LADACAN comments on submissions by Deadline 9 IP ref 20040757

Contents

Glossary

19mppa application	Application 21/00031/VARCON on the LBC Planning Portal – submitted by LLAOL to LBC to further increase noise contour limits and the passenger cap
2022 inquiry	Planning Inspectorate Inquiry (ref APP/B0230/V/22/3296455) into the called-in decision by LBC to grant the 19mppa application
Airport	London Luton Airport
Airport Operator	London Luton Airport Operations Ltd, currently the concessionaire at the Airport
Applicant	Luton Rising (London Luton Airport Ltd)
Application	This application TR020001 for a Development Consent Order
Bickerdike Allen	Noise consultants retained by LLAOL to validate and operate its INM noise contour model
CAP1498	'Definition of overflight', CAP 1498, Civil Aviation Authority, 2017
CAA	Civil Aviation Authority
LBC	Luton Borough Council, ultimate owner of and Local Planning Authority for LLA
LLA	London Luton Airport
LLAOL	London Luton Airport Operations Ltd, the operator of LLA
mppa	'million passengers per annum': a measure of an airport's passenger capacity or actual passenger throughput
NMT01-03	Fixed noise monitoring locations around the Airport, 6.5km from start of takeoff roll (informal mobile monitoring is performed for short periods at other locations)
noise contour	An outline on a map enclosing an area in which the 8-hour or 16-hour logarithmic average of aircraft noise for an average day in a defined 92-day summer period equals or exceeds a given value, expressed in terms of LAeq for an 8h or 16h period
Project Curium	Application 12/01400/FUL on the LBC Planning Portal – submitted by LLAOL to LBC in 2012 for development works to increase LLA capacity to 18mppa by 2028

Section 1: LADACAN's comments on the Applicant's REP9-051 submission

Comments use ID and page numbers from REP9-051, and may summarise the concern or response to provide a more manageable format.

I.D	Concerns raised	Luton Rising's Response	LADACAN further comments
2	Table 2.1 Climate Change and Greenhouse Gases [REP8-075] page 12	The Applicant does not agree that there are no measures in that will limit aviation emissions. The Jet Zero Strategy (Ref 1) at page 12 is clear that the Government has set a clear trajectory for the reduction of carbon emissions from aviation and that it will monitor progress against this. The Government is clear that it will monitor progress annually, with a major review of the Strategy every 5 years, and that "If we find that the sector is not meeting the emissions reductions trajectory, we will consider what further measures may be needed to ensure that the sector maximises in-sector reductions to meet the UK's overall 2050 net zero target." The Government has made clear its intention to ensure compliance with the trajectory of carbon reduction identified by the introduction of further measures if necessary, which would include long haul flights as well as flights covered by the UK Emissions Trading Scheme (ETS).	This has been a long-running issue tracing back through REP8-075 p12, to REP7-104 p22, to REP6-133 p4, to REP5-072 p3, to REP4-181 p6, to REP2-061 p21, to REP1-095 p8. The Applicant has consistently evaded one simple point: If in-sector emissions are going to be reduced in line with the Jet Zero Strategy, as the Applicant states, it inevitably follows that UK aviation emissions reduction will have to occur at the level of individual airports, since the aircraft using these airports create the emissions, and therefore the emissions at the Airport will have to reduce in line with that Strategy. Consequently, it would be irrational not to include measures in Green Controlled Growth to ensure that the Jet Zero aviation carbon emissions reduction trajectory is achieved at the Airport, and if there is deviation from that trajectory growth would be paused, consistent with the approach to other environmental impacts. We respectfully urge the ExA to agree that given the lack of clarity over the precise measures by which aviation carbon emissions reduction will be achieved, it would be appropriate as a precautionary measure to ensure that Green Controlled Growth limits future growth to the trajectory necessary to comply with achieving net zero.

I.D	Concerns raised	Luton Rising's Response	LADACAN further comments
3	Table 2.8 Need Case: Demand forecasts [REP8-075] page 15	As stated in Applicant's Response to Deadline 6 Submissions Appendix C – LADACAN [REP7-066] (Response to REP6-136, 2), the carbon costs used in the demand forecasts, as set out in Appendix B to the Need Case [APP-214] trend upwards from the current traded carbon price or CORSIA to the BEIS appraisal values precisely to ensure that they reflect that the rising costs of carbon or its abatement in future. The fact that current prices are below this level reflects the ongoing recovery of many industries post-pandemic. Even if prices are lower in the short-term than assumed in the Jet Zero High Ambition scenario, the amount of carbon emitted by the aviation sector will be subject to 5-yearly review by the Government (Ref 2) and action taken to ensure that the sector is on track to meet carbon targets. Hence, the Applicant does not consider that there is any risk to the demand forecasts nor to the carbon emissions projected in the ES for the Proposed Development [TRO20001/APP/5.01].	The Applicant is clearly confident that there is no risk to the carbon emissions projected in the ES for the proposed development. Therefore the Applicant has no rational grounds to object to including measures in Green Controlled Growth to ensure that trajectory is maintained or that growth is paused if not, in line with similar measures for other environmental impacts. Given the uncertainties inherent in knowing the precise means by which greenhouse gas emissions will be held to within the trajectory set out in Jet Zero, we respectfully ask the ExA to agree that it would be reasonable and precautionary for the Applicant to have included Limits for aviation operations carbon emissions in the Green Controlled Growth suite, and to question why it appears so unwilling to do so.

