Swanwick Airspace Improvement Programme Airspace Deployment 6, (SAIP AD6) ACP-2018-65

Proposed changes to

London Luton Airport Arrivals

Airspace Consultation Document

Photo © Graham Custance

Unclassified

Issue 1.1

Roles

Action	Role	Date
Produced	Airspace Change Specialist NATS Airspace and Future Operations	19/10/20
Reviewed Approved	Airspace and Noise Performance Manager London Luton Airport	19/10/20
Reviewed Approved	Airspace Delivery Manager NATS Swanwick Development	19/10/20
Reviewed Approved	Operations Director London Luton Airport	19/10/20

Drafting and Publication History

Issue	Month/Year	Changes this issue
1.0	9/2020	Published on CAA portal
1.1	1/2021	Minor typo correction on p.46. Table corrected on p.E-10. All changes highlighted in cyan.

References

Ref No	Description	Hyperlinks
1	SAIP AD6 CAA web page – progress through CAP1616	Link to portal
2	Stage 1 Statement of Need	Link to document
4	Stage 1 Assessment Meeting Minutes	Link to document
5	Stage 1 Design Principles	Link to document
6	Stage 2 Design Options	Link to document
7	Stage 2 Design Principle Evaluation	Link to document
8	Stage 2 Initial Options Appraisal and Safety Assessment	Link to document
10	Stage 3 Consultation Strategy	Link to portal, please navigate to Step 3b
11	Stage 3 Full Options Appraisal	Link to portal, please navigate to Step 3b
12	Airspace change: Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information CAP1616	Link to document
13	Environmental requirements technical annex CAP1616a	Link to document
14	Definition of Overflight CAP1498	Link to document
15	Airspace Modernisation Strategy AMS CAP1711	Link to document
16	UK Government Department for Transport's 2017 Guidance to the CAA on its environmental objectives when carrying out its air navigation functions, and to the CAA and wider industry on airspace and noise management (abbreviated to ANG2017)	Link to document

Contents

1. Executive Summary

1.1 This consultation is about a proposed change to the flightpaths of aircraft arriving at London Luton Airport (LLA).

1.2 It is sponsored jointly by NATS and LLA. NATS provides air traffic services at the airport itself and for the wider air route network across the country and LLA is responsible for the lower level arrival routes.

1.3 Air traffic control in the London region is complex, especially for aircraft arriving at LLA and London Stansted Airport because they are geographically close to each other. The current airspace design has been fundamentally unchanged in decades, since before the low-fare carrier expansion at both airports and their associated subsequent growth. It forces LLA and Stansted, which are two of the five busiest airports in the UK, to share the same arrival flows, in a relatively small region north of London (if combined, the figures for LLA and Stansted would make it the second busiest in the UK).

1.4 The more complex the airspace, the greater the need for the airborne holding of arrivals when it gets busy, delaying and disrupting the travelling public.

1.5 Controllers take each aircraft from the shared flows towards the destination airport, descending them safely to their respective runways. This can be an intense task and is unique in the UK; arrival flows to most busy airports are separated, by airspace design, higher and further away.

1.6 LLA's and Stansted's arrival flows are shared until aircraft descend through c.8,000ft (around 25 miles from the airport), which is comparatively close and leaves little room for controllers to operate. Any arrival delay or disruption at one airport causes unnecessary arrival delay to the other, because the flows are so closely shared.

1.7 During periods where the workload of our air traffic controllers is predicted to become too intense, safety dictates that we apply temporary limits (known as flow restrictions) to the numbers of aircraft that a controller can manage, before safe limits are exceeded. This causes delay to the travelling public (at both LLA and Stansted), and is a short-term, temporary solution to the underlying problem.

1.8 We have identified that, unless we do something now, the intensity of air traffic control workload may become unsustainable for air traffic controllers in the longer term. This would make arrival delays and airborne holding more common, creating increased environmental impacts - including the aviation fuel burnt and greenhouse gases, such as CO_2.

1.9 The amount of air traffic has been impacted by the 2020 coronavirus pandemic, but the need to change the design of this airspace remains. We must ensure it is fit for purpose when traffic recovers to pre-pandemic levels, and we must allow for future growth.

1.10 We propose to reduce this complexity by moving LLA's arrival flightpaths, leaving Stansted's arrival flows unchanged. This would reduce air traffic controller workload because the arrival flows to each airport would be separated further out and higher up, assuring a safe and efficient operation for the future.

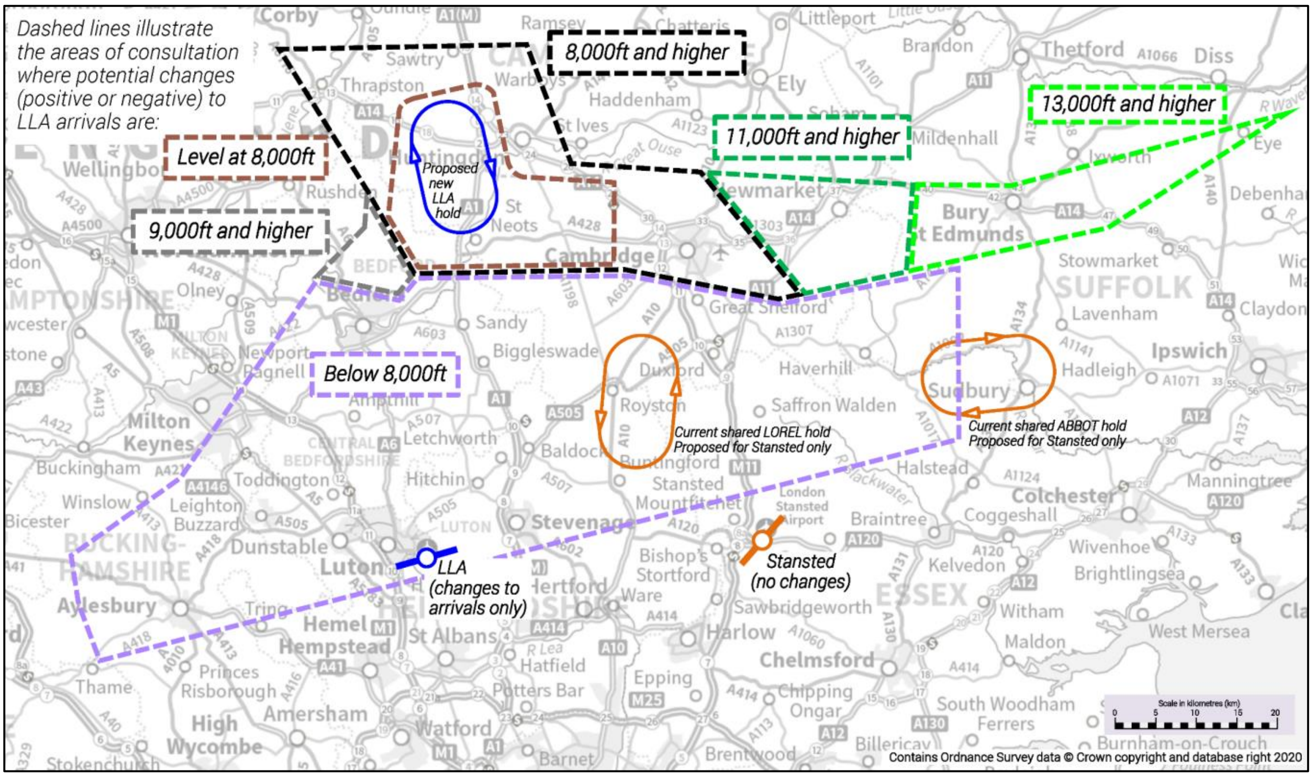
1.11 We are not proposing any change to the way aircraft depart from LLA, nor would there be changes to the way Stansted arrivals and departures fly under this proposal.

1.12 Within this consultation we have described the impacts of no-change, and two options for airspace change to address the complexity issue.

1.13 The first option seeks to establish a new airborne hold, or stack, for LLA arrivals, with associated airspace and air routes, above approximately 8,000ft. From that new hold, the method air traffic controllers use to bring arrivals from 8,000ft to the runway would be similar to today – providing each aircraft with heading, descent and speed instructions, manually managing each flight (known as vectoring). This reduces complexity and minimises the change from today's flightpaths at lower altitudes.

1.14 The second option also seeks to establish a new airborne hold, or stack, for LLA arrivals, with associated airspace and air routes, at 8,000ft and above. From that new hold, air traffic controllers would still use the vectoring method described in the first option, to descend aircraft to the runway. However, there would also be a number of predetermined arrival flightpaths which aircraft could fly automatically and without intervention by controllers. These predetermined arrival flightpaths would reduce air traffic complexity even more than the first option, making this our preferred option.

1.15 The areas for consultation are shown below:



1.16 If we were to do nothing, the current situation can be managed safely in the short term, however this would not be sustainable once traffic grows beyond pre-pandemic levels. There is the potential for a reduction in safety as a result of increased arrival delay if we were to do nothing. We must be prepared for those levels of traffic, and airspace changes such as this take time to progress.

1.17 We have described the no-change option solely as a baseline for comparison, between the proposed options and what happens today, so that you can determine if you will experience any change.

1.18 Consultation is an essential part of the airspace change process. It allows us to explain our proposal in a fair, transparent and effective way, and gather information to understand views about the impact of the options presented. It allows stakeholders to provide relevant and timely feedback to us, which we can then use to inform our final proposal.

1.19 This consultation started at 0001 Monday 19th October 2020 and closes at 2359 Friday 5th February 2021, a period of 15 weeks and 5 days.

1.20 We expect to submit a formal Airspace Change Proposal (ACP) to the Civil Aviation Authority (CAA) in June 2021.

1.21 If approved by the CAA (the regulator), we plan to implement the change no earlier than February 2022.

2. Introduction and overview

2.1 NATS and London Luton Airport (LLA) are co-sponsors of this proposal. The scope of this project is to reduce the complexity of LLA arrivals (and their interacting relationship with Stansted arrivals), in turn reducing air traffic controller workload and assuring a safe and efficient operation for the future.

About London Luton Airport (LLA)

2.2 LLA is an important international centre for commercial, business and cargo aviation, as well as aircraft maintenance. In 2019 LLA handled 17.9 million passengers. The main aircraft types operating in 2019 were Airbus A320 and A321 aircraft, operated by easyJet and Wizz Air, with Ryanair operating Boeing 737s.

2.3 LLA has one runway which is 2,160 metres in length and has six main Noise Preferential Routes[1] (NPRs); three departing in an easterly direction and three departing in a westerly direction[2]. There are two main arrival flightpaths, one arriving to the runway from a westerly direction and one from the east, however both these arrival routes start at one of the two holding patterns, which are further east of LLA and are shared with Stansted (see below). The closest residential areas to the airport are those located to the west and southwest, however the more densely populated areas are to the north. There are also several small villages near to the airport.

2.4 Due to the impact of the coronavirus pandemic on the aviation industry, the number of flights significantly reduced across the whole of the UK and Europe during the second and third quarters of 2020. Previously, demand for air travel across the UK had been increasing faster than predicted. In response to that growing demand, LLA has recently undertaken a redevelopment making the biggest investment in its history to transform the airport. The redevelopment of the terminal has brought huge benefits for passengers, but it is vitally important that the local community also shares in the success of the airport. This redevelopment is ready for the return to pre-pandemic passenger levels and safe for future growth.

2.5 LLA's aim is to work constructively with the local community and partners to strike the right balance between maximising the positive social and economic benefits to the local area and the UK as a whole, while minimising negative impacts to the community and the environment.

About LLA and Stansted Airport's airspace relationship

2.6 Currently, LLA and Stansted Airport - two of the five busiest airports in the UK in terms of air traffic movements - share exactly the same arrival flows to the same holds[3].

2.7 This is a unique situation – other airports sometimes share arrival routes, but one always has a much bigger proportion of movements (for example, London Heathrow and RAF Northolt, or London City and Biggin Hill). Splitting arrival flows is sustainable for those airports because only a small number of aircraft need to be redirected to the less-busy airport. LLA and Stansted are both major airports and all the arrival flows need splitting all the time. The interdependency between these two airports creates an especially complex situation for air traffic controllers to manage.

Why must this change happen now?

2.8 Where complex air traffic flows cross each other within UK airspace, restrictions are used to separate aircraft by 1,000ft vertically and/or by a minimum lateral distance of either 3 or 5 nautical miles (nm)[4] depending on the rules applicable to the particular airspace. This places a significant workload on the controller because they issue heading and altitude instructions to many aircraft simultaneously, ensuring they are all kept safely separated.

---

[1] Aircraft taking off from Luton follow specific flightpaths called NPRs, unless directed otherwise by air traffic control. The flightpath is designed to minimise the impact of noise on the local community.

[2] This consultation is not about departures – there would be no change under this proposal.

[3] When aircraft hold, they usually fly a racetrack shaped pattern at different heights, so they can all be contained in a stack and brought on to land when the air traffic controller decides it is best. These are known as holds, holding patterns or stacks and mean the same thing.

[4] A nautical mile is a unit of measurement used in both air and marine navigation. Historically, it was defined as one minute (1/60th of a degree) of latitude along any line of longitude. Today the international nautical mile is defined as exactly 1,852 metres (about 1.15 statute miles).

