

# NATS Support to the Airports Commission

## Appraisal Module 14: Operational Efficiency: Airspace Efficiency Report.

This submission to the Airports Commission sets out NATS (En Route) plc (NERL) input to the Secretariat as requested in support of Phase 2 of its undertaking. Other parts of the NATS Group are providing specialist input to some of the scheme proposers under separate commercial arrangements.

The request was for NERL to investigate the safety and operational efficiency (from an airspace perspective) of the three schemes that the Commission had decided to take forward into Phase 2, specifically considering:

1. A second runway at Gatwick Airport located to the south of the existing runway, submitted by Gatwick Airport Ltd (GAL) and referred to in this report as the Gatwick Airport Second Runway;
2. A third runway at Heathrow Airport located to the north west of the existing runways, submitted by Heathrow Airport Ltd (HAL) and referred to in this report as the Heathrow Airport North West Runway; and,
3. The extension to the west of the existing northerly runway at Heathrow to provide a runway of sufficient length to support simultaneous arrival and departures, submitted by Heathrow Hub Ltd (HUB) and referred to in this report as the Heathrow Airport Northern Runway Extension.

This report sets out NATS' input on how each of the three schemes could be integrated into the London Terminal Manoeuvring Area (TMA) at the level of traffic asserted by the scheme promoters, the operating environment that will enable such operations in the timeframe being considered (i.e. from c.2025 onwards) and the assumptions that have been made during this analysis and the potential outcomes if these prove to be incorrect.

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## Acronyms & Abbreviations

ANSP	Air Navigation Service Provider
ATMs	Air Traffic Movements
CDA	Continuous Descent Approach
D	Departure (mode)
DfT	Department for Transport
FAS	Future Airspace Strategy
GA	General Aviation
GAL	Gatwick Airport Limited
HAL	Heathrow Airport Limited
HUB	Heathrow Hub Limited
ILS	Instrument Landing System
ICAO	International Civil Aviation Organisation
L	Landing (mode)
LAMP	London Area Management Programme
LTMA	London Terminal Manoeuvring Area
PBN	Performance Based Navigation
P-RNAV	Precision Area Navigation
RNP-AR	Required Navigation Performance – Authorisation Required
RMA	Radar Manoeuvring Area
R’x’L/R/C	Runway ‘x’ Left/Right/Centre
SID	Standard Instrument Departure
SOIR	Simultaneous Operations on Parallel or Near-Parallel Instrument Runways
SoS	Secretary of State (for Transport)
STAR	Standard Terminal Arrival Routes
SESAR	Single European Sky ATM Research
TMA	Terminal Manoeuvring Area
TBS	Time Based Separation
XMAN	Extended Arrival Management

## 1. Executive Summary

- 1.1 The Airports Commission requested that NATS consider and report on the safety and operational efficiency of the three schemes that have been taken forward into Phase 2 of its investigations.
- 1.2 The basis of NATS' analysis was the material submitted by the three scheme promoters to the Airports Commission Secretariat and subsequently supplemented as required by additional material provided upon request and meetings with the scheme promoters.
- 1.3 The assessment found that all three concepts of operation for the revised airport operations can be supported by the London TMA operation at the levels of traffic asserted, subject to the necessary safety case being approved by the CAA, these being:
- A Gatwick Airport Second Runway proposed by GAL – up to 560k ATMs pa (an increase at Gatwick airport of c.300k ATMs pa).
  - A Heathrow Airport North West Runway proposed by HAL – up to 740k ATMs pa (an increase at Heathrow Airport of c.260k ATMs pa).
  - A Heathrow Airport Northern Runway Extension proposed by HUB – up to 700k ATMs pa (an increase at Heathrow airport of c.220k ATMs pa).
- 1.4 NERL does not consider the annual level of ATMs proposed by all three scheme promoters to be the maximum of what could be managed. An increase in the duration of peak operating hours would result in greater annual movements being delivered. There is however a trade-off between the amount of traffic movements that can be managed and the resilience of the operation at both the airports and within the London TMA.
- 1.5 It should be noted that it is possible that the additional level of movements at a particular airport may not result in the same increase within the overall network due to potential inter-airport airspace interactions. The impact on the London TMA of the additional movements asserted by each of the proposals will be tested by Fast Time Simulations.
- 1.6 All three proposals would require the development of new operating procedures (including Missed Approach Procedures) and potentially require additional airspace<sup>1</sup> to be provided to ensure safe and efficient operations.
- 1.7 The proximity and relative runway orientations of Heathrow airport and RAF Northolt ('Northolt') could have a detrimental mutual impact their respective operations. The potential outcomes of the mutual interactions between Northolt and either of the Heathrow Airport North West Runway or Heathrow Airport Northern Runway Extension proposals are set out in this report (Annex 2).
- 1.8 Additional departure & arrival routes would be required to support an additional runway at either Heathrow or Gatwick airports. From sight of the promoters' latest proposals on this matter, NATS is confident that these could be safely and efficiently integrated into the future London TMA route network structure and operating environment that will existing in c.2025. All additional routes below 4,000ft require the approval of the Secretary of State for Transport.

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<sup>1</sup> Controlled Airspace is airspace that is classified as Class A to E as defined by the UK Manual of Air Traffic Services Part 1, CAA CAP493.

## 2. Methodology

- 2.1 The assessment comprised a review of the relevant designs, operating concepts and asserted levels of traffic of each of the schemes, supplemented by further information and clarification as required and revised/updated written submissions.
- 2.2 The investigations and analyses were undertaken by Subject Matter Experts, including Air Traffic Controllers with suitable Certificates of Competence for the London Terminal Control operation and Operational Analysts experienced in runway modelling and capacity assessment techniques.
- 2.3 The following material factors were considered for each scheme:
- The impact of the revised airport operation on the TMA operation, with a particular focus on:
    - The location, orientation and length of the additional runway to assess what (if any) dependencies or operating restrictions could exist that would have an impact on the London TMA operation;
    - The proposed operating modes of the revised runway configurations to examine the extent to which (if any) the effectiveness of the London TMA operation would be affected by both the operating modes proposed and the times & frequency of changing from one mode to another (as this needs to be pre-planned to minimise additional workload and contain complexity);
    - The departure & arrival philosophy, to consider the extent to which the de-confliction of crossing traffic would be required to be performed by the London TMA operation or whether this would be expected to be achieved at the airport; and,
    - Whether the angles of approach being proposed would have an impact on London TMA operation.
  - Whether the annual and hourly movement levels were expected to be sustainably achievable. Industry-standard benchmarks for the various operating modes and number of runways proposed were used to assess the validity of the scheme proposers' hourly traffic levels (as further amplified in Annex 1);
  - The operational feasibility of the proposed departure and arrival routes, accepting that these will ultimately be proposed and owned by the airports' operator;
  - Whether Missed Approach situations had been considered and whether these could be safely accommodated within the London TMA;
  - The impact of any necessary changes in airspace on other users, primarily though the need for additional Controlled Airspace, either through a lower base or an extension of lateral confines;

- The impact of any impacts on adjoining States and any changes that may be necessary or beneficial, either as the result of revised operating procedures (e.g. revised STARs) or through requests to support revised traffic patterns and quantities;
- How the revised operation that has been identified would be enabled or enhanced by European ATM programmes and initiatives; and,
- What operational procedures would need to be developed to enable a safety case to be approved.

2.4 For the purposes of assessing the operational viability of each scheme proposal it was necessary to produce indicative flight path designs. These designs are for illustrative purposes only and should not be interpreted as representative of the location of future flight paths, should a particular scheme be recommended and ultimately granted Government approval. It should also be noted that finalising the routes of future flight paths will be a matter for detailed design in future years prior to runway opening.

- For the Gatwick Airport Second Runway proposal, indicative flight path designs were constructed by the Commission in conjunction with expert advisers – please see Annex 3.
- For the Heathrow Airport North West Runway proposal, the airport operator supplied indicative flight path designs covering a range of operating modes – please see Annex 4.
- For the Heathrow Airport Northern Runway Extension proposal, indicative flight path designs were constructed by the Commission in conjunction with expert advisers – please see Annex 5.

### **3 Operating Requirements & Constraints**

#### **3.1 Simultaneous Operations on Parallel or Near-Parallel Instrument Runways**

3.1.1 ICAO Document 9643 (SOIR) sets out detailed criteria to support ‘Simultaneous Operations on Parallel or Near-Parallel Instrument Runways’. Although proposals have been drafted to update SOIR, it none the less sets out the current ICAO recommendations on this matter and ones which the CAA can be expected to defer to. The extent to which a scheme can meet the requirements of SOIR as this is a material factor affecting both operating modes and asserted traffic levels.

3.1.2 Where proposals are made for an additional runway to operate in parallel with other runways at an airport, then it should be clearly stated how these requirements will be satisfied. Where a proposal sets out an operation that uses serial or tandem runways, then the assurances provided by asserting compliance against SOIR will need to be developed and asserted by other means. Such a situation applies to the Heathrow Airport Northern Runway Extension proposal where a tandem and parallel runway configuration would result.

#### **3.2 Safe & Efficient Departure Structures**

3.2.1 Safe and efficient operations within the London TMA are predicated upon the use of Standard Instrument Departures (SIDs). These are assured airspace route structures that form a departure path to enable traffic to safely and efficiently leave the airspace surrounding the airport and enter the London TMA at known points and levels.

3.2.2 The use of existing and the establishment of new SIDs that aircraft are able to adhere will be an essential prerequisite to deliver the level of traffic movements envisaged by all the schemes being considered.

3.2.3 Detailed design criteria have been established by ICAO to ensure that SIDs are designed and operated appropriately to ensure independent instrument departures. Specifically, SIDs must diverge by 15 degrees or greater to enable simultaneous departures.

<i>Spacing between runways</i>	<i>Course divergence after take-off</i>	<i>Radar required</i>
Less than 1 525 m (5 000 ft) but not less than 760 m (2 500 ft)	15° or more	Yes

The diagram shows two parallel runways, each represented by a horizontal rectangle with a dashed centerline. A vertical double-headed arrow between the centerlines is labeled '760 m (2 500 ft) or more'. From the right end of each runway, an aircraft is shown taking off. Dashed lines represent the diverging flight paths of the two aircraft. A curved arrow between these two paths is labeled '15° or more', indicating the required course divergence.

**Figure 3-2. Independent instrument departures when parallel runway spacing is less than 1 525 m (5 000 ft) but not less than 760 m (2 500 ft)**

Source: ICAO Document 9643, Simultaneous Operations on Parallel or Near-Parallel Instrument Runways.

### **3.3 Operating Hours & Restrictions**

- 3.3.1 The analyses assumed that the operating hours and night time restrictions that currently exist throughout the London TMA will remain in force over the period that the additional runway would be operable.

### **3.4 The Impact of Northolt on Future Heathrow Operations**

- 3.4.1 The mutual impact of Northolt and a future Heathrow operation as envisaged by either of the Heathrow Airport North West Runway or Heathrow Airport Northern Runway Extension proposals has been identified as a potentially limiting factor. A detailed analysis of the expected impact of such interactions is reported in Annex 2.

### **3.5 Separation Standards**

- 3.5.1 The key determinant to securing safe operations is the application of pre-determined separation standards, i.e. minimum distances that aircraft must be separated from each other at all times. Within the London TMA these are 3 nautical miles laterally and 1,000 feet vertically. There are no plans to reduce these minima. During Final Approach, where aircraft are positioned behind the one



in front, other criteria that reflect the impact of the vortex generated by the leading aircraft on the following aircraft are also applied (in Nautical Miles) as set out in following table:

		Follower					
		Super Heavy	Heavy	Upper Medium	Lower Medium	Small	Light
Leader	Super Heavy	4	6	7	7	7	8
	Heavy	4	4	5	5	6	7
	Upper Medium	*	*	3	4	4	6
	Lower Medium	*	*	*	*	3	5
	Small	*	*	*	*	3	4
	Light	*	*	*	*	*	*

\* = No wake vortex constraint exists but the minimum radar separation applies.

3.5.2 There is no expectation that these minima will reduce before the new runway comes into operation, although the mandated operation of Performance Based Navigation systems may allow reductions to be considered during the operating life of the new runway.