I.D	Concerns raised	Luton Rising's Response	LADACAN further comments
9	Table 2.8 Need Case: 2019 Baseline [REP8-075] page 13	For the reasons set out in the Applicant's Response to Deadline 6 Submissions Appendix C - LADACAN [REP7-066], the Applicant does not consider it necessary to model the impacts of the Proposed Development against a baseline of less than 18 mppa. This would not alter the assessment of the impacts between the With and Without Development Cases. The Without Development Case is compliant with the consented baseline in all assessment years.	The Applicant has not addressed the original point. Unless the Without Development case is correctly modelled using less than 18mppa for 2019, it will not accurately reflect the impacts across all areas including surface transport. Having some 20% less passengers in 2019 than the Applicant has modelled would inevitably reduce other baseline impacts, such as the loading on the surface transport network, so those baselines should also have been derived from a more realistic Without Development model than the Applicant has used. We respectfully ask the ExA to assess whether the evidence it has been given takes account of this point.
5	Table 2.9 Noise and vibration [REP8-075] page 6	LADACAN provided their 2019 92-day data for NMT01 and NMT02 and it was found that the SEL 50th percentile data was within 0.1dB of the Applicant's validation data. The exception to this was A321Neo departures measured at NMT01, which was within 0.3dB. Comparison of LADACAN's LASmax data with validation data also provided a strong correlation, with the biggest difference being 0.2dB. As such, it is unclear what LADACAN are referring to when they identify "differences of 0.5dB".	REP9-081 provided additional clarification subsequent to the brief comment in REP8-075, following further data analysis. To summarise: a) We are unclear why the Applicant only used 92-day data from the fixed monitors to validate the contour model, when hitherto Bickerdike Allen has used annual data to validate the INM model, therefore we tested the LASmax data for the 2019 full year against the Applicant's data b) We have further investigated the reliability of the mobile monitoring data used by the Applicant to assess its model and have concerns over the reliability of that data. These are further evidenced below (see Section 2) regarding elevation angles, and out of courtesy we communicated this intention to the Applicant at 10:00 on Friday 2nd Feb

I.D	Concerns raised	Luton Rising's Response	LADACAN further comments
6	Table 2.9 Noise and Vibration [REP8-076] page 1	The Applicant has addressed the topic of shoulder period movement limits in Applicant's Position on Noise Contour & Movement Limits [TR020001/APP/8.184]	Please see our response to the Applicant's Position Paper on Noise Contour & Movement Limits in Section 3 below.

Section 2: LADACAN's further concerns regarding noise contour modelling

Confirmation of flight representations on Travis

A representative of LADACAN recently visited the garden of a property in South Luton at the invitation of the residents, who had reported being concerned that the flight path had changed and aircraft were now flying closer to their home. Their garden had been used by LLAOL for community noise monitoring during 2022. The focus of the visit was on establishing whether the position of the aircraft in the sky tallied with the tracks shown on Travis, the web-based public-facing interface to LLAOL's noise and track keeping system Tanos. Travis can be accessed at https://travisltn.topsonic.aero/

An observation point was chosen such that the flights at point of closest approach passed directly above or behind a tall straight tree in the garden and the geometry of two reference flights which just grazed the top of the tree were investigated in detail. The height of the observation point above sea level was found from https://tessadem.com/ which gives map-based access to TessaDEM, a near-global Digital Elevation Model (DEM) with vertical accuracy specified as 2 meters or better for 58% of the data. Its local accuracy was confirmed by obtaining the elevation of the centre of the Luton Airport runway, which is correctly reported as 160m.[1] The angle of elevation of the top of the tree was found using a 1.5m sighting pole with a plumbline. The altitude and distance of the reference flights were interpolated from the 2D view provided by Travis. The observations confirmed that Travis does appear to represent the locations and altitudes of the flights in a way consistent with the elevation angle from the ground.

The survey described above drew attention to the elevation angles of flights from monitoring positions used by LLAOL for its Community Noise Reports (CNRs), which were referred to in REP9-081 section 2. Visiting this location also revealed that there is a tall substantial tree in the line-of-sight to the aircraft transits, behind which most flights pass – see photograph. We therefore reassessed the other locations near the airfield upon which the Applicant had relied for noise contour validation data.

Elevation angles from CNR noise monitoring locations

Two locations are of particular concern: LTN_SLTN and LTN_BG (using the references from REP7-013).

LTN_SLTN

The owner of the property used for monitoring has been in regular contact with LADACAN for some time and has kindly provided photographs of the garden in which the monitor was placed.

Panoramic 180° curved view from the location of the monitor towards the direction of aircraft transits.

[1] Wikipedia puts the runway elevation at 160m, NATS reference information for EGGW puts it at 160.6m

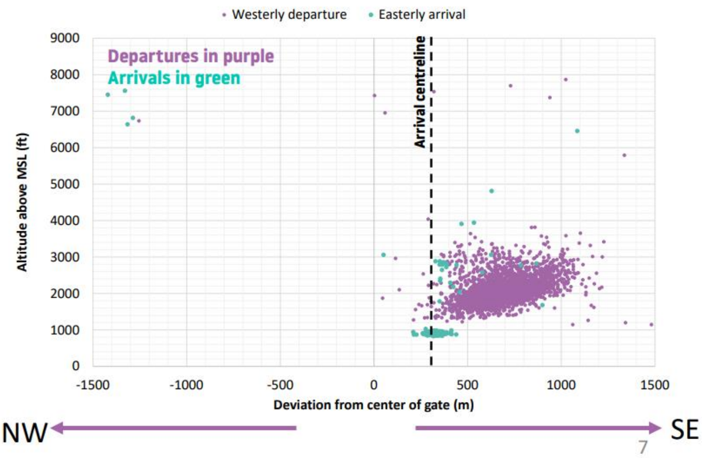
Above: Normal view showing the school building which bounds the garden to the south in the direction of aircraft transits. The resident has advised that this is a 3-storey building.

