysis, the model included the proposal assumption that there would be no reduction in capacity due to curved approaches.

## 3.2. Heathrow Airport Northern Runway Extension proposal




As required by the Airports Commission Secretariat, the mode of operation for the three runways which presents the most difficulty from an ATC perspective was identified and modelled. This was the Peak Flow Mode as supplied in 'Heathrow Airport Northern Runway Extension Updated Scheme Design 14/05/14' (Ref 3) Page 45 shown below in Figure 8.

It was assumed that all runways at Heathrow operated independently.

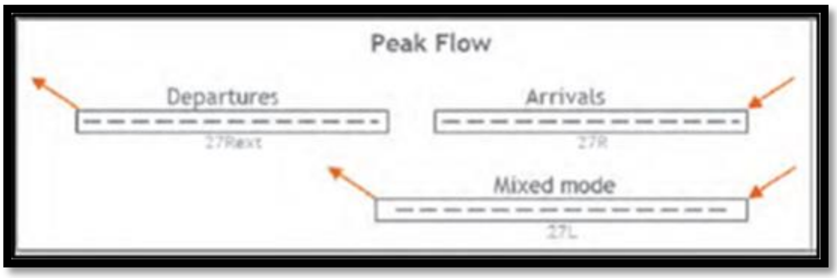



Figure 8 - Schematic Illustration of Peak Flow Mode of Operation for the Heathrow Airport Northern Runway Extension proposal

### 3.2.1. Departures

Figure 9 is taken from Annex 5, 'NATS input to Module 14, Operational Efficiency' (Ref 2) as provided by the Airports Commission in conjunction with expert advisers.

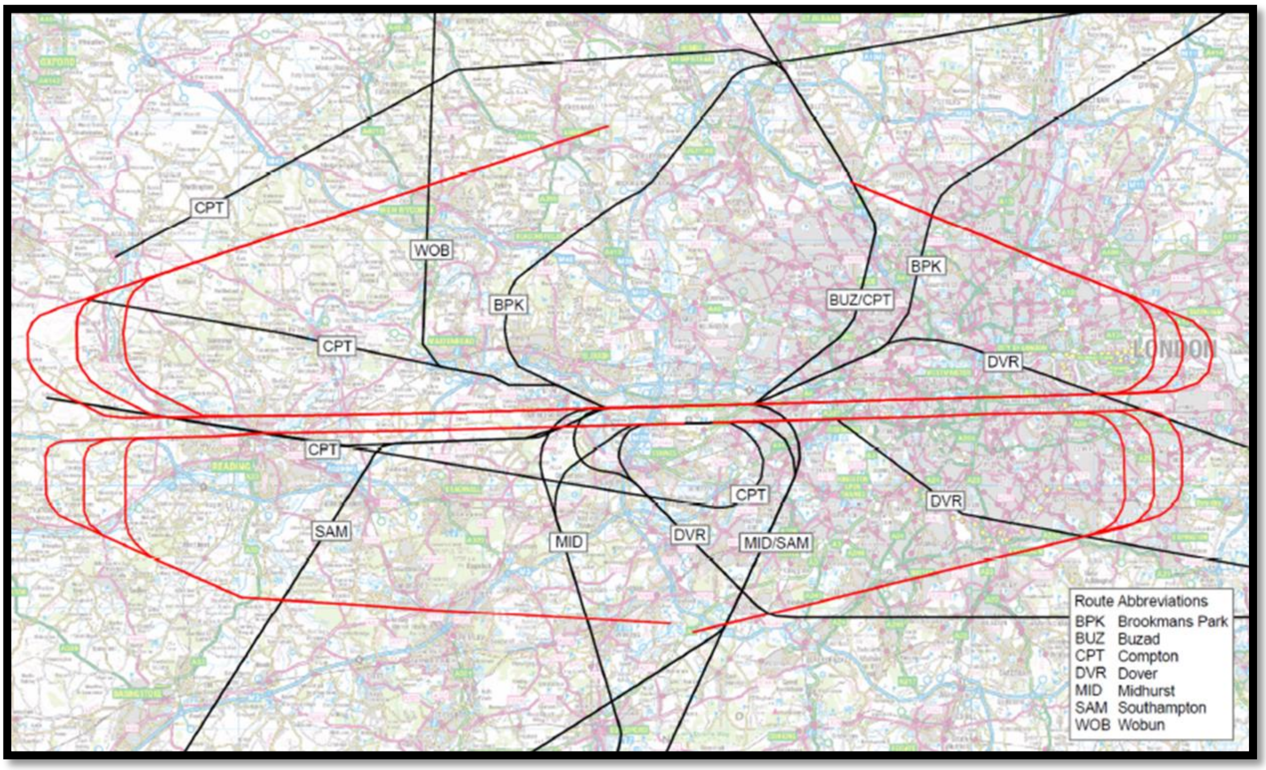



Figure 9 - Heathrow Airport Northern Runway Extension: Indicative Arrival and Departure Paths[15]

[15] Crown Copyright and Database Rights 2014. Annex 5, 'NATS input to Module 14, Operational Efficiency' (Ref 2)

From this information the SIDs were grouped as shown in Figure 10 for Westerly runway operations and Figure 11 for Easterly runway operations where the same colour indicates the same initial SID routing.

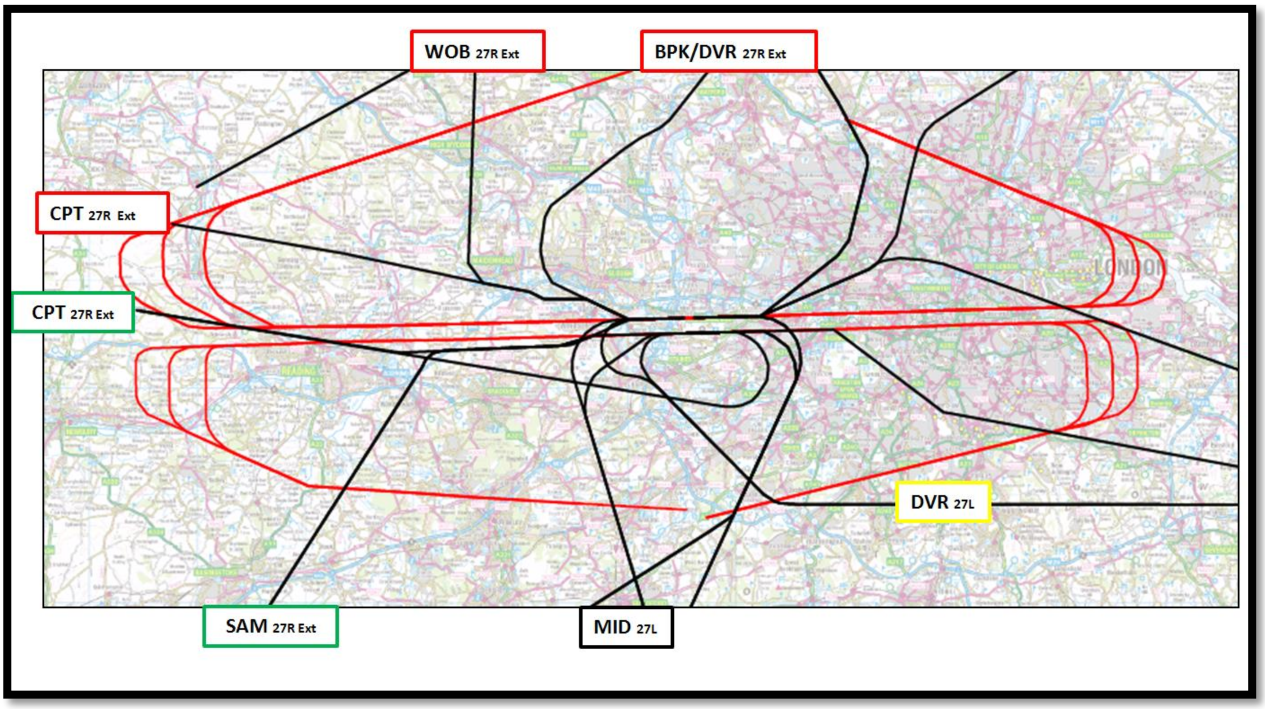



Figure 10 - Heathrow Airport Northern Runway Extension: Departure Path Assumptions during Westerly Runway Operations[16]

Table 6 and Table 7 show the departure intervals necessary for successive departures from runways 27R Ext and 27L respectively (during Westerly runway operations) in the Heathrow Airport Northern Runway Extension proposal for the mode of operation modelled.

| Leading Aircraft SID | BPK | CPT | WOB |
|---|---|---|---|
| <u>Subsequent Aircraft SID</u> | | | |
| BPK | 2 min | 2 min | 2 min |
| CPT | 2 min | 2 min | 2 min |
| WOB | 2 min | 2 min | 2 min |

Table 6 - Minimum Time-Based Separation for Successive Departures from Heathrow; Runway 27R Extended

| Leading Aircraft SID | CPT | DVR | MID | SAM |
|---|---|---|---|---|
| <u>Subsequent Aircraft SID</u> | | | | |
| CPT | 2 min | 1 min | 1 min | 2 min |
| DVR | 1 min | 2 min | 1 min | 1 min |
| MID | 1 min | 1 min | 2 min | 1 min |
| SAM | 2 min | 1 min | 1 min | 2 min |

Table 7 - Minimum Time-Based Separation for Successive Departures from Heathrow; Runway 27L

[16] Crown Copyright and Database Rights 2014. Annex 5, 'NATS input to Module 14, Operational Efficiency' (Ref 2)

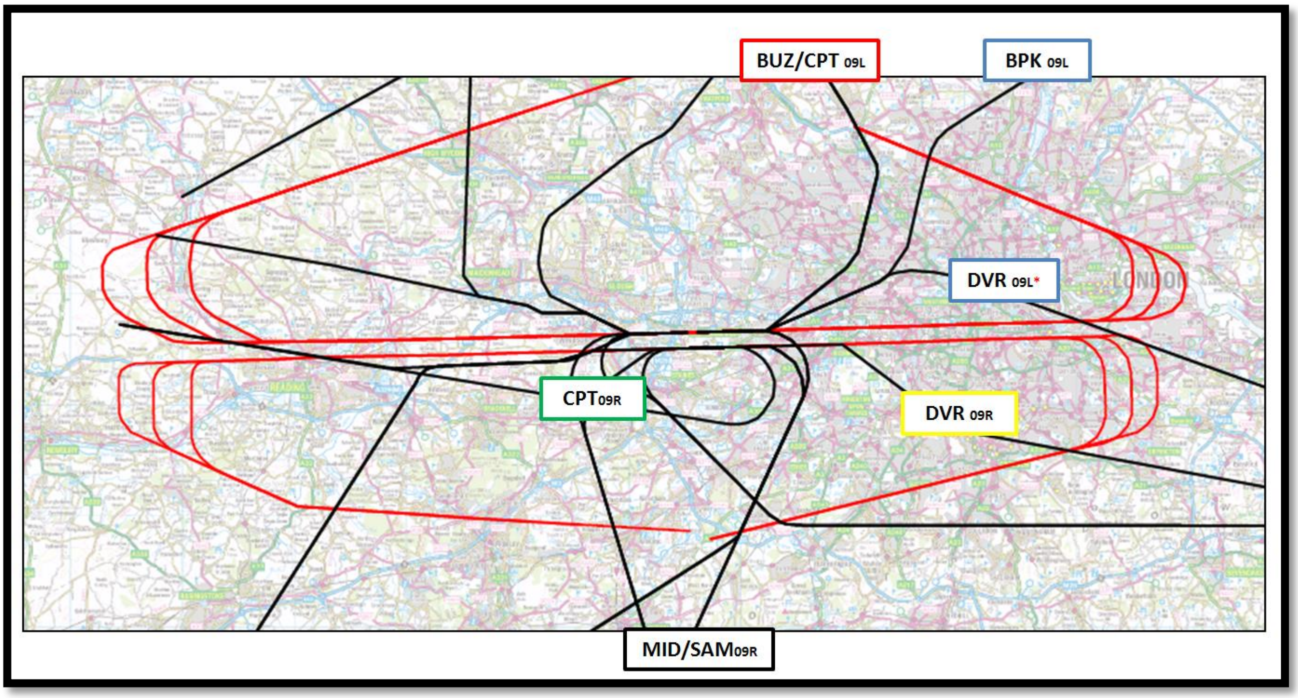



Figure 11 - Heathrow Airport Northern Runway Extension: Departure Path Assumptions during Easterly Runway Operations[17]

Table 8 and Table 9 show the departure intervals necessary for successive departures from runways 09R and 09L respectively (during Easterly runway operations) in the Heathrow Airport Northern Runway Extension proposal for the mode of operation modelled.

| Leading Aircraft SID | BPK | BUZ | CPT | DVR |
|---|---|---|---|---|
| **Subsequent Aircraft SID** | | | | |
| **BPK** | 2 min | 1 min | 1 min | 2 min |
| **BUZ** | 1 min | 2 min | 2 min | 1 min |
| **CPT** | 1 min | 2 min | 2 min | 1 min |
| **DVR** | 2 min | 1 min | 1 min | 2 min |

Table 8 - Minimum Time-Based Separation for Successive Departures from Heathrow; Runway 09L

| Leading Aircraft SID | CPT | DVR | MID | SAM |
|---|---|---|---|---|
| **Subsequent Aircraft SID** | | | | |
| **CPT** | 2 min | 1 min | 1 min | 1 min |
| **DVR** | 1 min | 2 min | 1 min | 1 min |
| **MID** | 1 min | 1 min | 2 min | 2 min |
| **SAM** | 1 min | 1 min | 1 min | 2 min |

Table 9 - Minimum Time-Based Separation for Successive Departures from Heathrow; Runway 09R

The assumptions made in this report are consistent between the Gatwick Airport Second Runway and Heathrow Airport North West Runway proposals. However, owing to the difference in geographical location and number of runways involved it is not possible to apply exactly the same assumptions to the Heathrow Airport Northern Runway Extension proposal.

Compass departures were modelled as well as DVR departures to the North East and CPT departures to the North West. The proposed DVR departure route from 09L would be very challenging to accommodate (explained in Section 7.1), but was included in the model with vertical level restrictions.

As any MID or DVR departures from the main departure runways (27R Ext or 09L) would stop any departures from the Southern runways 27L/09R it was assumed that these departures were restricted to depart only from 27L or 09R. It may be possible for such departures to use the main departure runways (27R Ext or 09L) during off-peak hours; however, testing this possibility was not a requirement of the analysis and therefore was not included in the model.

[17] Crown Copyright and Database Rights 2014. Annex 5, 'NATS input to Module 14, Operational Efficiency' (Ref 2)

The Heathrow Airport Northern Runway Extension proposal involved traffic departing from 09L using the CPT North West SID and depicted taking excessive track mileage to the north via BUZAD. This was deemed unfeasible due to conflicting traffic flows in the subsequent region; it was instead assumed such traffic would turn west prior to BUZAD.

Figure 12 and Figure 13 illustrate the departure routes as modelled.

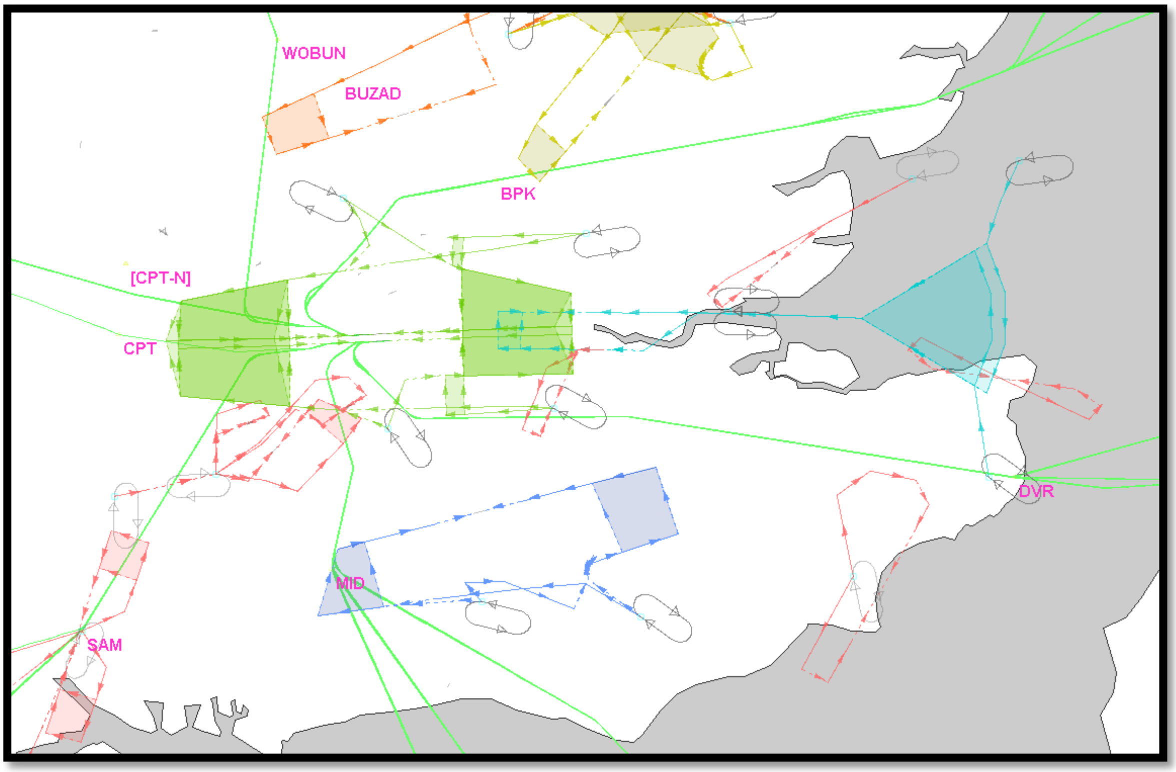



**Figure 12 - Heathrow Airport Northern Runway Extension: Heathrow Departure Routes as Modelled (Westerly Runway Operations)**

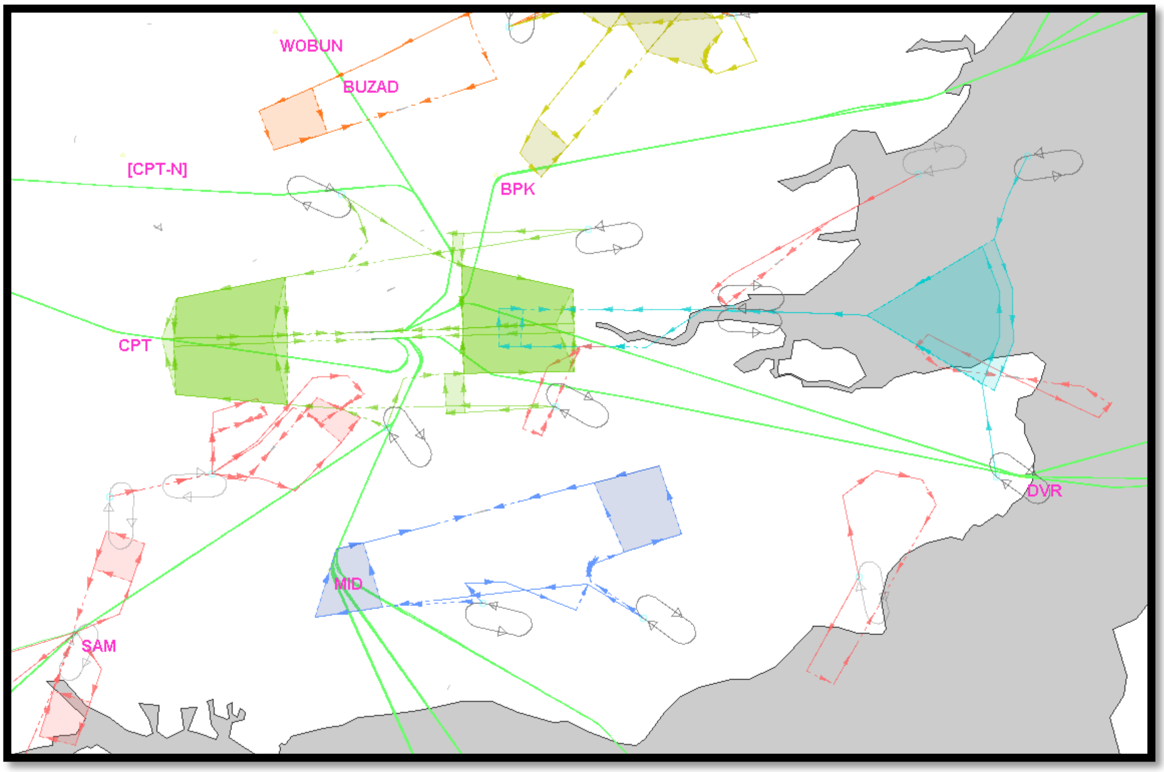
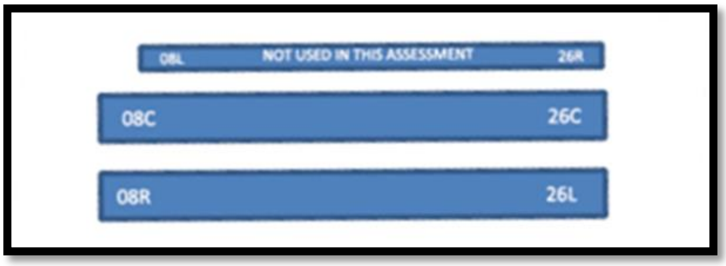



**Figure 13 - Heathrow Airport Northern Runway Extension: Heathrow Departure Routes as Modelled (Easterly Runway Operations)**

### 3.2.2. Arrivals

The paths proposed appear similar to today's operation although with a much longer final approach; a likely requirement for vertical separation between the arrival streams until established on final approach.

## 3.3. Gatwick Airport Second Runway Proposal




### 3.3.1. Departures

The Gatwick Airport Second Runway proposal included only one mode of operation; This was mixed-mode operations on both runways with compass departures as proposed in 'Gatwick Airport Ltd.'s response to the Airports Commission' (Ref 4) Appendix A5 Page 40 and illustrated below in Figure 14.

It was assumed that both active runways at Gatwick operated independently.

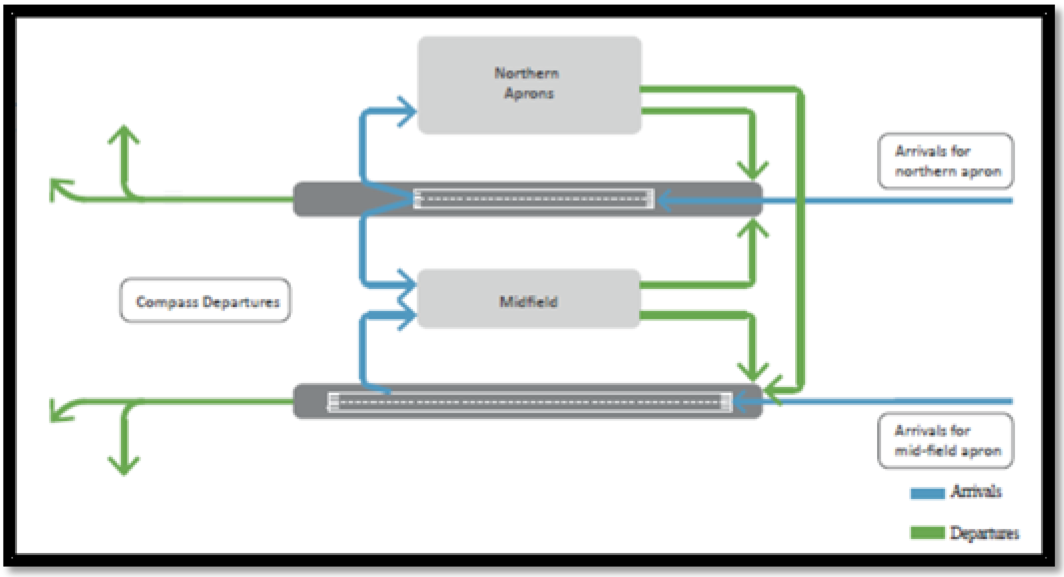



**Figure 14 - Schematic Illustration of Mixed-Mode of Operation for the Gatwick Airport Second Runway proposal**

Figure 15 is taken from Annex 3, 'NATS input to Module 14, Operational Efficiency' (Ref 2) as provided by the Airports Commission in conjunction with expert advisers.

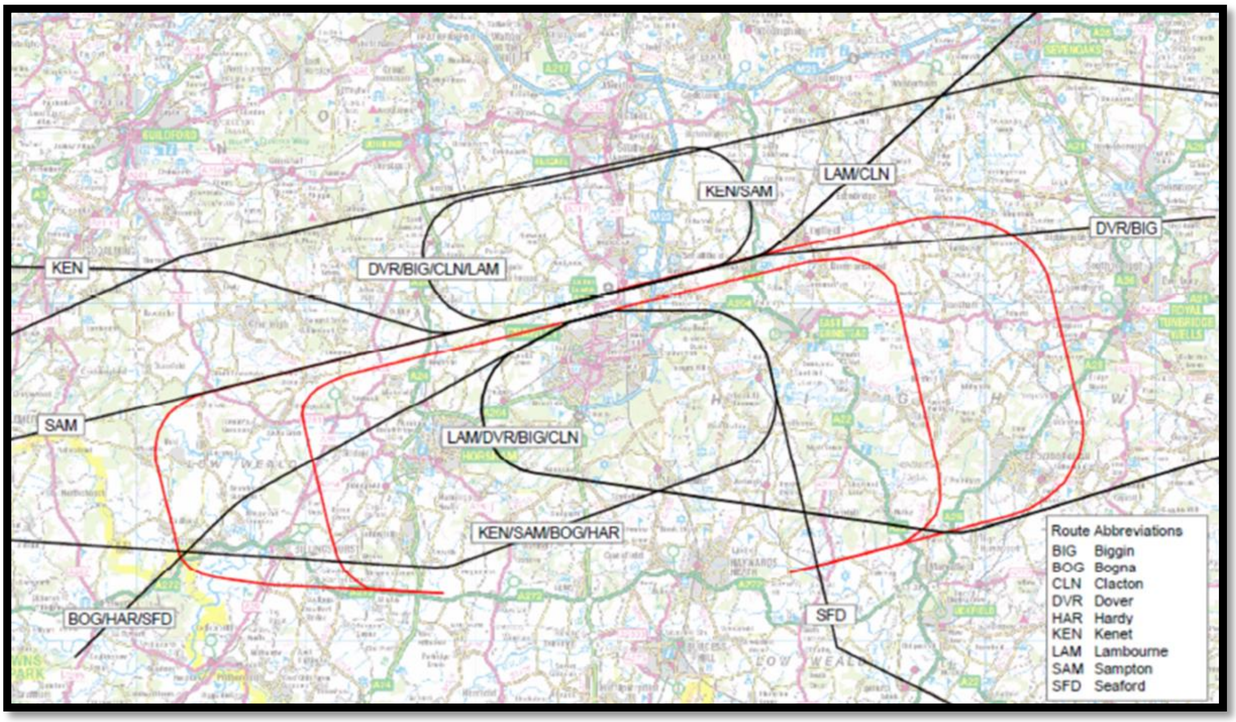



Figure 15 - Gatwick Airport Second Runway: Indicative Arrival and Departure Paths[18]

From this information the SIDs were grouped as shown in Figure 16 for Westerly runway operations and Figure 17 for Easterly runway operations where the same colour indicates the same initial SID routing.

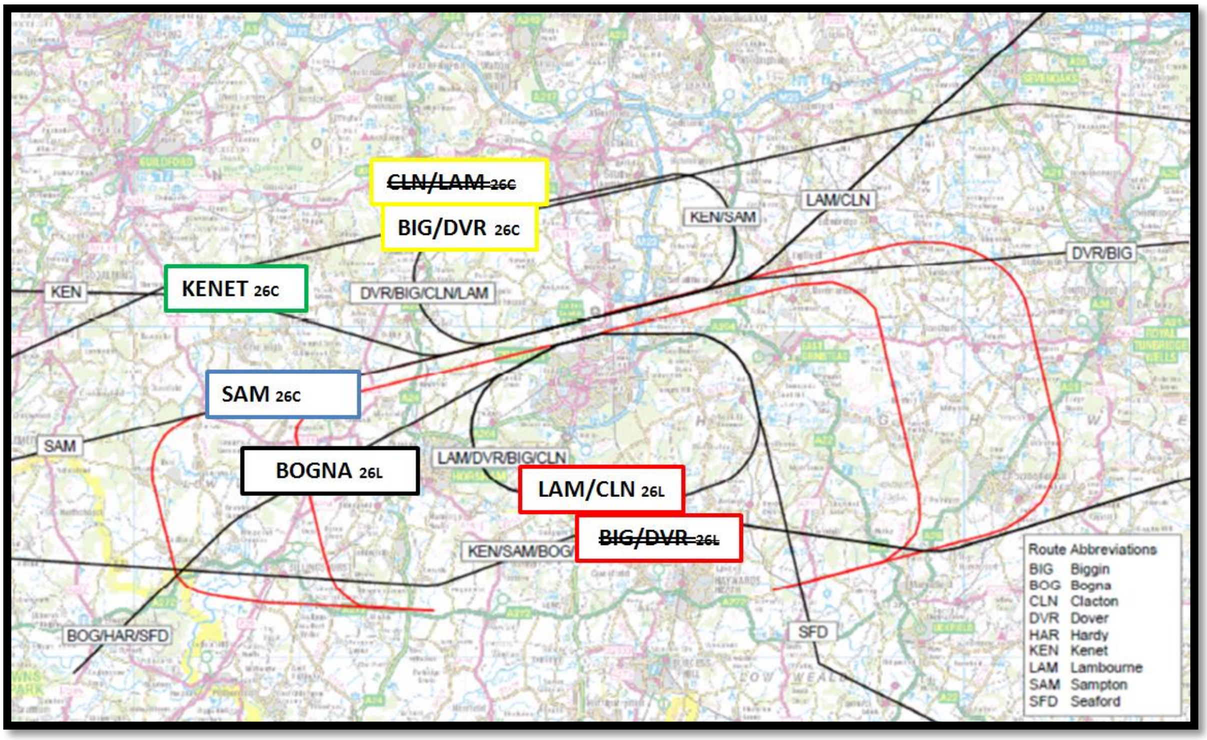



Figure 16 – Gatwick Airport Second Runway: Departure Path Assumptions during Westerly Runway Operations[18]

Table 10 and Table 11 show the departure intervals necessary for successive departures from runways 26C and 26L respectively (during Westerly runway operations), in the Gatwick Airport Second Runway proposal for the mode of operation modelled.

[18] Crown Copyright and Database Rights 2014. Reproduced with data from Annex 3 'NATS input to Module 14, Operational Efficiency' (Ref 2)

| Leading Aircraft SID | BIG | DVR | KENET | SAM |
|---|---|---|---|---|
| **Subsequent Aircraft SID** | | | | |
| **BIG** | 3 min | 2 min | 1 min | 1 min |
| **DVR** | 3 min | 2 min | 1 min | 1 min |
| **KENET** | 1 min | 1 min | 2 min | 2 min |
| **SAM** | 1 min | 1 min | 2 min | 2 min |

Table 10 - Minimum Time-Based Separation for Successive Departures from Gatwick; Runway 26C

As the Gatwick Biggin (BIG) SID is only used for positioning traffic operating between Gatwick and either Heathrow or Northolt, and that such traffic was not present in the model, no traffic was subject to the BIG departure separation criteria.

| Leading Aircraft SID | BOGNA | CLN | LAM |
|---|---|---|---|
| **Subsequent Aircraft SID** | | | |
| **BOGNA** | 2 min | 1 min | 1 min |
| **CLN** | 1 min | 2 min | 2 min |
| **LAM** | 1 min | 2 min | 2 min |

Table 11 - Minimum Time-Based Separation for Successive Departures from Gatwick; Runway 26L

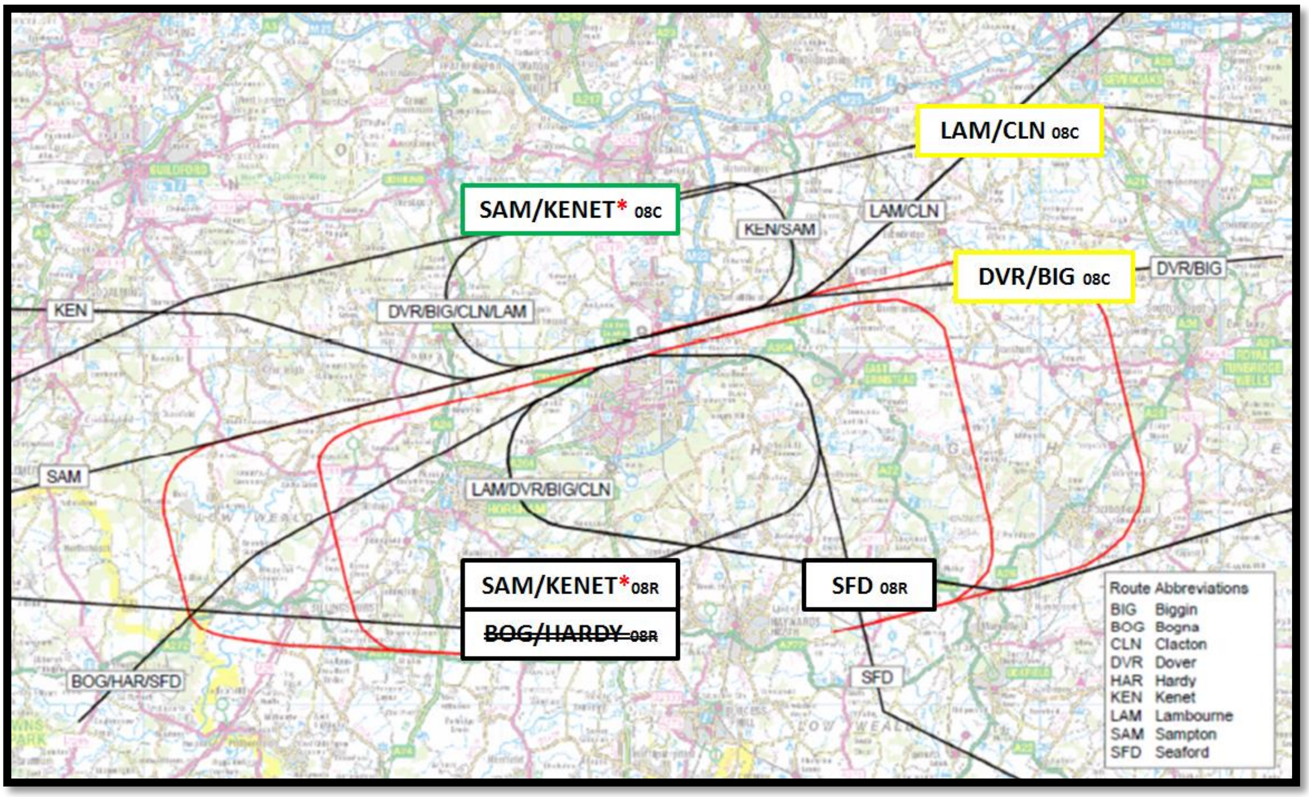



Figure 17 – Gatwick Airport Second Runway: Departure Path Assumptions during Easterly Runway Operations[19]

Table 12 to Table 14 show the departure intervals necessary for successive departures from runways 08C and 08R respectively (during Easterly runway operations) , in the Gatwick Airport Second Runway proposal for the mode of operation modelled.

[19] Crown Copyright and Database Rights 2014. Reproduced with data from Annex 3 'NATS input to Module 14, Operational Efficiency' (Ref 2)

| Leading Aircraft SID | BIG | CLN | DVR | KEN | LAM | SAM |
|---|---|---|---|---|---|---|
| Subsequent Aircraft SID | | | | | | |
| BIG | 3 min | 2 min | 2 min | 1 min | 2 min | 1 min |
| CLN | 3 min | 2 min | 2 min | 1 min | 2 min | 1 min |
| DVR | 3 min | 2 min | 2 min | 1 min | 2 min | 1 min |
| KEN | 1 min | 1 min | 1 min | 2 min | 1 min | 2 min |
| LAM | 3 min | 2 min | 2 min | 1 min | 2 min | 1 min |
| SAM | 1 min | 1 min | 1 min | 2 min | 1 min | 2 min |

Table 12 - Minimum Time-Based Separation for Successive Departures from Gatwick; Runway 08C

As the Gatwick Biggin (BIG) SID is only used for positioning traffic operating between Gatwick and either Heathrow or Northolt, and that such traffic was not present in the model, no traffic was subject to the BIG departure separation criteria.

| Leading Aircraft SID | SAM | SFD |
|---|---|---|
| Subsequent Aircraft SID | | |
| SAM | 2 min | 2 min |
| SFD | 2 min | 2 min |

Table 13 - Minimum Time-Based Separation for Successive Departures from Gatwick; Runway 08R

Whilst the SAM and KENET departures from runways 08C and 08R were assumed to have separate NPRs, due to the limited distance from take-off until reaching SAM and KENET, together with the airspace restrictions present in both areas, additional restrictions were assumed for such departures, regardless of departure runway.

| Leading Aircraft SID | SAM 08C | SAM 08R | KENET 08C |
|---|---|---|---|
| Subsequent Aircraft SID | | | |
| SAM 08C | 2 min | 2 min | 2 min |
| SAM 08R | 2 min | 2 min | 2 min |
| KENET 08C | 2 min | 2 min | 2 min |

Table 14 - Minimum Time-Based Separation for Successive Departures from Gatwick; Runway 08R and 08C SID Groups

The separation matrices above show the minimum intervals between successive departures; additional criteria were applied in the fast time models depending upon the speeds of each aircraft. These are described in Section 5.

The assumptions made in this report are consistent between the Heathrow Airport North West Runway and Heathrow Airport Northern Runway Extension proposals. However, owing to the difference in geographical location and number of runways involved it is not possible to apply exactly the same assumptions to the Gatwick Airport Second Runway proposal.

In the Gatwick Airport Second Runway proposal the departure route options vary considerably depending on whether the runway operation is Easterly or Westerly which made it more difficult to ascertain how these might be integrated into the network.

The impact of the Gatwick Airport Second Runway proposed departure routes on the LTMA sector loadings are different owing to the sectorisation currently in place in the LTMA. Whereas with Heathrow, departures are split between four LTMA sectors, with Gatwick, they are only handled by three. So in the Westerly configuration it is highly unlikely the LTMA could handle DVR departures from 26L and 26C at the same time although DVR departures from either runway individually are possible as they transit the same LTMA sector. During the Easterly runway operations, the Gatwick Airport Second Runway proposal only includes one DVR route from runway 08C and subsequently scheduling would have to be based around only one DVR route. For these reasons, it was assumed that DVR departures would only depart from runway 26C during Westerly runway operations.

The same issue exists during Easterly runway operations for the SAM and KENET departures albeit with additional complications. SAM and KENET departures from runway 08R would be subject to major limitations in current airspace owing to a confliction between Heathrow MID departures which are held down by the OCK stack. Whilst this could be designed out (via LAMP Phase 2 or subsequent airspace re-designs), in the current airspace configuration the 08R SAM/KENET route is not viable. However, the SAM route has been included in the model (unrestricted by Heathrow MID departures) as without it the Southern runway would have only one departure route during Easterly runway operations. This would otherwise have the potential to hide an impact on the LTMA as it is feasible that alternative departure routes could be developed which would improve the runway throughput. As it is outside the scope of this analysis to re-design any of the departure routes the most appropriate option was to include the SAM route, which had a greater forecast demand than the KENET route.