## 4. The Future Operating Environment

### 4.1 Context

- 4.1.1 The airspace aspects of each of the three scheme proposals being considered will need to be safely and efficiently integrated into the London Terminal Manoeuvring Area (LTMA). This is the airspace, route network structure and operation designed to provide a systemised interface between the London airports and the 'en-route' airspace to ensure that arriving and departing traffic is safely and expeditiously transferred between these two distinct aspects of the operation
- 4.1.2 The TMA structure and operation maximises the available capacity of the airspace. The airspace is subdivided into discrete volumes of airspace called sectors which are constructed and managed to provide safe and efficient flows of traffic.
- 4.1.3 Operations within the London TMA follow agreed and promulgated standards and procedures. To operate within this airspace, airframes need to be sufficiently capable to follow the route network structure and equipped to support the communication, navigation and surveillance facilities used.
- 4.1.4 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.

### 4.2 Technological Advances

- 4.2.1 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 will enable a variety of new tools and applications to be used, the key ones being:

- **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.

- **Performance Based Navigation.** Advanced avionic navigation capabilities enable aircraft to adhere to flight paths to a far greater accuracy than previously possible. Such improved capabilities enable predefined airport departure routes – known as Standard Instrument Departures (SIDs) – to be developed with greater certainty that the aircraft will be able to adhere to them. 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 departing traffic away from major populations and fly more predictable departure paths. The establishment and use of SIDs which are ‘de-conflicted by design’ and the ability of aircraft to reliably and accurately navigate them is a key determinant of the safe and effective operation of airports within the London TMA. Such operations are already starting to become the standard across the industry; Gatwick Airport now has full PBN replication on all SIDs and this is the default departure. Other UK airports are also implementing such concepts.
- **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. In the timeframe being considered by this report, TBS will be operational at Heathrow and Gatwick airports.

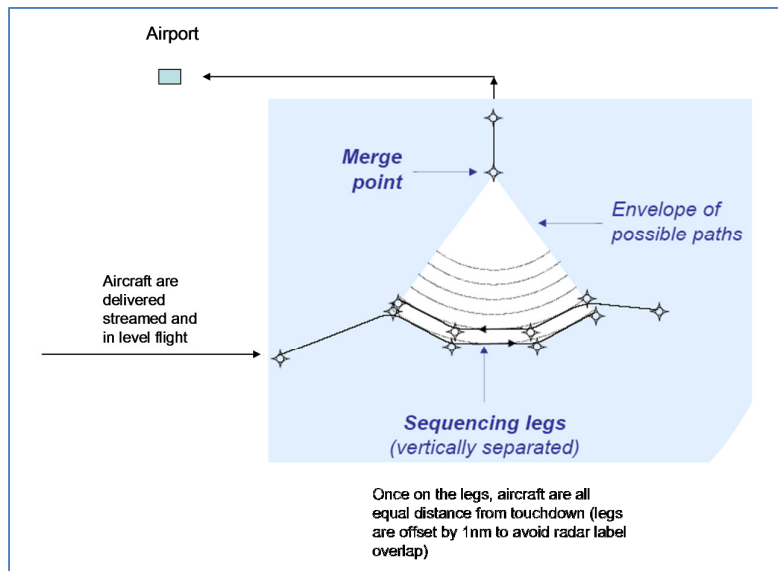
### 4.3 Airspace Developments

- 4.3.1 The London TMA covers airspace in south-east England up to 24,500ft. The existing airspace design and route network structure have evolved over 50 years to support the growth of the five main London airports and is now one of the most complex and busy operational environments in the world.
- 4.3.2 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.
- 4.3.3 The London Airspace Management Programme (LAMP) has been established to provide a complete redesign of the London TMA to provide more efficient operations to all the airports in a manner which reflects progressive advances in aircraft capabilities (both avionics and performance) and addresses forecast future demand based on existing infrastructure. Extensive further design work would be required should any additional runways be built.
- 4.3.4 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 operations. If required, additional airspace sectors will be provided to manage the additional traffic volumes and peak flow rates envisaged.
- 4.3.5 The airspace redesign 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. It will be complete by 2020 and, depending upon the proposal ultimately taken forward to delivery, provide airspace planners with at least five years notice before the new runway will need to be integrated into the TMA airspace structure.

- 4.3.6 The use of holding stacks is a key feature of today's operation, which sees the use of tiered orbital tracks which aircraft fly around when the demand on arrival runways exceeds capacity. Such operations are inefficient for service delivery as they require controller monitoring/intervention, and are fuel inefficient for operators. 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 holding, termed Linear Holding.
- 4.3.7 Further developments are in hand to deliver improvements to this phase of flight through revised airspace and route networks that (by design) reduce or avoid where possible the need for downstream queuing through the more predictable presentation of traffic, supported by concepts that aim to deliver efficient queuing if required through linear holding and Point Merge and Tromboning concepts.

#### 4.4 Point Merge

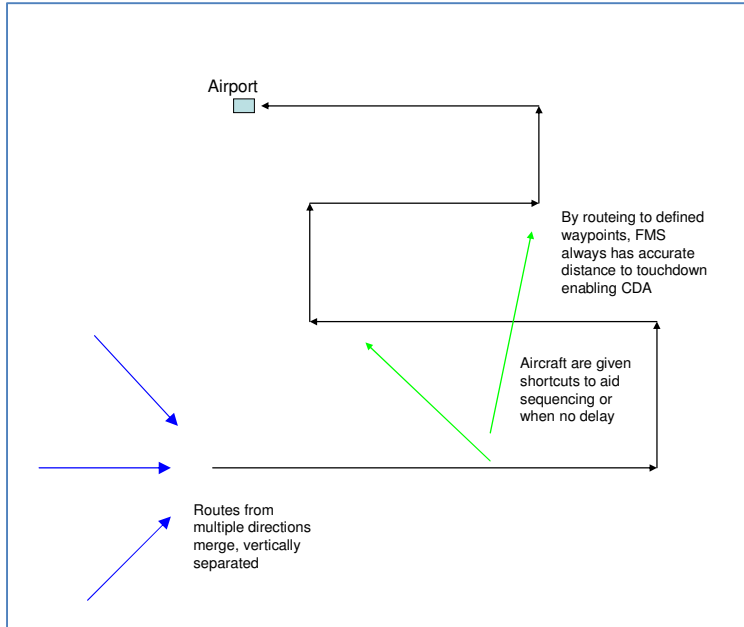
- 4.4.1 Point Merge is an innovative method for merging arrival flows with existing technology including precision area navigation (P-RNAV). It is designed to enable extensive use of the flight management system and continuous descents, even under high traffic load conditions.
- 4.4.2 Point Merge will be used in conjunction with (revised) Standard Terminal Arrival Routes (STARs) to reduce the need for airborne holding in holding stacks. In effect, Point Merge sees the management of arrival streams on arcs from a common point (the 'merge point') rather than utilising holding stacks. The concept of a Point Merge system is illustrated below:



- 4.4.3 LAMP will deliver Point Merge arrival concepts to Gatwick, Stansted and London City airports, although conventional Holding Stacks will still be required to mitigate instances of over-delivery of traffic or runway outage.

## 4.5 Tromboning

- 4.5.1 Airspace limitations to the north and south of Heathrow and Luton caused by other London airports prevent Point Merge being used at Heathrow and Luton, which will both use the concept of 'tromboning'. Tromboning is a similar principle to Point Merge but support traffic which has not been or cannot be streamed as accurately as Point Merge requires. Rather than conventional stack holding, aircraft follow elongated arrival routes; the longer the delay to be absorbed, the greater distance along the arrival route is flown until the aircraft is turned onto final approach. The concept of tromboning is illustrated below:



- 4.5.2 However, conventional Holding Stacks will still be required to mitigate instances of over-delivery of traffic or runway outage.

## 4.6 Summary

- 4.6.1 All of the above concepts will be operational and deployed within the London TMA by the time the additional runway becomes operations. All have been considered as forming part of the future operational baseline when considering the capabilities and requirements of the three schemes proposed, although their development and future use is not predicated on any future increase in the number of runways serviced by the London TMA.

## **5. The Gatwick Airport Second Runway proposal**

### **5.1 Introduction**

5.1.1 This scheme proposes a second runway at Gatwick, located to the south of and parallel to the existing runway. A Mixed Mode operation is proposed. All types of aircraft can be accommodated by either runway. The proposal is based around the concept of Compass Departures and Terminal Arrivals.

### **5.2 Runway Operations**

5.2.1 The new runway will be sited to the south of and run parallel to the existing runway.

5.2.2 In this report the airport runway configuration is termed: the Northerly runway operating as either 26R or 08L and the Southerly runway operating as either 26L or 08R.

5.2.3 The Southerly runway will be separated from the Northerly runway by 1,045m, thereby enabling independent operations subject to the requirements of SOIR being met.

5.2.4 At 3,400m, the Southerly runway is sufficiently long to accommodate all known and future expected aircraft types, including Code F airframes. The Northerly runway will use displaced (inset) thresholds; the extent of the displacement is not expected to have an impact on throughput or utilisation.

5.2.5 The runways would operate within the existing operating hours and with existing night time bans/quotas.

5.2.6 The runways will operate in Mixed Mode, whereby both runways are used for departures and arrivals. The London TMA can support such operations from Gatwick.

5.2.7 Both runways support Easterly and Westerly operations with no reduction in operating capacity.

5.2.8 The principles of operating Compass Departures and Terminal Arrivals are proposed. Both concepts can be supported by the London TMA operation.

5.2.9 The primary landing aid will be the Instrument Landing System using a 3.2 degrees glide slope. The London TMA operation can deliver traffic to support such an approach angle.

5.2.10 The proposer has identified the use of Offload SIDs to enable runway capacity/demand balancing. Whilst this will better support ground-based operations, their use will reduce the efficiency of the surrounding airspace as crossing traffic is will need to be deconflicted whilst airborne.

### **5.3 Traffic Levels**

5.3.1 The proposed traffic movements of 98 ATMs per hour and 560k ATMs per annum are both supportable by the London TMA as being redeveloped by LAMP. This can be achieved through the use of Mixed Mode operations on both runways.

5.3.2 The annual figure of ATMs is not considered to be maximum or upper limited that can be operated from a revised Gatwick operation as proposed by the scheme promoter. The extension of peak operating hours would result in greater annual movements being delivered. There is however a trade-off between the amount of traffic movements that can be managed and the resilience of the operation at both the airport and within the London TMA.

#### **5.4 Operational Deliverability of Proposed Departure & Arrival Routes**

5.4.1 Standard Instrument Departure routes (SIDs) that are predicated on PBN capabilities will need to be established to ensure that such situations have minimal impact on the efficiency of the London TMA operation.

5.4.2 NATS has seen some indicative and initial departure routes supporting a two runway Gatwick operation. The departure routes predominately follow and link into existing traffic patterns and flight paths.

5.4.3 NATS has seen some indicative and initial arrival routes supporting a two runway Gatwick operation. The arrival routes can be serviced by the London TMA operation, initially from a single Point Merge arc, but may need to be supported by two arcs, one to support each arrival path.

5.4.4 Arrivals to the Northern runway will incur extra track mileage as one arrival stream splits into two arrival streams to service the two runways. Applying vertical separation to traffic on the two arrival streams may result in some flights not being able to be offered a Continuous Descent Approach.

5.4.5 Both arrival streams are established to the south of the airport, serviced by a single Point Merge arc. Whilst this would be operationally feasible at the outset, the peak traffic level proposed could be more effectively serviced by two separate arrival streams – one to the north of the airport for traffic landing on the Northerly runway and one to the south of the airport for traffic landing on the Southerly runway.

5.4.6 Such a development would require a review of the respective airspace needs of Gatwick and other airports in the London TMA (notably Heathrow).

5.4.7 Additional routes below 4,000ft will require the approval of the Secretary of State for Transport.

#### **5.5 Missed Approaches**

5.5.1 No Missed Approach Procedures have been submitted by the proposer. Further work will be required to design missed approach procedures. A two-runway operation is a known concept in the UK and it is envisaged that such procedures will be straightforward to develop.

