AD6 PIR

AD6 PIR Report

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1 Introduction

This report has been prepared by Noise Consultants Limited on behalf of Trax International Limited and presents the environmental appraisal in support of the London Luton Airport Limited (LLA) Airspace Deployment 6 (AD6) Post Implementation Review (PIR).

The CAA's airspace change process is a seven-stage mechanism that is set out in detail in CAP1616. Stage 7 of this process is the Post Implementation Review (PIR). The PIR analyses the impacts of the airspace change a year after its implementation to allow the CAA to determine whether the airspace change has produced the intended outcomes, and if not, to inform the CAA on the steps required to be taken.

The Post Implementation Review (PIR) request received from the Civil Aviation Authority (CAA) which is set out in Annex A of this report. This sets out the information that is to be provided as part of the PIR. The environmental topics covered in this report are as follows:

- Air Quality and Biodiversity (see Section 3)
- Aircraft Noise (See Section 4)

This report:

- Identifies differences between the AD6 modelled flight paths as presented in the Stage 3 FOA and Stage 4 Final Options Appraisal, and the AD6 airspace as actually occurred since its implementation;
- Highlight the key differences which have occurred specifically as a result of AD6 implementation by comparing the pre and post AD6 implementation scenarios;
- Present an updated assessment using the actual AD6 airspace configuration in the implementation year, highlighting any key differences with the Stage 3 FOA and Stage 4 Final Options Appraisal AD6.

1.1 Background

The scope of the Swanwick Airspace Improvement Programme Airspace Deployment 6 (SAIP AD6) was to reduce the complexity of LLA arrivals (and their interacting relationship with London Stansted Airport Arrivals), in turn reducing air traffic controller workload and assuring a safe and efficient operation for the future.

It comprised of a set of new westerly and easterly approach routes and procedures replacing the previous ones implemented at airport. No changes to the airport's departure procedures were proposed as part of the AD6 project. Individual components and their relative use within the airspace were based on discussions and collaboration with NATS.

The AD6 Full Option Appraisal (FOA) took place in 2020. A 15-week consultation was held on two combined systems of options, which were named Option 1 Vectoring, and Option 2 PBN Routes with Vectoring.

LLA received over 2,400 responses to the consultation. LLA analysed the responses, summarised and categorised them all. LLA drew conclusions from the analysis, and developed actions for the next stage, based on those conclusions.

At Stage 4 LLA analysed all the disparate design change suggestions and summarised them into specific recommendations. LLA explained how each recommendation could be acted upon, and the influence it would have on the final design.

LLA changed elements of the airspace design in accordance with the recommendations, unless recommendations could not be acted upon, and explained why in the Step 4A Consultation Response Document.

LLA published the Final Design technical map and Final Options Appraisal document in June 2021 proposing Option 1A as the final design option as part of the Stage 4 Final Options Appraisal. This option was similar to the FOA Option 1 with changes to the holding region, route adjustments and CAS volume reductions compared with Option 1. The Final Option Appraisal compares the consulted design with the modified design of Option 1A and concludes that the modified Option 1A – Final Design should have progressed.

1.2 Structure of this report

This report has been prepared in accordance with the requirements of CAP1616 version 5 and CAP1616i, along with other associated guidance.

The report is structured as follows:

- **Section 2**: Radar Track Review;
- **Section 3**: Impacts on Local Air Quality and Biodiversity
- **Section 4**: Noise Modelling and Assessment;
- **Section 5**: PIR assessment: Impact of Noise.

2 Radar track review

2.1 Introduction

This chapter will present an overview of the main differences between the pre and post AD6 implementation based on the comparison between 2019 pre AD6 implementation and 2023 post AD6 implementation radar data.

Pre AD6 data have been taken from 2019 LLA radar track and runway movement records for the 92-day summer noise policy period from 15 June to 16 September inclusive.

Data for the implementation of AD6 has been taken from 2023 LLA radar track and runway movement records for the 92-day summer noise policy period from 15 June to 16 September inclusive.

2.2 Westerly arrivals

2.2.1 Pre AD6

The 2019 westerly arrivals included 4 main routes and a shortcut route, which are briefly presented as follow:

- **Route A**: included flights originated from the east;
- **Route B**: included flights originated from the west;
- **Route C**: included flights originated from the south-east;
- **Route D**: included flights originated from the south and south-west;
- **Route S** (shortcut): included flights originated from the east not using the main route A.

2019 pre-AD6 tracks are presented in the following figures.

Figure 1 - Pre AD6: Route A

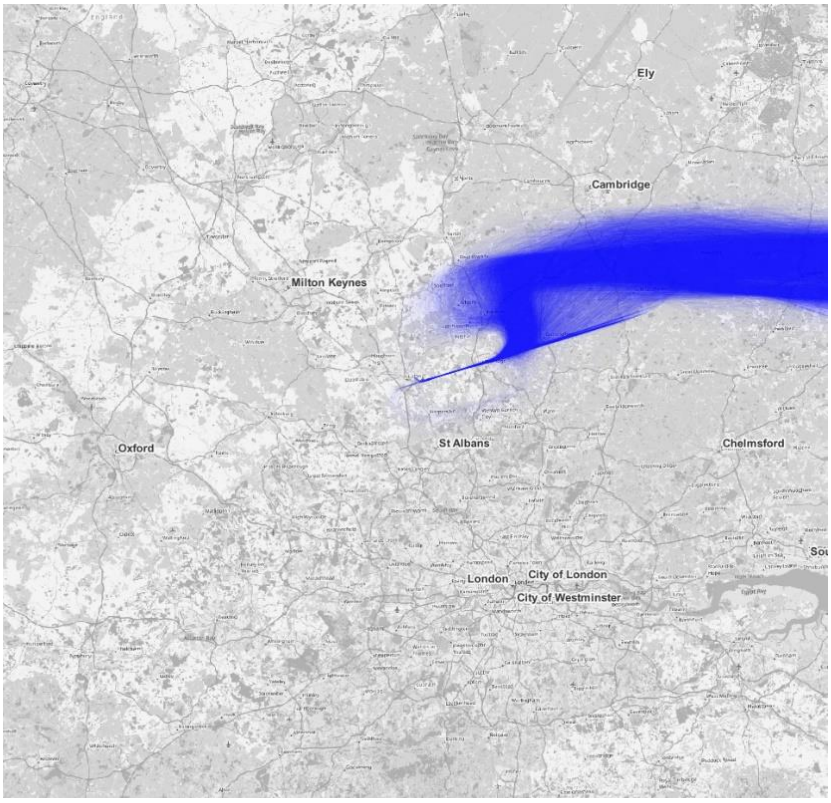


Figure 2 - Pre AD6: Route B

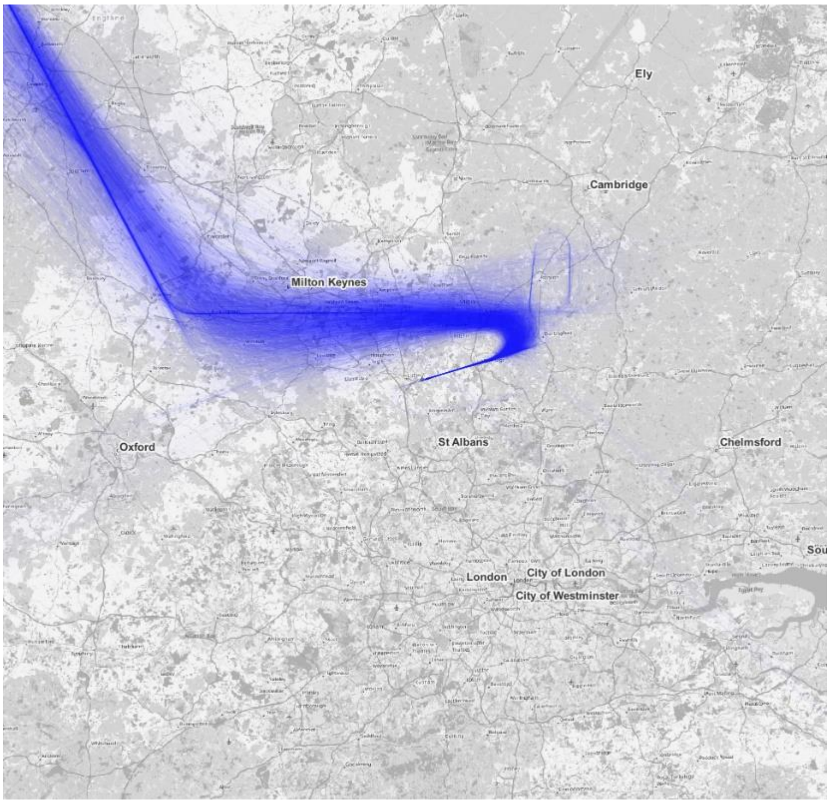


Figure 3 - Pre AD6: Route C and D

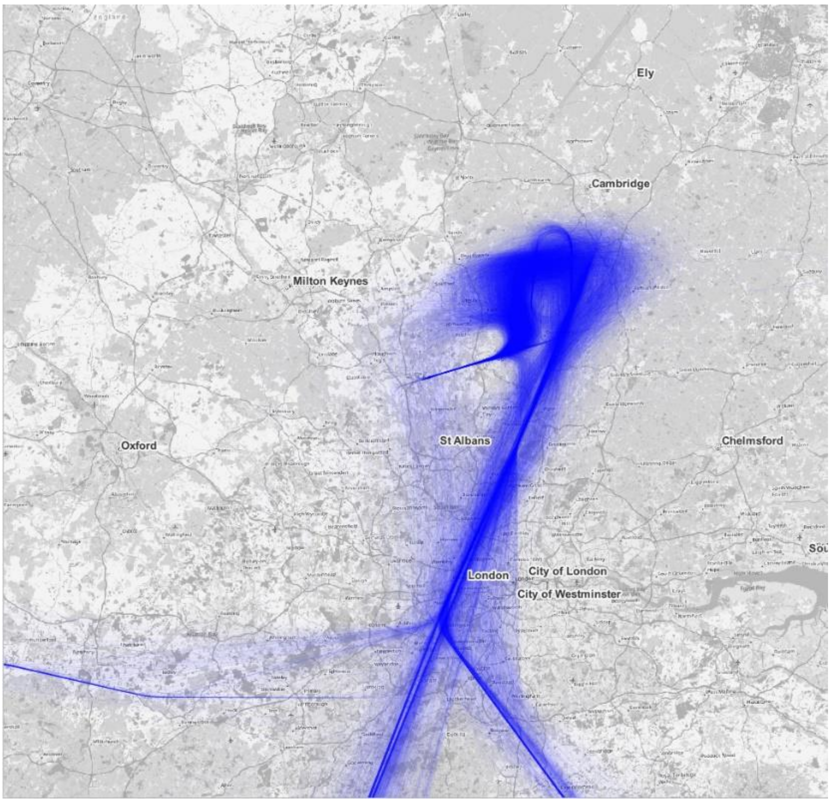
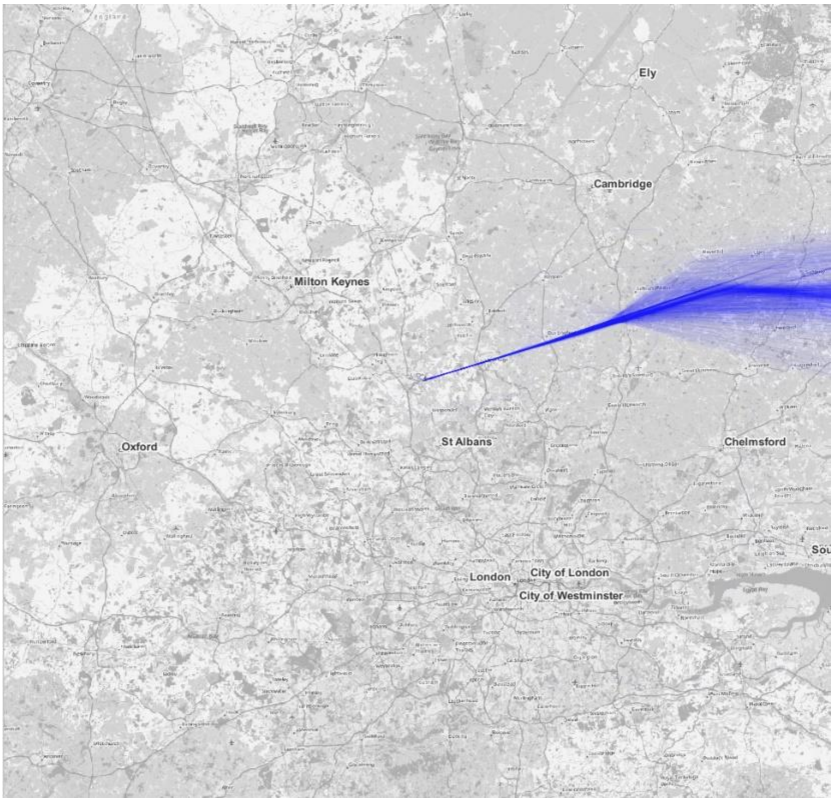


Figure 4 - Pre AD6: Route S



2.2.2 Post AD6

The 2023 westerly arrivals entail 2 main routes and 3 shortcut routes, which are briefly presented as follow:

- **Vector 1**: included flights originated from the east and south;
- **Vector 2**: included flights originated from the west and south;
- **Route S1** (shortcut1): included flights originated from the east not using the main Vector 1 route. This route is used during the daytime.
- **Route S2** (shortcut2): included flights originated from the east not using the main Vector 1 route. This route is used during the night-time.
- **Route S3** (shortcut3): included flights originated from the south not using the main Vector 1 route. This route is used during the night-time.

2023 post-AD6 tracks are presented in the following figures.

Figure 5 - Post AD6: Route Vector 1

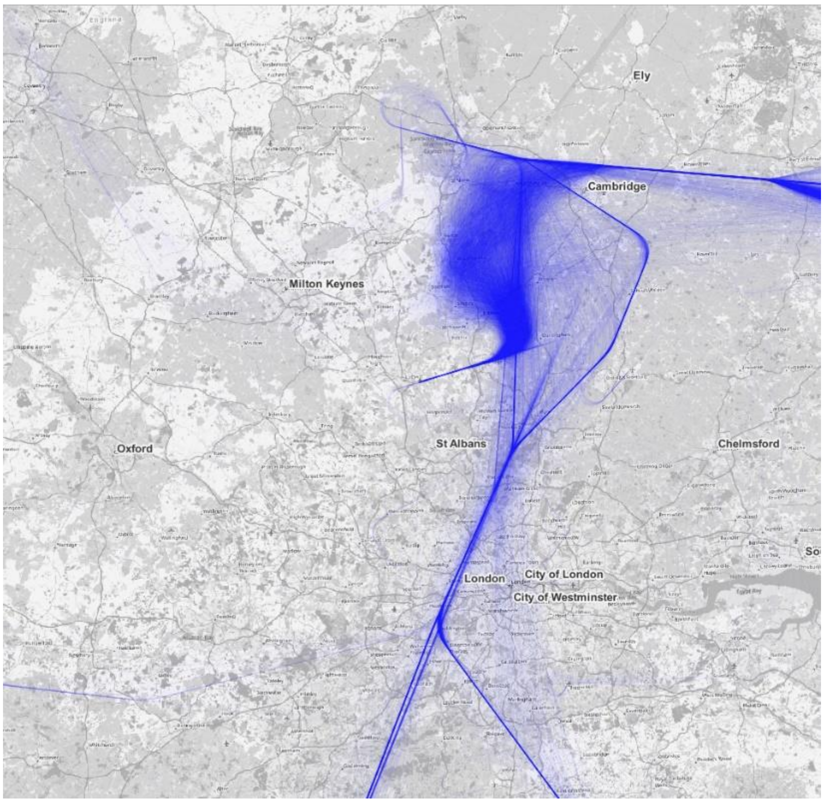


Figure 6 - Post AD6: Route Vector 2

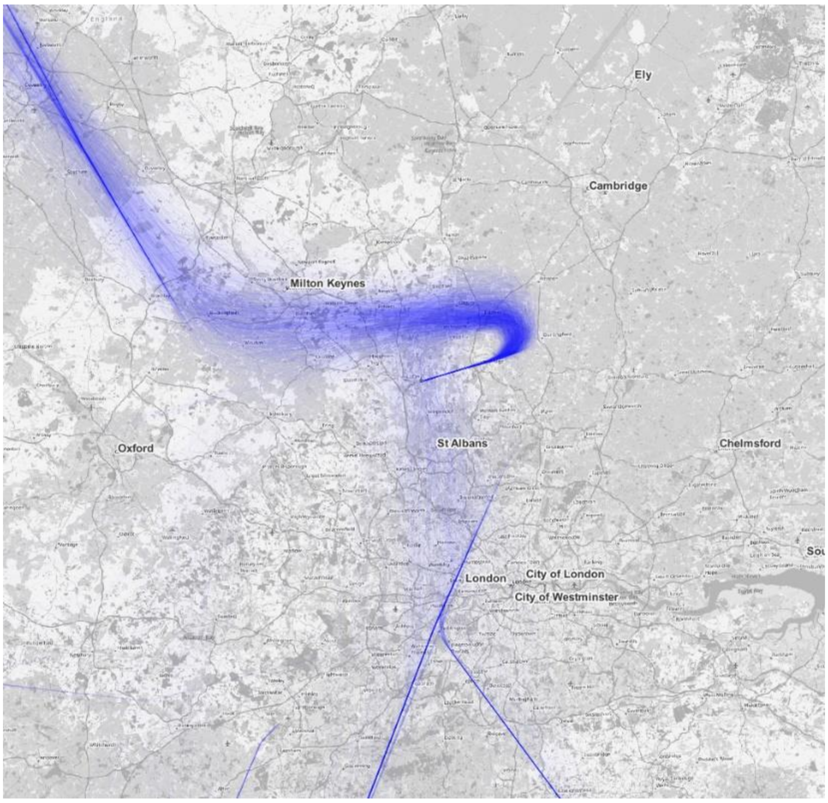


Figure 7 - Post AD6: Route S1

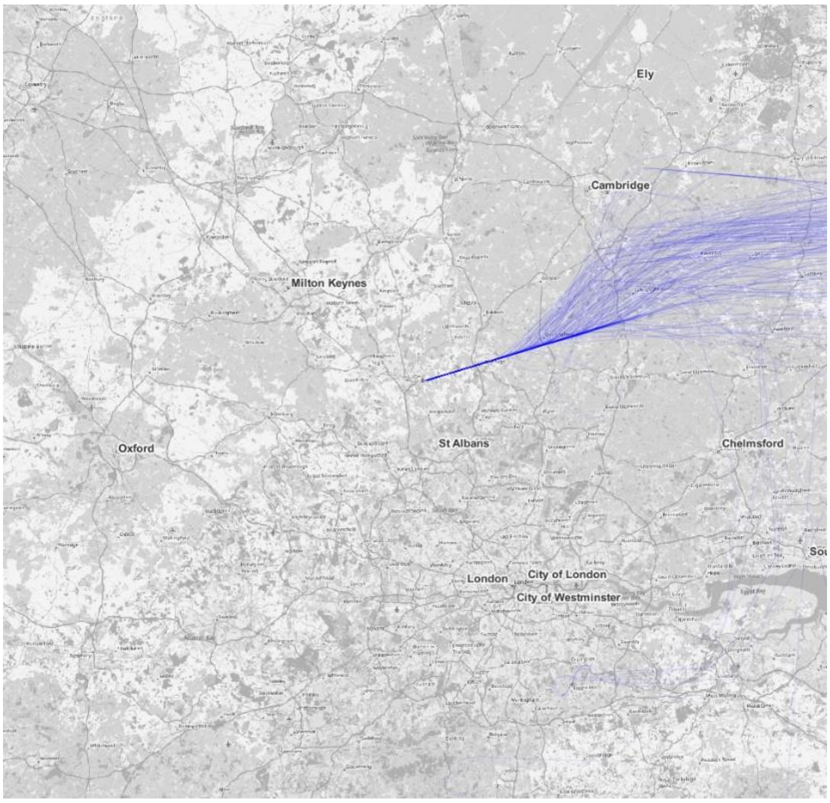


Figure 8 – Post AD6: Route S2

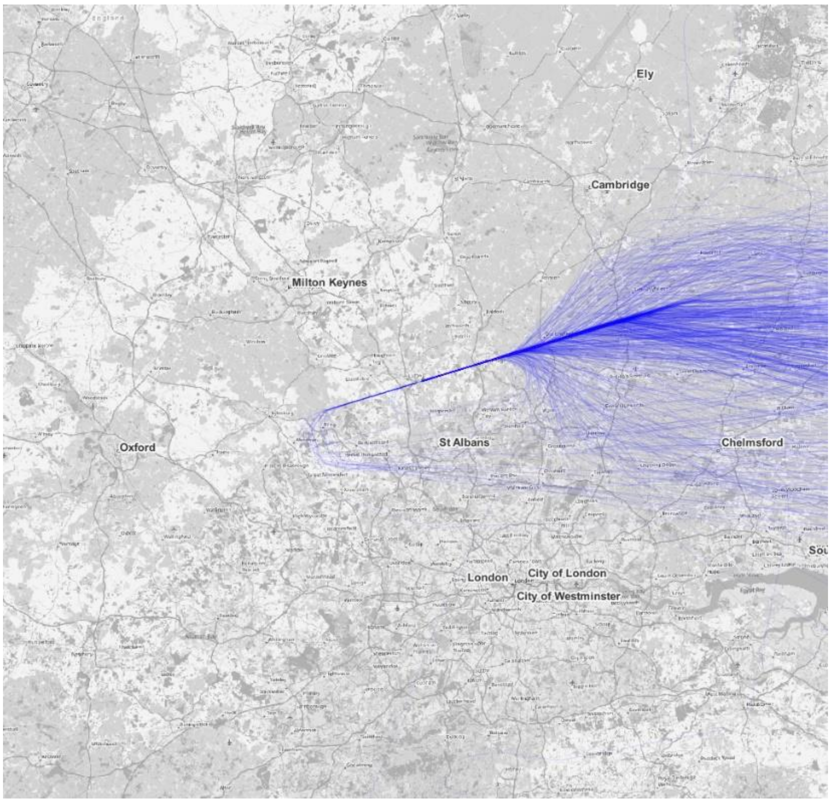
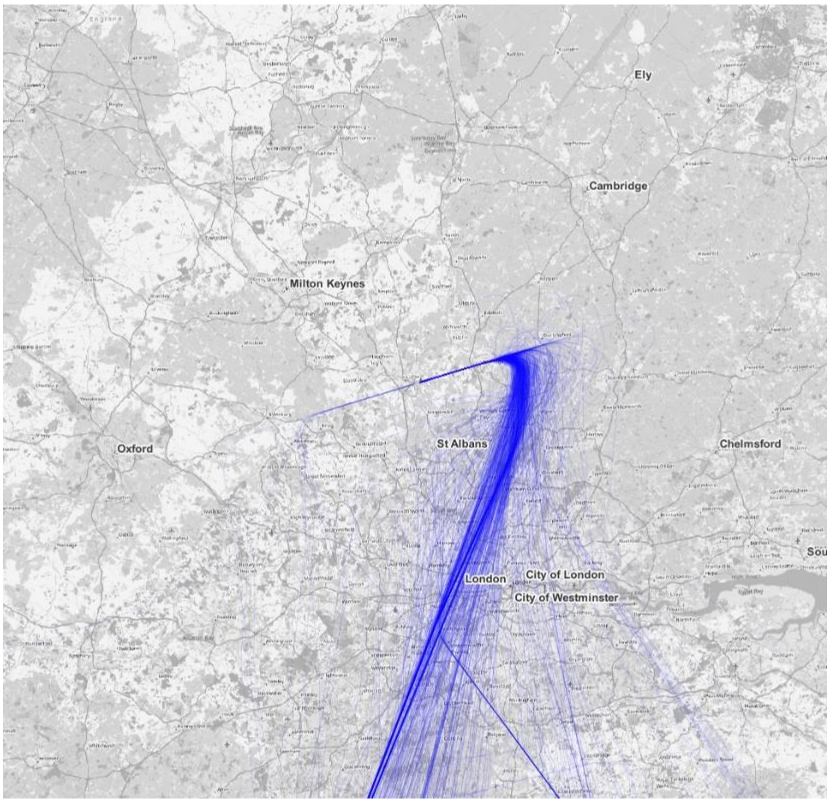


Figure 9 - Post AD6: Route S3



With the introduction of AD6, Routes A, C and D from 2019, have been replaced with the main AD6 Vector 1 route.

As shown in Figure 5 on p.10, aircraft join the Vector 1 route further north compared to the pre-AD6 routes. This was designed to avoid conflicts with Stansted Airport airspace.

Aircraft join the Vector 1 route at an altitude of 10,000ft, which is higher than the joining points of route C and D which are set at an altitude between 4,000ft and 6,000ft.

Route B has been maintained and translated into the Vector 2 route. This route replicates the old Route B, however, it also includes some of the traffic from the south, previously not included in the pre-AD6 scenario.

2.3 Easterly Arrival

2.3.1 Pre AD6

The 2019 easterly arrivals included 4 main routes and a shortcut route, which are briefly presented as follow:

- **Route A**: included flights originated from the east;
- **Route B**: included flights originated from the west;
- **Route C**: included flights originated from the south-east;
- **Route D**: included flights originated from the south and south-west;
- **Route S** (shortcut): included flights originated from the south not using the main routes C or D.

2019 pre-AD6 routes are presented in the following figures.