2.9 The LLA and Stansted region is especially complex due to the number of crossing traffic flows[5], and the amount of air traffic has grown faster than expected over the last few years, increasing the workload of air traffic controllers. Safety is always the first priority. We have identified that, unless something is done now, the intensity of the air traffic control workload may become unsustainable for controllers. This would lead to more holding, in order to manage the workload safely, and therefore delay. While the amount of air traffic has been reduced as a result of the coronavirus pandemic, the need to change the design of this airspace remains. We must ensure it is fit for purpose when traffic recovers to pre-pandemic levels and we must allow for safe potential future growth.

2.10 During periods when the workload of air traffic controllers is predicted to become too intense, safety dictates that temporary limits (known as flow restrictions) are applied to the numbers of aircraft that a controller can manage before safe limits are exceeded. This causes delay to the travelling public (at both LLA and Stansted), and is a short-term temporary solution to the underlying latent problem. Over a day, temporary limits increase the amount of delay and may cause flights to be delayed into the night-time noise period[6] which is detrimental to local communities. These delays can also result in increases in fuel burn and associated CO_2 emissions. The sponsors acknowledge the likely temporary impacts of the Covid-19 coronavirus on aviation, but are clear that this air traffic complexity issue must be resolved. Doing nothing would increase the potential for a reduction in safety as a result of increased arrival delay. It is assumed that air traffic will return to the pre-pandemic levels and the analysis forecasts remain valid, albeit delayed by a year[7]. During that recovery period, temporary limits to the numbers of aircraft may not be required as often as previously, minimising the impacts on the travelling public until this change is delivered.

2.11 All proposals to change airspace are regulated by the Civil Aviation Authority (CAA). The sponsor(s) of an airspace change must follow the process set out in the CAA's guidance for the regulatory process for changing airspace design CAP1616 (ref 12). This document forms part of the document set required for the CAP1616 Airspace Change process's Stage 3 (Consult).

2.12 Its purpose is to present clear information about the airspace options we are consulting upon, the potential impact the proposed changes may have on you.

What is this document?

2.13 This consultation document explains the history, impacts and benefits of this proposal. There are two complementary documents available, providing more details on how the options were appraised and how this consultation will be conducted:

- Stage 3 Consultation Strategy, which provides details on how we will conduct the consultation. See ref 10.
- Stage 3 Full Options Appraisal, which provides analysis of the evidence for each option in comparison to the baseline. See ref 11.

How far is this proposal through the airspace change process?

2.14 It is currently in the third stage of the seven stage process.

2.15 Stage 1 Define has been completed, where the need for an airspace change, and the design principles underpinning it, was established.

2.16 Stage 2 Develop and Assess has also been completed: where the initial options at upper and lower altitudes[8] were developed, evaluated against the design principles from Stage 1 and an initial appraisal of each option was performed. This crucial stage of the airspace change process removed the least suitable potential airspace designs from further development: for example, those that were not as safe, those needing excessive volumes of airspace, or those not technically viable.

[5] Traffic flows are explained in Section 6 on p.43 .
[6] Regulating the amount of traffic within a sector is a human-centric process. An airspace design which significantly reduces the need for flow regulation also reduces the number of processes needed to manage the airspace, thus improving safety.
[7] For more information on forecasts, assumptions, and the impact on aviation of the coronavirus pandemic see Annex C on p.C-1.
[8] For this proposal we refer to upper altitudes as c.8,000ft and above, and lower altitudes as below c.8,000ft.

2.17 All previous material relating to Stages 1 and 2 is published on the CAA's airspace change portal at [this link](#).

2.18 The design options that have progressed to the current stage are all viable and would resolve the current problem. This proposal is now at Stage 3 Consult, where stakeholders are asked for feedback on these options.

2.19 The following flowchart illustrates the airspace change process (known as CAP1616) on the left, with details of Stage 3 on the right:

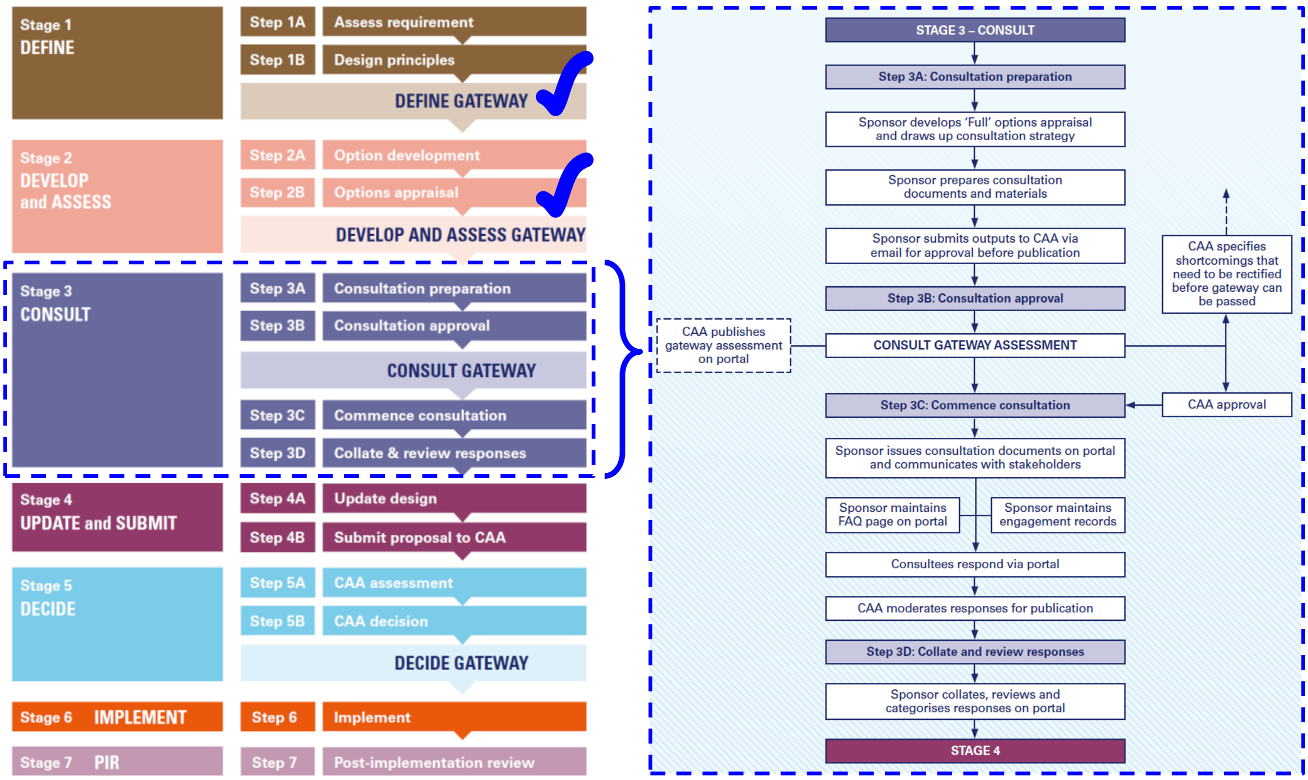


Figure 1 Overview of the Airspace Change Process CAP1616, and details of Stage 3 Consult

What is a 'stakeholder'? Who are they?

2.20 A stakeholder is an interested third party in an airspace change proposal.

2.21 If you are reading this document, you are most likely a stakeholder in this proposal.

2.22 Stakeholders include airlines, local government councils, community organisations, members of the public, private pilots, MPs and more.

2.23 This document has been written for the non-technical stakeholder. Some stakeholders are aviation-technical experts and we have provided Section 7 for those stakeholders who need more specific technical information. That section uses common aviation technical language. Feedback is welcomed from everyone – aviation experts and non-experts.

2.24 Many stakeholders can be identified in advance, and for this proposal they are listed in the Consultation Strategy, see ref. 10.

Has anything changed since Stage 2?

2.25 Some options have been refined following simulations. Stage 2's Initial Options Appraisal (ref 8) concluded that:

It is possible, indeed preferable, that some or all of the six lower options [that progressed through the initial options appraisal] could be combined into a system of options to convey Luton arrivals from the upper option to the runway.

2.26 Two combined options were developed, from the six that passed the previous assessment stage. Two key themes determined the combination of options for consultation. Firstly, to minimise change from today's flightpaths, which resulted in a system where air traffic controllers provide heading, altitude and speed instructions to pilots to transition aircraft from a hold to the runways. Secondly, alignment to the CAA's Airspace Modernisation Strategy (AMS, ref 15)[9], which resulted in an option to introduce a combination of Performance Based Navigation (PBN)[10] transitions (predetermined flight paths) from a hold to the runways. The AMS (ref 15) and PBN are described in more detail later in this document.

2.27 Some technical changes were made, to refine the Upper design (c.8,000ft[11] and above). These were driven by air traffic control simulations post-Stage-2, which gathered more evidence from a wider pool of air traffic control experts. This led to the revision of the dimensions and locations of some volumes of controlled airspace (CAS). These opportunities would not have been identified until those simulations were completed, and the additional expert opinions gathered. The Civil Aviation Authority and the stakeholders who would be impacted by these changes were engaged, to ensure transparency and understanding. Due to the technical nature of these changes, full details are described in Section 7. Note that the technical changes between stages would have passed the design principle evaluation, and in doing so, would have progressed to this stage.

What is within the scope of this consultation?

2.28 The scope of this proposal specifically addresses arrival flows to LLA and removing their interaction with Stansted arrival flows in the existing London Terminal Manoeuvring Area (LTMA). The LTMA consists of a complex network of air traffic service (ATS) routes (for all commercial air traffic) plus Standard Departure/Arrival Routes (known as SIDs/STARs), existing airborne holding facilities and the airspace that protects the routes for all London airports.

2.29 This separation of LLA arrival flows from Stansted arrival flows would start at the end of the en-route or cruise phase of flight, known as Top of Descent (TOD) typically between 60-150nm (15,000ft-30,000ft), and would end at final approach to LLA's runway. Amendments to the flows for other airports within the LTMA are outside of the scope of this ACP and therefore the final design must complement the existing airspace design.

2.30 Given the need to change the way arrivals work at LLA, contingency procedures will be updated to match – these are:

- Radio Communications Failure (RCF) - the procedures to be used should the radio fail, so a pilot can navigate to the runway and land safely. These procedures enable aircraft to safely reposition to the final approach under certain circumstances if they are unable to land from their initial approach They detail how a pilot could fly, without assistance from a controller, to make an approach at the runway if they suffer a radio failure. RCF is a very rare event because the radio technology is extremely reliable, and aircraft have several backups (no failures causing the use of these contingency procedures were recorded in the past ten years).
  Procedures would also apply should there be a problem with the controller's radar. The pilot would be able to self-navigate the aircraft to the runway without guidance from the controller, but in this case there would be radio contact. Radar failures are also extremely rare and no failures causing the use of radar-fail procedures were recorded in the last ten years.
- Missed Approach Procedure (MAP): where the pilot has to break off from the approach (for example something on the runway) the MAP gives them a route to fly to a safe contingency holding pattern from where they can commence another approach.

[9] CAP1711, Airspace Modernisation Strategy, Paragraph 4.24. Airspace modernisation at lower altitudes (below c.7,000 feet) will provide sufficient capacity between the terminal airspace and runways, by implementing more precise and flexible satellite-based arrival and departure routes – while managing the impact of aircraft noise on local communities.
[10] A concept developed by ICAO that moves commercial aviation away from the traditional use of aircraft navigating by ground-based beacons to a system more reliant on airborne technologies, utilising area navigation and global navigation satellite systems. (Air Navigation Guidance 2017). More specifically, area navigation based on performance requirements for aircraft operating along an ATS route, or an instrument approach procedure or in a designated airspace. (ICAO Doc 9613) https://www.icao.int
[11] Where we write 'c.' and then a number, this is short for 'circa', meaning 'approximately'.

2.31 Contingency procedures are designed to be used and interpreted by professional aviation technical specialists familiar with the subject, and are unavoidably technical in nature. The proposed contingency procedures are described in Section 7, the aviation technical information part of this document (see paragraphs 7.42-7.55 from p.56). We welcome feedback from everyone – aviation experts and non-experts – should anyone wish to comment on the technical content.

2.32 All airports, including LLA, must have a suite of procedures available to accommodate such situations, even though they are rarely used (not in the last ten years at LLA). Pilots have them stored for emergency use.

2.33 Not within scope of this consultation are future growth plans at London Luton Airport, including the Development Consent Order (DCO) application for 32 million passengers per year. The growth aspiration to 32 million passengers per year is a separate project being conducted by London Luton Airport Limited (LLAL), the owners of the airport. This Airspace Change Proposal is co-sponsored by London Luton Airport Operations Limited (LLAOL) who are the current operators of the airport.
Even though the DCO is separate from this consultation, its forecast impacts for increased air traffic have been analysed and are provided as part of this consultation. Thus our analyses provide data on without-DCO and with-DCO traffic levels to ensure the potential impacts are described whether or not LLAL's separate DCO progresses.
To find out more about LLAL's separate DCO please visit www.futureluton.llal.org.uk/

2.34 Over the past 12 months, London Luton Airport Operations Limited (LLAOL) has submitted a scoping document and Environmental Screening request to the local planning authority (Luton Borough Council) for consideration to grow to 19 million passengers per annum. The growth to 19 million passengers per year is also not within the scope of this consultation or proposal.

How does this Airspace Change Proposal align with the Government's Airspace Modernisation Strategy, and other proposals?

2.35 The UK Government has tasked the aviation industry to modernise airspace in the whole of the UK. The long-term strategy of the CAA and the UK Government is called the Airspace Modernisation Strategy (AMS, ref 15). The AMS identifies fifteen initiatives to modernise airspace. These include a fundamental redesign of the routes in and around the southern UK. This programme of modernisation in the southern UK is known as 'Future Airspace Strategy Implementation – South', or FASI-S.