5.5.2 In a Mixed Mode environment Missed Approach Procedures need to ensure separation can be provided from aircraft departing from the same runway. They must also address the situations of aircraft departing from the other runway.

5.5.3 The scheme proposer will need to develop Missed Approach Procedures in collaboration with the London TMA operation and the airport ATC service provider.

## **5.6 Impact of Proposed Airspace Changes on Other Users**

5.6.1 Although proposed airspace changes have not been provided, it is expected that:

- The bases of Controlled Airspace may need to be lowered to accommodate the Final Approach to Runway 08 (Right and Left) which will have an impact on the GA community, notably Redhill.
- Runway 08 (Right and left) Final Approach could be longer and will therefore infringe the revised airspace configurations being proposed under the current Farnborough Airspace Change Proposal.
- Runway 26 (Right and Left) Final Approach may be longer and possibly lower than current operations.

5.6.2 Nothing has been identified within the proposal that would affect military operations.

## **5.7 Impact on Adjoining States**

5.7.1 Currently, airspace capacity limitations exist in the southern part of the London TMA, specifically between the UK and France for departing traffic (routing via DOVER) and arriving traffic (routing via BREST). This situation will be exacerbated by more movements, thus discussions and airspace changes will need to be made with adjacent ANSPs.

5.7.2 In the timescales being considered neighbouring ANSPs should be operating the advanced SESAR concepts mentioned earlier in this paper and should be better placed to deal with the increased demand on the airspace.

5.7.3 None of the impacts envisaged on adjoining states is considered insurmountable.

## **5.8 Connectivity to European Programmes**

5.8.1 NATS expects to use many of the advanced concepts envisaged by the SESAR programme to support a future Gatwick operation as envisaged by the scheme promoter, including the use of: Trajectory-Based Operations; Point Merge linear holding; Extended Arrival Management (XMAN); Time Based Separation to sustain landing rates in strong headwind conditions; and PBN operations for arrival and departure routes.

5.8.2 NATS is either currently deploying these SESAR concepts or is working collaboratively with others to ensure that they form part of the operation in the timeframe that the additional runway will be operational.

5.8.3 NATS will use such concepts to support operations within the London TMA to service the London airports irrespective of whether or where an additional runway is provided.



## **5.9 Future Operating Procedures**

5.9.1 New ATC procedures will be required to ensure the safe and efficient integration of the revised airport operation into the surrounding TMA infrastructure. Procedures for new or revised service delivery will be required, include the future use of Independent Parallel Approaches and Missed Approaches.

5.9.2 Specific factors that relate to this particular proposal are:

- Effective Missed Approach procedures that will need to be established to cater for two runways. The current operation is supported by Missed Approach procedures that cater for single runway operations, with an aircraft following a Missed Approach procedure being able to turn away from the recently departed aircraft ahead. In a two runway situation, it is possible that an aircraft departing from the other runway may prevent such a solution.

5.9.3 The need for the Missed Approach Procedures identified above is considered to be feasible and should not be considered to present insurmountable constraints.

## **5.10 Conclusions**

5.10.1 The proposed concept of airport operations (i.e. Mixed Mode) can be supported by the London TMA, and at the traffic levels identified.

5.10.2 Additional airspace may be required to ensure that efficient arrival routes can be provided, delivered through a redesign on the LTMA to the north of Gatwick.

5.10.3 Effective arrival and departure routes will need to be developed to ensure that a two runway Gatwick operating in Mixed Mode does not have an intolerable impact on airspace used to support Heathrow.

5.10.4 Effective Missed Approach Procedures will need to be developed.

## 6. The Heathrow Airport North West Runway

### 6.1 Introduction

6.1.1 This scheme proposes the operation of a third runway sited to the north-west of, and parallel with, the existing two runways at Heathrow. All three runways are of sufficient length to accommodate all types of traffic and are sufficiently separated to enable the requirements of SOIR to be satisfied. Various operating modes are identified to deliver noise respite. The proposal is based on Compass Departures.

### 6.2 Runway Operations

6.2.1 The new runway will be sited to the north-west and will run parallel to the existing northerly runway. It will be separated from the current northerly runway by 1,045m, thereby enabling independent operations from the current northerly runway to be conducted subject to the requirements of SOIR being met.

6.2.2 In this report, the airport runway configuration is termed: the North West runway operating as either 27R or 09L, the Centre runway operating as either 27C or 09C, and the Southerly runway operating as either 27L or 09R.

6.2.3 At 3,500m, the North West runway is sufficiently long to accommodate all known and future expected aircraft types, including Code F.

6.2.4 The North West runway will be sufficiently separated from the Centre runway to support fully independent operations.

6.2.5 The proposal does not require or propose the reduction in length of the Centre runway nor the Southerly runway.

6.2.6 The runways would operate within the existing operating hours and with existing night time bans/quotas.

6.2.7 All three runways can support Easterly and Westerly operations with no reduction in operating capacity.

6.2.8 Four operating 'modes' have been proposed to utilise the three runways in various combinations to deliver respite:

Runway	Mode 1	Mode 2	Mode 3	Mode 4
North West	D/L	D/L	L	D
Centre	L	D	D	L
Southerly	D	L	D/L	D/L

6.2.9 All four operating modes are operationally feasible and the London TMA operation can deliver traffic to and accept traffic from all of the four modes identified.

- 6.2.10 Modes 1 and 4, i.e. those that use the Centre runway for landing, are more straightforward to accommodate into the TMA operation from an airspace perspective. Modes 2 and 3, i.e. those that use the Centre runway for departures would result in departing aircraft being in closer proximity to aircraft departing from either the North West or Southerly runway.
- 6.2.11 Managing traffic flows to prepare for and implement a change of operating mode requires significant preparation and has the potential to lead to inefficiencies in service delivery, especially during peak traffic periods.
- 6.2.12 Compass Departures and Terminal Arrivals are proposed. Both concepts can be supported by the London TMA operation.
- 6.2.13 The primary landing aid will be the Instrument Landing System using a 3.0 degrees glide slope. In 2030 this will increase to 3.2 degrees and by 2040 increase further to 3.5 degrees. The TMA operation can deliver traffic to support such an approach angles.
- 6.2.14 The proposer has identified the use of Offload SIDs to enable runway capacity/demand balancing. Whilst this will better support ground-based operations, their use will reduce the efficiency of the surrounding airspace as crossing traffic is will need to be deconflicted whilst airborne.

### **6.3 Traffic Levels**

- 6.3.1 The scheme proposer is proposing a maximum movement rate of 128 per hour during normal operating conditions, comprising 48 per hour Mixed Mode, 38 per hour Arrivals and 42 per hour Departures. A traffic volume of 740k ATMs pa is proposed. Such rates can be supported by the London TMA as being redeveloped by LAMP.
- 6.3.2 The annual figure of ATMs is not considered to be maximum or upper limited that can be operated from a revised Heathrow operation as proposed by the scheme promoter. The extension of peak operating hours would result in greater annual movements being delivered. There is however a trade-off between the amount of traffic movements that can be managed and the resilience of the operation at both the airport and within the London TMA.

### **6.4 Operational Deliverability of Proposed Departure & Arrival Routes**

- 6.4.1 Standard Instrument Departure routes (SIDs) that are predicated on PBN capabilities will need to be established to ensure that such situations have minimal impact on the efficiency of the London TMA operation.
- 6.4.2 NATS has seen some indicative and initial departure routes supporting a three parallel runway Heathrow operation. The departure routes predominately follow and link into existing traffic patterns and flight paths and as such are expected to be able to integrate into the London TMA airspace structure (post-LAMP).
- 6.4.3 NATS has seen some indicative and initial arrival routes supporting a three parallel runway Heathrow operation. The arrival routes can be serviced by the London TMA operation, supported by individual tromboning linear holding techniques to support arrival runways.

6.4.4 Additional routes below 4,000ft will require the approval of the Secretary of State for Transport.

## **6.5 Missed Approaches**

6.5.1 No Missed Approach Procedures have been submitted by the proposer. Further work will be required to design missed approach procedures. From a service delivery viewpoint, it will be essential that Missed Approach Procedures exist. A three-runway operation is not used in the UK but there are examples of such operations elsewhere in the world and it is envisaged that procedures will be able to be developed, although it can be expected that they will be more complex than such procedures for a two-runway operation.

6.5.2 In a Mixed Mode environment Missed Approach procedures need to ensure separation can be provided from departing aircraft from the same runway. They must also address the instances of aircraft from the other departing runway.

6.5.3 Missed Approach situations on the centre runway would need to reflect the possibility that a conflict could occur from a northerly departure taking off from the southerly runway and a southerly departure taking off from the North West runway.

6.5.4 The scheme proposer will need to develop Missed Approach Procedures in collaboration with the London TMA operation and the airport ATC service provider.

## **6.6 Impact of Proposed Airspace Changes on Other Users**

6.6.1 Northolt could be affected by the operation of the third runway (Annex 2 refers). The lateral confines of the Heathrow Radar Manoeuvring Area (RMA) may need to be extended to accommodate increased traffic on Final Approach which may have an impact on other London airports; effective airspace design will be needed to ensure that this does not have an adverse impact on Luton. If CAS boundaries need to be lowered, this could have an impact on GA.

## **6.7 Impact on Adjoining States**

6.7.1 Currently, airspace capacity limitations exist in the southern part of the London TMA, specifically between the UK and France for departing traffic (routing via DOVER) and arriving traffic (routing via BREST). This situation will be exacerbated by more movements, thus discussions and airspace changes will need to be made with the adjacent ANSP.

6.7.2 In the timescales being considered, neighbouring ANSPs should be operating the advanced SESAR concepts mentioned earlier in this paper (4D trajectory based operations) and be better placed to deal with the increased demand on the airspace.

6.7.3 None of the impacts envisaged on adjoining states is considered insurmountable.

## **6.8 Connectivity to European Programmes**

- 6.8.1 NATS expects to use many of the advanced concepts envisaged by the SESAR programme to support a future Heathrow operation as envisaged by the scheme promoter, including the use of: Trajectory-Based Operations; Trombone linear holding; Extended Arrival Management (XMAN); Time Based Separation to sustain landing rates in strong headwind conditions; and PBN operations for arrival and departure routes.
- 6.8.2 NATS is either currently deploying these SESAR concepts or is working collaboratively with others to ensure that they form part of the operation in the timeframe that the additional runway will be operational.
- 6.8.3 NATS will use such concepts to support operations within the London TMA to service the London airports irrespective of whether or where an additional runway is provided.

## **6.9 Future Operating Procedures**

- 6.9.1 New ATC procedures will be required to ensure the safe and efficient integration of the revised airport operation into the surrounding TMA infrastructure. Procedures for new or revised service delivery will be required, include the future use of Independent Parallel Approaches and Missed Approaches.
- 6.9.2 Specific factors that relate to this particular proposal are:
  - The interaction between Northolt and the North West runway, which will present significant challenges which will need to be supported by robust operating procedures. New Missed Approach procedures will be required to address instances of the following scenarios:
    - Northolt R25 Missed Approach against a Heathrow R27R Missed Approach.
    - Northolt R25 Departure against a Heathrow R27R Missed Approach.
    - Northolt R07 Approach against a Heathrow R09L Missed Approach.
    - Northolt R07 Departure against a Heathrow R09L Missed Approach.
  - Additional effective procedures will need to be established to address the following scenario/s:
    - Northolt R07 Approach against a Heathrow R09L approach.
    - Northolt R25 Departure against a Heathrow R27R departure.
  - In both Westerly and Easterly operations, procedures will need to be developed that address a scenario whereby a southerly departure taking off from the North West runway and/or a northerly departure taking off from the Southerly runway needs to be separated from traffic aborting its landing on the Centre Runway.

6.9.3 All of the circumstances of Missed Approach Procedures identified above are considered to be manageable and should not be considered to present insurmountable constraints.

## **6.10 Conclusions**

6.10.1 The increased level of traffic that this proposal asserts can be supported by the future TMA operation.

6.10.2 The proximity and relative runway orientations of Heathrow airport and RAF Northolt ('Northolt') could have a detrimental mutual impact their respective operations. The potential outcomes of the mutual interactions between Northolt and Heathrow airport as proposed by either of the Heathrow Airport North West Runway or Heathrow Airport Northern Runway Extension proposals are set out in this report (Annex 2).