Figure 10 - Pre AD6: Route A

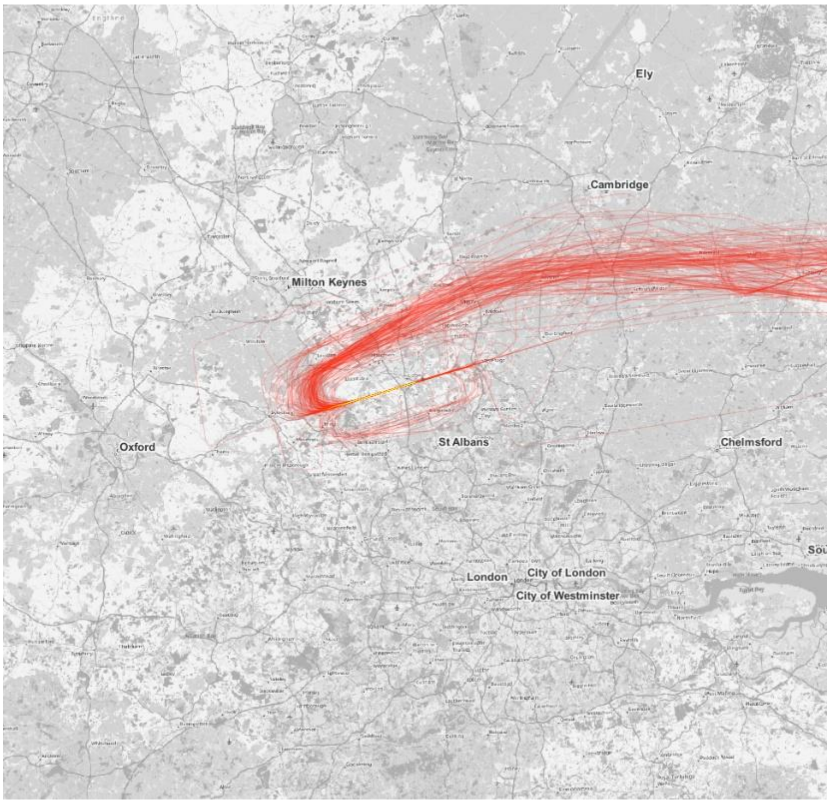


Figure 11 - Pre AD6: Route B

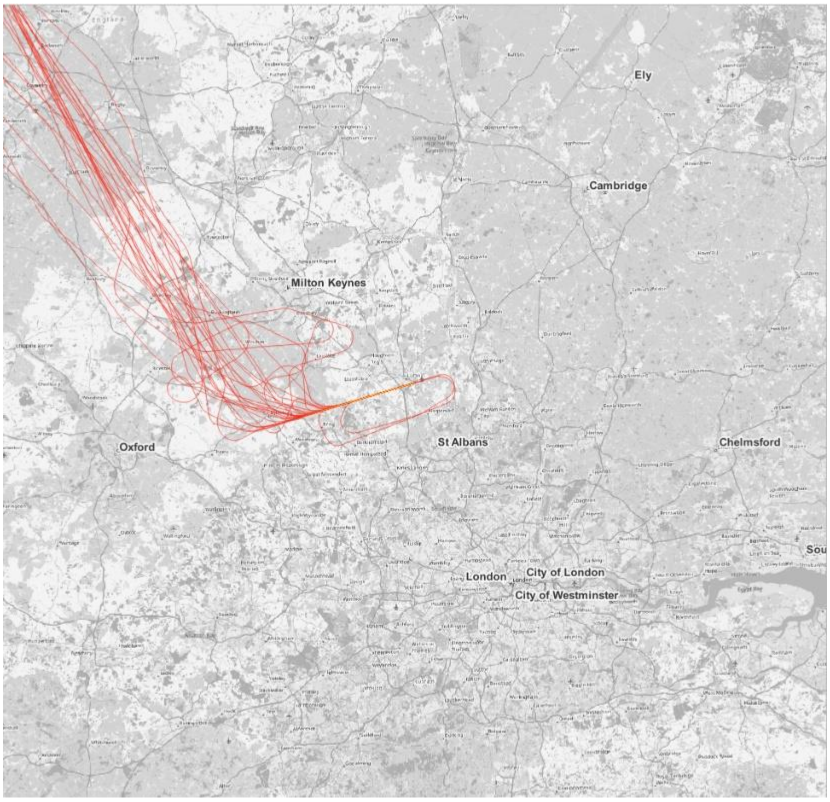


Figure 12 - Pre AD6: Route C and D

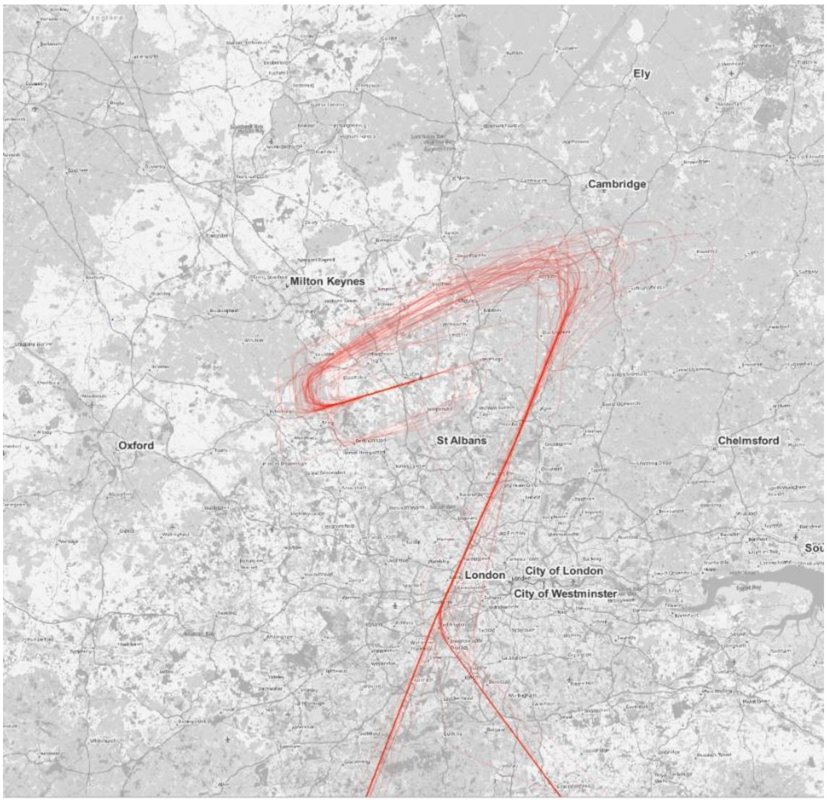
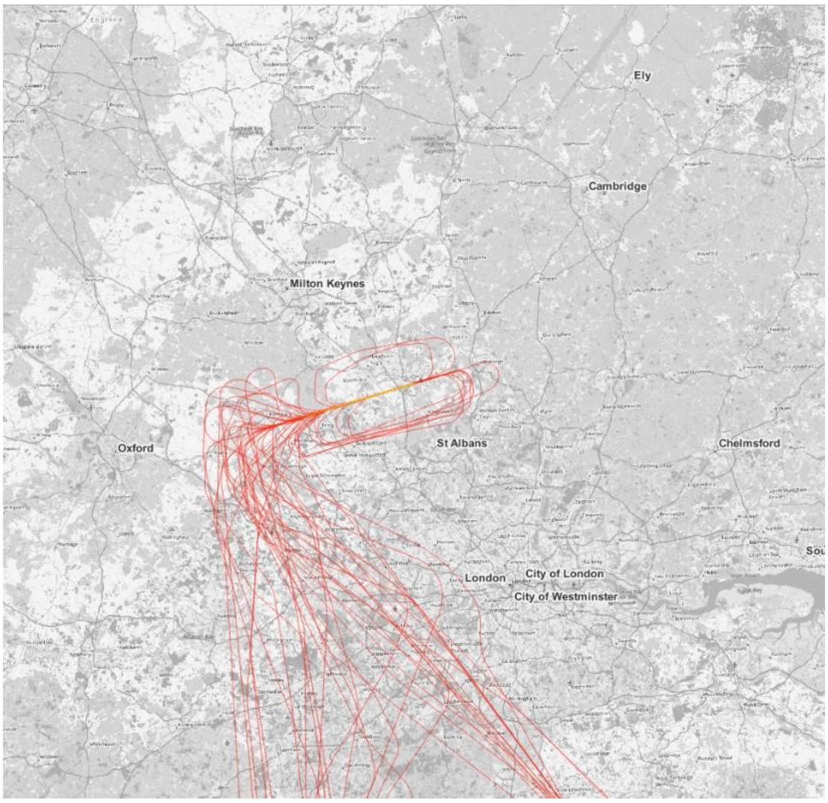


Figure 13 - Pre AD6: Route S



2.3.2 Post AD6

The 2023 easterly arrivals entail 2 main vector routes and 4 shortcut routes, which are briefly presented as follow:

- **Vector 1**: included flights originated from the east and south.
- **Route S1** (shortcut1): replace the pre-AD6 north arrival route.
- **Route S2** (shortcut2): split in two routes S2R1 and S2R2. The first route includes events coming from the south. The second route from south-east.
- **Route S3** (shortcut3): included flights originated from the east not using the main Vector route. it is used during the night-time.

2023 post-AD6 routes are presented in the following figures.

Figure 14 - Post AD6: Vector 1

Figure 15 - Post AD6: Route S1

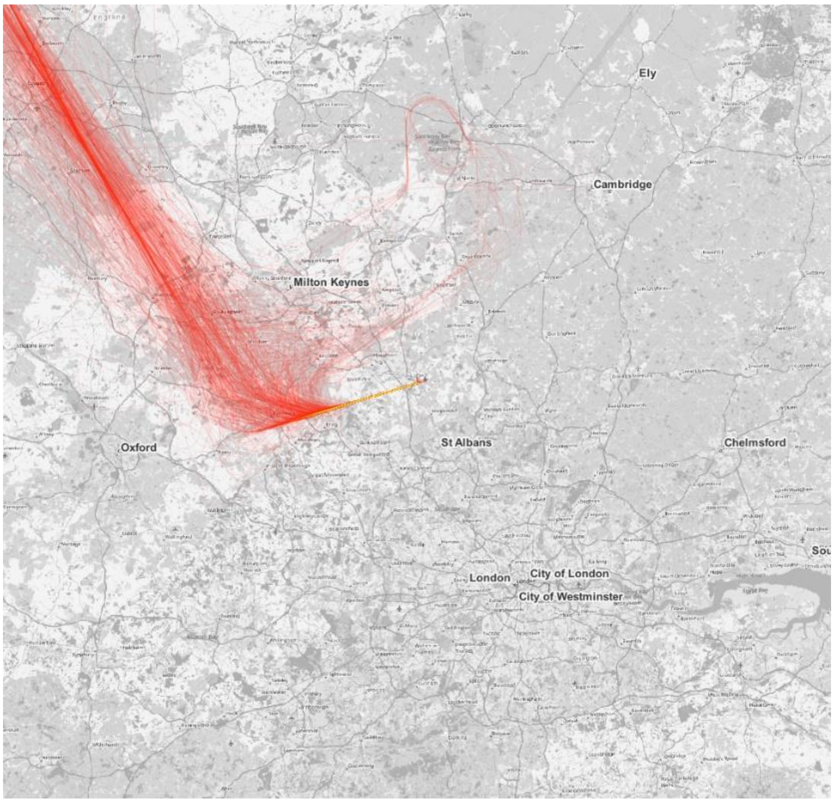
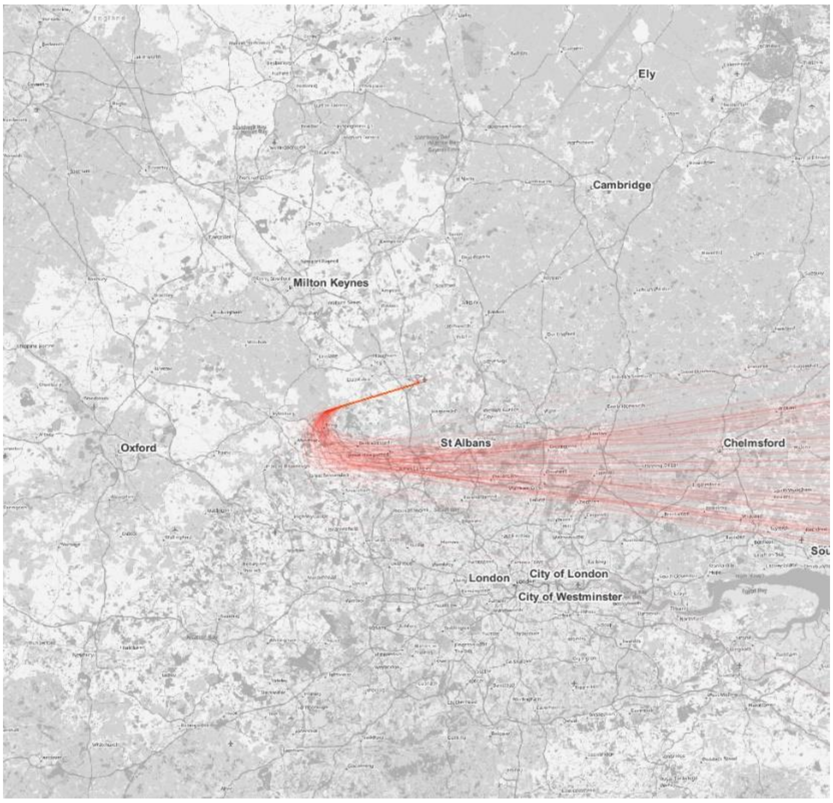


Figure 16 – Post AD6: Route S2R1

Figure 17 - Post AD6: Route S2R2

Figure 18 - Post AD6: Route S3



With the introduction of AD6, routes A, C and D, have been replaced with the main Vector 1 route.

As shown in Figure 14 on p.17, aircraft join Vector 1 route further north compared to the pre-AD6 routes. Similarly to the westerly Vector 1 route, this was designed to avoid conflicts with Stansted Airport airspace.

Aircraft join the vector route at an altitude of 10,000ft, which is higher than the joining points for route C and D which are set at an altitude between 4,000ft and 6,000ft.

A key difference between the pre-AD6 airspace design and the AD6 airspace design is the incorporation of 4 shortcuts.

The arrival route coming from the North (Route B), has been replaced with the Route S1 shortcut.

Route S2 is split in two routes. The first route includes events coming from the south. The second route from south-east. These routes replace the pre AD6 shortcut.

Route S3 is used only during the night-time and includes arrivals from the east, joining the final approach from the south. This is a completely new route introduced by AD6 airspace.

3 Impact on Local Air Quality and Biodiversity

3.1 Local Air Quality

The DfT's Air Navigation Guidance (2017) states that: "*Studies have shown that NO_x emissions from aviation related operations reduce rapidly beyond the immediate area around the runway. Due to the effects of mixing and dispersion, emissions from aircraft above 1,000 feet are unlikely to have a significant impact on local air quality. Therefore, the impact of airspace design on local air quality is generally negligible compared to changes in the volume of air traffic and that of the local transport infrastructures feeding the airport.*" ICAO's Airport Air Quality Manual (International Civil Aviation Organization Doc 9889 Airport Air Quality Manual, Second Edition, 2020, Canada) similarly states that 1,000ft is the typical limiting altitude for ground-level NO_2 impacts from aircraft emissions.

CAP1616 states that: "*Change sponsors must produce information on local air quality impacts only where there is the possibility of pollutants breaching legal limits following the implementation of an airspace change (or worsening an existing breach of legal limits)*. The CAA deems that this is only likely to become a possibility where:

- there is likely to (be) a change in aviation emissions (by volume or location) below 1,000 feet, and
- the location of the emissions is within or adjacent to an identified AQMA" (Air Quality Management Area)

3.2 Biodiversity

CAA guidance states that "*In general, airspace change proposals are unlikely to have an impact upon biodiversity because they do not involve ground-based infrastructure. As such they are unlikely to have a direct impact that would engage the Birds or Habitats legislation*". Though there is limited research available on the effects of aircraft noise on wildlife, there is some evidence that disturbance effects associated with aircraft can occur during take-off and landing where aircraft are below around 500m (~1640ft). [Drewitt, A. (1999) Disturbance effects of aircraft on birds. English Nature Birds Network Information Note].

Potential impacts on biodiversity may arise where there is either an increase in aircraft events over the site and/or a change in the location and potential habitats overflown, particularly between 0 and 1640ft altitude range.

3.3 Assessment of the impacts

A qualitative assessment has been undertaken considering the overflight comparison between the pre-AD6 and the post-AD6 airspace implementation as shown in Figure 19 on p.22.

Overflight cones have been generated according to the CAA's CAP1498 "Definition of Overflight" which defines 'overflight' as based on the angle of elevation between a person on the ground and an aircraft in the sky. The report advises on two elevation angles, 60° and 48.5°.

The elevation angle of 48.5° has been chosen for the overflight generated for this report as requested by the document CAP1616i as this states *"sponsors must use a 48.5° angle for representation of overflight".*

Figure 19 – Comparison of the overflights up to 1,000 and 1,640ft between pre-AD6 (red) and post-AD6 (blue) airspace implementation.

No significant differences have been found in the overflight comparison between the pre-AD6 and the post-AD6 airspace implementation up to either 1,000ft or 1,640ft which suggests that there are no impacts on both local air quality and biodiversity caused by the implementation of AD6 airspace.

4 Noise modelling and assessment

The adopted methodology and assumptions for the PIR noise modelling and assessment are set out in the following sections.

4.1 PIR scenarios and assessment of the noise impacts

As part of the PIR, change sponsors have to undertake an updated assessment of the environmental impacts that were presented within the airspace change proposal (see Annex A). This updated assessment is informed by actual behaviours following implementation and presented in a comparable format to that used for the change proposal.

Following discussions with the Civil Aviation Authority (CAA) it is understood that the following five scenarios are to be considered as part of the PIR for the assessment of the noise impacts. These scenarios have been developed to help differentiate changes directly as a result of the AD6 airspace change as opposed to differences in modelling inputs and assumptions since the FOA in 2020.

Table 1 – PIR scenarios for the assessment of the noise impacts

PIR Scenario	Description	Assumptions		
		Airspace	Fleet	Modal Split
1. 2023 Actual	As it is occurred in 2023 following AD6 implementation	AD6 as occurred in 2023	Actual 2023 Summer	Actual Summer 2023
2. 2023 Without AD6	Considering the airspace as before AD6 implementation, but with fleet and modal split as it occurred in 2023	Pre-AD6 implementation (2019)	Actual 2023 Summer	Actual Summer 2023
3. Option 1A – Final Design in the implementation year	As prepared for the SAIP AD6 4A Final Option Appraisal	AD6 as prepared for 4A Final Option Appraisal	Forecast Fleet for implementation year (2021) as assumed in 4A Final Option Appraisal	As prepared for AD6 4A Final Option Appraisal
4. **Option 1A – with AD6 airspace configuration as occurred**	As prepared for the SAIP AD6 4A Final Option Appraisal but using AD6 airspace configuration as it occurred in 2023	AD6 as occurred in 2023	Forecast Fleet for implementation year (2021) as assumed in 4A Final Option Appraisal	As prepared for AD6 4A Final Option Appraisal
5. Option 0 – Baseline do-nothing in the implementation Year	As prepared for the SAIP AD6 4A Final Option Appraisal	Pre-AD6 implementation	Forecast Fleet for implementation year (2021) as assumed in 4A Final Option Appraisal	As prepared for AD6 4A Final Option Appraisal

As per the Stage 3 FOA and Stage 4 Final Option Appraisal, the reference period for operations considered in the PIR modelling are representative of the aviation noise policy 92-day summer period (from 16 June to 15 September inclusive) as advised by airspace policy and associated guidance[1].

For consistency, as required by the PIR, the assessment of the actual noise impacts is carried out using the same metrics used in the Stage 3 FOA and Stage 4 Final Option Appraisal which referred to the fourth edition of CAA CAP1616 guidance and CAP1616a Environmental Requirements and include the following metrics:

- $L_{Aeq,\ 16hr}$
- $L_{Aeq,\ 8hr}$
- N65
- N60
- Overflight
- WebTAG

4.2 Modelling Methodology and Software

All noise modelling undertaken for this PIR has had regard for CAA guidance as provided in the recently published CAP1616i.

The noise models have been developed using the Aviation Environmental Design Tool (AEDT) version 3.0e in accordance with CAP2091 requirements.

CAP2091 sets out the minimum requirements for noise modelling. Within CAP2091, the CAA defines 'Categories' of noise modelling sophistication, based on likely population experiencing an average noise exposure above the daytime and night-time LOAEL i.e. 51 dB $L_{Aeq,16hr}$ and 45 dB $L_{Aeq,8hr}$ respectively.

[1] DfT Air Navigation Guidance 2017 (ANG17) and CAA CAP1616i

Table 2 - Summary of Noise Modelling Categories

Category	Aircraft Noise		Aircraft tracks (arrival and departure routes)		
	Noise data	Flight profiles	Centreline (mean track)	Dispersion (variation around centreline)	Usage (allocation of traffic to routes)
A	ICAO dataset modified for local noise monitor data for all aircraft types	Local track-keeping data	Local track-keeping data	Local track-keeping data	Local track-keeping data
B	ICAO dataset validated by local noise monitor data for major aircraft types	Local track-keeping data	Local track-keeping data	Local track-keeping data	Local track-keeping data
C	ICAO dataset	Local track-keeping data for major aircraft types	Local track-keeping data	Local track-keeping data	Local track-keeping data
D	ICAO dataset	ICAO dataset	Local data from airport	ECAC guidance or data from airport	Local data from airport
E	ICAO dataset	ICAO dataset	Local data from airport	ECAC guidance or data from airport	Local data from airport

Table 3 - Thresholds for noise modelling Categories, average summer day, population exposed to 51 dB $L_{Aeq,16h}$ or above.

Category	Lower threshold	Recommended minimum threshold	Mandated minimum threshold	Maximum threshold
A	0	400,000	500,000	None
B	0	160,000	200,000	500,000
C	0	20,000	25,000	200,000
D	0	1,600	2,000	25,000
E	0	0	0	2,000

Table 4 - Thresholds for noise modelling Categories, average night, population exposed to 45 dB $L_{Aeq,8h}$ or above

Category	Lower threshold	Recommended minimum threshold	Mandated minimum threshold	Maximum threshold
A	0	400,000	500,000	None
B	0	160,000	200,000	500,000
C	0	20,000	25,000	200,000
D	0	1,600	2,000	25,000
E	0	0	0	2,000

The noise models which have been prepared for the AD6 airspace change conform to the highest modelling category (Category A) as outlined in CAP2091, even if it would fall into a lower category based on the likely number of people exposed to noise. Local noise monitoring and track-keeping data collected by the airport have been used for the modelling as requested for Category A.

Noise and aircraft position data have been used to identify noise produced by specific aircraft types with adjustments made to both flight profile and noise data (both SEL and L_{ASmax}) held within the ICAO sponsored Aircraft Noise and Performance (ANP) database to reflect local conditions.

Flight track-keeping data has been used to provide statistics on the mix of aircraft traffic on each departure and arrival route, the actual tracks flown along each route, the dispersion of aircraft either side of the mean route centrelines and vertical flight profiles at the airport.

The AEDT model has used this local data and the airport schedule to calculate noise exposure (and therefore noise contours) and other metrics such as Nx.

4.3 Airfield

London Luton Airport's airfield information has been obtained from the Airport's Aeronautical Information Publication (AIP). This information has been used to define the input parameters to the noise models and covers:

- Runway end coordinates;
- Displaced approach thresholds;
- ARP;
- Airport Elevation.

This information is summarised in Table 5 below.

Table 5 - Runway Information

Runway	Modelled Information
Runway 07/25	Length (ft) = 13456 Width (ft) = 151
Runway 07	Lat: 51.87188 Lon: -0.384384 Displaced Approach Threshold (ft): 189 Elevation (ft): 515
Runway 25	Lat: 51.87725 Lon: -0.35332 Displaced Approach Threshold: 274 Elevation (ft): 508

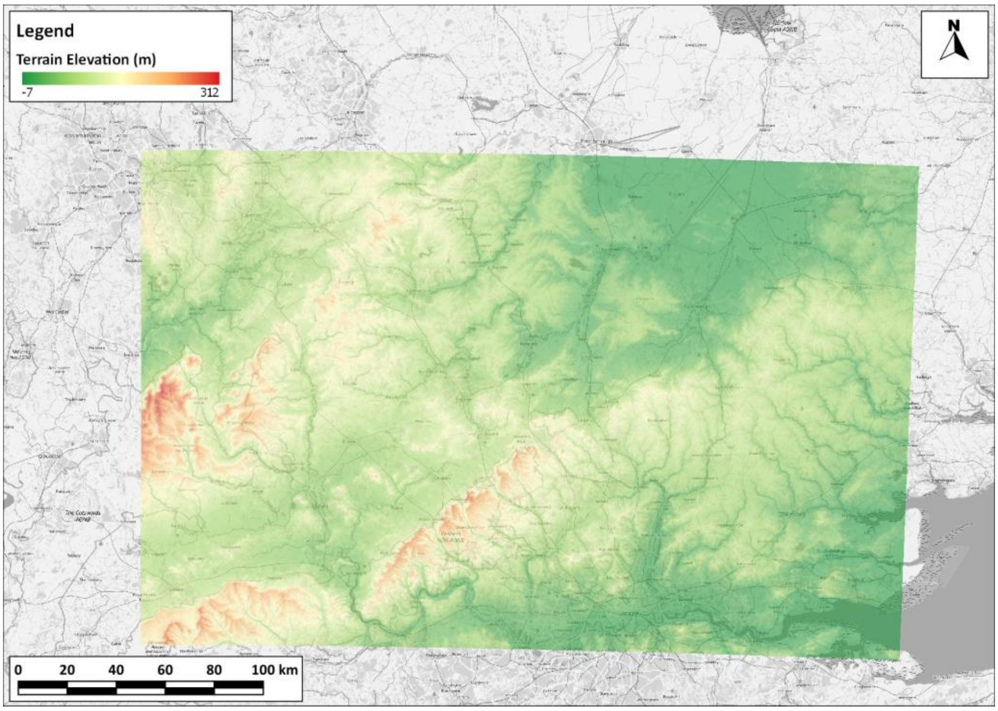
For each runway end, a displaced departure threshold of 492 ft has been assumed for both the 07 and 25 runway ends.

It is to note that since the Stage 3 FOA and Stage 4 Final Options Appraisals, the runway names have been updated from 08/26 to 07/25.

4.4 Local Terrain

All modelling for each of the scenarios has considered local terrain conditions. A terrain file has been generated in "dem" format from Ordnance Survey Terrain 50 Open Data. This presents terrain elevations at 50m postings on the Ordnance Survey grids.

Figure 20 - AEDT Model Terrain



4.5 Airspace

4.5.1 Airspace for PIR scenarios considering pre-AD6 implementation (PIR Scenario 2 and 5)

The modelling of the PIR Scenarios "2023 Without AD6" (PIR Scenario 2) and "Option 0 – Baseline do-nothing" (PIR Scenario 5) consider the airspace arrangement as it was prior to the implementation of AD6.

Models for these scenarios have been based on 2019 runway activity logs obtained from London Luton Airport. These logs have provided the following information:

- Date and Time;
- Airline;
- Service Number;
- Origin / Destination (ICAO);
- Arrival / Departure Designation;
- AC Type (Full name);
- AC Type (ICAO);
- Terminal;
- Runway.

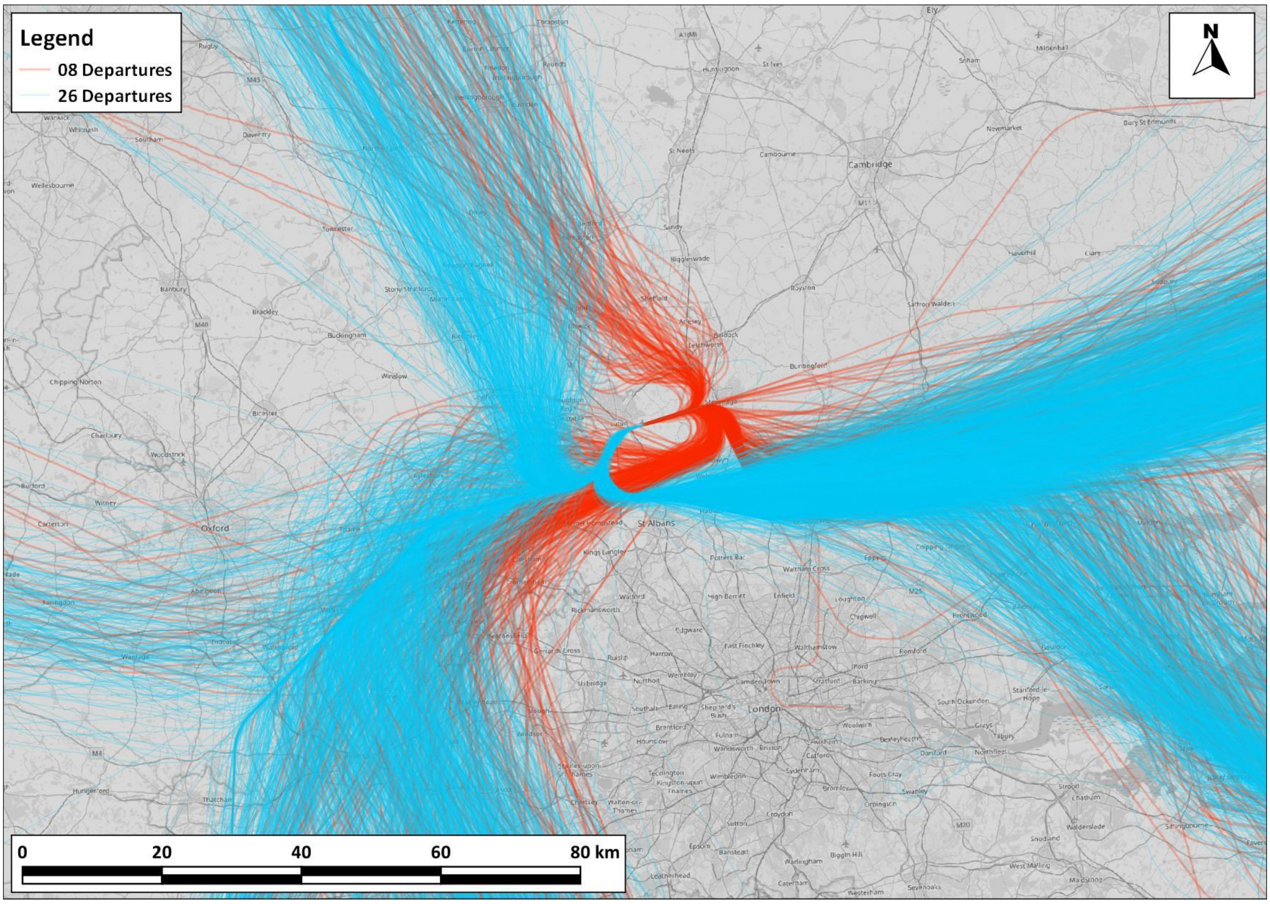
4.5.1.1 *Airspace Arrangements*

For the Stage 3 FOA and Stage 4 Final Options Appraisal, the do-nothing scenario, i.e. “Option 0 – Baseline” has been based on LLA’s 2019 airspace arrangements.