Above: Normal view showing the location of the noise monitor on the north side of the 6m wide garden opposite the school building wall.

Below: image from Google Maps showing the monitoring location and school building.

Altitude Analysis During Monitoring Period

The altitude analysis for South Luton shows the vertical and lateral dispersion of aircraft 1.5km either side of the noise monitor. The map below shows the 3km gate which is drawn across perpendicular to the NPRs from north-west to south-east and will gather information about every aircraft passing through the gate area. The scatter graph below shows the distance and altitude of aircraft from the noise monitor during the monitoring period. The westerly noise preferential routes (NPRs) and the easterly arrival route are displayed by the shaded area. Departing aircraft must remain within the NPR until reaching release altitude of 3,000ft during the day or 4,000ft at night (4,000ft at all times for Match route). Due to the close proximity of South Luton to the airport, local residents may see aircraft flying near South Luton at a low altitude.



The information above from page 7 of the LLAOL 2019 South Luton CNR corresponding to the LTN_SLTN monitoring used by the Applicant confirms:

a) That arriving aircraft at this location are typically between 800 and 100ft in altitude
b) That the distance from the monitor to the northernmost spread of arrival flight tracks measured perpendicular to the departure Noise Preferential Route is of the order of 300m
c) That departing aircraft can be as low as 1400ft, though the majority are at 2000-2500ft

To assess the elevation angle of arriving flights a more accurate distance to the arrival swathe is needed: This can be found from Google maps, measuring distance from the monitoring location to the extended runway centreline, which is some 260m and less than the 300m indicated in the CNR for reasons stated. The width of the arrivals swathe perpendicular to the arrivals centreline is taken as roughly 200m.

The topographical map shows the elevation of the monitoring location as 162m, to which we add 2m to account for the height of the monitoring tripod mast. Distances in meters are converted to feet and the elevation of the monitor is subtracted from the altitude of the aircraft to enable the spread of elevation angles in degrees to be calculated using simple trigonometry. Results are shown below for arrivals:

LTN_SLTN 162m asl	**260m N of Arr c/line**	Aircraft distance	Aircraft altitude	Elevation angle
North edge of swathe		525	800	27
North edge of swathe		525	1000	41
South edge of swathe		1181	800	13
South edge of swathe		1181	1000	21
Centre of swathe		853	900	23

The results show a 3:1 variation in elevation angle for the arrivals passing the monitoring location, due to lateral offset from the swathe and variation in aircraft position and altitude.

A 2m high mast looking across a 6.1m garden at 23° elevation would reach 8.5+12=21ft high, less than the 3-storey building wall.

The centre-of-swathe value of 23° is well below what the CAA considers reliable in noise measurement[2]. However, as the photographs show, the location is unsuitable for reliable aircraft noise monitoring in any case given the proximity of the adjacent tall building and vegetation in line of sight to the flights.

[2] CAA CAP 1498 "Definition of overflight" identifies factors which affect noise readings taken at reducing elevation angles. At 60° aircraft are approximately 1.5dB quieter than when directly overhead; at 48.5°they are some 3dB quieter. At elevation angles lower than 35° lateral attenuation, due to atmospheric scattering, engine shielding and ground absorption, increases dramatically. See Annex A for relevant extracts.

For departures passing the LTN-SLTN monitor, the distance to the centre of the swathe from the CNR scatter graph on p7 is 700m. Aircraft altitudes vary from 1200-3000ft (outliers above this are likely to be less noisy business jets). The departure swathe width is some 800m. Elevation angles are shown below:

LTN_SLTN 162m asl	**700m N of Dep c/line**	Aircraft distance	Aircraft altitude	Elevation angle
North edge of swathe		984	1200	34
North edge of swathe		984	3000	68
South edge of swathe		3608	1200	10
South edge of swathe		3608	3000	34
Centre of swathe		2296	2100	34

The results show a 7:1 variation in elevation angle for departures passing the monitoring location, due to lateral offset from the swathe and variation in aircraft position and altitude.

A 2m high mast looking across a 6.1m garden at 34° elevation would reach 13.5+12=26ft high, less than the 3-storey building wall.

The centre-of-swathe value of 34° is at the threshold below which the CAA advises noise measurement would increasingly be affected by lateral attenuation, which means all the aircraft at lower elevations due to distance and/or reduced altitude, would be affected by variable and increasing attenuation.

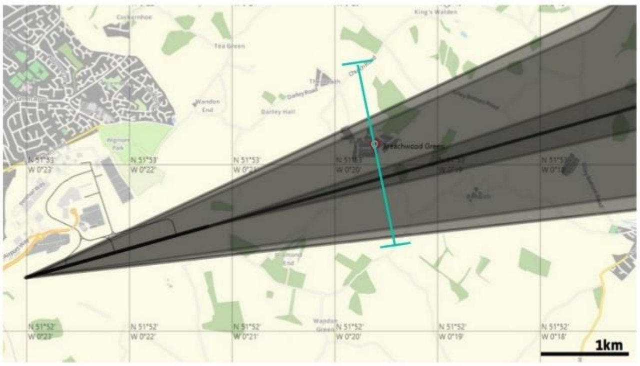
Furthermore, as in the case of arrivals, it would appear that the majority of flight transits would pass behind the adjacent building and therefore be subject to further indeterminate attenuation and/or scattering.