6.10.3 Effective Missed Approach Procedures will need to be developed.

## **7. The Heathrow Airport Northern Runway Extension**

### **7.1 Introduction**

7.1.1 This scheme proposes an additional runway located in tandem with the current (and shortened) northerly runway. The tandem northerly runways will operate in parallel with the southerly runway. Compass departures are proposed, although the two, serial, northerly runways will be shorter than the southerly runway, thereby placing a limitation on traffic that needs the greater length of the southerly runway.

### **7.2 Runway Operation**

7.2.1 This scheme proposes a new runway being located to the west of the existing northerly runway.

7.2.2 In this report, the new runway is termed the 'Northern Runway Extension' and the existing northerly runway the 'Northern' runway. The current southerly runway continues to be termed as is.

7.2.3 The location of the Northern Runway Extension will be in tandem with the Northern runway, will have a common centre line and have the same width. These two runways will be operated as separate runways and not as a single extended length runway unless emergency situations dictate (e.g. unavoidable overruns).

7.2.4 The ICAO SOIR requirements were not developed to cater for such a runway configuration and thus it is not possible to assert compliance with those regulations. A safety case will be required to cover this particular runway configuration.

7.2.5 The two northerly runways will be oriented in parallel with the existing southerly runway.

7.2.6 None of the runways will be sufficiently separated from each other to support independent operations unless the requirements as set out in SOIR are satisfied (as supplemented by other evidence & capabilities to support tandem runway operations).

7.2.7 The new runway (i.e. the Northern Runway Extension) will be 3,000m long, with the Northern runway reduced in length by 600m to 3,000m. The proposal states that this would not affect the operations of the vast majority of aircraft currently operating out of Heathrow. Such a restriction would result in some traffic either requesting or needing to depart from the (longer) southerly runway irrespective of its destination. This would result in some instances of aircraft heading north departing from the southerly runway, leading to the need for de-confliction from aircraft departing from northerly runways. Such a situation will have an impact on both airport and en-route capacity.

7.2.8 The Southerly runway will remain as currently operated.

7.2.9 The runways would operate within the existing operating hours and with existing night time bans/quotas.

- 7.2.10 All three runways can support Easterly and Westerly operations with no reduction in operating capacity.
- 7.2.11 Five operating modes have been proposed to provide varying degrees of noise respite during the day. Only during peak periods would all three runways be used at the same time. All five operating modes are operationally feasible and the London TMA operation can deliver traffic to and accept traffic from all of the five modes identified.
- 7.2.12 The principle of Compass Departures are proposed, accepting that some traffic routing north may need to use the southerly runway. The proposer has identified that this could be c.13% of departing traffic. This which would have an impact on the workload in the TMA operation but would still support the traffic levels asserted.
- 7.2.13 The primary landing aid will be the Instrument Landing System using a 3.2 degrees glide slope. The London TMA operation can deliver traffic to support such an approach angle.
- 7.2.14 The proposer has identified the use of Offload SIDs to enable runway capacity/demand balancing. Whilst this will better support ground-based operations, their use will reduce the efficiency of the surrounding airspace as crossing traffic is will need to be deconflicted whilst airborne.

### **7.3 Traffic Levels**

- 7.3.1 The scheme proposer is proposing a maximum movement rate of 130 per hour during normal operating conditions, comprising 48 per hour Mixed Mode, 40 per hour Arrivals and 42 per hour Departures. A traffic volume of 700k ATMs pa is proposed. Such rates and volumes can be supported by the London TMA as being redeveloped by LAMP.
- 7.3.2 The annual figure of ATMs is not considered to be maximum or upper limited that can be operated from a revised Heathrow operation as proposed by the scheme promoter. The extension of peak operating hours would result in greater annual movements being delivered. There is however a trade-off between the amount of traffic movements that can be managed and the resilience of the operation at both the airport and within the London TMA.

### **7.4 Operational Deliverability of Proposed Departure & Arrival Routes**

- 7.4.1 SIDs that are predicated on PBN capabilities will need to be established to ensure that such situations have minimal impact on the efficiency of the London TMA operation.
- 7.4.2 NATS has seen some indicative and initial departure routes supporting the tandem and parallel runway configuration proposed by the scheme promoter. The departure routes predominately follow and link into existing traffic patterns and flight paths and as such are expected to be able to integrate into the London TMA airspace structure (post-LAMP).
- 7.4.3 NATS has seen some indicative and initial arrival routes supporting the tandem and parallel runway configuration proposed by the scheme promoter. The arrival routes can be serviced by the London TMA operation, supported by individual tromboning linear holding techniques to support arrival runways.



7.4.4 Additional routes below 4,000ft will require the approval of the Secretary of State for Transport.

## **7.5 Missed Approaches**

7.5.1 No Missed Approach Procedures have been submitted by the proposer. Further work will be required to design missed approach procedures. From a service delivery viewpoint, it will be essential that Missed Approach Procedures exist. The concept of tandem and parallel runway operations for civil air traffic operations is not used anywhere in the world and the development of Missed Approach Procedures will be more challenging and complex than for solely parallel-runway operations.

7.5.2 The scheme proposer will need to develop Missed Approach Procedures in collaboration with the London TMA operation and the airport ATC service provider.

## **7.6 Impact of Proposed Airspace Changes on Other Users**

7.6.1 The lateral confines of the Heathrow Radar Manoeuvring Area (RMA) may need to be extended to accommodate increased traffic on Final Approach which may have an impact on other London airports; effective airspace design will be needed to ensure that this does not have an adverse impact on Luton. If CAS boundaries need to be lowered, this could have an impact on GA.

## **7.7 Impact on Adjoining States**

7.7.1 Currently, airspace capacity limitations exist in the southern part of the London TMA, specifically between the UK and France for departing traffic (routing via DOVER) and arriving traffic (routing via BREST). This situation will be exacerbated by more movements, thus discussions and airspace changes will need to be made with the adjacent ANSP.

7.7.2 In the timescales being considered, neighbouring ANSPs should be operating the advanced SESAR concepts mentioned earlier in this paper (4D trajectory based operations) and be better placed to deal with the increased demand on the airspace.

7.7.3 None of the impacts envisaged on adjoining states is considered insurmountable.

## **7.8 Connectivity to European Programmes**

7.8.1 NATS expects to use many of the advanced concepts envisaged by the SESAR programme to support a two parallel runway operation at Heathrow, including the use of: Trajectory-Based Operations; Trombone linear holding; Extended Arrival Management (XMAN); Time Based Separation to sustain landing rates in strong headwind conditions; and PBN operations for arrival and departure routes.

7.8.2 NATS is either currently deploying these SESAR concepts or is working collaboratively with others to ensure that they form part of the operation in the timeframe that the additional runway will be operational.

7.8.3 NATS will use such concepts to support operations within the London TMA to service the London airports irrespective of whether or where an additional runway is provided.

## **7.9 Future Operating Procedures**

7.9.1 New ATC procedures will be required to ensure the safe and efficient integration of the revised airport operation into the surrounding TMA infrastructure. Procedures for new or revised service delivery will be required, include the future use of Independent Parallel Approaches and Missed Approaches.

7.9.2 Specific factors that relate to this particular proposal are:

- The proximity of the Northern Runway Extension to Northolt which presents some challenges to both operations. Safe Missed Approach procedures would need to be developed to cater for the following scenarios:
  - Westerly Operations: Northolt 25 departure with a Heathrow Northern Runway Extension Missed Approach.
  - Westerly Operations: Northolt 25 arrival Missed Approach with a Heathrow Northern Runway Extension Missed Approach.
  - Easterly Operations: Heathrow Northern Runway Extension arrival Missed Approach with Northolt 07 arrival.
- Furthermore additional Missed Approach procedures would also need to address the following scenarios:
  - Westerly Operations: Heathrow Northern Runway arrival Missed Approach with Heathrow Northern Runway Extension departure.
  - Easterly Operations: Heathrow Northern Runway Extension arrival Missed Approach with Heathrow Northern Runway departure.
- An effective nomenclature will be required to ensure that all users can unambiguously identify the runway configuration.
- Effective procedures will need to be developed to address the fact that the Northern Runway Extension will be c.3.6km closer to the White Waltham aerodrome to mitigate instances of departing aircraft failing to secure the necessary height (as may be caused by an engine loss following take off).
- Effective SID/Approach path design will need to consider the proximity of White Waltham and allied GA & London Control Zone users.

## **7.10 Conclusions**

7.10.1 Subject to safety assurances being developed, the increased level of traffic that this proposal asserts can be supported by the TMA operation.

- 7.10.2 Due to the innovative nature of this proposal, additional safety analysis will need to be undertaken to verify that independent operations can be safely delivered by the two serial northerly runways.
- 7.10.3 In particular, Missed Approach procedures will need to be established to ensure effective independent operation of all three runways proposed by the scheme promoter and cognisant of operations from Northolt.
- 7.10.4 Changing modes of operation to deliver noise respite would result in operational inefficiencies and a potential reduction in the hourly movement rates.

## 8. Assumptions

The table below sets out the assumptions have been made whilst developing this report and the potential implications and consequences if these subsequently are proven to be incorrect.

No.	Scheme	Assumption	Implications if Incorrect
1	All	That the requirements of ICAO SOIR will be satisfied to enable independent operations to occur.	The asserted quantity of traffic may not be able to be delivered on either an hourly or an annual basis, thereby limiting the effectiveness of the airport.
2	All	That Missed Approach Procedures can be approved.	The operational will not be able to be approved as current asserted and other mitigating features will be required.
3	All	That the development of Standard Instrument Departures is predicated on the ability of aircraft to support Performance Based Navigation	The departure routes will require more airspace than would otherwise be the case, potentially impacting airspace capacity.
4	All	That airline operators invest to ensure that their aircraft are capable of supporting Performance Based Navigation.	Not all aircraft will be able to fly the promulgated departure route, with a detrimental impact on airspace capacity.
5	All	That the ultimate SID and STAR routes are flyable by all types of aircraft that will operate from the revised airport/runway configurations.	Adverse impact on airspace capacity resulting from unexpected distribution of traffic entering/operating within the London TMA.
6	All	That sufficient runway Rapid Exit Taxiways exist to enable required/asserted runway throughput and utilisation	Runway utilisation & throughput will be reduced as landing aircraft will be on the runway for longer, thereby increasing the likelihood of a go-around procedure.
7	All	That all aircraft are capable of supporting the approach angle used by the primary landing aid (i.e. 3.2 degrees for all three schemes, increasing to 3.5 degrees for the HAL proposal)	Aircraft types not capable of supporting the approach angle may not be able to operate from that airport unless a landing aid that also supports the existing 3.0 degree glide slope is also provided.
8	All	That the advanced concepts being developed and validated by the SESAR Programme will be delivered and used in the timeframe being considered (i.e. 2025).	The increase in airspace capacity within the London TMA is not delivered, thereby jeopardising the ability to support the hourly movement rated and annual movement figures asserted.
9	All	That the airspace changes required to support the Point	Existing holding concepts will be required to continue to be used,

		Merge and Tromboning concepts of linear holding will be approved by the appropriate authorities (e.g. CAA and SoS)	jeopardising the ability to service the asserted airport capacity rates.
10	All	That the assertions regarding the schemes to deliver Compass Departures and Terminal Arrivals are valid.	Adverse impact on airspace capacity as air-crossing will be required, which has the potential to significantly affect airspace capacity.
11	All	That the current operating hours and night time restrictions that currently exist throughout the London TMA would remain in force over the period that the additional runway would be operable.	Further restrictions would reduce the amount of annual movements asserted; a relaxation could result in a corresponding increase.
12	Note A	That a safety case can be made for the use of two serial runways supporting independent operations at the traffic levels asserted by the proper.	Dependant operations would need to be provided, limiting the traffic levels that could be supported.
13	Note B	That the existing operating procedure of Northolt operating the same landing direction as Heathrow would be retained.	Significant increase in complexity of delivering traffic to and from Northolt, with resultant adverse impact on local network capacity.