2.36 Airspace changes are necessary from time to time, due to a specific need (such as solving an airspace design issue) or due to Government policy.

2.37 The airspace change described in this document is for a specific need – to solve an airspace design issue. But it is necessary to also discuss how this specific proposal aligns with wider Government policy.

2.38 LLA, other airports in the south, and NATS are all working on separate (but coordinated) airspace change proposals to meet these AMS objectives via FASI-S airspace change proposals. Each airport's FASI-S proposal interacts with, and has some reliance upon, the FASI-S proposals of other airports and of NATS which manages the UK's air route network.

2.39 The fundamental redesign of the South's air route network is a large programme. It involves redesigning the routes serving many airports at all altitudes in a coordinated way, using precise and flexible satellite navigation. This is expected to bring efficiencies to the air route network by enabling more continuous climbs and descents, while systemising[12] the routes to keep them separated from those of neighbouring airports.

2.40 The FASI-S programme will take longer than the timescales driving this specific proposal and is considered to be a once-in-a-generation airspace modernisation due to the overall complexity of the route structure, and the fundamental aim to future-proof the South's air route network.

[12] Systemised airspace uses technology and tools to provide air routes which are separated from each other. This reduces the tactical elements of the controllers' job – vectoring aircraft – and increases the ability of a controller to become more of a manager of the airspace volume, having confidence that the aircraft will follow a specific path with minimal manual intervention.

2.41 For the avoidance of doubt, there are two airspace change proposals that could change lower-altitude flightpaths in the vicinity of LLA:

- This NATS-LLA joint proposal - its purpose is to address the air traffic complexity of intertwined LLA and Stansted arrivals. This proposal is progressing now, even though the coronavirus pandemic has impacted the aviation industry, because the latent airspace design issue must be addressed before air traffic exceeds pre-pandemic levels. This proposal addresses a specific airspace design need, in the shorter term.
- LLA's separate FASI-S proposal (external link to CAA airspace change portal) – its purpose is to address the need for airspace modernisation, to align with the UK Government's AMS, in the medium to longer term. It encompasses changes to low altitude flightpaths for both arrivals and departures.
  At the time of writing, that proposal is temporarily paused pending a revised timescale as a result of the coronavirus pandemic's impacts on the aviation industry. LLA remains committed to its progression.

2.42 This proposal would change LLA arrival flightpaths using one of two airspace design options (subject to modifications following consultation feedback and CAA approval) – see Section 5 from p.26, which describe Option 1 and Option 2. Both Option 1 and Option 2 would solve the underlying safety issue in the shorter term.

2.43 In this proposal, should a version of Option 1 progress, another significant change to low altitude arrival flightpaths is more likely to be required in the medium to longer term. That second significant change would progress under LLA's separate FASI-S proposal, because Option 1 only partially aligns with the AMS.

2.44 Should a version of Option 2 progress, the likelihood or scope of a significant change to low altitude arrival flightpaths is reduced because Option 2 is generally aligned with the AMS. However, we cannot rule out a second change to low altitude arrival flightpaths in the medium to longer term under LLA's separate FASI-S proposal.

2.45 To be clear, this proposal would not change LLA departures. LLA's FASI-S proposal is considering changes to all departure and arrival procedures in the medium to longer term. That FASI-S proposal follows the same CAP1616 airspace change process, and will have its own stakeholder engagement and consultation.

2.46 More details on the AMS and FASI-S are available on the CAA website here and here respectively.

3. Key Technical Details Explained

Operational diagrams

3.1 These maps present a representation of how the airspace is to be used. They do not contain specific information on noise, but do illustrate the predicted extents, direction, distribution and altitudes of aircraft using the airspace. Operational diagrams are provided in Section 5 from p.26, for the baseline do-nothing Option 0, Option 1 and Option 2. Section 6 on p.43 explains how to understand these maps and use the data to determine your current noise impacts and how that might change under the proposed options.

How is the runway direction managed?

3.2 Like most airports, LLA has a single 'runway' which can be used in two directions – easterly or westerly. These are referred to as separate runways even though they use the same strip of concrete and asphalt. Runways are always designated by the magnetic compass direction they most closely align with; at LLA this is runway 07 (070°; easterly) and runway 25 (250°; westerly)[13]. The decision on which runway direction to use is predominantly determined to ensure the general direction of departing and arriving traffic are facing into the wind. This enables aircraft to reduce speed over the ground just before landing and to maximise efficiency during take-off. The prevailing wind in the UK is from the South West, which results in the westerly runway being used c.70% of the time and the easterly runway used c.30% of the time.

What is Controlled Airspace?

3.3 Controlled Airspace (CAS) is the name given to a volume of airspace which normally requires the pilot of an aircraft to obtain permission from an air traffic controller prior to entry. The primary purpose of CAS is to provide protection for aircraft flying along air traffic routes.

What is Performance Based Navigation (PBN)? What do we mean by vectoring?

3.4 As part of the Airspace Change Process, there is a requirement to align new airspace designs with the Civil Aviation Authority (CAA) Airspace Modernisation Strategy, and as part of this, Performance Based Navigation (PBN) must be considered.

3.5 PBN utilises an accurate form of satellite navigation rather than relying on an aircraft calculating its position based on ground-based navigational reference points, commonly referred to as navigational beacons. PBN enables aircraft to fly along pre-determined flightpaths more accurately and it means that the location of routes is not constrained relative to the position of beacons.

3.6 The level of accuracy, safety and integrity that these satellite navigation systems must reach is set out in the international requirements for PBN. There are various standardised PBN[14] specifications that can be considered; all of which sit under the umbrella of Area Navigation, commonly referred to as RNAV. Within this consultation we focus on RNAV1, which specifies that aircraft will fly to a tolerance of 1nm either side of the route centreline 95% or more of the time. In practice, the accuracy is typically much greater than this which leads to concentrated aircraft tracks over the ground. We have focused on the RNAV1 specification because almost all aircraft at LLA (c.95%) are currently equipped to the RNAV1 standard and by the time this proposal is planned to be introduced, this is expected to be the case for every LLA arrival.

3.7 Using PBN offers opportunities to reduce controller workload by significantly reducing the need for 'vectoring'. Vectoring is a method used by air traffic controllers to separate and sequence air traffic. It will remain a vital part of the air traffic management toolkit for the foreseeable future. Controllers issue instructions, via radio, telling pilots to fly a compass heading and to climb or descend to an altitude, and sometimes to change speed. In other words, the controller is navigating the aircraft laterally and vertically. Currently, all aircraft in this region are being vectored to manage the air traffic flows, keeping

---

[13] Magnetic compass headings are not constant and change over time depending on position on the Earth's surface. This means that on occasion, the designators used to identify runway direction also have to change, as they are rounded to the nearest ten degrees. LLA's runways designators changed on 22nd May 2020 from runways 26 and 08 to runways 25 and 07. Note that the runway itself does not move.

[14] For further information about PBN, you may find this International Civil Aviation Organisation (ICAO) video helpful: https://youtu.be/5eMENLKYY6o (External video which is not subject to control by NATS-LLA)

them as efficient as possible while maintaining safe separation. Each time a controller vectors an aircraft, they transmit their instruction on the radio, and the receiving pilot repeats the instruction back to the controller for checking. Controllers may have up to seven different aircraft under their control at once, occasionally more. If anything is misunderstood or misheard, the controller makes another corrective radio transmission and the pilot repeats the correct instruction. The intense workload of the controller, vectoring arrivals to two different airports in a complex, compact airspace volume, is the primary driver for the changes we propose. Simplifying the arrival flows would reduce the need for flow restrictions caused when workload approaches a safe limit, which causes arrival delay and/or airborne holding.

3.8 Routes are predetermined and published paths through the sky, much like roads are published on a map. Flightpaths are the tracks over the ground that aircraft actually fly, which may not coincide with a planned route (e.g. to accept a controller's shortcut). Traffic flows are used to describe where multiple aircraft fly, usually beginning or ending at the same place. For example, an arrival traffic flow is the general flow of traffic towards the airport's final approach to land.

What are shortcuts?

3.9 At present, a proportion of arriving aircraft are directed by air traffic controllers to take a shortcut. Shortcuts are given when the air traffic situation permits, usually during quieter periods when aircraft can be routed more directly to the final approach, but also used opportunistically. During the period when air travel was significantly reduced under the coronavirus pandemic, you may have noticed aircraft flying in different places than usual – this is because there was so little traffic, almost every arrival was given a shortcut. Over time, more typical flightpaths would resume as traffic recovers, but shortcuts remain an important tool for the controller to make the arrival sequence as efficient as possible This saves time and money for airlines by reducing the track miles flown, saving fuel and offering better environmental performance. Sometimes these shortcuts are vectored, sometimes the controller may instruct the pilot to miss out one or more of the flight-planned waypoints and go direct to a specific waypoint further down the route. Sometimes, shortcuts take quite a different route from the one originally planned, depending on the other aircraft in the airspace at the time. The low traffic levels due to the pandemic are a good example of shortcuts being different from the flightplan.

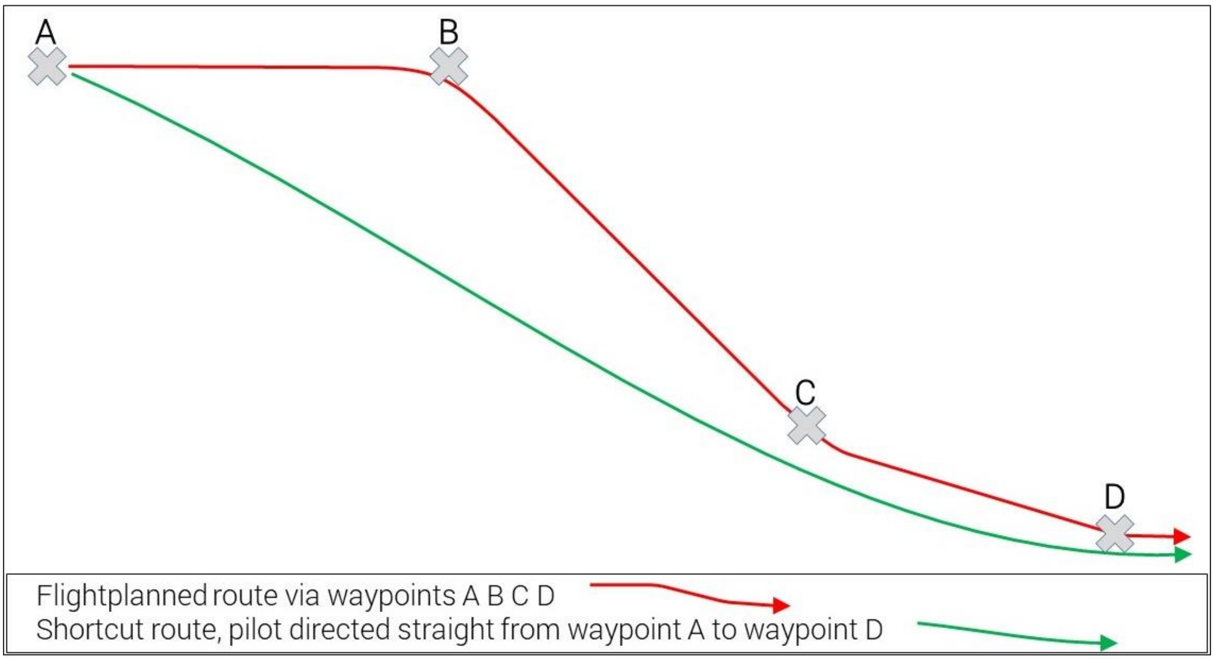


Figure 2 Plan-view illustration of aircraft being given a shortcut

Reference to how high aircraft fly

3.10 Throughout the consultation documents we explain how high we expect aircraft to be at any given location for each option. Aircraft altimeters use barometric pressure to interpret how high they are – air pressure reduces with height, so the lower the pressure, the higher an aircraft altimeter will indicate. However, the weather also changes the air pressure so where we state that an aircraft will be at an altitude or a Flight Level[15], it may be slightly higher or slightly lower depending on the local air pressure at the time.

How many arrival flights?

3.11 Table 1 illustrates the average number of arrivals per hour of the day (from 0001 to 2359), for the year 2019.

Hour (local time)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2019	5	5	2	1	1	0	2	13	7	6	7	9	13	12	10	9	11	13	12	11	11	12	12	9

Table 1 Average number of arrivals per hour, local time, using 24hr clock

3.12 In 2019 there were between c.157-218 arrivals at LLA per day, based on average monthly arrival figures.

3.13 In July and September 2019 the average number of flights per day increased to 218 with June averaging 217, and the peak summer day (2nd June) was 248.

3.14 Busy periods can occur at any time of year – on 24th February there were also 248 arrivals, but the overall daily average for the month was considerably lower at 174.

3.15 From Table 1 we can see the peak hours of the day are the morning 7-8am, a lunchtime busy period from noon to 2pm, then a longer evening busy period from 5pm-11pm.

3.16 On 17th June, there were 24 arrivals in one hour, between noon and 1pm – this was the busiest hour of the year for arrivals.

3.17 We used Table 1, the current schedules and the experience of our air traffic control team to predict the number of flights you might expect to see per day, per hour, and when the busiest hours are likely to occur.

3.18 Noting that the coronavirus pandemic has temporarily reduced the numbers of flights in the UK and across Europe, this table illustrates the expected pattern of busiest hours as traffic recovers, and grows beyond, pre-pandemic levels.