It is possible the Gatwick Airport Second Runway proposal would intend to use either the 08C or 08R SAM/KENET route but not both at the same time. As a balance and in a bid to ensure the runways did move up to 98/Hr, NATS elected to model the Gatwick Airport

Second Runway proposal as having an Easterly option for SAM/KENET but applied a restriction such that SAM/KENET departures from a different runway needed to depart at least 2 minutes apart.

During Easterly runway operations the Gatwick Airport Second Runway proposal involved a 1 minute departure separation between LAM/CLN and DVR departures. However, the LAM/CLN route from runway 08C heading to the north east would not be viable. As this study does not involve re-designing the airway structures this route was modelled but to take account of this issue, the route was included in the same departure group as the DVR route, thereby increasing the minimum departure separations as per Table 12.

Figure 18 and Figure 19 illustrate the departure routes as modelled. As shown in the latter illustration, the SFD departure route was modelled such that aircraft headed direct to the subsequent waypoint after passing radial 345 at 7NM from SFD, passing close to the SFD waypoint rather than overhead. This approximation was made to ensure the SID terminated at a common point in each simulation regardless of whether a Westerly or Easterly runway operation was simulated. This approximation had no effect on the conclusions drawn during the analysis as the traffic remained within the same sector.

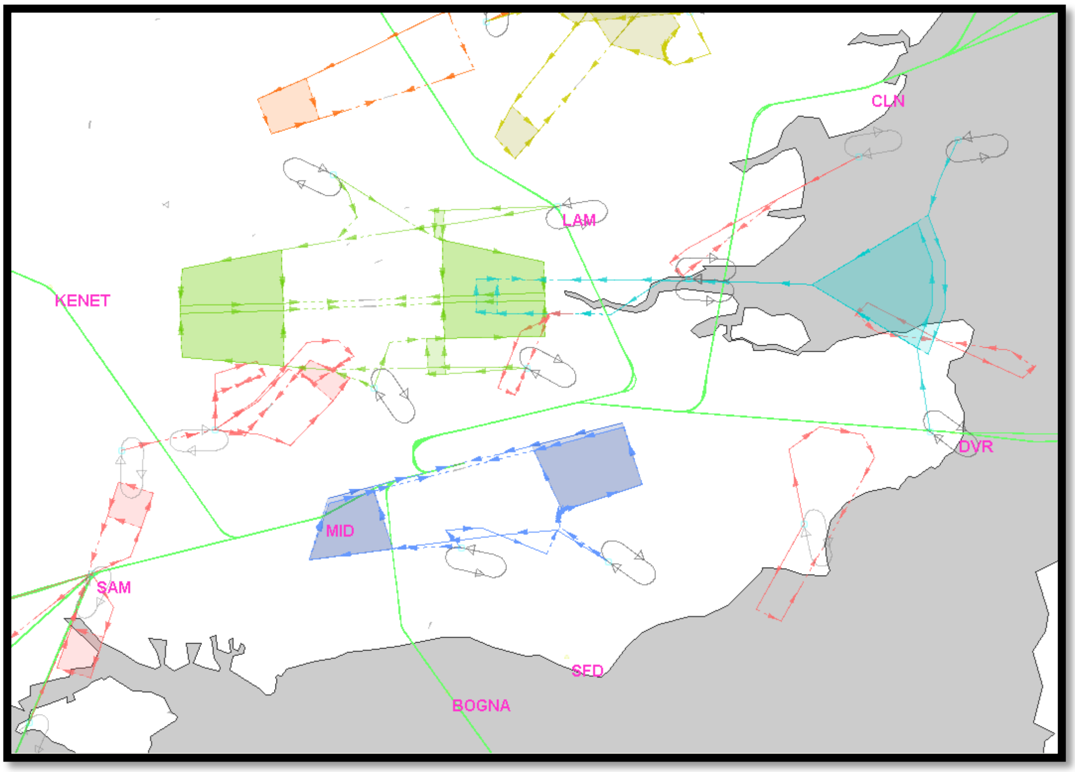



**Figure 18 - Gatwick Airport Second Runway: Gatwick Departure Routes as Modelled (Westerly Runway Operations)**

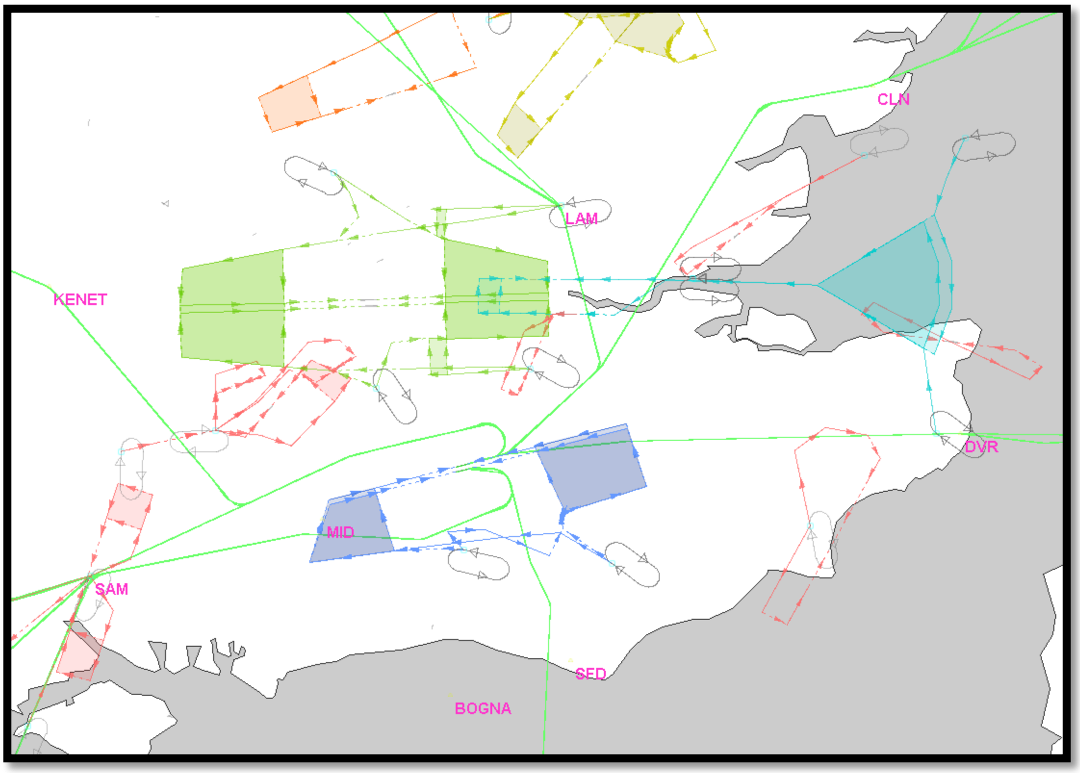



**Figure 19 - Gatwick Airport Second Runway: Gatwick Departure Routes as Modelled (Easterly Runway Operations)**

### 3.3.2. Arrivals

The Gatwick Airport Second Runway proposal shows two clear arrival streams, one to each runway. It has not been possible to demonstrate the delivery of accurate final approach spacing using fixed arrival routes without vectoring onto an ILS or RNAV approach. If further work was unable to validate use of curved approaches during peak hours there would be a reduction in runway capacity.

The limitation of arriving traffic approaching both runways from the South of the airfield only will make an efficient solution, i.e. the ability to deliver CDAs and optimised track mileage, challenging.

# 4. The Do Minimum Scenario

A 'Do Minimum' model was created to provide a comparison scenario, using current airspace and devoid of any airfield developments; the impact of a 2040 forecast traffic demand was then simulated. In order to enable the simulator to function satisfactorily under these conditions, some alterations were necessary on the approach transitions at Heathrow and Gatwick. Specifically it was necessary to increase the volume of the radar manoeuvring areas (RMA) at both airfields to prevent excessive simulation errors due to excessive stack holding.

In order to provide a fair comparison, these changes were made common to all scenarios. Likewise the airspace structure and traffic routings were also common as were the departure routings (SIDs) and separation criteria for those airfields not subject to development in the airfield development proposals.

The 2040 forecast traffic demand was as per the Airports Commission 'Low Cost is King' Carbon Traded forecasts, as described in section 5.2.
A further reference simulation with 2013 traffic demand was conducted by excluding any grown flights from the 2040 sample; this was used to assist in the sector occupancy comparisons.

As such the principal differences between the Do Minimum 2040 and proposal scenarios were the transitions to the new runways, SIDs and connectivity of these into the airspace network together with the forecast traffic demand, including variations in demand for surrounding airfields.

It was assumed that both runways at Heathrow operated independently.

## 4.1. Departures

Table 15 through to Table 18 show the minimum departure intervals necessary for successive departures from runways 08R and 26L at Gatwick and 09R and 27L at Heathrow, as per the current operation. These values were applied to the airspace models used in the relevant fast time simulation scenarios, together with application of the minimum separation requirements for aircraft speed groups. Whilst these parameters were used for Heathrow and Gatwick in the Do Minimum scenario, the Heathrow departure separations were also applied in the Gatwick Airport Second Runway scenario and the Gatwick departure separations applied in the Heathrow Airport North West Runway and Heathrow Airport Northern Runway Extension scenarios.

| Leading Aircraft SID | BIG | CLN | DVR | KEN | LAM | SAM | SFD |
|---|---|---|---|---|---|---|---|
| Subsequent Aircraft SID | | | | | | | |
| **BIG** | 3 min | 2 min | 2 min | 1 min | 2 min | 1 min | 1 min |
| **CLN** | 3 min | 2 min | 2 min | 1 min | 1 min | 1 min | 1 min |
| **DVR** | 3 min | 2 min | 2 min | 1 min | 1 min | 1 min | 1 min |
| **KEN** | 1 min | 1 min | 1 min | 2 min | 1 min | 2 min | 1 min |
| **LAM** | 3 min | 2 min | 2 min | 2 min | 2 min | 2 min | 1 min |
| **SAM** | 1 min | 1 min | 1 min | 2 min | 1 min | 2 min | 1 min |
| **SFD** | 1 min | 1 min | 1 min | 1 min | 1 min | 1 min | 2 min |

Table 15 - Minimum Time-Based Separation for Successive Departures from Gatwick; Runway 08R

| Leading Aircraft SID | BIG | BOG | CLN | DVR | KEN | LAM | SAM |
|---|---|---|---|---|---|---|---|
| Subsequent Aircraft SID | | | | | | | |
| **BIG** | 3 min | 1 min | 2 min | 2 min | 1 min | 2 min | 1 min |
| **BOG** | 2 min | 2 min | 1 min | 1 min | 2 min | 1 min | 2 min |
| **CLN** | 3 min | 1 min | 2 min | 2 min | 1 min | 2 min | 1 min |
| **DVR** | 3 min | 1 min | 2 min | 2 min | 1 min | 2 min | 1 min |
| **KEN** | 2 min | 2 min | 1 min | 1 min | 2 min | 1 min | 2 min |
| **LAM** | 3 min | 1 min | 2 min | 2 min | 1 min | 2 min | 1 min |
| **SAM** | 2 min | 2 min | 1 min | 1 min | 2 min | 1 min | 2 min |

Table 16 - Minimum Time-Based Separation for Successive Departures from Gatwick; Runway 26L

As the Gatwick Biggin (BIG) SID is only used for positioning traffic operating between Gatwick and either Heathrow or Northolt, and that such traffic was not present in the model, no traffic was subject to the BIG departure separation criteria.

| Leading Aircraft SID | BPK | BUZ | CPT | DET | DVR | MAY | MID | SAM | WOB |
|---|---|---|---|---|---|---|---|---|---|
| Subsequent Aircraft SID | | | | | | | | | |
| **BPK** | 2 min | 2 min | 1 min | 1 min | 1 min | 1 min | 1 min | 1 min | 2 min |
| **BUZ** | 2 min | 2 min | 1 min | 1 min | 1 min | 1 min | 1 min | 1 min | 2 min |
| **CPT** | 1 min | 1 min | 2 min | 2 min | 2 min | 2 min | 2 min | 2 min | 1 min |
| **DET** | 1 min | 1 min | 2 min | 2 min | 2 min | 2 min | 2 min | 2 min | 1 min |
| **DVR** | 1 min | 1 min | 2 min | 2 min | 2 min | 2 min | 2 min | 2 min | 1 min |
| **MAY** | 1 min | 1 min | 2 min | 2 min | 2 min | 2 min | 2 min | 2 min | 1 min |
| **MID** | 1 min | 1 min | 2 min | 2 min | 2 min | 2 min | 2 min | 2 min | 1 min |
| **SAM** | 1 min | 1 min | 2 min | 2 min | 2 min | 2 min | 2 min | 2 min | 1 min |
| **WOB** | 2 min | 2 min | 1 min | 1 min | 1 min | 1 min | 1 min | 1 min | 2 min |

Table 17 - Minimum Time-Based Separation for Successive Departures from Heathrow; Runway 09R

| Leading Aircraft SID | BPK | BUZ | CPT | DET | DVR | MAY | MID | SAM | WOB |
|---|---|---|---|---|---|---|---|---|---|
| Subsequent Aircraft SID | | | | | | | | | |
| **BPK** | 2 min | 2 min | 1 min | 1 min | 1 min | 1 min | 1 min | 1 min | 2 min |
| **BUZ** | 2 min | 2 min | 1 min | 1 min | 1 min | 1 min | 1 min | 1 min | 2 min |
| **CPT** | 1 min | 1 min | 2 min | 1 min | 1 min | 1 min | 2 min | 2 min | 1 min |
| **DET** | 1 min | 1 min | 1 min | 2 min | 2 min | 2 min | 2 min | 1 min | 1 min |
| **DVR** | 1 min | 1 min | 1 min | 2 min | 2 min | 2 min | 2 min | 1 min | 1 min |
| **MAY** | 1 min | 1 min | 1 min | 2 min | 2 min | 2 min | 2 min | 1 min | 1 min |
| **MID** | 1 min | 1 min | 2 min | 2 min | 2 min | 2 min | 2 min | 2 min | 1 min |
| **SAM** | 1 min | 1 min | 2 min | 1 min | 1 min | 1 min | 2 min | 2 min | 1 min |
| **WOB** | 2 min | 2 min | 1 min | 1 min | 1 min | 1 min | 1 min | 1 min | 2 min |

Table 18 - Minimum Time-Based Separation for Successive Departures from Heathrow; Runway 27L

The separation matrices above show the minimum intervals between successive departures; additional criteria were applied in the fast time models depending upon the speeds of each aircraft. These are described in Section 5.

## 4.2. Arrivals

The arrival transitions and separation criteria remained as per current airspace, with the exception of the increased volume of the radar manoeuvring areas (RMA) at both Heathrow and Gatwick as described above.

# 5. Methodology

The Fast Time Simulations utilised an airspace model constructed to represent the London TMA and surrounding Area Control Sectors for the LAMP Phase 1A airspace. This model was composed of a variety of airspace entities and ATM procedures, including but not limited to; sector definitions, stack holds, departure procedures, arrival transitions, separation standards and coordination agreements.

Application of the relevant airport development scenarios to individual airspace models was made for each of the three scenarios. A fourth scenario without these airport developments was also used to act as a reference model, "Do Minimum". The models were built to a sufficient level of fidelity to ensure valid conclusions could be drawn from analysis of the data generated. Detailed modelling assumptions can be found in Appendix A together with scenario specific assumptions, including the modes of runway operation, in Appendix B.

Traffic samples were applied to each of these models, with demand grown to the 2040 forecasts, as supplied by the Airports Commission. Different forecasts were applicable for each proposal and therefore each model used a different sample of traffic. A 2013 traffic sample was also simulated for the Do Minimum scenario to provide additional context for the sector occupancy metrics.

The analysis emanating from this study was therefore dependent upon both the direct physical impact of each proposal and indirect impacts each proposal was expected to have via the influences on traffic demand.

## 5.1. Airspace Models

Where possible the parameters applied were common to each model to reduce the effects of unrelated variables on the subsequent analysis. Where each proposal differed, as described in section 3 above, the associated parameters were tailored to include these variations. Principally these parameters were associated with the location of runways, arrival transitions, departure SIDs and their linkages to the airway system, associated departure separation criteria and the relevant modes of runway operation.

As a requirement of the analysis was that each proposal used independent runway operations and the focus of the assessments was on the airspace network impacts, the exact location of the runways was not required. For this reason, the location of the proposed runways in the model was approximated from the scheme information available and the location of the existing runways.

Similarly, the arrival transitions, which began at the same location as the current arrival transitions, were approximated based upon the proposal information provided and the requirement to include CDAs where practical. The principal differences affected the location of the final approach structures owing to the presence of the new runways.

Due to excessive arrival demand at each of the proposed airfield developments, it was necessary to increase the volume of the radar manoeuvring areas (RMA) at Heathrow and Gatwick within each model to prevent excessive simulation errors; however these changes were made common to each model.

The SID routings were modelled using the coordinate information provided and was understood to be the same as used in the external Noise Assessments. Limited speed and vertical constraints were applied to these SIDs based on NATS ATCO judgement for the purpose of ensuring separation from neighbouring traffic flows;  continuous climb departures were modelled where and when possible. NATS ATCO judgement was also used to provide the linkages between the SIDs termination points and the current airway system.
The SID separations applied were as described in section 3 above. The departure intervals were however the greater of both these SID separations and the aircraft speed groups. The aircraft speed groups are to prevent the loss of separation caused by an aircraft with a speed greater than that of a preceding aircraft operating on the same departure route.

The aircraft speed groups were common to each model, however they were only applicable to traffic departing on the same route as the preceding aircraft. Furthermore, as the departure runways in the proposed airfield development scenario were treated as independent, these speed groups were only applicable when the two departures used the same runway.

Note that Heathrow operated with one departure runway in the 'Do Minimum' and Gatwick Airport Second Runway scenarios.

To maximise runway capacity, the order in which aircraft depart is usual optimised to take account of the departure intervals; this has secondary effects on the airspace. To capture this optimisation within the simulations a parameter was specified to allow each aircraft, queuing to use the departure runway, the chance to jump to the front of the queue if they had waited more than 10 minutes. As ground infrastructure was not modelled this optimisation ignored the airfield layout, specifically the physical ability of such aircraft to access the runway due to the presence of other aircraft. On reaching the front of the queue, they were treated as ready to depart and appear lined-up on the runway.

As per the restrictions imposed upon the Terminal Controller prior to 4NM DME, the standard arrival separations were applied using the greater of either the minimum radar separation of 3NM or the arrival Wake Turbulence Separation Minima (specified by distance) as described in Table 19.

For runways operating in mixed-mode at Heathrow, Gatwick, Stansted and Luton, arrival aircraft took priority over departing aircraft. When a departure queue of at least one aircraft (for a specific runway) existed, a gap was created in the arrival stream, to enable the departure to become airborne. This in effect increased the arrival separation minima to 6NM for one pair of arriving aircraft.

| Following Aircraft: / Leading Aircraft | Super | Heavy | Upper Medium | Medium | Small | Light |
|---|---|---|---|---|---|---|
| **Super** | 4 | 6 | 7 | 7 | 7 | 8 |
| **Heavy** | 4 | 4 | 5 | 5 | 6 | 7 |
| **Upper Medium** | 0 | 0 | 3 | 4 | 4 | 6 |
| **Medium** | 0 | 0 | 0 | 0 | 3 | 5 |
| **Small** | 0 | 0 | 0 | 0 | 3 | 4 |
| **Light** | 0 | 0 | 0 | 0 | 0 | 0 |

Table 19 - NATS Wake Turbulence Separation Minima for Arriving Aircraft[20]

Note, the clear weather, no-wind assumption meant that these distance-based separations were the same as the equivalent time-based separations.

## 5.2. Traffic Samples

Traffic samples (with associated routings) tailored to the forecast future demand in 2040 for each of the proposals and representing the expected traffic flows within the LAMP Phase 1A environment were then simulated in each of the models. 2040 was chosen as this is the year when all scheme proposals were expected to have reached 'peak' capacity. The aim of the modelling was to stress-test the capacity of the LTMA.

The traffic samples were created by applying forecast traffic demand for each scenario to a sample of flightplans that occurred on a peak traffic day in 2013. In order to identify a suitable date, a full year of flightplan data was analysed; the most recently available set of data covered the year 2013; this analysis can be found in Appendix D. The number of movements for the whole of 2013 was also used to create a baseline from which to 'grow' the traffic to the forecast levels. The chosen peak traffic date for which flightplans were extracted was 5th July 2013.

The traffic forecasts used were category dependent as requested by the Airports Commission Secretariat:

- For movements at UK airfields, excluding the expanded airports in their respective scenarios, the 2040, 'Low Cost Is King' Carbon Traded Airports Commission forecasts were used.
- For movements at the expanded airports in their respective scenarios, the number of movements in each traffic sample aligned with the schedules created for 'Noise: Local Assessment' (Ref 5) provided.
- For over-flights (flights in UK airspace which neither depart nor arrive at a UK airfield) it was agreed with the Airports Commission Secretariat that a 2% year on year growth was a reasonable assumption to be applied up to the year 2040 followed by a 10% reduction of this total figure in 2040 to reflect a degree of market maturity. This category was used as the 'Low Cost Is King' Carbon Traded Airports Commission forecasts do not consider such movements.

Application of the annual forecasts to the daily traffic sample was possible by comparing total actual movements from 2013 with the relevant forecast movements on an airfield / region-pair basis. A maximum growth rate of 2500% (i.e. each flight in the 2013 sample became a maximum of 25 flights in the resulting 2040 sample) was applied to avoid the potential for unrealistic numbers of flights in the single day traffic sample, where a large traffic growth was predicted over the year. Identification of flights that were forecast on an airfield / region-pair basis in 2040 but not present in the 2013 sample, was performed during post-growth analysis, as detailed in Appendix E. In these cases, the number of flights added to the sample was equal to the number of forecast flights (per year) divided by the number of operating days per year where the resulting value was greater than one. Any movements between airfield / region-pairs that were forecast to decline were correspondingly reduced.

For example, if there were 300 movements between Airport A and the Canary Islands in 2013, and 600 forecast in 2040, then the growth rate was 200%. Subsequently a selection of the original 300 flightplans were cloned to provide double the number of flights operating between Airport A and the Canary Islands compared to the 2013 base sample. However, if movements between Airport A and the Canary Islands went from 300 in 2013 to a forecast of 150 in 2040, the growth rate was 50% and a selection of the original 300 flightplans were removed to provide half the number of flights operating between Airport A and the Canary Islands compared to the 2013 base sample.

[20] Heathrow MATS Part 2, Ed 2.14 and Gatwick MATS Part 2, Ed. 2.14

The traffic samples also took account of changes to the mix of different aircraft types forecast, i.e. the fleet mix, at the expanded airfields. These used the fleet mix (categorised by the Airports Commission aircraft groups) contained in the schedules provided from 'Noise: Local Assessment' (Ref 5). Future aircraft types were not modelled due to the lack of aircraft performance data available. However, suitable existing aircraft types were used to adhere to these aircraft type groups and take into account any changes in the distribution of wake turbulence categories and aircraft speed categories, which would affect arrival and departure spacing.

Cognisance was also paid to the requested flight level (RFL) associated with each flightplan. RFLs vary due to different airline flight planning regimes whilst being particularly influenced by routing and aircraft type. It was not possible to predict a specific RFL for a forecast flight, therefore RFLs were unchanged for flights forecast to use the same aircraft type and routing as a predecessor in the 2013 sample. Where a new aircraft type was forecast on a route, the RFL was set to match that of another in the same aircraft type category on the same route (in the same direction). In the case of a new route, an equivalent route was used. This ensured the distribution of vertical preferences was only affected by the changes in aircraft types and airfield / region-pairs forecast rather than assumptions around changes to the RFL.

Following the application of the forecasts to each traffic sample, runway demand at the expanded airfields was assessed. Where the hourly demand was found to exceed the hourly movement limits, as specified in Table 20, grown flights were moved into hours where this limit had not been reached. Similarly, in line with the assumption that the number of night time flight would not increase, any grown flights which had been forecast to occur during periods of night time restrictions were moved into non-restricted periods, cognisant of the hourly movement limits.

| Scenario | Gatwick | Heathrow |
|---|---|---|
| **'Do Minimum'** | 55 per hour | 85 per hour |
| **Gatwick Airport Second Runway** | 98 per hour | 85 per hour (as per Do Min) |
| **Heathrow Airport North West Runway** | 55 per hour (as per Do Min) | 128 per hour |
| **Heathrow Airport Northern Runway Extension** | 55 per hour (as per Do Min) | 130 per hour |

Table 20 - Runway Demand Limits (Movements per Hour)

Further details on the assumptions relating to the traffic samples can be found in Appendix C and details of the flightplan demand modelled can be found in Appendix F.

For each model, the traffic samples were simulated twice; once in which each airfield operated with a Westerly runway operation and a second in which each operated with an Easterly runway operation. Assessment of situations in which airfields operated with counter flows, i.e. one airfield operating with a Westerly runway operation and another airfield with an Easterly runway operation or vice-versa, did not form part of the requirement. This was decided based on additional analysis showing the infrequency of counter flows occurring at the largest London Airfields; this analysis can be found in Appendix G.

## 5.3. Data Generation

Data generated by the model was recorded and analysed. This data related to the aspects of the airspace being studied; such data included sector entry and exit events, stack holding use and trajectory locations.

The sector demand was recorded for each event triggered for the LAMP Phase 1A London Terminal Control Sectors and adjacent area control centres, covering:
Area Control Sectors, 1, 2, 12 to 26, 28, 34 and combined Sectors 27 & 32.
Terminal Control Sectors, Biggin, Compton, Cowly, Dagga, Godlu, Jacko, Lambourne, Lorel, North East Deps, North West Deps, Ockham, Redfa, Saber, South West Deps, Timba, Vaton, Welin and Willo.

Stack holding use was recorded and analysed for Gatwick holding stacks Timba (TIMBA) and Willo (WILLO) and Heathrow holding stacks Biggin Hill (BIG), Bovingdon (BNN), Lambourne (LAM) and Ockam (OCK).

Trajectory information was recorded for each flight from its initial creation in the simulation until its removal.

Due to the complex nature of the LTMA and the variable complexity associated with different traffic interactions, interpretation of the data is reliant upon expert controller knowledge. This knowledge was provided by the same, currently operational, controller for each of the scenarios. This controller also has extensive experience of current and future operational concepts and of the LAMP Phase 1A airspace used in the model. Sector throughput, stack holding and track distance metrics for each scenario were interpreted with a comparison against both the 2040 and 2013 traffic demand in the 'Do Minimum' scenario.

# 6. Analysis of Do Minimum Scenario in 2040:

The Do Minimum scenario simulation output demonstrated that nearly all the sectors modelled will be under substantial increases in demand, beyond their current capacities. Assuming that the sector configuration and route interaction remained constant based on the schedules and traffic forecasts modelled, all 39 sectors modelled in this scenario will require at least a doubling of sector capacity to handle the peak flows through those sectors by 2040. Without this increase in sector capacity there would be a resulting impact upon traffic delays.

Some AC sectors, namely Daventry (DTY): Sectors 28 and 34, London Upper Sector (LUS): Sectors 1 and 2, Worthing (WOR): Sector 22 may require a tripling of capacity at peak times.

Interestingly, this scenario demonstrated that demand in some sectors was significantly higher in the Do Minimum scenario compared to the expanded airport scenarios. Namely, London Middle Sector (LMS): Sector 26, LUS: Sector 2, Brecon (BCN): Sector 23, WOR: Sector 19 and TC Midlands (TC MIDS): COWLY and WELIN all show higher demand in the Do Minimum scenario than any other. The comparative demand for Sector 26 can be seen in Figure 20 below.

On investigation, this was due to the higher forecasted demand for regional airfields and some London airfields when a new runway is not made available at Heathrow or Gatwick.

Birmingham, East Midlands, Coventry, Bristol, Southampton and Southend all experience higher traffic demand in the 2040 Do Minimum scenario than compared to the forecast demand for any of the expanded airport scenarios. Table 21 shows that in the 2040 Do Minimum forecast, the annual traffic demand on these 6 regional airfields increases from approximately 0.6m ATMs per year in 2013 to 1.1m ATMs per year in 2040. Our London FIR Network is currently configured around the bigger LTMA airfields, such as Heathrow and Gatwick. When the forecast 2040 demand at the smaller, regional airfields is modelled the requirement for additional capacity on the sectors mentioned above becomes apparent.

| | | Do Minimum | Gatwick Airport Second Runway | Heathrow Airport North West Runway | Heathrow Airport Northern Runway Extension |
|---|---|---|---|---|---|
| 2040 forecasted ATMs | Birmingham | 206,496 | 187,503 | 171,858 | 181,021 |
| | East Midlands | 110,060 | 106,367 | 81,902 | 82,673 |
| | Coventry | 28,935 | 131 | 131 | 131 |
| | Bristol | 106,192 | 101,511 | 86,086 | 85,501 |
| | Southampton | 120,439 | 105,603 | 68,430 | 81,090 |
| | Bournemouth | 53,040 | 57,929 | 39,860 | 37,759 |
| | Southend | 35,754 | 32,565 | 20,180 | 20,524 |
| | **Total** | **660,916** | **591,609** | **468,447** | **488,699** |
| **Difference from Do Minimum** | Total ATMs in 2040 | - | 69,307 | 192,469 | 172,217 |
| | ATMs per day[21] | - | 190 | 527 | 472 |

**Table 21 - Forecast ATMs at selected regional airfields in 2040 as per the Airports Commission 2040 'Low Cost is King' Carbon Traded forecasts**

Note: The traffic demand forecasts provided suggest that in the Do Minimum scenario, Coventry airport attracts approximately 29,000 ATMs in 2040. In the expanded airport scenarios, there is no forecasted growth at Coventry and the traffic levels at the airport remain negligible.

Figure 20 shows the rolling sector occupancy for Sector 26 in all scenarios. The brown line shows higher sector demand in the Do Minimum scenario than in any of the expanded airport scenarios. The highest demand on the sector with 2013 traffic levels is 31 flights in an hour. In the Do Minimum scenario, this increases to 83 in an hour - nearly three times as many. S26 is a sector which currently doesn't handle Gatwick or Heathrow traffic. The impact of Do Minimum on this sector is due to the growth of the regional airfields, especially Birmingham, East Midlands, Coventry and Bristol which is lower in the other scenarios. The red line shows the

[21] Assuming uniform distribution of demand across 365 days

Monitoring Value (MV) for the sector. As the capacity of a sector depends not only on the number of aircraft in the sector but also on the complexity of the traffic situation, an occupancy count above the monitoring value does *not* indicate that the sector is overloaded but can be used as a simple indication that the workload *may* be close to exceeding capacity.

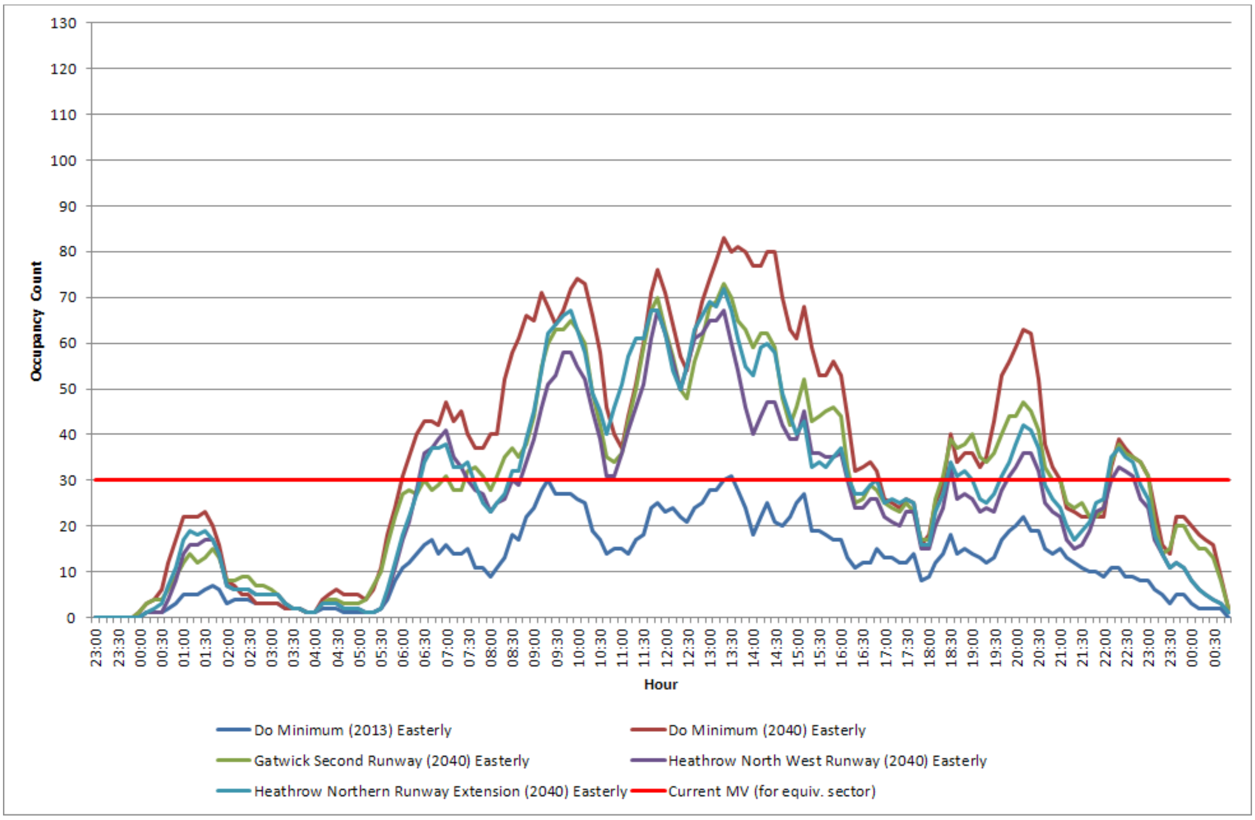



**Figure 20 - Sector Occupancy for Sector 26, all scenarios (Easterly Runway Operations)**

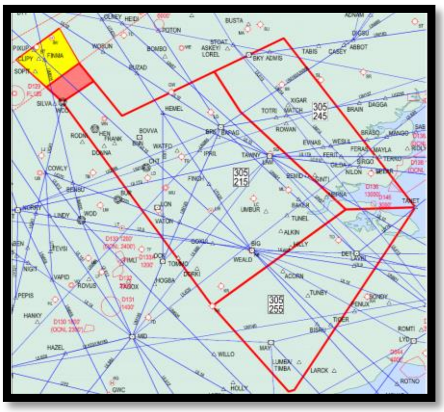


**Figure 21 - Sector 26 Illustration**

If nothing were to change in the airspace design or the way air traffic is managed, the impact would be considerable with restrictions and delays applied to most flights in order to maintain the high safety standards which are non-negotiable in the UK operation.

It should be noted that the simulations were based on procedural operations; tactical interventions could offer some assistance in reducing holding demand, such as through the use of 'stack-swapping' as well as en-route holding. In practice the amount of stack holding observed in the simulations would not be experienced in individual stacks due to the application of these tactical mitigations. However, the following stack holding data has been included to provide an indication of issues relating to excessive arrival demand for each arrival flow.