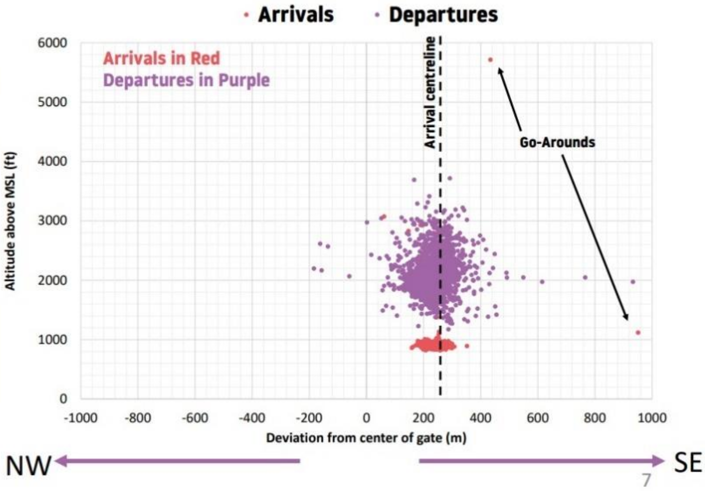
LTN_BG

A resident of Breachwood Green who lives close to where the 2019 monitoring was performed has advised LADACAN of the precise location, which enables a similar analysis to be conducted.

Altitude Analysis During Monitoring Period

The altitude analysis for Breachwood Green shows the vertical and lateral dispersion of aircraft 1km either side of the noise monitor. The map below shows the 2km gate which is drawn across perpendicular to the runway centreline from north-west to south-east and will gather information about every aircraft passing through the gate area. The scatter graph below shows the distance and altitude of aircraft from the noise monitor during the monitoring period. The noise preferential routes (NPRs) and the westerly arrival route are displayed by the shaded area. Departing aircraft must remain within the NPR until reaching release altitude of 3,000ft during the day or 4,000ft at night (4,000ft at all times for Match route). Due to the close proximity of Breachwood Green to the airport, local residents may see aircraft flying near Breachwood Green at a low altitude.





The information above from page 7 of the LLAOL 2019 Breachwood Green CNR corresponding to the LTN_BG monitoring used by the Applicant confirms:

a) That arriving aircraft at this location are typically between 800 and 100ft in altitude
b) That the distance from the monitor to the northernmost spread of arrival flight tracks measured perpendicular to the centre line is of the order of 240m
c) That departing aircraft can be as low as 1400ft, though the majority are at 1800-2400ft

The width of the arrivals swathe perpendicular to the arrivals centreline is taken as roughly 160m.

The topographical map shows the elevation of the monitoring location as 149m, to which we add 2m to account for the height of the monitoring tripod mast. Distances in meters are converted to feet and the elevation of the monitor is subtracted from the altitude of the aircraft to enable the spread of elevation angles in degrees to be calculated using simple trigonometry. Results are shown below for arrivals and for departures:

LTN_BG 149m asl	**240m N of Arr c/line**	Aircraft distance	Aircraft altitude	Elevation angle
North edge of swathe		525	800	30
North edge of swathe		525	1000	44
South edge of swathe		1050	800	16
South edge of swathe		1050	1000	26
Centre of swathe		787	900	27

The results show a 2.75:1 variation in elevation angle for the arrivals passing the monitoring location, due to lateral offset from the swathe and variation in aircraft position and altitude.

LTN_BG 149m asl	**240m N of Dep c/line**	Aircraft distance	Aircraft altitude	Elevation angle
North edge of swathe		394	1400	66
North edge of swathe		394	3000	81
South edge of swathe		1181	1400	37
South edge of swathe		1181	3000	65
Centre of swathe		787	2200	65

The results show a 2:1 variation in elevation angle for the departures passing the monitoring location, due to lateral offset from the swathe and variation in aircraft position and altitude.

As for LTN_SLTN, the centre-of-swathe elevation angle of 27° for arrivals is well below what the CAA considers is necessary for reliable noise measurement. The vast majority of arrivals noise measurements would be affected by lateral attenuation of varying degrees.

Departures passing LTN_BG are less affected unless at the southern edge of the swathe and/or at low altitudes. Nevertheless, the vast majority is below 60°, the elevation angle above which attenuation due to distance can be ignored.

Conclusions regarding reliability of monitoring information

Whilst we understand that noise modelling software is able to an extent to take account of laterally displaced noise measurements, the evidence provided above indicates that informal noise monitoring of the kind produced by LLAOL staff who are non-acousticians can be worthless for noise model validation.

In the case of the 2019 LTN_SLTN monitoring, line of sight from the noise monitor to both arriving and departing aircraft was in the most part blocked by a substantial building of which the noise model would have no knowledge. The significant variation in elevation angle would mean very significant variation in distance attenuation, lateral attenuation and scattering rendering either arithmetic averaging of results or 50th percentile values difficult or impossible meaningfully to accommodate and correlate with output from the model. This would no doubt explain why the Applicant's noise experts were unable to resolve the mismatch between predicted and measured results for South Luton (REP9-017, Section 6.10).