3.19 Later in this document you will see maps showing where and how high aircraft are expected to fly, and a table for each airspace design option illustrating the estimated frequency of overflight in busy periods. Using these maps and tables you can understand how the noise impacts might affect where you live, work or spend time.

How loud might aircraft be? What are the noise impacts, and how might that change?

3.20 These paragraphs describe some technical data about noise. Section 6 on p.43 is provided to describe how to interpret the diagrams, maps and tables so you can decide how noise impacts may affect you.

3.21 Table 2 opposite illustrates the typical noise in decibels (LA_{max} dB[16]) that an observer on the ground might expect to experience from an arriving aircraft, and is colour banded to highlight these three priorities based on altitude:

[15] There are technical differences between Altitude, Flight Level and Height, however, for purposes of explaining how high we expect aircraft to be within this document set they have been considered comparable. We assume that aviation technical readers will be aware of these differences. See this link to a NATS explanatory article.

[16] LA_{max} dB is the maximum noise experienced during a single noise event (i.e. one aircraft overflying the observer).

Aircraft at altitude…	Government guidance on environmental priorities	Additional points of note extracted from government guidance
Below 4,000ft	Limit and, where possible, reduce the total adverse effects on people; and Where similar numbers of people are affected, prefer the option most consistent with existing arrangements	Where practicable, it is desirable that airspace routes below 7,000ft should seek to avoid flying over Areas of Outstanding Natural Beauty (AONB); All changes below 7,000ft should take into account local circumstances in the development of the airspace design; Consultation with environmental stakeholders will usually only be necessary where the proposed changes concern controlled airspace below an altitude of 7,000 feet
4,000ft, to below 7,000ft	Minimise the impact of aviation noise in a manner consistent with the government's overall policy on aviation noise, unless… disproportionately increases CO_2 emissions	
7,000ft and above	Prioritise the reduction of aircraft CO_2 emissions and the minimising of noise is no longer the priority	Changes at or above 7,000 feet will usually not have a noticeable impact.

Height (ft)	Turboprop	50 seat regional jet	70-90 seat regional jet	125-180 seat single-aisle 2-eng jet	250 seat twin-aisle 2-eng jet	300-350 seat twin-aisle jet
1,000-2,000	79-70	73-63	77-67	77-69	84-74	83-73
2,000-3,000	70-66	63-56	67-61	69-64	74-68	73-67
3,000-4,000	66-64	56-55	61-57	64-61	68-64	67-63
4,000-5,000	64-62		57-56	61-59	64-60	63-60
5,000-6,000	62-61		56-55	59-57	60-58	60-57
6,000-7,000	61-59			57-56	58-56	57-56
7,000-8,000	59-57			56-55	56-55	56-56
8,000-9,000	57-57					56-55
9,000-10,000	57-56					
10,000-11,000	56-55					

Table 2 Arrival noise information and LA_{max} dB by aircraft grouping

3.22 In this CAA-sourced table, measurements stop at 55dB – below that level, the accuracy of individual aircraft noise readings is difficult to maintain and is masked by background noise. However, aircraft noise can be less distinguishable at altitudes higher than 7,000ft depending on local circumstances. Government guidance states that, at 7,000ft and above, the minimising of noise is no longer a priority, and this has been considered as part of this proposal.

3.23 Most aircraft that operate at LLA fall into the category of '125-180 seat single-aisle 2-engined jet' which comprise similar types with similar noise such as Airbus A320 and Boeing 737 versions, with the A320 family being the most common. The proportions of arrivals at LLA in each noise category are detailed in Table 3, for 2019. We expect these proportions to continue, and we do not predict that this proposal would cause a change in the proportions of aircraft types using LLA.

Noise category	Count	Proportion
Turboprop* (inc all sizes of corporate aircraft, both turboprop and jet)	12,196	17.4%
50 seat regional jet	1,109	1.58%
70-90 seat regional jet	54	0.08%
125-180 seat single-aisle 2-eng jet	55,224	78.6%
250 seat twin-aisle 2-eng jet	1,585	2.26%
300-350 seat twin aisle jet	98	0.14%
Other	8	0.01%
Total arrivals 2019	70,274	

Table 3 Proportions of arrivals at London Luton Airport by noise category (full year 2019)

*Note that corporate and business travel occurs in a range of aircraft types, from small single turboprop aircraft up to larger business jets and there is no CAA-defined noise category. For consistency, all these types have been placed in the turboprop category.

3.24 To help you understand what these numbers mean in practice, we have provided typical sounds and their approximate noise level using the same LA_{max} dB measurements:

Typical sound	Approximate noise level LA_{max} dB
Pneumatic Drill 7 metres away	95
Heavy diesel lorry at 40kmh or 25mph, 7 metres away	85
Vacuum cleaner 3 metres away	70
Busy general office	60
Quiet office	50
Quiet bedroom, library	35

Table 4 Table of comparison sounds

3.25 On 30th July 2020 the Independent Commission on Civil Aviation Noise (ICCAN) released a 'toolkit' for consulting on airspace change. It would not be proportional to assess this consultation against the ICCAN toolkit given the short time between that publication and the submission of this material to the CAA (6th August 2020) for assessment.

Noise analysis data

3.26 Noise analysis has taken place as per CAA guidance CAP1616a (ref.13), and the results are provided in Annexes E, F and G. As part of your feedback, you may wish to consider the noise analysis data provided in these annexes, comparing the data of summer 2019 with any differences due to the design options presented in this proposal.

Noise Contours: LA_{eq}16hr day time, LA_{eq}8hr night-time, N65 day time and N60 night-time

3.27 Noise exposure contours sum the cumulative noise throughout the entire period (e.g. 16 hours) and average it to show a set of closed lines on a map. Hence each contour shows places where people get the same cumulative amount of noise from aircraft, and are calculated for an average summer day over the period from 16 June to 15 September inclusive, for traffic in the busiest 16 hours of the day, between 0700 and 2300 local time. These contours, known as LA_{eq}16hr contours, are shown in 3dB increments from 51dB to 72dB, and are provided in the annexes. For night-time, the equivalent contours are provided for the 8hr night period 2300-0700 in 3dB increments from 45dB to 72dB, known as LA_{eq}8hr contours. LA_{eq} contours are averaged over time, rather than referring to individual events of noise (i.e. flights). An LA_{eq} contour marked as 57 shows the area where the noise exposure reaches 57dB LA_{eq}, averaged over the summer period (16hrs day, or 8hrs night). The smaller (inner) contours, correspond to areas with greater noise exposure, where aircraft are lower, closer to the runway.

3.28 Other contours are provided – N65 and N60. These provide a different perspective on aircraft noise impacts. These contours show the locations where a specified number of noise events (flights) exceed the defined noise level, in LA_{max} dB. For N65 contours that noise level is 65dB LA_{max}, and the number of events is averaged over the summer day time period described above. For N60 contours that noise level is 60dB LA_{max}, averaged over the summer night-time period. An N65 contour marked as 10 would mean, within that contour, on an average summer day there would be 10 events (flights) where the noise exceeded 65dB LA_{max}. The larger the number of events, the smaller the contour, closer to the runway.

3.29 For LA_{eq}16hr day time, LA_{eq}8hr night-time, N65 day time and N60 night-time contours, data tables have been provided for the areas of each contour, the population, households, numbers of hospitals, places of worship and schools within, for each airspace design option. You may wish to consider the influence each option has, and include it as part of your feedback. It should also be noted that the contours in this submission have all been created using the Federal Aviation Administration's (FAA) Aviation Environmental Design Tool (AEDT) version 3.0b. This software is different from the normal reporting undertaken by LLAOL, which uses the FAA's Integrated Noise Model (INM) version 7.0d and therefore should not be directly compared. Instead, a baseline using the AEDT software has been used for comparison.

CAP1498 Overflight 48.5°, N65 day and N60 night

3.30 An overflight assessment has been provided, in accordance with the principles described in the CAA's publication known as CAP1498 (Definition of Overflight), ref.14.

3.31 This is a measure of how many people, households, hospitals, places of worship and schools are overflown a specified number of times by aircraft noise exceeding 65dB (N65) by day, or by 60dB (N60) by night. This is the same N65 & N60 as above, but instead of contours, overflight is shown.

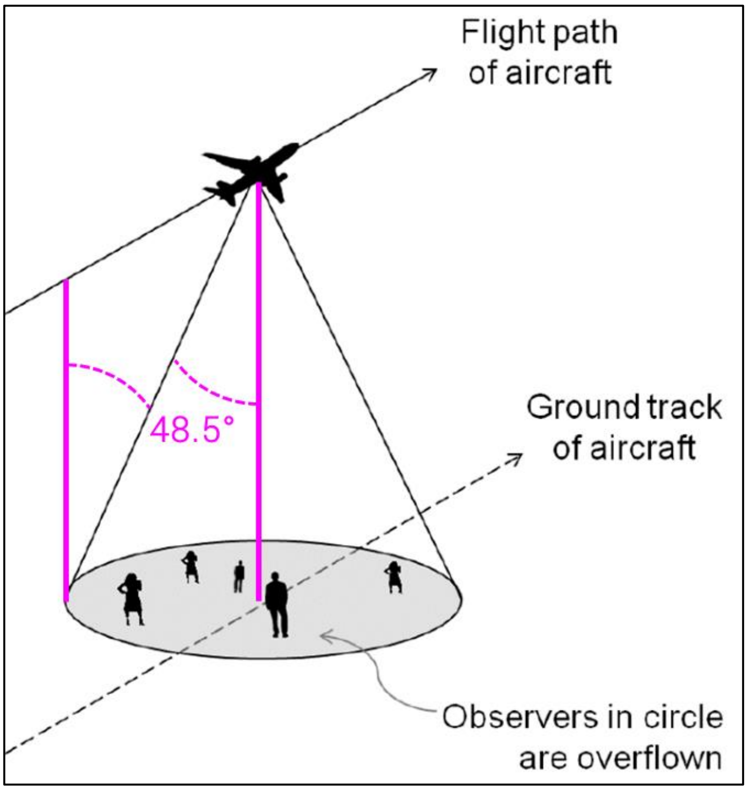


Figure 3 Illustration of how overflight is defined by a 48.5° cone

3.32 CAP1498 sets out how 'overflight' is defined based on an imagined cone projected beneath the aircraft which becomes a circle on the ground, bigger if the aircraft is higher, smaller if the aircraft is lower. That circle moves beneath the flightpath as the aircraft moves forward, and the numbers are counted of people, households and sensitive buildings within that circle at its different sizes, changing with the height of the aircraft.

3.33 The recommended angle of that cone is set at 48.5° from the vertical, as illustrated in this diagram adapted and extracted from CAP1498. Data tables are associated with these overflight diagrams to provide an added dimension on how many people, households, hospitals, places of worship and schools would be overflown, and how often.

3.34 For example, in a CAP1498 N65 data table, a column marked '>=10' would show the number overflown, ten times or more per day, by an aircraft exceeding 65dB LA_{max}.

Greenhouse gas emissions and aviation fuel burn

3.35 A change in track distance flown would change the amount of fuel needed to fly that new distance – a longer route – may burn more fuel. A change in fuel burn (kg) can be converted to CO_2 equivalent (kg CO_2e, using a standard multiplier of 3.18), hence the equivalent estimated change in greenhouse gas impacts can be calculated.

3.36 Often an increase in track mileage can be partially offset by keeping aircraft higher (where fuel efficiency is significantly better), and a longer route can result in fewer delays due to less holding.

3.37 Using the analogy of driving a car, it can be more efficient to take a longer route to travel around a city by motorway, than to take a shorter route straight through the city centre.

3.38 This is because a car operates more efficiently at a constant speed on a motorway than stop/start or crawling in traffic jams on the shorter route thereby burning less fuel per mile.

3.39 We have reviewed each option in terms of total annual fuel burn/mass of CO_2e in metric tonnes emitted and this is detailed for each option based on the current traffic levels and the traffic levels predicted for ten years after implementation.

4. What happens today – the baseline – Option 0

4.1 Before looking at the proposed options for this Airspace Change, it is important to understand the current day airspace operation at LLA. The airspace in this region is some of the most congested and complex in the UK with the integration of traffic from LLA, London Stansted, London Heathrow, and London City Airports and other airspace users in the region, such as military aircraft.

4.2 LLA and Stansted traffic both arrive from all directions at high levels into the shared airborne holding patterns called LOREL (near Royston, Herts) and ABBOT (near Sudbury, Suffolk and Great Yeldham, Essex) and descend to about 8,000ft. Figure 4 illustrates how LLA and Stansted flights arrive, high-level, from the upper network to the shared airborne holding patterns.

4.3 Each holding pattern contains a mix of traffic, for example two LLA arrivals may be held above a Stansted arrival at LOREL, with the opposite at ABBOT, or any other combination. Together with the wider operations within the airspace, this results in a very complex air traffic situation.

4.4 Once within the holding stacks at LOREL and ABBOT, air traffic controllers then separate the shared arrivals using vectoring (see paragraph 3.7 on p.12). This requires intense and complex air traffic control interactions to be solved within the congested airspace, mostly at lower altitudes from 8-7,000ft and below.

4.5 Once the aircraft have been separated, they are vectored to the final approach. It is this vectoring that, at present, tends to disperse aircraft tracks across a swathe when aircraft are descending from 7,000ft.

4.6 As the aircraft get closer to the final approach and converge to line up along the extended runway centreline, the swathes narrow.