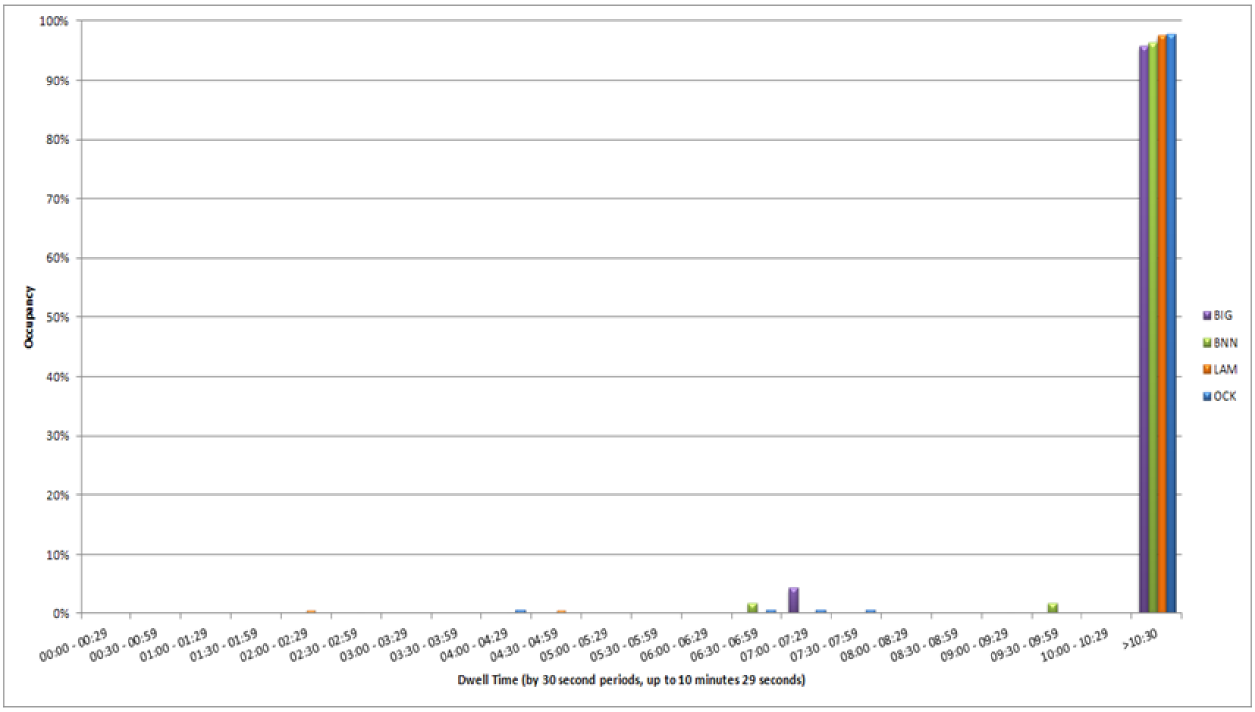



Figure 22 - Stack Holding Dwell Times per stack [for aircraft that held] - Heathrow, Westerly Runway Operations

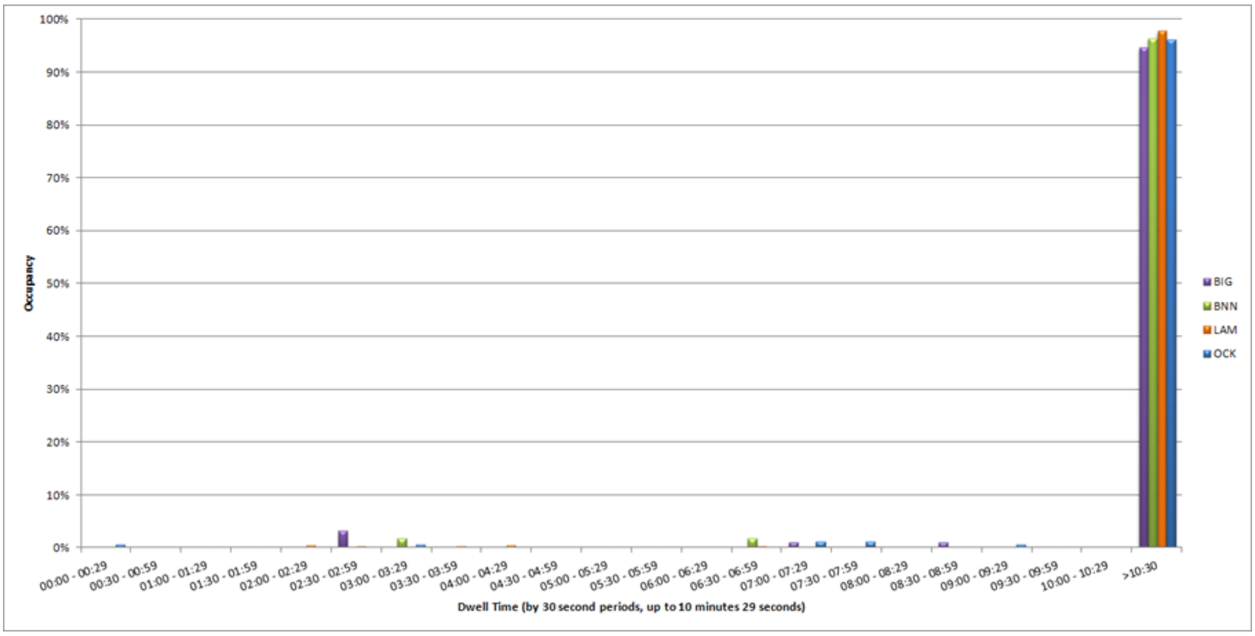



Figure 23 - Stack Holding Dwell Times per stack [for aircraft that held] - Heathrow, Easterly Runway Operations

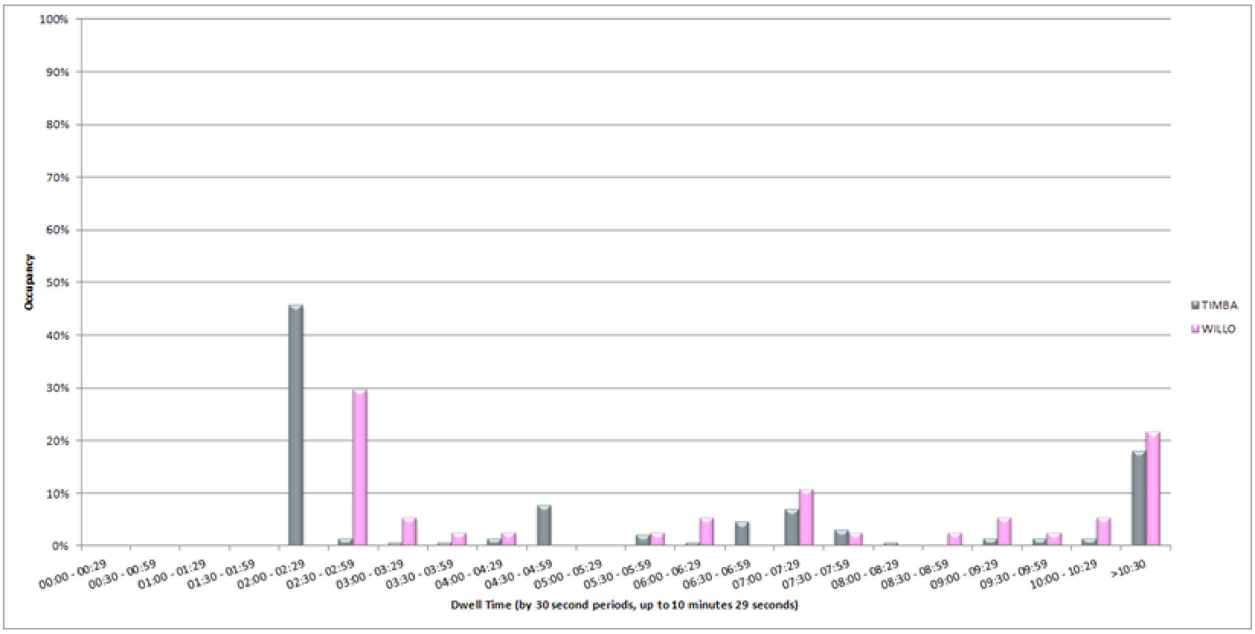



Figure 24 - Stack Holding Dwell Times per stack [for aircraft that held] - Gatwick, Westerly Runway Operations

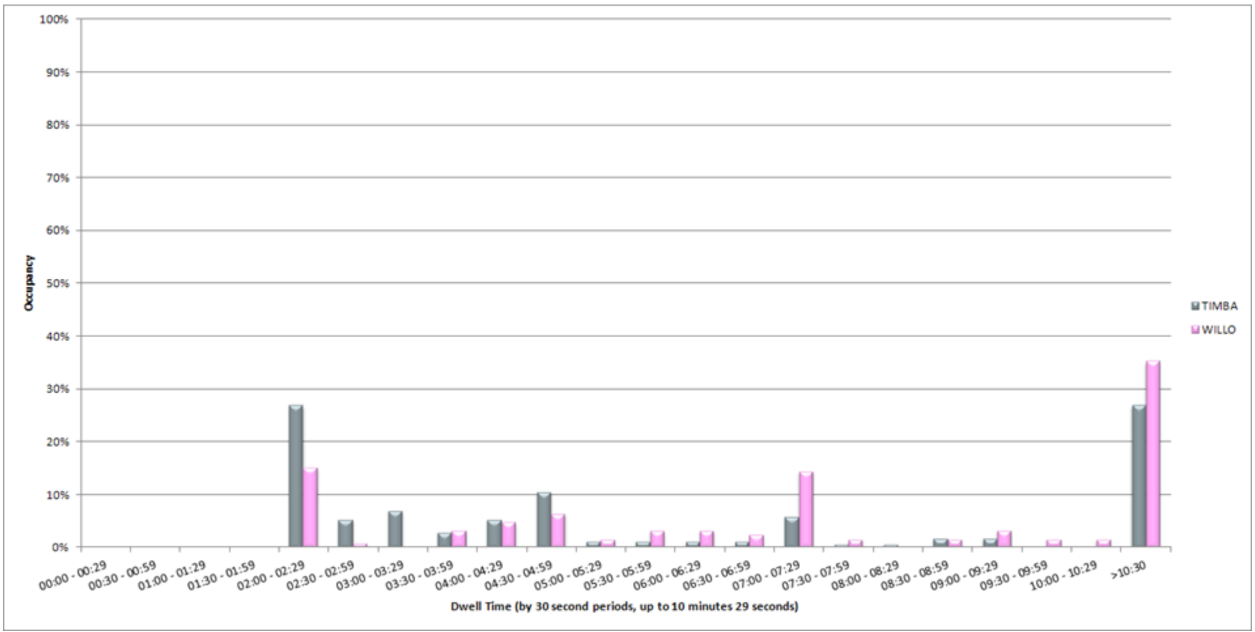



Figure 25 - Stack Holding Dwell Times per stack [for aircraft that held] - Gatwick, Easterly Runway Operations

It is important to appreciate that these results assume the approach structures were capable of serving the demand in a safe and effective manner; loses of separations, airfield ground modelling, the inclusion of missed approaches and other situations have not been considered in the model and thus not reflected in these holding distributions. Similarly, whilst the RMAs have been made common to each scenario, they have nonetheless been approximated based on the information available and further extended to reduce simulation errors. The size of these areas has an impact upon the stack holding demand as it provides an additional portion of the arrival transition for absorbing delay, and thus affects the above distributions.

Whilst it is not possible to quote these figures with certainty, due to the lack of fidelity in this aspect of the modelling, they are nonetheless an indication of a requirement to absorb delay through means other than stack holding, e.g. schedule planning and technology such as AMAN. These also serve to illustrate the large demand on the airspace that is required to feed these holds.

As indicated by the Hold Dwell Times in Figure 22 and Figure 23, in the Do Minimum scenario for Heathrow arrivals, the overwhelming majority of aircraft had to hold for an excessive period of time (at least 10 minutes 30 seconds) due to demand far surpassing the available capacity. This was despite a lessening of the vertical constraints on the transitions and increases in the RMAs (applied to all scenarios) to overcome initial simulation errors associated with the excessive demand. The continuous nature of the high traffic demand forecast, unbalanced with respect to the four holding stacks, also contributed to these results as this prevented instances of 'firebreaks' which may have allowed periods of excess demand on one hold to recover, so as to lessen the overall impact across the day. This illustrates a lack of resilience and the acute consequences that can occur when operating at a continuously high level of demand.

As indicated by the Hold Dwell Times in Figure 24 and Figure 25 in the Do Minimum scenario for Gatwick arrivals, there were occasions when a number of aircraft were holding in excess of 10 minutes 30 seconds, indicating demand in excess of available capacity. Considering that the impact upon controller workload associated with these movements, which may be a limiting factor, has been ignored in the simulations, these observations suggests that the increased traffic demand (as per the forecast data) would necessitate changes to the operation and schedules.

As such both sets of figures illustrate, with the forecast traffic demand assumed, there would be a need to be modifications made to the current environment to avoid excessive delay.

The results also indicate that stack holding times are more consistent during Easterly runway operations than during Westerly runway operations together with a lower average dwell time. This is a consequence of the assumptions that multiple levels could be used on the transitions, therefore the increased track mileage to final approaches during Easterly runway operations which led to an increase in the potential to separate aircraft during the downwind approach transitions.

## 6.1. Potential mitigations required to cater for Do Minimum Growth

These mitigations also apply to the expanded airport scenarios as well as to the Do Minimum scenario. Any additional mitigation for each of the expanded airport scenarios are suggested in the relevant parts of Section 7.

- Technology and automation such as Trajectory Based Operations, Free Route Airspace, Air-Ground Datalink Operations, voice recognition and systemisation.
- Learning from independent parallel approaches which are currently being investigated by NATS.
- Extended use of TEAM and / or mixed-mode operations at Heathrow.
- Deployment of the advanced operational concepts currently under validation by the SESAR Programme.
- Queue Management including cross-border arrival management and techniques and effective scheduling of arrivals.
- Airfield, airlines and NATS working collaboratively to balance the demand across the sectors in a structured, scheduled manner, taking into account compass demand and assigning slots across all airfields' routes more efficiently to enable balanced sector demand.
- Delivery of CAA's Future Airspace Strategy; Airspace and route re-design exploiting advanced avionics such as performance based navigation capabilities.
- Effective coordination with adjacent ANSPs to ensure the effective presentation of traffic at airspace borders.

All of these mitigations are concepts which are currently being delivered (e.g. FAS, Queue Management) or are being researched throughout SESAR therefore already form part of industry's goals.

# 7. Analysis of Each Scheme Proposal's Peak Operating Scenario in 2040:

## 7.1. Heathrow Airport North West Runway proposal

The Heathrow Airport North West Runway Proposal presents particular challenges in terms of low-level route design and route deconfliction. Adding a third runway to the North of Heathrow in close proximity of Northolt, Luton, Stansted and London City will require a complicated airspace re-design.

The Heathrow Airport North West Runway proposal assumes curved approaches, steeper approaches, respite routes and runway alternation which all add layers of complexity to the airspace design and Concept of Operations (CONOPS) required.

No airspace re-design was considered in the proposal modelled in this analysis except for the integration of the proposal routes as detailed in section 3.1. The Heathrow Airport North West Runway scenario Fast Time simulations and their outputs provide sufficient assurance that NATS believe this proposal's additional runway, and the associated effect on traffic levels and flows, could be integrated into the LTMA. In addition, the impact of the proposal on the overall Network is less when compared to the 2040 Do Minimum scenario. However, this must be considered alongside the complexity of the necessary low-level route integration which should not be underestimated.

### 7.1.1. Departures

Any DVR departures to the North East via BPK will be an issue from any Heathrow runway as there is already a very busy traffic flow leaving the LTMA in this direction from Luton, Northolt, Stansted, London City, Southend and of course Heathrow. To get to DVR, the Heathrow flow has to cross the inbound stream to Heathrow from the East along with Luton, Northolt and Stansted departures. Likewise, departures via CPT to the North present an issue as they will need to be integrated with the flow via CPT from Luton, Northolt, Stansted, London City and Southend. This can be seen in the TC NW and TC NE sectors, where the effect of these additional flows adds to demand. This is illustrated in Figure 26 where the purple line shows the increase in sector demand due to the increase in Heathrow departures to the North.

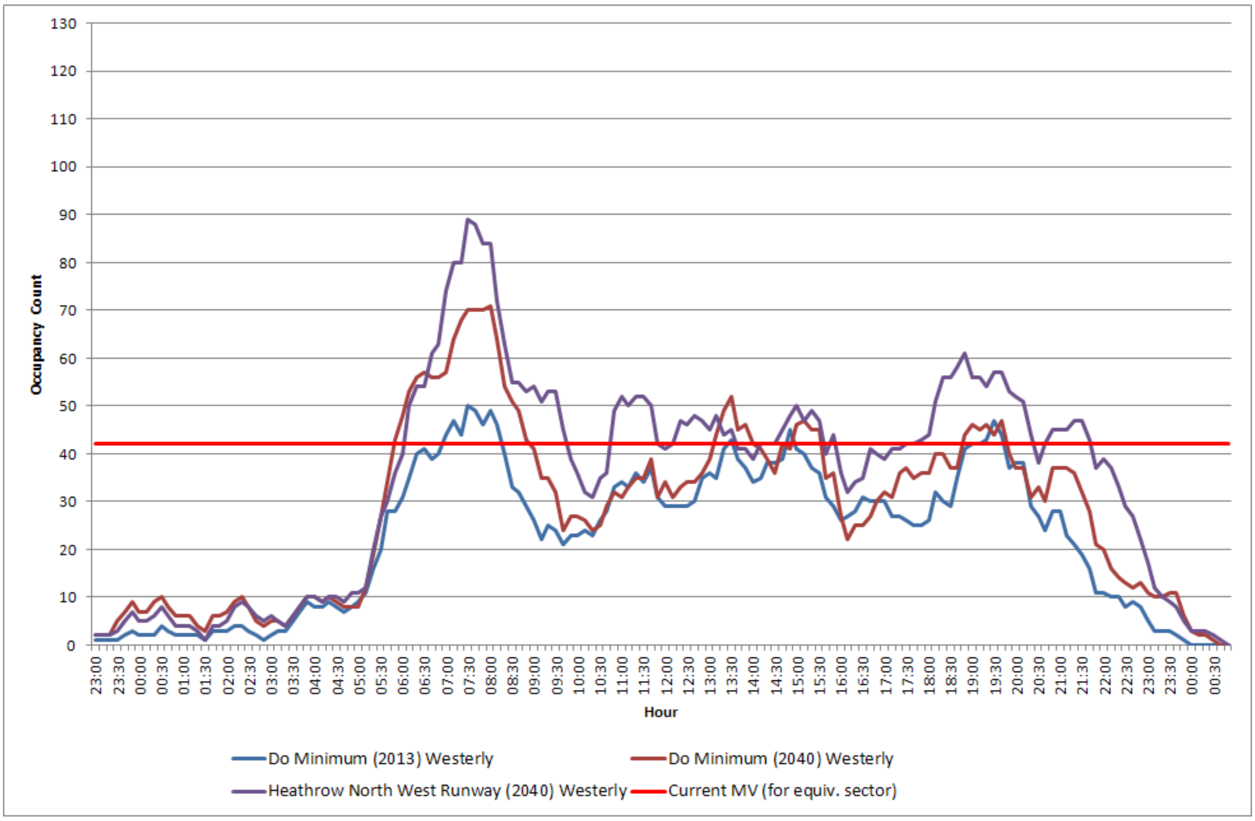



Figure 26 - Sector Occupancy, TC North East, Heathrow Airport North West Runway Scenario (Westerly Runway Operations)

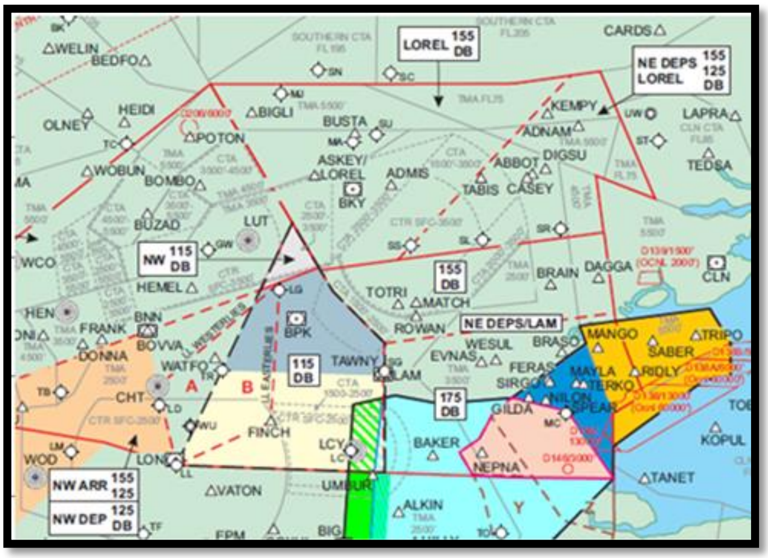



Figure 27 - Sector TC North East Illustration

The requirement to increase the minimum departure interval from one minute to two minutes between successive departures from 27R will reduce departure capacity. However, 'Taking Britain Further' (Ref 1) Volume 1, 3.5.1.3 states:

*"These splits are not required from a runway being used in Departures and Landing mode (DL), as the assumption is that any two departures will be separated by an arrival."*

The Westerly departure routes from the northern runway as provided by Heathrow Airport North West Runway proposal (shown in Figure 2) only follow one NPR, i.e. all departures from this runway will require a two minute departure gap. The main departure runway (27C) also has departure routes indicated for northbound traffic, although this is contradictory to the application of Compass Departures. It is suggested that an alternative route allowing a one minute split from the mixed-mode runway would offer more operational efficiency in Compass Departure mode - similar to the proposed routes for Easterly runway operations. However, achieving the modelled one minute split between CPT(N)/BUZAD and BPK/DVR(N) departures during Easterly runway operations relies on the departure routes being deconflicted with London City and Northolt departures; Figure 28 illustrates this requirement.

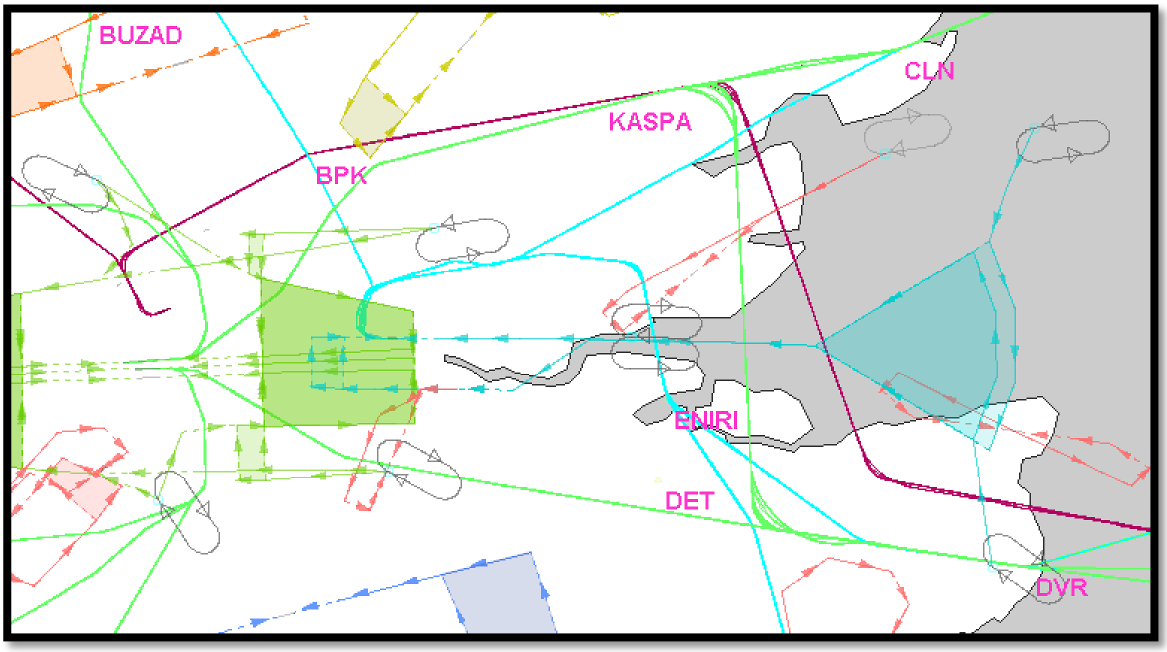



Figure 28 - Departure Routes: Heathrow Easterly Ops (Green), Northolt Westerly Ops (Burgundy), London City Westerly Ops (Blue)

In general, the potential departure throughput during Westerly runway operations is higher than during Easterly runway operations as there are fewer combinations of SIDs with one minute departure intervals during Easterly runway operations.

The LTMA is configured for Heathrow's already busy departure runway and the high workload resulting from the departures in the early stages of flight is shared between four LTMA sectors. Operating largely in Compass Mode means that these departures are consistently busier but are still effectively 'metered' into the LTMA. It is the additional departure routes in the Heathrow Airport North West Runway proposal, such as the CPT and DVR northbound SIDs, which place a larger peak demand on the TC North sectors.

For the mode of operation modelled, the impact on airfields in close proximity of Heathrow, with the exception of Northolt, is not thought to be detrimental compared to the Do Minimum scenario. The impact on Northolt may not be detrimental but without very detailed analysis and design it is not possible to determine either way with any level of confidence.

### 7.1.2. Arrivals

The LTMA is already configured with Heathrow as the busiest airfield with four stacks serving the arrival demand within four dedicated ATC sectors. It is felt that the existing arrival sectors, following improvements made when the LAMP Phase 2 is delivered, can cope with the extra Heathrow arrival demand without substantial upheaval to the current method of operation.

Additional holding stacks are unlikely to be required as supported by the stack dwell times indicated in Figure 29 and Figure 30 below, although more en-route holds may be necessary for contingency purposes. It is anticipated that effective Queue Management techniques will be well established to absorb delay en-route to negate the need for regular extended use of the terminal holds.

It is expected that the LAMP Phase 2 will have delivered an enhanced Heathrow arrival function and replaced the current four stacks however the LAMP Phase 2 airspace will not cater for a third runway. The challenges associated with safely and efficiently providing two landing streams of 38 per hour and 24 per hour, without the loss of CDAs and taking into account curved, steep or offset approaches and modes of respite, should not be underestimated. That challenge does not form part of this assessment.

It should be noted that the simulations were based on procedural operations; tactical interventions could offer some assistance in reducing holding demand, such as through the use of 'stack-swapping' as well as en-route holding. In practice the amount of stack holding observed in the simulations would not be experienced in individual stacks due to the application of these tactical mitigations. However, the following stack holding data has been included to provide an indication of issues relating to excessive arrival demand for each arrival flow.

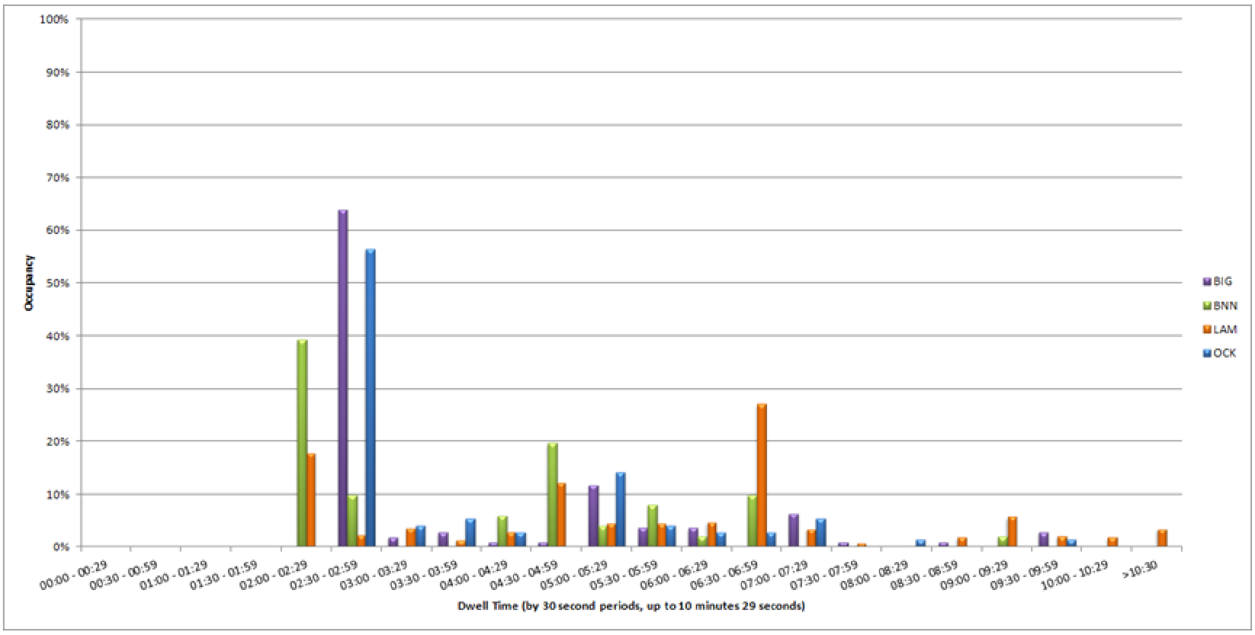



Figure 29 - Stack Holding Dwell Times per stack [for aircraft that held] - Heathrow, Westerly Runway Operations

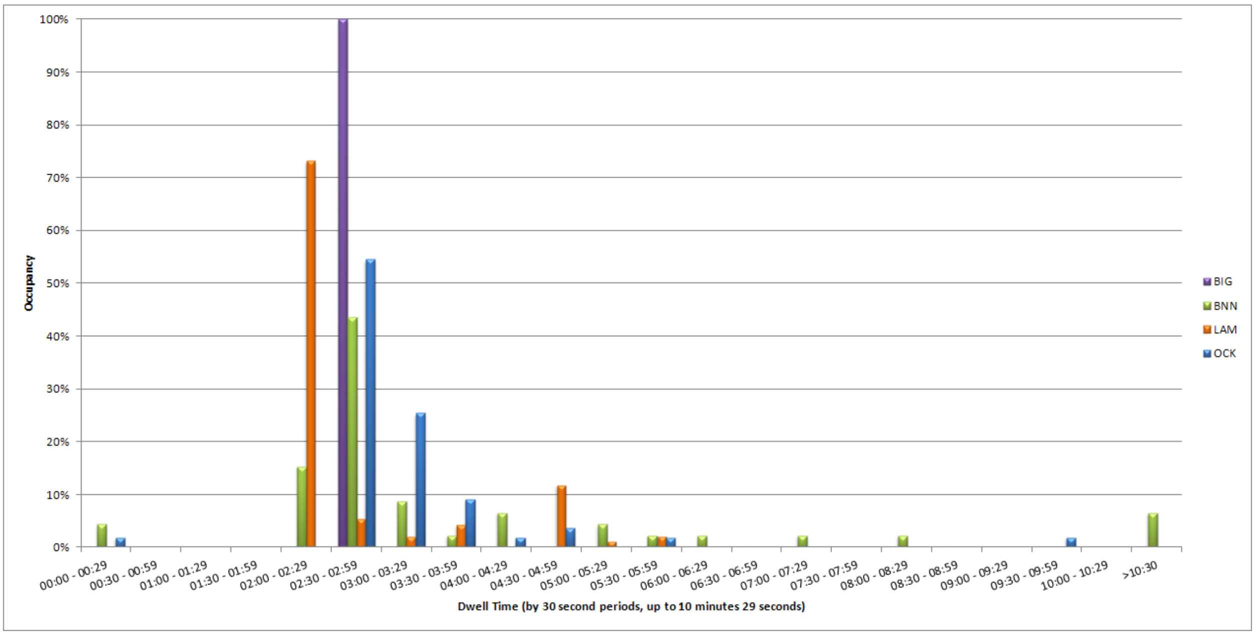


**Figure 30 - Stack Holding Dwell Times per stack [for aircraft that held] - Heathrow, Easterly Runway Operations**

It is important to appreciate that these results assume the approach structures were capable of serving the demand in a safe and effective manner; controller workload, loses of separations, airfield ground modelling, the inclusion of missed approaches, controller workload and other situations have not been considered in the model and thus not reflected in these holding distributions. Similarly, whilst the RMAs and vertical constraints on the approach transitions have been made common to each scenario, they have nonetheless been approximated based on the information available and further extended to reduce simulation errors. The size of these areas has an impact upon the stack holding demand as it provides an additional portion of the arrival transition for absorbing delay, and thus affects the above distributions.

Whilst it is not possible to quote these figures with certainty, due to the lack of fidelity in this aspect of the modelling, they are nonetheless an indication of a requirement to absorb delay through means other than stack holding, e.g. schedule planning and technology such as AMAN. These also serve to illustrate the large demand on the airspace that is required to feed these holds.

As indicated by the Hold Dwell Times, a number of aircraft were in excess of the standard hold time, indicating demand in excess of available capacity. In the case of Figure 29 and Figure 30, Lambourne (LAM) hold and Bovingdon (BNN) hold respectively, experience an excess of demand. Whilst this is not ideal, it does compare favourably to the Do Minimum scenario in which all holds experienced unfeasible levels of excess demand which applied to the overwhelming majority of arrival aircraft that held. This reduction compared to the Do Minimum scenario is due to a greater number of aircraft on the arrival transition as a result of the additional final approach. This does ignore any impact upon controller workload associated with these movements which may be a limiting factor to be mitigated. The vertical constraints currently employed but that were reduced in the model (in all scenarios) to overcome simulation errors associated with the excessive demand will have contributed to an extent, however as these were common to all models their impact will have been similar in each.

These distributions also indicate that the demand is imbalanced between each holding stack, suggesting that increased tactical intervention would be required and improved schedule planning to avoid over demand on a specific hold would be beneficial.

The results also indicate that stack holding times are more consistent during Easterly runway operations than during Westerly runway operations together with a lower average dwell time. This is a consequence of the assumptions that multiple levels could be used on the transitions, therefore the increased track mileage to 09R and 09L final approaches led to an increase in the potential to separate aircraft during the downwind approach transitions.

### 7.1.3. Network Impact Assessment

For the 39 sectors assessed, the demand was higher in 17 sectors compared with the Do Minimum scenario. Sector 18 and South-west Departures (SW DEPs) were the only sectors for which the higher demand seen in the Heathrow Airport North West Runway scenario was deemed significant.

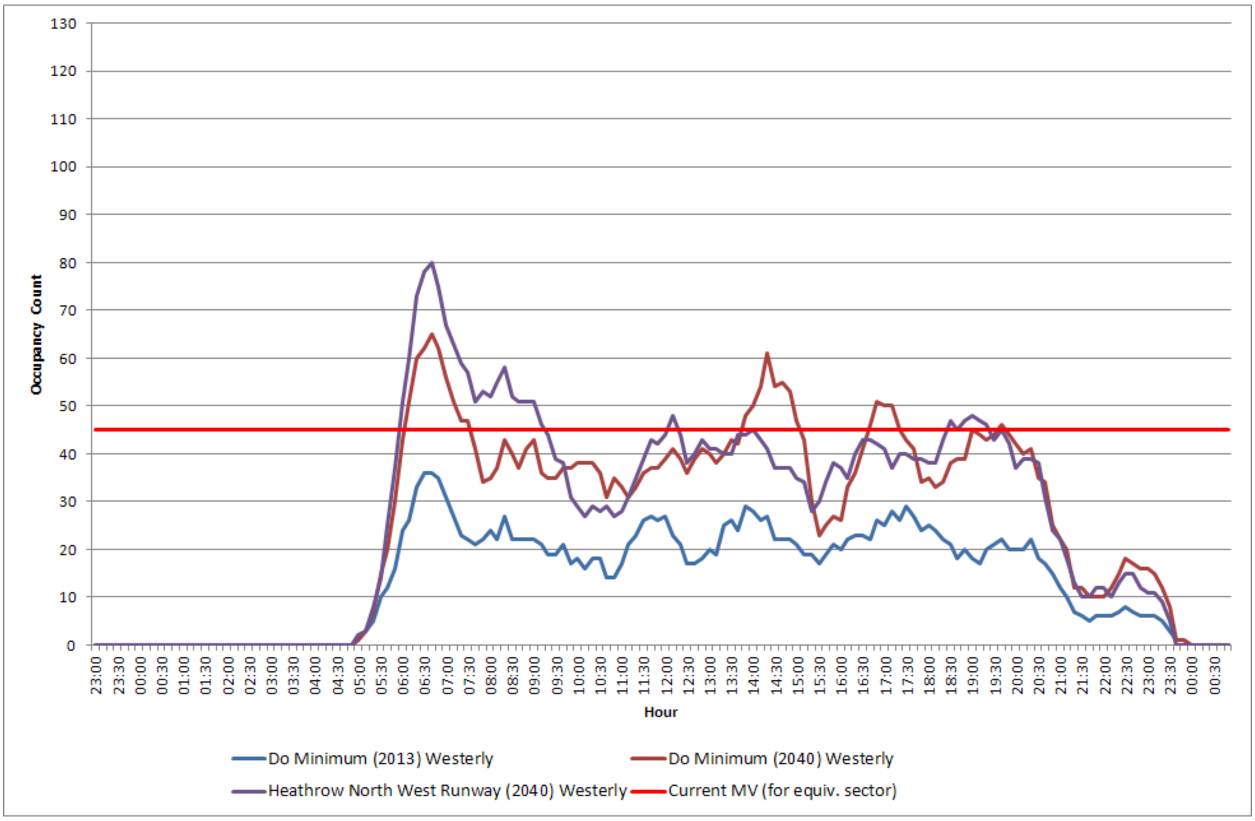



Figure 31 - Sector Occupancy for Sector 18, Heathrow Airport North West Runway scenario (Westerly Runway Operations)

Figure 31 shows the rolling sector occupancy for the Sector 18. The Heathrow Airport North West Runway simulation results are compared with the Do Minimum and 2013 simulation results. There is a noticeable peak at around 06:30 when the number of flights in the sector in an hour was approximately 125% of the equivalent peak in the Do Minimum scenario.

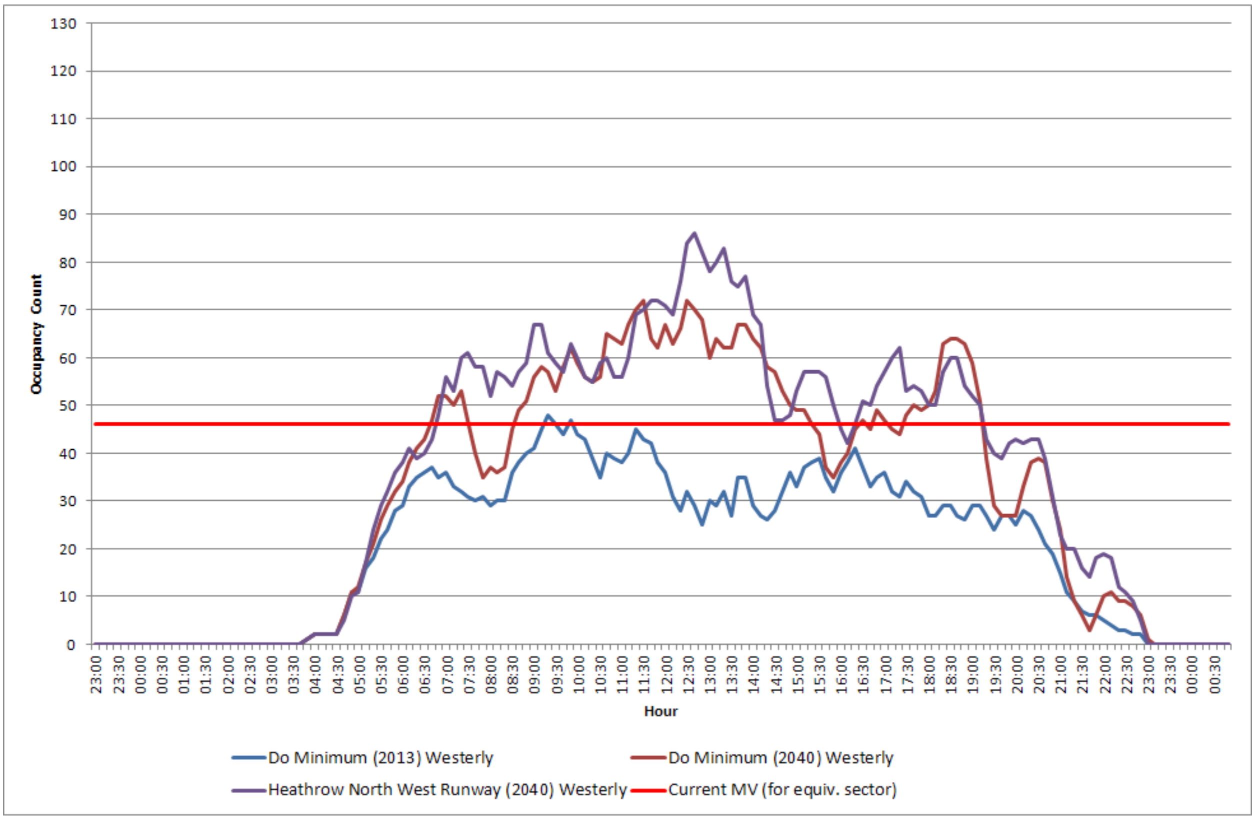



Figure 32 - Sector Occupancy for TC SW DEPs, Heathrow Airport North West Runway scenario (Westerly Runway Operations)

Figure 32 shows the rolling sector occupancy for TC SW DEPs. The Heathrow Airport North West Runway simulation results are compared with the Do Minimum and 2013 simulation results. There is a noticeable peak at around 06:30 when the number of flights in the sector in an hour, again, was approximately 125% of the equivalent peak in the Do Minimum scenario.

Leaving aside the design complexities of integrating this proposal into the low-level and dense LTMA airspace, the overall impact on the LTMA and adjacent AC sectors is less than the Do Minimum scenario in terms of generating peak demand loading on individual sectors.

In the Do Minimum scenario, the annual number of ATMs at Heathrow, Gatwick, Stansted, Luton, London City, Southend, Southampton, Bournemouth, Birmingham, East Midlands, Coventry and Bristol combined rises from approximately 1.3m ATMs per year in 2013 to forecast 1.9m ATMs per year in 2040.

In the Heathrow Airport North West Runway scenario, the 2040 forecast number of ATMs for this group of airfields is 1.95m ATMs per year, 0.05m above the Do Minimum forecasted ATMs.

However, there is less impact on overall network capacity in the Heathrow Airport North West Runway scenario than in the Do Minimum scenario as the forecast demand at the regional airfields such as Southend, Southampton, Bournemouth, Birmingham, East Midlands, Coventry and Bristol is lower. As the regional airfields become busier, there is more potential for delays and other restrictions in the current airspace as, in general, the controller workload per flight is greater for movements arriving or departing these airfields than for traffic arriving or departing the main London airports.