Note A: Heathrow Airport Northern Runway Extension

Note B: Heathrow Airport North West Runway and Heathrow Airport Northern Runway Extension

## **Annex 1: Airport Capacity Benchmarking**

As part of the first stage of the NATS' assessment process, a review was undertaken of the individual scheme submission specifications of the mode of runway operations and proposed Runway Service Rates.

Runway Service Rates are different to capacity declarations - they are typically used for planning purposes and include a level of resilience to ensure that a level of runway throughput can be sustained or rapidly recovered to following unexpected and abnormal situations.

Benchmark Service Rate values that are considered appropriate for the type of operation (e.g. segregated mode or mixed mode) and mix of traffic proposed (i.e. the expected class of traffic and its associated wake vortex characteristics) were compared to those proposed for each of the three schemes.

It was concluded that each proposal quoted Service Rates that are valid for the purpose of planning which includes a level of resilience. This was not an unexpected outcome: the proposals had been developed in a manner that reflected the experiences of the current operation at the airport, the current and future traffic mix that was planned to be supported, and the modes of operation.

For a Mixed Mode runway operating and a mix of aircraft types, a Service Rate planning parameter of 48 ATMs per hour is considered as an appropriate figure to use. This figure assumes a standard final approach spacing of 6NM (allowing a single departure to take off between two arrivals).

For Segregated Mode runways and considering the proposed mix of traffic and considering existing Heathrow planning parameters, and current, actual arrival and departure rates, 38-40 Arrival ATMs per hour and ~42 departure ATMs per hour are again sensible planning parameters.

The hourly rates were then assessed by scaling them up to produce annual ATMs considering airport operating hours and night curfew. No changes to existing curfew and restrictions were envisaged or reflected.

In doing so, the NATS' assessment concluded that the proposers' suggested annual movement rates were as expected, realistic and achievable.

## Annex 2: The Impact of Northolt on Future Heathrow Operations

### Background

Initial findings provided to the Airports Commission as part of the Phase 2 analysis identified that there could be significant mutual interactions between an expanded Heathrow (under either of the Heathrow Airport North West Runway or Heathrow Airport Northern Runway Extension proposals) and RAF Northolt ('Northolt'). Any such impacts would be due to both the proximity of Northolt to Heathrow and the relative orientation of the runways. This annex sets out the expected operational impact of expanding Heathrow on the overall capacity of these two airports and the surrounding airspace that would result from either of the schemes as proposed.

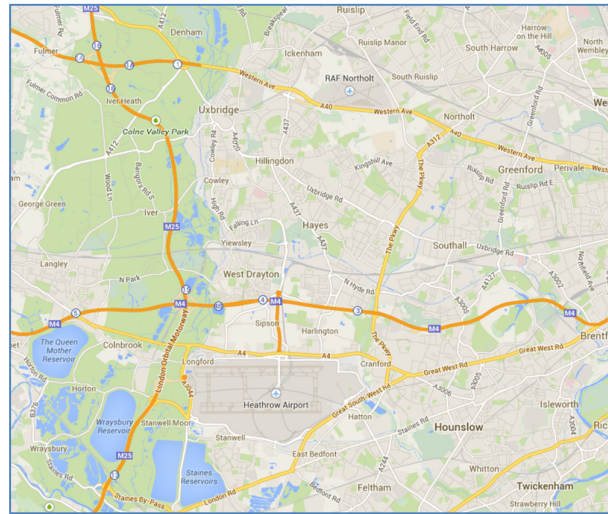
### Current Operations

Northolt is 4.8NM on a bearing of 20 degrees from Heathrow<sup>2</sup>. Heathrow operates runways orientated at magnetic bearings of 90 degrees and 270 degrees. Northolt operates a single runway on a magnetic bearing of 70 degrees and 250 degrees. This results in an approach/departure angle of convergence/divergence of 20 degrees.

The current Heathrow operation can sustainably deliver the declared capacity (17 hour period), the arrival scheduling limit typically ranges between 38 and 44 movements per hour and for departures it ranges between 38 and 46 movements per hour (excluding the shoulder hours).

Operations from Northolt are both significantly fewer and, due to the type of traffic operated, far less predictable in nature, with the vast majority (c.80%) being Executive/Private flights (as set out in Appendix A).

With a few exceptions<sup>3</sup>, traffic inbound to both aerodromes is managed by the London Terminal Control operation until established on the respective Instrument Landing System.



The use of an additional runway at Heathrow, as proposed by either scheme, could be expected to increase the complexity of the surrounding airspace and thus have an adverse impact on the capacity of the airspace around Heathrow.

Currently, both airports are operated on a common runway direction, determined by the prevailing wind direction and the Westerly Preference at Heathrow. Consequently, if Heathrow is operating on Westerlies, the Northolt operation will match this to avoid localised opposite direction arriving/departing traffic. Such a situation will need to continue, irrespective of whether Heathrow has two runway or three runways.

<sup>2</sup> Calculated from the mid-points of Heathrow Runway 09L/27R and Northolt Runway 07/25.

<sup>3</sup> Some traffic operating in to / out of Northolt operates outside Controlled Airspace and is not subject to Air Traffic Services provided by NATS within the London TMA.

The current operation is supported by Missed Approach Procedures that address all possible combinations of go-around situations at both Heathrow and Northolt.

## Methodology

The use of the additional runway for the various operating modes identified by the scheme promoters was considered for both Easterly and Westerly operations. It was assumed that the existing requirement placed on Northolt to operate the same runway direction as Heathrow would be retained. It has been further assumed that Northolt will retain the same level of traffic movements as currently limited by its planning cap.

The impact on Heathrow and Northolt resulting from each operating scenario as set out by both schemes was considered as to whether it would have:

- No effect on capacity, with any impact being readily mitigated through revised operating procedures (colour coded Green);
- A limited effect on capacity that would be expected to be mitigated by the development of new operating procedures, additional departure & arrival information and/or advanced airborne capabilities (e.g. through the development of departure and arrival routes that conform to a more specific navigational performance than exists today such as Required Navigation Performance – Authorisation Required (RNP-AR) procedures. Without such mitigating capabilities being established this could result in a movement operating to/from one airport impacting the other, but not to the extent of '1:1' (colour coded Amber). This has the potential to result in a marginal reduction in landing capacity at either Heathrow or Northolt (with any priority given on a tactical and operational basis as the situation arises).
- A significant effect on capacity that could only be mitigated through the establishment of more challenging mitigating capabilities and procedures (e.g. PBN-based arrivals & departures) and in the absence of which, would result in one Northolt movement being serviced at the expense of greater than one Heathrow movement or vice versa (colour coded Red).

The review did not develop Missed Approach Procedures for the revised Heathrow operation. These will however need to be developed to reflect both the revised runway configuration at Heathrow and in a manner that accommodates its interaction with Northolt. NATS does not envisage the development and approval of such procedures as unachievable in the timeframe being considered for the use of the additional runway.

Given the timeframe being considered in this analysis and the fact that the maximum traffic movements will not occur from the outset of any revised operation, NATS is confident that deconflicted arrival and departure routes supporting the Heathrow and Northolt operations could be developed.

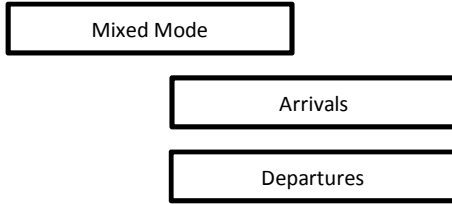
If approval for a third runway at Heathrow was granted, NATS redesign of the London TMA would ensure that sufficient airspace capacity will be available to support a three runway Heathrow at the peak and annual ATMs envisaged by both proposals.



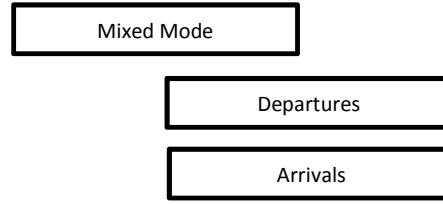
# The potential impact of the Heathrow Airport North West Runway Proposal

Four, equally utilised, Operating Periods are proposed as illustrated below:

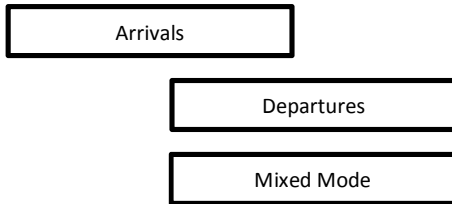
## Westerly Operations



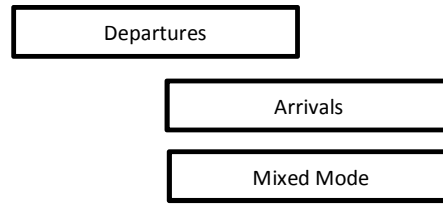
*Period 1 (Westerly operations)*



*Period 2 (Westerly operations)*

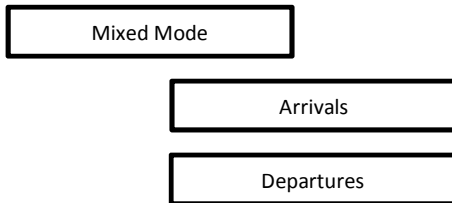


*Period 3 (Westerly operations)*

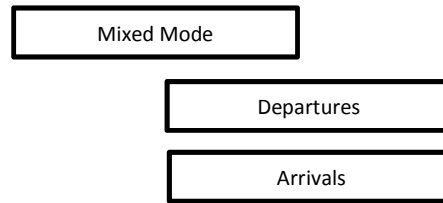


*Period 4 (Westerly operations)*

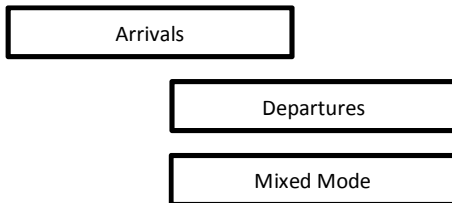
## Easterly Operations



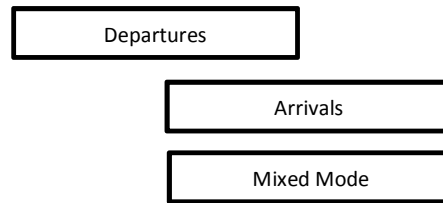
*Period 1 (Easterly operations)*



*Period 2 (Easterly operations)*



*Period 3 (Easterly operations)*



*Period 4 (Easterly operations)*

Applying the historical apportionment of Westerly to Easterly operations (70%:30%) results in the following proportion of time each of the directional operating modes will be used:

Operating Period	Operating Direction	Operating Percentage
1	Westerlies	17.5%
1	Easterlies	7.5%
2	Westerlies	17.5%
2	Easterlies	7.5%
3	Westerlies	17.5%
3	Easterlies	7.5%
4	Westerlies	17.5%
4	Easterlies	7.5%

The scheme seeks to operate an additional runway 1,045m to the north of the existing northerly runway (identified as Runway 09R on Westerlies and 27L on Easterlies). This will reduce the distance from the centre point of the existing northerly runway to the centre point of the Northolt runway from 4.8NM to c.4.2NM. Such a reduction in separation will increase the complexity of the airspace supporting the Heathrow and Northolt operations as the thresholds of the new runway at Heathrow and the Northolt runway will be closer. The impact on capacity is set out in the table below.

Mode	New Runway Operation	Direction	Utilisation	Northolt Inbound	Northolt Outbound
1	Mixed Mode	Westerlies <sup>4</sup>	17.5%		
1	Mixed Mode	Easterlies <sup>5</sup>	7.5%		
2	Mixed Mode	Westerlies	17.5%		
2	Mixed Mode	Easterlies	7.5%		
3	Landing	Westerlies	17.5%		
3	Landing	Easterlies	7.5%		
4	Departure	Westerlies	17.5%		
4	Departure	Easterlies	7.5%		

<sup>4</sup> Westerly operations result in Heathrow Airport North West Runway and Northolt Runway 25 being used.

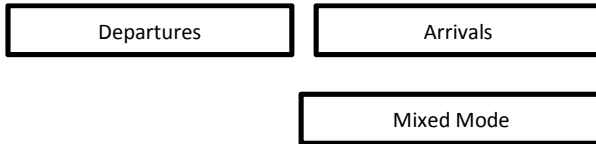
<sup>5</sup> Easterly operations result in Heathrow Airport North West Runway and Northolt Runway 07 being used.