In the case of the 2019 Breachwood Green monitoring, a clear line of sight is available but the angle of elevation of arrivals is below the CAA threshold for 3dB distance attenuation and in more than half of cases also below the 35° threshold at which lateral attenuation and scattering increases rapidly.

The Applicant chose not to include the LTN_SLTN results in the validation due to the anomalies. We have now explained the cause of the consistent over-prediction – essentially it results from under-measurement of the noise impacts. However the Applicant has included the LTN_BG measurements even though they are affected by some of these issues on Arrivals and may also be unreliable.

Effect on the noise model validation and Limits

The Application is for a major development of the capacity at LLA, with significantly increased annual flight movements, particularly at night, and overall an increase in the impacts of noise at night.

An essential aspect of noise modelling close in to the Airport is to validate the departure profiles which are assigned to aircraft types in order that predicted noise close in correlates to measured noise close in, since these are the area where the noise contours have an effect on ES assessment of impacts, and on the modelling of contour values for the Limits to be applied in Green Controlled Growth.

If the noise model over-predicts, the ES effects appear larger but the Limits are more accommodating.

If the noise model under-predicts, the ES effects appear smaller, but the Limits are comparatively more strict.

By simply omitting the key LTN_SLTN noise monitoring due to anomalies which apparently could not be resolved by the noise experts of the Applicant or of LLAOL (REP9-017, paragraph 6.10.3) key uncertainty arises – yet a visit to survey the monitoring site would have revealed the cause exactly as we have done above. A further and more competent noise survey could then have been conducted.

As it is, due to the rush with which the Applicant has approach this key exercise, the noise monitoring is substandard and the noise modelling is not able to be relied on with adequate certainty. We invite the ExA to take the view that in the absence of adequate information it is inappropriate for the Applicant simply to have omitted LTN_SLTN data from the validation, and that as a result it is quite possible that the model is over-conservative, over-predicting, and hence the Limits are over-lenient.

As we have suggested, it would be appropriate under the circumstances to revalidate the model using more reliable data. Extensive monitoring was carried out in South Luton during 2022 from a somewhat less compromised location in Cutenhoe Road. By our calculations this is marginal to acceptable from the perspective of elevation angles, but aircraft transits were not sheltered by a solid brick building, merely a coniferous tree. We ask the ExA to request such re-validation based on 2022 noise measurements.

Available 2022 monitoring reports (in addition to the annual data from NMT01 and NMT02:

Caddington November – December
Dagnall May – June
Harlington May – June
Hitchin Mar - May
Kensworth October - December
Redbourn June – September
Shefford April – July
South Luton January – May
South Luton June – October
Stagenhoe May – June
St Albans (Jersey Farm) June - September
Flamstead and Cheverell's Green June – October

(source: LLAOL website at: https://www.london-luton.co.uk/corporate/community/noise/community-noise-reports)

(The period of Noise Abatement trials would have to be ignored – as far as we know it was 1 month)

Section 3: LADACAN's comments on the Applicant's REP9-055 submission

We comment by reference to section numbers in REP9-055.

4.1.1 We find the Applicant's arguments bizarre in the following respects:

a) airline refleeting decisions will be unaffected by whether or not LLA has a movement cap – as the Applicant has previously suggested, airlines will move their business to suit their commercial objectives.

b) whilst the Applicant may prefer simply a noise contour limit, its Noise Envelope Design Group did not, for good reasons which it documented.

c) the Applicant states that a noise contour Limit addresses the effects of growth: it does not. It is one means, but an incomplete means as we have previously indicated, because it gives no information about numbers of aircraft noise events, no information about the mix of louder or less loud noise events, and no granularity of information about when they occur.

d) the Applicant only has regard to what it describes as beneficial growth, and takes little or no regard in this position paper or elsewhere to the impacts of harmful growth particularly where that causes additional flights which cause health harms in the sensitive ate evening, night and early morning periods.

4.1.2 The annual limit proposed by the Applicant should instead be the Core Growth limit.

4.1.3 The Applicant is acknowledging here the inherent uncertainty in fleet mix forecasting, yet has dismissed previous suggestions by the Harpenden Society (for example) that the fleet forecasts may not match the future fleet makeup of major airlines using LLA.

4.1.5 The Applicant proposes that an equally possible scenario is next generation aircraft being smaller with lower seat capacities. In that scenario, many more slots would be required, and flight times may encroach further into the night period due to the runway capacity limits being reached in the early morning shoulder departure period. This underlines the need for more protection of the sensitive shoulder and night periods, not less. That is not to say additional aircraft couldn't be accommodated during the day, since of course the smaller aircraft would likely have reduced range and therefore not be flying such long stages. However, the Applicant has failed to evidence whether the use of such aircraft, in potentially greater numbers than new generation aircraft, would actually reduce emissions, since the landing and takeoff cycle is emissions intensive so the more flights the worse the emissions budget is likely to be.

5.1.1 A morning shoulder cap of 7,000 movements annually is already in place as a result of Project Curium for the purpose of protecting residential amenity. The 8-hour contour limit provides no granularity of control during the sensitive night period, as indicated under 4.1.1(c) above. The unfettered freedom for airlines to respond to the market during the night period would clearly have an adverse impact on noise and health which a contour area simply cannot and does not control, and does not constitute sustainable nor responsible growth. The Applicant has already proposed to increase night flights by 70% and this is regarded by communities as unacceptable.