### 7.1.4. Track Mileage Assessment

| Category of Traffic | Average Change in Track Mileage versus Do Minimum |
|---|---|
| **Departures from Heathrow** | 0 % |
| **Arrivals to Heathrow** | -46% (reduction) |
| **UK Domestic Flights (excluding Heathrow)** | -1 % (reduction) |
| **Overflights** | 0 % |
| **Total (all flights modelled)** | -6% (reduction) |

**Table 22 - Track Mileage Comparison against Do Minimum (2040 Traffic Demand) for the Heathrow Airport North West Runway Model within the UKFIR**

Track mileage comparisons are based upon on the trajectories produced within the model and include all segments of a flight whilst airborne and within the boundary of all UK FIRs. The model is a reflection of airspace procedures rather than the day-to-day tactical intervention and relies on a number of modelling assumptions; for this reason it would be misleading to produce absolute mileage values. As these modelling assumptions are consistent for each of the models constructed, it is possible to make a relative comparison. Table 22 above shows that within the Heathrow Airport North West Runway model, an overall reduction in track mileage was experienced compared to the Do Minimum scenario. This result is largely due to the excessive arrival holding within the Do Minimum scenario and is influenced by the changes in demand for each traffic flow according to the 2040 forecasts.

### 7.1.5. Potential Mitigations Required in Addition to Do Minimum

- As, should this proposal be recommended, the biggest foreseen challenge is the development of the low-level design and CONOPS for the arrival and departure routes and procedures, the over-arching mitigation would be a collaborative approach to the task, undertaken with joint responsibility by HAL, NATS, the CAA and the UK Government. Pro-active and leading engagement with the airport consultative committee is paramount.
- Further investigation into the feasibility and compatibility of the assumptions made in the Heathrow Airport North West Runway proposal will be required during a detailed design phase (such as curved approaches, steep approaches, proposed respite routes and runway alternation).
- The impact on Sector 18 could be mitigated through re-design of the existing routes and the addition of new routes, resulting in multiple routes using the same airway[22] (such as L151, N859 and M605). Sector 18 interfaces directly with the French FIR so such re-design of the sector is dependent on inter-state collaboration.
- When the system is operating at capacity the impacts of service reduction can create significant disruption. Mitigations surrounding service resilience could be to include this as a factor to consider when balancing sector demand, i.e. ensuring there is always an amount of spare runway capacity across LTMA airports at any one time.

[22] This will be possible when aircraft are mandated to be equipped to RNAV1 specification.

## 7.2. Heathrow Airport Northern Runway Extension proposal

The Heathrow Airport Northern Runway Extension proposal presents a need to design and develop safe missed approach procedures and the location of landing systems for a new runway which is an extension of an existing one. Should suitable solutions be found for these known issues and because of the nature of the design proposed, the impact on the airspace network is more comparable to a two runway airfield than a three runway airfield which, of course, Heathrow already is. The main difference is the addition of a second arrival stream operated in parallel, discussed in 7.1.2.

No airspace re-design was considered in the proposal modelled in this analysis except for the integration of the proposal routes as detailed in section 3.2. The Heathrow Airport Northern Runway Extension scenario Fast Time simulations and their outputs provide sufficient assurance that NATS believe this proposal's extended runway, and the associated effect on traffic levels and flows, could be successfully integrated into the LTMA. In addition, the impact of the proposal on the overall Network is less when compared to the 2040 Do Minimum scenario.

### 7.2.1. Departures

In this mode, 27R Ext is the main departure runway. However, while operating in this mode, any MID or DVR southbound departures from 27R Ext would stop all departures from the mixed-mode 27L. This is obviously undesirable, especially during peak hours, so these departures would have to be limited to the mixed-mode runway during these times. This leaves 27R Ext for northbound departures, shown in red boxes, and SAM or CPT departures, shown in green boxes, in Figure 33 below. When Heathrow has a high CPT and DVR/MID departure demand, there would be limited sequencing options to optimise the departure splits and therefore it is unlikely that the DVR northbound departure would be used much during peak hours. Subsequently, the MID and DVR departures would likely all depart from the mixed-mode runway 27L during these times. Today MID and DVR departures make up approximately 40% of Heathrow's departure demand which could be constrained to one departure every 2-3 minutes in this scenario when sequenced between arrivals. It is expected that demand on these routes will only increase with Heathrow's increase in capacity and limiting these departures in this way will likely lead to ground delay.

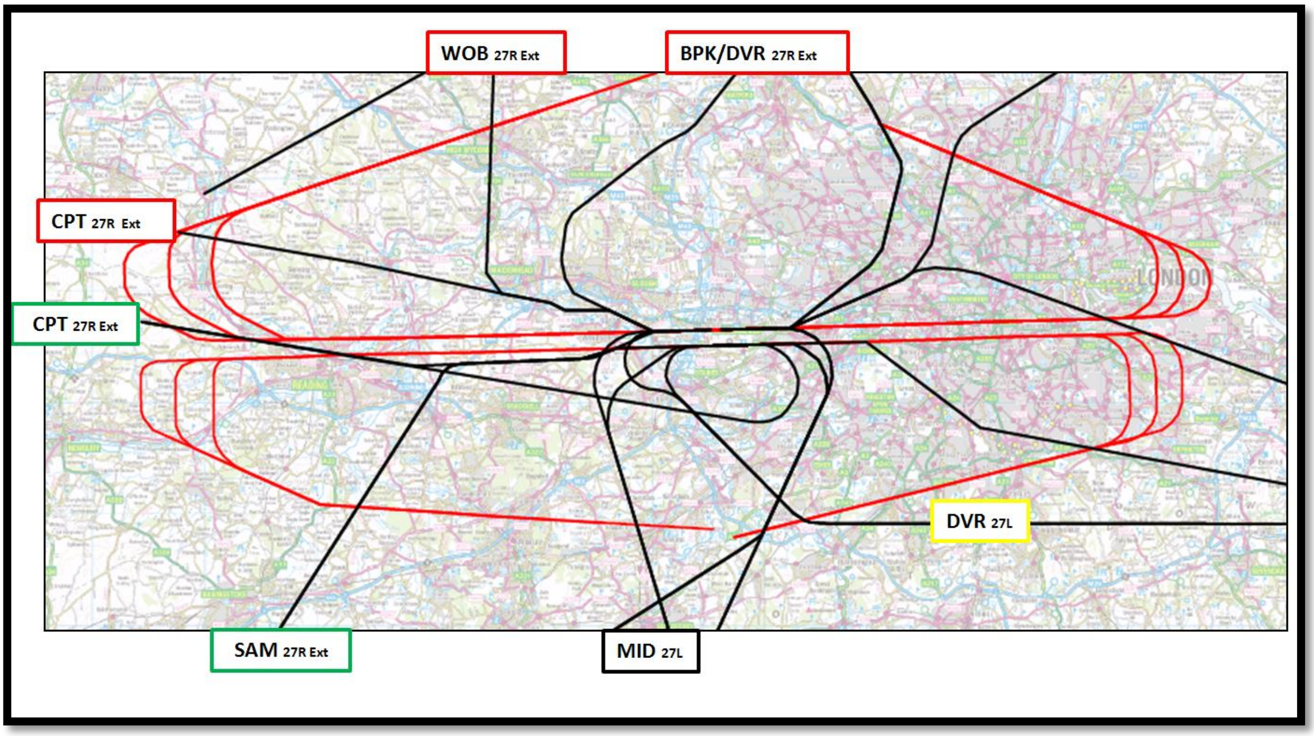



Figure 33 - Heathrow Airport Northern Runway Extension: Departure Path Assumptions during Westerly Runway Operations[23]

Subsequently, the Heathrow Airport Northern Runway Extension proposal puts extra demand on TC NW during Westerly runway operations (TC NW would handle the CPT North departures). However, during Easterly runway operations this demand on TC NW is reduced due to the increased flexibility afforded from the additional one-minute split options. This can be seen in Figure 34 and Figure 35 respectively.

[23] Crown Copyright and Database Rights 2014. Reproduced with data from Annex 5, 'NATS input to Module 14, Operational Efficiency' (Ref 2)

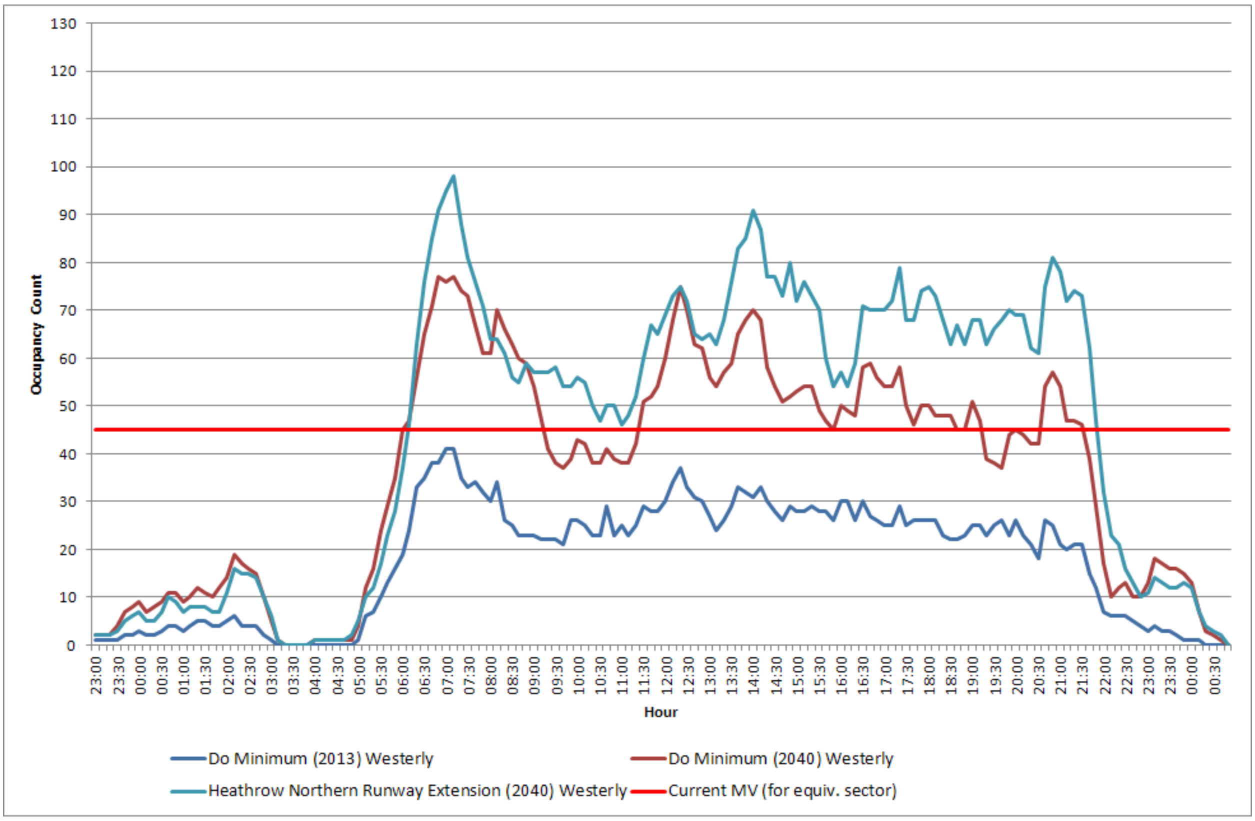



**Figure 34 - Sector Occupancy Chart, TC North West Deps, Heathrow Airport Northern Runway Extension Scenario (Westerly Runway Operations)**

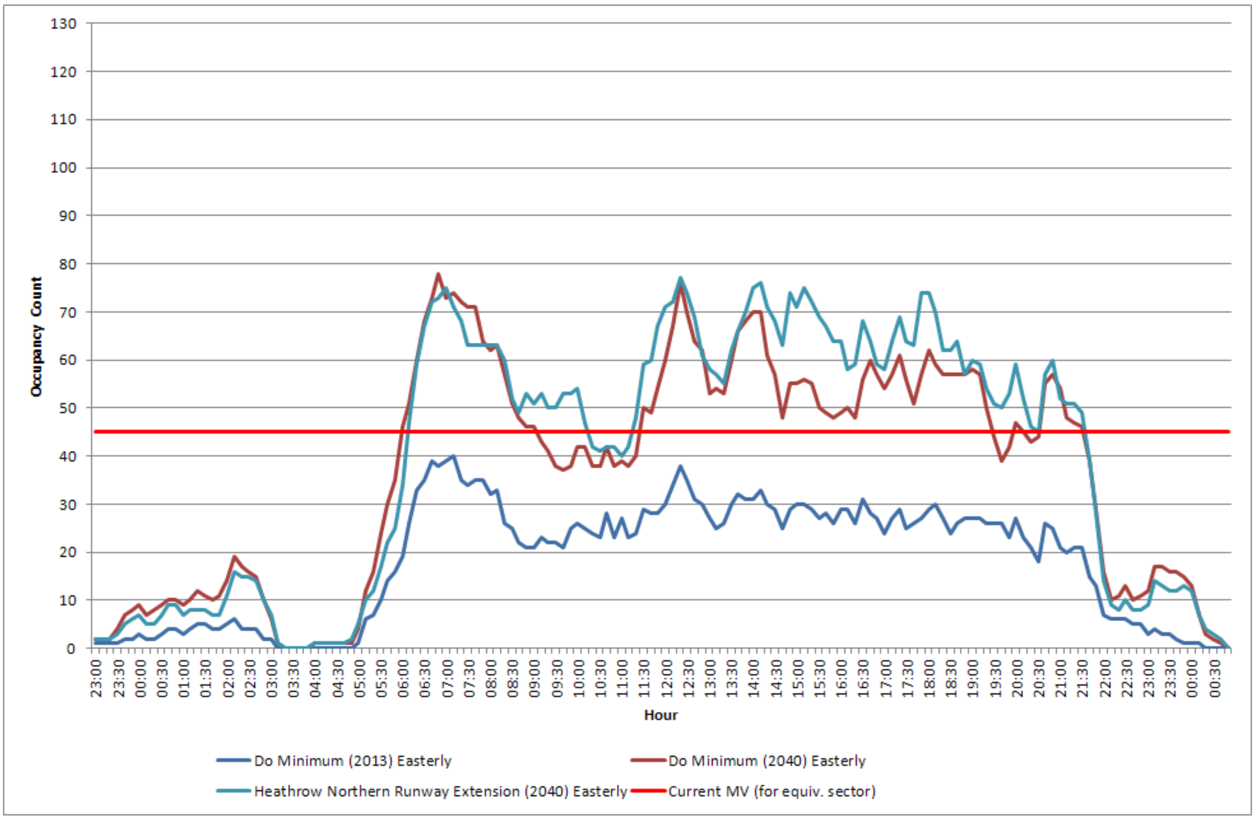



**Figure 35 - Sector Occupancy Chart, TC North West Deps, Heathrow Airport Northern Runway Extension Scenario (Easterly Runway Operations)**

During Easterly runway operations, it was assumed that the NPRs for CPT(N)/BUZAD and BPK/DVR(N) were sufficiently separated to allow a one minute gap between successive departures (see Table 8). However, designing such routes could be challenging due to the relative locations of London City to the East and Northolt to the West. As the DVR (N) route provided by the Heathrow Airport Northern Runway Extension proposal, in keeping with the principal of compass mode departures, departs to the North-East before heading south to DVR, this takes the departures into very close proximity with London City. A possible mitigation is if only aircraft able to achieve high rates of climb were allowed to use this route but it is likely Hazard Analysis of such a route could make finding acceptable mitigations extremely challenging.

### 7.2.2. Arrivals

The LTMA is already configured with Heathrow as the busiest airfield with four stacks serving the arrival demand within four dedicated ATC sectors. It is felt that the existing arrival sectors, following improvements made when the LAMP Phase 2 is delivered, can cope with the extra Heathrow arrival demand without substantial upheaval to the current method of operation.

Additional holding stacks are probably not required as indicated in Figure 36 and Figure 37 below, although more en-route holds may be necessary for contingency purposes. It is anticipated that effective Queue Management techniques will be well established to absorb delay en-route to negate the need for regular extended use of the terminal holds.

It is expected that the LAMP Phase 2 will have delivered an enhanced Heathrow arrival function and replaced the current four stacks however the LAMP Phase 2 airspace will not cater for an extended runway. The arrival routes indicated by the Heathrow Airport Northern Runway Extension proposal include longer final approach paths than in operation today. This may help to meet the requirement to vertically separate the independent streams to the different runways until aircraft are established on final approach. This relies on one or both of the aircraft flying lower than ideal (and subsequently not achieving a CDA) whilst also having a longer final approach than ideal (incurring additional track mileage at low-level), allowing 2 Final Approach (FIN) controllers to independently sequence the arrival streams.

It should be noted that the simulations were based on procedural operations; tactical interventions could offer some assistance in reducing holding demand, such as through the use of 'stack-swapping' as well as en-route holding. In practice the amount of stack holding observed in the simulations would not be experienced in individual stacks due to the application of these tactical mitigations. However, the following stack holding data has been included to provide an indication of issues relating to excessive arrival demand for each arrival flow.

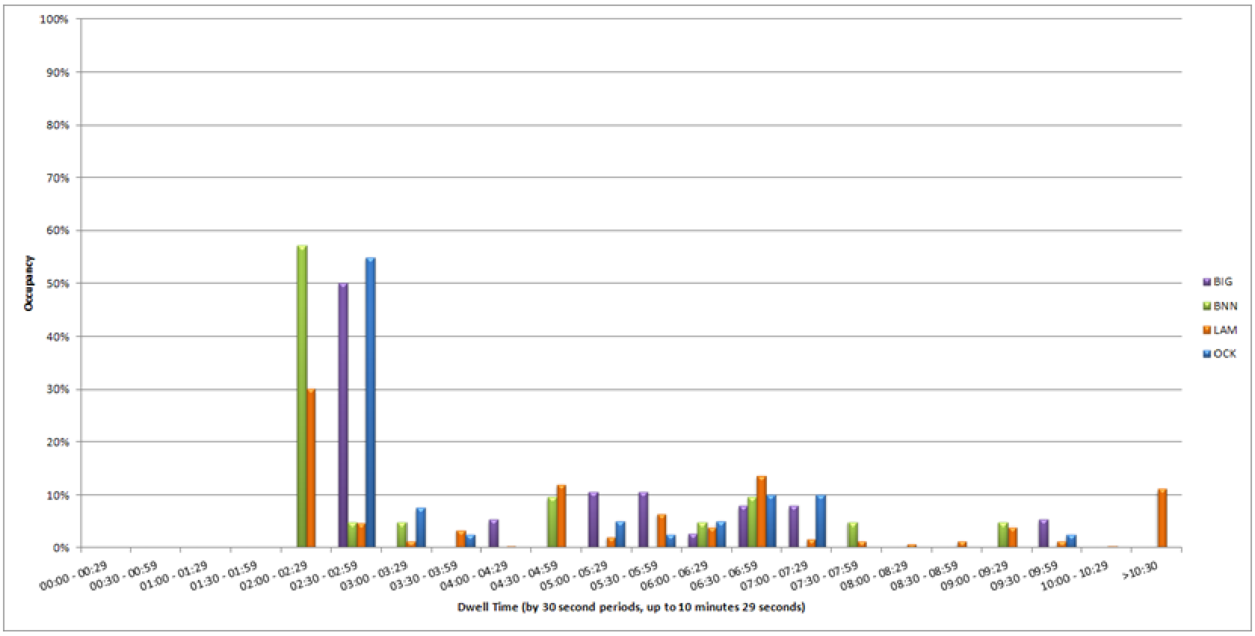



Figure 36 - Stack Holding Dwell Times per stack [for aircraft that held] - Heathrow, Westerly Runway Operations

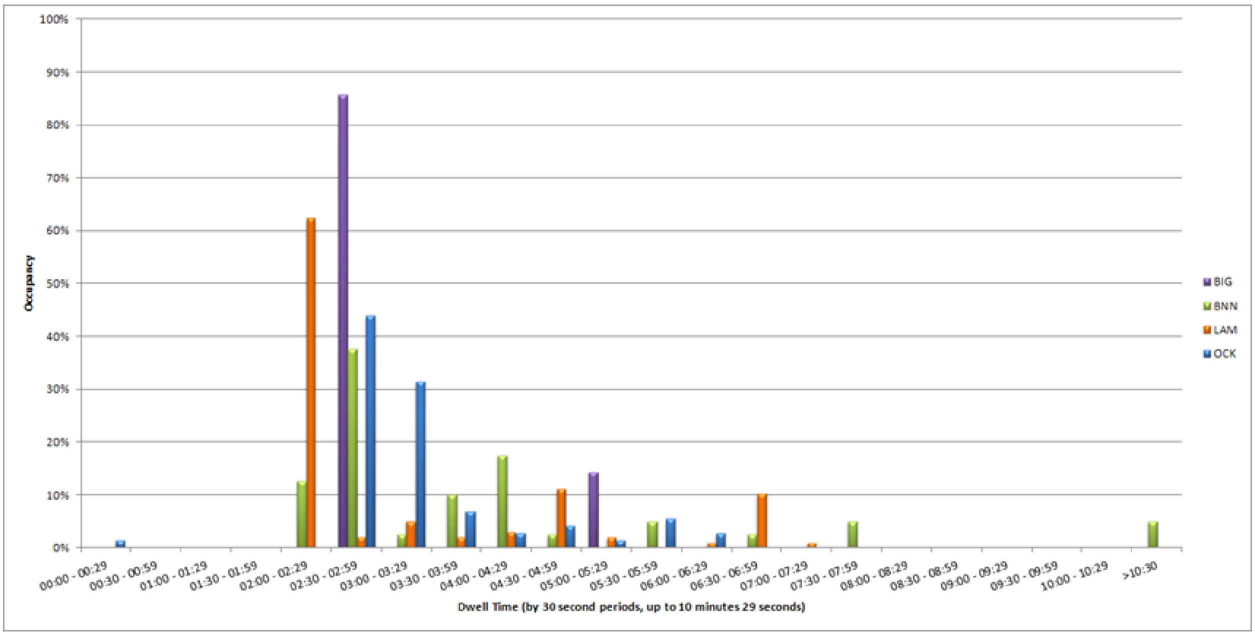



**Figure 37 - Stack Holding Dwell Times per stack [for aircraft that held] - Heathrow, Easterly Runway Operations**

It is important to appreciate that these results assume the approach structures were capable of serving the demand in a safe and effective manner; loses of separations, airfield ground modelling, the inclusion of missed approaches and other situations have not been considered in the model and thus not reflected in these holding distributions. Similarly, whilst the RMAs have been made common to each scenario, they have nonetheless been approximated based on the information available and further extended to reduce simulation errors. The size of these areas has an impact upon the stack holding demand as it provides an additional portion of the arrival transition for absorbing delay, and thus affects the above distributions.

Whilst it is not possible to quote these figures with certainty, due to the lack of fidelity in this aspect of the modelling, they are nonetheless an indication of a requirement to absorb delay through means other than stack holding, e.g. schedule planning and technology such as AMAN. These also serve to illustrate the large demand on the airspace that is required to feed these holds.

As indicated by the Hold Dwell Times, a number of aircraft were in excess of the standard hold time, indicating demand in excess of available capacity. In the case of Figure 36 and Figure 37, Lambourne (LAM) hold and Bovingdon (BNN) hold respectively, experience an excess of demand. Whilst this is not ideal, it does compare favourably to the Do Minimum scenario in which all holds experienced unfeasible levels of excess demand which applied to the overwhelming majority of arrival aircraft that held. This reduction compared to the Do Minimum Scenario is due to a greater number of aircraft on the arrival transition as a result of the additional final approach. This does ignore any impact upon controller workload associated with these movements which may be a limiting factor to be mitigated. The vertical constraints currently employed but that were reduced in the model (in all scenarios) to overcome simulation errors associated with the excessive demand will have contributed to an extent, however as these were common to all models their impact will have been similar in each.

These distributions also indicate that the demand is imbalanced between each holding stack, suggesting that increased tactical intervention would be required and improved schedule planning to avoid over demand on a specific hold would be beneficial.

The results also indicate that stack holding times are more consistent during Easterly runway operations than during Westerly runway operations together with a lower average dwell time. This is a consequence of the assumptions that multiple levels could be used on the transitions, therefore the increased track mileage to 09R and 09L Ext final approaches led to an increase in the potential to separate aircraft during the downwind approach transitions.

### 7.2.3. Network Impact Assessment

For the 39 sectors assessed, the demand was higher in 17 sectors compared to the Do Minimum scenario. SW DEPs was the only sector for which the higher demand seen in the Heathrow Airport Northern Runway Extension scenario was deemed significant.

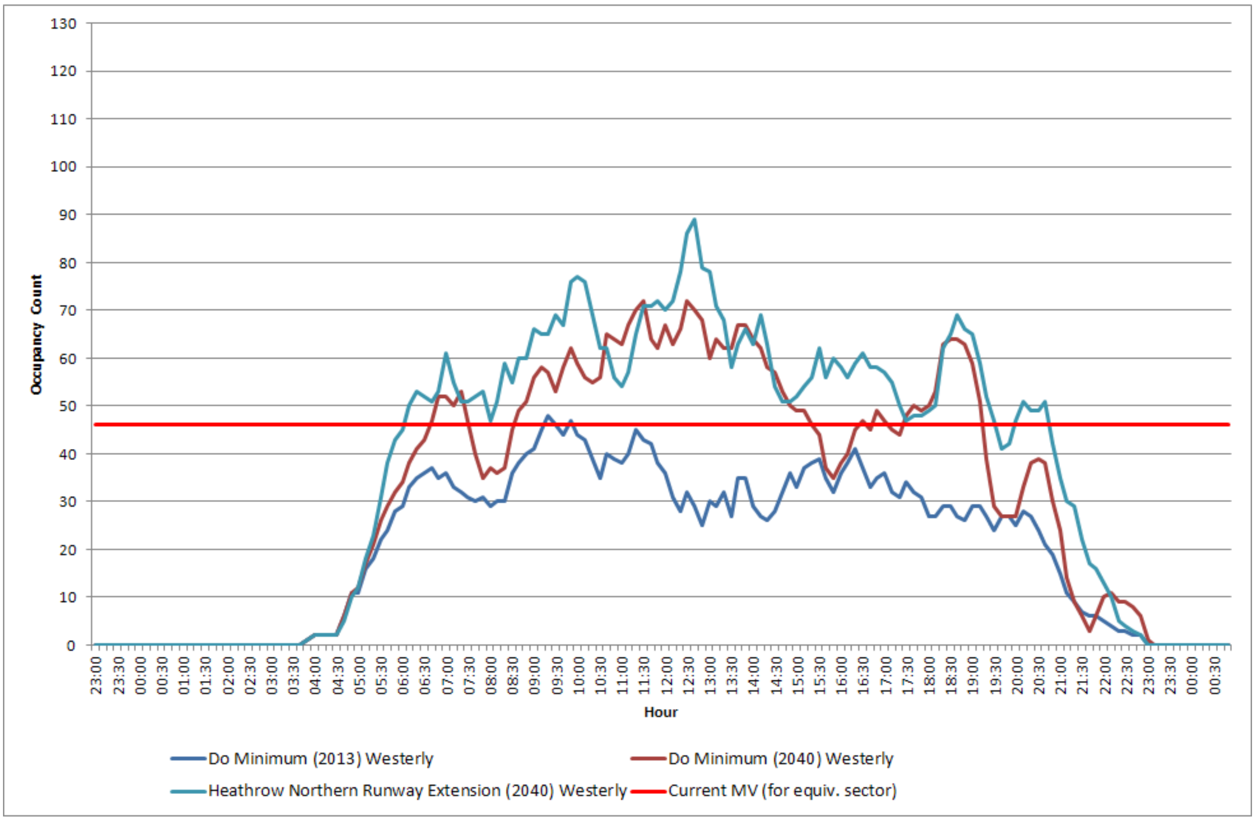



**Figure 38 - Sector Occupancy for TC South West Deps, Heathrow Airport Northern Runway Extension scenario (Westerly Runway Operations)**

Figure 38 shows the rolling sector occupancy for the TC SWDEPs. The Heathrow Airport Northern Runway Extension simulation results are compared with the Do Minimum and 2013 simulation results.

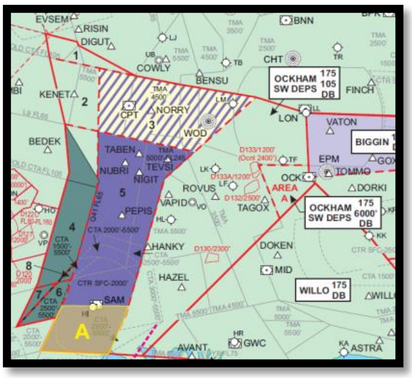



**Figure 39 - LAMP Phase 1A, Sector TC South West Deps Illustration**

The overall impact on the LTMA and adjacent AC sectors is smaller than the Do Minimum scenario in terms of generating peak capacity.

In the Do Minimum scenario, the annual number of ATMs at Heathrow, Gatwick, Stansted, Luton, London City, Southend, Southampton, Bournemouth, Birmingham, East Midlands, Coventry and Bristol combined rises from approximately 1.3m ATMs per year in 2013 to forecast 1.9m ATMs per year in 2040.

In the Heathrow Airport Northern Runway Extension scenario, the 2040 forecast number of ATMs for this group of airfields is 1.93m ATMs per year, 0.03m above the Do Minimum forecasted ATMs.

However, there is less impact on overall network capacity in the Heathrow Airport Northern Runway Extension scenario than in the Do Minimum scenario as the forecast demand at the regional airfields such as Southend, Southampton, Bournemouth, Birmingham, East Midlands, Coventry and Bristol is lower. As the regional airfields become busier, there is more potential for delays and other restrictions in the current airspace as, in general, the controller workload per flight is greater for movements arriving or departing these airfields than for traffic arriving or departing the main London airports.

#### 7.2.4. Track Mileage Assessment

| Category of Traffic | Average Change in Track Mileage versus Do Minimum |
|---|---|
| **Departures from Heathrow** | -1% (reduction) |
| **Arrivals to Heathrow** | -47% (reduction) |
| **UK Domestic Flights (excluding Heathrow** | -1 % (reduction) |
| **Overflights** | 0 % |
| **Total (all flights modelled)** | -6% (reduction) |

**Table 23 - Track Mileage Comparison against Do Minimum (2040 Traffic Demand) for the Heathrow Airport Northern Runway Extension Model within the UKFIR**

The track mileage comparisons in Table 24 are based upon on the trajectories produced within the model and include all segments of a flight whilst airborne and within the boundary of all UK FIRs. The model is a reflection of airspace procedures rather than the day-to-day tactical intervention and relies on a number of modelling assumptions; for this reason it would be misleading to produce absolute mileage values. As these modelling assumptions are consistent for each of the models constructed, it is possible to make a relative comparison. Table 23 above shows that within the Heathrow Airport Northern Runway Extension model, an overall reduction in track mileage was experienced compared to the Do Minimum scenario. This result is largely due to the excessive arrival holding within the Do Minimum scenario and is influenced by the changes in demand for each traffic flow according to the 2040 forecasts.

#### 7.2.5. Potential Mitigations Required in Addition to Do Minimum

- As should this proposal be recommended, the biggest foreseen challenge is the development of the low-level design and CONOPS for the arrival and departure routes and procedures, the over-arching mitigation would be a collaborative approach to the task, undertaken with joint responsibility by HAL, NATS, the CAA and the UK Government. Pro-active and leading engagement with airport consultative committee is paramount.

- When the system is operating at capacity the impacts of service reduction can create significant disruption. Mitigations surrounding service resilience could be to include this as a factor to consider when balancing sector demand, i.e. ensuring there is always an amount of spare runway capacity across LTMA airports at any one time.

## 7.3. Gatwick Airport Second Runway proposal

As detailed in Section 3.3, the Gatwick Airport Second Runway proposed departure routes have the potential to limit departure capacity, particularly during Easterly runway operations. However, NATS believes that feasible design solutions do exist which would provide more flexible departure capacity and subsequently the model was configured to allow for this where possible.

This analysis shows the overall impact is large and integration of a mixed-mode operation in the TC South sectors will be challenging.

The increase in traffic arriving at or departing from Gatwick will require considerable re-structuring of on the LTMA and surrounding sectors. Furthermore, the ability to safely and efficiently deliver traffic to two parallel, mixed-mode runways, approaching only from the South of the airfield will be challenging as the requirement to separate a pair of arriving aircraft vertically may result in the loss of CDA for at least one of the pair.

### 7.3.1. Departures

As detailed in Section 3.3.1, it is not viable to integrate the proposed departure routes into the LTMA as they are currently designed. For example, in LAMP Phase 1A airspace, SAM and KENET departures from runway 08R would be subject to major limitations owing to a confliction between Heathrow MID departures which are held down by the OCK stack. However, NATS is confident that the departure routes and wider LTMA could be re-designed to overcome such issues.

Departures from Gatwick are currently delivered into three LTMA sectors. The Westerly configuration proposed allows high departure throughput, however there is an impact on TC BIG as Gatwick can depart LAM/CLN departures and BIG departures independently to each other (see Figure 40) but both to the same sector. Figure 41 shows the sector occupancy for TC BIG for the Gatwick Airport Second Runway scenario compared against the 2013 and 2040 Do Minimum simulations.

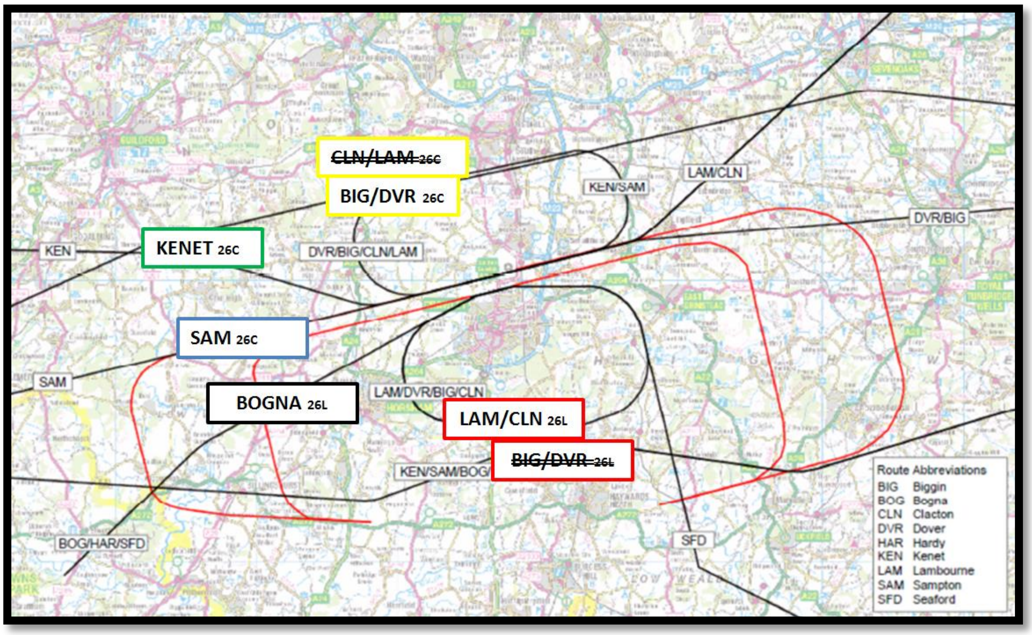



Figure 40 - Gatwick Airport Second Runway: Departure Path Assumptions during Westerly Runway Operations[24]

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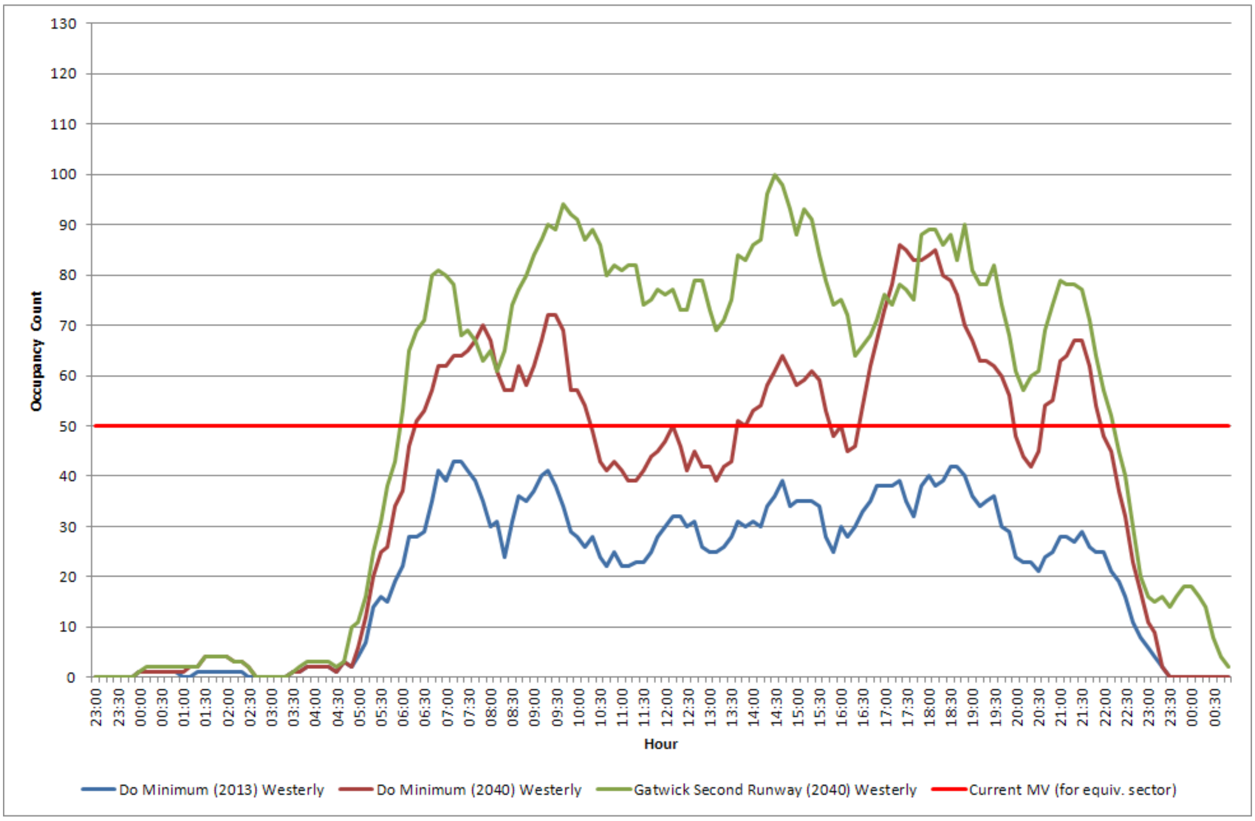



Figure 41 - Sector Occupancy for TC BIG, Gatwick Airport Second Runway scenario (Westerly Runway Operations)

During Westerly runway operations, these independent departures allow the airfield to balance departure demand quite evenly across the two runways and with ample one minute split options. However, during the Easterly configuration (shown in Figure 42), only SFD and SAM/KENET departures depart from 08R, all following the same NPR. This means that 2 minute departure gaps would be required between all successive departures from 08R whereas from 08C SAM/KENET departures can depart one minute behind a LAM/CLN/DVR and vice versa. This suggests that 08R would be used mainly for SFD departures.