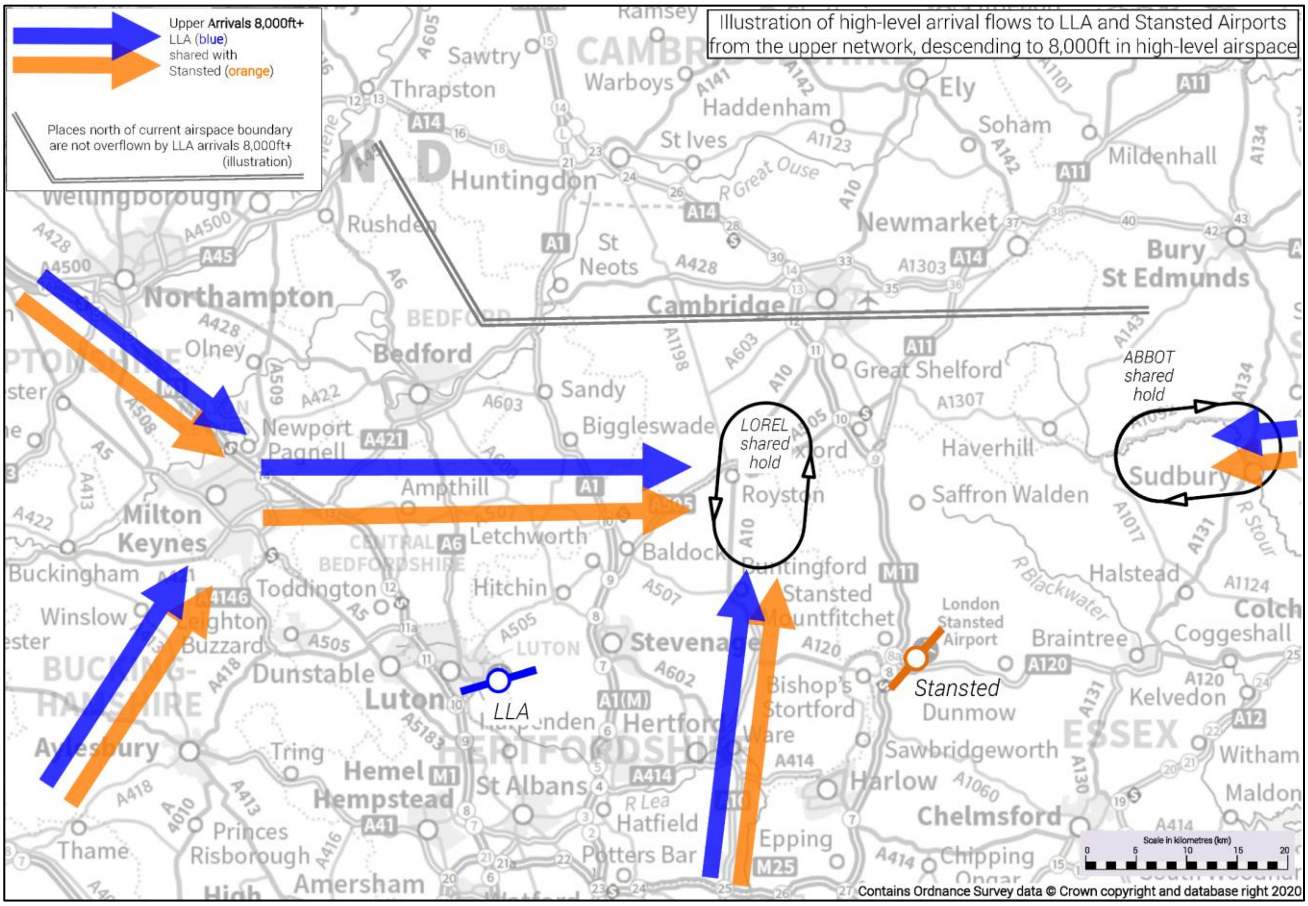


Figure 4 LLA and Stansted shared arrival flows at high level

High level arrivals

4.7 In this map, areas north of the grey airspace boundary are not currently overflown by LLA arrivals. This includes Bury St Edmunds, Newmarket, most of Cambridge, Huntingdon and St Neots.

4.8 The following pages present these full-page operational diagram maps from c.8,000ft and below:

- Figure 5 (p.22) shows the typical density of LLA arrivals descending from the holds c.8,000ft to easterly Runway 07.
- Figure 6 (p.23) illustrates how high these Runway 07 arrivals are, how they tend to flow, and where they tend to be most concentrated.
- Figure 7 (p.24) and Figure 8 (p.25) illustrate the same for westerly Runway 25 arrivals.

Runway 07 easterly arrivals

4.9 Controllers descend the holding traffic, then separate out the LLA traffic from each hold, vectoring it from 5,000ft near Royston heading west between Letchworth and Biggleswade. The LLA arrival flow continues west, level at 5,000ft for about 40-50km, over the northern part of the Chilterns AONB, with the controller vectoring most aircraft south of Leighton Buzzard (but some are vectored to the north).

4.10 As the traffic reaches an area northeast of Aylesbury the controller turns the aircraft left, roughly perpendicular to the extended runway centreline, and descends it to 4,000ft, then turns left and descends once more to establish on final approach, typically somewhere between the east of Stoke Mandeville area around 4,000ft and Pitstone Hill around 3,000ft.

4.11 Vectoring naturally causes some dispersion, but the area within the black lines is typically the most commonly used flightpath.

4.12 Some aircraft are given shortcuts or alternate routes as illustrated by the blue dashed arrows.

4.13 The swathe generally gets narrower until it aligns with the runway on final approach.

4.14 The final approach path to Runway 07 always overflies part of the Chilterns Conservation AONB, from Pitstone Hill to Kensworth Common, in a narrow swathe.

Runway 25 westerly arrivals

4.15 Controllers descend the holding traffic, then separate out the LLA traffic from each hold, vectoring it from 5,000ft near Royston heading west between Letchworth and Biggleswade. The LLA arrival flow may continue generally west, level at 5,000ft for about 15km before the controller turns it south (Biggleswade, Henlow), or they may turn south soon after passing Royston, but generally somewhere in between. That turn to the south might be in an S-shape, or it may be straight.

4.16 As the traffic reaches the Letchworth-Baldock-Wallington area the controller turns the aircraft roughly perpendicular to the extended runway centreline, and descends it to 4,000ft, then turns right and descends once more to establish on final approach typically around Buntingford from 4,000ft to 3,000ft and Stevenage 3,000ft and below.

4.17 Vectoring naturally causes some dispersion, but the central third of the swathe is typically the most commonly used flightpath.

4.18 Some aircraft are given shortcuts, or alternate routes as illustrated by the blue dashed arrows.

4.19 The swathe generally gets narrower until it aligns with the runway on final approach.

4.20 The final approach path to Runway 25 always overflies Ardeley, Walkern, Stevenage and St Paul's Walden in a narrow swathe.

Why isn't 'do nothing' an option? Is it safe?

4.21 If we were to do nothing, the current situation can be managed safely, however it would not be sustainable once traffic grows beyond pre-pandemic levels.

4.22 There is the potential for a reduction in safety as a result of increased delay if we were to do nothing.

4.23 The region's airspace has evolved over time to cope with an increase in air traffic, and that evolution has gone as far as it can go.

4.24 The way air traffic controllers have to split up LLA and Stansted's joint arrival flows is not safely sustainable because of today's piecemeal airspace design.

4.25 For controllers to safely manage this situation, aircraft would need to be delayed which creates a backlog.

4.26 A backlog creates additional complexity because this region does not have room to hold aircraft without them getting in the way of more and more traffic flows, to and from other airports.

4.27 We must be prepared for those levels of traffic, and airspace changes such as this take time to progress. The baseline do-nothing option was therefore discounted during the design principle evaluation Stage 2A (ii) (Ref 7). We have described the current day operation solely as a means of comparison between the proposed options and what happens today so that you can determine if you will experience any change.

4.28 All airports (including LLA) have contingency procedures which pilots have stored for emergency use (such as radio or radar failure). These events are extremely rare, and the current contingency flight procedures have not been used at LLA for at least ten years.
Doing nothing is not an option, so the current contingency procedures would also need to change as part of this proposal. See paragraphs 2.30-2.32 on p.9 for more information on contingency procedures

4.29 As part of your feedback, you may wish to consider the noise analysis data provided in Annexes D, E and F of this document, such as noise contours, population counts, and the numbers of sensitive buildings (for example, hospitals, schools, and places of worship) overflown now and any differences due to the design options presented in this proposal.