## The potential impact of the Heathrow Airport Northern Runway Extension Proposal

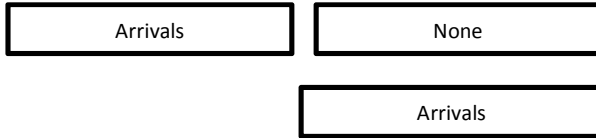
The scheme seeks to operate an additional runway to the west of the existing runway, identified as the Northern Runway Extension (Westerly or Easterly depending upon its operational use). This will increase the distance from the centre point of the Northern Runway Extension to the centre point of the Northolt runway from 4.8NM to c.5.7NM. Such an increase in separation will help to reduce the complexity of the operations as the thresholds of the Northern Runway Extension and the Northolt runway will be further apart.

Four Operating Modes are proposed, illustrated below:

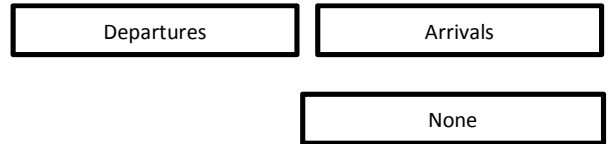
### Westerly Operations



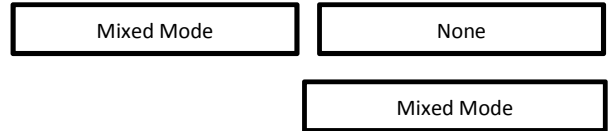
*Mode: Peak Flow (Westerly operations)*



*Mode: Deep Landings (Westerly operations)*

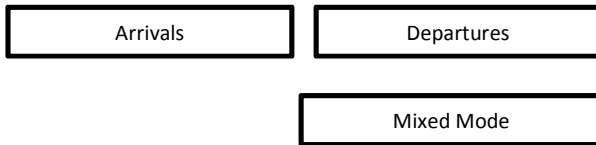


*Mode: Southern Relief (Westerly operations)*

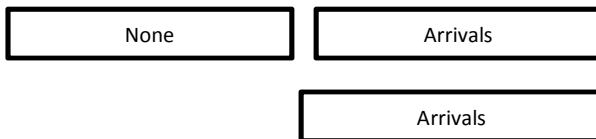


*Mode: Northern Relief (Westerly operations)*

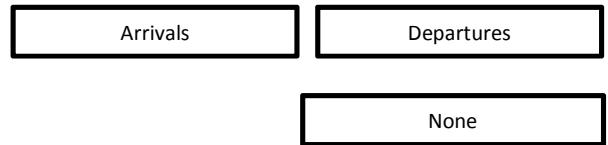
### Easterly Operations



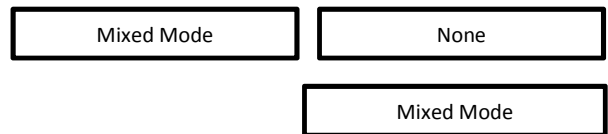
*Mode: Peak Flow (Easterly operations)*



*Mode: Deep Landings (Easterly operations)*



*Mode: Southern Relief (Easterly operations)*



*Mode: Northern Relief (Easterly operations)*

The impact on capacity is set out in the table below.

<b>Operating Mode</b>	<b>New Runway Operation</b>	<b>Direction</b>	<b>Northolt Inbound</b>	<b>Northolt Outbound</b>
Southern Relief	Departures	Westerlies <sup>6</sup>		
Southern Relief	Arrivals	Easterlies <sup>7</sup>		
Deep Landings	Arrivals	Westerlies		
Deep Landings	Arrivals	Easterlies	N/A	N/A
Northern Relief	Mixed Mode	Westerlies		
Northern Relief	Mixed Mode	Easterlies	N/A	N/A
Peak Flow	Departure	Westerlies		
Peak Flow	Arrival	Easterlies		

N/A: Not Applicable – this operating scenario does not exist (but has been included / identified for completeness).

The scheme proposal will also result in a change to the current northerly runway at Heathrow (R09L/R27R), which is not ordinarily used for easterly departures. Such use will not have an impact on Northolt departures due to simultaneous departures operating divergent departure angles.

<sup>6</sup> Westerly operations result in Northern Runway Extension (Westerly) and Northolt Runway 25 being used.

<sup>7</sup> Easterly operations result in Northern Runway Extension (Easterly) and Northolt Runway 07 being used.

## Conclusions

Against a baseline of today's operation, the impact of the Heathrow Airport North West Runway scheme on the interactions on the Heathrow and Northolt interface is greater than currently exists. This is due to the fact that the North West runway will be closer to Northolt, and in some operating scenarios, will need traffic to be manually coordinated between the two operating units to deliver dependant operations (e.g. Westerly departures from the North West runway and Northolt R25). Two operating scenarios were identified where NATS is not currently confident that suitable mitigation could be assured to be developed and which would result in a reduction in airspace capacity:

- Using the North West runway for Landing in a Easterly direction whilst integrating a Northolt arrival into the arrival sequence; and
- Using the North West runway for Departures in a Westerly direction whilst integrating a Northolt departure into the departure sequence.

Such operating scenarios are estimated to occur 25% of the time.

Whilst it is not possible to quantify the specific reduction in airspace capacity, both scenarios could result in some impact between traffic arriving at / departing from Heathrow and Northolt but this would not be on a '1:1' ratio given the distances between the runways being operated.

However, the use of arrival and departure routes supporting Heathrow and Northolt that support more stringent RNP capabilities than which currently exist would avoid such a situation and thus remove any operational restrictions and inter-dependencies (subject to Missed Approach Procedures being developed & approved). If such routes were to be developed, Heathrow and Northolt would be able to support independent operation and therefore would be able to operate without causing reduction in capacity or adverse consequences on safety.

It should also be noted that advanced use of RNP is already being trailed in a number of locations worldwide, including the use of over 170 RNP-AR procedures in the USA.

The impact of the Heathrow Airport Northern Runway Extension scheme on the interactions on the Heathrow and Northolt interface does not make the existing operation any more complex than as currently exists; indeed, in some, circumstances it reduces the complexity as the Northern Runway Extension is further from Northolt than the existing (northerly) runway at Heathrow. The operation would however be further enhanced by the use of arrival and departure routes that support more stringent RNP capabilities than currently exist. In the timeframes being considered, NATS is confident that such capabilities will exist and be an established part of the Heathrow operation (noting that the aircraft capabilities required to operate from an airport are a matter for that airport operator).

A key conclusion is that whilst the Heathrow Airport North West Runway scheme proposal presents greater operational challenges than the Heathrow Airport Northern Runway Extension scheme proposal (due to the greater proximity of the additional runway to Northolt) when compared against today's baseline operation, neither present insurmountable challenges and NATS is confident that in the timeframes being considered, both the Heathrow and Northolt operation could co-exist provided that more stringent and de-conflicted arrival and departure routes could be operated at both airports.

**Appendix A: Northolt Movements January 2012 to July 2014**

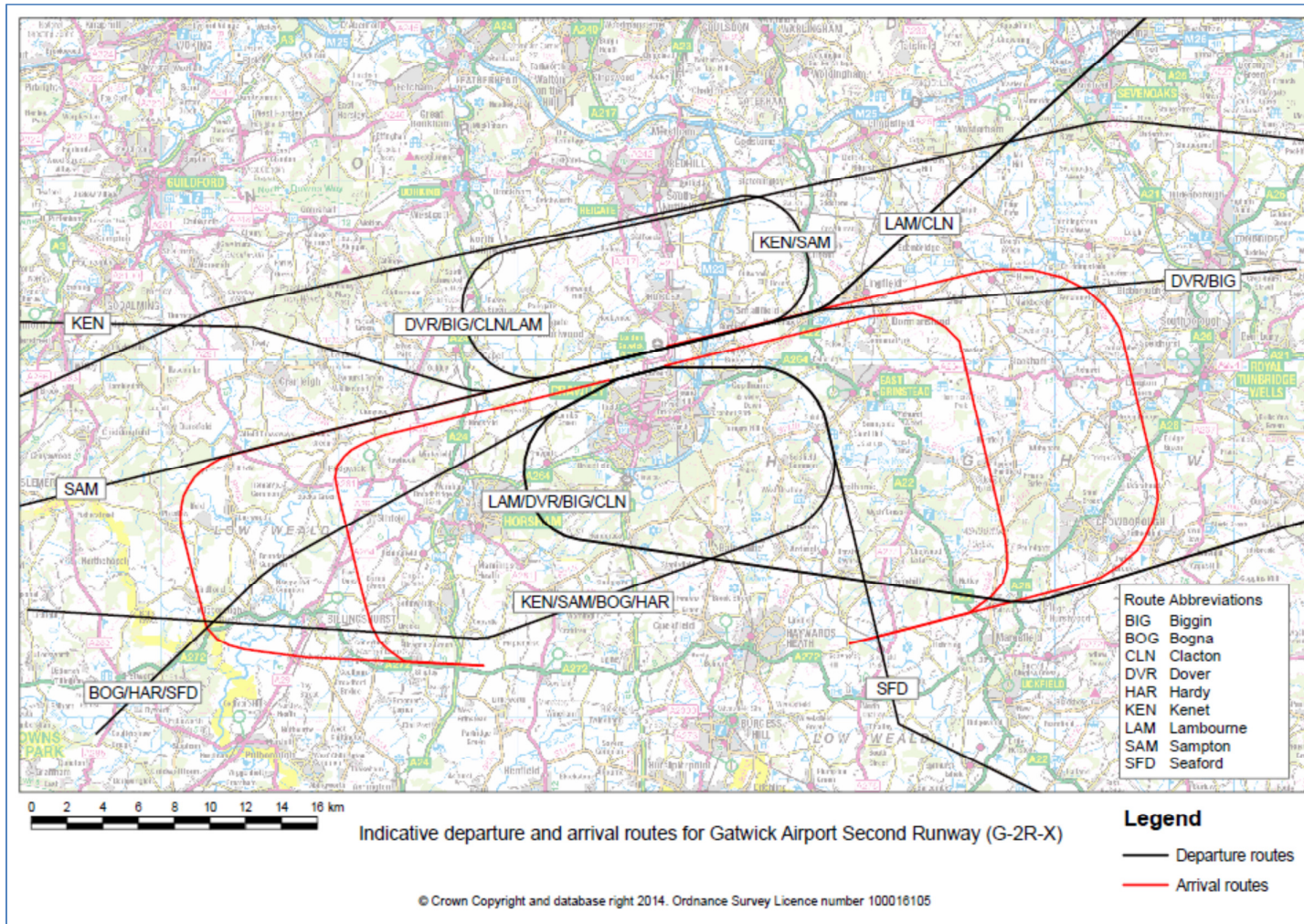
Year	Departures				Arrivals				Total
	ATM Movements	Executive/Private	Military	Total	ATM Movements	Executive/Private	Military	Total	
2012	245	3258	584	4087	251	3347	448	4046	8133
2013	427	4267	626	5320	445	4321	450	5216	10536
2014*	276	2692	328	3296	283	2737	289	3309	6605

Year	Departures				Arrivals			
	ATM Movements	Executive/Private	Military	Total	ATM Movements	Executive/Private	Military	Total
2012	6%	80%	14%	100%	6%	83%	11%	100%
2013	8%	80%	12%	100%	9%	83%	9%	100%
2014*	8%	82%	10%	100%	9%	83%	9%	100%

2014\*: January 2014 to July 2014 inclusive

Source: The UK Flight Data Base and covers the Instrument Flight Rules (IFR) FR Exempted and Chargeable Flights at NATS Centres.