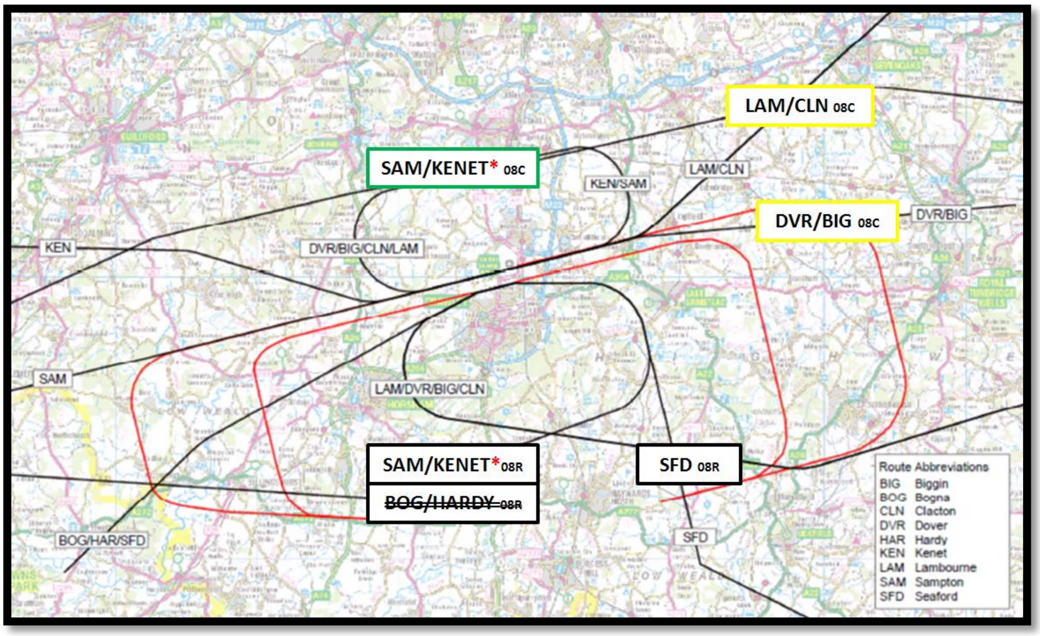



Figure 42 - Gatwick Airport Second Runway: Departure Path Assumptions during Easterly Runway Operations[25]

Multiple, successive SFD departures coupled with demand from Gatwick arrivals has an impact on TC WILLO which can be seen in Figure 43 below. Figure 43 shows the sector occupancy for TC VATON for the Gatwick Airport Second Runway scenario during Easterly

[25] Crown Copyright and Database Rights 2014. Reproduced with data from Annex 3 'NATS input to Module 14, Operational Efficiency' (Ref 2)

runway operations compared to the 2013 and 2040 Do Minimum simulations. There are two notable peaks at around 08:00 and 14:30 where the capacity required is roughly 180% of the peak capacity required in the 2040 Do Minimum scenario.

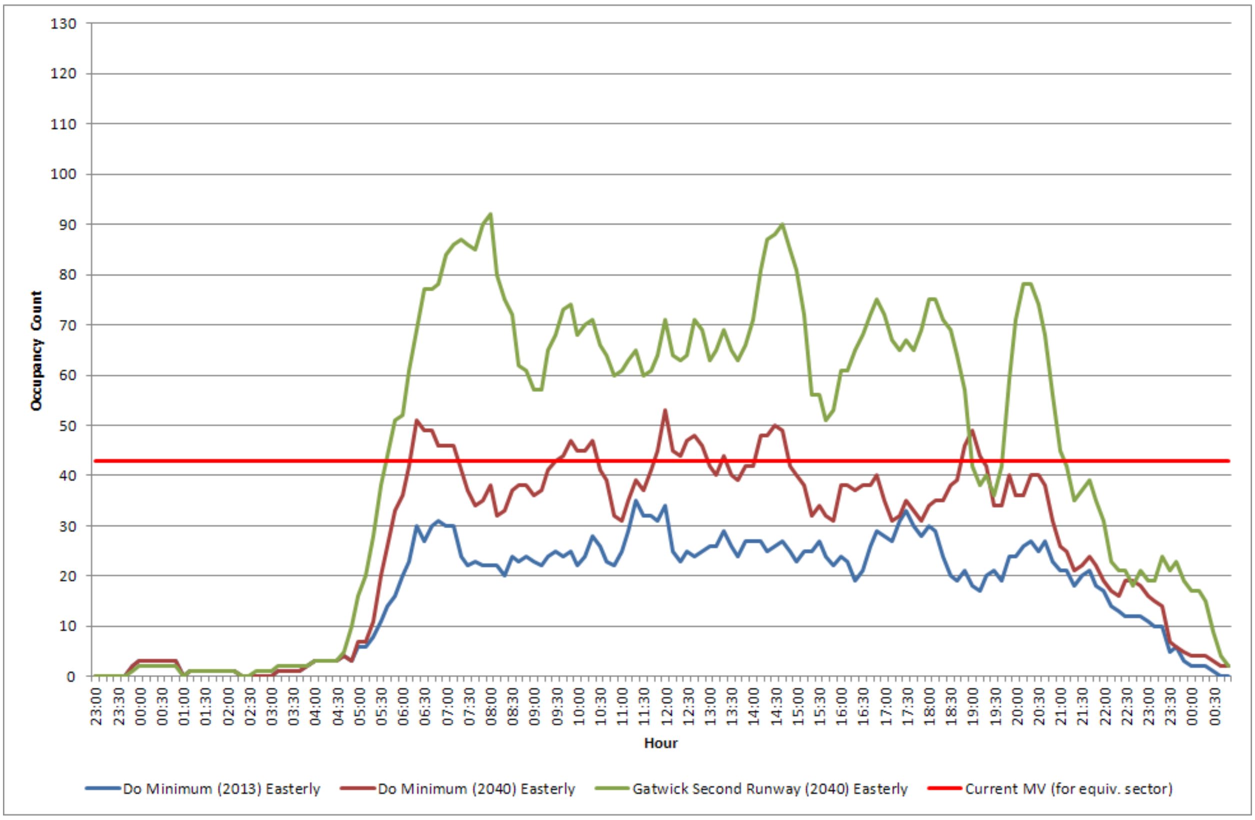



Figure 43 - Sector Occupancy for TC WILLO, Gatwick Airport Second Runway scenario (Easterly Runway Operations)

#### 7.3.2. Arrivals

The impact of the Gatwick arrivals creates by far the greatest peaks in sector demand across the Network, predominantly caused by the greater number of arrivals into the WILLO stack rather than these being balanced across both WILLO and TIMBA stacks, as illustrated in Table 76, Appendix F. These effects are further exacerbated for the TC WILLO function which is also handling Gatwick departures.

Although not insurmountable, there will be challenges in efficiently delivering traffic to two parallel runways in a mixed-mode configuration whilst approaches are only from the South of the airfield; resolution of this issue is beyond the scope of this assessment.

It should be noted that the simulations were based on procedural operations; tactical interventions could offer some assistance in reducing holding demand, such as through the use of 'stack-swapping' as well as en-route holding. In practice the amount of stack holding observed in the simulations would not be experienced in individual stacks due to the application of these tactical mitigations. However, the following stack holding data has been included to provide an indication of issues relating to excessive arrival demand for each arrival flow.

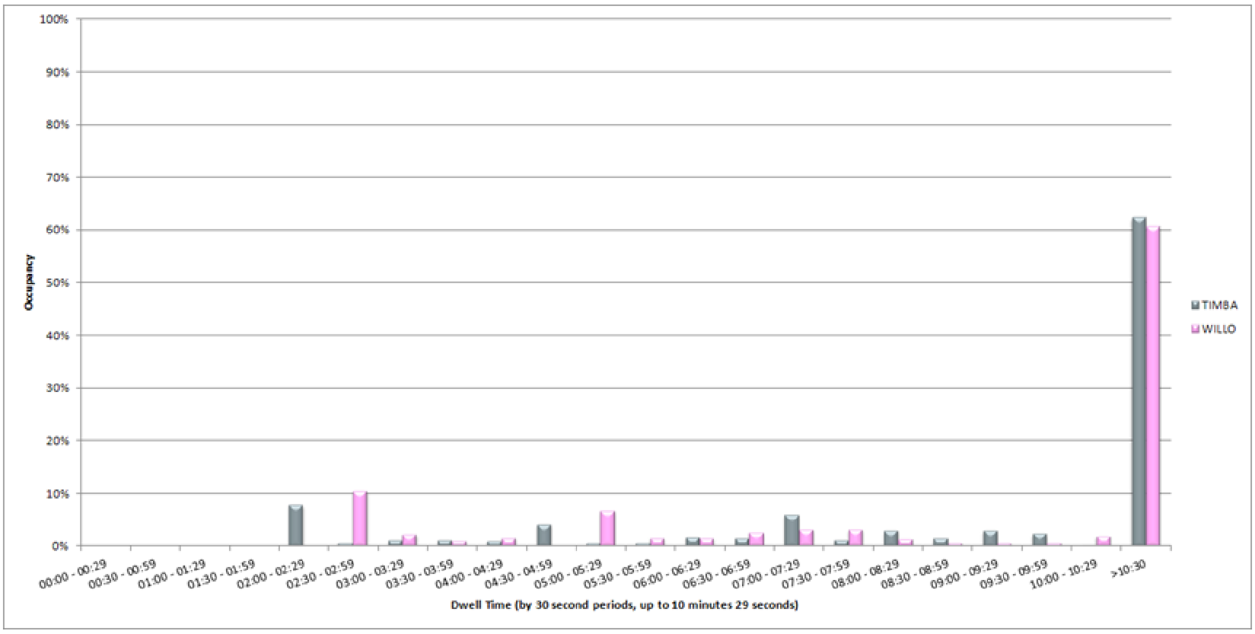



Figure 44 - Stack Holding Dwell Times per stack [for aircraft that held] - Gatwick, Westerly Runway Operations

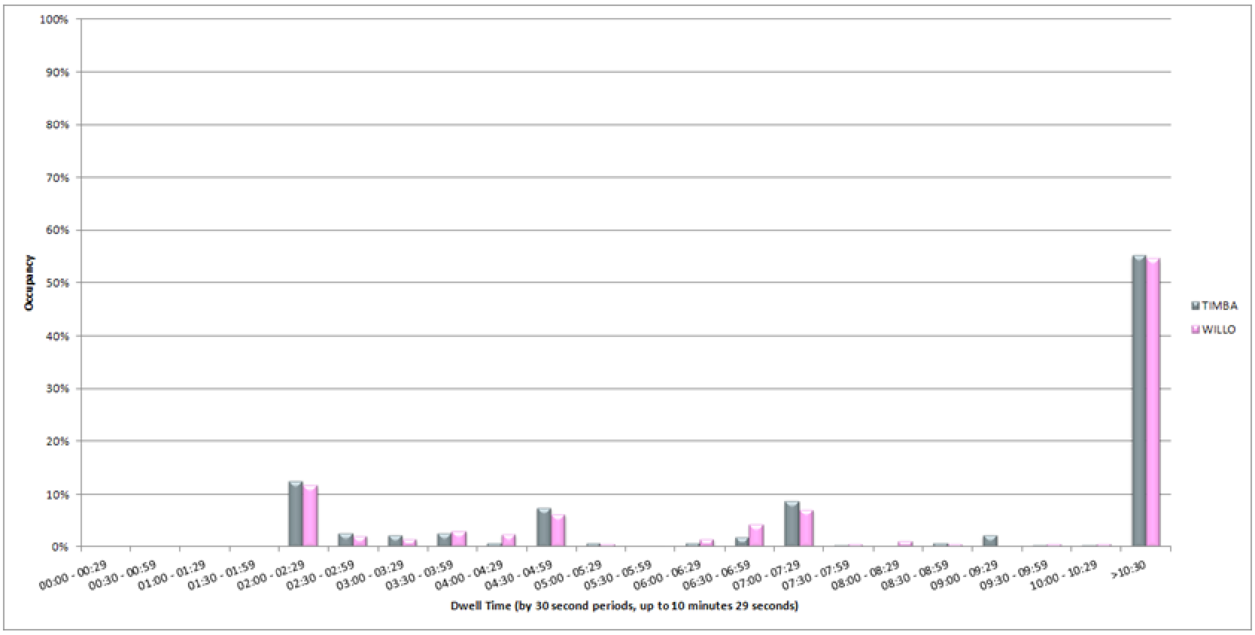



Figure 45 - Stack Holding Dwell Times per stack [for aircraft that held] - Gatwick, Easterly Runway Operations

It is important to appreciate that these results assume the approach structures were capable of serving the demand in a safe and effective manner; loses of separations, airfield ground modelling, the inclusion of missed approaches and other situations have not been considered in the model and thus not reflected in these holding distributions. Similarly, whilst the RMAs have been made common to each scenario, they have nonetheless been approximated based on the information available and further extended to reduce simulation errors. The size of these areas has an impact upon the stack holding demand as it provides an additional portion of the arrival transition for absorbing delay, and thus affects the above distributions.

Whilst it is not possible to quote these figures with certainty, due to the lack of fidelity in this aspect of the modelling, they are nonetheless an indication of a requirement to absorb delay through means other than stack holding, e.g. schedule planning and technology such as AMAN. These also serve to illustrate the large demand on the airspace that is required to feed these holds.

As indicated by the Hold Dwell Times, a number of aircraft were in excess of the standard hold time, indicating demand in excess of available capacity. As seen in Figure 44 and Figure 45, both Gatwick stacks, Timba and Willo, experienced an excess of demand during both Westerly and Easterly runway operations. The proportion of flights using the holding stacks that experience this excess demand was a notable increase compared to the Do Minimum scenario. This increase compared to the Do Minimum Scenario is despite the additional final approach and lessening of vertical constraints, the latter of which was applied (in all scenarios) to overcome simulation errors associated with the excessive demand. Considering that the impact upon controller workload associated with these movements, which may be a limiting factor, has been ignored in the simulation, this observation suggests that the increased traffic demand (as per the forecast data) occurring due to the second runway would necessitate the creation of additional holding stacks and additional approach transitions that are segregated from those already present.

The results also indicate that the average dwell times are slightly reduced during Easterly runway operations than during Westerly runway operations. This is a consequence of the assumptions that multiple levels could be used on the transitions, therefore the increased track mileage to 08C and 08R final approaches led to an increase in the potential to separate aircraft during the downwind approach transitions.

### 7.3.1. Network Impact Assessment

For the 39 sectors assessed, the demand was higher in 22 sectors compared to the Do Minimum scenario. Of these, S20, S22, TC JACKO, TC VATON and TC WILLO for which the higher demand seen in the Gatwick Airport Second Runway scenario was deemed significant.

Figure 46 shows the sector occupancy for S20 for the Gatwick Airport Second Runway scenario during Easterly runway operations compared to the 2013 and 2040 Do Minimum simulations. There is a notable peak around 08:00 where the capacity required is roughly 150% of the peak capacity required in the 2040 Do Minimum scenario.

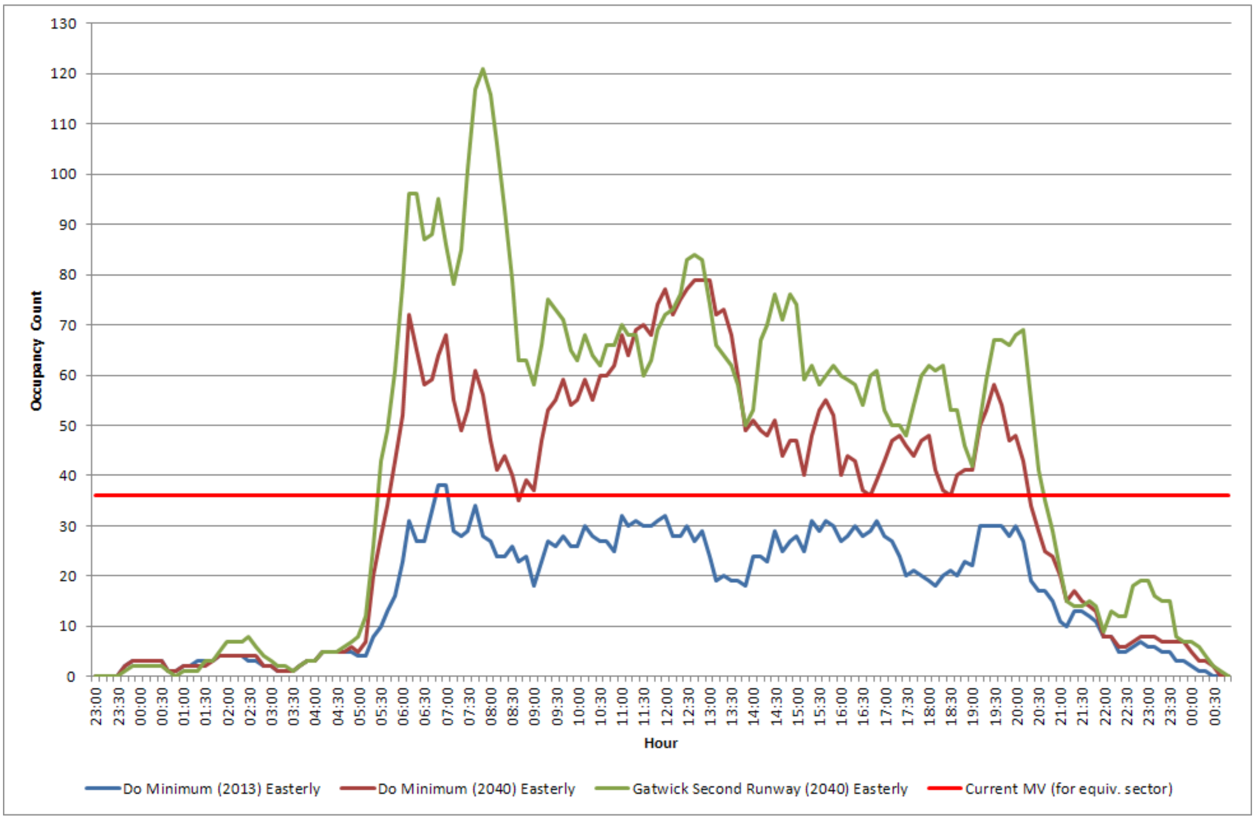



**Figure 46 - Sector Occupancy for S20, Gatwick Airport Second Runway scenario (Easterly Runway Operations)**

Figure 47 shows the sector occupancy for S22 for the Gatwick Airport Second Runway scenario during Easterly runway operations compared to the 2013 and 2040 Do Minimum simulations. Again, there is a notable peak around 08:00 where the capacity required is roughly 130% of the peak capacity required in the 2040 Do Minimum scenario.

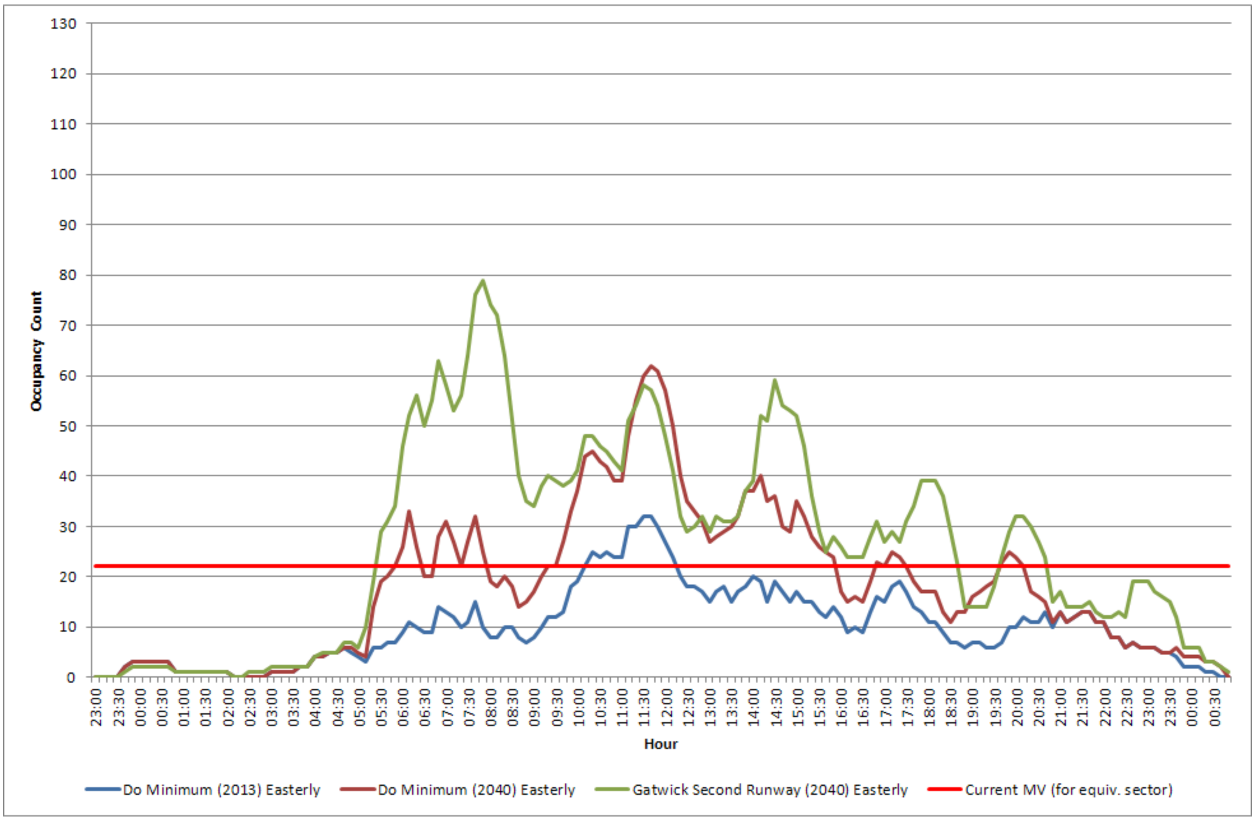



**Figure 47 - Sector Occupancy for S22, Gatwick Airport Second Runway scenario (Easterly Runway Operations)**

Figure 48 shows the sector occupancy for TC JACKO for the Gatwick Airport Second Runway scenario during Easterly runway operations compared to the 2013 and 2040 Do Minimum simulations. There is a notable peak around 18:00 where the capacity required is roughly 140% of the peak capacity required in the 2040 Do Minimum scenario.

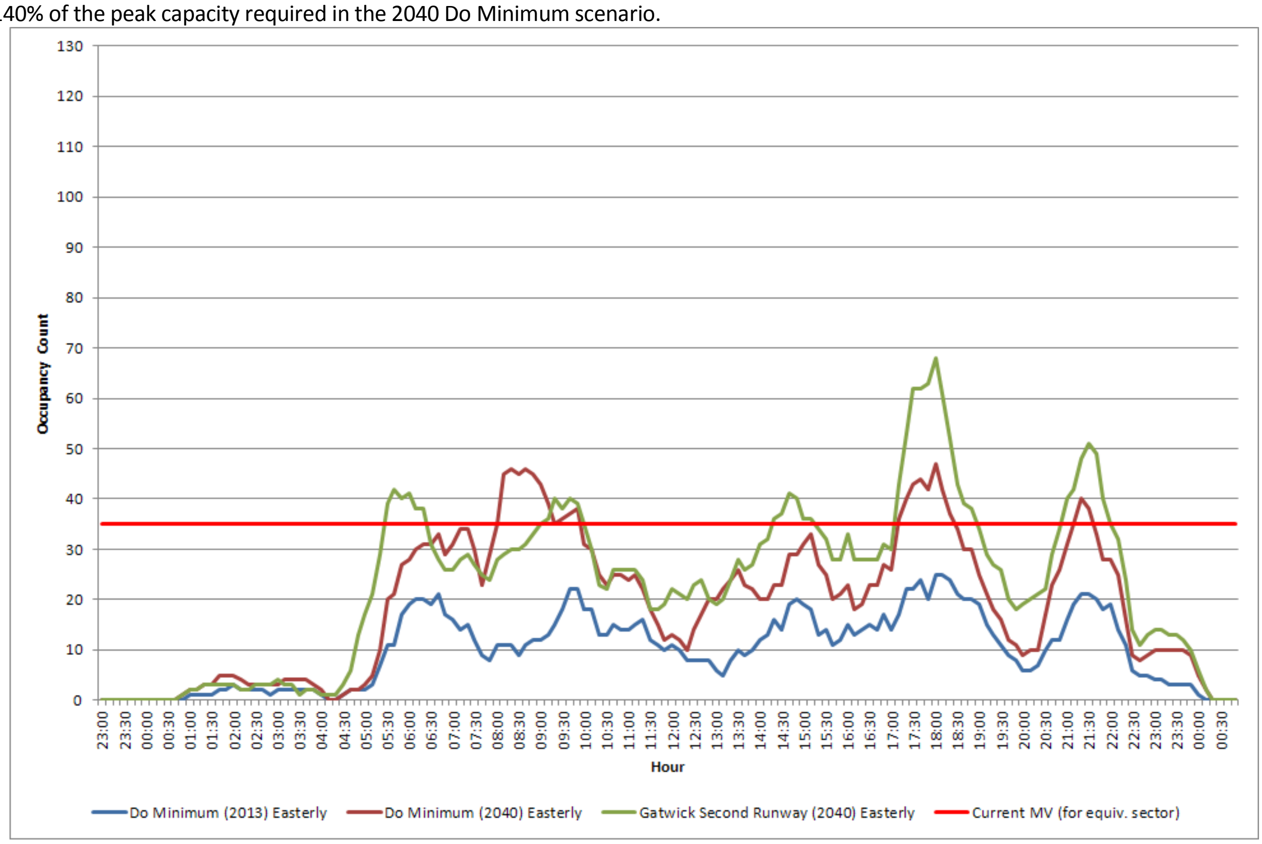



**Figure 48 - Sector Occupancy for TC JACKO, Gatwick Airport Second Runway scenario (Easterly Runway Operations)**

Figure 49 shows the sector occupancy for TC VATON for the Gatwick Airport Second Runway scenario during Easterly runway operations compared to the 2013 and 2040 Do Minimum simulations. There is a notable peak around 12:00 where the capacity required is roughly 140% of the peak capacity required in the 2040 Do Minimum scenario.

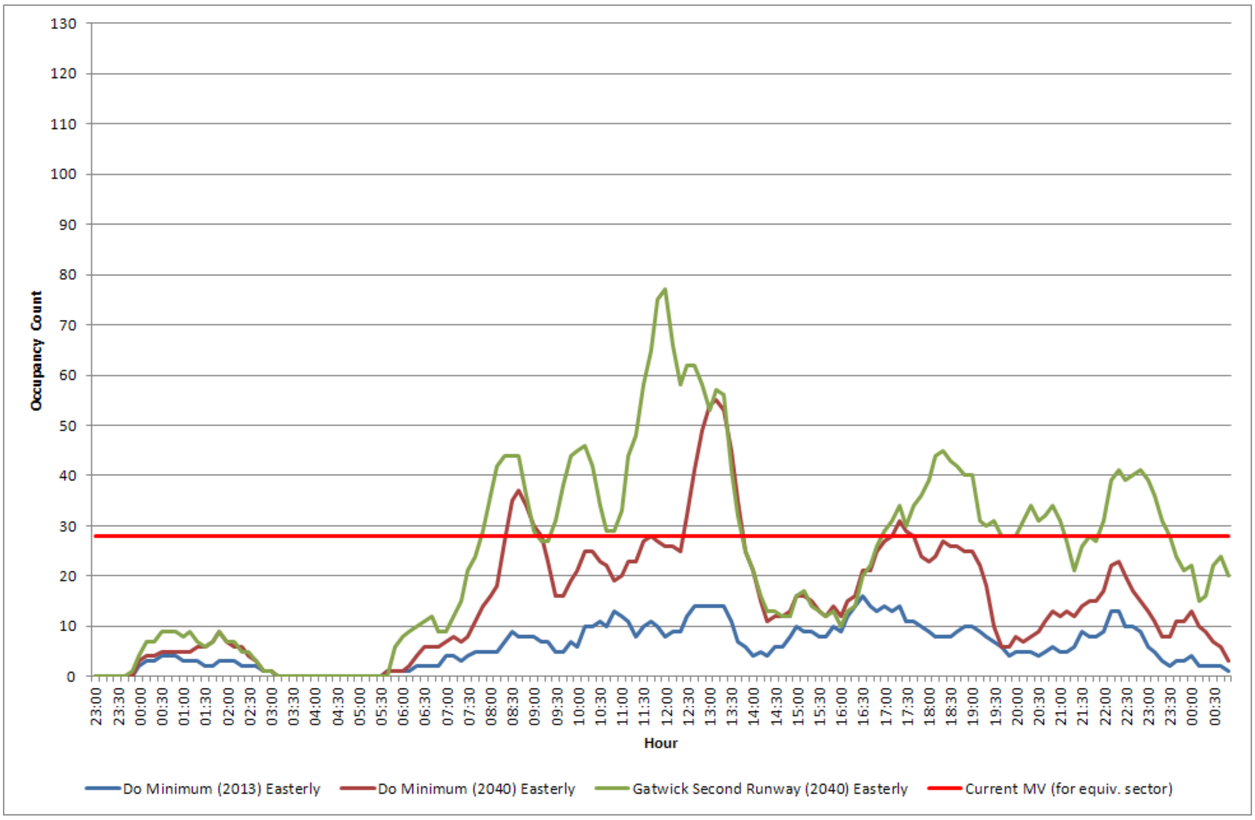


Figure 49 - Sector Occupancy for TC VATON, Gatwick Airport Second Runway scenario (Easterly Runway Operations)

The overall impact on the LTMA and adjacent AC sectors is greater than the Do Minimum scenario in terms of generating peak capacity.

In the Airports Commission 2040 Gatwick Airport Second Runway scenario forecasts, the demand at the main regional airfields affecting the LTMA (i.e. Southend, Southampton, Bournemouth, Birmingham, East Midlands and Bristol), while still less than in the Do Minimum scenario, is much higher than in either Heathrow option (see Table 24 below). Interestingly, the forecast demand at Luton (Table 25) is greater in the Gatwick Airport Second Runway scenario than any of the others, including Do Minimum, by nearly 18,000 ATMs in 2040.

| | | Do Minimum | Gatwick Airport Second Runway | Heathrow Airport North West Runway | Heathrow Airport Northern Runway Extension |
|---|---|---|---|---|---|
| **2040 forecasted ATMs** | Birmingham | 206,496 | 187,503 | 171,858 | 181,021 |
| | East Midlands | 110,060 | 106,367 | 81,902 | 82,673 |
| | Coventry | 28,935 | 131 | 131 | 131 |
| | Bristol | 106,192 | 101,511 | 86,086 | 85,501 |
| | Southampton | 120,439 | 105,603 | 68,430 | 81,090 |
| | Bournemouth | 53,040 | 57,929 | 39,860 | 37,759 |
| | Southend | 35,754 | 32,565 | 20,180 | 20,524 |
| | Total | 660,916 | 591,609 | 468,447 | 488,699 |

Table 24 - 2040 forecast ATMs for key regional airfields, all scenarios

| | Do Minimum | Gatwick Airport Second Runway | Heathrow Airport North West Runway | Heathrow Airport Northern Runway Extension |
|---|---|---|---|---|
| **Luton** | 119,973 | 137,949 | 117,114 | 116,052 |

Table 25 - 2040 forecast ATMs for Luton, all scenarios

This increased demand requires the network to cater for an increase in flights arriving and departing Luton and the regional airfields as well as serving the doubling of traffic levels at Gatwick.

### 7.3.2. Track Mileage Assessment

| Category of Traffic | Average Change in Track Mileage versus Do Minimum |
|---|---|
| **Departures from Gatwick** | 11% (increase) |
| **Arrivals to Gatwick** | 20% (increase) |
| **UK Domestic Flights (excluding Gatwick)** | -4 % (reduction) |
| **Overflights** | 1 % (increase) |
| **Total (all flights modelled)** | -2% (reduction) |

**Table 26 - Track Mileage Comparison against Do Minimum (2040 Traffic Demand) for the Gatwick Airport Second Runway Model within the UKFIR**

Track mileage comparisons are based upon on the trajectories produced within the model and include all segments of a flight whilst airborne and within the boundary of all UK FIRs. The model is a reflection of airspace procedures rather than the day-to-day tactical intervention and relies on a number of modelling assumptions; for this reason it would be misleading to produce absolute mileage values. As these modelling assumptions are consistent for each of the models constructed, it is possible to make a relative comparison. Table 26 above shows that within the Gatwick Airport Second Runway model, an overall increase in track mileage was experienced compared to the Do Minimum scenario. This result is largely due to the increased arrival holding compared to the Do Minimum scenario as well as being influenced by the changes in demand for each traffic flow according to the 2040 forecasts. In particular and most visible in the Gatwick departure category, these forecasts included an increase in the proportion of traffic using routings of greater length within the UKFIR, predominantly transatlantic flights, which were not forecast within the Do Minimum scenario. The overall track mileage change was however a reduction due to the effects at other UK airfields, a reflection of the changes in flows expected in the forecast demand.

### 7.3.3. Potential Mitigations Required in Addition to Do Minimum

- Should this proposal be recommended, fundamental re-design of TC and AC South sectors will be necessary. This will potentially require increased access to the large number of MoD Danger Areas in the South West. Mitigation must also be developed to prevent large delays to arrivals when the Portsmouth Danger areas are active at high level.
- At least one additional holding stack and / or Point Merge system at Gatwick would better cope with the three separate streams of traffic from the North-West, West and South-West together with enhanced queue management techniques.
- Further design work of Gatwick SIDs on the most demanded routes to allow uninterrupted optimised sequencing, would be necessary to achieve the required level of efficiency for the departures and runway throughput.
- Gatwick operating in a segregated mode could provide substantial mitigation. The challenge of streaming two arrival flows from one direction has not been addressed to date and integrating departures into both streams is an added complication. A single, dedicated arrival stream would be less complex. The proposal assessed was a mixed-mode runway operation; however another benefit of a segregated mode would be that Gatwick departures would be metered into the LTMA sectors more smoothly. It should also be noted that there would be an overall reduction in the declared runway capacities which would reduce the demand on the network in the TC South and AC Worthing sectors.
- When the system is operating at capacity the impacts of service reduction can create significant disruption. Mitigations surrounding service resilience could be to include this as a factor to consider when balancing sector demand, i.e. ensuring there is always an amount of spare runway capacity across LTMA airports at any one time.

# 8. Conclusions

The assessment objective was to understand and test the ability of the three scheme proposals to be integrated into the London airspace system, to identify potential breaking points in the airspace system (network) from the increase in traffic on different flows and suggest any possible future mitigation. The proposals were assessed independently of each other to provide an impartial view of each.

The assessment undertaken considered a multi-dimensional problem; one aspect of which was the traffic forecasts. The results are highly sensitive to the traffic demand scenario used and the commercial framework within which they deliver, i.e. 2040, 'Low Cost is King', Carbon Traded. This forecast was used to incorporate the highest ATMs thus stress-testing the airspace; other traffic forecasts and economic frameworks can be expected to result in different outcomes being observed for each proposal.

None of the proposals could be delivered into the operating environment modelled (i.e. LAMP Phase 1A) as all would place unserviceable demands on the airspace and route network structures. As reported in earlier input to the Commission (Ref 2), the London TMA would need to be substantially redesigned (post LAMP Phase 2) to enable an additional runway as well as the forecast growth at the other London airfields to be efficiently supported.

With the increase in demand predicted, the traffic levels in 2040 will be challenging for the airspace network, even without the addition of a new runway to the LTMA (i.e. the Do Minimum scenario). Historically, the solution to accommodate large capacity increases has been to resectorise the airspace to create additional airspace sectors. However, resectorisation can lead to diminishing returns and solutions that leverage technology will be needed to deliver the type and scale of additional capacity required to service the increased levels of demand expected in 2040.

NATS is constantly modernising its ATC solutions and will continue to do so, with substantial investment in airspace re-design and technological advancements. These are expected to provide substantial mitigations to the challenges that the forecast traffic levels will present to the operation, as well as enabling the efficient integration of an additional runway at either Gatwick or Heathrow.

## 8.1. Heathrow Airport North West Runway

The assessment has concluded that the Heathrow Airport North West Runway scenario presents fewer challenges for the airspace network than the Do Minimum scenario. The traffic forecasts provided 90,000 additional ATMs in 2040 when compared to the Do Minimum scenario however growth at the main regional airfields affecting the LTMA is less pronounced. This concentrates network growth at Heathrow and, currently, the sectors assessed are arranged to cater for the dominance of Heathrow's movements within the LTMA with four holding stacks for arrivals and four LTMA sectors for departures.

The results from the aircraft holding dwell times for Heathrow Airport North West Runway support this view whereby the proportion of aircraft which held for over 10 minutes 30 seconds at the four Heathrow stacks are lower in the proposal scenario compared to the Do Minimum scenario.

Whilst the assessment has not encountered any evidence to assert that the reference runway throughput rate of 128 movements per hour are unachievable, this report does not support or refute the ability for the runway configurations to deliver these peak movement rates claimed.

The current design proposal provides some resilience during the peak traffic demand due to the possibility in using alternative modes of runway operation.

This proposal did not present a notable impact upon surrounding airfields within the LTMA that would directly affect their growth potential.

## 8.2. Heathrow Airport Northern Runway Extension

The assessment has concluded that the Heathrow Airport Northern Runway Extension scenario presents fewer challenges for the airspace network than the Do Minimum scenario. The traffic forecasts provided 70,000 additional ATMs in 2040 when compared to the Do Minimum scenario however growth at the main regional airfields affecting the LTMA is less pronounced. This concentrates network growth at Heathrow and, currently, the sectors assessed are arranged to cater for the dominance of Heathrow's movements within the LTMA with four holding stacks for arrivals and four LTMA sectors for departures.

The results from the aircraft holding dwell times for Heathrow Airport Northern Runway Extension support this view whereby the proportion of aircraft which held for over 10 minutes 30 seconds at the four Heathrow stacks are lower in the proposal scenario compared to the Do Minimum scenario.

Whilst the assessment has not encountered any evidence to assert that the reference runway throughput rate of 130 movements per hour are unachievable, this report does not support or refute the ability for the runway configurations to deliver these peak movement rates claimed.

The current design proposal provides limited resilience due to the peak traffic demand only being serviced by one mode of runway operation. This could be redesigned however there would be a trade-off with the impact upon the surrounding environment.

This proposal did not present a notable impact upon surrounding airfields within the LTMA that would directly affect their growth potential.

## 8.3. Gatwick Airport Second Runway

The assessment has concluded that the Do Minimum scenario presents fewer challenges for the airspace network than the proposal set out by Gatwick Airport Second Runway when using the traffic forecasts provided (which propose over 200,000 additional ATMs in 2040 when compared to the forecasts used to support the Heathrow Airport Northern Runway Extension and Heathrow Airport North West Runway proposals). Some of the impacts are directly due to the additional runway at Gatwick and airspace structure, whilst there are secondary effects due to the assumed economic impact driving growth at the main regional airfields affecting the LTMA. The LTMA and Area Control sectors around Gatwick would require significant re-development to cater for additional flows of traffic and holding stacks and / or Point Merge systems for Gatwick arrivals.

The results from the aircraft holding dwell times for Gatwick Airport Second Runway support this view whereby the proportion of aircraft which held for over 10 minutes 30 seconds at the two Gatwick stacks are higher in the proposal scenario compared to Do Minimum. This supports the controller commentary that additional holding stack(s) is / are required.

Whilst the assessment has not encountered any evidence to assert that the reference runway throughput rate of 98 movements per hour are unachievable, this report does not support or refute the ability for the runway configurations to deliver these peak movement rates claimed.

The current design proposal provides limited resilience due to the peak traffic demand only being serviced by one mode of runway operation. This could be redesigned however there would be a trade-off with the impact upon the surrounding environment.

This proposal did not present a notable impact upon surrounding airfields within the LTMA that would directly affect their growth potential.

## 8.4. Summary

Subject to a substantial and complete redesign of the LTMA, NATS believes that an additional runway at either Heathrow or Gatwick can be effectively integrated into the Terminal and en-route airspace network. The key determinate in safe and efficient air traffic services will be the use of advanced operating concepts and techniques, underpinned by expected future ATM technological advances. Many of the concepts required are currently being deployed or are in development, such as through SESAR, and will start to be validated over the next 5-10 years.