4.30 See Section 6 on p.43 for full details on how to understand the maps and data tables.

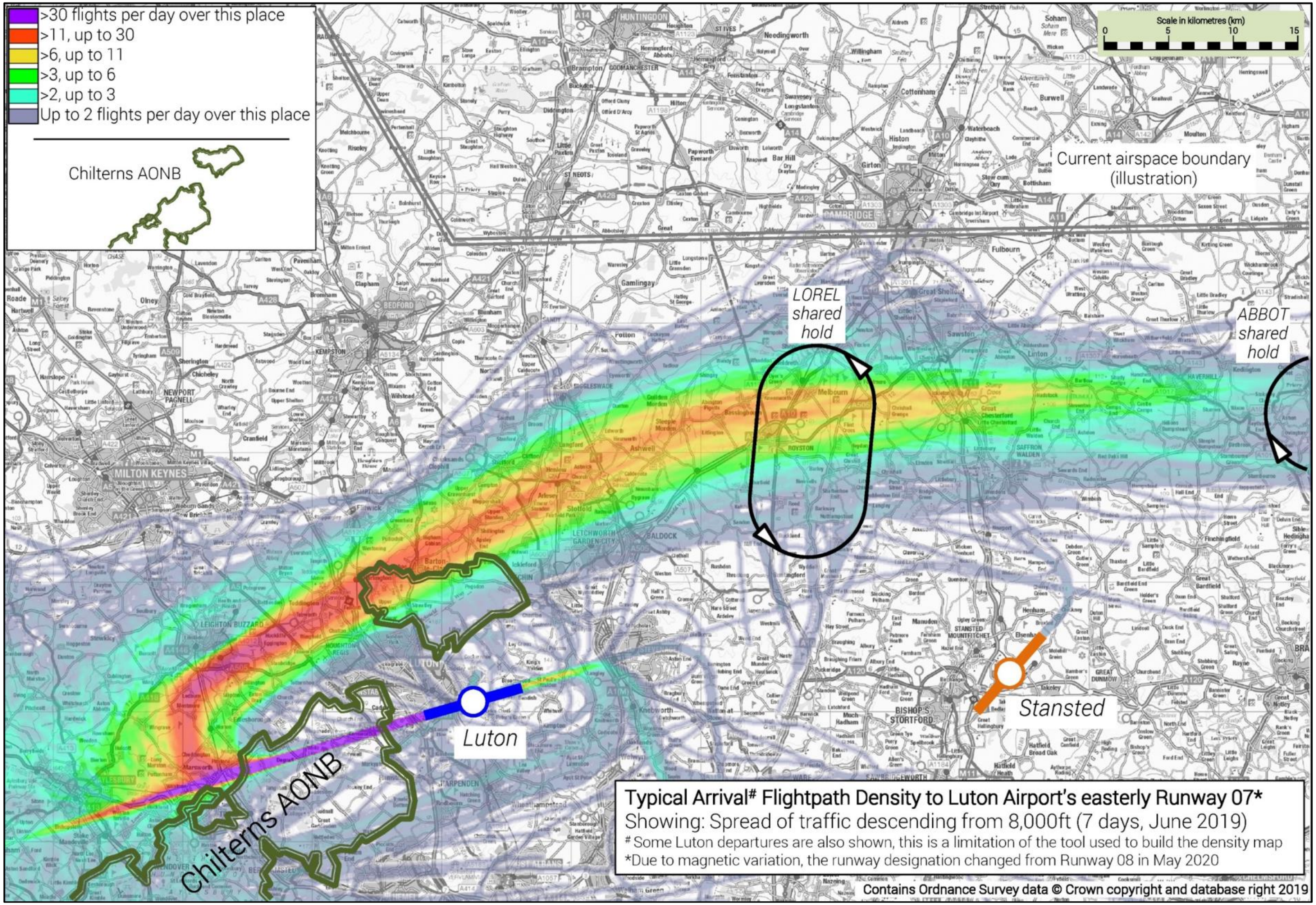


Figure 5 Density map of LLA arrivals from 8,000ft to easterly Runway 07

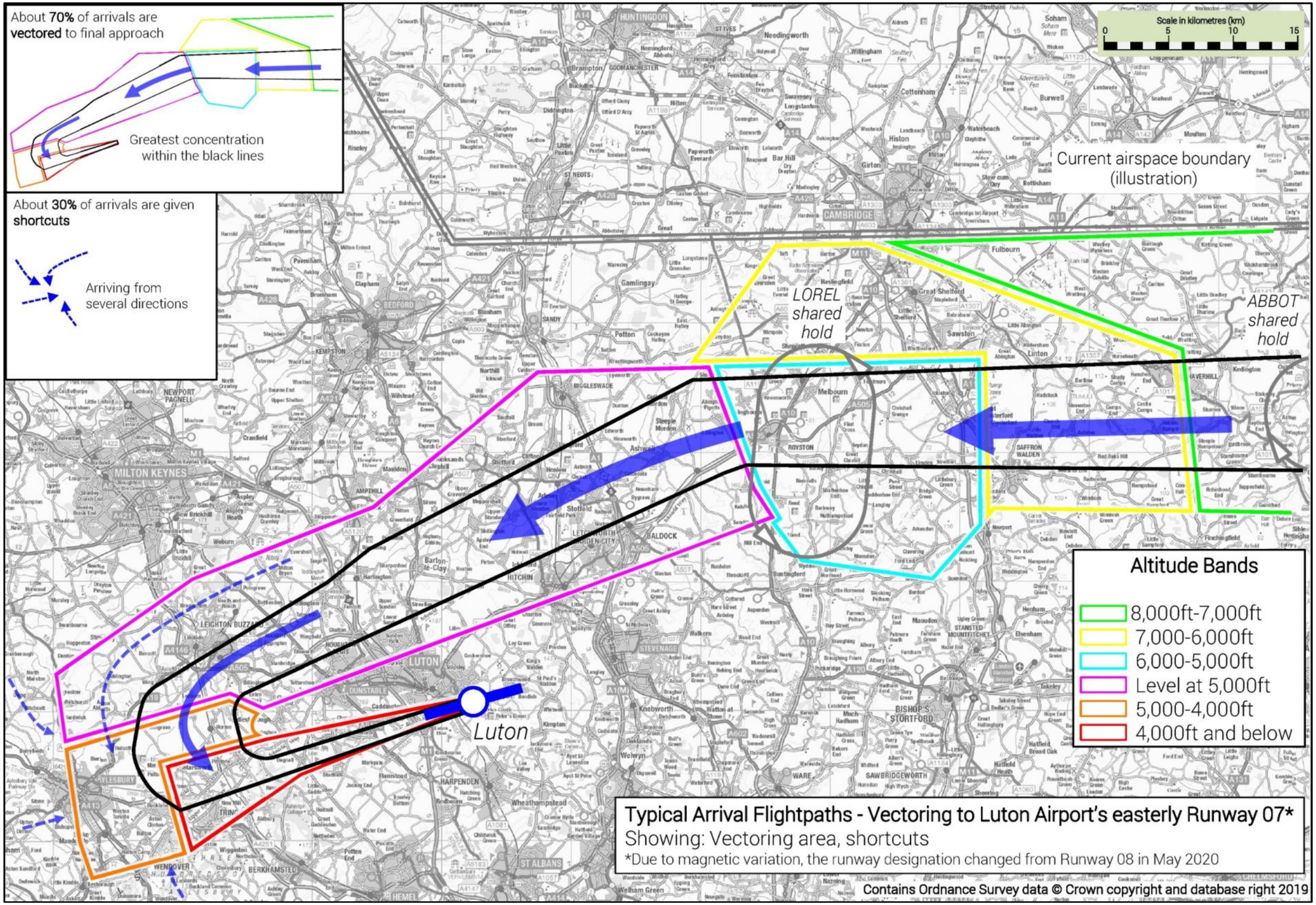


Figure 6 Diagram summarising altitudes, flows and greatest concentration of LLA arrivals from 8,000ft to easterly Runway 07

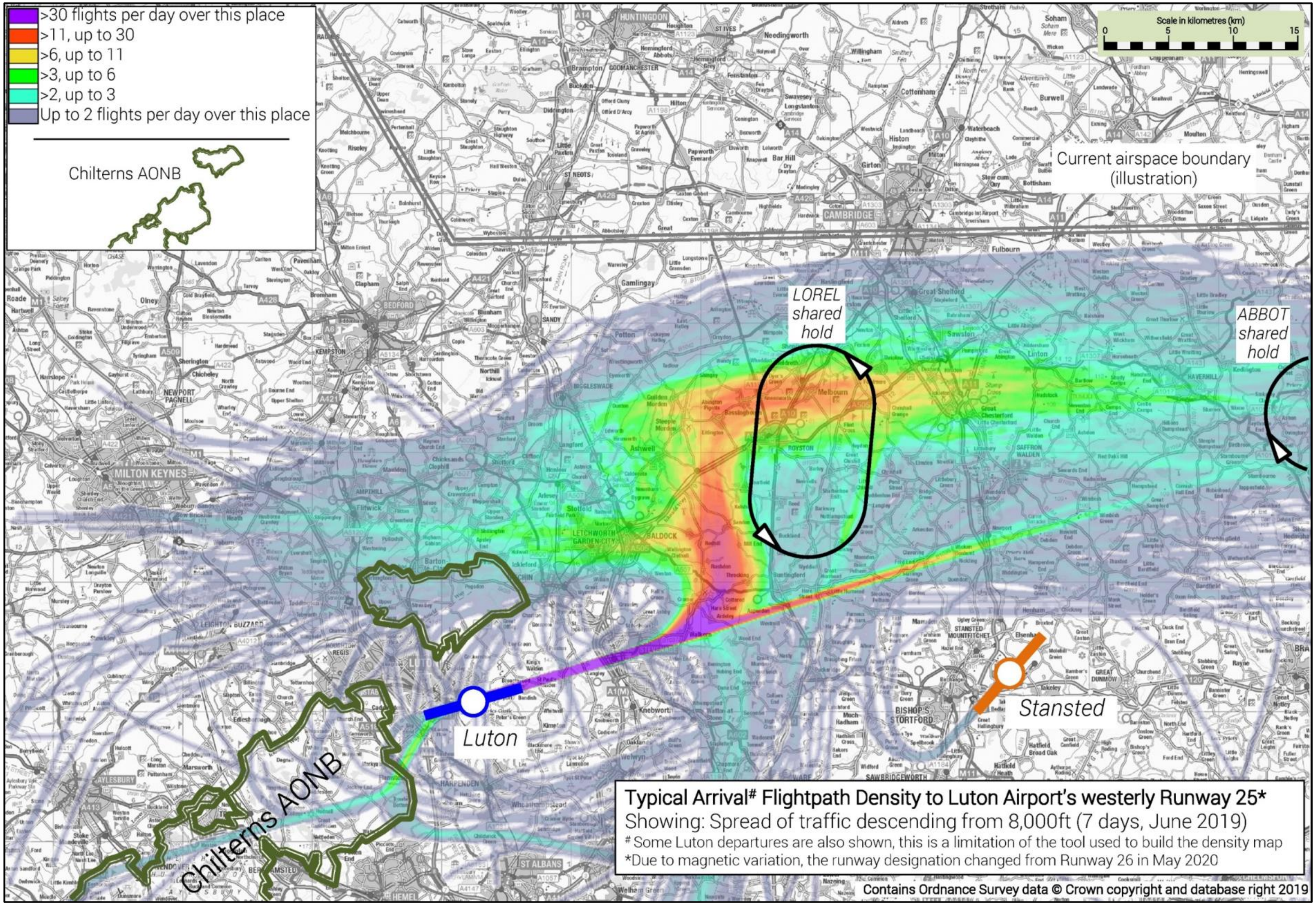


Figure 7 Density map of LLA arrivals from 8,000ft to westerly Runway 25

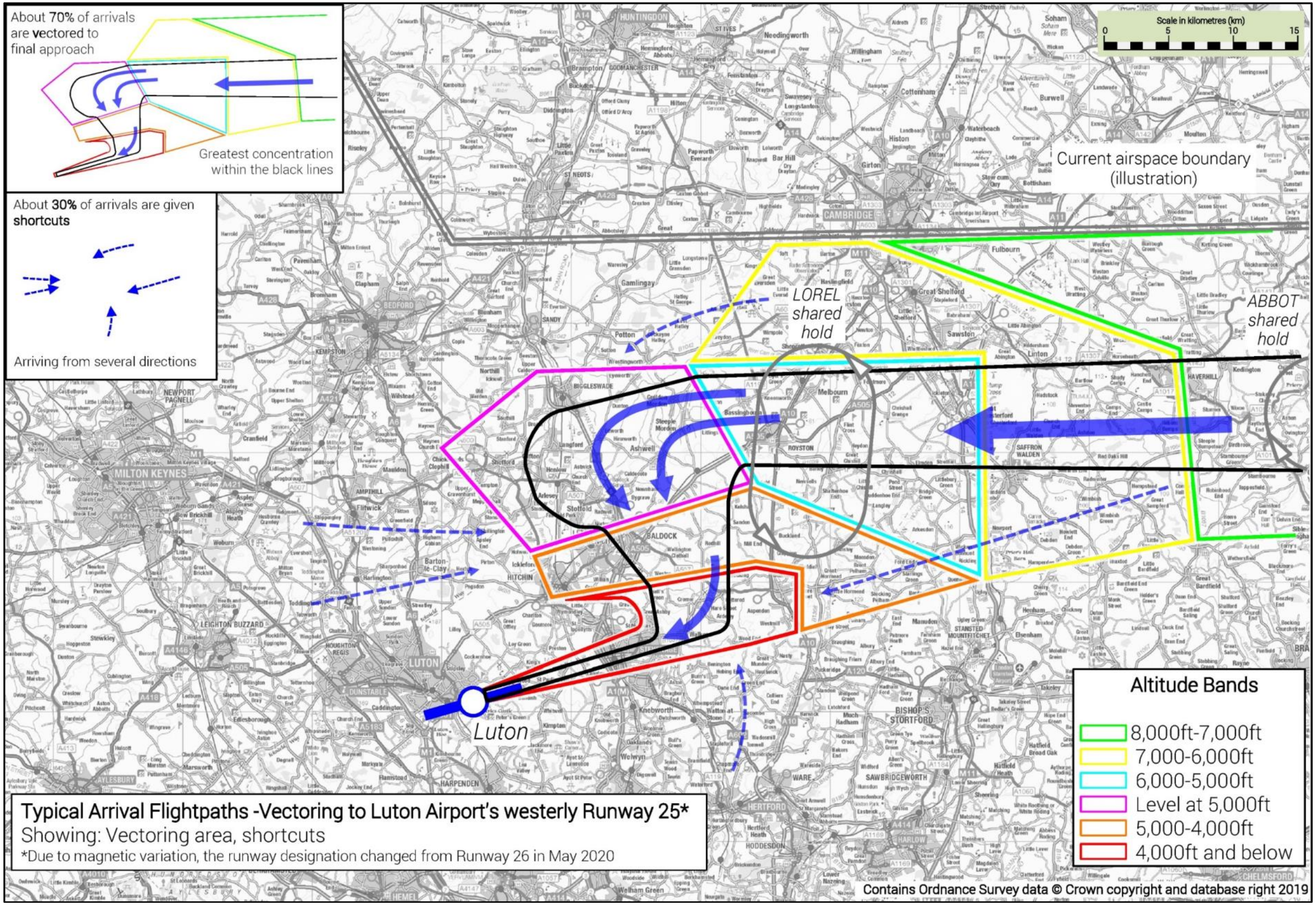


Figure 8 Diagram summarising altitudes, flows and greatest concentration of LLA arrivals from 8,000ft to the westerly Runway 25

5. Airspace Design Options for Consultation: Option 1 and Option 2

Where would they fly, and how narrow might the flightpath be?

5.1 As part of each section for each option, there is a detailed map which you can use to find where you live, work or spend time, to see where aircraft would go, and at what altitude, and how broad or narrow each option's flightpath would be. We have also provided a textual description of the option and impacts with links to where you can find further information.

5.2 See Section 6 on p.43, which explains how to study and use the maps, tables and diagrams, and relate them to where you live, work or spend time.

Where can I find more detail about the costs and benefits of the options, and their impacts?

5.3 A summary of the Full Options Appraisal can be found in Annex B of this document.

5.4 The Full Options Appraisal is an assessment of the costs and benefits of the proposal. Each option is analysed, quantified, monetised, or – where this would be disproportionate – qualitatively assessed and compared. This helps stakeholders to see detailed information and potential impacts of different options, in order to be able to make an informed response to the consultation. If you would like to read the complete full options appraisal document, it is available on the CAA Airspace Change Portal (see FOA, ref 11).

Some parts of the airspace design are common to both Options

5.5 The upper airspace design, upper arrival route design, and holding pattern (all c.8,000ft & above) are common.

5.6 During Stage 2 of the airspace change process (November 2019) a long list of higher-level options (c.8,000ft and above) was developed to separate LLA and Stansted arrival flows (see ref 6). When these options were evaluated against our design principles, all failed to adequately meet them except the single higher-level option presented within this document. Full details of the evaluation of these options is available on the CAA Airspace Change Portal under Stage 2 (see ref 7).

5.7 The proposed new hold would be located over Grafham Water, close to the junction of the A1 and the A14 west of Huntingdon as shown in Figure 9 opposite.

5.8 New routes called Standard Arrival Routes (STARs) would be introduced exclusively for LLA arrivals, to connect the existing route network to the proposed hold.

5.9 New controlled airspace (CAS) is needed to contain those routes and the hold, at higher levels c.7,500ft and above – the base of CAS is always at least 500ft lower than the lowest aircraft within, which would be c.8,000ft in the vicinity of the hold. This change of airspace is most likely to impact aviation stakeholders, so we have provided more technical details in Section 7.

5.10 The proposed new LLA STARs are illustrated by the blue arrows in Figure 9. The amber arrows depict today's STARs and holds that are currently shared between both airports, and which would become dedicated to aircraft arriving at Stansted[17].

5.11 The aircraft on these new blue STARs would descend from the cruise phase of flight to a minimum altitude of c.8,000ft, which is the lowest an aircraft can descend to in this region. If there is no requirement for an aircraft to use the hold, then air traffic controllers can bypass the hold and route them to the runway as described for the lower options later in this section.

5.12 We generally expect aircraft to bypass the hold because the proposed upper airspace system is less likely to require holding – but some holding would still be necessary. As described above, this upper airspace design and holding pattern is the only one that progressed to this stage of the process.