### Annex 3: Gatwick Airport Second Runway – Indicative Arrival and Departure Paths

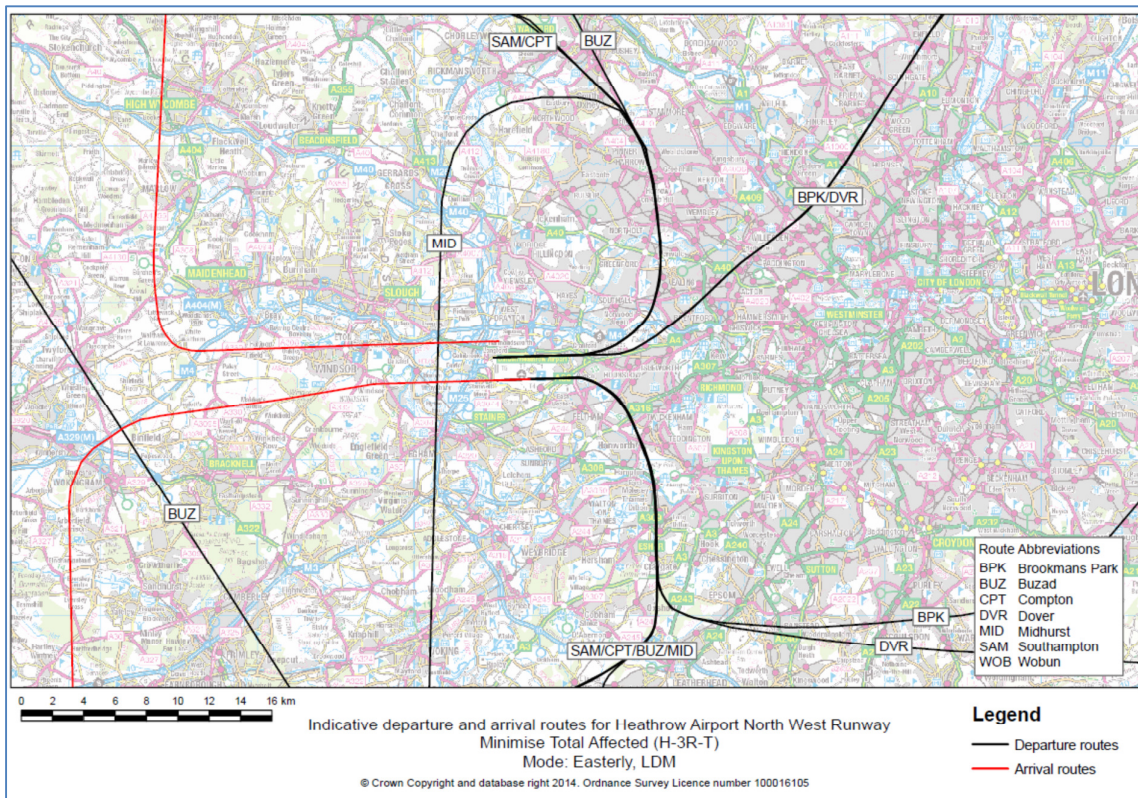
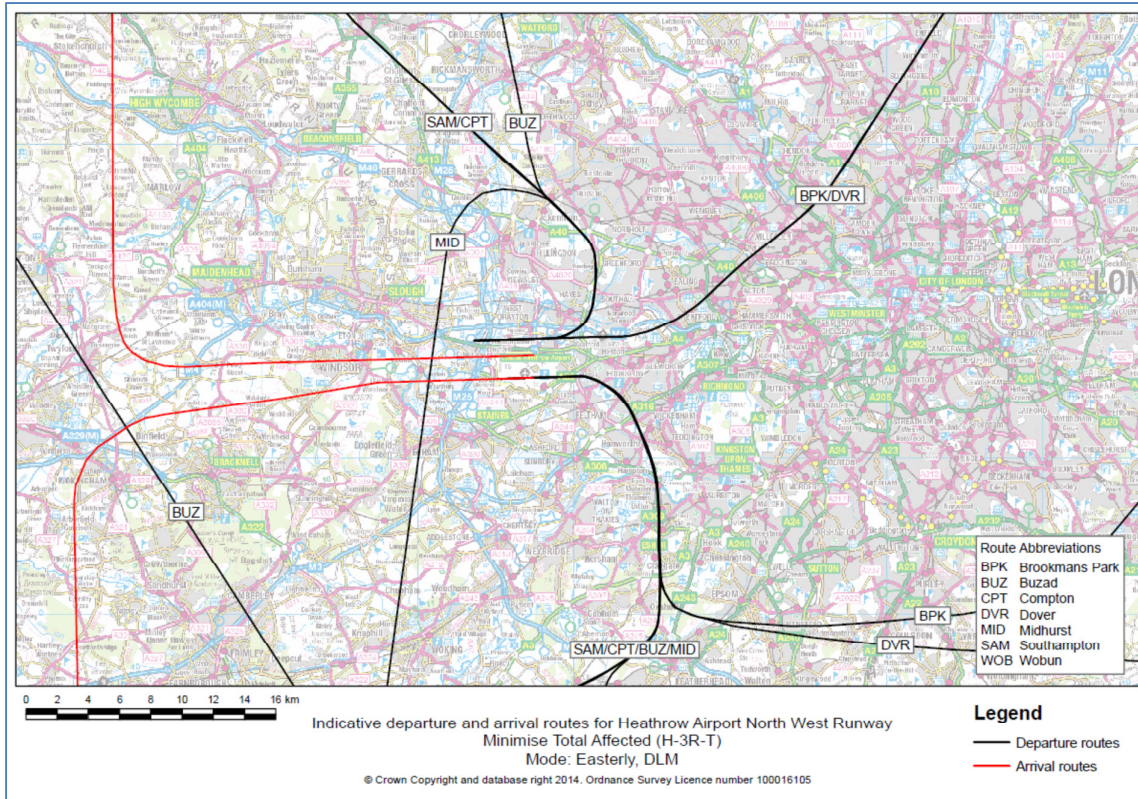


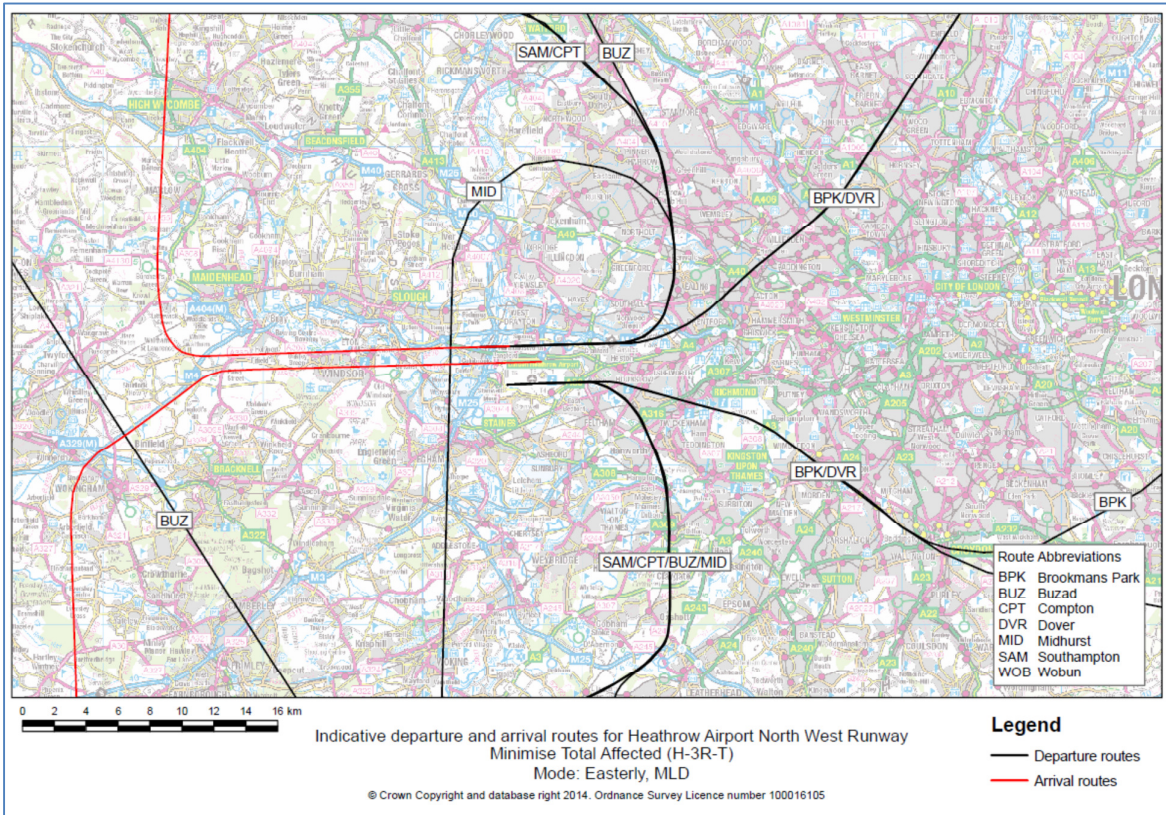
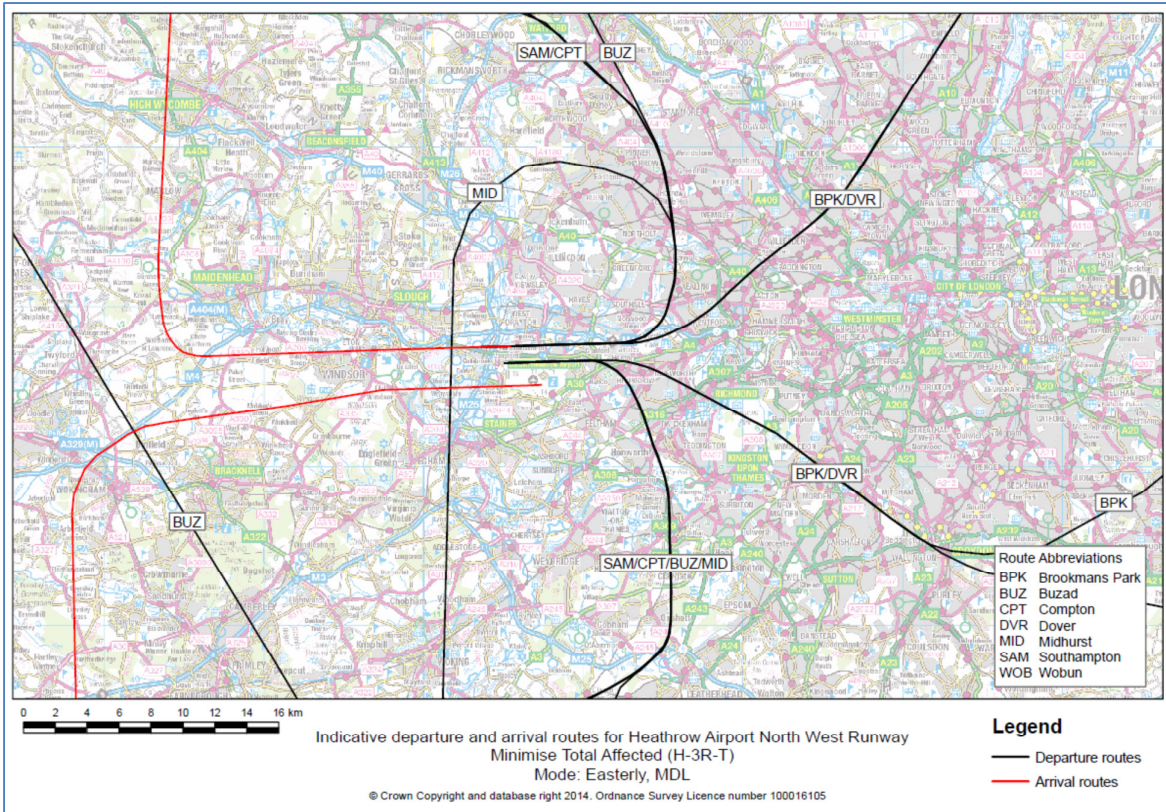
## **Annex 4: Heathrow Airport North West Runway - Indicative Arrival and Departure Paths**