None of the proposals presented a notable impact upon surrounding airfields within the LTMA that would directly affect their growth potential.

The simulations were run with clear weather conditions and with an absence of runway closures, go-arounds or technical failures. With these assumptions the large and continuous traffic demand still resulted in prolonged stack dwell times. With conditions that are not as ideal the resilience of the system would be tested further. Whilst the system may cater for this level of demand under ideal conditions, it would be unrealistic to expect an operation this busy to be completely problem free and any issues would quickly lead to significant disruption. Service resilience could be mitigated by considering this factor when balancing sector demand, i.e. ensuring there is always an amount of spare runway capacity across LTMA airports at any one time.

This report should be considered as one aspect of the various assessments being undertaken by the Commission and should be considered alongside other reports to enable a holistic picture of the potential outcomes to be developed. Ordinarily at this stage, a high level airspace design would be developed to support a Real Time Simulation to provide further evidence and assurances. However, due to the timescales being considered, further formative analysis would need to be undertaken to further develop the arrival and departure paths to ensure that they can be effectively integrated into the network expected to exist at that time.

# Appendix A. Modelling Assumptions

- Aircraft linking (the linkage between inbound and outbound flights) was not modelled, i.e. the number of flights equalled the number of aircraft.
- All airfields were modelled with an elevation of 0 ft. above mean sea level.
- Airfield ground movement modelling was not implemented.
- While taxiing time was allowed for in calculating initial departure times, neither taxiways nor variations in taxi routes were modelled.
- Once aircraft had reached the front of the runway entry queue, they would appear lined up on the runway.
- The maximum time an aircraft could jump to the front of the runway entry queue was 10 minutes.
- For arrivals to UK airfields with runways modelled, the flights were removed from the simulation once they had landed and decelerated to a taxi speed of 30kts.
- For arrivals to UK airfields for which runways were not modelled, the flights were removed once they had reached the airfield's published coordinates. Such airfields were outside the study area of interest.
- Aircraft Performance data was specified using BADA Version 3 (Base of Aircraft Data) nominal performance values.
- Aircraft Performance ignored the variations seen in aircraft operator behaviour, e.g. the variations seen between individual airlines due to difference in standard operating procedures.
- Altitude and speed restrictions on approach transitions and SIDs were modelled with aircraft attempting to reach or maintain their RFL (requested flight level) for as long as possible, subject to adherence to the restrictions. Aircraft performance data dictated the rates of climb/descent possible per aircraft type.
- Altitude and speed restriction rules were modelled representing sector coordination agreements ('letters of agreement').
- The models did not include flow restrictions, minimum departure intervals or slot compliance such that unconstrained demand was modelled. This ensured that any problems indicating the airspace was unable to service the traffic demand were not masked by these demand management mechanisms.
- Arrival and departure separations were included, cognisant of aircraft speed groups, wake turbulence, SID divergence and runway operating modes.
- Conflict resolution (en-route and tactical) was not applied.
- Controller tasks were completed instantaneously with each controller able to control multiple aircraft simultaneously.
- A "blue sky" weather picture with no wind was assumed. To avoid the difficulties associated with a change in pressure between airfields and at transition altitudes, a fixed atmospheric pressure of 1013mb and a Minimum Stack Level of FL80 was used at Heathrow and Gatwick for all scenarios. This ensured any observed differences were due to the design of the airspace, not due to changes in the atmospheric assumptions.
- Instances of go-arounds, runway closures or low visibility procedures were excluded from the model.
- As per normal operating practice, Gatwick runway 26R/08L was not included in the models. This runway is typically used whilst the main runway 26L/08R is closed for servicing; neither runway operates at the same time as the other.
- Runway direction was consistent throughout each simulation and for each runway included in the model; each scenario was modelled as a wholly Westerly runway operation and separately as a wholly Easterly runway operation.
- The presence of potential future ATM Technology was not replicated within the model directly due to the difficulties in determining which technological development would be both available in 2040 and be beneficial to each of the scenarios, as well as the extent of such benefits. However potential future ATM Technology is taken into account when assessing the resultant analysis; ATCO expertise is used to consider whether any issues identified could be mitigated through the use of such technologies.
- All times are quoted in UTC.

# Appendix B. Scenario Assumptions

- All scenarios considered the airspace contained within the London FIR; whilst some modelling fidelity was applied to airfields and airspace on or close to the boundary with the London FIR, e.g. Birmingham, other areas were not changed, save for ensuring a consistent runway direction.
- The SID and approach transitions outlined in the three expanded airport concepts were modelled using the coordinate information provided.
- The requirement to adhere to 3 degree glide slopes from 3000ft at the expanded airports was incorporated. No other vertical parameters were supplied.
- It was assumed that the outlined transitions and SIDs were flyable with adequate spacing provided to ensure safety standards were met, e.g. SOIR and PANS-OPS criteria.
- The distance to which the outlined transitions and SIDs supplied by each proposal extended was limited. Therefore, the subsequent route and integration into the airspace network was approximated using expert ATCO judgement.
- Where possible, the profile of SIDs and transitions were assumed to enable continuous climb departures and continuous descent approaches as soon as practicable. In many of the proposals, SID tracks were at risk of conflict with other traffic flows, either arrival traffic for the same airfield, or movements at another airfield. These safety risks were assumed to be mitigated through the application of vertical level restrictions and/or extended tracks, as guided by ATCO expertise.
- It was assumed that Missed Approach Procedures could be developed by the airfield ATC supplier and approved by the CAA to support the traffic levels asserted by the proposers and without alteration to any of the routes or other assumptions input to the model. Note that without these procedures there is a risk that peak runway rates may not be serviceable.
- Airfields that were unchanged by the three proposed concepts were modelled as per the LAMP Phase 1A airspace.
- Where approach structures led to multiple arrival runways aircraft were assigned the runway requiring the least arrival delay. This assignment occurred during the transition onto final approach.
- For runways operating in mixed-mode, arrival aircraft took priority over departing aircraft. When a departure queue of at least one aircraft (for a specific runway) existed, a gap was created in the arrival stream, to enable the departure to become airborne.
- In line with scheme proposals compass mode was used with the exception of some SIDs that were sufficiently separated from neighbouring tracks. These are described in the relevant concept specific sections below. NB. Without the use of some SID alternation resulting in 1-minute departure-departure separations, the forecast 2040 traffic demand would not be serviced during peak times in the model.
- Where departure routes operated from multiple departure runways aircraft were assigned the runway estimated to encounter the least departure delay.
- Runway modes of operation varied depending upon the scenario. These modes of operation and the departure runway assignments are described in Table 29 - Table 35 below.
- The standard arrival-arrival separation between arrival pairs was assumed as the greater of the minimum radar separation and the NATS Wake Turbulence separation (specified by distance).
- The minimum arrival-arrival separation was 3NM, except at Biggin Hill where it was 6NM
    - Note. London City was assumed to operate with an extended taxiway, avoiding the need for runway back-tracking, thus reducing the current separation requirement in both runway operating directions.

- The NATS Wake Turbulence separation (specified by distance) was:

| Following Aircraft: / Leading Aircraft | Super | Heavy | Upper Medium | Medium | Small | Light |
|---|---|---|---|---|---|---|
| **Super** | 4 | 6 | 7 | 7 | 7 | 8 |
| **Heavy** | 4 | 4 | 5 | 5 | 6 | 7 |
| **Upper Medium** | 0 | 0 | 3 | 4 | 4 | 6 |
| **Medium** | 0 | 0 | 0 | 0 | 3 | 5 |
| **Small** | 0 | 0 | 0 | 0 | 3 | 4 |
| **Light** | 0 | 0 | 0 | 0 | 0 | 0 |

Table 27 - Table 28 - NATS Wake Turbulence Separation Minima for Arriving Aircraft[26]

Note, the clear weather, no-wind assumption meant that these distance-based separations were the same as the equivalent time-based separations.

- The models included the assumption that there would be no reduction in capacity due to curved approaches.

[26] Heathrow MATS Part 2, Ed 2.14 and Gatwick MATS Part 2, Ed. 2.14

## Heathrow Airport Northern Runway Extension

- The parallel runways at Heathrow operated independently.
- Heathrow Traffic can arrive on the two arrival runways without a staggered separation on the assumption that development of the airfield and a consistent increase arrival demand will require the ability to reduce today's required minimum radar separation on final approach.
- Departure aircraft at Heathrow were assigned runways based on compass mode, with the exception of SIDs connected to multiple runways, indicated in Table 30, and aircraft with wake turbulence category "Super" (A380s), which would depart from the mixed-mode runway.

| Runway Direction | Westerly | Easterly |
|---|---|---|
| EGLL 27L | Mixed | Closed |
| EGLL 27R | Arrivals | Closed |
| EGLL 27E (extended) | Departures | Closed |
| EGLL 09R | Closed | Mixed |
| EGLL 09L | Closed | Departures |
| EGLL 09E (extended) | Closed | Arrivals |
| EGKK 26L | Mixed | Closed |
| EGKK 08R | Closed | Mixed |

Table 29 - Heathrow Airport Northern Runway Extension - Runway Modes of Operation

| Runway Direction | Westerly | Easterly |
|---|---|---|
| EGLL 27L | CPT, DVR, MID, SAM | Closed |
| EGLL 27R | Arrivals | Closed |
| EGLL 27E (extended) | BPK, CPT, WOB | Closed |
| EGLL 09R | Closed | CPT, DVR, MID, SAM |
| EGLL 09L | Closed | CPT, BPK, BUZ, DVR |
| EGLL 09E (extended) | Closed | Arrivals |

Table 30 - Heathrow Airport Northern Runway Extension – Departure Runway Assignment

## Heathrow Airport North West Runway

- The parallel runways at Heathrow operated independently.
- Heathrow Traffic can arrive on the two arrival runways without a staggered separation on the assumption that development of the airfield and a consistent increase of arrival demand will require the ability to reduce today's required minimum radar separation on final approach.
- Departure aircraft at Heathrow were assigned runways based on compass mode, with the exception of SIDs connected to multiple runways, indicated in Table 32, and aircraft with wake turbulence category "Super" (A380s), which would depart from the mixed-mode runway.

| Runway Direction | Westerly | Easterly |
|---|---|---|
| EGLL 27L | Arrivals | Closed |
| EGLL 27C | Departures | Closed |
| EGLL 27R (north) | Mixed | Closed |
| EGLL 09R | Closed | Arrivals |
| EGLL 09C | Closed | Departures |
| EGLL 09L (north) | Closed | Mixed |
| EGKK 26L | Mixed | Closed |
| EGKK 08R | Closed | Mixed |

Table 31 - Heathrow Airport North West Runway - Runway Modes of Operation

| Runway Direction | Westerly | Easterly |
|---|---|---|
| EGLL 27L | Arrivals | Closed |
| EGLL 27C | CPT, DVR, MID, SAM | Closed |
| EGLL 27R (north) | CPT, BPK, DVR, WOB | Closed |
| EGLL 09R | Closed | Arrivals |
| EGLL 09C | Closed | CPT, DVR, MID, SAM |
| EGLL 09L (north) | Closed | CPT, BPK, BUZ, DVR |

Table 32 - Heathrow Airport North West Runway – Departure Runway Assignment

- It was assumed that the MID departure route could be re-designed to follow an NPR suitably separated from the CPT and SAM departure NPRs to enable a minimum departure interval of 1 minute.

## Gatwick Airport Second Runway

- The parallel runways at Gatwick operated independently.
- The parallel runways at Heathrow operated independently.
- *At Heathrow Tactically Enhanced Arrival Management was enacted during the 05:00 – 06:00 UTC when an increase in arrival traffic is scheduled; during this period, both runways were made available for arrivals, with the former departure runway operating in mixed-mode. These are indicated with an asterisk in Table 33.
- During Tactically Enhanced Arrival Management (TEAM) at Heathrow, Heathrow Traffic could arrive on the two arrival runways but only with adherence to a staggered separation. It is assumed no change to today's operation of TEAM; that is a minimum radar separation on final approach of 2.5nm.
- Departure aircraft at Gatwick were assigned runways based on compass mode with the exception of the SAM SID during Easterly runway operations as indicated in Table 34.

| Runway Direction | Westerly | Easterly |
|---|---|---|
| EGKK 26L (south) | Mixed | Closed |
| EGKK 26C | Mixed | Closed |
| EGKK 08R (south) | Closed | Mixed |
| EGKK 08C | Closed | Mixed |
| EGLL 27L | Arrivals | Closed |
| EGLL 27R | Departures* | Closed |
| EGLL 09R | Closed | Departures* |
| EGLL 09L | Closed | Arrivals |

Table 33 - Gatwick Airport Second Runway - Runway Modes of Operation

| Runway Direction | Westerly | Easterly |
|---|---|---|
| EGKK 26L (south) | BOGNA, CLN, LAM | Closed |
| EGKK 26C | DVR, KENET, SAM | Closed |
| EGKK 08R (south) | Closed | SAM, SFD |
| EGKK 08C | Closed | CLN, DVR, KENET, LAM, SAM |

Table 34 - Gatwick Airport Second Runway - Departure Runway Assignment

## Do Minimum

- The parallel runways at Heathrow operated independently.
- Standard arrival-arrival separation was assumed as 3NM.
- At Heathrow Tactically Enhanced Arrival Management was enacted during the 05:00 – 06:00 UTC when an increase in arrival traffic is scheduled; during this period, both runways were made available for arrivals, with the former departure runway operating in mixed-mode. These are indicated with an asterisk in Table 35.
- During Tactically Enhanced Arrival Management (TEAM) at Heathrow, Heathrow Traffic could arrive on the two arrival runways but only with adherence to a staggered separation. It is assumed no change to today's operation of TEAM; that is a minimum radar separation on final approach of 2.5nm.

| Runway Direction | Westerly | Easterly |
|---|---|---|
| EGKK 26L | Mixed | Closed |
| EGKK 08R | Closed | Mixed |
| EGLL 27L | Arrivals | Closed |
| EGLL 27R | Departures* | Closed |
| EGLL 09R | Closed | Departures* |
| EGLL 09L | Closed | Arrivals |

Table 35 - Do Minimum - Runway Modes of Operation

# Appendix C. Traffic Sample Assumptions

- Preliminary Flightplan information was obtained from CFMU planned data rather than actual flown data. This ensured that problems arising from excess demand were not masked by the re-filing of flight plans or aircraft substitutions, for example in response to the application of flow regulations.
- A single day's traffic sample was selected and agreed with the Airports Commission Secretariat as detailed in Appendix D. This date was considered to represent a 'typically busy' demand from summer 2013.
- The Airports Commission 2040 'Low Cost is King' Carbon Traded forecasts were used to grow the traffic for each scenario, as per the Airports Commission Secretariat request.
- Future traffic demand was determined by comparing actual movements from 2013 with the Airports Commission forecasted movements on an airfield / region-pair basis. A maximum growth rate of 2500% was applied to avoid the potential for unrealistic numbers of flights in the one day traffic sample where a large traffic growth was predicted over the year. Where there were flights forecast in 2040 but none present in the 2013 sample it was identified in the post-growth analysis detailed in Appendix E. In these cases, where the number of forecast flights divided by the number of operating days per year was more than 1, this number of flights was added to the sample.
- It was requested that the traffic samples for the expanded airports (i.e. the Gatwick traffic samples in the Gatwick second runway scenario or the Heathrow samples in the Heathrow Airport North West Runway or Heathrow Airport Northern Runway Extension scenarios) align with those used in 'Noise: Local Assessment' (Ref 5). However, as these schedules did not include enough information to create the flightplans required for Fast Time Simulation, the samples grown from the 2013 actual flightplans were adjusted to reflect the number of movements and fleet mix from the noise modelling schedules.
- The future traffic demand process also reduced the number of flights that were present in the 2013 sample but were forecast to reduce in demand by 2040.
- The Airports Commission forecasts did not include overflights (flights in UK airspace which do not depart from or arrive at a UK airfield). Therefore it was agreed with the Airports Commission secretariat that a 2% year on year growth assumption should be applied up to the year 2040 followed by a reduction of this total figure by 10% in 2040 to reflect a degree of market maturity.
- Only existing aircraft types were modelled due to the non-existence of aircraft performance data for future aircraft types. Thus the aircraft groups featured in the Airports Commission forecasts were approximated by current aircraft types.
- It is not possible to predict a specific requested flight level for a forecast flight, therefore requested flight levels were unchanged for flights forecast to use the same aircraft type and routing as a predecessor in the 2013 sample. When a new aircraft type was assigned to a route, aircraft types of the same aircraft type category (equivalent to the Airports Commission aircraft groups) and using the same or similar routing (and direction) were assumed to request the same flight level.
- Where the resulting flightplan demand exceeded hourly runway capacity limits, the excess demand was moved into alternative hours.
- The underlying assumption affecting the timing of grown traffic within the schedule was that the greatest complexity impacting upon the airspace network would arise from a growth of existing trends in runway demand rather than a smoothing of the demand profile across the day.
- (Pre-Simulation) flightplan demand on runways was estimated from the initial flightplan activation time;
    - For traffic outbound from a UK airfield, the flightplan activation time was obtained from the CFMU initial demand Estimated Off-Block Time plus standard taxi times as indicated in the CFMU data.
    - For traffic inbound to a UK airfield, the flightplan activation time together with aircraft performance data and the shortest length of the proposed route was used to ascertain its arrival at the runway.
- Standard Taxi-times for 2040 were assumed as Gatwick: 25 minutes Heathrow: 20 minutes
- No growth of traffic demand at Heathrow or Gatwick was to occur during periods subject to night time restrictions. Any traffic that the growth process placed into such a period, were moved into later periods of the day (whilst being cognisant of the hourly runway capacity limits).
- Night time restrictions were assumed to cover the hours midnight to 04:59 UTC. Note that as the traffic sample used was from summer, local time is BST i.e. UTC+1.
- Traffic routings were initially based on their initial flightplan, as per the CFMU data, and adjusted as necessary for the LAMP Phase 1A airspace change. Traffic was generated and removed for the simulation at the planned UK entry and exit fix locations, for inbound and outbound traffic respectively. UK Overflights were generated at their planned UK entry fix locations and removed at their planned UK exit fix locations.

# Appendix D. Traffic Sample Selection

The scope of the Airports Commission FTS work calls for a single day's sample of traffic chosen to stress-test the airspace. The requirement is for a busy traffic sample, to be taken from 2013, which represents the typical traffic flows seen in UK airspace. It is not necessary to consider fleet mix in the traffic sample selection as it is intended that this will be manipulated in accordance with fleet mix forecasts after the sample has been selected and grown.

Figure 50 shows number of ATMs for all UK airfields by month during 2013. It shows that July was the busiest month by over 17,500 movements.

| | |
|---|---|
| January | **134,204** |
| February | **153,159** |
| March | **164,093** |
| April | **178,433** |
| May | **191,878** |
| June | **151,548** |
| July | **212,997** |
| August | **191,099** |
| September | **188,149** |
| October | **195,366** |
| November | **140,498** |
| December | **158,913** |

**Figure 50 – Air Transport Movements at UK airfields for 2013.**

The number of total UK ATMs per day in July is shown in Figure 51, split by flight type, i.e. departures, arrivals, domestic and overflights.
Demand varies over the month with weekends generally being the least busy days and thus they are discounted from the selection for this reason. The busiest day overall was the 5th July (highlighted with a green bar on the chart).

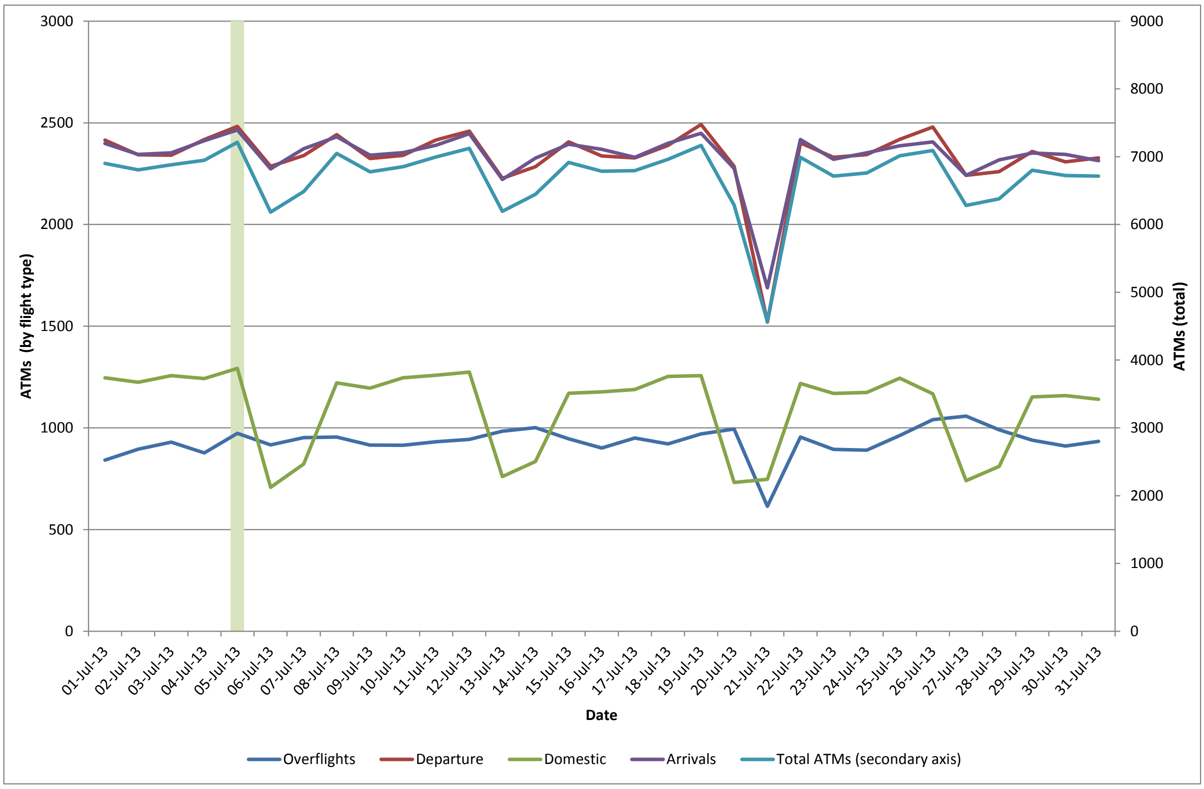



**Figure 51 - Air Transport Movements at UK airfields for July 2013**

Table 36 shows the average, minimum and maximum distributions of flight types for weekdays in July 2013. By this measure the traffic make-up on the 5th July 2013 can be considered representative.

| | Average | Min | Max | 5th July 2013 |
|---|---|---|---|---|
| Overflights | 14% | 12% | 17% | 13% |
| Departure | 35% | 33% | 37% | 34% |
| Domestic | 16% | 11% | 18% | 18% |
| Arrivals | 35% | 34% | 37% | 34% |

Table 36 – Proportion of flight types during July 2013 (5th July and weekdays)

Figure 52 shows the number of movements at the UK's busiest airfields as a percentage of all UK movements (excluding overflights) for weekdays in July.

The distribution of traffic between airfields is fairly constant throughout the month although some variations can be seen particularly at the smaller airfields. It should be noted that as Heathrow is at full capacity, the fluctuations that can be seen throughout the month for Heathrow are far more affected by the total number of UK movements, rather than variation in the number of movements at Heathrow.

By this measure, the traffic composition on the 5th July can be considered representative.

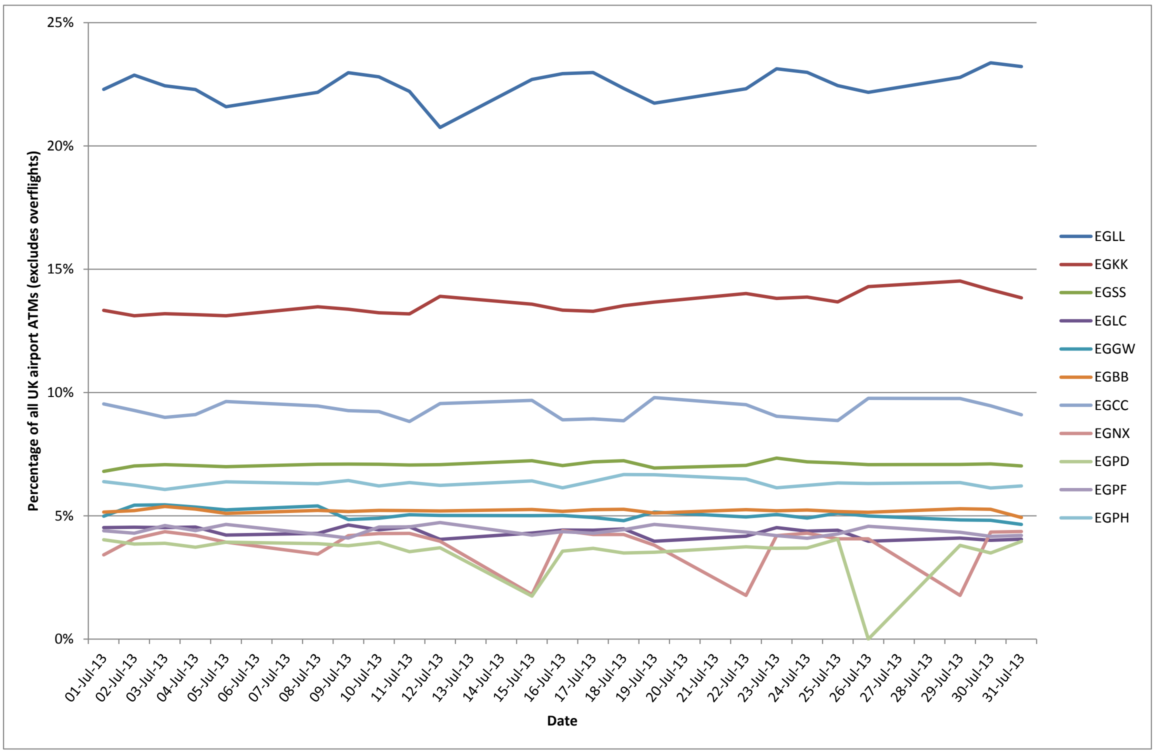



Figure 52 - ATMs at the busiest UK airfields as a proportion of all UK airfield ATMs

Information on traffic flows was analysed using movement data, with origin and destination country employed as a proxy. Figure 53 shows the average traffic flows for weekdays in July 2013 and for the 5th of July 2013. Traffic is shown by its country of arrival or departure country outside the UK.

Countries with less than 10 movements have been grouped into the category 'Other'.

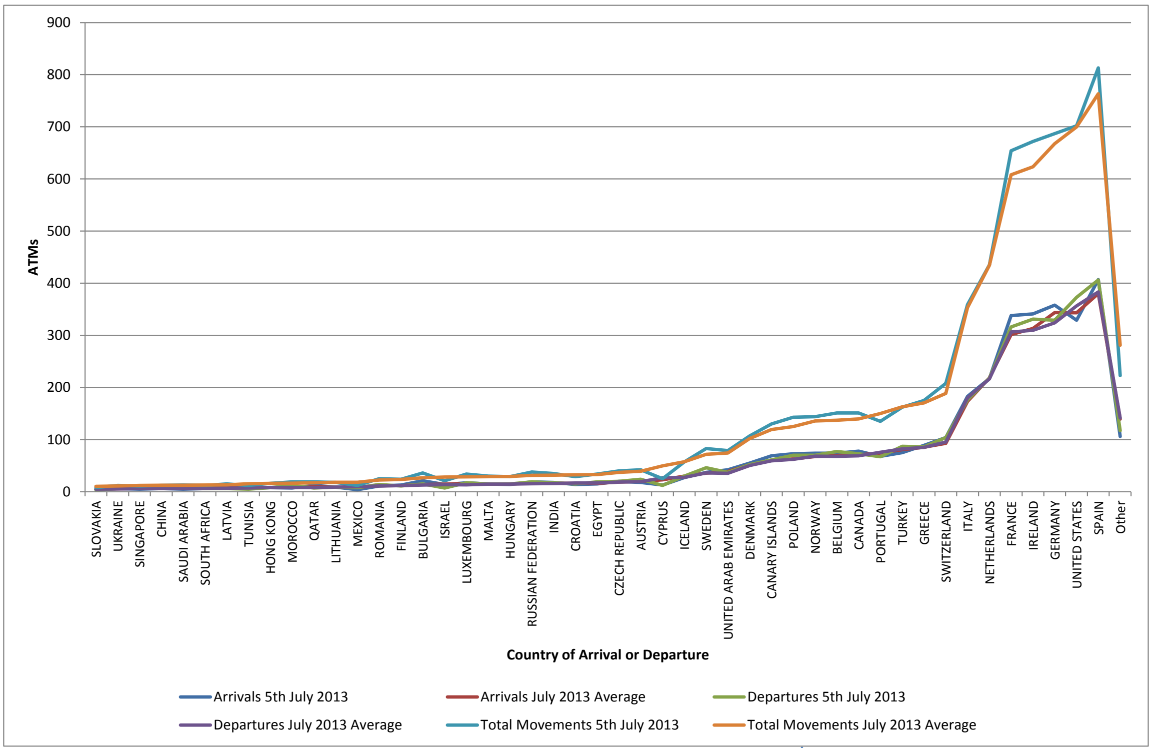



**Figure 53 – Traffic Flows for weekdays in July 2013 and 5th July 2013**

Figure 53 shows that the traffic flows on the 5th July 2013 are sufficiently similar to those of the average July 2013 weekday for it to be considered a representative sample.

Figure 54 shows the number of departures from UK airfields by take-off time while Figure 55 shows the number of arrivals to UK airfields by touch-down time, throughout the day for each weekday of July 2013. The 5th of July 2013 is represented by the black line in each case and reflects the same peaks in demand seen throughout whole of July.

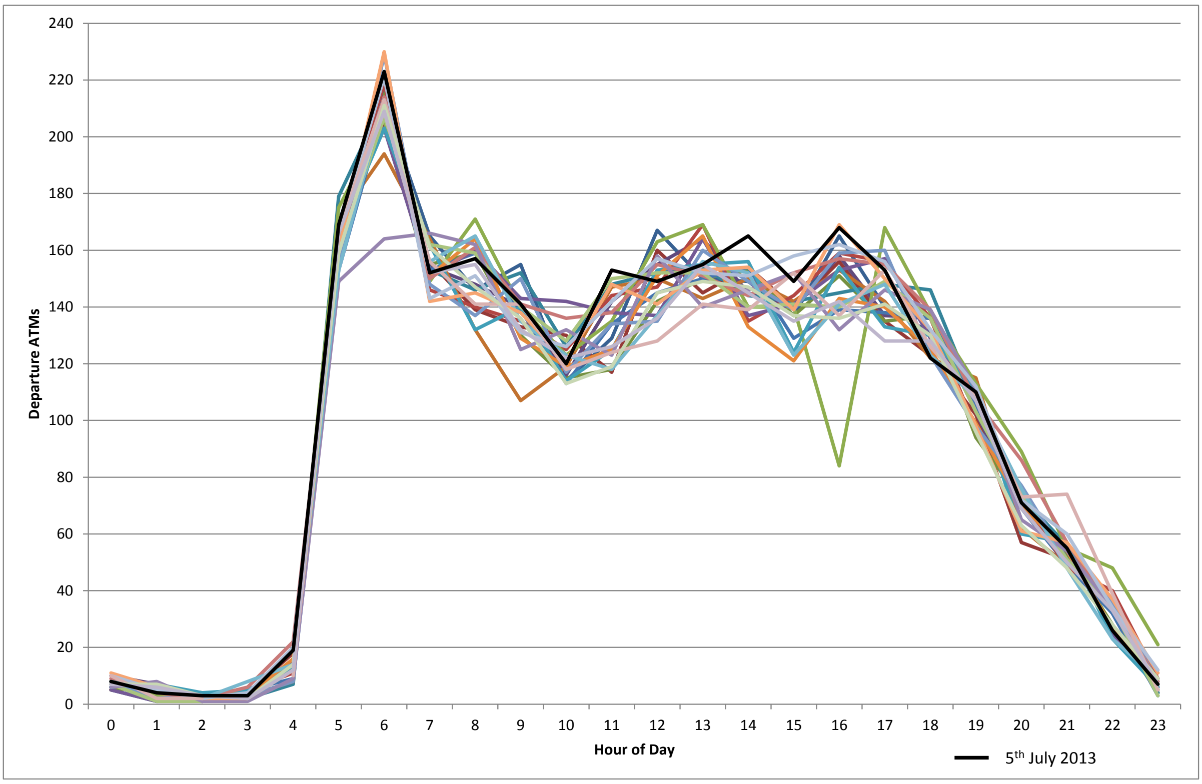



**Figure 54 – Departures from UK airfields by airfield departure time (July 2013)**

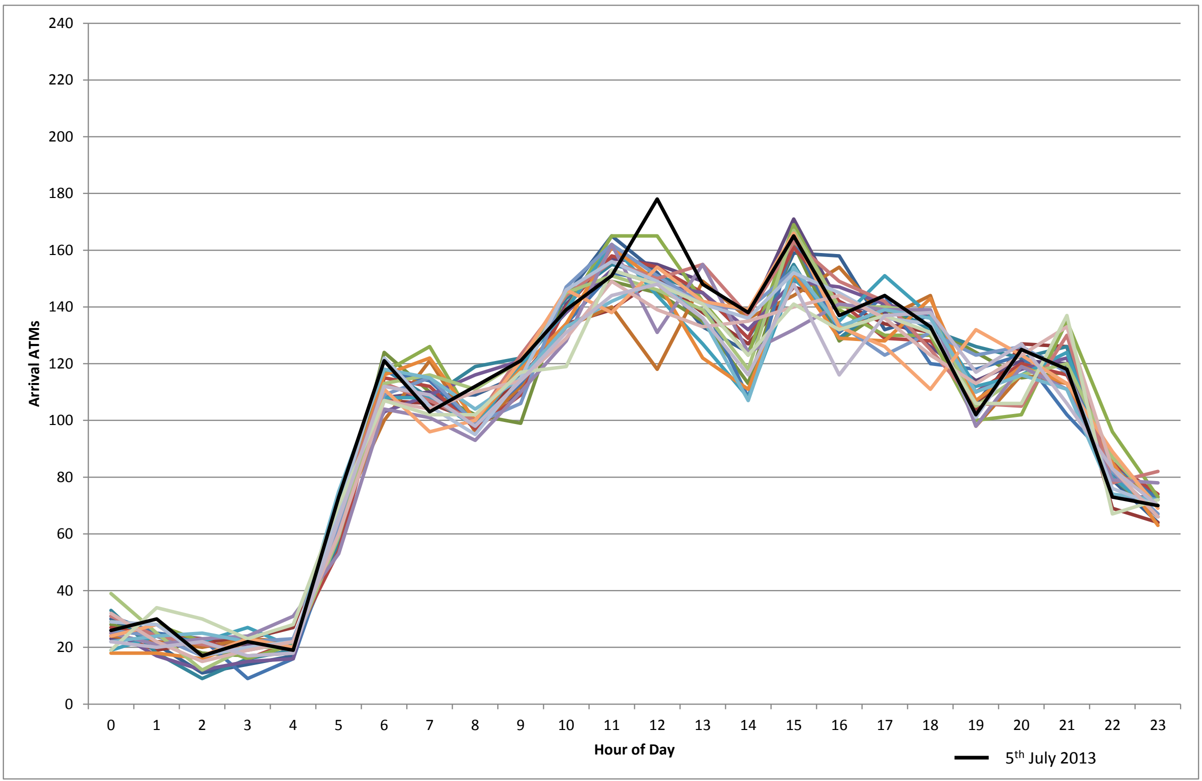



Figure 55 – Arrivals to UK airfields by airfield arrival time (July 2013)

The 5th July 2013 traffic sample has also been checked for unusual occurrences and it was found that no significant events or weather regulations occurred that would have affected air traffic. Therefore 5th July 2013 has been selected as the base date from which to produce the grown traffic sample for use in the Airports Commission Fast Time Simulation assessments.

# Appendix E. Post Traffic Growth Analysis

As detailed in section 5.2 the traffic samples for this analysis were 'grown' from a busy 2013 sample day according to the growth rates determined by comparing the 2040 forecasted ATMs between airfields / regions with the 2013 actual flown movements. For the resulting generated traffic samples, the biggest 7 UK airfields were then analysed to ensure that;

- The traffic samples represent a busy 2040 day. As demand is not uniform throughout the year, it was a requirement of this study that peak demand be modelled to stress-test the airspace.
- The percentage growth forecast to 2040 for each airfield / region was reflected in the single day sample. This was important as it highlighted where demand was forecast for 2040 but there were no applicable flightplans filed on the 2013 selected sample day. In these cases, where the number of forecast flights divided by the number of operating days per year was more than 1, this number of flights was added to the sample.