To support the modelling of the PIR Scenarios 2 and 5, which both assume the airspace as it was prior to AD6 implementation, it has been carried out an analysis to establish how airspace was being used based on aircraft origins and destinations. It has also been used to establish mean route centrelines and associated dispersion patterns.

Location and dispersion of the LLA’s arrival and departure routes have been based on an analysis of radar data for the whole of 2019. An example of these data is presented in Figure 21 below.

Figure 21 - LLA 2019 Departure Radar Data



4.5.1.2 *Track Digitisation and Dispersion Analysis*

For each route, the density of the radar tracks has been used to inform the location of mean track centrelines and dispersion patterns for use within the PIR Scenario 2 and 5 models.

Analysis of the radar data was also undertaken to determine the appropriate distribution of aircraft movements to apply to the mean track centrelines and dispersed sub-tracks.

The process for calculating the distribution of aircraft movements across centreline and dispersion tracks is outlined in the following sections.

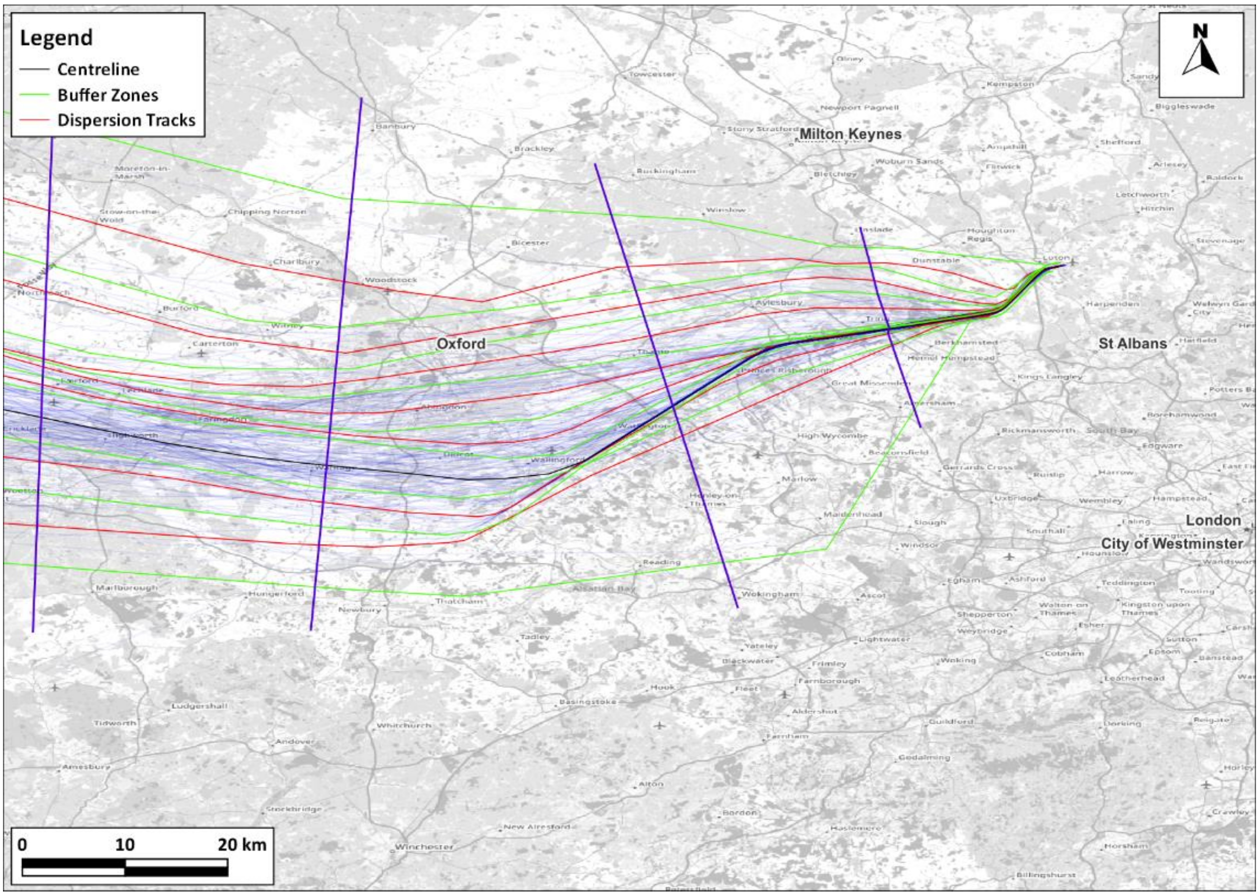
Route Centreline, Buffer Zones and Dispersion Tracks

The radar tracks are presented within GIS to show track density, whereby darker the swathes of radar tracks indicate higher concentrations of aircraft movements. The route centreline is then digitised along a path shown by the radar tracks to have the highest concentrations of aircraft movements. If the radar tracks expand to the extent that there is no area of radar tracks that are shown to be particularly more concentrated than any other areas, then the centreline is routed down the middle of the entire swathe of radar tracks.

Once the centreline has been digitised, the swathe of radar tracks is split into zones, (referred to as "buffer zones") using polylines. The first buffer zone is digitised around the route centreline, then subsequent buffer zones are created by digitising more polylines at suitable intervals across the swathe of radar tracks. A dispersion track is then digitised within each buffer zone.

Figure 22Figure 22 below presents an example of digitised buffer zones, dispersion tracks and the centreline track across a swathe of departure radar tracks.

Figure 22 - Example of Digitised Tracks and Buffer Zones



Calculating the Distribution of Aircraft Along Each Track

To calculate the distribution of aircraft movements to apply to each dispersion and centreline track, the number of radar tracks moving through each buffer zone is sampled at key locations along the route, with one sample taken as close to the runway as possible, where aircraft are at lower altitudes, therefore their noise emissions have a larger influence on the calculated noise levels within the model. The number of samples taken is dependent upon how the distribution of radar tracks varies along the route within each buffer zone.

The number of radar tracks at each sample taken within each buffer zone is then averaged and used to determine the percentage of aircraft movements to be applied to each dispersion and radar track for use within the model. Table 6 below presents an example of the calculated distribution of aircraft tracks to be applied to the dispersion and centreline tracks within each buffer zone (labelled A – H).

Table 6 - Example of Aircraft Distribution Calculations

Sample	Number of Radar Tracks Within Buffer Zones							
	SL3	SL2	SL1	C0	SR1	SR2	SR3	SR4
1	15	49	204	293	14	39	40	17
2	14	60	151	322	25	41	52	21
3	15	102	117	142	17	70	91	74
4	46	96	98	139	23	121	89	44
Average Number of Radar Tracks	22.5	76.8	142.5	224	19.8	67.8	68	39
Total (from average)	660							
% of Movements	3.4	11.6	21.6	33.9	3	10.3	10.3	5.9

4.5.1.3 Routing

To support the modelling, it was necessary to determine the probability of aircraft using the airport's various approach and departure routes. To facilitate this, the exit and entry points from the network have been identified and drawn within GIS.

For each radar track, the origin or destination is recorded and then marked against the network exit / entry point the track goes through. This process identifies the probability of a certain aircraft coming from or going to a certain origin or destination taking a certain route to or from the airport. An example of this process and calculation is presented in Table 7 on p.32 and Figure 23 on p.32.

Figure 23 - Example 08 Arrival Route Identification from Origin Ibiza Airport (LEIB)

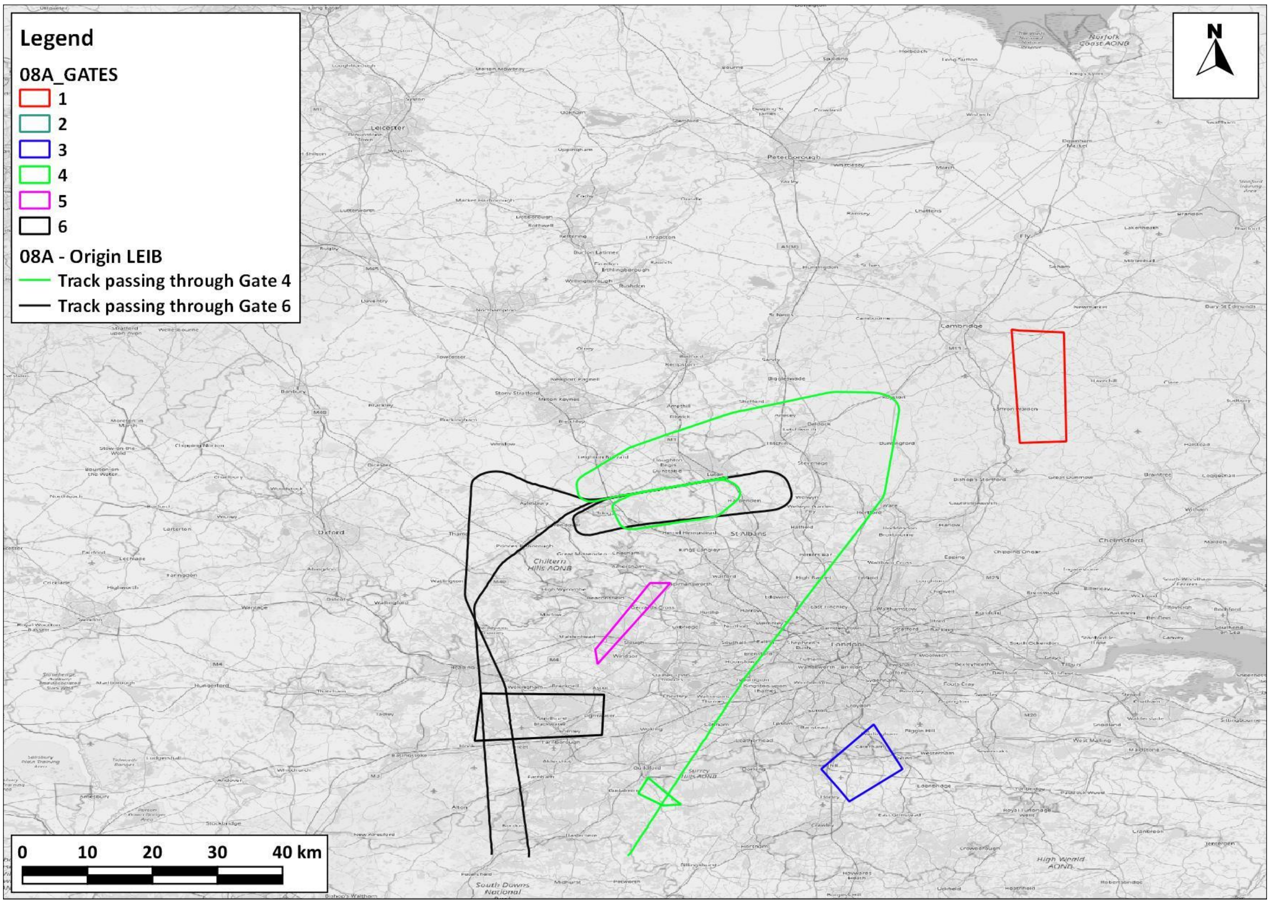


Table 7 - Example Analysis Results for easterly Arrival Route from Origin Ibiza Airport (LEIB)

Track Origin	Probability of Aircraft Travelling Through Gate (%)					
	Gate 1	Gate 2	Gate 3	Gate 4	Gate 5	Gate 6
Ibiza (LEIB)	0	0	0	33.3%	0	66.7%

4.5.2 Modelling AD6 as occurred in 2023 (PIR Scenario 1 and 4)

The modelling of the PIR Scenarios “2023 Actual” (PIR Scenario 1) and “Option 1A – with AD6 airspace configuration as occurred” (PIR Scenario 4) consider the airspace arrangement as it has been actually implemented since its adoption.

Models for these scenarios have been based on 2023 radar data obtained from London Luton Airport. These data have provided the following relevant information:

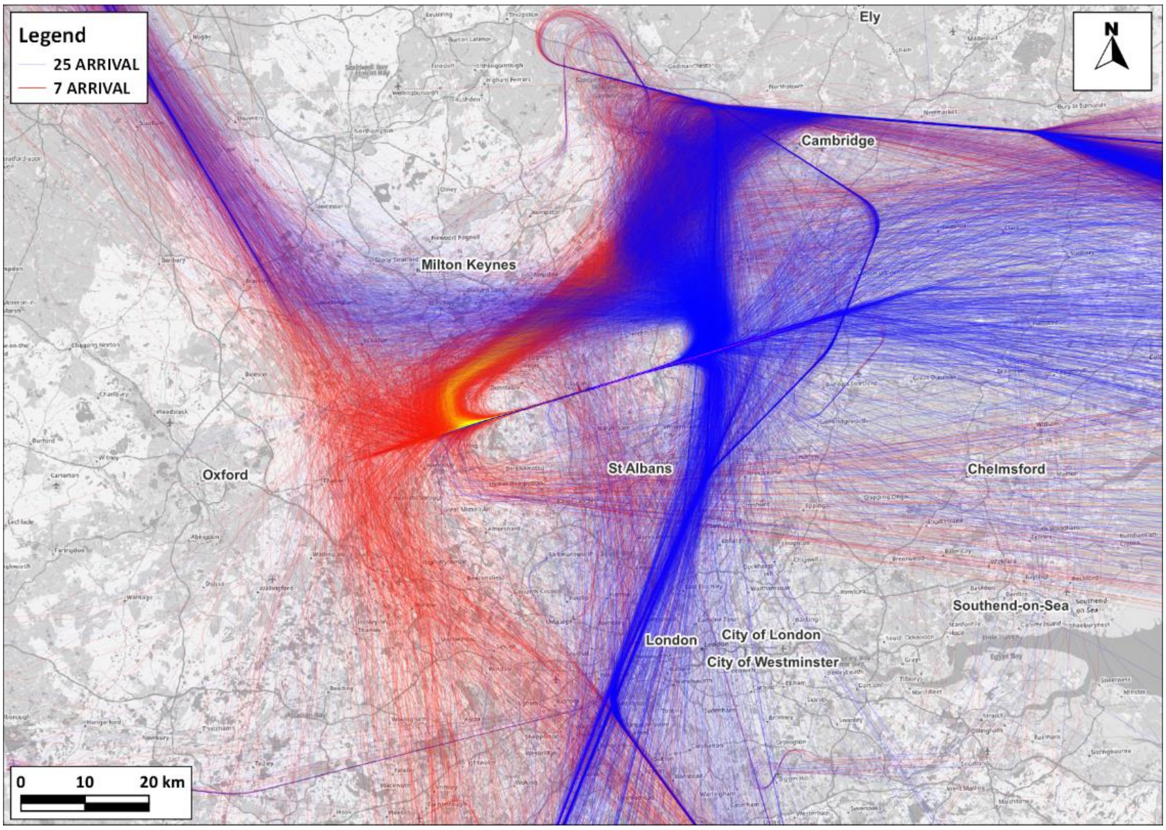
- Date and Time;
- Operation number;
- Correlation ID;
- Service Number;
- Origin / Destination (ICAO);
- Arrival / Departure Designation;
- AC Type (ICAO);
- Runway;
- Coordinates in WGS84;
- Altitude (ft).

4.5.2.1 Airspace Arrangements

The “2023 Actual” and “Option 1A – with AD6 airspace configuration as occurred” PIRI scenarios have been based on LLA’s airspace arrangements as actually occurred since AD6 implementation.

An analysis was undertaken to establish the routes used by origins and destinations, and the dispersion patterns. Location and dispersion of the airport’s arrival and departure routes were based on the analysis of the radar data for the whole 2023 provided by LLA. An example of this data is presented in Figure 24 below.

Figure 24 - LLA 2023 Arrival Radar Data



4.5.2.2 *Track Digitisation and Dispersion Analysis*

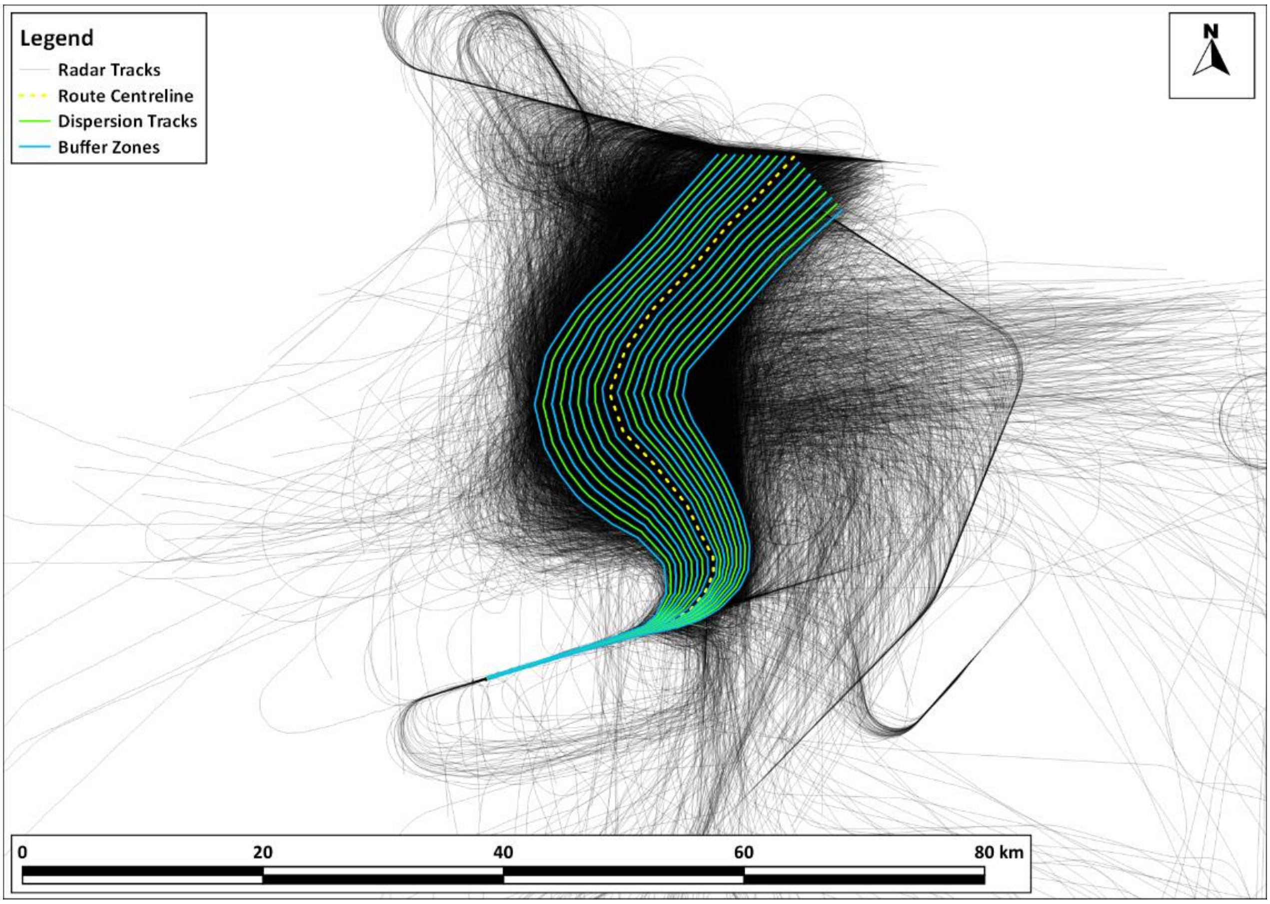
For each route, the density of the radar tracks was used to inform the digitisation of the centreline and dispersion tracks to be used within the PIR Scenario 1 and 4 models. Analysis of the radar data was also undertaken to determine the appropriate distribution of aircraft movements to apply to the centreline and dispersion lines.

The process for calculating the distribution of aircraft movements across centreline and dispersion tracks is outlined in the following sections.

Route Centreline, Buffer Zones and Dispersion Tracks

The same process described above for the PIR Scenario 2 and 5 has been used for the digitisation of the centreline and the creation of the dispersed tracks. An example of the process is indicated in Figure 25 below.

Figure 25 - Example of Digitised Tracks and Buffer Zones



Calculating the Distribution of Aircraft Along Each Track

To calculate the distribution of aircraft movements to apply to each dispersion and centreline track, the number of radar tracks moving through each buffer zone is sampled at key locations along the route, similarly to the methodology applied for the PIR Scenario 2 and 5. Two locations have been chosen for the samples, one at 4,000ft and one as close to the runway as possible, where aircraft are at lower altitudes, therefore their noise emissions have a larger influence on the calculated noise levels within the model.

The number of radar tracks at each sample taken within each buffer zone is then averaged and used to determine the percentage of aircraft movements to be applied to each dispersion and radar track for use within the model.

Table 8 below presents an example of the calculated % of aircraft tracks to be applied to the dispersion and centreline tracks within each buffer zones.

Table 8 - Example of Aircraft Distribution Calculations of Westerly Vector1 Route

Sample	% Movements Within Buffer Zones								
	SL4	SL3	SL2	SL1	centreline	SR1	SR2	SR3	SR4
Close to runway	0.50%	1.10%	4.30%	26.60%	26.10%	23.30%	11.80%	4.80%	1.60%
4000ft	4.80%	8.20%	11.40%	15.30%	13.80%	12.60%	12.00%	12.50%	9.30%
Average Number of Radar Tracks	2.70%	4.70%	7.90%	21.00%	20.00%	18.00%	11.90%	8.70%	5.50%
% of Movements	2.70%	4.70%	7.90%	20.00%	21.00%	18.00%	11.90%	8.70%	5.50%

4.5.2.3 Routing

To support the modelling of the PIR scenarios that consider the AD6 airspace as it has actually been implemented, it was necessary to determine the probability of aircraft using the airport's various approach and departure routes.

To facilitate this analysis has been carried out on the radar tracks to examine the exit and entry points to and from the network to separate the radar tracks. From this analysis the number of occurrences of an origin or destination for each route has then been recorded. This process identifies the probability of a certain aircraft coming from or going to a certain origin or destination and taking a certain route to or from the LLA and the wider network.

This process is repeated for each runway and all routes and then combined in a single lookup table, which has been used as input for the model.

An example of this process and calculation is presented in Figure 26 on p.36 and Table 9 on p.36 for approaches to Runways 07 and 25.

Figure 26 - Example Easterly Arrival S1 Route

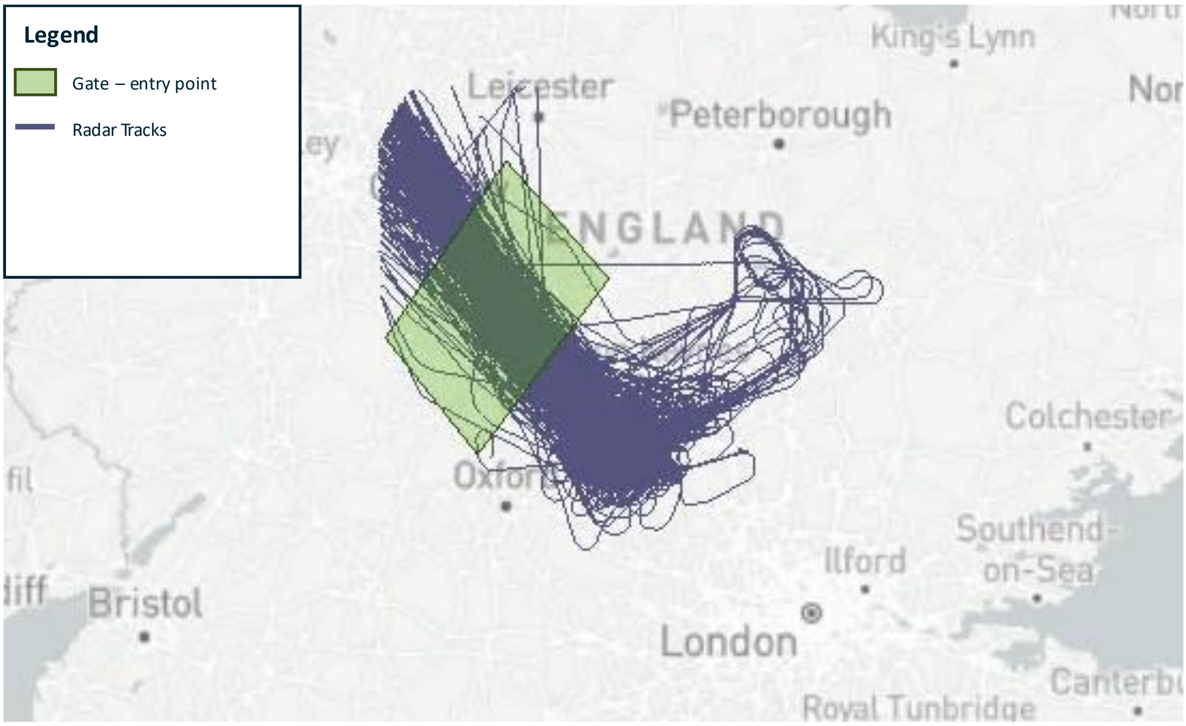


Table 9 - Analysis Results for AD6 routes during night-time from origin Paris Charles de Gaulle Airport (CDG)

Track Origin	Probability of Aircraft using a Route (%)									
	Easterly Arrivals (Runway 7)					Westerly Arrival (Runway 25)				
	Vectored Approach	Shortcuts				Vectored Approach		Shortcuts		
	Vector 1	Route S1	Route S2R1	Route S2R2	Route S3	Vector 1	Vector 2	Route S1	Route S2	Route S3
CDG	0.0%	0.0%	0.0%	100%	0.0%	28.6%	71.4%	0.0%	0.0%	0.0%

4.5.3 Models for AD6 airspace as per Final Option Appraisal (PIR Scenario 3)

4.5.3.1 Airspace Arrangements, Track Digitalisation and Dispersion

The modelling of the PIR Scenario "Option 1A – Final Design" (PIR Scenario 3) consider the airspace arrangement as prepared and consulted for the SAIP AD6 3 Full Option Appraisal (referred as Option 1) and the SAIP AD6 4A Final Option Appraisal (referred as Option 1A implementing the changes following consultation).