5.1.3 LADACAN's proposal was measured, conciliatory and based on evidence from consultation. It is improper for the Applicant to describe is as arbitrary: it reflects the approach which the NEDG should have taken, namely to start by agreeing the scope of the noise impacts.

5.2.2 The Applicant provides no evidence to substantiate its assertion that the proposal to cap the number of flights in the noise-sensitive shoulder periods would fundamentally constrain growth. It merely speculates in 5.2.9 - 5.2.12 based on current airlines current models, whilst having also acknowledged as indicated above that there is uncertainty in forecasting.

5.2.6 The Applicant seeks to justify its position by referring to the claimed importance of business flights, yet its proposal foresees the elimination of business aviation at LLA and the transfer of business slots to commercial airlines.

5.2.7 See response to 5.2.6.

5.4.2 Making Best Use does not, as we have represented from the start of this Examination, give carte blanche to aviation expansion proposals. Neither does it or any other government policy we are aware of condone such aggressive aviation expansion that planning conditions are breached, as has happened at LLA in recent years, at the behest and financial incentivisation of the Applicant. As a result, LLA is the only major UK airport to have breached its noise planning conditions, and no enforcement action has been taken. We suggest to the ExA that adequate protection of the sensitive night period is essential, and that a noise contour even if supported by a quota limit does not provide adequate protection for those living closest to the Airport or for those in the wider area who would be at increasing risk of being awoken by individual aircraft movements.

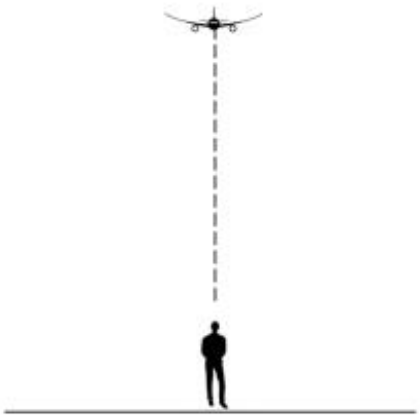
Annex A – extracts from CAP 1498

Development

Definition based on perception

3.4 To date, overflight has been assessed to be when an aircraft passes directly over the observer, see Figure 6. This has been calculated using the grid method described in Chapter 2.

Figure 6: Overflight assessed as aircraft passing directly over the observer



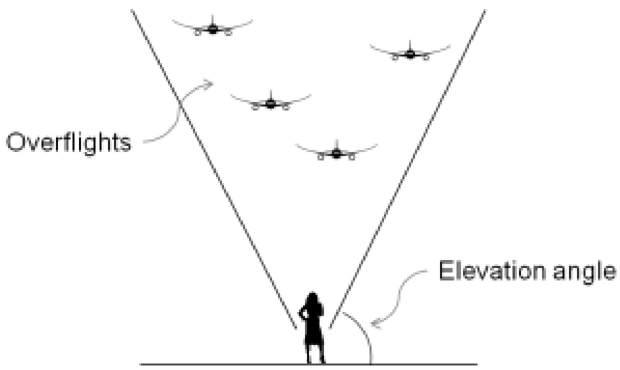
3.5 However, we understand that an aircraft does not have to be directly overhead to be considered an overflight by a person on the ground, see Figure 7. Feedback from residents affected by recent SID trials at the London airports has highlighted the difficulties in determining whether an aircraft is considered to be overhead or to the side of its expected flight path.

Figure 7: An aircraft not directly overhead still being considered an overflight

3.6 An illustrative example arose during helicopter monitoring for the Greater London Council (GLC) in the 1980's and refers to monitoring of routine helicopter flights in central London that were required to navigate along the river, as today. Analysis of logs showed that observers on both the north and south banks of the river reported the same aircraft had overflown them, but the aircraft could not have been directly above both banks at the same time.

3.7 To accommodate this, we propose to define overflight so as to include aircraft that pass above and to the side of an observer. The distance that an aircraft can be to the side and still be considered an overflight will be set using a threshold on the elevation angle of the aircraft. Figure 8 below illustrates this. The elevation angle is the angle between the ground and the aircraft as seen from the observer at ground level. An aircraft flying directly overhead would be at an elevation angle of 90°, and an aircraft on the ground would be at an elevation angle of 0°.

Figure 8: Overflight when an aircraft passes an observer above an elevation angle threshold



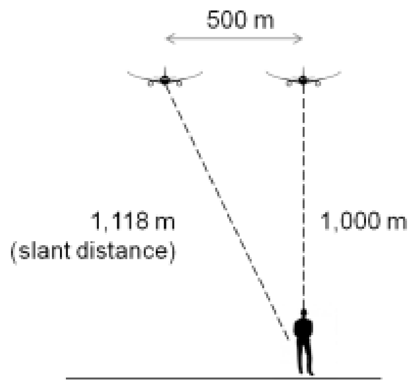
3.8 This accommodates the perception that an aircraft is overhead even when it is above and to the side (lateral) of an observer. Anecdotal evidence (see paragraph 3.6) suggests that the visual location of an aircraft in the sky is a part of how an observer decides whether an aircraft is overflying them. By basing the threshold on an elevation angle, aircraft at higher altitudes may be at greater lateral distances and still be considered overflights. This meets the second criterion listed earlier, that the metric

represents the experience of residents affected by noise from aircraft flying nearby.