Table 37 shows the number of movements for the biggest 7 UK airfields for the chosen sample day as a percentage of the total 2013 movements for those airfields. From this, it is possible to derive the percentage of annual movements for each airfield which constitute a busy traffic day.

| **2013 base year** | **HEATHROW** | **GATWICK** | **STANSTED** | **LUTON** | **LONDON CITY** | **BIRMINGHAM** | **MANCHESTER** | **UK arrivals and Departures** |
|---|---|---|---|---|---|---|---|---|
| **Year total** | **471,841** | **250,285** | **142,807** | **96,787** | **73,891** | **91,457** | **168,739** | **2,129,287** |
| 05/07/2013 | 1,412 | 845 | 442 | 335 | 265 | 299 | 543 | 6,307 |
| Sample day proportion | 0.30% | 0.34% | 0.31% | 0.35% | 0.36% | 0.33% | 0.32% | 0.29% |

Table 37 - Number of ATMs in 2013 traffic sample at the 7 biggest UK airfields

Table 2, Table 39, Table 40 and Table 41 show the same information for the Do Minimum, Gatwick Airport Second Runway, Heathrow Airport North West Runway and Heathrow Airport Northern Runway Extension scenarios respectively. In each scenario the number of movements in the traffic sample as a percentage of the annual forecasted movements for each airfield is within 0.03% of the same calculation for the 2013 base year. The figures for the expanded airports are detailed separately in Table 42 to Table 44 as these were taken from the schedules used in 'Noise: Local Assessment' (Ref 5) as requested by the Airports Commission Secretariat.

| **2040 Do Minimum** | **HEATHROW** | **GATWICK** | **STANSTED** | **LUTON** | **LONDON CITY** | **BIRMINGHAM** | **MANCHESTER** | **UK arrivals and Departures** |
|---|---|---|---|---|---|---|---|---|
| **2040 forecasts** (Airports Commission) | **478,781** | **281,500** | **215,217** | **119,973** | **123,014** | **206,559** | **283,599** | 3,104,060 |
| 05/07/2040 | 1,433 | 918 | 653 | 392 | 430 | 709 | 877 | 8,755 |
| Sample day proportion | 0.30% | 0.33% | 0.30% | 0.33% | 0.35% | 0.34% | 0.31% | 0.28% |

Table 38 - Number of ATMs in 2040 Do Minimum scenario at the 7 biggest UK airfields

| **2040 Gatwick Airport Second Runway** | **HEATHROW** | **GATWICK** | **STANSTED** | **LUTON** | **LONDON CITY** | **BIRMINGHAM** | **MANCHESTER** | **UK arrivals and Departures** |
|---|---|---|---|---|---|---|---|---|
| **2040 forecasts** (Airports Commission) | **478,536** | **n/a** | **215,513** | **137,949** | **114,657** | **187,553** | **301,693** | **3,410,280** |
| 05/07/2040 | 1,403 | n/a | 644 | 437 | 385 | 605 | 920 | 9,214 |
| Sample day proportion | 0.29% | n/a | 0.31% | 0.33% | 0.35% | 0.34% | 0.31% | 0.28% |

Table 39 - Number of ATMs in 2040 Gatwick Airport Second Runway scenario at the 7 biggest UK airfields

| 2040 Heathrow Airport North West Runway | HEATHROW | GATWICK | STANSTED | LUTON | LONDON CITY | BIRMINGHAM | MANCHESTER | UK arrivals and Departures |
|---|---|---|---|---|---|---|---|---|
| **2040 forecasts** **(Airports Commission)** | **n/a** | **282,301** | **211,432** | **117,114** | **121,413** | **171,913** | **285,869** | **3,197,350** |
| 05/07/2040 | n/a | 918 | 616 | 385 | 420 | 581 | 899 | 8,939 |
| Sample day proportion | n/a | 0.33% | 0.31% | 0.34% | 0.36% | 0.35% | 0.32% | 0.31% |

Table 40 - Number of ATMs in 2040 Heathrow Airport North West Runway scenario at the 7 biggest UK airfields

| 2040 Heathrow Airport Northern Runway Extension | HEATHROW | GATWICK | STANSTED | LUTON | LONDON CITY | BIRMINGHAM | MANCHESTER | UK arrivals and Departures |
|---|---|---|---|---|---|---|---|---|
| **2040 forecasts** **(Airports Commission)** | **n/a** | **285,216** | **212,083** | **116,052** | **120,846** | **181,083** | **286,515** | **3,172,586** |
| 05/07/2040 | n/a | 918 | 618 | 381 | 421 | 614 | 895 | 8,935 |
| Sample day proportion | n/a | 0.33% | 0.31% | 0.33% | 0.36% | 0.36% | 0.32% | 0.31% |

Table 41 - Number of ATMs in 2040 Heathrow Airport Northern Runway Extension scenario at the 7 biggest UK airfields

| 2040 Gatwick Airport Second Runway | GATWICK |
|---|---|
| **2040 forecasts** **(Airports Commission)** | **566,428** |
| Number of flights in sample | 1,634 |
| Sample day proportion | 0.29% |

Table 42 - Number of ATMs in 2040 Gatwick Airport Second Runway scenario at Gatwick

| 2040 Heathrow Airport North West Runway | HEATHROW |
|---|---|
| **2040 forecasts** **(Airports Commission)** | **748,983** |
| Number of flights in sample | 2,054 |
| Sample day proportion | 0.27% |

Table 43 - Number of ATMs in 2040 Heathrow Airport North West Runway scenario at Heathrow

| 2040 Heathrow Airport Northern Runway Extension | HEATHROW |
|---|---|
| **2040 forecasts** **(Airports Commission)** | **703,366** |
| Number of flights in sample | 1,944 |
| Sample day proportion | 0.28% |

Table 44 - Number of ATMs in 2040 Heathrow Airport Northern Runway Extension scenario at Heathrow

Table 45 through to Table 69 below show the airfield / region percentage growth breakdown for each of the biggest 7 UK airfields from 2013 to 2040 for each of the scenarios. The 'Year' column shows the percentage difference between the actual 2013 flights and the 2040 forecast flights while the 'Day' column shows the percentage growth between the original 2013 day sample and the 2040 day sample as produced by the 'growth' process.

- The percentages quoted are the percentage growth between the 2013 and 2040 samples i.e.100% means that the 2013 sample has been doubled (an additional 100% has been added to the original number of flights).
- A negative percentage means that the number of flights has been reduced i.e. -50% means that the number of flights in the 2013 sample has been halved.
- Where an airfield / region is not present in the tables, there were no movements forecast between this airfield / region and the table airfield.
- Figures for the expanded airports are not included as these were taken from the schedules used in Noise: Local Assessment (Ref 5) as requested by the Airports Commission Secretariat.
- The few large percentage growth differences between the year figures and the day sample are due to the number of flights in the sample. Where the number of flights in the day sample is small, the smallest possible difference of one flight can translate to a misleading percentage jump which is not reflected in the year figures (as they contain more flights).

| Do Minimum | 2013vs2040 | |
| --- | --- | --- |
| **Manchester** | Year | Day |
| BEL_LUX | 40% | 43% |
| BRISTOL | 189% | None in 2013 sample |
| CANADA | 267% | 250% |
| CANARIES | 15% | 18% |
| CEN_EUROPE | 235% | 238% |
| CHANNEL_ISLES | 208% | 200% |
| EAST_AFRICA | 478% | 482% |
| EAST_ANGLIA | 47% | None in 2013 sample |
| EAST_EUROPE | -93% | -100% |
| EDINBURGH | 89% | 83% |
| EIRE | 98% | 100% |
| FAR_EAST | 4739% | None in 2013 sample |
| FRANCE | 73% | 71% |
| GERMANY | -8% | -11% |
| GREECE | 82% | 83% |
| GREEN_ICELAND | 130% | 133% |
| HOLLAND | 151% | 150% |
| IBERIA | 45% | 48% |
| ITALY | -21% | -23% |
| LATIN_AMERICA | 408% | 400% |
| LUTON | 992% | None in 2013 sample |
| MIDDLE_EAST | 72% | 73% |
| N_IRELAND | 50% | 53% |
| OTHER_MED | 141% | 143% |
| SCANDINAVIA | 28% | 31% |
| SCOTLAND | 3% | 0% |
| SOUTH_WEST | 58% | 50% |
| SOUTHAMPTON | -45% | -60% |
| USA | 137% | 130% |
| WEST_AFRICA | -33% | -67% |

Table 45 – Traffic Growth: Do Minimum, Manchester

| Do Minimum | 2013vs2040 | |
| --- | --- | --- |
| **Luton** | Year | Day |
| CEN_EUROPE | -10% | -6% |
| CHANNEL_ISLES | -25% | -67% |
| EAST_EUROPE | 43% | 43% |
| EDINBURGH | -89% | -100% |
| GERMANY | -42% | -47% |
| GLASGOW | 750% | 756% |
| GREECE | 1% | 0% |
| IBERIA | 100% | 100% |
| MANCHESTER | 992% | None in 2013 sample |
| N_IRELAND | 96% | 100% |
| OTHER_MED | 262% | 265% |
| SCANDINAVIA | -97% | -100% |
| SCOTLAND | 351% | 360% |

Table 46 – Traffic Growth: Do Minimum, Luton

| Do Minimum | 2013vs2040 | |
| --- | --- | --- |
| **Birmingham** | Year | Day |
| BEL_LUX | 226% | 222% |
| CANADA | 497% | None in 2013 sample |
| CANARIES | -3% | -18% |
| CEN_EUROPE | 480% | 480% |
| CHANNEL_ISLES | 129% | 133% |
| EAST_EUROPE | 1028% | 1000% |
| EDINBURGH | -72% | -85% |
| EIRE | 111% | 125% |
| FRANCE | -12% | -15% |
| GERMANY | 119% | 122% |
| GLASGOW | 47% | 50% |
| GREECE | 594% | 590% |
| GREEN_ICELAND | 2700% | None in 2013 sample |
| HOLLAND | 49% | 50% |
| IBERIA | 205% | 205% |
| ITALY | -4% | -25% |
| N_IRELAND | 4% | 0% |
| NORTH | 128% | None in 2013 sample |
| OTHER_MED | 194% | 189% |
| SCANDINAVIA | 497% | 500% |
| SCOTLAND | 120% | 115% |
| WEST_AFRICA | -98% | -100% |
| WEST_MID | -100% | -100% |

Table 47 – Traffic Growth: Do Minimum, Birmingham

| Do Minimum | 2013vs2040 | |
| --- | --- | --- |
| **Heathrow** | Year | Day |
| CANADA | 38% | 38% |
| CEN_EUROPE | -33% | -32% |
| EAST_EUROPE | 27% | 29% |
| EIRE | 15% | 14% |
| FAR_EAST | 58% | 58% |
| FRANCE | -24% | -23% |
| GERMANY | 1% | 1% |
| GREECE | 44% | 49% |
| HOLLAND | 23% | 21% |
| IBERIA | 46% | 45% |
| ITALY | -77% | -75% |
| MIDDLE_EAST | 89% | 89% |
| N_IRELAND | 30% | 33% |
| NORTH | -67% | -59% |
| OTHER_MED | 80% | 80% |
| SCANDINAVIA | -47% | -46% |
| SOUTH_AFRICA | 100% | 102% |
| USA | 15% | 14% |
| WEST_AFRICA | 87% | 86% |

Table 48 – Traffic Growth: Do Minimum, Heathrow

| Do Minimum | 2013vs2040 | |
|---|---|---|
| Stansted | Year | Day |
| CANADA | 100% | 100% |
| CANARIES | 113% | 125% |
| CEN_EUROPE | 198% | 200% |
| CHANNEL_ISLES | -5% | -100% |
| EAST_EUROPE | 30% | 31% |
| EDINBURGH | 273% | 274% |
| EIRE | 20% | 19% |
| FAR_EAST | 522% | 500% |
| FRANCE | 68% | 70% |
| GERMANY | -22% | -28% |
| IBERIA | 121% | 124% |
| ITALY | 35% | 35% |
| N_IRELAND | 29% | 29% |
| NORTH | 376% | 400% |
| OTHER_MED | 94% | 92% |
| SCANDINAVIA | 29% | 32% |
| SCOTLAND | 279% | 300% |

Table 49 – Traffic Growth: Do Minimum, Stansted

| Do Minimum | 2013vs2040 | |
|---|---|---|
| Gatwick | Year | Day |
| CANADA | -99% | -100% |
| CANARIES | -41% | -42% |
| CEN_EUROPE | 17% | 15% |
| CHANNEL_ISLES | -26% | -30% |
| EAST_AFRICA | 468% | 462% |
| EAST_EUROPE | -97% | -100% |
| EDINBURGH | -82% | -89% |
| EIRE | -5% | -7% |
| FAR_EAST | -16% | -40% |
| FRANCE | -35% | -37% |
| GERMANY | 182% | 179% |
| GLASGOW | -79% | -88% |
| GREECE | 48% | 50% |
| GREEN_ICELAND | -93% | -100% |
| IBERIA | -16% | -14% |
| ITALY | 40% | 40% |
| LATIN_AMERICA | 218% | 218% |
| MIDDLE_EAST | -94% | -100% |
| N_IRELAND | -2% | -9% |
| NORTH | -38% | 0% |
| OTHER_MED | 45% | 45% |
| SCANDINAVIA | 93% | 93% |
| SCOTLAND | -13% | -14% |
| SOUTH_WEST | 41% | 33% |
| WEST_AFRICA | -66% | -71% |

Table 50 – Traffic Growth: Do Minimum, Gatwick

| Do Minimum | 2013vs2040 | |
|---|---|---|
| London City | Year | Day |
| BEL_LUX | 65% | 68% |
| CANARIES | 231225% | None in 2013 sample |
| CEN_EUROPE | 230% | 230% |
| CHANNEL_ISLES | 286% | 300% |
| EAST_EUROPE | 2507% | None in 2013 sample |
| EDINBURGH | 5% | 0% |
| FRANCE | 203% | 206% |
| GLASGOW | -23% | -13% |
| IBERIA | 201% | 200% |
| ITALY | 101% | 100% |
| SCANDINAVIA | 116% | 117% |

Table 51 – Traffic Growth: Do Minimum, London City

| Gatwick Airport Second Runway | 2013vs2040 | |
|---|---|---|
| Manchester | Year | Day |
| BEL_LUX | 26% | 29% |
| BOURNEMOUTH | -62% | None in 2013 sample |
| BRISTOL | 189% | None in 2013 sample |
| CANARIES | 24% | 24% |
| CEN_EUROPE | 288% | 288% |
| CHANNEL_ISLES | 228% | 233% |
| EAST_AFRICA | 434% | 436% |
| EAST_ANGLIA | 43% | None in 2013 sample |
| EAST_EUROPE | -88% | -100% |
| EDINBURGH | 84% | 83% |
| EIRE | 112% | None in 2013 sample |
| FAR_EAST | 4198% | None in 2013 sample |
| FRANCE | 66% | 64% |
| GATWICK | 2051% | 1000% |
| GERMANY | -14% | -17% |
| GREECE | 102% | 100% |
| GREEN_ICELAND | -54% | -33% |
| HOLLAND | 171% | 175% |
| IBERIA | 51% | 52% |
| ITALY | -20% | -23% |
| LATIN_AMERICA | 234% | 300% |
| LUTON | 626% | None in 2013 sample |
| MIDDLE_EAST | 63% | 65% |
| N_IRELAND | 45% | 47% |
| OTHER_MED | 148% | 146% |
| SCANDINAVIA | 11% | 13% |
| SCOTLAND | 0% | -8% |
| SOUTH_WEST | 49% | 50% |
| USA | 121% | 130% |
| WEST_AFRICA | -38% | -67% |
| WEST_MID | -97% | -100% |

Table 52 – Traffic Growth: Gatwick Airport Second Runway, Manchester

| Gatwick Airport Second Runway | 2013vs2040 | |
|---|---|---|
| Heathrow | Year | Day |
| BEL_LUX | -37% | -42% |
| BOURNEMOUTH | 53% | None in 2013 sample |
| CEN_EUROPE | 3% | 3% |
| EAST_EUROPE | 58% | 56% |
| EIRE | 20% | 20% |
| FAR_EAST | 3% | 18% |
| FRANCE | 29% | 29% |
| GERMANY | 12% | 12% |
| GREECE | 28% | 31% |
| HOLLAND | 39% | 41% |
| IBERIA | 73% | 75% |
| ITALY | -65% | -67% |
| MIDDLE_EAST | 57% | 65% |
| N_IRELAND | 25% | 30% |
| OTHER_MED | 113% | 113% |
| SCANDINAVIA | -48% | -49% |
| SOUTH_AFRICA | -49% | -50% |
| USA | 2% | 2% |
| WEST_AFRICA | 90% | 91% |
| WEST_MID | -14% | None in 2013 sample |

Table 53 – Traffic Growth: Gatwick Airport Second Runway, Heathrow

| Gatwick Airport Second Runway | 2013vs2040 | |
|---|---|---|
| Stansted | Year | Day |
| BOURNEMOUTH | -62% | None in 2013 sample |
| CANARIES | 75% | 75% |
| CEN_EUROPE | 213% | 212% |
| CHANNEL_ISLES | 182% | 200% |
| EAST_EUROPE | 22% | 25% |
| EDINBURGH | 261% | 258% |
| EIRE | 13% | 13% |
| FAR_EAST | 320% | 300% |
| FRANCE | 51% | 52% |
| GERMANY | 31% | 30% |
| IBERIA | 127% | 127% |
| ITALY | 25% | 24% |
| N_IRELAND | 29% | 6% |
| NORTH | 143% | 133% |
| OTHER_MED | 82% | 85% |
| SCANDINAVIA | 19% | 21% |
| WEST_MID | -96% | None in 2013 sample |

Table 54 – Traffic Growth: Gatwick Airport Second Runway, Stansted

| Gatwick Airport Second Runway | 2013vs2040 | |
|---|---|---|
| Luton | Year | Day |
| BOURNEMOUTH | -85% | -100% |
| CEN_EUROPE | -37% | -42% |
| EAST_EUROPE | 48% | 47% |
| EDINBURGH | -85% | -100% |
| EIRE | 95% | 100% |
| GERMANY | 76% | 73% |
| GLASGOW | 294% | 300% |
| GREECE | 747% | 740% |
| IBERIA | 88% | 90% |
| ITALY | 190% | 187% |
| MANCHESTER | 626% | None in 2013 sample |
| N_IRELAND | 96% | 100% |
| OTHER_MED | 263% | 245% |
| SCANDINAVIA | -97% | -100% |
| SCOTLAND | 43% | 40% |
| WEST_MID | -99% | -100% |

Table 55 – Traffic Growth: Gatwick Airport Second Runway, Luton

| Gatwick Airport Second Runway | 2013vs2040 | |
|---|---|---|
| London City | Year | Day |
| BEL_LUX | 72% | 72% |
| BOURNEMOUTH | -64% | -100% |
| CANARIES | 221075% | None in 2013 sample |
| CEN_EUROPE | 165% | 163% |
| EDINBURGH | 5% | 5% |
| GREECE | 77548% | None in 2013 sample |
| IBERIA | 488% | 488% |
| ITALY | 188% | 186% |
| SCANDINAVIA | 142% | 142% |
| WEST_MID | -95% | -100% |

Table 56 – Traffic Growth: Gatwick Airport Second Runway, London City

| Gatwick Airport Second Runway | 2013vs2040 | |
|---|---|---|
| Birmingham | Year | Day |
| BEL_LUX | 195% | 200% |
| BOURNEMOUTH | -46% | None in 2013 sample |
| CANADA | 292% | None in 2013 sample |
| CANARIES | -97% | -100% |
| CEN_EUROPE | 347% | 340% |
| CHANNEL_ISLES | 93% | 100% |
| EAST_EUROPE | 1061% | 1000% |
| EDINBURGH | -79% | -85% |
| EIRE | 108% | 100% |
| FRANCE | 46% | 46% |
| GERMANY | 122% | 122% |
| GLASGOW | 63% | 67% |
| GREECE | 293% | 290% |
| GREEN_ICELAND | 3604% | None in 2013 sample |
| HOLLAND | 33% | 38% |
| IBERIA | 164% | 164% |
| ITALY | -19% | -25% |
| N_IRELAND | 4% | -5% |
| NORTH | 127% | None in 2013 sample |
| OTHER_MED | 91% | 89% |
| SCANDINAVIA | 446% | 450% |
| SCOTLAND | 137% | 138% |
| WEST_AFRICA | -99% | -100% |
| WEST_MID | -99% | -100% |

Table 57 – Traffic Growth: Gatwick Airport Second Runway, Birmingham

| Heathrow Airport North West Runway | 2013vs2040 | |
|---|---|---|
| Manchester | Year | Day |
| BEL_LUX | 36% | 43% |
| BOURNEMOUTH | -62% | -100% |
| BRISTOL | 189% | None in 2013 sample |
| CANADA | 190% | 200% |
| CANARIES | 17% | 12% |
| CEN_EUROPE | 223% | 225% |
| CHANNEL_ISLES | 208% | 200% |
| EAST_AFRICA | 448% | 445% |
| EAST_ANGLIA | 45% | None in 2013 sample |
| EAST_EUROPE | -86% | -100% |
| EDINBURGH | 89% | 83% |
| EIRE | 101% | 100% |
| FAR_EAST | 4411% | None in 2013 sample |
| FRANCE | 71% | 71% |
| GERMANY | 2% | 4% |
| GREECE | 93% | 94% |
| GREEN_ICELAND | 135% | 133% |
| HOLLAND | 151% | 150% |
| IBERIA | 47% | 49% |
| ITALY | 39% | 38% |
| LATIN_AMERICA | 368% | 400% |
| LUTON | 1042% | None in 2013 sample |
| MIDDLE_EAST | 61% | 62% |
| N_IRELAND | 47% | 47% |
| OTHER_MED | 148% | 146% |
| SCANDINAVIA | 41% | 44% |
| SCOTLAND | 2% | 0% |
| SOUTH_WEST | 60% | 50% |
| SOUTHAMPTON | -46% | -60% |
| USA | 125% | 120% |
| WEST_AFRICA | -44% | -67% |
| WEST_MID | -97% | -100% |

Table 58 – Traffic Growth: Heathrow Airport North West Runway, Manchester

| Heathrow Airport North West Runway | 2013vs2040 | |
|---|---|---|
| **Birmingham** | Year | Day |
| BEL_LUX | 126% | 122% |
| BOURNEMOUTH | -46% | None in 2013 sample |
| CANADA | 284% | None in 2013 sample |
| CANARIES | -14% | -18% |
| CEN_EUROPE | 295% | 300% |
| CHANNEL_ISLES | 93% | 100% |
| EAST_EUROPE | 627% | 633% |
| EDINBURGH | -82% | -85% |
| EIRE | 70% | 75% |
| FRANCE | 52% | 54% |
| GERMANY | 69% | 67% |
| GLASGOW | 31% | 33% |
| GREECE | 369% | 370% |
| GREEN_ICELAND | 3605% | None in 2013 sample |
| HOLLAND | 33% | 38% |
| IBERIA | 107% | 110% |
| ITALY | 339% | 350% |
| N_IRELAND | 4% | -5% |
| NORTH | 128% | None in 2013 sample |
| OTHER_MED | 70% | 68% |
| SCANDINAVIA | 346% | 350% |
| SCOTLAND | 129% | 131% |
| WEST_MID | -99% | -100% |

Table 59 – Traffic Growth: Heathrow Airport North West Runway, Birmingham

| Heathrow Airport North West Runway | 2013vs2040 | |
|---|---|---|
| **Stansted** | Year | Day |
| BOURNEMOUTH | -62% | None in 2013 sample |
| CANARIES | 144% | 150% |
| CEN_EUROPE | 236% | 235% |
| CHANNEL_ISLES | 136% | 100% |
| EAST_EUROPE | -38% | -44% |
| EDINBURGH | 188% | 184% |
| EIRE | 41% | 42% |
| FAR_EAST | 1557% | 1000% |
| FRANCE | 73% | 73% |
| GERMANY | -34% | -35% |
| IBERIA | 150% | 151% |
| ITALY | -12% | -12% |
| N_IRELAND | 29% | 6% |
| NORTH | 215% | 200% |
| OTHER_MED | 99% | 100% |
| SCANDINAVIA | 34% | 32% |
| WEST_MID | -96% | -100% |

Table 60 – Traffic Growth: Heathrow Airport North West Runway, Stansted

| Heathrow Airport North West Runway | 2013vs2040 | |
|---|---|---|
| **Gatwick** | Year | Day |
| BOURNEMOUTH | -47% | None in 2013 sample |
| CANADA | -92% | -100% |
| CANARIES | -30% | -38% |
| CEN_EUROPE | 12% | 15% |
| CHANNEL_ISLES | 3% | 5% |
| EAST_AFRICA | 420% | 423% |
| EAST_EUROPE | -75% | -75% |
| EDINBURGH | -93% | -100% |
| EIRE | 0% | 0% |
| FAR_EAST | -6% | -40% |
| FRANCE | -11% | -14% |
| GERMANY | 160% | 157% |
| GLASGOW | -88% | -94% |
| GREECE | 64% | 62% |
| GREEN_ICELAND | 56% | 50% |
| IBERIA | -23% | -21% |
| ITALY | -18% | -20% |
| LATIN_AMERICA | 233% | 232% |
| MIDDLE_EAST | -94% | -100% |
| N_IRELAND | -2% | -9% |
| NORTH | -17% | -33% |
| OTHER_MED | 67% | 66% |
| SCANDINAVIA | 70% | 70% |
| SCOTLAND | 185% | 186% |
| SOUTH_WEST | 56% | 67% |
| USA | -93% | -100% |
| WEST_AFRICA | -60% | -64% |
| WEST_MID | -57% | None in 2013 sample |

Table 61 – Traffic Growth: Heathrow Airport North West Runway, Gatwick

| Heathrow Airport North West Runway Luton | 2013vs2040 Year | Day |
|---|---|---|
| BOURNEMOUTH | -85% | -100% |
| CEN_EUROPE | -50% | -52% |
| CHANNEL_ISLES | 2% | 0% |
| EAST_EUROPE | 70% | 70% |
| GERMANY | -99% | -100% |
| GLASGOW | 708% | 700% |
| GREECE | 13% | 0% |
| IBERIA | 62% | 68% |
| MANCHESTER | 1042% | None in 2013 sample |
| N_IRELAND | 96% | 100% |
| OTHER_MED | 417% | 395% |
| SCANDINAVIA | -96% | -100% |
| SCOTLAND | 185% | 200% |
| WEST_MID | -99% | -100% |

Table 62 – Traffic Growth: Heathrow Airport North West Runway, Luton

| Heathrow Airport North West Runway London City | 2013vs2040 Year | Day |
|---|---|---|
| BEL_LUX | 68% | 68% |
| BOURNEMOUTH | -64% | -100% |
| CANARIES | 273975% | None in 2013 sample |
| CEN_EUROPE | 184% | 187% |
| CHANNEL_ISLES | 291% | 300% |
| EAST_EUROPE | 2450% | None in 2013 sample |
| EDINBURGH | 4% | 0% |
| FRANCE | 101% | 100% |
| GERMANY | -69% | -69% |
| GLASGOW | -23% | -13% |
| HOLLAND | -35% | -38% |
| IBERIA | 331% | 335% |
| ITALY | -52% | -64% |
| SCANDINAVIA | 133% | 133% |
| WEST_MID | -95% | -100% |

Table 63 – Traffic Growth: Heathrow Airport North West Runway, London City

| Heathrow Airport Northern Runway Extension Manchester | 2013vs2040 Year | Day |
|---|---|---|
| BEL_LUX | 37% | 43% |
| BOURNEMOUTH | -62% | -100% |
| BRISTOL | 189% | None in 2013 sample |
| CANADA | 202% | 200% |
| CANARIES | 17% | 12% |
| CEN_EUROPE | 226% | 225% |
| CHANNEL_ISLES | 208% | 200% |
| EAST_AFRICA | 452% | 455% |
| EAST_ANGLIA | 46% | None in 2013 sample |
| EAST_EUROPE | -87% | -100% |
| EDINBURGH | 89% | 83% |
| EIRE | 101% | 100% |
| FAR_EAST | 4479% | None in 2013 sample |
| FRANCE | 73% | 71% |
| GERMANY | 1% | 0% |
| GREECE | 91% | 89% |
| GREEN_ICELAND | 133% | 133% |
| HOLLAND | 151% | 150% |
| IBERIA | 48% | 49% |
| ITALY | 40% | 38% |
| LATIN_AMERICA | 374% | 400% |
| LUTON | 1030% | None in 2013 sample |
| MIDDLE_EAST | 63% | 65% |
| N_IRELAND | 48% | 47% |
| OTHER_MED | 146% | 143% |
| SCANDINAVIA | 38% | 38% |
| SCOTLAND | 2% | 0% |
| SOUTH_WEST | 59% | 50% |
| SOUTHAMPTON | -46% | -60% |
| USA | 129% | 120% |
| WEST_AFRICA | -42% | -67% |
| WEST_MID | -97% | -100% |

Table 64 – Traffic Growth: Heathrow Airport Northern Runway Extension, Manchester

| Heathrow Airport Northern Runway Extension | 2013vs2040 | |
|---|---|---|
| **London City** | Year | Day |
| BEL_LUX | 67% | 68% |
| BOURNEMOUTH | -64% | -100% |
| CANARIES | 263225% | None in 2013 sample |
| CEN_EUROPE | 178% | 180% |
| CHANNEL_ISLES | 287% | 300% |
| EAST_EUROPE | 2488% | None in 2013 sample |
| EDINBURGH | 4% | 5% |
| FRANCE | 108% | 111% |
| GERMANY | -99% | -100% |
| GLASGOW | -23% | -13% |
| HOLLAND | -35% | -38% |
| IBERIA | 283% | 288% |
| ITALY | 59% | 64% |
| SCANDINAVIA | 129% | 125% |
| WEST_MID | -95% | None in 2013 sample |

**Table 65 – Traffic Growth: Heathrow Airport Northern Runway Extension, London City**

| Heathrow Airport Northern Runway Extension | 2013vs2040 | |
|---|---|---|
| **Birmingham** | Year | Day |
| BEL_LUX | 142% | 144% |
| BOURNEMOUTH | -46% | 0% |
| CANADA | 289% | None in 2013 sample |
| CANARIES | -10% | -18% |
| CEN_EUROPE | 306% | 300% |
| CHANNEL_ISLES | 93% | 133% |
| EAST_EUROPE | 719% | 700% |
| EDINBURGH | -82% | -85% |
| EIRE | 73% | 75% |
| FRANCE | 54% | 54% |
| GERMANY | 87% | 89% |
| GLASGOW | 32% | 33% |
| GREECE | 414% | 415% |
| GREEN_ICELAND | 3604% | None in 2013 sample |
| HOLLAND | 33% | 38% |
| IBERIA | 111% | 114% |
| ITALY | 352% | 350% |
| N_IRELAND | 4% | -5% |
| NORTH | 128% | None in 2013 sample |
| OTHER_MED | 102% | 100% |
| SCANDINAVIA | 409% | 400% |
| SCOTLAND | 129% | 131% |
| WEST_AFRICA | -99% | -100% |
| WEST_MID | -99% | -100% |

**Table 66 – Traffic Growth: Heathrow Airport Northern Runway Extension, Birmingham**

| Heathrow Airport Northern Runway Extension | 2013vs2040 | |
|---|---|---|
| **Gatwick** | Year | Day |
| BOURNEMOUTH | -47% | None in 2013 sample |
| CANADA | -92% | -100% |
| CANARIES | -32% | -38% |
| CEN_EUROPE | 13% | 15% |
| CHANNEL_ISLES | 1% | 0% |
| EAST_AFRICA | 435% | 438% |
| EAST_EUROPE | -92% | -100% |
| EDINBURGH | -92% | -100% |
| EIRE | -1% | -7% |
| FAR_EAST | -7% | -40% |
| FRANCE | -18% | -21% |
| GERMANY | 180% | 179% |
| GLASGOW | -86% | -88% |
| GREECE | 62% | 60% |
| GREEN_ICELAND | 42% | 50% |
| IBERIA | -21% | -21% |
| ITALY | -12% | -13% |
| LATIN_AMERICA | 232% | 232% |
| MIDDLE_EAST | -94% | -100% |
| N_IRELAND | -1% | -9% |
| NORTH | -17% | -33% |
| OTHER_MED | 68% | 66% |
| SCANDINAVIA | 92% | 92% |
| SCOTLAND | 77% | 71% |
| SOUTH_WEST | 56% | 67% |
| USA | -94% | -100% |
| WEST_AFRICA | -61% | -64% |
| WEST_MID | -57% | None in 2013 sample |

**Table 67 – Traffic Growth: Heathrow Airport Northern Runway Extension, Gatwick**

| Heathrow Airport Northern Runway Extension | 2013vs2040 | |
|---|---|---|
| **Luton** | Year | Day |
| BOURNEMOUTH | -85% | -100% |
| CEN_EUROPE | -35% | -39% |
| EAST_EUROPE | 70% | 70% |
| GERMANY | -99% | -100% |
| GLASGOW | 704% | 700% |
| GREECE | 12% | 0% |
| IBERIA | 55% | 59% |
| MANCHESTER | 1030% | None in 2013 sample |
| N_IRELAND | 96% | 100% |
| OTHER_MED | 393% | 370% |
| SCANDINAVIA | -84% | -100% |
| SCOTLAND | 262% | 260% |
| WEST_MID | -99% | -100% |

**Table 68 – Traffic Growth: Heathrow Airport Northern Runway Extension, Luton**

| Heathrow Airport Northern Runway Extension | 2013vs2040 | |
|---|---|---|
| **Stansted** | Year | Day |
| BEL_LUX | -84% | -100% |
| BOURNEMOUTH | -62% | -100% |
| CANARIES | 141% | 150% |
| CEN_EUROPE | 225% | 224% |
| CHANNEL_ISLES | 21% | 0% |
| EAST_EUROPE | -36% | -38% |
| EDINBURGH | 208% | 205% |
| EIRE | 37% | 39% |
| FAR_EAST | 1517% | 1000% |
| FRANCE | 70% | 70% |
| GERMANY | -28% | -30% |
| GREECE | -91% | -100% |
| HOLLAND | -97% | -100% |
| IBERIA | 145% | 144% |
| ITALY | -10% | -12% |
| MIDDLE_EAST | -88% | -100% |
| N_IRELAND | 29% | 6% |
| NORTH | 254% | 267% |
| OTHER_MED | 96% | 96% |
| SCANDINAVIA | 32% | 32% |
| SCOTLAND | 302% | 300% |
| USA | -94% | -100% |
| WEST_AFRICA | -85% | -100% |
| WEST_MID | -96% | -100% |

**Table 69 – Traffic Growth: Heathrow Airport Northern Runway Extension, Stansted**

# Appendix F. Flightplan Demand

The flightplan demand used by the simulation at Heathrow and Gatwick in each of the scenarios is detailed in the Table 70 to Table 77. As per Appendix C, the demand was estimated based upon the information obtained from the initial flightplan activation times;

- For traffic outbound from a UK airfield, the flightplan activation time was obtained from the CFMU initial demand Estimated Off-Block Time plus standard taxi times as indicated in the CFMU data.
- For traffic inbound to a UK airfield, the flightplan activation time together with aircraft performance data and the shortest length of the proposed route was used to ascertain its arrival at the runway.

These figures represent the demand estimates post-simulation; as information on an arriving aircraft's shortest route changes during the simulation there will be some variations between these and the initial pre-simulation estimates. When a flight's demand time occurs close to the hour the change in estimations can affect the hour in which the movement is classified, thereby showing a variation against the hourly runway demand limits as given in Table 20.

| Hour | Departure Route | | | | | | Arrival Route | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | BOG/SFD | CLN | DVR | KENET | LAM | SAM | TIMBA | WILLO | |
| 00 | | | | | | | 5 | 3 | 8 |
| 01 | | | | | | | 1 | 1 | 2 |
| 02 | | | | | | | 2 | | 2 |
| 03 | | | | | | | 1 | 1 | 2 |
| 04 | 2 | | 1 | | | | 2 | 2 | 7 |
| 05 | 13 | 3 | 16 | | | 5 | 5 | 9 | 51 |
| 06 | 10 | 3 | 12 | 1 | 1 | 4 | 12 | 11 | 54 |
| 07 | 9 | | 9 | 1 | 1 | 4 | 12 | 16 | 52 |
| 08 | 13 | 7 | 4 | 1 | 3 | 5 | 9 | 9 | 51 |
| 09 | 3 | 5 | 7 | 1 | | 11 | 19 | 6 | 52 |
| 10 | 4 | 3 | 7 | 2 | 1 | 10 | 11 | 13 | 51 |
| 11 | 10 | 5 | 8 | | 1 | 8 | 15 | 8 | 55 |
| 12 | 8 | 4 | 14 | | | 4 | 14 | 10 | 54 |
| 13 | 7 | 4 | 14 | 3 | | 4 | 19 | 4 | 55 |
| 14 | 5 | 2 | 12 | 1 | 1 | 5 | 9 | 12 | 47 |
| 15 | 4 | | 7 | 1 | 3 | 6 | 19 | 5 | 45 |
| 16 | 5 | 5 | 9 | 2 | 1 | 5 | 22 | 6 | 55 |
| 17 | 12 | 6 | 4 | 1 | | 2 | 17 | 10 | 52 |
| 18 | 3 | 4 | 7 | 1 | 3 | 7 | 18 | 7 | 50 |
| 19 | 5 | 15 | | 1 | 3 | 4 | 18 | 5 | 51 |
| 20 | 3 | 7 | 3 | 1 | | 1 | 24 | 8 | 47 |
| 21 | 1 | | 1 | | 1 | | 21 | 11 | 35 |
| 22 | 2 | 2 | | | | | 7 | 5 | 16 |
| 23 | | | | | | | 12 | 4 | 16 |

Table 70 - Flightplan Demand in 2040 Do Minimum Scenario for Gatwick Airport

| Hour | Departure Route | | | | | | | | Arrival Route | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BPK | CPT | DET | DVR | KENET | MID | SAM | BUZ/WOB | BIG | BNN | LAM | OCK | |
| **00** | | | | | | | | | | | | | 0 |
| **01** | | | | | | | | | | | | | 0 |
| **02** | | | | | | | | | | | | | 0 |
| **03** | | | | | | | | | 1 | | 8 | | 9 |
| **04** | | | | | | | | | 1 | | 8 | 7 | 16 |
| **05** | 5 | | 3 | | | 2 | 1 | | 12 | 2 | 16 | 22 | 63 |
| **06** | 10 | | 10 | | 2 | 6 | 3 | 1 | 5 | 2 | 16 | 22 | 77 |
| **07** | 7 | | 12 | | 7 | 5 | 3 | | 4 | 4 | 12 | 15 | 69 |
| **08** | 9 | | 19 | | 6 | 2 | 1 | 1 | 6 | 4 | 11 | 20 | 79 |
| **09** | 6 | | 11 | | 12 | 3 | 1 | 9 | 4 | 6 | 16 | 16 | 84 |
| **10** | 7 | | 12 | | 9 | 3 | 4 | 3 | 1 | 5 | 19 | 13 | 76 |
| **11** | 9 | | 10 | | 10 | 8 | 5 | 7 | 5 | 4 | 17 | 10 | 85 |
| **12** | 10 | | 11 | | 9 | 2 | | 7 | 4 | 5 | 22 | 5 | 75 |
| **13** | 16 | | 8 | | 6 | 4 | 5 | 6 | 6 | 4 | 22 | 8 | 85 |
| **14** | 7 | | 13 | | 12 | 6 | 3 | 8 | 7 | 1 | 23 | 5 | 85 |
| **15** | 2 | | 7 | | 11 | 9 | 1 | 7 | 9 | 3 | 21 | 12 | 82 |
| **16** | 10 | | 10 | | 9 | 5 | 4 | 7 | 8 | 2 | 25 | 5 | 85 |
| **17** | 12 | | 6 | | 10 | 5 | 3 | | 8 | 3 | 28 | 5 | 80 |
| **18** | 16 | | 5 | | 6 | 10 | 5 | 2 | 6 | 2 | 27 | 5 | 84 |
| **19** | 9 | | 10 | | 4 | 11 | 3 | 2 | 4 | 3 | 25 | 7 | 78 |
| **20** | 17 | | 18 | | 1 | 8 | | | 3 | 3 | 13 | 9 | 72 |
| **21** | 13 | | 16 | | 1 | 4 | | | 1 | 2 | 4 | 4 | 45 |
| **22** | 1 | | 4 | | | 8 | | | | | | | 13 |
| **23** | | | | | | | | | | | | | 0 |

Table 71 - Flightplan Demand in 2040 Do Minimum Scenario for at Heathrow Airport

| Hour | Departure Route | | | | | | Arrival Route | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | BOG/SFD | CLN | DVR | KENET | LAM | SAM | TIMBA | WILLO | |
| **00** | | | | | | | 6 | 3 | 9 |
| **01** | | | | | | | 1 | 2 | 3 |
| **02** | | | | | | | 2 | | 2 |
| **03** | | | | | | | 1 | 2 | 3 |
| **04** | 2 | | 1 | | | | 1 | 2 | 6 |
| **05** | 9 | 4 | 11 | | | 6 | 4 | 7 | 41 |
| **06** | 10 | 2 | 10 | 1 | 2 | 3 | 11 | 17 | 56 |
| **07** | 9 | 2 | 9 | 1 | 1 | 6 | 10 | 11 | 49 |
| **08** | 9 | 8 | 6 | 1 | 5 | 7 | 7 | 12 | 55 |
| **09** | 2 | 4 | 9 | 1 | | 11 | 16 | 8 | 51 |
| **10** | 3 | 5 | 9 | 2 | 3 | 8 | 13 | 14 | 57 |
| **11** | 10 | 3 | 10 | | 4 | 9 | 9 | 5 | 50 |
| **12** | 8 | 3 | 10 | | | 5 | 15 | 9 | 50 |
| **13** | 5 | 4 | 17 | 3 | | 5 | 14 | 4 | 52 |
| **14** | 2 | 1 | 12 | 1 | 1 | 6 | 11 | 18 | 52 |
| **15** | 2 | | 8 | 1 | 5 | 10 | 18 | 7 | 51 |
| **16** | 5 | 5 | 9 | 2 | 1 | 5 | 20 | 6 | 53 |
| **17** | 9 | 7 | 2 | 1 | 2 | 1 | 14 | 15 | 51 |
| **18** | 4 | 3 | 10 | 1 | 6 | 6 | 17 | 8 | 55 |
| **19** | 5 | 9 | | 1 | 2 | 4 | 19 | 5 | 45 |
| **20** | 2 | 5 | 3 | 1 | 1 | 1 | 21 | 6 | 40 |
| **21** | 1 | | 3 | 1 | 1 | | 22 | 14 | 42 |
| **22** | 1 | 2 | | | | | 11 | 9 | 23 |
| **23** | | | | | | | 13 | 3 | 16 |