Westerly Approaches

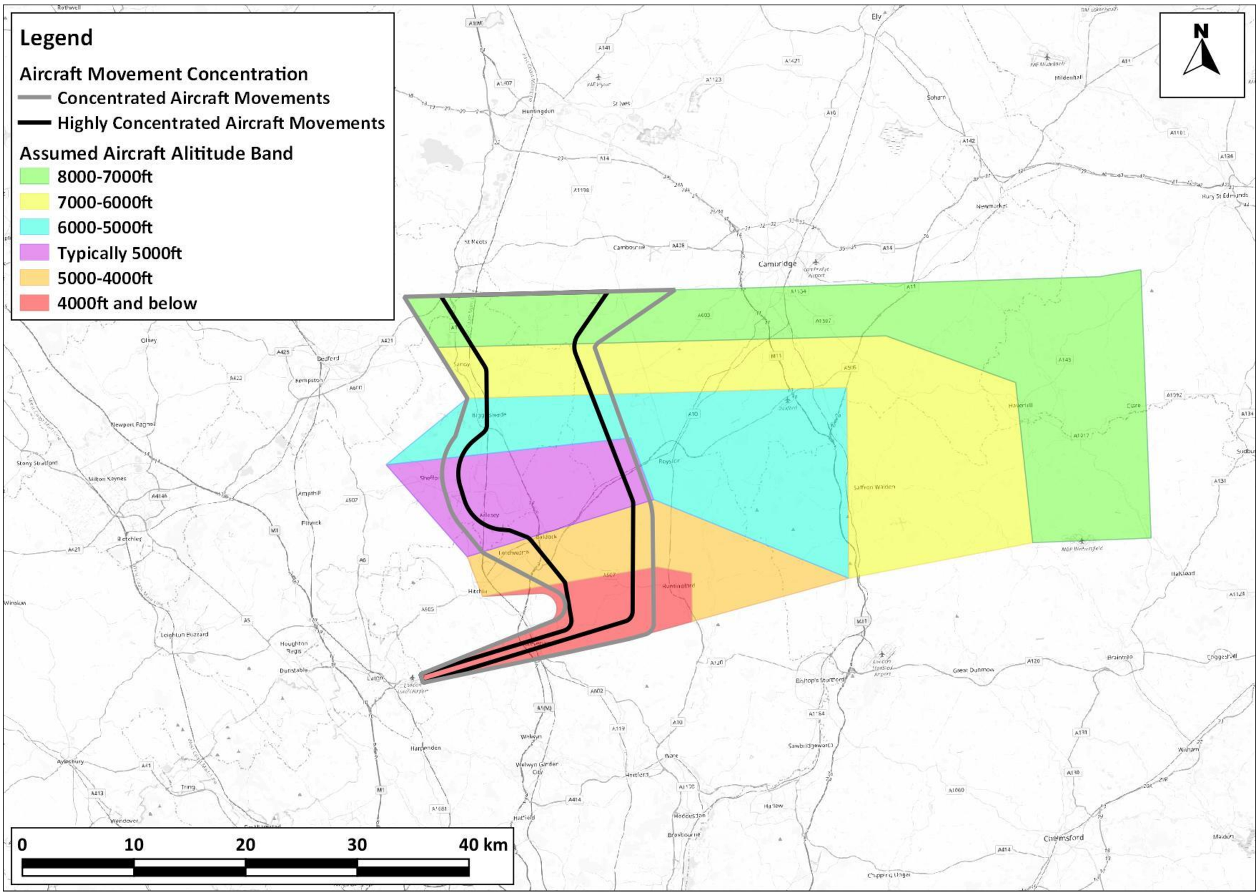
The westerly approach procedures comprise a combination of vectoring and shortcuts, which all affect how, and which areas will be overflown as a result of the change.

For Westerly Approaches, the design comprised of:

- Vectored Approaches;
- Shortcuts.

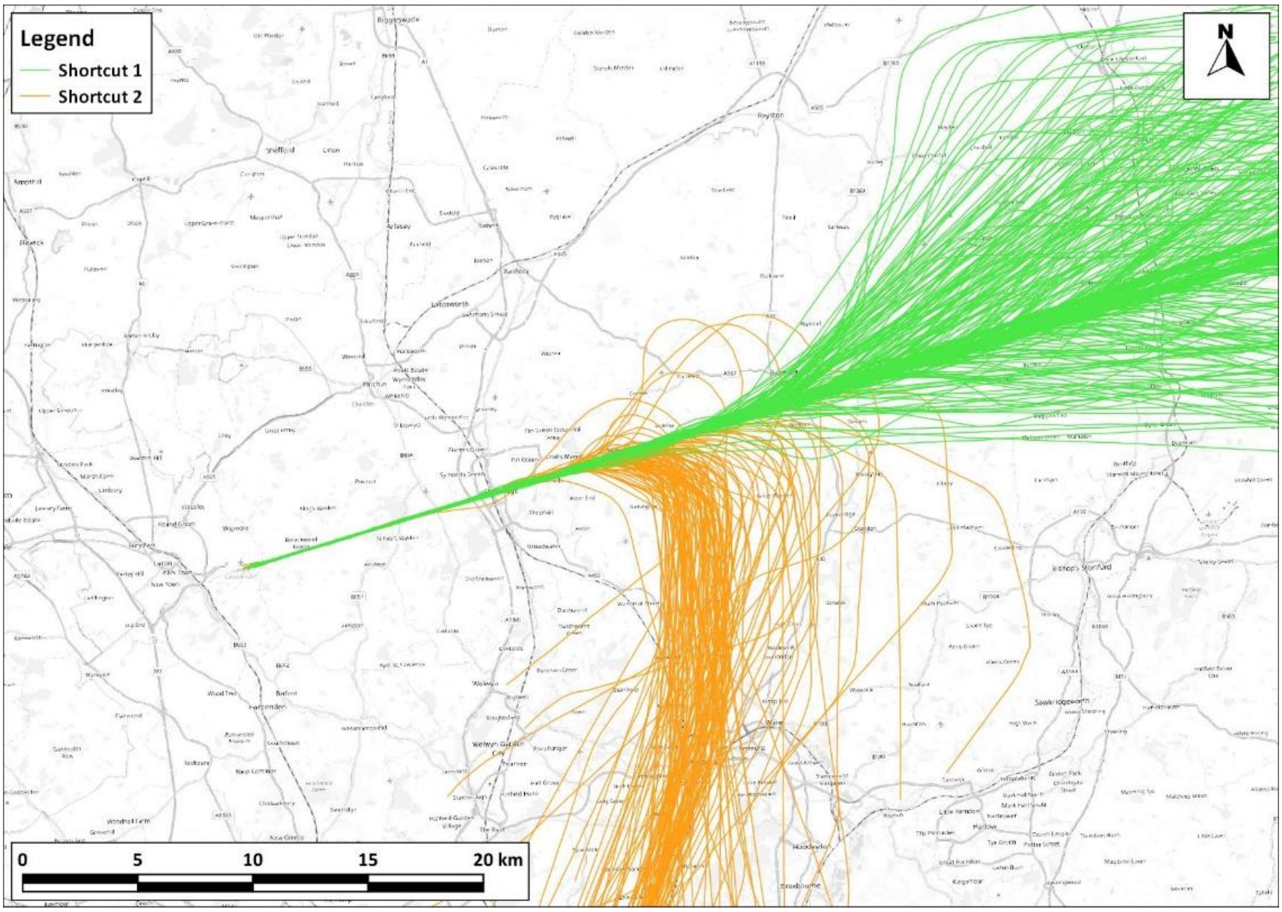
Figure 27 below presents the designed Westerly Vectored Approach component and associated likely aircraft altitude bands.

Figure 27 - Westerly Vectored Approach Component



The Westerly Approach Shortcut components are the same shortcut routes as those employed by LLA before the AD6 implementation. Figure 28 below presents radar data showing the westerly approach shortcuts.

Figure 28 - Westerly Shortcut Approach Components



Easterly Approaches

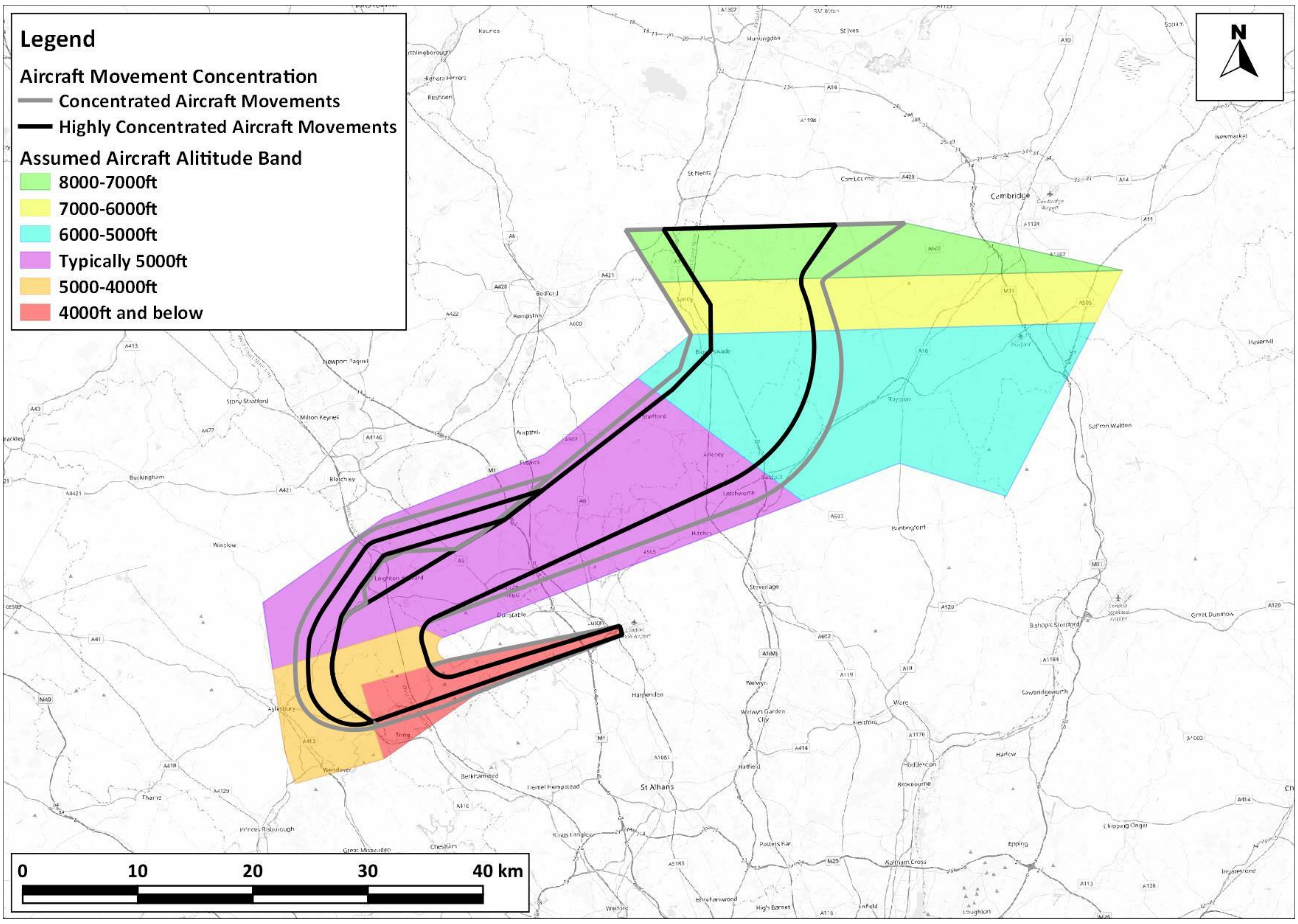
The easterly approach procedures comprise a combination of vectoring and shortcuts, which all affect how and which areas will be overflown as a result of the change.

For Easterly Approaches, the design comprised of:

- Vectored Approaches;
- Shortcuts.

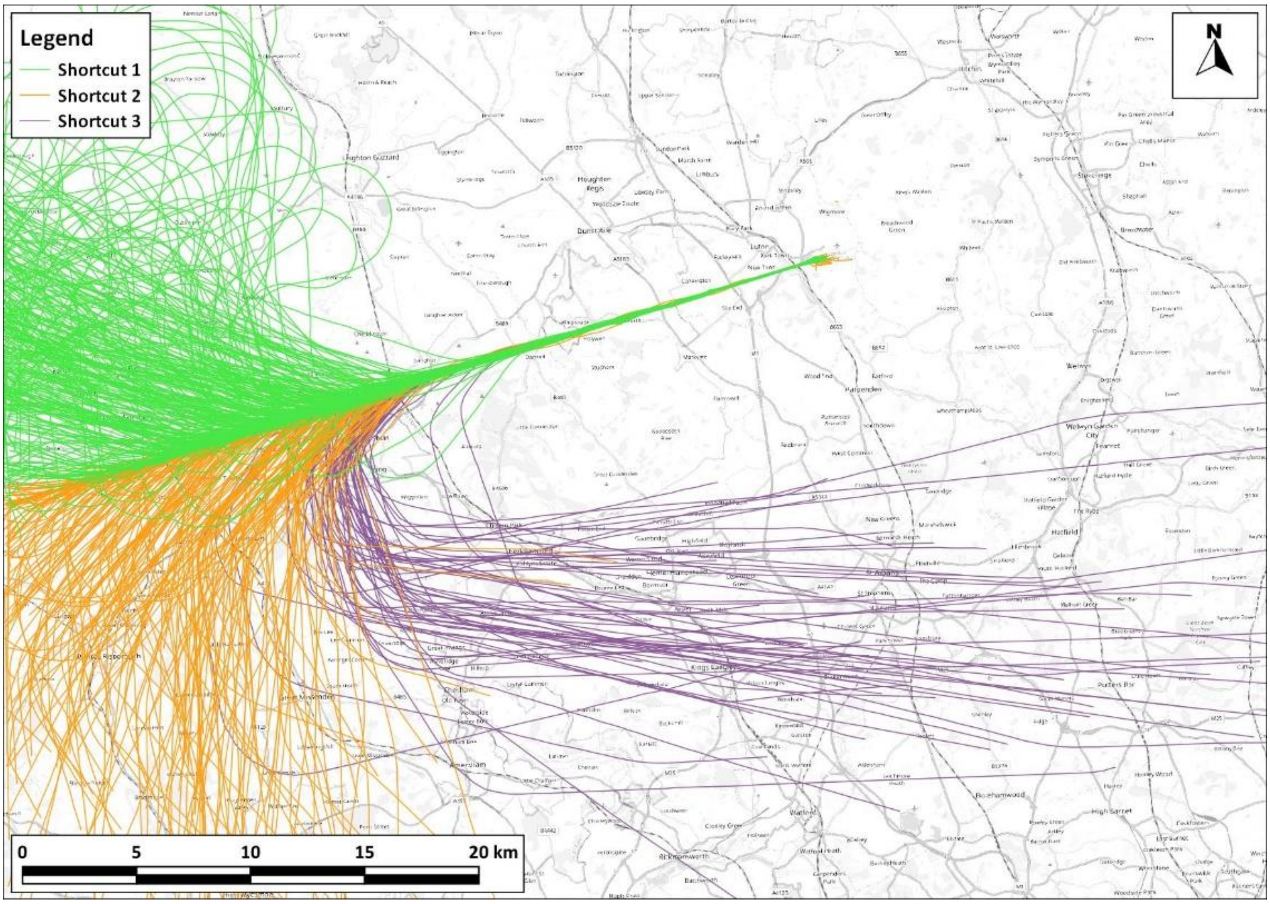
Figure 29 below presents the Easterly Vectored Approach component and associated likely aircraft altitude bands.

Figure 29 - Easterly Vectored Approach Component



The Easterly Approach Shortcut components are the same shortcut routes as those employed by LLA before the implementation of AD6. Figure 30 on p.40 presents radar data showing the easterly approach shortcuts.

Figure 30: Easterly Shortcut Approach Components



4.5.3.2 *Routing*

The relative use of the approach components used for AD6 as prepared for Stage 3 FOA and Stage 4 Final Option Appraisal were identified through consultation with NATS.

The proportion of the westerly and easterly approach routing that have been used for FOA and Final Options Appraisal modelling is summarised in Table 10 below.

Table 10 - Proportion of Use of the New Westerly Approach Components

Probability of Aircraft using a Route (%)			
Easterly Arrivals (Runway 7)		Westerly Arrival (Runway 25)	
Vectored Approach	Shortcuts	Vectored Approach	Shortcuts
70.0%	30.0%	70.0%	30.0%

These proportions were assumed to be the same for daytime and night-time and did not have regard of the origin of the arrival flights and how the AD6 routes would effectively been used.

4.6 Fleet

4.6.1 Fleet for PIR scenarios considering Forecast Fleet for implementation year as assumed in 4A Final Option Appraisal (PIR Scenario 3, 4 and 5)

The noise modelling relative to “Option 1A – Final Design” and “Option 0 – Baseline do nothing” from AD6 Final Options Appraisal assumed 2021 to be the implementation year, assuming arrivals & departures for the 92-day summer period (16 June-15 Sept inclusive).

This used forecast for 2021 containing the following information:

- Aircraft types;
- Runway / Stand Times – Local;
- Origin and Destination of Aircraft.

4.6.1.1 Noise and Aircraft Performance Validation

For the FOA, all modelling was underpinned by an aircraft noise and performance validation which was carried out using data obtained from the airport’s noise and track keeping (NTK) system for the 2019 calendar year.

Depending upon on number of factors, including weight, ground tracks, obstacles and standard operating procedures, aircraft approach and climb away from airports at different rates and speeds. This can vary from airport to airport.

AEDT utilises the ICAO sponsored Aircraft Noise Performance (ANP) Database which provides an international resource for noise modellers. This database marries aircraft flight performance information with aircraft Noise Power Distance (NPD) data for use within the methodologies set out in ECAC Doc 29 4th Edition to generate noise level grids and derive noise contours.

The aircraft flight performance data held within the ANP describes a set of procedures for how aircraft can approach and depart an airport. This data is held in the form of ‘procedural profiles’. For arrivals, these profiles describe information such as speeds, flap and landing gear settings along with angles of decent. For departures, a similar approach is taken with more emphasis on engine settings and climb rates. This is addressed through the concept of ‘stage lengths’ which provides a proxy for aircraft take-off weight based on the distance from the departure airport to its link or destination.

Through the ECAC Doc29 methodology, AEDT utilises the ANP to compute flight data based on ground tracks input into the model. The departure and arrival procedures are then linked to engine power settings, from which the NPD data is used to calculate the level of noise from the aircraft operation.

Based on the recommendations from the CAA, the noise modelling that was undertaken for the FOA made compliant with Category A minimum requirements according to CAA CAP2091.

Validating Aircraft Flight Performance and Noise

Using radar data for the 2019 calendar year, the vertical and horizonal position of all aircraft arriving and departing LLA was computed. Aircraft airspeed was also calculated. This information was broken and grouped into the following:

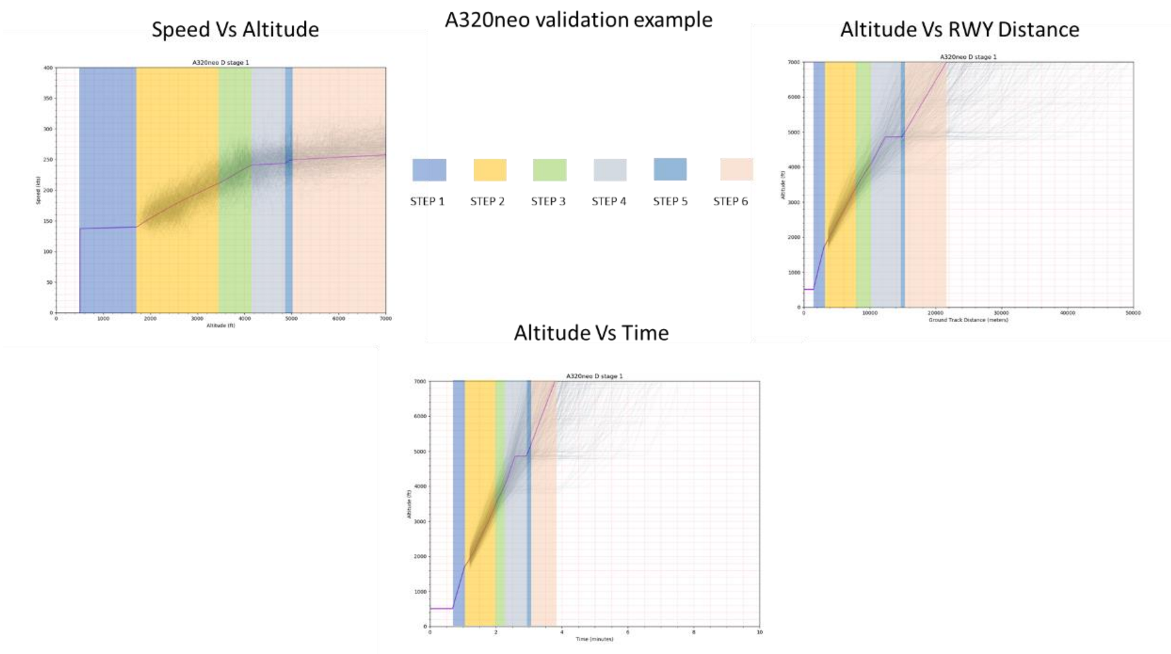
- AEDT aircraft type – based on the airline and aircraft type codes available from the radar data;

- Arrivals and Departures by Runway End;
- Stage Length, for departures – based on the distance in nautical miles between LLA and the aircraft destination set out in the radar data.

From this pooling of data, the following analysis was undertaken to support the development of customised procedural profiles for arrivals and departures. From this analysis, customised profiles were generated through the identification of 'steps' as required by AEDT. Figure 31 below presents an example of this. Judgements are required with respect to determining at what point a new step is necessary to describe the procedure. This is determined through the cross-referencing of the altitude and speed information as this can be used to highlight whether aircraft are climbing, levelling, accelerating or whether the operation is a combination of these factors.

The development of radar-derived profiles can be time consuming as professional judgements can sometimes be required when considering differential changes in the flight performance or where a transition to a new step in the procedures as part the profile is required, along with the values it may need to be set to.

Figure 31 - Developing AEDT Aircraft Procedural Profile Steps from Radar Data



It should be noted that when developing adjusted flight profiles, consideration has been given to the two families of departure procedures in operation i.e. NADP-1 and NADP-2. For aircraft types where it is evident that for a certain aircraft type both departures procedures have been in operation, modified flight profiles have been produced for both.

The frequency of which these procedures are used and by what proportion has been obtained from the analysis of the radar data by identifying clear differentiation in the climb profiles of each aircraft.

The development of customised procedure profiles for aircraft types is repeated for each 'stage length' which provides a proxy for aircraft take-off weight based on the distance from the departure airport to its link or destination.

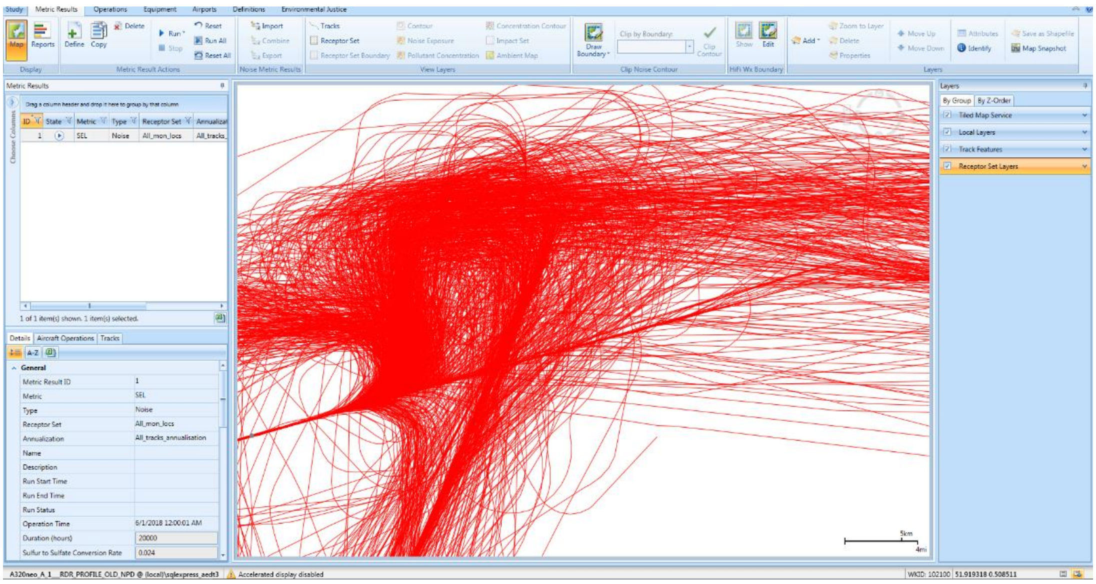
NPD Adjustments

The development of custom procedure profiles that reflect aircraft performance and airport-specific conditions as outlined above is just one factor of the ANP database used as part of the modelling and calculation process.

Although aircraft procedures within the model can be made more representative of actual conditions, this does not necessarily mean that modelled noise levels from these procedures becomes more representative of what is measured on the ground.

Using the data of fixed noise monitoring terminals, measured noise levels was reviewed against their modelled equivalents to identify whether adjustments to the underlying default NPD data held within the ANP is required to improve the representativeness of the noise model. This process relied upon a comparison of the calculated aircraft events levels using the actual flown ground tracks and corresponding customisations, with their measured equivalents. This yielded a comparison between the actual measured level and the modelled level from the corresponding event flight track. An example of this for the A320neo within AEDT is presented in Figure 32 below.

Figure 32 - Actual Radar Tracks in AEDT from A320neo Operations to Enable Validation



The process relied on the use of AEDT's detailed grid outputs as these provide not just the modelled level at each Noise Monitoring Terminal (NMT) but the interpreted thrust, altitude, elevation angles and speeds related to each modelled aircraft event. Except for the thrust data and the elevation angle, this information can be cross-referenced directly to the equivalent radar data.

The process yields a comparison between measured and modelled aircraft event noise level for the same aircraft type and the operation. The use of actual flight tracks within this process has the advantage of accounting for dispersion i.e. the fact that not all aircraft will directly overfly the NMTs.

The absence of recorded thrust data is a limitation, and this cannot be overcome without access to flight data recorder (FDR) information. However as outlined above, thrust can be reasonably estimated and assumed based on the climb rates determined by the model and ensuring adherence to the flight profile. On this basis it is considered that the thrusts adopted within the model where a procedure profile has been verified through the customisation are informed estimates and the identification of that thrust value can be used to assist in any adjustments to the NPD data.

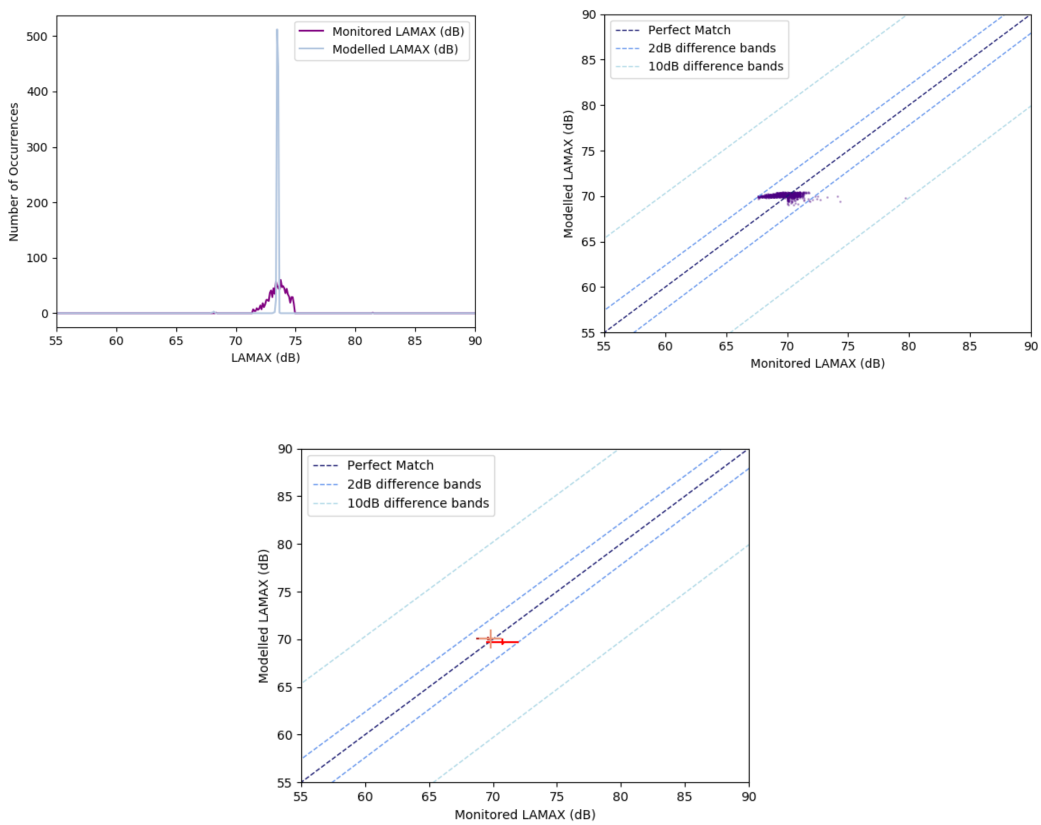
Statistical comparisons for each NMT allows differences between the measured and modelled values to be revealed with respect to altitude and thrust, the two key indexes of how noise data is stored within the NPD data. This provides the basis for reducing the net average difference between the measured and modelled values by identifying average differences which can be used as a basis for adjusting the NPD data. This is represented by comparing the thrust and distance values in the NPD data, alongside average differences in noise event levels. This was achieved by taking the average differences by thrust and distance between aircraft and monitor, as represented within the matrix by a hexagon and applying this back to the NPD data.