[17] Arrivals to Cambridge Airport also follow the arrival routes for Stansted. This arrangement would continue unchanged under this proposal.

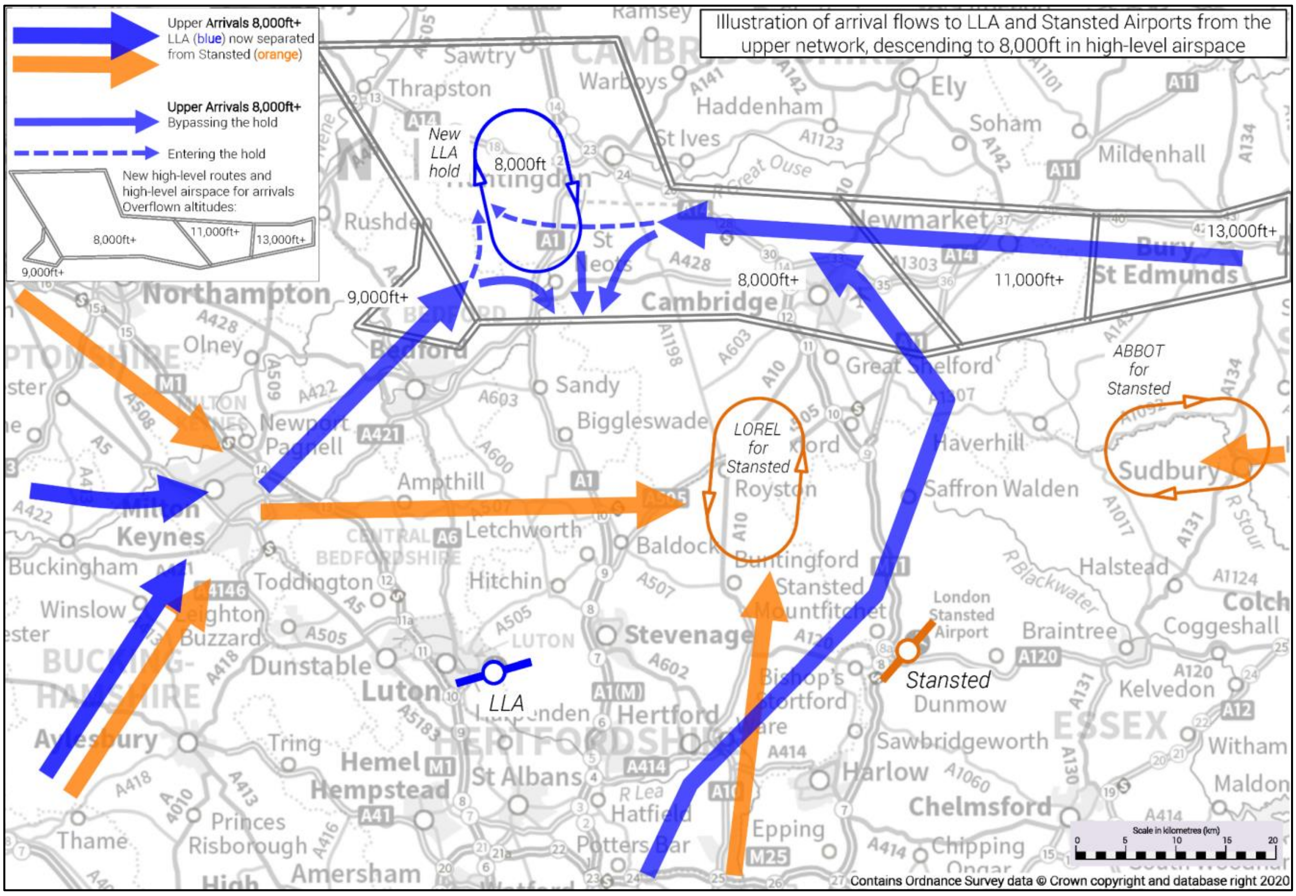


Figure 9 Illustrating how we propose to separate LLA arrivals from Stansted arrivals at a high level in the upper network, descending to 8,000ft. This upper design is compatible with both the lower designs.

High level arrivals

5.13 In Figure 9 it is clear that areas within the new grey airspace boundary would be newly overflown at higher altitudes by LLA arrivals. This includes Bury St Edmunds (13,000ft and above), Newmarket (11,000ft and above), most of Cambridge (typically above 8,000ft), Huntingdon and St Neots (8,000ft).

5.14 In addition to the upper airspace design being common to both lower options, we identified volumes of lower altitude CAS that are no longer required by commercial aircraft. We are therefore proposing that these specific airspace volumes are re-categorised as uncontrolled (Class G) airspace. This change is considered technical in nature and is not related to any proposed change in commercial aircraft flightpaths, and again is fully compatible with both the lower airspace options. This element of the proposal is of benefit to general aviation and sport & recreational aviation stakeholders and is explained further in Section 7.

5.15 Our descriptions of the options over the following pages focus on the impact aviation noise would have on local communities, because Government guidance states that this is the highest priority at altitudes below 7,000ft.

5.16 Both lower design options start at approximately 8,000ft descending to the runway, and both are fully compatible with this upper design. At and above 7,000ft for this upper design option, the Government's priority is the reduction of aircraft CO_2 emissions.

5.17 All airports (including LLA) have contingency procedures which pilots have stored for emergency use (such as radio or radar failure). These events are extremely rare, and the current contingency flight procedures have not been used at LLA for at least ten years.
Under either Option, new contingency procedures are needed because LLA arrivals would no longer use the current shared holds, which is where the current contingency procedures start. Instead they would arrive at a new dedicated hold for LLA, which is where the new contingency procedures would need to start. See paragraphs 2.30-2.32 on p.9 for more information on contingency procedures

5.18 The tables in Annex B summarise the outcome of the Full Options Appraisal (ref 11) to help you understand all the anticipated impacts of implementing these options.

Option 1 – use vectoring and shortcuts to reach the runway

Overview

5.19 For this option, the controller takes the arrival flow from the upper design – which has already been separated from the Stansted arrival flows – and either vectors aircraft towards the runway, or gives them shortcuts if the opportunity arises, or mixes both methods. (See paragraph 3.7 on p.12 for a description of vectoring, and paragraph 3.9 on p.13 for a description of shortcuts.)

5.20 Arrivals to LLA are currently vectored or given shortcuts all the time, are naturally dispersed to a certain extent, and do not tend to follow precisely the same track.

5.21 Most arrivals would start from the new upper design, further north than today's flows – there would be significant flightpath changes from c.8,000ft-6,000ft. Between 6,000ft-5,000ft this option starts to become similar to the current flightpath. From 5,000ft and below, the flightpath becomes even more similar to the current flightpath, with similar dispersion/concentration. Some shortcuts miss out the upper design entirely (in the same way some current flights miss out today's shared upper design), and we expect this to continue. This paragraph applies to both easterly Runway 07 and westerly Runway 25.

How many aircraft might there be, what proportion of aircraft would be vectored, and what proportion would use shortcuts?

5.22 We used forecasts for the summer season (an industry standard period of 92 days, always from 16th June to 15th September) to estimate the number of arriving flights per day, the average number of arrivals per hour and the expected peak number of arrivals per hour. Given that the proportion of traffic arriving during the day is different from that arriving at night, that Runway 25 and Runway 07 are used in different proportions due to the prevailing wind, and that a proportion of arrivals would be given a shortcut rather than vectored, we have produced a table to help illustrate how these combinations of proportions were determined. This table of proportions is provided in Annex C, and also informed the environmental technical analysis in later Annexes.

5.23 From this, we can estimate the greatest number of overflights per hour you might see, and how they are likely to behave. (Noting that the coronavirus pandemic has temporarily reduced the numbers of flights in the UK and across Europe.) The data we provide illustrates the expected pattern of busiest hours and most likely proportions of vectored traffic vs shortcut traffic as volumes recover, and grow beyond, pre-pandemic levels.

Summer Flights	2022		2032 No DCO		2032 With DCO	
Daily range (Min-Max)	192-249		192-249		246 - 319	
Daily average	219		219		280	
Average Per Hour	9		9		12	
Expected Peak Per Hour	24		24		31	
Split between shortcuts and vectoring	Shortcut approx. 7	Vectors approx. 17	Shortcut approx. 7	Vectors approx. 17	Shortcut approx. 9	Vectors approx. 22
Likely Busiest hours	0700-0800, 1200-1300, 1800-1900, 2200-2300		0700-0800, 1200-1300, 1800-1900, 2200-2300		0700-0800, 1800-1900, 1900-2000, 2200-2300	

Table 5 Option 1 - Estimated number of LLA arrival flights per day, and peak flights per hour split into shortcuts and vectoring

5.24 Note that these are **indicative** figures for the **peak hour** (whichever runway is in use). This gives an indication of the greatest number of flights we expect to be experienced in an hour ('worst case' for overflight). Should air traffic recover from the effects of the coronavirus pandemic more slowly, then these numbers per day and per hour would be lower and the impacts would be lesser.

Where would arriving aircraft fly?

Easterly Runway 07 - Vectoring and shortcuts to final approach (Figure 10, p.35)

5.25 Controllers would take most of the LLA arrivals at 8,000ft and vector them within the swathes depicted in Figure 10. Note that controllers do not always use ground references (towns, roads, lakes or other features) though some may be marked on their radar displays. They are included here to help stakeholders understand where the traffic is likely to be positioned. Arrival traffic would fly south of Grafham Water past St Neots, to the east of the A1 main road and roughly parallel with it. To the east of Sandy, aircraft would be descended to 5,000ft and turned right (in the vicinity of Biggleswade or Henlow), mostly north of the A1-A505 junction near Letchworth similar to today. The LLA arrival flow continues west, level at 5,000ft for about 40km, over the northern part of the Chilterns AONB, with the controller vectoring most aircraft south of Leighton Buzzard (though some may be vectored to the north). As the traffic reaches an area northeast of Aylesbury the aircraft would be turned left, roughly perpendicular to the extended runway centreline, and descended to 4,000ft, then turned left and descended once more to establish on final approach, typically somewhere between the east of Stoke Mandeville area around 4,000ft and Pitstone Hill around 3,000ft. The swathe within which controllers vector aircraft narrows until it aligns with the runway on final approach. The final approach path to Runway 07 always overflies part of the Chilterns AONB, from Pitstone Hill to Kensworth Common, in a very narrow path. Vectoring naturally causes some dispersion, and our controllers expect the areas described here to be the most commonly overflown b5.23-elow 7,000ft. Some would be vectored on shortcuts from the east similar to today, or to the north of Leighton Buzzard like today[18].

5.26 In Figure 10 we have shown the areas likely to be overflown by aircraft arriving to Runway 07. The coloured shapes represent the area in which aircraft would be vectored to the runway at different altitudes. The greatest concentration of vectored aircraft would be within the solid black lines via the solid blue arrows. Areas outside the coloured polygons would typically experience the same level of overflight as today, and these flows are represented by the blue dashed arrows (shortcuts or alternate flightpaths).

Westerly Runway 25 - Vectoring and shortcuts to final approach (Figure 11, p.35)

5.27 Controllers would take most of the LLA arrivals at 8,000ft and vector them within the swathes depicted in Figure 11. Arrival traffic to runway 25 would fly south of Grafham Water past St Neots, to the east of the A1 main road and roughly parallel with it, some traffic heading further east, so the 8,000ft arrivals may be spread between the east of Sandy and the west of Bourn. The controllers would then descend the traffic to 5,000ft in this same spread, between Biggleswade and Royston, where it would likely stay level at 5,000ft for about 10-15km. The controllers would turn the traffic to the south, either in an S-shape, or straight. As the traffic reaches the Letchworth-Baldock-Wallington area the controller turns the aircraft roughly perpendicular to the extended runway centreline, and descends it to 4,000ft, then turns right and descends once more to establish on final approach typically around Buntingford from 4,000ft to 3,000ft and Stevenage 3,000ft and below. The swathe narrows until it aligns with the runway on final approach. The final approach path to Runway 25 always overflies Ardeley, Walkern, Stevenage and St Paul's Walden in a very narrow path. Vectoring naturally causes some dispersion, and our controllers expect the areas described here to be the most commonly overflown below 7,000ft. Some could be vectored from the east to shortcut aircraft to the runway if the opportunity exists, similar to today.

5.28 In Figure 11 we show the areas likely to be overflown by aircraft arriving to Runway 25. The coloured shapes represent the area in which aircraft would be vectored to the runway at different altitudes. The greatest concentration of vectored aircraft would be within the solid black lines via the solid blue arrows. Areas outside the coloured polygons would typically experience the same level of overflight as today, and these flows are represented by the blue dashed arrows (shortcuts or alternate flightpaths).

5.29 As part of your feedback, you may wish to consider the noise analysis data provided in Annexes D, E, and F of this document, such as noise contours, population counts, and the numbers of sensitive buildings (hospitals, schools, and places of worship) overflown now and any differences due to the design options presented in this proposal. See Section 6 on p.43 for full details on how to understand the maps and data tables.

[18] Under a previous airspace change implemented in May 2006, the CAA placed a condition on Luton arrivals which is that arriving traffic for Runway 07 (formerly Runway 08, designation changed in May 2020 due to magnetic variation) should not be routinely vectored over the town of Leighton Buzzard, unless tactically unavoidable. We infer that the intent of this CAA condition is to minimise overflight of the town (whether via a published route, or vectoring), unless tactically unavoidable. See CAA Airspace Policy, Post Implementation Review letter dated 31 Jan 2008, ref 8AP/066/02/06/02 p.3 para 2.2.3 et seq.