Table 72 - Flightplan Demand in Heathrow Airport North West Runway Scenario at Gatwick Airport

| Hour | Departure Route | | | | | | Arrival Route | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | BPK | CPT | DVR | MID | SAM | BUZ/WOB | BIG | BNN | LAM | OCK | |
| **00** | | | | | | | | | | | 0 |
| **01** | | | | | | | | | | | 0 |
| **02** | | | | | | | | | | | 0 |
| **03** | | | | | | | 1 | | 8 | | 9 |
| **04** | | | | | | | 3 | | 7 | 7 | 17 |
| **05** | 6 | | 5 | 3 | 2 | | 14 | 1 | 24 | 28 | 83 |
| **06** | 19 | 2 | 18 | 15 | 4 | 3 | 12 | 6 | 19 | 21 | 119 |
| **07** | 15 | 8 | 19 | 19 | 8 | 2 | 7 | 6 | 20 | 21 | 125 |
| **08** | 13 | 9 | 21 | 12 | 6 | 3 | 12 | 4 | 24 | 23 | 127 |
| **09** | 14 | 12 | 17 | 7 | 1 | 14 | 7 | 10 | 20 | 24 | 126 |
| **10** | 8 | 11 | 14 | 8 | 5 | 7 | 6 | 8 | 24 | 14 | 105 |
| **11** | 11 | 14 | 12 | 13 | 3 | 11 | 12 | 5 | 28 | 17 | 126 |
| **12** | 15 | 12 | 14 | 8 | 2 | 11 | 15 | 10 | 34 | 5 | 126 |
| **13** | 21 | 5 | 15 | 9 | 6 | 8 | 16 | 7 | 27 | 12 | 126 |
| **14** | 10 | 12 | 14 | 16 | 6 | 11 | 13 | 2 | 32 | 9 | 125 |
| **15** | 7 | 11 | 11 | 18 | 3 | 8 | 15 | 4 | 33 | 18 | 128 |
| **16** | 17 | 9 | 14 | 9 | 5 | 11 | 12 | 4 | 41 | 6 | 128 |
| **17** | 18 | 11 | 13 | 10 | 4 | 4 | 16 | 6 | 29 | 11 | 122 |
| **18** | 23 | 8 | 8 | 19 | 5 | 2 | 17 | 7 | 33 | 6 | 128 |
| **19** | 11 | 4 | 16 | 20 | 6 | 3 | 18 | 5 | 31 | 10 | 124 |
| **20** | 18 | 4 | 14 | 12 | | 1 | 15 | 5 | 18 | 15 | 102 |
| **21** | 12 | 7 | 24 | 9 | | 2 | 8 | 3 | 10 | 8 | 83 |
| **22** | 1 | | 7 | 8 | | | | | 2 | 3 | 21 |
| **23** | | | | | | | | | | | 0 |

Table 73 - Flightplan Demand in Heathrow Airport North West Runway Scenario at Heathrow Airport

| Hour | Departure Route | | | | | | Arrival Route | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | BOG/SFD | CLN | DVR | KENET | LAM | SAM | TIMBA | WILLO | |
| **00** | | | | | | | 6 | 3 | 9 |
| **01** | | | | | | | 1 | 1 | 2 |
| **02** | | | | | | | 2 | | 2 |
| **03** | | | | | | | 1 | 2 | 3 |
| **04** | 1 | | 1 | | | | 1 | 2 | 5 |
| **05** | 11 | 3 | 14 | | | 6 | 3 | 8 | 45 |
| **06** | 9 | 3 | 11 | 1 | 1 | 3 | 12 | 16 | 56 |
| **07** | 9 | | 7 | 1 | 2 | 6 | 14 | 11 | 50 |
| **08** | 9 | 7 | 6 | | 3 | 7 | 9 | 12 | 53 |
| **09** | 3 | 4 | 7 | 1 | | 12 | 14 | 9 | 50 |
| **10** | 3 | 5 | 9 | 2 | 3 | 7 | 13 | 14 | 56 |
| **11** | 8 | 4 | 10 | | 4 | 9 | 11 | 7 | 53 |
| **12** | 8 | 4 | 13 | | | 6 | 16 | 9 | 56 |
| **13** | 7 | 4 | 18 | 3 | | 5 | 15 | 2 | 54 |
| **14** | 4 | 2 | 12 | 1 | 1 | 6 | 9 | 19 | 54 |
| **15** | 2 | | 7 | 1 | 3 | 7 | 20 | 9 | 49 |
| **16** | 6 | 5 | 6 | 2 | 1 | 5 | 22 | 6 | 53 |
| **17** | 8 | 6 | 2 | 1 | 1 | 2 | 17 | 12 | 49 |
| **18** | 3 | 4 | 8 | 1 | 3 | 7 | 19 | 8 | 53 |
| **19** | 4 | 15 | | 1 | 2 | 4 | 17 | 5 | 48 |
| **20** | 3 | 7 | 4 | 1 | 1 | 1 | 19 | 4 | 40 |
| **21** | 1 | | 2 | 1 | 1 | | 21 | 11 | 37 |
| **22** | 1 | 2 | | | | | 6 | 6 | 15 |
| **23** | | | | | | | 13 | 3 | 16 |

Table 74 - Flightplan Demand in Heathrow Airport Northern Runway Extension Scenario at Gatwick Airport

| Hour | Departure Route | | | | | | Arrival Route | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | BPK | CPT | DVR | MID | SAM | BUZ/WOB | BIG | BNN | LAM | OCK | |
| **00** | | | | | | | | | | | 0 |
| **01** | | | | | | | | | | | 0 |
| **02** | | | | | | | | | | | 0 |
| **03** | | | | | | | 1 | | 8 | | 9 |
| **04** | | | | | | | 2 | | 7 | 7 | 16 |
| **05** | 4 | | 4 | 3 | 2 | | 13 | 1 | 22 | 24 | 73 |
| **06** | 19 | 2 | 12 | 14 | 8 | 4 | 10 | 5 | 18 | 24 | 116 |
| **07** | 10 | 8 | 19 | 16 | 5 | 2 | 7 | 6 | 15 | 21 | 109 |
| **08** | 14 | 9 | 23 | 10 | 3 | 3 | 7 | 4 | 17 | 23 | 113 |
| **09** | 10 | 12 | 19 | 7 | 1 | 13 | 7 | 12 | 22 | 21 | 124 |
| **10** | 8 | 11 | 18 | 10 | 6 | 4 | 6 | 5 | 24 | 15 | 107 |
| **11** | 11 | 15 | 15 | 12 | 7 | 10 | 8 | 6 | 26 | 17 | 127 |
| **12** | 15 | 10 | 14 | 5 | | 11 | 14 | 10 | 31 | 6 | 116 |
| **13** | 20 | 5 | 13 | 9 | 8 | 8 | 14 | 7 | 26 | 11 | 121 |
| **14** | 10 | 15 | 17 | 20 | 10 | 11 | 11 | 2 | 27 | 7 | 130 |
| **15** | 5 | 9 | 13 | 14 | 2 | 10 | 14 | 5 | 36 | 17 | 125 |
| **16** | 16 | 12 | 14 | 7 | 9 | 7 | 9 | 3 | 41 | 11 | 129 |
| **17** | 16 | 14 | 11 | 9 | 4 | 6 | 14 | 6 | 34 | 9 | 123 |
| **18** | 20 | 6 | 6 | 23 | 7 | 3 | 14 | 7 | 35 | 7 | 128 |
| **19** | 12 | 6 | 14 | 17 | 2 | 4 | 11 | 6 | 26 | 13 | 111 |
| **20** | 16 | 1 | 18 | 9 | | | 11 | 5 | 15 | 13 | 88 |
| **21** | 11 | 2 | 20 | 5 | | 2 | 6 | 2 | 9 | 8 | 65 |
| **22** | 1 | | 5 | 7 | | | | | 1 | | 14 |
| **23** | | | | | | | | | | | 0 |

Table 75 - Flightplan Demand in Heathrow Airport Northern Runway Extension Scenario at Heathrow Airport

| Hour | Departure Route | | | | | | Arrival Route | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | BOG/SFD | CLN | DVR | KENET | LAM | SAM | TIMBA | WILLO | |
| **00** | | | | | | | 4 | 2 | 6 |
| **01** | | | | | | | 1 | 1 | 2 |
| **02** | | | | | | | 2 | 1 | 3 |
| **03** | | | | | | | 1 | 1 | 2 |
| **04** | | | | | | | 3 | 2 | 5 |
| **05** | 13 | 6 | 16 | | 4 | 5 | 17 | 30 | 91 |
| **06** | 11 | 11 | 14 | 1 | 7 | 5 | 12 | 36 | 97 |
| **07** | 12 | | 3 | 1 | 12 | 7 | 14 | 49 | 98 |
| **08** | 11 | 12 | 3 | 2 | 17 | 16 | 10 | 25 | 96 |
| **09** | 3 | 6 | 13 | 1 | 4 | 29 | 20 | 22 | 98 |
| **10** | 3 | 5 | 5 | 2 | 19 | 12 | 20 | 18 | 84 |
| **11** | 15 | 7 | 9 | | 12 | 22 | 20 | 9 | 94 |
| **12** | 9 | 18 | 15 | | 2 | 10 | 23 | 17 | 94 |
| **13** | 10 | 14 | 34 | 3 | 2 | 10 | 15 | 8 | 96 |
| **14** | 4 | 3 | 17 | 2 | 5 | 8 | 15 | 43 | 97 |
| **15** | 2 | | 7 | 2 | 18 | 14 | 23 | 18 | 84 |
| **16** | 6 | 5 | 9 | 4 | 6 | 13 | 30 | 17 | 90 |
| **17** | 11 | 9 | 3 | 2 | 14 | 3 | 21 | 28 | 91 |
| **18** | 5 | 5 | 19 | 1 | 12 | 7 | 20 | 24 | 93 |
| **19** | 5 | 18 | 1 | 1 | 16 | 18 | 17 | 11 | 87 |
| **20** | 8 | 8 | 7 | 1 | 5 | 1 | 30 | 20 | 80 |
| **21** | 1 | | 7 | 1 | 1 | 1 | 25 | 21 | 57 |
| **22** | 1 | 3 | | | | | 14 | 8 | 26 |
| **23** | | 6 | | | 11 | 1 | 18 | 19 | 55 |

Table 76 - Flightplan Demand in Gatwick Airport Second Runway Scenario at Gatwick Airport

| Hour | Departure Route | | | | | | | | Arrival Route | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BPK | CPT | DET | DVR | KENET | MID | SAM | BUZ/WOB | BIG | BNN | LAM | OCK | |
| **00** | | | | | | | | | | | | | 0 |
| **01** | | | | | | | | | | | | | 0 |
| **02** | | | | | | | | | | | | | 0 |
| **03** | | | | | | | | | 1 | | 8 | | 9 |
| **04** | | | | | | | | | 1 | | 8 | 9 | 18 |
| **05** | 4 | | 3 | | | 1 | 2 | | 2 | 1 | 17 | 16 | 46 |
| **06** | 12 | | 12 | | 2 | 10 | 5 | 1 | 8 | 2 | 16 | 16 | 84 |
| **07** | 7 | | 16 | | 4 | 11 | 5 | | 4 | 3 | 14 | 14 | 78 |
| **08** | 8 | | 18 | | 7 | 3 | 3 | 1 | 8 | 3 | 16 | 11 | 78 |
| **09** | 6 | | 14 | | 10 | 5 | 1 | 7 | 5 | 5 | 15 | 17 | 85 |
| **10** | 7 | | 11 | | 7 | 7 | 3 | 3 | 3 | 2 | 15 | 9 | 67 |
| **11** | 10 | | 10 | | 6 | 8 | 3 | 7 | 7 | 3 | 20 | 11 | 85 |
| **12** | 11 | | 13 | | 7 | 3 | | 4 | 5 | 5 | 26 | 4 | 78 |
| **13** | 16 | | 9 | | 5 | 4 | 3 | 5 | 8 | 3 | 21 | 10 | 84 |
| **14** | 6 | | 13 | | 8 | 8 | 4 | 9 | 9 | 1 | 21 | 6 | 85 |
| **15** | 2 | | 10 | | 8 | 11 | 3 | 3 | 8 | 3 | 24 | 11 | 83 |
| **16** | 9 | | 9 | | 7 | 9 | 6 | 4 | 8 | 2 | 28 | 5 | 87 |
| **17** | 13 | | 5 | | 6 | 5 | 3 | | 10 | 3 | 26 | 5 | 76 |
| **18** | 15 | | 5 | | 6 | 7 | 3 | 2 | 8 | 2 | 29 | 7 | 84 |
| **19** | 10 | | 9 | | 4 | 9 | 4 | 2 | 8 | 3 | 23 | 6 | 78 |
| **20** | 13 | | 11 | | 2 | 8 | | | 7 | 3 | 15 | 12 | 71 |
| **21** | 10 | | 18 | | 1 | 5 | | | 1 | 1 | 4 | 5 | 45 |
| **22** | 1 | | 4 | | | 6 | | | | | 1 | | 12 |
| **23** | | | | | | | | | | | | | 0 |

Table 77 - Flightplan Demand in Gatwick Airport Second Runway Scenario at Heathrow Airport

# Appendix G. Counter Flow Analysis

The percentage of time that opposing runway operations occurred between Gatwick or Heathrow (i.e. the airports currently being considered for expansion) and other airports in the London system was identified using airfield movement data.

The airfields considered were Gatwick, Heathrow, London City, Luton and Stansted.

The entirety of electronic flightplan strip (EFPS) data available until the 1st November 2014 was used to perform each analysis; as EFPS systems were installed at these airfields at various times over the past 4 years, the availability of data covers different timespans at each airfield.

Northolt does not use an EFPS system and therefore relevant data was not available. As expert ATC opinion has previously indicated that Northolt operates with the same runway direction as Heathrow and that it would be considered very unusual not to, this was not felt to present an issue.

One pair of airfields was considered at a time. The movement data obtained for each airfield was grouped into hourly time bands. When movements (arrivals or departures) were found to occur at both of the airfields within the same hour band, the directions were compared. Each hour was then assigned into one of four categories:

- **Coincident Flow** – when movements at both airfields were operating in the same direction for the entirely of the hour.
- **Counter Flow** – when movements for both airfields were operating in opposing directions, for the entirely of the hour.
- **Counter Flow Change in Direction** – when movements at either (or both) airfields changed directions during the hour, thereby creating a counter flow for a period of time. NB. In order to take a pessimistic view, a change in direction at both airfields was considered to create a counter flow.
- **One Airfield Operating Direction** – when movements existed at one of the airfields but no movements existed at the other.

Hours in which there were no movements at either airfield were excluded from the analysis in order to look at a pessimistic scenario.

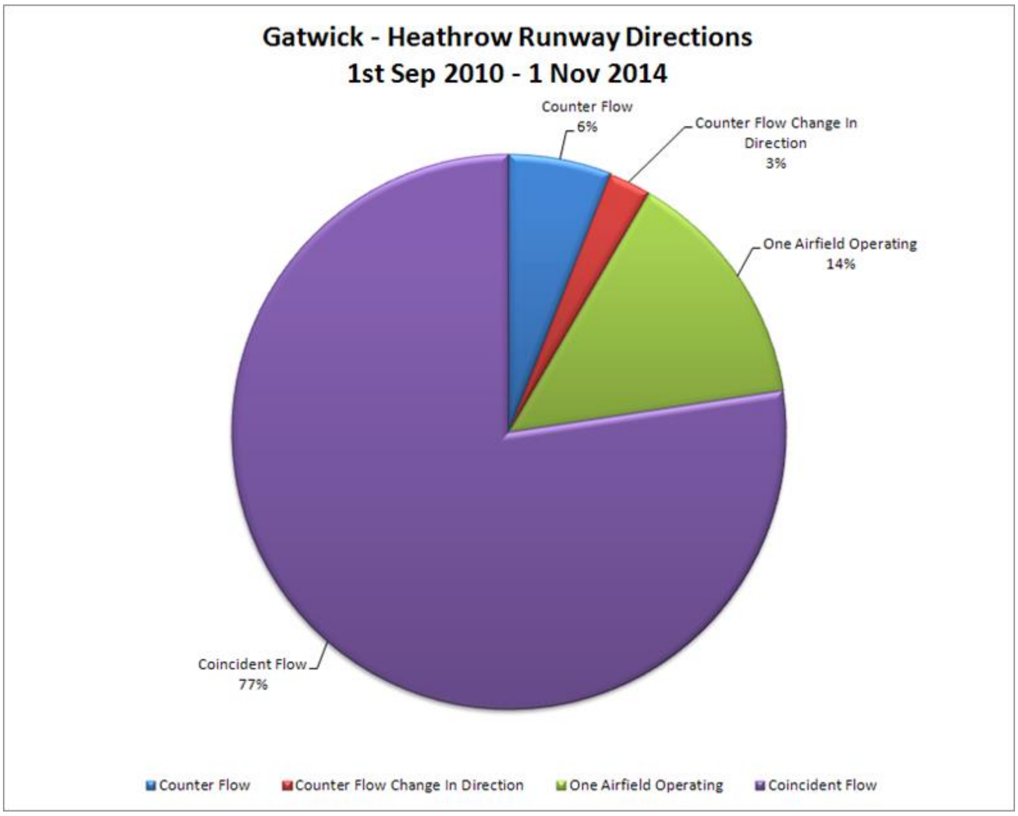
These hourly bands were then analysed to provide a proportion of time that each flow occurred.

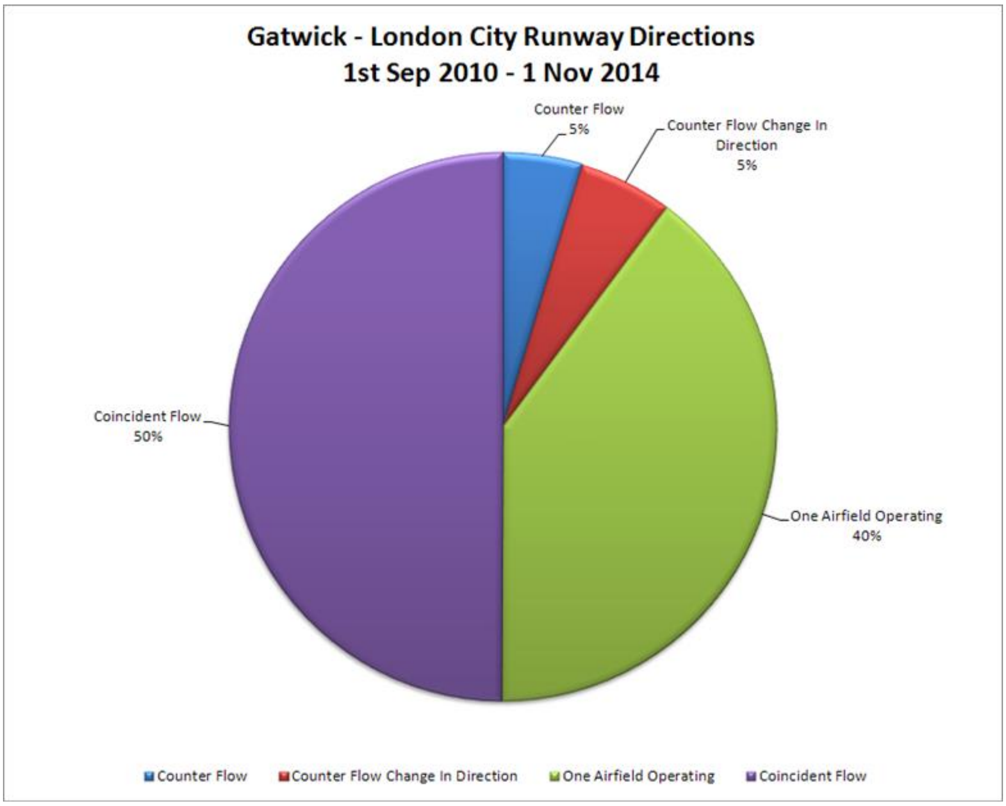
**Results**

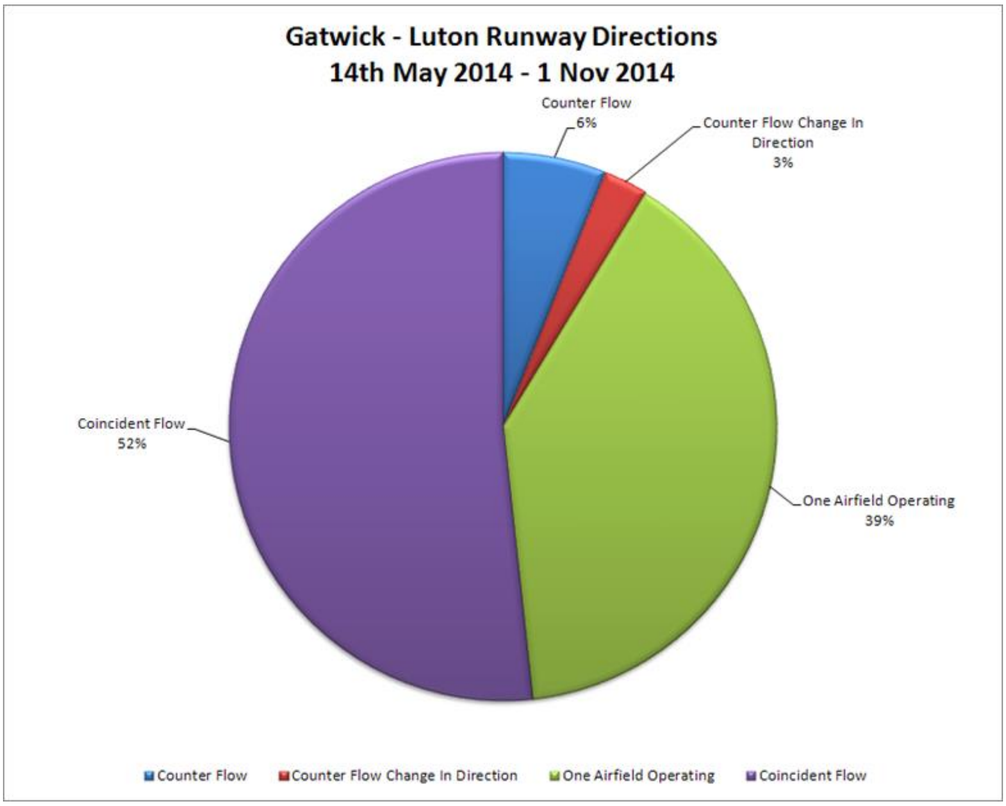
For each airfield pair the percentage of time that counter flows existed between the other large airfields was generally found to be minimal, as summarised in Table 78. Counter Flows between Gatwick and Stansted and between Heathrow and Stansted occur for a relatively higher proportion of the time. This is due to the northeast-southwest orientation of the Stansted runways, rather than the approximately east-west orientation at the other large London airfields. As per earlier expert ATC opinion, this is not felt to have an impact on the wider sector complexity.

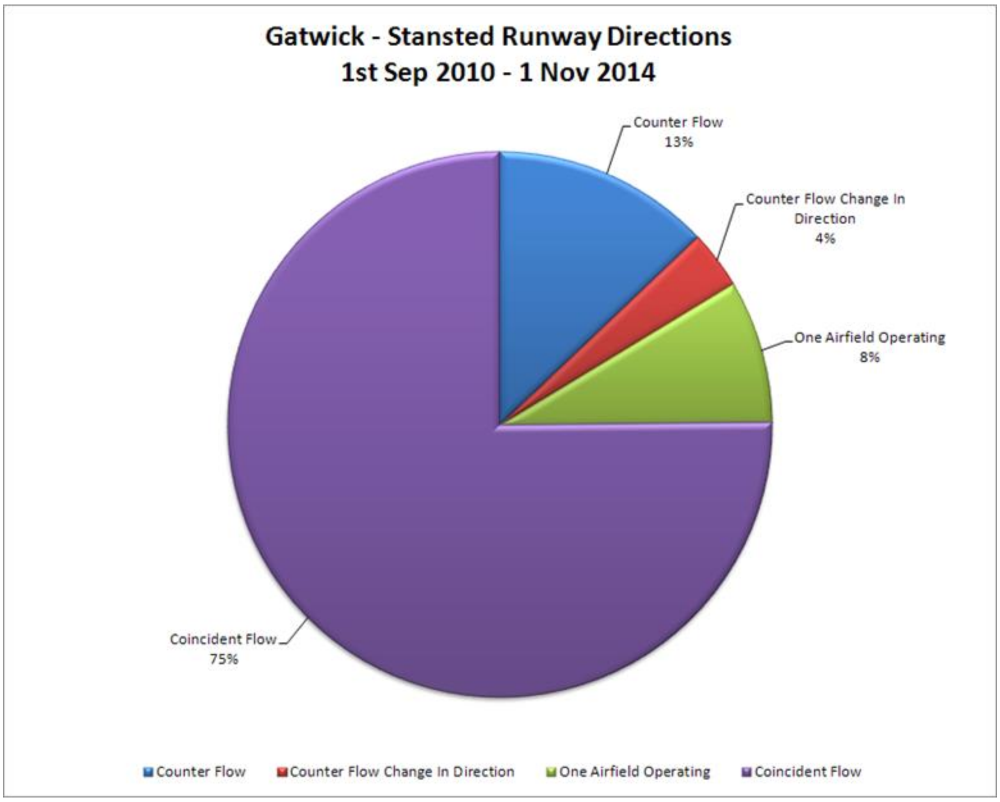
| Airfield 1 | Airfield 2 | Counter Flow Existence |
|---|---|---|
| Gatwick | Heathrow | 9% |
| Gatwick | London City | 10% |
| Gatwick | Luton | 9% |
| Gatwick | Stansted | 17% |
| Heathrow | London City | 10% |
| Heathrow | Luton | 7% |
| Heathrow | Stansted | 15% |

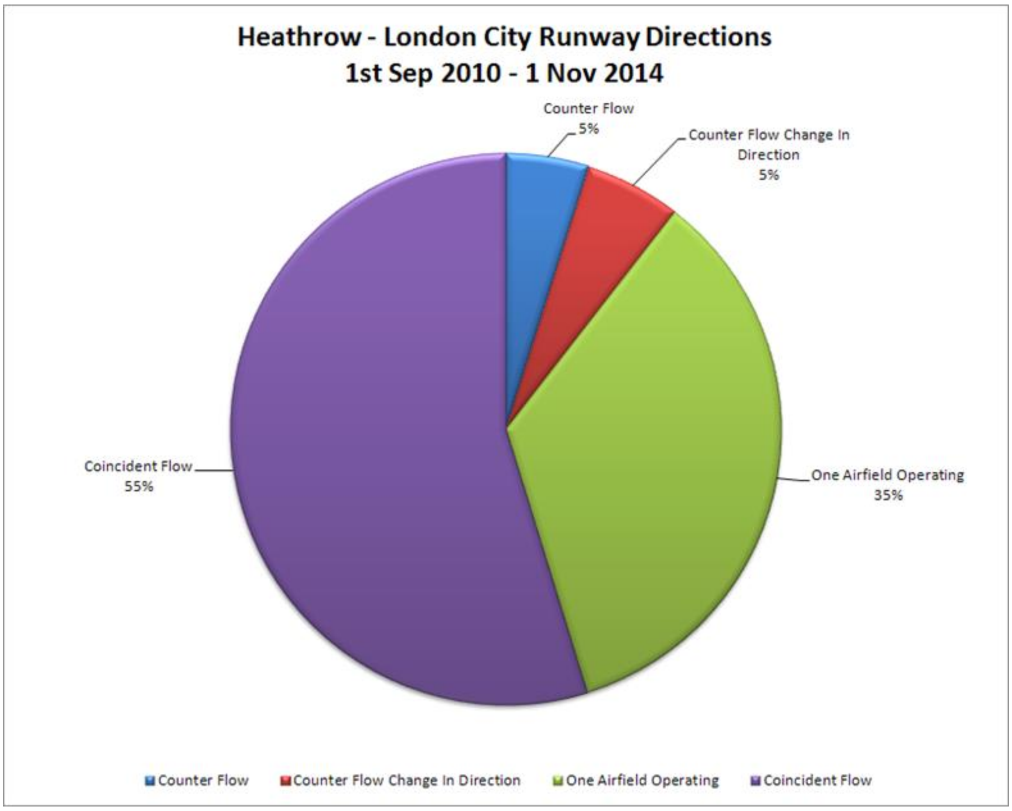
Table 78 – Proportion of Hours in which Counter Flows Existed between two Airfields (various timeframes)

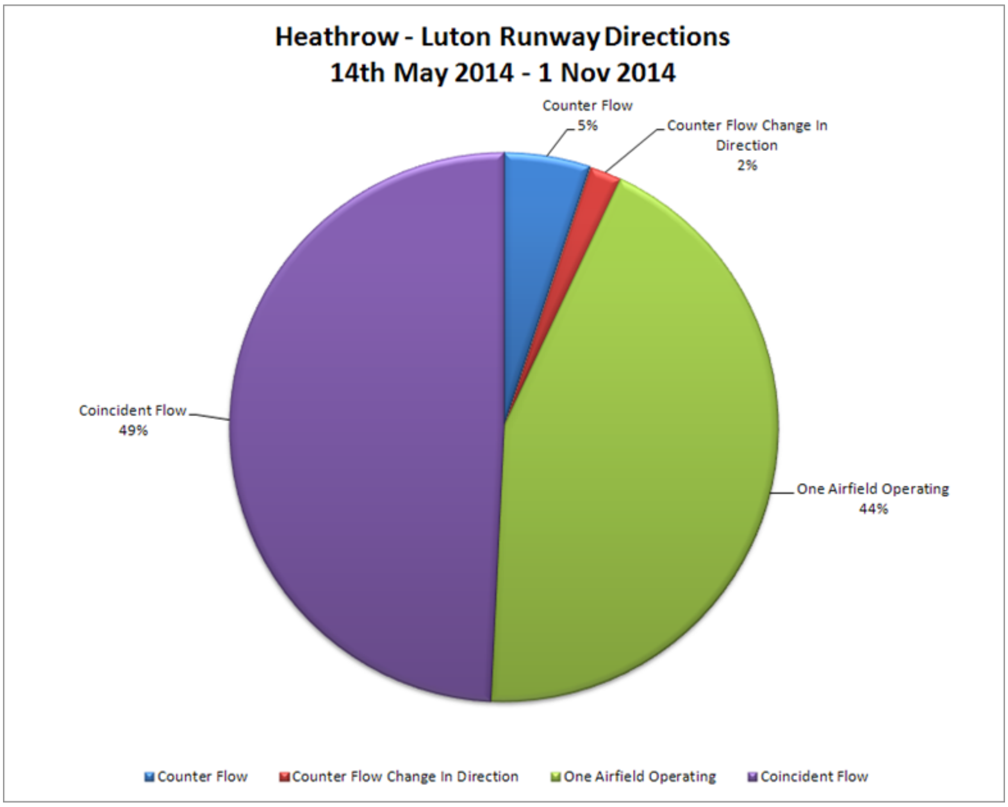

Gatwick - Heathrow Runway Directions
1st Sep 2010 - 1 Nov 2014
Counter Flow
6%
Counter Flow Change In Direction
3%
One Airfield Operating
14%
Coincident Flow
77%
Counter Flow
Counter Flow Change In Direction
One Airfield Operating
Coincident Flow

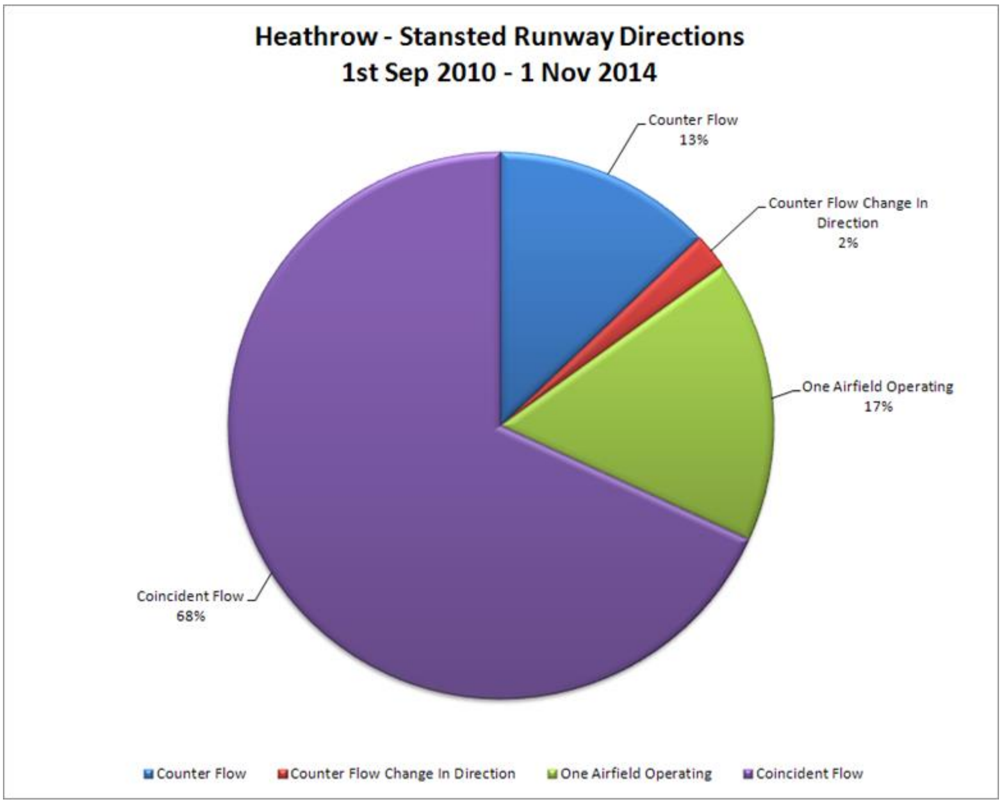

Gatwick - London City Runway Directions
1st Sep 2010 - 1 Nov 2014
Counter Flow
5%
Counter Flow Change In Direction
5%
One Airfield Operating
40%
Coincident Flow
50%
Counter Flow
Counter Flow Change In Direction
One Airfield Operating
Coincident Flow


Gatwick - Luton Runway Directions
14th May 2014 - 1 Nov 2014
Counter Flow
6%
Counter Flow Change In
Direction
3%
One Airfield Operating
39%
Coincident Flow
52%
Counter Flow
Counter Flow Change In Direction
One Airfield Operating
Coincident Flow


Gatwick - Stansted Runway Directions
1st Sep 2010 - 1 Nov 2014
Counter Flow
13%
Counter Flow Change In
Direction
4%
One Airfield Operating
8%
Coincident Flow
75%
Counter Flow
Counter Flow Change In Direction
One Airfield Operating
Coincident Flow


Heathrow - London City Runway Directions
1st Sep 2010 - 1 Nov 2014
Counter Flow
5%
Counter Flow Change In
Direction
5%
One Airfield Operating
35%
Coincident Flow
55%
Counter Flow
Counter Flow Change In Direction
One Airfield Operating
Coincident Flow


Heathrow - Luton Runway Directions
14th May 2014 - 1 Nov 2014
Counter Flow
5%
Counter Flow Change In
Direction
2%
One Airfield Operating
44%
Coincident Flow
49%
Counter Flow
Counter Flow Change In Direction
One Airfield Operating
Coincident Flow


Heathrow - Stansted Runway Directions
1st Sep 2010 - 1 Nov 2014
Counter Flow
13%
Counter Flow Change In
Direction
2%
One Airfield Operating
17%
Coincident Flow
68%
Counter Flow
Counter Flow Change In Direction
One Airfield Operating
Coincident Flow

# Appendix H. Glossary

| | |
|---|---|
| AMAN | Arrival Management |
| AC | Area Control |
| APC | Approach Control |
| ATC | Air Traffic Control |
| ATCO | Air Traffic Control Officer |
| ATM | Air Traffic Management |
| ATMs | Air Transport Movements |
| ATS | Air Traffic Services |
| B-RNAV/RNAV5 | Navigation Standards B-RNAV (RNAV5) permits aircraft to navigate above FL95 without the use of point source navigation aids. This allows direct tracks and fuel savings provided that track keeping accuracy is +/- 5 nautical miles of the displayed position for at least 95% of the time. |
| BST | British Summer Time |
| CAA | Civil Aviation Authority |
| CCD | Continuous Climb Departures |
| CDA | Continuous Descent Approaches |
| CONOPS | Concept of Operations |
| DfT | Department for Transport |
| EASA | European Aviation Safety Agency |
| Easterly | Direction of runway operations, i.e. aircraft take-off and land facing East |
| EFPS | Electronic Flightplan Strip |
| EOBT | Estimated Off-Block Time |
| FAS | Future Airspace Strategy |
| FIN | Final approach controller |
| FIR | Flight Information Region |
| FTS | Fast Time Simulation |
| ILS | Instrument Landing System |
| LAMP | London Airspace Management Programme |
| LTC | London Terminal Control |
| LTMA | London Terminal Manoeuvring Area |
| MV | Monitor Value. Customised to each sector and used to detect traffic peaks. |
| NM | Nautical Mile |
| NPR | Noise Preferential Route |
| PANS-OPS | Procedures for Air Navigation Services Operations |
| PBN | Performance Based Navigation |
| RFL | Requested Flight Level |
| RMA | Radar Manoeuvring Area |
| RNAV1 | Navigation Standards RNAV 1 permits aircraft to navigate with track keeping accuracy that is +/- 1 nautical miles of the displayed position for at least 95% of the time. |
| R/T | Radio Telephony |
| RTS | Real Time Simulations |
| SESAR | Single European Sky ATM Research |
| SIDs | Standard Instrument Departures |
| SOIR | Simultaneous Operation on Independent Runways |
| STARs | Standard Arrival Routes |
| SVFR | Special Visual Flight Rules. A VFR flight cleared by air traffic control to operate within a control zone in meteorological conditions below visual meteorological conditions. |
| TA | Transition Altitude |
| TC | Terminal Control |
| TEAM | Tactically Enhanced Arrival Management |
| TMA | Terminal Manoeuvring Area |
| UK FIRs | London Flight Information Region and Scottish Flight Information Region |
| UTC | Universal Co-ordinated Time |
| VFR | Visual Flight Rules. |
| VOR | VHF Omni-directional range. A ground- based navigation radio beacon |
| Westerly | Direction of runway operations i.e. aircraft take-off and land facing West |