When adjusting the NPD curves, priority is given to aircraft events where the elevation angles are greater than 48.5° to align with these being representative of 'overflight' as defined in CAP1498. In situations where alterations would improve the representativeness for some operations and deteriorate it for other operations, the operations with the largest elevation angle are given priority as event levels underneath the flight paths will most likely drive noise outcomes.

The updated NPD curves are then input into AEDT for the same aircraft, flight profiles and tracks as initially used and the event model re-run to test the effect of the changes at the NMT locations.

Figure 33 below presents a comparison of default, procedure validated, and procedure and NPD validated modelled and measured comparisons. The example provided is for the A320.

Figure 33 - Modelled v Measured Event Comparisons following Profile and NPD Adjustments



Summary of Modifications and Adaptions

Table 11 below presents an overview of the adapted flight profiles and NPD, alongside the AEDT aircraft types validated used in the noise modelling relative to Option 1A – Final Design and Option 0 – Baseline do nothing from AD6 Stage 3 FOA and Stage 4 Final Options Appraisal.

Table 11 - Overview of AEDT Noise Model Validations

Aircraft Type	Arrival Profiles	Departure Profile and Stage			
		Stage 1	Stage 2	Stage 3	Stage 4
737400	✔	✔	✔	✔	
737800	✔	✔	✔	✔	✔
737900	✔	✔			✔
757200	✔	✔	✔	✔	✔
7878R	✔	✔			✔
A300-600	✔	✔	✔	✔	
A319-131	✔	✔	✔	✔	
A320-232	✔	✔	✔	✔	✔
A321neo	✔	✔	✔		
A330-343	✔	✔	✔	✔	
ATR72	✔	✔			
CNA560XL	✔	✔			
E190	✔	✔	✔		

4.6.2 Fleet for PIR scenarios considering Actual 2023 Summer (PIR scenarios 1 and 2)

The noise modelling relative to "2023 Actual" (PIR Scenario 1) and "2023 Without AD6" (PIR Scenario 2) considered the fleet data from the 2023 data for the 92-day summer period (16 June-15 Sept inclusive).

The used forecast for 2021 contained the following information:

- Aircraft types;
- Runway / Stand Times – Local ;
- Origin and Destination of Aircraft.

4.6.2.1 *Noise and Aircraft Performance Validation*

For the PIR Scenarios "2023 Actual" and "2023 Without AD6", the validated profiles and NPD used in the models are as per the ones for "Option 1A – Final Design" and "Option 0 – Baseline do nothing" validated for the FOA and the Final Options Appraisal and described in Section 4.6.1.1.

4.7 Modal Split

The modelling related to the PIR Scenarios 3, 4 and 5 (respectively "Option 1A – Final Design in the implementation year", "Option 1A – with AD6 airspace configuration as occurred" and "Option 0 – Baseline do-nothing in the implementation Year") have assumed a modal split of 70% westerly operations and 30% easterly as adopted in the Final Options Appraisal.

Based on the analysis of the 2023 radar data, the modelling related to the PIR Scenarios 1 and 2 (respectively "2023 Actual" and "2023 Without AD6") have considered 78% of westerly operations and 22% of easterlies for the daytime period (0700 - 2300), and 82% westerly and 18% easterly for night-time operations (2300 – 0700).

Table 12 – Modal split related to PIR scenarios

PIR Scenario	Modal Split (%)			
	Daytime (0700-2300)		Nigh-time (2300-0700)	
	Westerly operations	Easterly operations	Westerly operations	Easterly operations
1. 2023 Actual	78%	22%	82%	12%
2. 2023 Without AD6	78%	22%	82%	12%
3. Option 1A – Final Design in the implementation year	70%	30%	70%	30%
4. Option 1A – with AD6 airspace configuration as occurred	70%	30%	70%	30%
5. Option 0 – Baseline do-nothing in the implementation Year	70%	30%	70%	30%

4.8 Demographic Datasets

To facilitate the reporting of the population exposed to various thresholds of aircraft noise, a population dataset obtained from CACI has been used. The data provide population and household forecasts from 2019 to 2025 in incremental years, and in 2050 accounting for anticipated population growth.

For the purpose of this report, the population and household data for 2021 have been used for the PIR Scenario 3, 4 and 5 and 2023 for "2023 Actual" and "2023 Without AD6 scenarios".

In addition to population, a points of interest dataset (PointX) was obtained from Landmark Information in order to identify the locations of schools, hospitals and places of worship, as required for the reporting of noise exposure on community buildings by CAP1616.

5 PIR assessment: Impact of noise

The PIR requires an analysis of the impacts of the implemented airspace change in order to allow the CAA to determine if it has, or has not, produced the intended outcomes as presented in Stage 3 FOA and Stage 4 Final Options Appraisal.

This is achieved in this report through a series of comparison between the pre and post AD6 scenarios outlined in Table 1 and between the AD6 impacts as prepared for the Stage 4A Final Options Appraisal and AD6 as actually implemented.

The following tables summarise the comparisons carried out for the PIR with the relative metrics used for the assessments. As required for the PIR, these are the same metrics used in the Final Options Appraisal which referred to the fourth edition of CAA CAP1616 guidance and CAP1616a Environmental Requirements.

Table 13 – "2023 Actual" Vs "2023 without AD6"

PIR Scenario Comparison	Metric	Type of Assessment
1. 2023 Actual **Vs** **2. 2023 without AD6**	Overflight	Qualitative
	$L_{Aeq, 16hr}$	Contour area (km^2)
		Population exposed
	$L_{Aeq, 8hr}$	Contour area (km^2)
		Population exposed
	N65	Contour area (km^2)
	N60	Contour area (km^2)

Table 14 – "Option 1A – Final Design in the implementation year" Vs "Option 1A – with AD6 airspace configuration as occurred"

PIR Scenario Comparison	Metric	Type of Assessment
3. Option 1A – Final Design in the implementation year **Vs** **4. Option 1A – with AD6 airspace configuration as occurred**	$L_{Aeq, 16hr}$	Contour area (km^2)
		Population exposed
	$L_{Aeq, 8hr}$	Contour area (km^2)
		Population exposed
	N65	Contour area (km^2)
	N60	Contour area (km^2)

Table 15 – "Option 1A – with AD6 airspace configuration as occurred" Vs "Option 0 – Baseline do-nothing in the implementation Year"

PIR Scenario Comparison	Metric	Type of Assessment
4. Option 1A – with AD6 airspace configuration as occurred **Vs** **5. Option 0 – Baseline do-nothing in the implementation Year**	$L_{Aeq,\ 16hr}$	Contour area (km^2)
		Population exposed
	$L_{Aeq,\ 8hr}$	Contour area (km^2)
		Population exposed
	N65	Contour area (km^2)
	N60	Contour area (km^2)
	WebTAG	Net Present Value

The results of the comparisons of the PIR Scenarios for the assessment of the noise impact as described in the table above are presented in the following sections.

5.1 "2023 Actual" Vs "2023 Without AD6"

5.1.1 Overflight

Overflight cones have been generated according to the CAA's CAP1498 "Definition of Overflight" which defines 'overflight' as based on the angle of elevation between a person on the ground and an aircraft in the sky. The report advises on two elevation angles, 60° and 48.5°.

The elevation angle of 48.5° has been chosen for the overflight generated for this report as requested by the document CAP1616i as this states *"sponsors must use a 48.5° angle for representation of overflight".*

Furthermore, it is also stated that contours ranging from five overflights and above should be plotted.

Westerly Arrival

Daytime westerly arrivals pre and post AD6 implementation (respectively "2023 Without AD6" and "2023 Actual" scenarios) are presented in Figure 34 below and Figure 35 on p.50.

The arrival routes coming from the south and the east have been replaced with the AD6 vectoring arrivals joining the AD6 vector at higher altitude, reducing the overall overflown area. However, people below AD6 vector routes have experienced an increase in the number of overflights.

Aircraft join the AD6 vector routes further north respect to the pre-AD6 implementation airspace, in order to avoid conflict with Stansted's airspace.

The arrival route coming from the west has been maintained within AD6 airspace.

Figure 34 – Daytime Westerly Arrival for "2023 Without AD6" scenario (Pre-AD6)

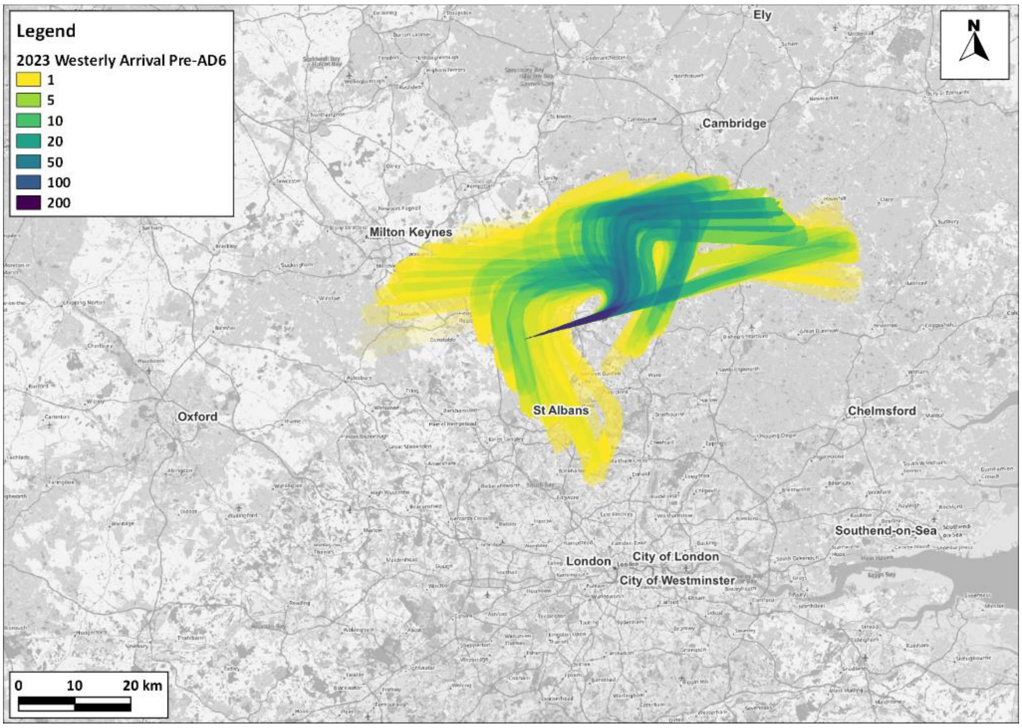


Figure 35 - Daytime Westerly Arrival for "2023 Actual" (post AD6 implementation)

Night-time Westerly arrivals pre and post AD6 implementation (respectively "2023 Without AD6" and "2023 Actual" scenarios) are presented in Figure 36 below and Figure 37 on p.51.

Figure 36 – Night-time Westerly Arrival for "2023 Without AD6" scenario (Pre-AD6)

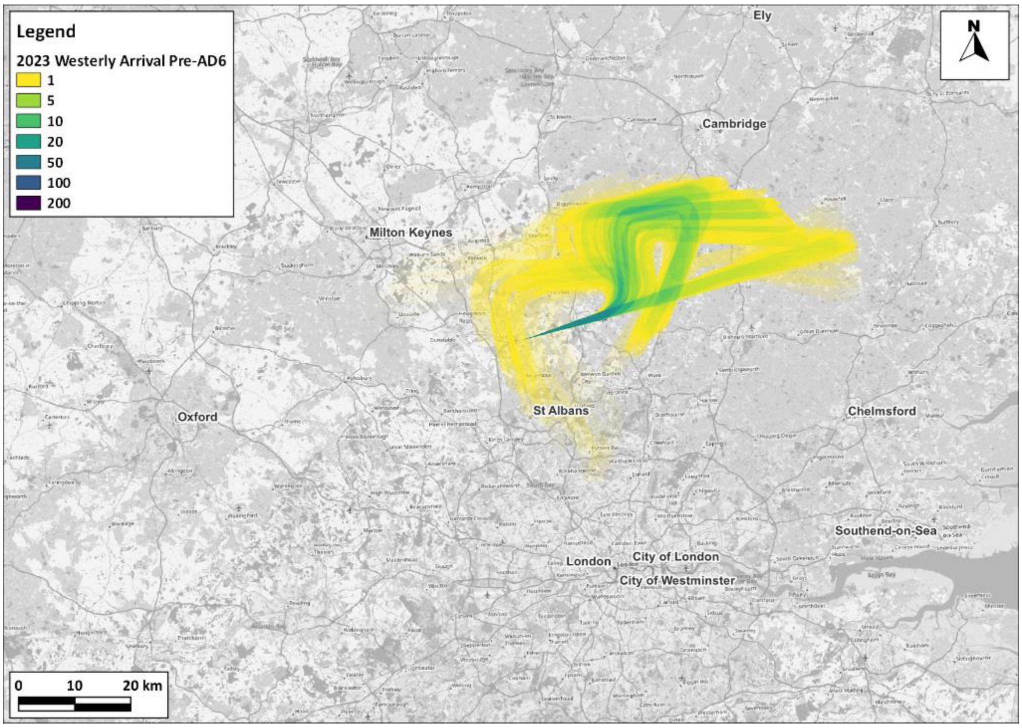
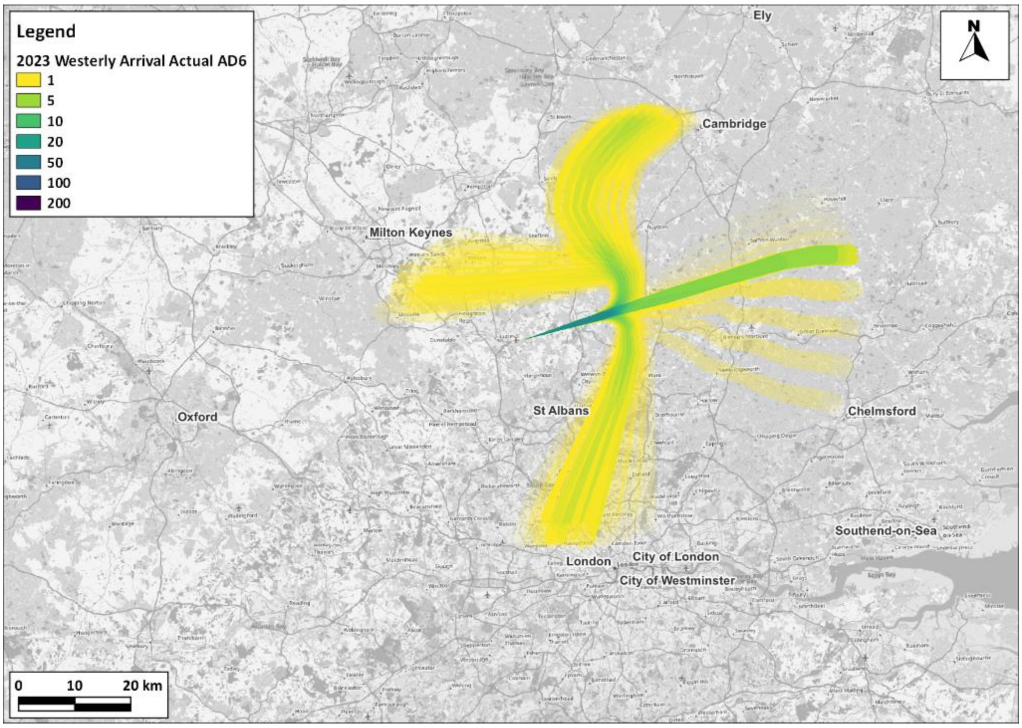


Figure 37 – Night-time Westerly Arrival for "2023 Actual" (post AD6 implementation)



Similar as what occurs during the daytime, the arrival routes coming from the south and the east have been replaced with the AD6 vectoring arrivals joining the AD6 vector routes at higher altitude. However, the introduction of a shortcut route from the south increases the overall area overflown by westerly arrivals.

It is observed that aircraft join the AD6 vector further north respect to pre-AD6 implementation, in order to avoid conflict with Stansted's airspace.

The arrival route coming from the West has been maintained within AD6 airspace.

Easterly Arrival

Daytime Easterly arrivals pre and post AD6 (respectively "2023 Without AD6" and "2023 Actual" scenarios) are presented in Figure 38 and Figure 39 below.

Figure 38 - Daytime Easterly Arrival for "2023 Without AD6" scenario (Pre-AD6)

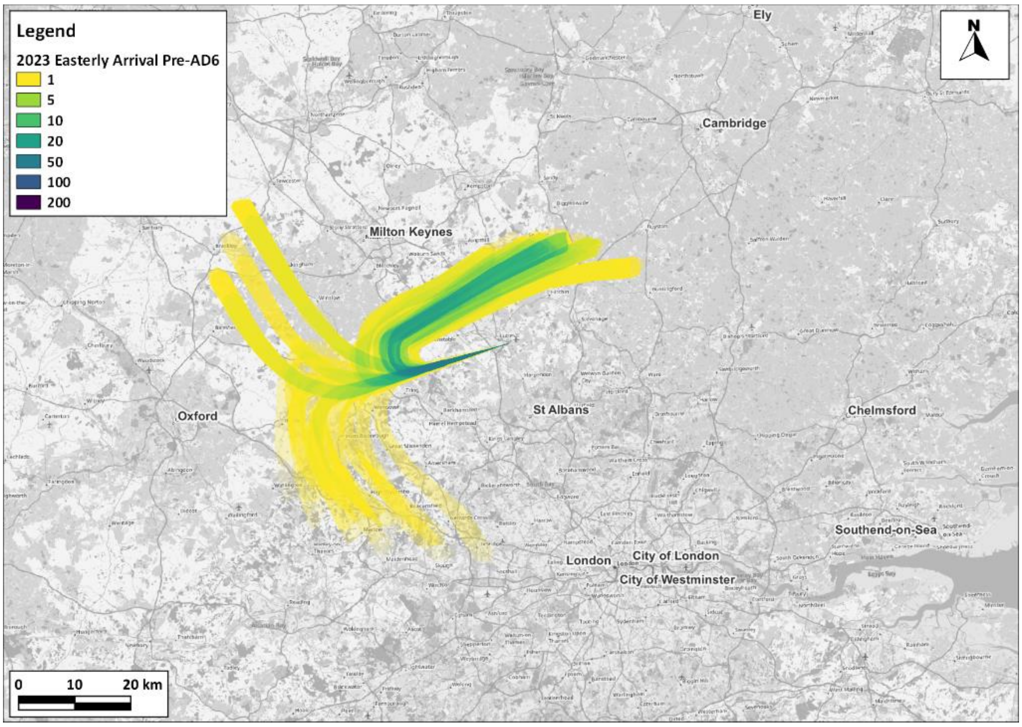


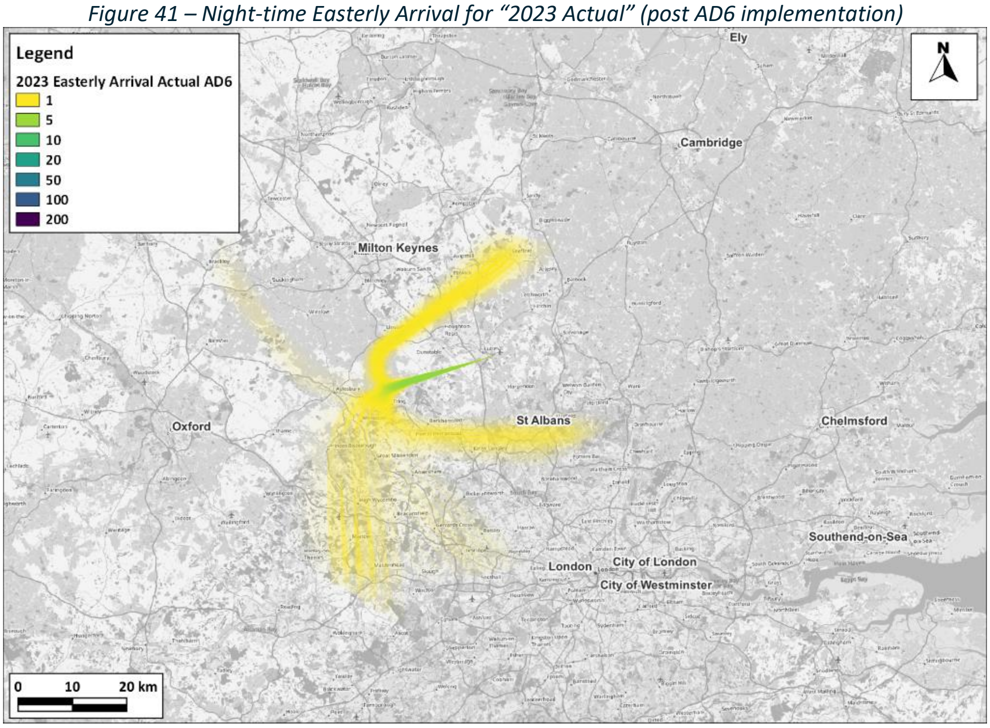
Figure 39 - Daytime Easterly Arrival for "2023 Actual" (post AD6 implementation)

The overflights for the easterly arrivals show a great similarity between the pre-AD6 and AD6 implementation airspace. The small differences that can be noted are related to different approaches to the modelling methodology on the dispersion. Aircraft join the AD6 vector further north respect to pre-AD6 implementation, in order to avoid conflicts with Stansted's airspace.

Night-time easterly night arrival overflights pre and post AD6 implementation are presented respectively in Figure 40 and Figure 41 below.

Figure 40 - Night-time Easterly Arrival for "2023 Without AD6" scenario (Pre-AD6)

Figure 41 – Night-time Easterly Arrival for "2023 Actual" (post AD6 implementation)



During the night-time, with the implementation of AD6 airspace, the traffic has been split between the main vector and the shortcut from the southeast, whilst with the pre-AD6 airspace the traffic was mainly concentrated on the main vector route.

Aircraft are found to join the AD6 vector routes further north respect to pre AD6, in order to avoid conflict with Stansted airport airspace.

5.1.2 Average Summer Daytime Noise Exposure ($L_{Aeq,16h}$)

Figure 42 below shows the average summer daytime $L_{Aeq,16h}$ contours of the “2023 Without AD6” scenario overlaid with the contours of “2023 Actual”. Both models assume the same modal split as reported in Table 12 on p.46.

The plotted contours of the two scenarios are basically coincident showing no significant differences between the pre-AD6 and post-AD6 airspace above the LOAEL of 51 dB $L_{Aeq,16hr}$. This is also confirmed by the comparison between the $L_{Aeq,16h}$ contour areas in km^2 presented in Table 16 on p.55.

Figure 42: $L_{Aeq,16h}$ contours of the “2023 Without AD6” scenario overlaid with the contours of “2023 Actual”

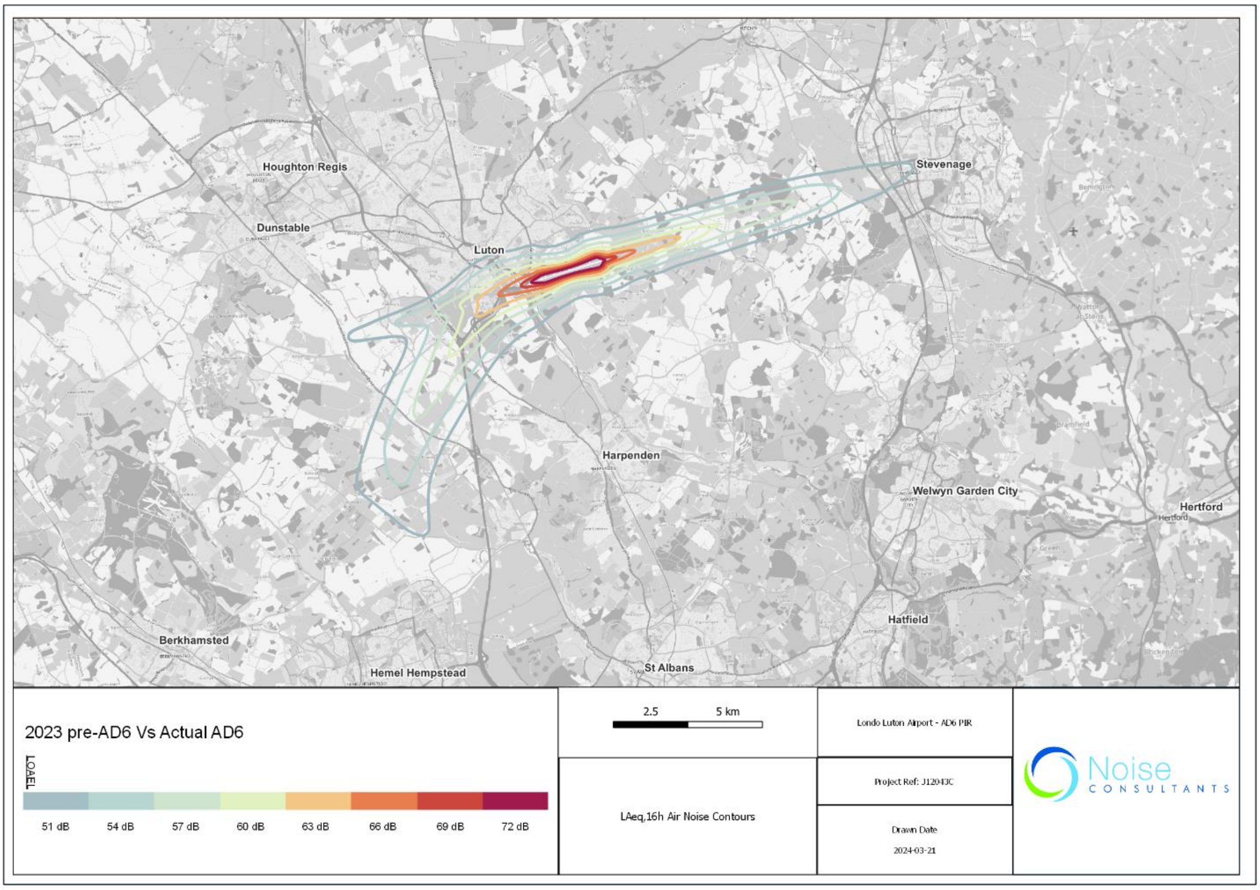


Table 16 – "2023 Without AD6" Vs "2023 Actual" $L_{Aeq,16h}$ contour areas in km²

$L_{Aeq,16h}$	2023 Without AD6 (pre AD6)	2023 Actual (post AD6)
Noise Bands	**Area (km²)**	
≥51 dB	49.4	49.3
≥54 dB	28.9	28.9
≥57 dB	15.6	15.6
≥60 dB	7.7	7.7
≥63 dB	4.0	4.0
≥66 dB	1.9	1.9
≥69 dB	1.0	1.0
≥72 dB	0.6	0.6

Table 17 below presents the comparison between the number of population and households exposed to $L_{Aeq,16h}$ noise levels for the "2023 Without AD6" and "2023 Actual" scenarios. The households and population statistics are presented in thousand and rounded to the nearest hundred.