3.9 The third criterion is that the definition should **relate to aircraft noise levels**. To meet this, our view is that for an observer on the ground, the noise produced by an overflight should be within a known range.

3.10 The distance between the aircraft and the observer is called the propagation distance. The greater the propagation distance, the further the sound has to travel, getting weaker in the process. For an aircraft overflying an observer at a given altitude, say 1,000 m (3,280 feet), the shortest propagation distance between the aircraft and the observer (known as the slant distance) occurs when the aircraft is directly overhead, i.e. 1,000 m. If the aircraft is 500 m to the side of the observer, the distance between the aircraft and the observer increases to 1,118 m. The extra 118 m (12%) added to the propagation distance results in a reduction in the maximum sound level of 1.3 dB. This is illustrated in Figure 9 below.

Figure 9: Illustrating effect of lateral distance on slant distance and noise level at the observer



3.11 In the example above, the elevation angle of the aircraft at 1,000 m altitude and 500 m lateral distance is 63°. If the aircraft was at 2,000 m altitude and 1,000 m lateral distance, the elevation angle would also be 63°, and again, the noise level at the observer aircraft would be 1.3 dB less than if the aircraft was directly overhead at 2,000 m altitude. In other words, compared to an aircraft flying directly overhead, the reduction in noise at the observer is constant for a constant elevation angle, no matter the altitude of the aircraft.

3.12 This means that we can define overflight to be when an aircraft passes by an observer at an elevation angle above a threshold angle. This definition relates to aircraft noise levels, and we think that this will better represent the experience of residents affected by noise from aircraft flying nearby than the metrics currently in use.

Elevation angle threshold

3.13 Having established that elevation angle is an appropriate parameter for the threshold, we now need to determine a suitable threshold elevation angle. In our recent work[8] to revise our guidance on the airspace change process, we have started using this concept with two trial elevation angle thresholds: 60° and 48.5°. These are discussed below.

3.14 Above elevation angles of 60°, aircraft sound is influenced by the propagation distance, the amount of sound generated by the aircraft and, for some noise metrics[9], the duration of the sound.

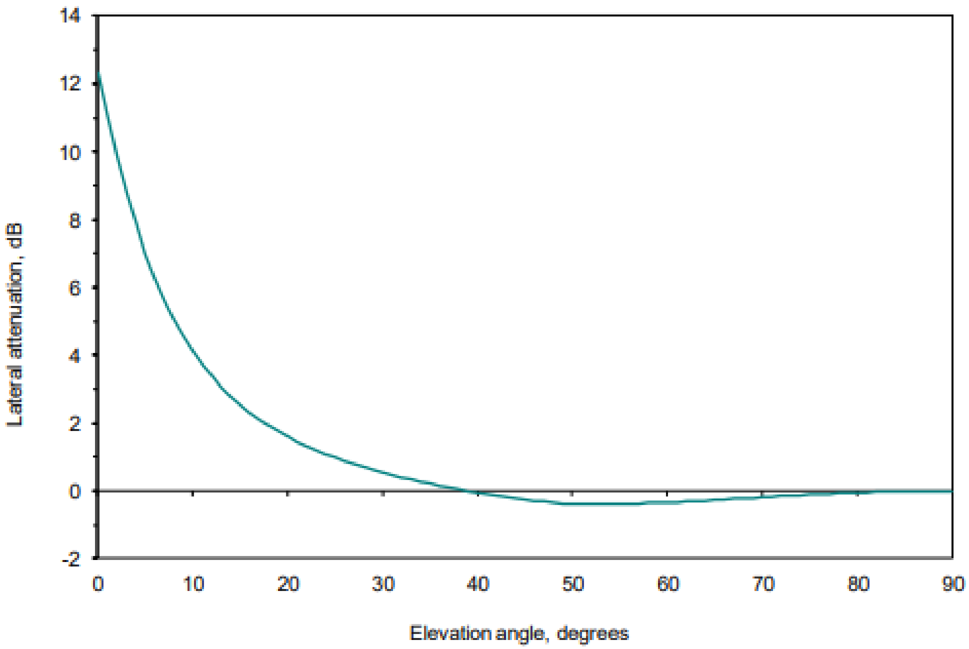
3.15 Below elevation angles of 60° the sound propagation begins to be influenced by additional factors such as atmospheric scattering effects, engine shielding (which is also influenced by engine type/location) and, at lower elevation angles, ground absorption. All these effects are collectively known as lateral attenuation.

3.16 Figure 10 shows the effect of lateral attenuation for aircraft with wing mounted engines. At elevation angles below approximately 60°, lateral attenuation starts to become important; noise attenuation is reduced (i.e. observer noise levels increase) by up to around 0.5 dB between 40° and 60°. Below about 35°, lateral attenuation increases dramatically, reducing noise levels at a given observer location.

8 CAP1378: Airspace Design Guidance: Noise Mitigation Considerations when Designing PBN Departure and Arrival Procedures, Civil Aviation Authority, April 2016.

9 Exposure noise metrics such as SEL and L_{eq} depend on not just the level of the noise, but also how long the noise is heard for by an observer.

Figure 10: Attenuation of noise from aircraft with wing-mounted engines vs elevation angle (source, SAE International AIR-5662)



3.17 By using a threshold elevation angle of 60° we can avoid the added complications of these effects. More information is given in a study we reported in 2003[10].