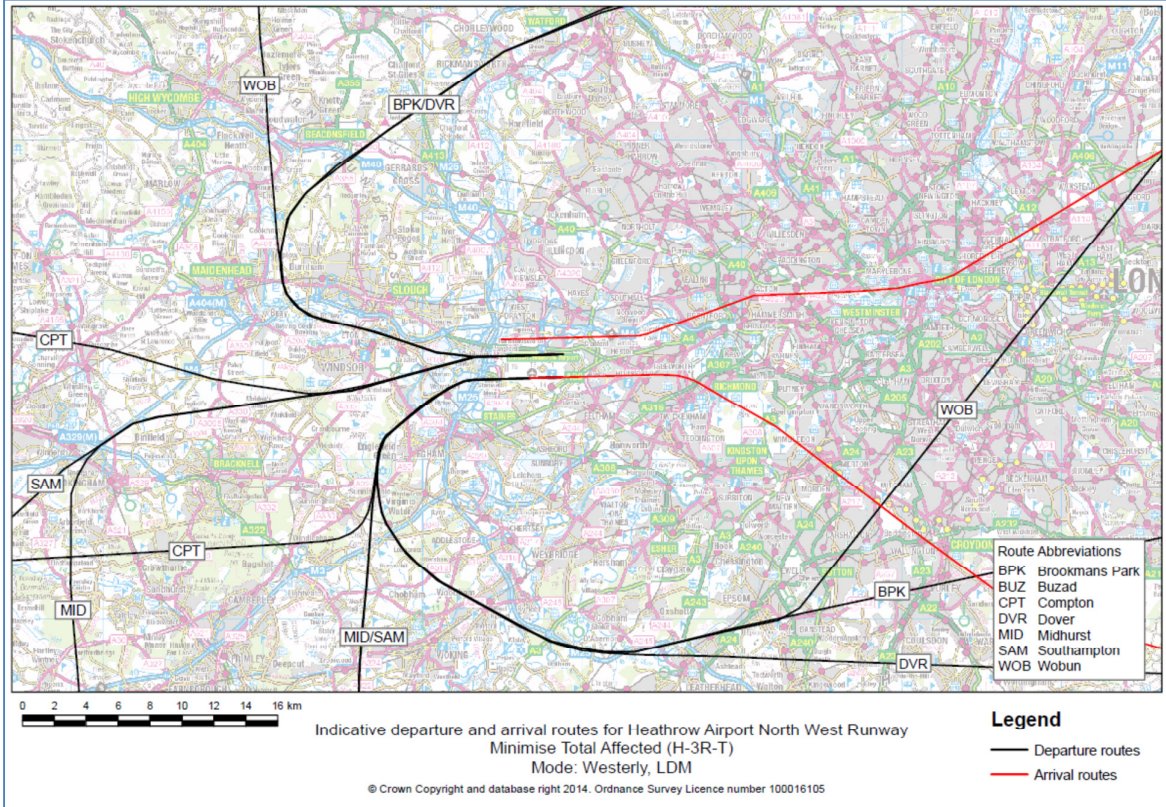
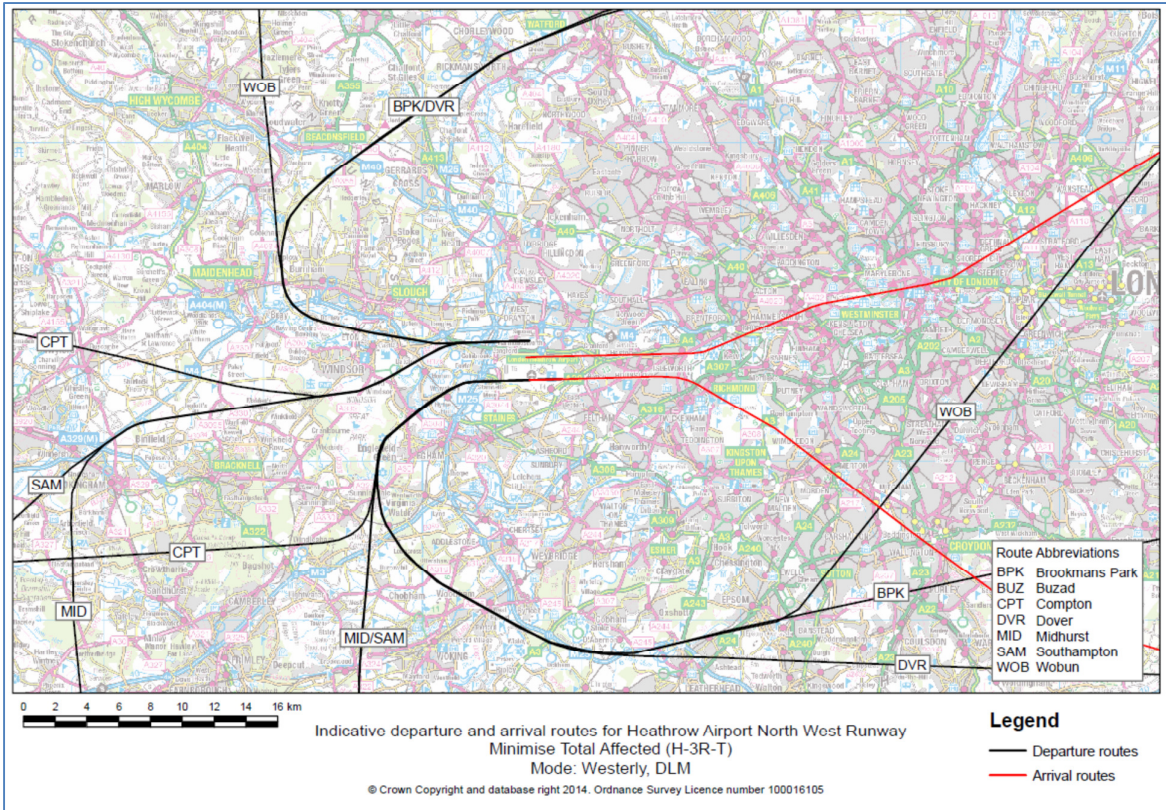
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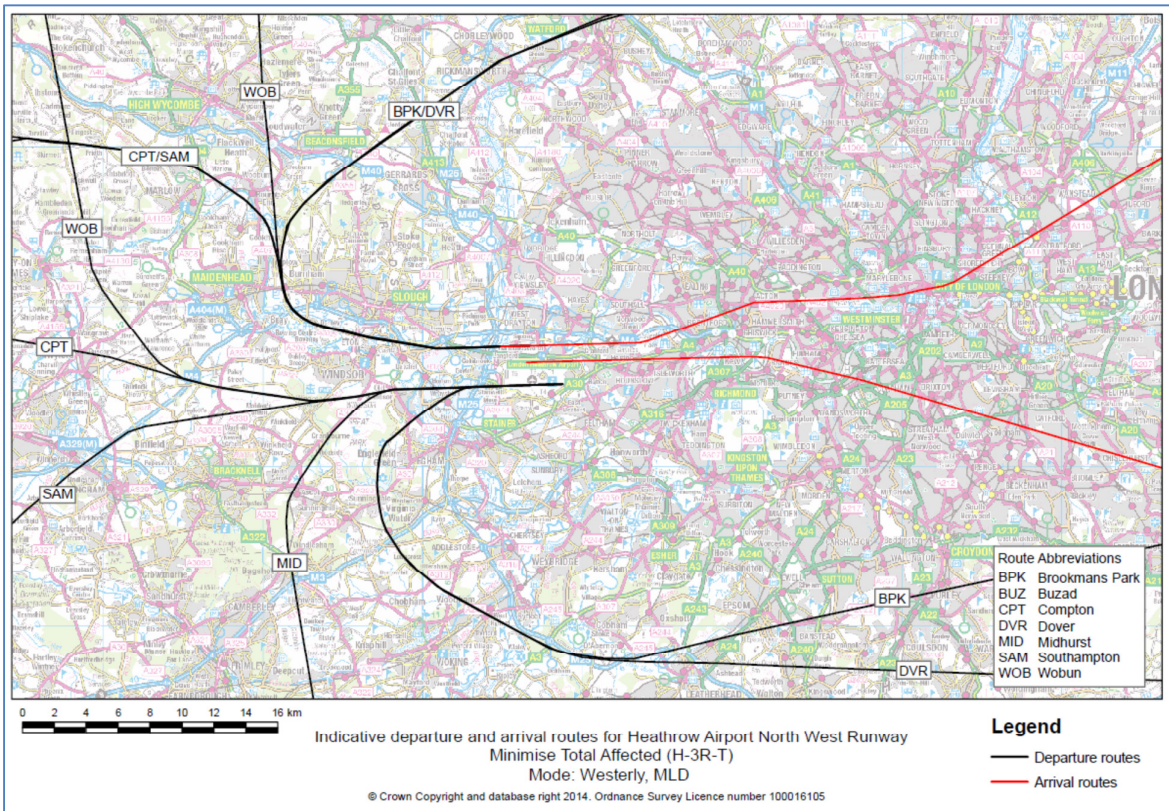
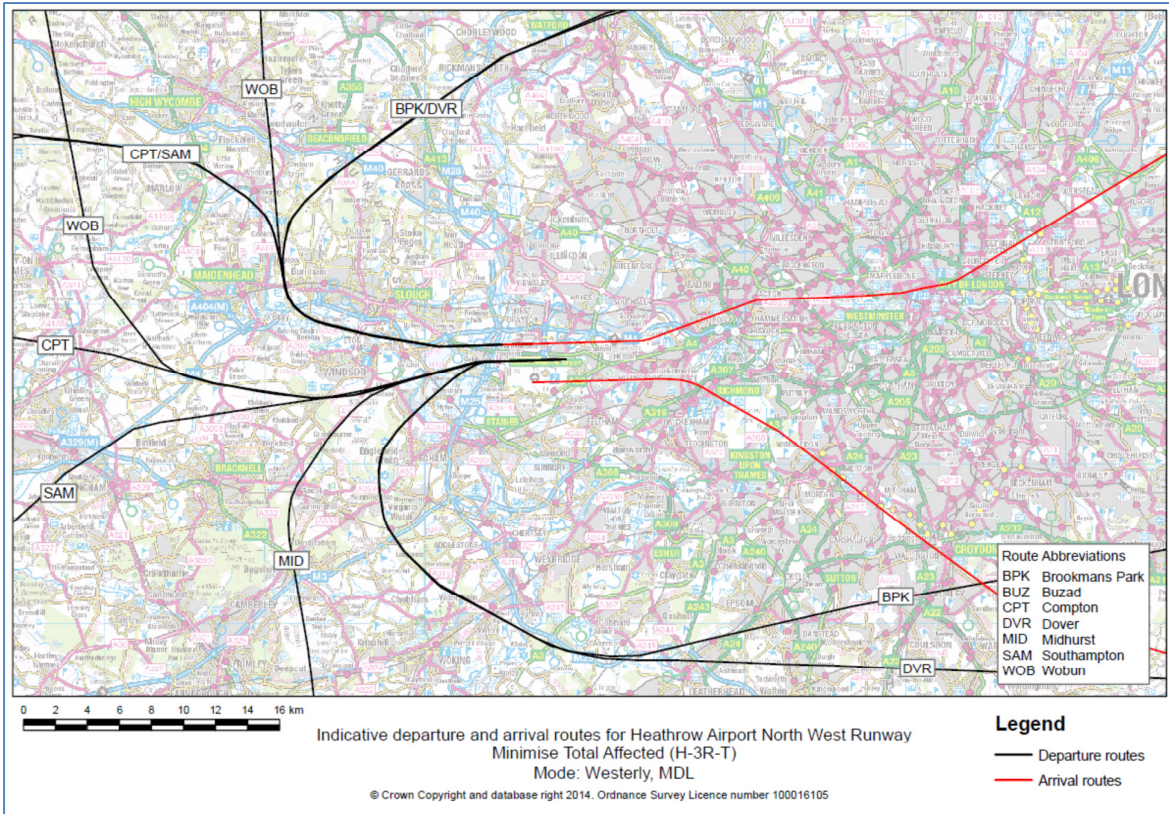
- Minimise Total Affected, Mode: Easterly DLM
- Minimise Total Affected, Mode: Easterly LDM
- Minimise Total Affected, Mode: Easterly MDL
- Minimise Total Affected, Mode: Easterly MLD
- Minimise Total Affected, Mode: Westerly DLM
- Minimise Total Affected, Mode: Westerly LDM
- Minimise Total Affected, Mode: Westerly MDL
- Minimise Total Affected, Mode: Westerly MLD











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## Annex 5: Heathrow Airport Northern Runway Extension - Indicative Arrival and Departure Paths