Table 18 on p.56 presents the same comparison considering the number of noise sensitive receptors.

Statistics presented on Table 17 below and Table 18 on p.56 show no significant differences between the two scenarios.

Table 17 Estimated Number of Households and Population exposed to LAeq,16h levels "2023 Without AD6" Vs "2023 Actual"

$L_{Aeq,16h}$	2023 Without AD6 (pre AD6)		2023 Actual (post AD6)	
Noise Bands	**Household (in thousand)**	**Population (in thousand)**	**Household (in thousand)**	**Population (in thousand)**
≥51 & <54 dB	5	12.2	4.9	12
≥54 & <57 dB	2.5	5.6	2.5	5.6
≥57 & <60 dB	2.1	5.2	2.1	5.2
≥60 & <63 dB	0.6	1.7	0.6	1.7
≥63 & <66 dB	0.2	0.6	0.2	0.6
≥66 & <69 dB	0	0	0	0
≥69 & <72 dB	0	0	0	0
≥72 dB	0	0	0	0

Table 18 - Estimated Noise Sensitive Receptors exposed to $L_{Aeq,16h}$ levels "2023 Without AD6" Vs "2023 Actual"

$L_{Aeq,16h}$	2023 Without AD6 (pre AD6)			2023 Actual (post AD6)		
Noise Bands	**Healthcare**	**Place of Worship**	**Education**	**Healthcare**	**Place of Worship**	**Education**
≥51 & <54 dB	0	18	4	0	18	4
≥54 & <57 dB	0	4	2	0	4	2
≥57 & <60 dB	0	1	4	0	1	4
≥60 & <63 dB	0	3	1	0	3	1
≥63 & <66 dB	0	0	2	0	0	2
≥66 & <69 dB	0	0	0	0	0	0
≥69 & <72 dB	0	0	0	0	0	0
≥72 dB	0	0	0	0	0	0

5.1.3 Average Summer Night-time ($L_{Aeq,8h}$)

Figure 43 below shows the $L_{Aeq,8h}$ contours of the "2023 Without AD6" scenario overlaid with the contours of "2023 Actual". Both models assume the same modal split as reported in Table 12 on p.46.

The plotted contours of the two scenarios are basically coincident showing no difference between the pre-AD6 and post-AD6 airspace. This is confirmed by the comparison between the $L_{Aeq,8h}$ contour areas in km2 presented in Table 19 on p.58.

Figure 43 - $L_{Aeq,8h}$ contours of the "2023 Without AD6" scenario overlaid with the contours of "2023 Actual"

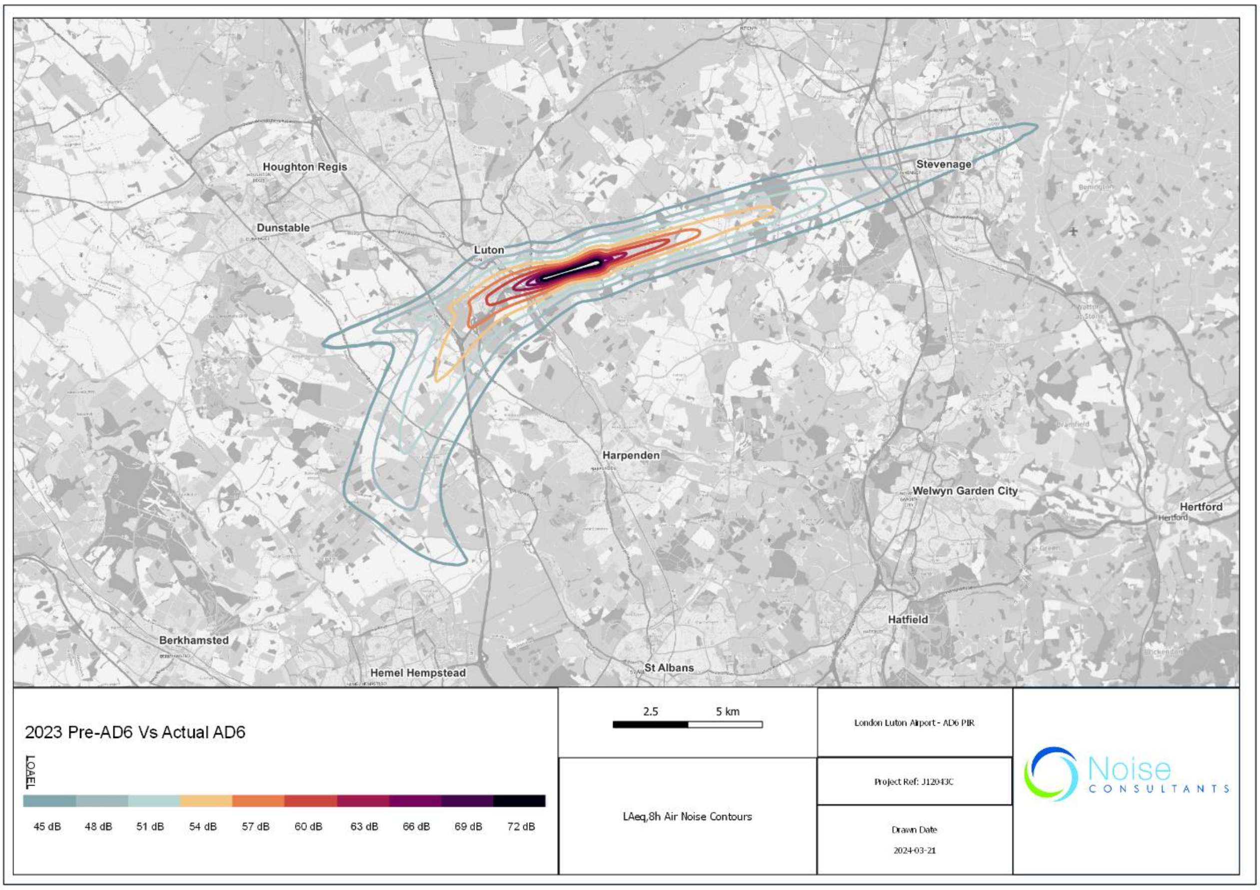


Table 19 – "2023 Without AD6" Vs "2023 Actual" $L_{Aeq,8h}$ contour areas in km2

$L_{Aeq,8h}$	2023 Without AD6 (pre AD6)	2023 Actual (post AD6)
Noise Bands	**Area (km²)**	
≥45 dB	66.9	66.9
≥48 dB	38.8	38.8
≥51 dB	22.0	22.0
≥55 dB	11.4	11.4
≥57 dB	5.6	5.6
≥60 dB	2.9	2.9
≥63 dB	1.4	1.3
≥66 dB	0.8	0.8
≥69 dB	0.5	0.5
≥72 dB	0.3	0.3

Table 20 on p.59 presents the comparison between the number of population and households exposed to $L_{Aeq,8h}$ noise levels for the "2023 Without AD6" and "2023 Actual" scenarios. The households and population statistics are presented in thousand and rounded to the nearest hundred.

Table 21 on p.59 presents the presents the same comparison considering the number of noise sensitive receptors.

Statistics presented on Table 20 on p.59 and Table 21 on p.59 show no significant differences between the two scenarios.

Table 20 - Estimated Number of Households and Population exposed to $L_{Aeq,8h}$ levels "2023 Without AD6" Vs "2023 Actual"

$L_{Aeq,8h}$	2023 Without AD6 (pre AD6)		2023 Actual (post AD6)	
Noise Bands	**Household (in thousand)**	**Population (in thousand)**	**Household (in thousand)**	**Population (in thousand)**
≥45 & <48 dB	14.5	33.7	14.5	33.8
≥48 & <51 dB	3.1	7.8	3	7.6
≥51 & <55 dB	3.2	7.3	3.2	7.3
≥55 & <57 dB	0.5	1.5	0.5	1.5
≥57 & <60 dB	0.6	1.6	0.6	1.6
≥60 & <63 dB	0	0	0	0
≥63 & <66 dB	0	0	0	0
≥66 & <69 dB	0	0	0	0
≥69 & <72 dB	0	0	0	0
≥72 dB	0	0	0	0

Table 21 - Estimated Noise Sensitive Receptors exposed to $L_{Aeq,8h}$ levels "2023 Without AD6" Vs "2023 Actual"

$L_{Aeq,8h}$	2023 Without AD6 (pre AD6)			2023 Actual (post AD6)		
Noise Bands	**Healthcare**	**Place of Worship**	**Education**	**Healthcare**	**Place of Worship**	**Education**
≥45 & <48 dB	0	25	20	0	25	20
≥48 & <51 dB	0	8	0	0	8	0
≥51 & <55 dB	0	2	5	0	2	5
≥55 & <57 dB	0	2	1	0	2	1
≥57 & <60 dB	0	1	2	0	1	2
≥60 & <63 dB	0	0	1	0	0	1
≥63 & <66 dB	0	0	0	0	0	0
≥66 & <69 dB	0	0	0	0	0	0
≥69 & <72 dB	0	0	0	0	0	0
≥72 dB	0	0	0	0	0	0

5.1.4 N65

Figure 44 below shows the N65 rate contours of the "2023 Without AD6" scenario overlaid with the contours of "2023 Actual".

The contours show no difference between the pre-AD6 and post-AD6 airspace. This is also confirmed by the comparison between the N65 rate contour areas in km^2 presented in Table 22 below.

Figure 44 - N65 rate contours of the "2023 Without AD6" scenario overlaid with the contours of "2023 Actual"

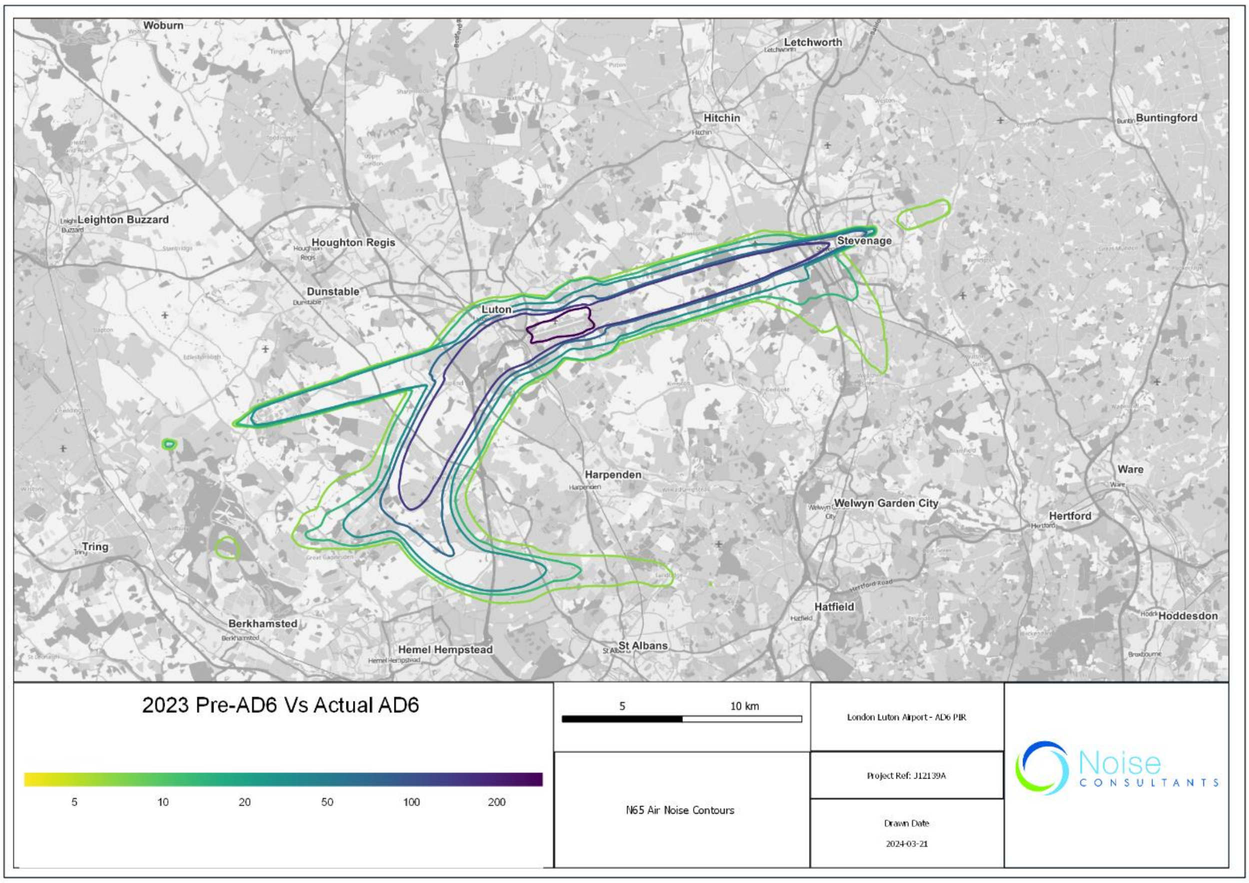


Table 22 - "2023 Without AD6" Vs "2023 Actual" N65 rate contour areas in km2

N65	2023 Without AD6 (pre AD6)	2023 Actual (post AD6)
Rate	**Area (km^2)**	
>5 & ≤10	128.2	128.2
>10 & ≤20	99.3	99.3
>20 & ≤50	74.9	74.9
>50 & ≤100	43.3	43.3
>100 & ≤200	30.8	30.8
>200	2.3	2.3

5.1.5 N60

Figure 45 below shows the N60 rate contours of the “2023 Without AD6” scenario overlaid with the contours of “2023 Actual”.

The contours show a minor divergence on the easterly arrivals. This is due to the presence of the S3 route in which aircraft coming from the east join the final approach from the south. As shown in Figure 41 on p.53, during the night-time, the traffic is almost evenly split between the main vector and the S3 route causing the N60 rate contours to bend to the south. Furthermore, the AD6 arrivals tends to be more concentrated on the final approach in respect to the pre-AD6, causing a slightly longer contour.

This is also reflected in the rate contour area results, presented in Table 23 on p.62, where at N60 rate 5 there is a difference of 2 km^2.

Figure 45 - N60 rate contours of the “2023 Without AD6” scenario overlaid with the contours of “2023 Actual”

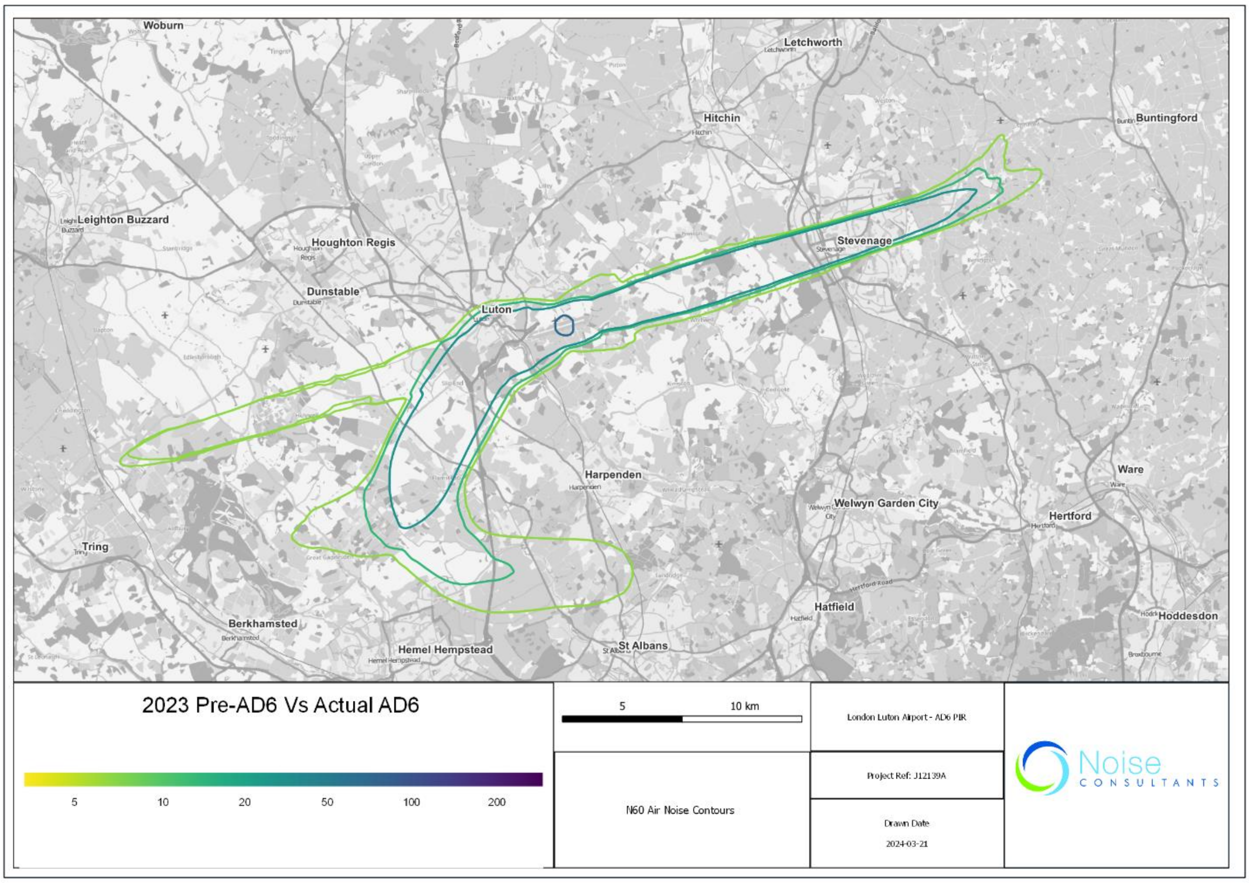


Table 23 - "2023 Without AD6" Vs "2023 Actual" N60 rate contour areas in km2

N60	2023 Without AD6 (pre AD6)	2023 Actual (post AD6)
Rate	**Area (km^2)**	
>5 & ≤10	136.4	138.5
>10 & ≤20	80.0	80.0
>20 & ≤50	55.4	55.4
>50 & ≤100	0.5	0.5
>100 & ≤200	0.0	0.0
>200	0.0	0.0

5.2 "Option 1A – Final Design in the implementation year" Vs "Option 1A – with AD6 airspace configuration as occurred"

5.2.1 Average Summer Daytime ($L_{Aeq,16h}$)

Figure 46 below shows the $L_{Aeq,16h}$ contours of the "Option 1A – with AD6 airspace configuration as occurred" scenario (AD6 as occurred) overlaid with the contours of "Option 1A – Final Design in the implementation year" (AD6 as per Final Options Appraisal).

The contours show minor variations between the Final Design and the AD6 as actually implemented. This is confirmed by the comparison between the $L_{Aeq,16h}$ contours area in km^2 presented in Table 24 on p.64, where the variation is in the order of 0.2 km^2 per each noise bands up to 66dB. The small increment that has been observed is due to a higher concentration on the final approach respect to the Final Design, causing a slightly longer contour.

Figure 46 - *$L_{Aeq,16h}$ contours of the "Option 1A – Final Design in the implementation year" scenario overlaid with the contours of "Option 1A – with AD6 airspace configuration as occurred"*

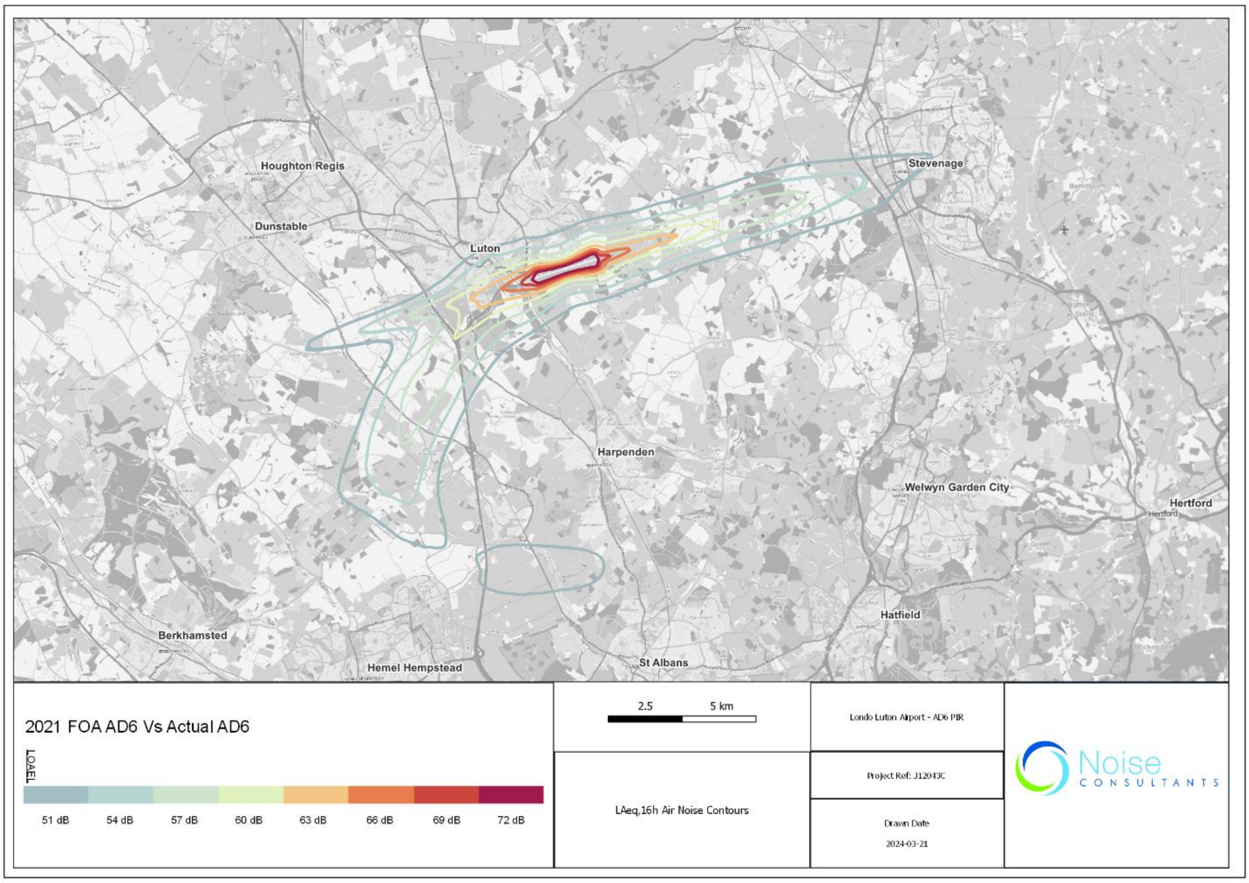


Table 24 - "Option 1A – Final Design in the implementation year" vs "Option 1A – with AD6 airspace configuration as occurred" $L_{Aeq,16h}$ contour area in km2

$L_{Aeq,16h}$	Option 1A – Final Design in the implementation year (AD6 as per Final Options Appraisal)	Option 1A – with AD6 airspace configuration as occurred (AD6 as occurred)
Noise Bands	Area (km²)	
≥51 dB	72.3	72.6
≥54 dB	39.5	39.8
≥57 dB	20.2	20.4
≥60 dB	8.5	8.6
≥63 dB	4.3	4.4
≥66 dB	2.1	2.1
≥69 dB	1.2	1.2
≥72 dB	0.7	0.7

Table 25 below presents the comparison between the number of population and households exposed to 2021 $L_{Aeq,16h}$ noise contours for AD6 Final Design and the AD6 airspace arrangement as occurred. The households and population statistics are presented in thousand and rounded to the nearest hundred.

Table 26 on p.65 presents the same comparison considering the number of noise sensitive receptors.

Statistics presented on Table 25 below and Table 26 on p.65 show minor differences between the two scenarios. Table 25 below shows a difference of 300 household between the two scenarios.

Statistics on the noise sensitive receptors are showing no meaningful differences between scenarios.

Table 25 Estimated Number of Households and Population exposed to LAeq,16h levels "Option 1A – Final Design in the implementation year" vs "Option 1A – with AD6 airspace configuration as occurred"

$L_{Aeq,16h}$	Option 1A – Final Design in the implementation year (AD6 as per Final Options Appraisal)		Option 1A – with AD6 airspace configuration as occurred (AD6 as occurred)	
Noise Bands	Household (in thousand)	Population (in thousand)	Household (in thousand)	Population (in thousand)
≥51 & <54 dB	7.4	17.6	7.8	18.4
≥54 & <57 dB	3.6	9	3.8	9.4
≥57 & <60 dB	2.6	5.8	2.5	5.6
≥60 & <63 dB	0.8	2.2	0.8	2.2
≥63 & <66 dB	0.2	0.6	0.2	0.6
≥66 & <69 dB	0	0	0	0
≥69 & <72 dB	0	0	0	0
≥72 dB	0	0	0	0

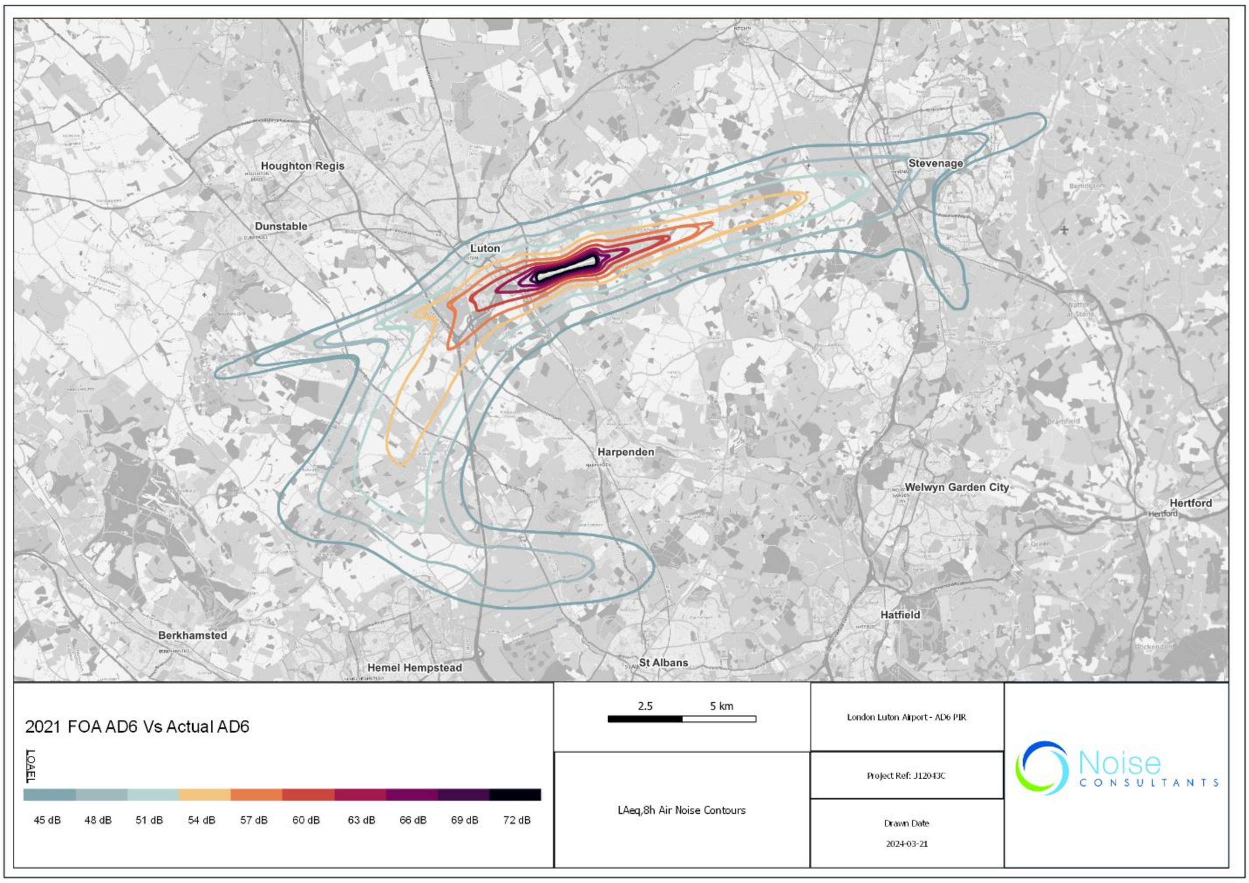
Table 26 Estimated Noise Sensitive Receptors exposed to $L_{Aeq,16h}$ levels "Option 1A – Final Design in the implementation year" vs "Option 1A – with AD6 airspace configuration as occurred"

$L_{Aeq,16h}$	Option 1A – Final Design in the implementation year (AD6 as per Final Options Appraisal)			Option 1A – with AD6 airspace configuration as occurred (AD6 as occurred)		
Noise Bands	**Healthcare**	**Place of Worship**	**Education**	**Healthcare**	**Place of Worship**	**Education**
≥51 & <54 dB	0	18	8	0	20	8
≥54 & <57 dB	0	9	1	0	9	1
≥57 & <60 dB	0	4	5	0	4	5
≥60 & <63 dB	0	1	2	0	1	2
≥63 & <66 dB	0	0	2	0	0	2
≥66 & <69 dB	0	0	0	0	0	0
≥69 & <72 dB	0	0	0	0	0	0
≥72 dB	0	0	0	0	0	0

5.2.2 Average Summer Night ($L_{Aeq,8h}$)

Figure 47 below shows the $L_{Aeq,8h}$ contours of the "Option 1A – with AD6 airspace configuration as occurred" scenario (AD6 as occurred) overlaid with the contours of "Option 1A – Final Design in the implementation year" (AD6 as per Final Options Appraisal).