3.18 Following our explanation in paragraph 3.11, an aircraft flying through the boundary of the 60° elevation angle threshold at any given height above the ground would give a noise level approximately 1.5 dB lower than if it had flown directly overhead at the same height.

3.19 It is widely accepted in the environmental acoustics profession that 3 dB is the smallest difference between two noise levels that the average person can perceive when the noises are not heard one immediately after the other. This is stated in former planning policy guidance[11] which set quantified guidelines on the acceptability for residential development of sites exposed to noise from existing sources. A threshold based on the

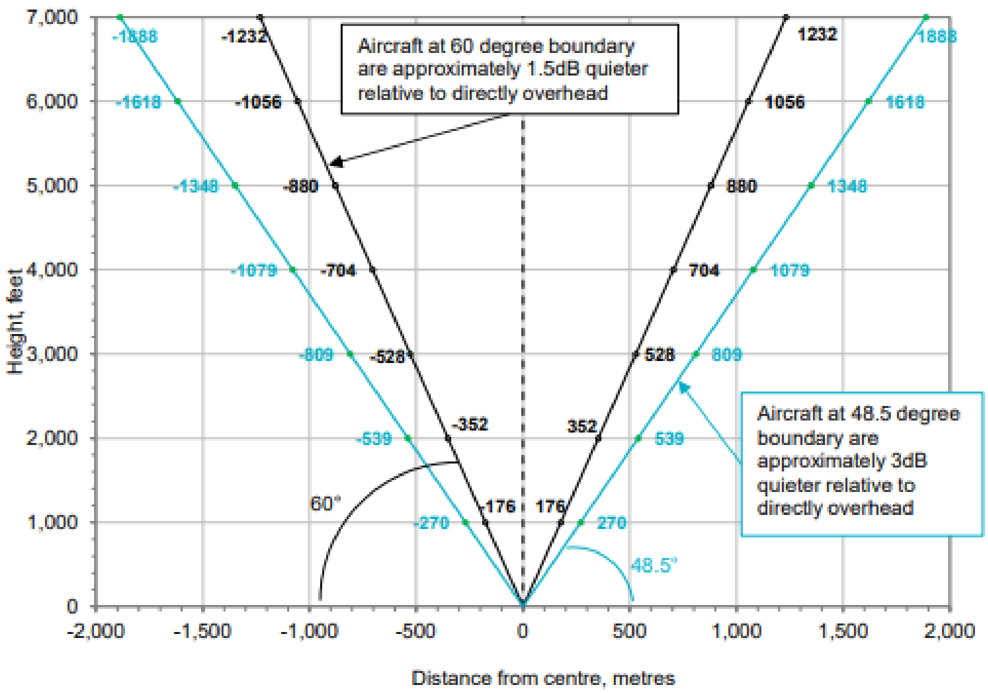
[10] ERCD Report 0207, 'Departure Noise Limits and Monitoring Arrangements at Heathrow, Gatwick and Stansted Airports', March 2003.

[11] Planning Policy Guidance 24: Planning and Noise, Department for Communities and Local Government, ISBN 9780117529243, October 1994.

smallest perceptible difference between noise levels is attractive from a noise perspective. For an aircraft to give a noise level approximately 3 dB lower than if it had directly overflown the centre at the same height, it would need to be at an elevation angle of 48.5°.

3.20 The 60° and 48.5° thresholds are illustrated in Figure 11. For a 60° elevation angle threshold, an aircraft at a height of 2,000 ft and located, for example, 400 m laterally would not be considered overhead. However, at the same lateral distance an aircraft flying at 3,000 ft would be considered overhead. Using a 48.5° threshold, the aircraft would be considered overhead in both the above examples. However, if it were at a height of 1,000 ft at the same lateral distance, it would not be considered overhead.

Figure 11: Lateral distance and altitude of aircraft on 60° and 48.5° elevation angle thresholds



3.21 This concept could be used for aircraft at any altitude. As the standard noise contours for assessing airspace change are affected by aircraft at altitudes of only a few thousand feet, this concept could be applied to aircraft and, importantly, locations outside the standard noise contours. This way, the definition meets the fourth criterion to **represent the interests of those affected by overflying aircraft whether they live inside or outside of the standard noise contours**.

3.22 Figure 11 shows this concept being used for aircraft at altitudes up to 7,000 ft. According to the ANG[12], this is the highest altitude for which noise management is prioritised above or equal to greenhouse gas emissions. At the same time, noise takes ultimate priority over emissions up to 4,000 ft, so this may may also be used as a threshold.

3.23 We will therefore take the elevation angle threshold concept forward using threshold angles of 60° and 48.5° and altitude cut-offs of 4,000 and 7,000 ft.

Illustration and quantification of overflights

3.24 Anyone with access to radar data who wishes to illustrate numbers of overflights on a map would need to be able to use computer modelling to consistently and reliably simulate what happens in the real world. In this section we develop the elevation angle concept to enable a computer programmer to write software to calculate numbers of overflights and illustrate these on a map.

3.25 So far we have discussed the elevation angle thresholds in two-dimensions. Since we live in a three-dimensional world, we need to adapt the concept to also work in three-dimensions. We therefore turn the flat triangular boundaries shown in Figure 11 into a cone, see Figure 12 below.

12 Guidance to the Civil Aviation Authority on Environmental Objectives Relating to the Exercise of its Air Navigation Functions, Department for Transport, 2014.