Figure 47 - $L_{Aeq,8h}$ contours of the "Option 1A – Final Design in the implementation year" scenario overlaid with the contours of "Option 1A – with AD6 airspace configuration as occurred"



The contours show a minor divergence on the easterly arrival. This is due to the presence of the S3 route in which aircraft coming from the east join the final approach from the south. As shown in Figure 41 on p.53, during the night-time, the traffic is almost evenly split between the main vector and the S3 route causing the $L_{Aeq,8h}$ contour to bend to the south. Furthermore, the AD6 arrivals as it occurred since the implementation tends to be more concentrated on the final approach respect to AD6 Final Design, causing a slightly longer contour.

A greater divergence is observed on the westerly arrivals. Such difference which is marginal when considering the actual traffic data from 2023 (PIR scenarios 1 and 2 (Section 5.1.3)) is instead more noticeable considering the 2021 forecasts used for the Stage 3 FOA and Stage 4 Initial Options Appraisal and is mainly due to:

- The considerations of a greater number of movements and a different fleet mix in 2021 compared to 2023.

- A different distribution of the traffic on the routes in 2023 compared to the one assumed for the 2021 forecasts. In fact, while for the 2021 scenarios the proportion of the westerly and easterly approach routing have been assumed to the same for daytime and night-time and did not have regard of the origin of the arrival flights, in 2023 it was determined the actual occurrence of aircraft using the airport's the AD6 approach routes.

These differences in the fleet and route distribution assumptions result to be the main factors that contribute to the different model outputs and outcomes from the Stage 3 FOA and Stage 4 Final Options when comparing the do-nothing scenario and the "Option 1A – with AD6 airspace configuration as occurred" as presented in Section 5.3.

Table 27 - "Option 1A – Final Design in the implementation year" vs "Option 1A – with AD6 airspace configuration as occurred" LAeq,8h contour area in km^2

$L_{Aeq,8h}$	Option 1A – Final Design in the implementation year (AD6 as per Final Options Appraisal)	Option 1A – with AD6 airspace configuration as occurred (AD6 as occurred)
Noise Bands	**Area (km^2)**	
≥45 dB	128.8	132.6
≥48 dB	78.5	79.5
≥51 dB	44.0	44.7
≥55 dB	22.7	23.3
≥57 dB	9.2	9.5
≥60 dB	4.6	4.7
≥63 dB	2.3	2.3
≥66 dB	1.3	1.3
≥69 dB	0.8	0.8
≥72 dB	0.5	0.5

Table 28 below presents the comparison between the number of population and households exposed to 2021 $L_{Aeq,8h}$ noise contours for AD6 Final Design and the AD6 airspace arrangement as occurred. The households and population statistics are presented in thousand and rounded to the nearest hundred.

Table 29 on p.69 presents the same comparison considering the number of noise sensitive receptors.

Population and household statistics presented on Table 28 below, reflect the discrepancies between the scenarios, with differences of 1,200 households and 3200 people between 45 dB and 48 dB, 1,000 households and 2,000 people between 48 dB and 51 dB and, 400 people between 51 dB and 55 dB. No differences are recorded for higher levels, where the contours resulted to have the same extension.

Similar outcomes are recorded for the noise sensitive receptors where differences are noticeable in the places of worship between the levels of 45 dB and 51dB.

Table 28 - Estimated Number of Households and Population exposed to LAqo16h levels "Option 1A – Final Design in the implementation year" vs "Option 1A – with AD6 airspace configuration as occurred"

$L_{Aeq,8h}$	Option 1A – Final Design in the implementation year (AD6 as per Final Options Appraisal)		Option 1A – with AD6 airspace configuration as occurred (AD6 as occurred)	
Noise Bands	**Household (in thousand)**	**Population (in thousand)**	**Household (in thousand)**	**Population (in thousand)**
≥45 & <48 dB	20.7	49.5	21.9	52.7
≥48 & <51 dB	7.1	17.2	8.1	19.2
≥51 & <55 dB	4.7	11.4	4.8	11.8
≥55 & <57 dB	1.9	4.2	1.9	4.1
≥57 & <60 dB	1.1	3.1	1.1	3.1
≥60 & <63 dB	0.3	0.8	0.3	0.8
≥63 & <66 dB	0	0	0	0
≥66 & <69 dB	0	0	0	0
≥69 & <72 dB	0	0	0	0
≥72 dB	0	0	0	0

Table 29 Estimated Noise Sensitive Receptors exposed to $L_{Aeq,8h}$ levels "Option 1A – Final Design in the implementation year" vs "Option 1A – with AD6 airspace configuration as occurred"

$L_{Aeq,8h}$	Option 1A – Final Design in the implementation year (AD6 as per Final Options Appraisal)			Option 1A – with AD6 airspace configuration as occurred (AD6 as occurred)		
Noise Bands	**Healthcare**	**Place of Worship**	**Education**	**Healthcare**	**Place of Worship**	**Education**
≥45 & <48 dB	0	31	30	0	29	30
≥48 & <51 dB	0	14	11	0	16	11
≥51 & <55 dB	0	15	0	0	16	0
≥55 & <57 dB	0	3	5	0	1	5
≥57 & <60 dB	0	1	2	0	3	2
≥60 & <63 dB	0	0	2	0	0	2
≥63 & <66 dB	0	0	0	0	0	0
≥66 & <69 dB	0	0	0	0	0	0
≥69 & <72 dB	0	0	0	0	0	0
≥72 dB	0	0	0	0	0	0

5.2.3 N65

Figure 48 below shows the N65 contours of the "Option 1A – with AD6 airspace configuration as occurred" scenario (AD6 as occurred) overlaid with the contours of "Option 1A – Final Design in the implementation year" (AD6 as per Final Options Appraisal).

The contours show a minor divergence.

This is confirmed by the comparison between the N65 rate contours area in km2 presented in Table 30 in p.71.

Figure 48: N65 rate contours of the "Option 1A – Final Design in the implementation year" scenario overlaid with the contours of "Option 1A – with AD6 airspace configuration as occurred"

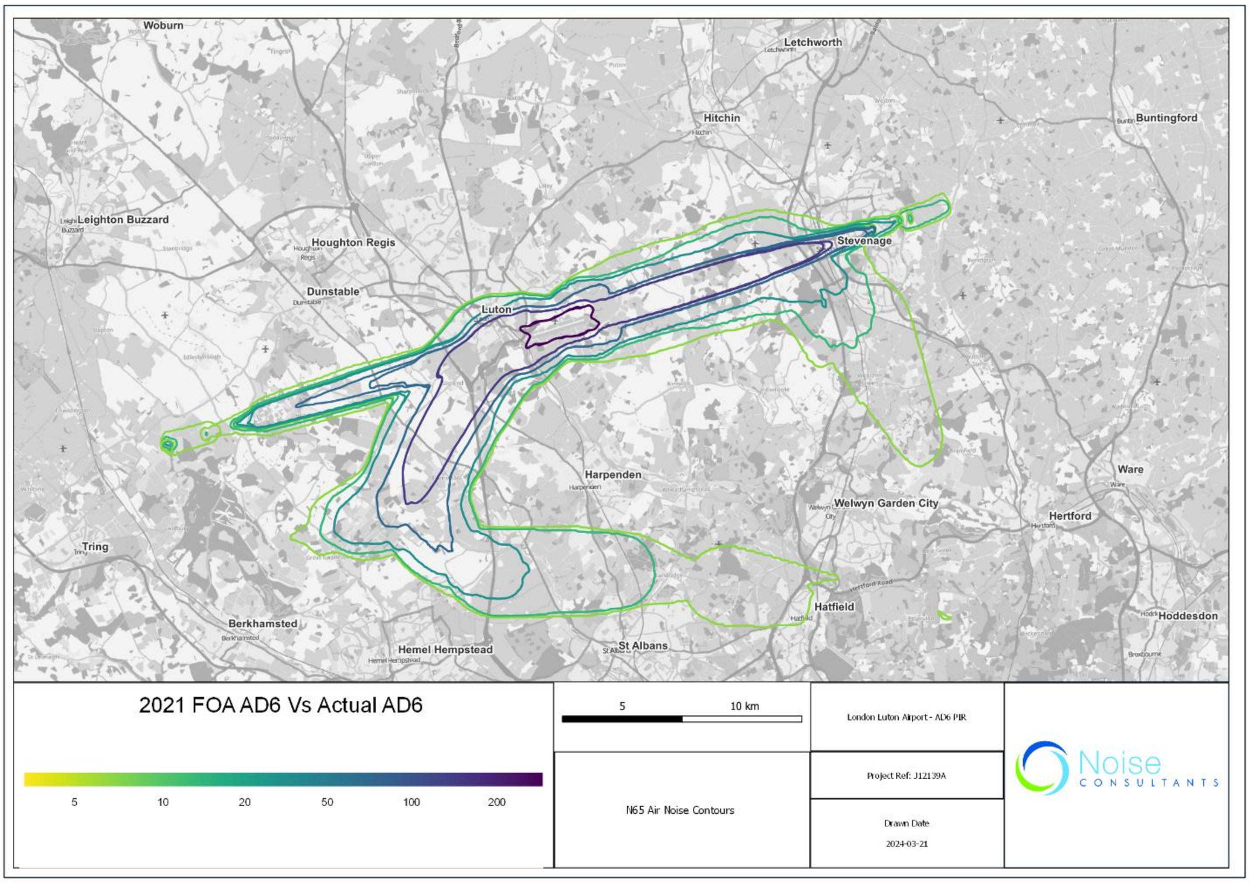
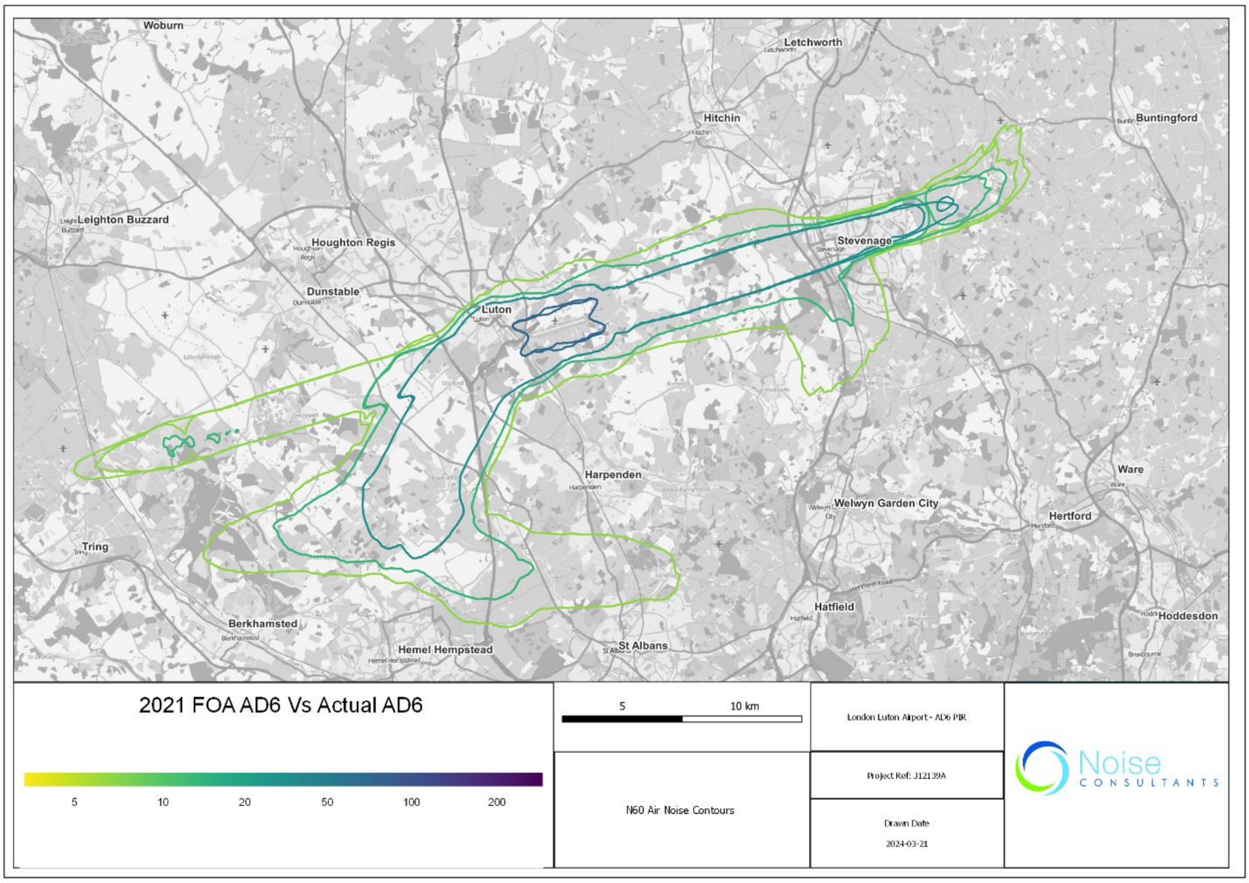


Table 30 "Option 1A – Final Design in the implementation year" vs "Option 1A – with AD6 airspace configuration as occurred" N65 rate contour area in km2

N65	Option 1A – Final Design in the implementation year (AD6 as per Final Options Appraisal)	Option 1A – with AD6 airspace configuration as occurred (AD6 as occurred)
Rates	Area (km^2)	
>5 & ≤10	204.7	203.4
>10 & ≤20	145.4	144.3
>20 & ≤50	97.9	97.0
>50 & ≤100	52.4	54.0
>100 & ≤200	32.4	32.7
>200	2.9	2.8

Figure 49 below shows the N60 rate contours of the “Option 1A – with AD6 airspace configuration as occurred” scenario (AD6 as occurred) overlaid with the contours of “Option 1A – Final Design in the implementation year” (AD6 as per Final Options Appraisal).

Figure 49: N60 rate contours of the “Option 1A – Final Design in the implementation year” scenario overlaid with the contours of “Option 1A – with AD6 airspace configuration as occurred”



The contours show a minor divergence on the easterly arrivals. This is due to the presence of the S3 route in which aircraft coming from the east join the final approach from the south. As shown in Figure 41 on p.53, during the night-time, the traffic is almost evenly split between the main vector and the S3 route causing the N60 contour to bend to the south. Furthermore, the AD6 arrivals as occurred since implementation tends to be more concentrated on the final approach respect to the AD6 Final Design, causing a slightly longer contour.

A greater divergence is observed on the westerly arrivals. Such difference which is marginal when considering the actual traffic data from 2023 (PIR scenarios 1 and 2 (Section 5.1.3)) is instead more noticeable considering the 2021 forecasts used for the Stage 3 FOA and Stage 4 Initial Options Appraisal and is mainly due to:

- The considerations of a greater number of movements and a different fleet mix in 2021 compared to 2023.

- A different distribution of the traffic on the routes in 2023 compared to the one assumed for the 2021 forecasts. In fact, while for the 2021 scenarios the proportion of the westerly and easterly approach routing have been assumed to the same for daytime and night-time and did not have regard of the origin of the arrival flights, in 2023 it was determined the actual occurrence of aircraft using the airport's the AD6 approach routes.

These differences in the fleet and route distribution assumptions result to be the main factors that contribute to the different model outputs and outcomes from the Stage 3 FOA and Stage 4 Final Options when comparing the do-nothing scenario and the "Option 1A – with AD6 airspace configuration as occurred" as presented in Section 5.3.

This is reflected in the contours area, presented in Table 31 below.

Table 31 "Option 1A – Final Design in the implementation year" vs "Option 1A – with AD6 airspace configuration as occurred" N60 rate contour area in km2

N60	Option 1A – Final Design in the implementation year (AD6 as per Final Options Appraisal)	Option 1A – with AD6 airspace configuration as occurred (AD6 as occurred)
Rates	**Area (km^2)**	
>5 & ≤10	220.8	224.2
>10 & ≤20	125.4	128.0
>20 & ≤50	72.0	73.4
>50 & ≤100	5.3	4.6
>100 & ≤200	0.0	0.0
>200	0.0	0.0

5.3 " Option 1A – with AD6 airspace configuration as occurred" Vs "Option 0 – Baseline do-nothing in the implementation Year"

5.3.1 Average Summer Daytime ($L_{Aeq,16h}$)

Figure 50 below shows the $L_{Aeq,16h}$ contours of the "Option 1A – with AD6 airspace configuration as occurred" scenario (post AD6) overlaid with the contours of "Option 0 – Baseline do-nothing in the implementation Year" (pre AD6).

The contours show minor variations between the pre-AD6 and post-AD6 airspace. This is confirmed by the comparison between the $L_{Aeq,16h}$ contours area in km^2 presented in Table 32 on p.75, where the variation is in the order of 0.2 km^2 per noise bands. The difference is due to subtle differences in the dispersion in the modelled approaches between the two scenarios.

Figure 50: $L_{Aeq,16h}$ contours of the "Option 0 – Baseline do-nothing in the implementation Year" scenario overlaid with the contours of "Option 1A – with AD6 airspace configuration as occurred"

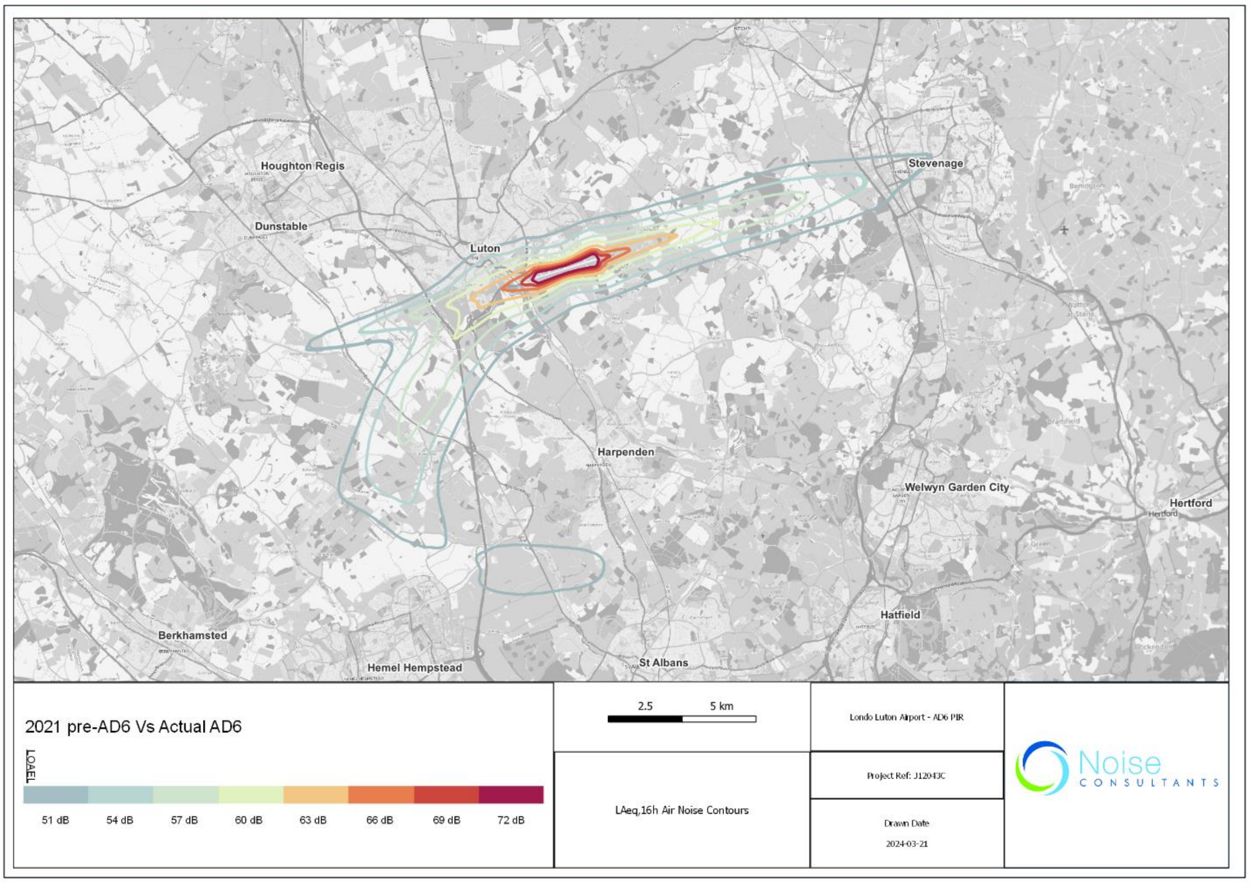


Table 32 – "Option 0 – Baseline do-nothing in the implementation Year" vs "Option 1A – with AD6 airspace configuration as occurred" $L_{Aeq,16h}$ contour area in km2

$L_{Aeq,16h}$	Option 0 – Baseline do-nothing in the implementation Year (pre AD6)	Option 1A – with AD6 airspace configuration as occurred (post AD6)
Noise Bands	**Area (km^2)**	
≥51 dB	72.4	72.6
≥54 dB	39.6	39.8
≥57 dB	20.2	20.4
≥60 dB	8.5	8.6
≥63 dB	4.3	4.4
≥66 dB	2.1	2.1
≥69 dB	1.2	1.2
≥72 dB	0.7	0.7

Table 33 below presents the comparison between the number of population and households exposed to $L_{Aeq,16h}$ noise contours for the pre-AD6 and actual AD6 scenario based on the 2021 forecast used for the FOA. The households and population statistics are presented in thousand and rounded to the nearest hundred. Table 34 on p.76 presents the same comparison considering the number of noise sensitive receptors. Statistics presented on Table 33 below and Table 34 on p.76 show minor differences between the two scenarios. The table shows a difference of circa 300 household between the two scenarios. Statistics on the noise sensitive receptors are showing no meaningful differences between scenarios.

Table 33 - Estimated Number of Households and Population exposed to $L_{Aeq,16h}$ levels "Option 0 – Baseline do-nothing in the implementation Year" vs "Option 1A – with AD6 airspace configuration as occurred"

$L_{Aeq,16h}$	Option 0 – Baseline do-nothing in the implementation Year (pre AD6)		Option 1A – with AD6 airspace configuration as occurred (post AD6)	
Noise Bands	**Household (in thousand)**	**Population (in thousand)**	**Household (in thousand)**	**Population (in thousand)**
≥51 & <54 dB	7.5	17.6	7.8	18.4
≥54 & <57 dB	3.7	9.1	3.8	9.4
≥57 & <60 dB	2.6	5.8	2.5	5.6
≥60 & <63 dB	0.8	2.2	0.8	2.2
≥63 & <66 dB	0.2	0.6	0.2	0.6
≥66 & <69 dB	0	0	0	0
≥69 & <72 dB	0	0	0	0
≥72 dB	0	0	0	0

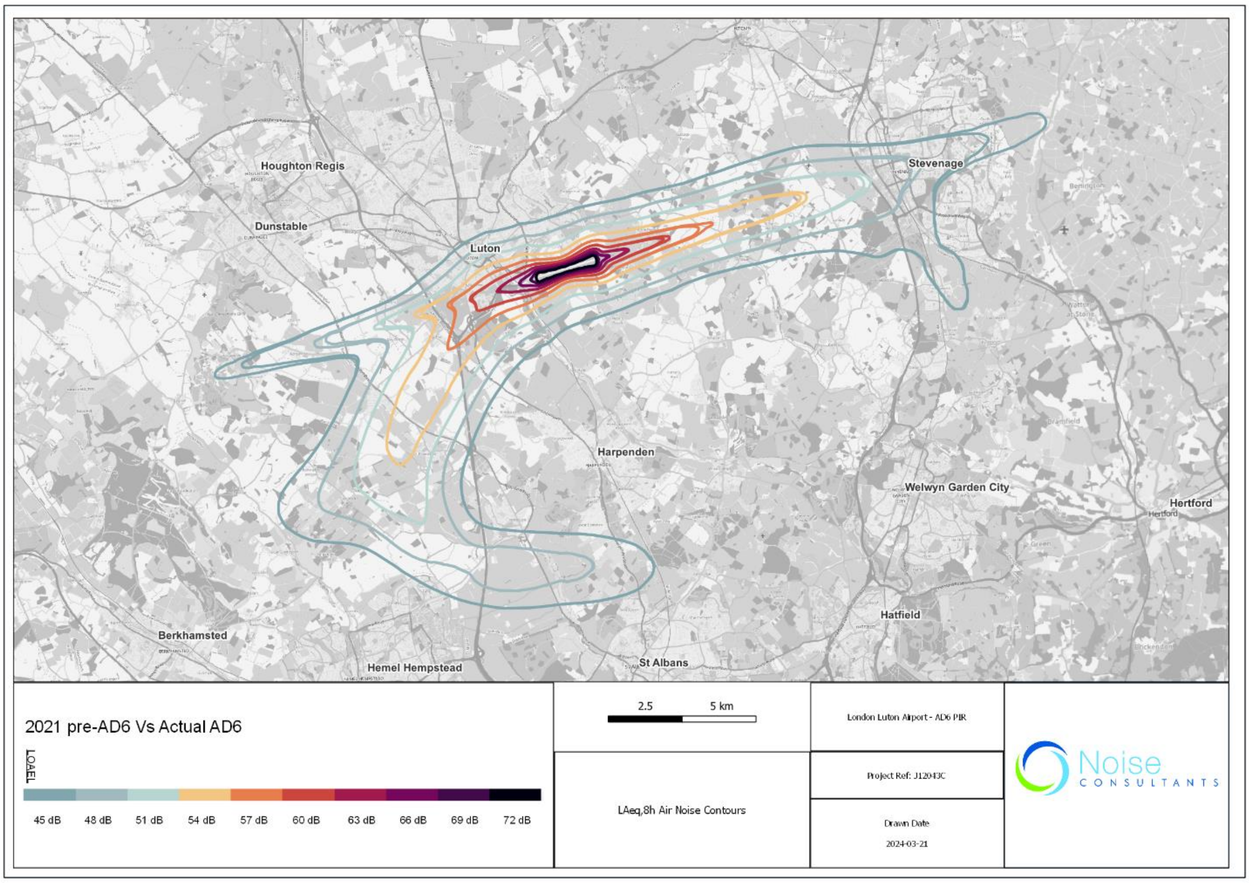
Table 34 - Estimated Noise Sensitive Receptors exposed to $L_{Aeq,16h}$ levels "Option 0 – Baseline do-nothing in the implementation Year" vs "Option 1A – with AD6 airspace configuration as occurred"

$L_{Aeq,16h}$	Option 0 – Baseline do-nothing in the implementation Year (pre AD6)			Option 1A – with AD6 airspace configuration as occurred (post AD6)		
Noise Bands	**Healthcare**	**Place of Worship**	**Education**	**Healthcare**	**Place of Worship**	**Education**
≥51 & <54 dB	0	19	8	0	20	8
≥54 & <57 dB	0	9	1	0	9	1
≥57 & <60 dB	0	4	5	0	4	5
≥60 & <63 dB	0	1	2	0	1	2
≥63 & <66 dB	0	0	2	0	0	2
≥66 & <69 dB	0	0	0	0	0	0
≥69 & <72 dB	0	0	0	0	0	0
≥72 dB	0	0	0	0	0	0

5.3.2 Average Summer Night-time ($L_{Aeq,8h}$)

Figure 51 below shows the average summer night-time ($L_{Aeq,8h}$) contours of the "Option 1A – with AD6 airspace configuration as occurred" scenario (post AD6) overlaid with the contours of "Option 0 – Baseline do-nothing in the implementation Year" (pre AD6).

Figure 51 – L_{Aeq8h} contours of the "Option 0 – Baseline do-nothing in the implementation Year" scenario overlaid with the contours of "Option 1A – with AD6 airspace configuration as occurred"



The contours show a minor divergence on the easterly arrival. This is due to the presence of the S3 route in which aircraft coming from the east join the final approach from the south. As shown in Figure 41 on p.53, during the night-time, the traffic is almost evenly split between the main vector and the S3 route causing the $L_{Aeq,8h}$ contour to bend to the south. Furthermore, the AD6 arrivals tends to be more concentrated on the final approach in respect to the pre-AD6, causing a slightly longer contour.

A greater divergence is observed on the westerly arrivals. Such difference which is marginal when considering the actual traffic data from 2023 (PIR scenarios 1 and 2 (Section 5.1.3)) is instead more noticeable considering the 2021 forecasts used for the Stage 3 FOA and Stage 4 Initial Options Appraisal and is mainly due to:

- The considerations of a greater number of movements and a different fleet mix in 2021 compared to 2023.

- A different distribution of the traffic on the routes in 2023 compared to the one assumed for the 2021 forecasts. In fact, while for the 2021 scenarios the proportion of the westerly and easterly approach routing have been assumed to the same for daytime and night-time and did not have regard of the origin of the arrival flights, in 2023 it was determined the actual occurrence of aircraft using the airport's the AD6 approach routes.

These differences in the fleet and route distribution assumptions result to be the main factors that contribute to the different model outputs and outcomes from the Stage 3 FOA and Stage 4 Final Options when comparing the do-nothing scenario and the "Option 1A – with AD6 airspace configuration as occurred" as presented in Section 5.3.

Table 35 - "Option 0 – Baseline do-nothing in the implementation Year" vs "Option 1A – with AD6 airspace configuration as occurred" L_{Aeq8h} contour area in km2

$L_{Aeq,8h}$	Option 0 – Baseline do-nothing in the implementation Year (pre AD6)	Option 1A – with AD6 airspace configuration as occurred (post AD6)
Noise Bands	**Area (km^2)**	
≥45 dB	129.0	132.6
≥48 dB	78.5	79.5
≥51 dB	44.1	44.7
≥55 dB	22.7	23.3
≥57 dB	9.2	9.5
≥60 dB	4.6	4.7
≥63 dB	2.2	2.3
≥66 dB	1.2	1.3
≥69 dB	0.8	0.8
≥72 dB	0.5	0.5

Table 36 on p.79 presents the comparison between the number of population and households exposed to $L_{Aeq,8h}$ noise contours for the pre-AD6 and actual AD6 scenario based on the 2021 forecast used for the Final Design appraisal. The households and population statistics are presented in thousand and rounded to the nearest hundred.

Table 37 on p.79 presents the same comparison considering the number of noise sensitive receptors.

Statistics presented on Table 36 on p.79, reflect the discrepancies between the scenarios, with differences of 1,500 households and 3,900 people exposed to levels between 45 dB and 48 dB and, 900 households and 1,900 people between 48 dB and 51 dB. No differences are recorded for higher levels, where the contours are identical.

Similar outcomes are recorded for the noise sensitive receptors where differences are noticeable in the places of worship between the 45 and 51dB noise level band.

Table 36 - Estimated Number of Households and Population exposed to $L_{Aeq,8h}$ levels "Option 0 – Baseline do-nothing in the implementation Year" vs "Option 1A – with AD6 airspace configuration as occurred"

$L_{Aeq,8h}$	Option 0 – Baseline do-nothing in the implementation Year (pre AD6)		Option 1A – with AD6 airspace configuration as occurred (post AD6)	
Noise Bands	**Household (in thousand)**	**Population (in thousand)**	**Household (in thousand)**	**Population (in thousand)**
≥45 & <48 dB	20.4	48.8	21.9	52.7
≥48 & <51 dB	7.2	17.3	8.1	19.2
≥51 & <55 dB	4.8	11.6	4.8	11.8
≥55 & <57 dB	1.9	4.1	1.9	4.1
≥57 & <60 dB	1.1	3.1	1.1	3.1
≥60 & <63 dB	0.3	0.8	0.3	0.8
≥63 & <66 dB	0	0	0	0
≥66 & <69 dB	0	0	0	0
≥69 & <72 dB	0	0	0	0
≥72 dB	0	0	0	0

Table 37 - Estimated Noise Sensitive Receptors exposed to $L_{Aeq,8h}$ levels "Option 0 – Baseline do-nothing in the implementation Year" vs "Option 1A – with AD6 airspace configuration as occurred"

$L_{Aeq,8h}$	Option 0 – Baseline do-nothing in the implementation Year (pre AD6)			Option 1A – with AD6 airspace configuration as occurred (post AD6)		
Noise Bands	**Healthcare**	**Place of Worship**	**Education**	**Healthcare**	**Place of Worship**	**Education**
≥45 & <48 dB	0	31	30	0	29	30
≥48 & <51 dB	0	14	11	0	16	11
≥51 & <55 dB	0	16	0	0	16	0
≥55 & <57 dB	0	3	5	0	1	5
≥57 & <60 dB	0	1	2	0	3	2
≥60 & <63 dB	0	0	2	0	0	2
≥63 & <66 dB	0	0	0	0	0	0
≥66 & <69 dB	0	0	0	0	0	0
≥69 & <72 dB	0	0	0	0	0	0
≥72 dB	0	0	0	0	0	0

5.3.3 N65

Figure 52 below shows the N65 rate contours of the “Option 1A – with AD6 airspace configuration as occurred” scenario (post AD6) overlaid with the contours of “Option 0 – Baseline do-nothing in the implementation Year” (pre AD6).

The contours show a minor divergence due to greater concentration on final approach on the AD6 scenario, which is the cause of longer contours.

The difference is more noticeable considering the 2021 forecasts due to the considerations of a greater number of movements in comparison to actual one occurred in 2023, and different fleet mix.

This is also confirmed by the comparison between the N65 rate contours area in km^2 presented in Table 38 on p.81.

Figure 52 - N65 rate contours of the “Option 0 – Baseline do-nothing in the implementation Year” scenario overlaid with the contours of “Option 1A – with AD6 airspace configuration as occurred”

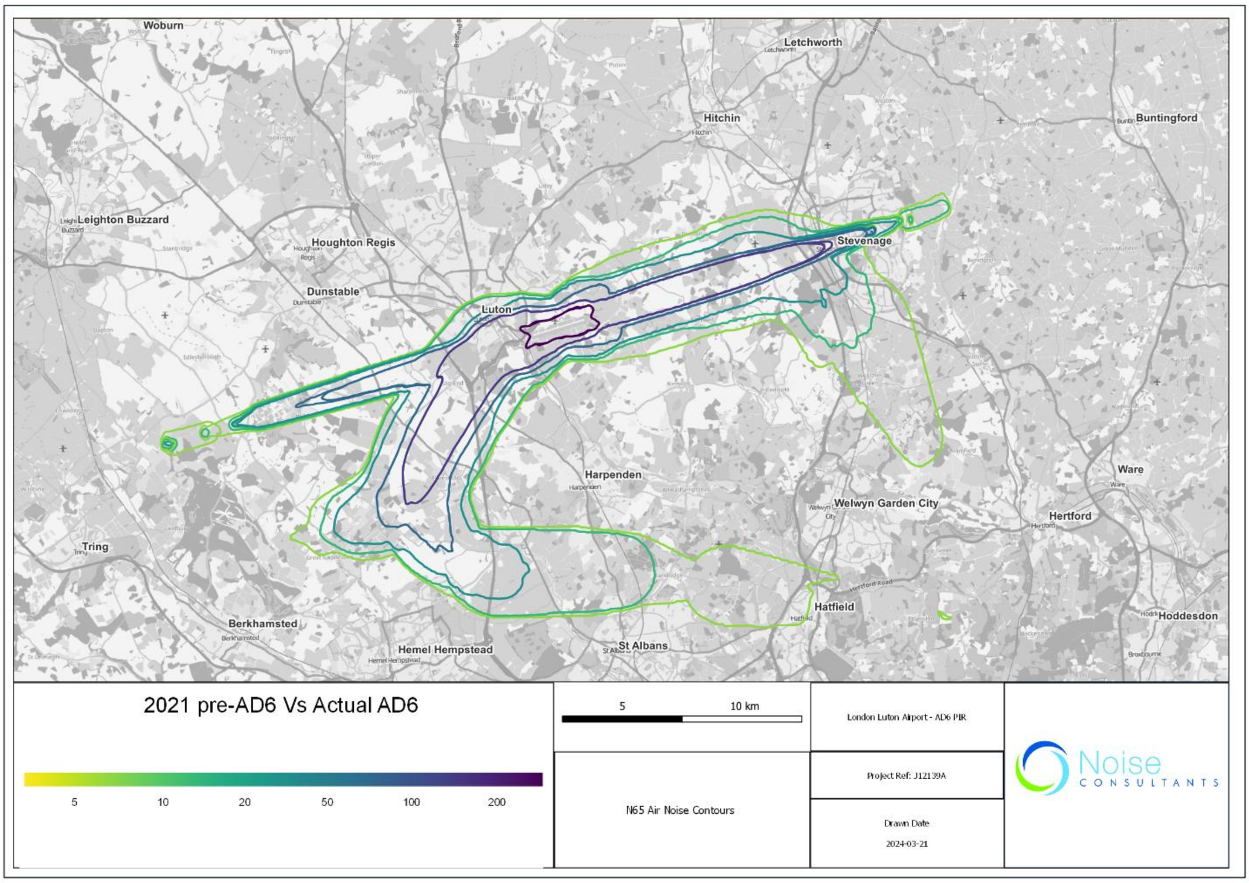


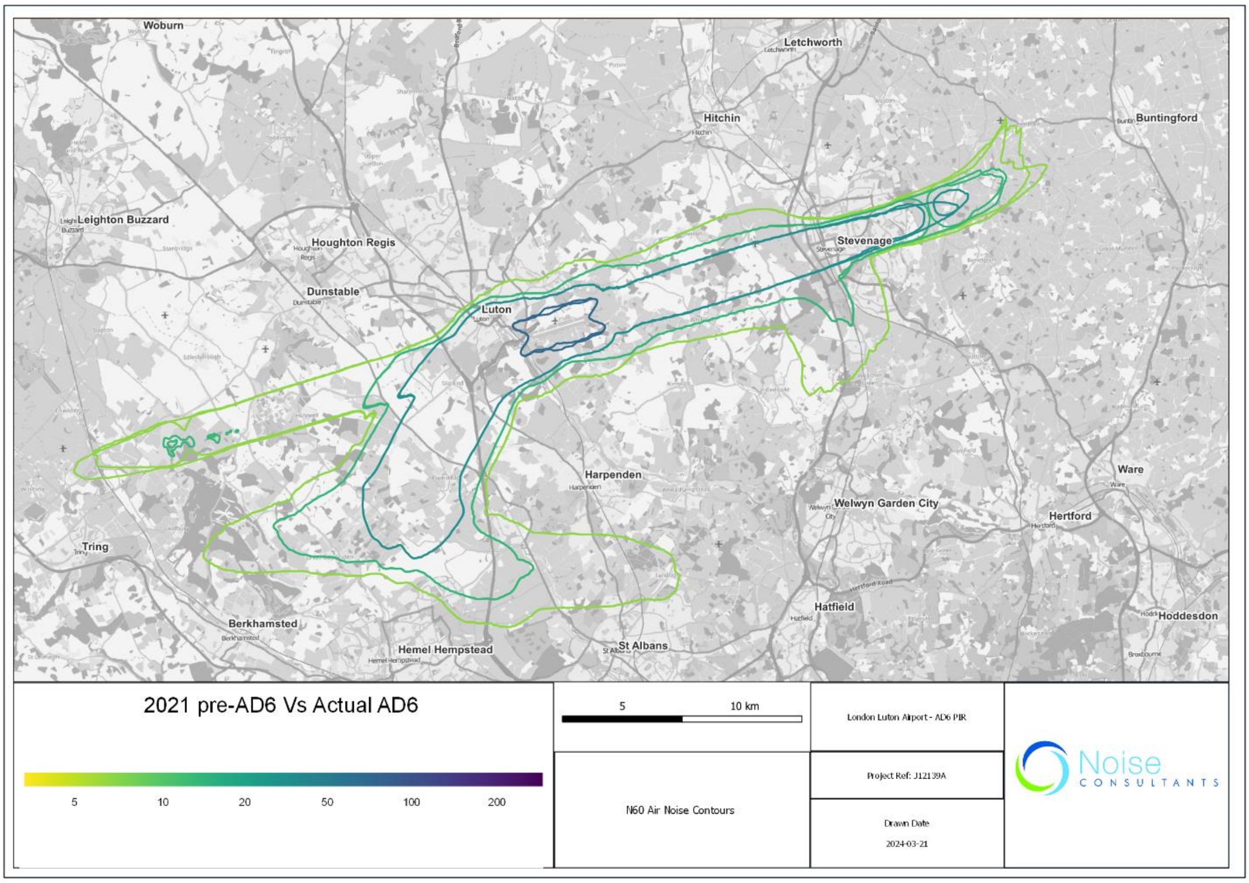
Table 38 - "Option 0 – Baseline do-nothing in the implementation Year" vs "Option 1A – with AD6 airspace configuration as occurred" N65 rate contour area in km2

N65	Option 0 – Baseline do-nothing in the implementation Year (pre AD6)	Option 1A – with AD6 airspace configuration as occurred (post AD6)
Rate	Area (km^2)	
>5 & ≤10	202.1	203.4
>10 & ≤20	144.5	144.3
>20 & ≤50	97.9	97.0
>50 & ≤100	53.8	54.0
>100 & ≤200	32.5	32.7
>200	2.9	2.8

5.3.4 N60

Figure 53 below shows the N60 rate contours of the "Option 1A – with AD6 airspace configuration as occurred" scenario (post AD6) overlaid with the contours of "Option 0 – Baseline do-nothing in the implementation Year" (pre AD6). The contours show a minor divergence on the easterly arrival. This is due to the presence of the S3 route in which aircraft coming from the east join the final approach from the south. As shown in Figure 41 on p.53, during the night-time, the traffic is almost evenly split between the main vector and the S3 route causing the N60 contour to bend to the south. Furthermore, the AD6 arrivals tends to be more concentrated on the final approach in respect to the pre-AD6, causing a slightly longer contour.

Figure 53: N60 rate contours of the "Option 0 – Baseline do-nothing in the implementation Year" scenario overlaid with the contours of "Option 1A – with AD6 airspace configuration as occurred"



A greater divergence is observed on the westerly arrivals. Such difference which is marginal when considering the actual traffic data from 2023 (PIR scenarios 1 and 2 (Section 5.1.3)) is instead more noticeable considering the 2021 forecasts used for the Stage 3 FOA and Stage 4 Initial Options Appraisal and is mainly due to:

- The considerations of a greater number of movements and a different fleet mix in 2021 compared to 2023.
- A different distribution of the traffic on the routes in 2023 compared to the one assumed for the 2021 forecasts. In fact, while for the 2021 scenarios the proportion of the westerly and

easterly approach routing have been assumed to the same for daytime and night-time and did not have regard of the origin of the arrival flights, in 2023 it was determined the actual occurrence of aircraft using the airport's the AD6 approach routes.

These differences in the fleet and route distribution assumptions result to be the main factors that contribute to the different model outputs and outcomes from the Stage 3 FOA and Stage 4 Final Options when comparing the do-nothing scenario and the "Option 1A – with AD6 airspace configuration as occurred" as presented in Section 5.3.

This is also reflected in the contours area, presented in Table 25 below.

Table 25 - "Option 0 – Baseline do-nothing in the implementation Year" vs "Option 1A – with AD6 airspace configuration as occurred" N60 rate contour area in km2

N60	Option 0 – Baseline do-nothing in the implementation Year (pre AD6)	Option 1A – with AD6 airspace configuration as occurred (post AD6)
Noise Bands	**Area (km^2)**	
>5 & ≤10	221.5	224.2
>10 & ≤20	126.2	128.0
>20 & ≤50	72.9	73.4
>50 & ≤100	5.3	4.6
>100 & ≤200	0.0	0.0
>200	0.0	0.0

5.3.5 WebTAG

A WebTAG assessment has been carried out based on differences between the baseline no-change option from the Stage 3 FOA and Stage 4 Final Options Appraisal and "Option 1A – with AD6 airspace configuration as occurred" scenario.

The approach taken is the same as adopted for the Stage 3 FOA and Stage 4 Final Options Appraisal, with the opening year data for the "with scheme scenario" being replaced with the number of households experiencing noise levels from the "Option 1A – with AD6 airspace configuration as occurred" model results.

These results are compared with the assessment originally carried out and presented as part of the Stage 3 FOA and Stage 4 Final Options Appraisal. Since this was based on a superseded version of WebTAG, the original assessment has been updated to the latest version of the WebTAG workbook currently available (Version Nov-23).

The base year has been set to 2010 because consistently with Stage 3 and Stage 4 assessment that made reference to CAP1616a.

Table 39 and Table 40 below present respectively the results of the WebTAG assessment for the "no DCO option" and "with DCO Option" situations.

Table 39 - WebTAG comparisons for the No DCO Scenarios

	Stage 4 Final Option Appraisal (Original)		Stage 4 Final Option Appraisal (Updated)		PIR	
	2032 No DCO Option 1A - Final Design		2032 No DCO Option 1A - Final Design		2032 No DCO Option 1A - AD6 as occurred	
Description ***positive value reflects a net benefit (i.e. a reduction in noise)**	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)
Net present value of change in noise (£, 2010 prices):	£471,306	-£30,221	£442,416	-£27,113	-£478,690	-£180,707
Net present value of impact on sleep disturbance (£, 2010 prices):	£236,442	£98,896	£221,957	£93,180	-£542,737	£7,947
Net present value of impact on amenity (£, 2010 prices):	£282,335	-£81,645	£264,745	-£76,007	£129,303	-£123,398
Net present value of impact on AMI (£, 2010 prices):	£4,844	£4,844	£4,601	£4,601	£5,230	£5,230
Net present value of impact on stroke (£, 2010 prices):	-£20,793	-£20,793	-£19,431	-£19,431	-£28,033	-£28,033
Net present value of impact on dementia (£, 2010 prices):	-£31,521	-£31,521	-£29,457	-£29,457	-£42,453	-£42,453

Table 40 - WebTAG comparisons for the with DCO Scenarios

	Stage 4 Final Option Appraisal		Stage 4 Final Option Appraisal Updated		PIR	
	2032 No DCO Option 1A - Final Design		2032 No DCO Option 1A - Final Design		2032 No DCO Option 1A - AD6 as occurred	
Description ***positive value reflects a net benefit (i.e. a reduction in noise)**	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)
Net present value of change in noise (£, 2010 prices):	£572,191	£402,581	£536,660	£377,176	-£384,447	£223,582
Net present value of impact on sleep disturbance (£, 2010 prices):	-£105,328	£122,790	-£97,297	£115,500	-£861,991	£30,267
Net present value of impact on amenity (£, 2010 prices):	£603,711	£205,978	£564,949	£192,668	£429,506	£145,276
Net present value of impact on AMI (£, 2010 prices):	£11,836	£11,836	£11,132	£11,132	£11,761	£11,761
Net present value of impact on stroke (£, 2010 prices):	£24,776	£24,776	£23,136	£23,136	£14,534	£14,534
Net present value of impact on dementia (£, 2010 prices):	£37,202	£37,202	£34,739	£34,739	£21,743	£21,743

The main differences in the WebTAG assessment are relative to the sleep disturbance. As observed in Section 0, the night contours resulting from the Stage 4 "Option 1A – Final Design" modelling tend to be smaller than the one considering the AD6 airspace as implemented, due to the different assumptions in the modelling on distribution of the traffic on the routes taken during the Stage 3 FOA and Stage 4 Final Options Appraisals.

In fact, while for the 2021 scenarios the proportion of the westerly and easterly approach routing have been assumed to be the same for daytime and night-time and did not have regard of the origin of the arrival flights, in 2023 it was determined the actual occurrence of aircraft using the airport's the AD6 approach routes.

This results therefore in different modelling outputs rather than effectively a worse outcome than the one expected. This consideration is also supported by the outcome of the analysis of the "2023 Actual" Vs "2023

Without AD6" scenarios where, when considering the same fleet and the same route distribution, there are either no or minimal differences between the pre and post AD6 implementation scenarios, similarly to the outcomes of the Stage 3 FOA and Stage 4 Final Options Appraisal.

6 Conclusions

The CAA's airspace change process is a seven-stage mechanism that is set out in detail in CAP1616. Stage 7 of this process is the Post Implementation Review (PIR). The PIR considers the impacts of the airspace change a year after its implementation to allow the CAA to determine whether the airspace change has produced the intended outcomes.

For the PIR, three different comparisons have been carried out between the pre and post AD6 scenarios to analyse the impacts of the implemented airspace:

1. "2023 Actual" vs "2023 without AD6";
2. "Option 1A – Final Design in the implementation year" Vs "Option 1A – with AD6 airspace configuration as occurred";
3. "Option 1A – with AD6 airspace configuration as occurred" vs "Option 0 – Baseline do-nothing in the implementation Year".

The first comparison has considered operations in 2023 adopting airspace assumptions that reflect the airspace before and after the implementation of the AD6 airspace change. This comparison utilises the same fleet mix and number of aircraft operations as actually occurred in 2023. The only difference between the two scenarios is about the routes which reflect the ground tracks and route utilisations before and after the implementation of AD6. Since the two models share a majority of the same modelling assumptions, this comparison is deemed to be the most reliable across the three to present the direct impacts of the AD6 airspace change.

The analysis of this first comparison has shown no discernible differences in terms of population exposed to the L_{Aeq16h} and L_{Aeq8h} noise levels and contour area. Small differences are observed for the N60 metric specifically in locations influenced by easterly arrivals. This is due to the presence of the S3 route in which aircraft coming from the east join the final approach from the south. As the traffic is almost evenly split between the main vector and the S3 route, the N60 rate 5 and N60 rate 10 contours are more pronounced to the south, causing a difference of 2km^2 compared to the pre AD6 scenario.

No significant differences have been found in the overflight comparison between the pre-AD6 and the post-AD6 airspace implementation up to either 1,000ft or 1,640ft which suggests that there are no impacts on both local air quality and biodiversity caused by the implementation of AD6 airspace.

For the other two comparisons, differences in the modelling assumptions are the main factors that contribute to different outcomes when comparing the "do-nothing scenario" and "Option 1A – Final Design in the implementation year" prepared for the Stage 3 FOA and Stage 4 Final Options with the "Option 1A – with AD6 airspace configuration as occurred". During the Stage 3 FOA and Stage 4 Final Options Appraisals different assumptions on the distribution of the traffic on the routes were in fact taken compared to how the traffic was effectively distributed on the routes in 2023. This resulted in different modelling outputs between the scenarios prepared for the FOA and Final Options Appraisal and the scenario considering the airspace as occurred in 2023 rather than effectively a worse outcome.

Based on the environmental analysis that has been carried out for the PIR, it is therefore concluded that there is no significant difference between the pre and post implementation of AD6 for the metrics and thresholds indicated in policy (i.e. 51 dB L_{Aeq16h} and 45 dB L_{Aeq8h}) and no impacts on both local air quality and biodiversity which are caused by the implementation of AD6 airspace.

Annex A – CAA PIR Data Request for impact on environmental factors

		Required for the review?	Format of the data required.	Any information of relevance in support of the request.
Local Air Quality – required where: • there is a change in aviation emissions (by volume or location) below 1,000 feet; and • the location of the emissions is within or adjacent to an identified AQMA.				
a)	Ambient air quality limit concentrations (in µg.m-3).	Yes☐ No☒	Narrative describing impact on AQMA with supporting concentration data (table format).	
b)	TAG Local Air Quality workbook outputs.	Yes☐ No☒	Workbook outputs (table format).	
c)	TAG Air Quality Valuation Workbook outputs.	Yes☐ No☒	Workbook outputs (table format).	
d)	Description of prediction model and version number.	Yes☐ No☒	Narrative.	
e)	Supporting input data (for example movement logs).	Yes☐ No☒	Narrative evidenced by supporting data (table format).	
f)	Aircraft track data to confirm there are no changes below 1,000ft	Yes☒ No☐	Narrative.	
Noise – required where: • There is a change which alters lateral aircraft tracks or dispersion, or changes aircraft height, below 7,000 feet (above mean sea level) over an inhabited area (Level 1).				
g)	N60 (night-time) / N65 (daytime) contours.	Yes☒ No☐	Noise contour figures overlaid on Ordnance Survey maps (or similar).	As noted within the CAA's Annex E Environmental Assessment the TAG assessment reported impacts below the defined LOAEL used for Air Navigation purposes. The PIR assessment should use corrected workbooks for pre and post implementation. Assessments need to consider impacts at both Luton Airport (quantitative) and Stansted Airport (qualitative).
h)	Leq contours (down to 51 dB LAeq,16h / 45 dB LAeq,8h).	Yes☒ No☐	Noise contour figures overlaid on Ordnance Survey Maps (or similar).	
i)	Leq contour population counts (in thousands), area counts (in km2) and noise sensitive area counts.	Yes☒ No☐	Table format.	
j)	TAG Noise Workbook – Aviation outputs.	Yes☒ No☐	Workbook outputs (table format).	
k)	Operational diagrams (for example, radar track diagrams and track density diagrams).	Yes☒ No☐	Operational diagrams overlaid on Ordnance Survey maps (or similar).	
l)	Confirmation of CAA CAP 2091 noise modelling category.	Yes☒ No☐	Narrative.	
m)	Description of prediction model and version number.	Yes☒ No☐	Narrative.	

n)	Description of modelling assumptions, for example modal split, route utilisation and respite.	Yes☒ No☐	Narrative evidenced by supporting data (table format).	
o)	Supporting input data (for example movement logs).	Yes☒ No☐	Narrative evidenced by supporting data (table format).	
Fuel and CO2 emissions:				
p)	Annual fuel and CO_2 usage (tCO2).	Yes☒ No☐	Table format.	Impacts for both Luton Airport and Stansted Airport should be reported.
q)	Per flight fuel and CO_2 usage (tCO2).	Yes☒ No☐	Table format.	
r)	TAG Greenhouse Gases Workbook outputs.	Yes☒ No☐	Workbook outputs (table format).	
s)	Supporting input data	Yes☒ No☐	Narrative evidenced by supporting data (table format).	
t)	Description of prediction model and version number.	Yes☒ No☐	Narrative.	
Tranquillity:				
u)	Operational diagrams clearly identifying AONBs, National Parks, designated quiet areas and any noise sensitive areas identified during Stage 1 (1B Design Principles).	Yes☒ No☐	Narrative and Operational diagrams overlaid on Ordnance Survey maps (or similar).	
Biodiversity:				
v)	Assessment of biodiversity factors including any identified during Stage 1 (Step 1B Design Principles).	Yes☒ No☐	Narrative.	