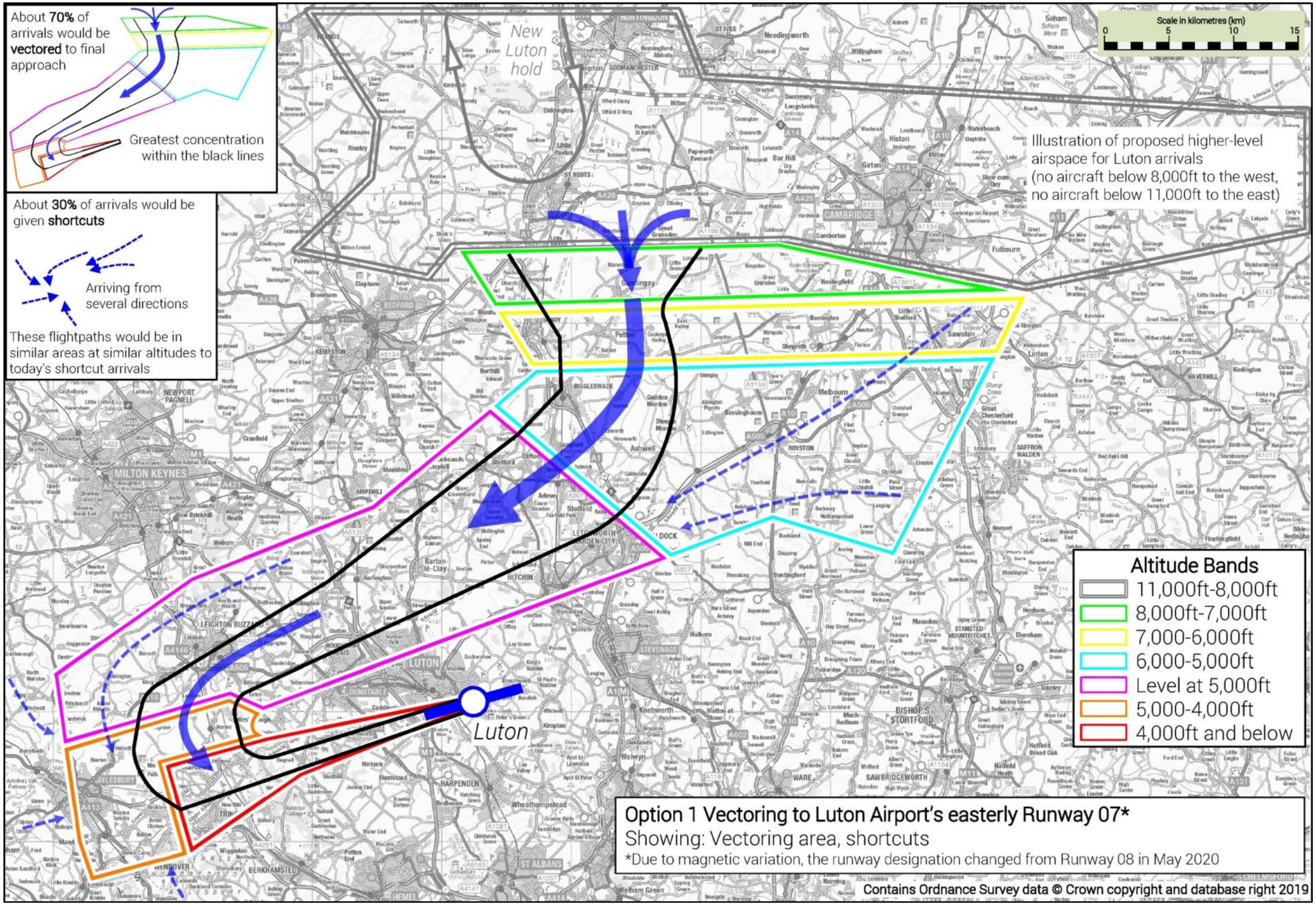


Figure 10 Option 1 for Easterly Runway 07 – Vectoring and Shortcuts

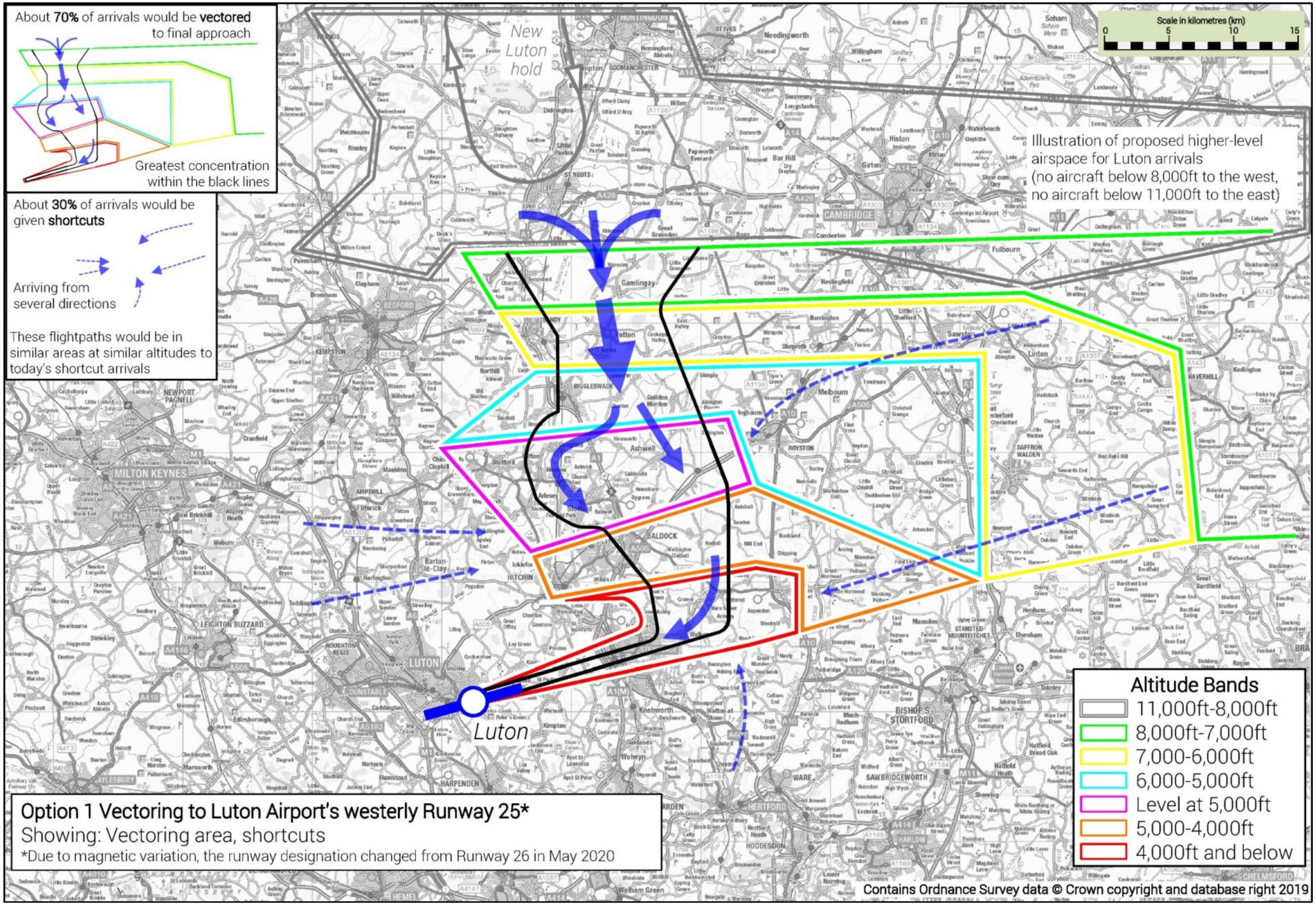


Figure 11 Option 1 for Westerly Runway 25 – Vectoring and Shortcuts

Option 2 – Use automatically flown PBN routes, vectoring, & shortcuts to reach the runway

Overview

5.30 Option 2 is our preferred option. It has many similarities to Option 1, and covers the same region at the same altitudes, but crucially has differences in concentration of overflight. It is important that you understand Option 1 because we will highlight where Option 2 is similar to, and where it is different from, Option 1.

5.31 Option 2's aim is to align as closely as possible with the objectives of the CAA Airspace Modernisation Strategy (AMS, ref 15). In addition to the new hold, four Performance Based Navigation (PBN) routes would be implemented, allowing the controller to transition aircraft from the new hold to the runways; two from the hold to Runway 07 and two from the hold to Runway 25.

5.32 For this option, the upper arrival routes would follow the same design as Option 1 – which is separated from the Stansted arrival flows. However, in Option 2, the controller is then able to decide either to send the aircraft on one of the specified PBN routes in use on the day, or to vector them towards the runway, or to give them a shortcut if the opportunity arises. It is possible that the controller may mix all three. . (See paragraphs 3.4-3.6 on p.12 for a description of PBN, paragraph 3.7 also on p.12 for a description of vectoring, and paragraph 3.9 on p.13 for a description of shortcuts.)

5.33 Arrivals to LLA are currently vectored or given shortcuts all the time, so are naturally dispersed and do not tend to follow precisely the same track. Aircraft issued a PBN route would consistently and accurately follow the predetermined flightpath set by that route, overflying the same areas at the same altitudes. The routes can be designed to minimise overflight of population centres, subject to meeting airspace design criteria, however, this means that people overflown by a route are more likely to be overflown more often, and would be more likely to have an increased noise impact. The consequence is that, based on the Government's method of calculating the impacts of noise on health and quality of life (known as WebTAG), the monetised assessment for Option 2 is a disbenefit on all metrics where Option 1 shows a benefit on most metrics. For full details see the Full Options Appraisal document where there are tables discussing community noise impact on health and quality of life.

5.34 The rationale for two PBN transitions to each runway is to enable them to be used in a rotation pattern to provide periods of more equitable distribution, or respite, for communities under the flightpaths. Controllers would not be able to direct all aircraft to use the PBN transitions all the time, so this option does include an element of shortcutting and vectoring, as described in Option 1. We estimate about half of the aircraft arriving at LLA would follow the PBN route in use on the day, the rest would be vectored or given a shortcut. It will help you to understand the impacts presented in Option 1 to appreciate how you would be affected when aircraft are vectored under Option 2. This is explained in more detail later in this document.

Additional Controlled Airspace (CAS) specific to Option 2

5.35 The PBN route to Runway 07 that passes to the north of Leighton Buzzard, shown in this document as PBN Route 2, also requires a small additional volume of CAS. Its base would be 4,500ft and its ceiling 5,500ft, beneath the existing CAS base of 5,500ft. It would need to be re-classified as controlled airspace to ensure that LLA arrivals flying on this route have the appropriate level of protection. Because this CAS provides a buffer between uncontrolled airspace and the PBN route, LLA arrivals would not actually expect to fly within this proposed new volume. But the volume is necessary to comply with the CAA's airspace containment rules.

5.36 Because the reclassification of this volume of airspace would have a small impact on members of the General Aviation community who fly from aerodromes in the vicinity of LLA, we are proposing that it is managed to allow access to General Aviation when the northerly PBN route is not in use (only needed c.15% of the time). More detail on this aspect of this option is available in Section 7.

How many aircraft might there be, what proportion of aircraft would use the PBN routes, what proportion would use vectors and what proportion would use the shortcuts?

5.37 We used forecasts for the summer season (an industry standard period of 92 days, always from 16th June to 15th September) to estimate the number of arriving flights per day, the average number of arrivals per hour and the expected peak number of arrivals per hour. Given that the proportion of traffic arriving during the day is different from that arriving at night, that Runway 25 and Runway 07 are used in different proportions due to the prevailing wind, and that a proportion of arrivals would be given a shortcut rather than use the PBN route or vectored, we have produced a table to help illustrate how these combinations of proportions were determined. This table of proportions is provided in Annex C and also informed the environmental technical analysis in later Annexes.

5.38 From this, we can estimate the greatest number of overflights per hour you might see, and how they are likely to behave. The coronavirus pandemic temporarily reduced the numbers of flights in the UK and across Europe. The data we provide illustrates the expected pattern of busiest hours and most likely proportions of PBN traffic vs vectored traffic vs shortcut traffic as volumes recover, and grow beyond, pre-pandemic levels.

Summer Flights	2022	2032 No DCO	2032 With DCO
Daily range (Min-Max)	192-249	192-249	246 - 319
Daily average	219	219	280
Average Per Hour	9	9	12
Expected Peak Per Hour	24	24	31
Split between shortcuts, PBN, vectoring	Shortcut approx. 7 PBN approx. 12 Vectors approx. 5	Shortcut approx. 7 PBN approx. 12 Vectors approx. 5	Shortcut approx. 9 PBN approx. 15 Vectors approx. 7
Likely Busiest hours	0700-0800, 1200-1300, 1800-1900, 2200-2300	0700-0800, 1200-1300, 1800-1900, 2200-2300	0700-0800, 1800-1900, 1900-2000, 2200-2300

Table 6 Option 2 - Estimated number of flights per day, and peak flights per hour split into shortcuts, PBN route and vectoring

5.39 Note that these numbers are **indicative** figures for the **peak** hour (whichever runway is in use). This gives an indication of the greatest number of flights we expect would be experienced in an hour ('worst case' for overflight). Should air traffic recover from the effects of the coronavirus pandemic more slowly, then these numbers per day and per hour would be lower and the impacts would be lesser.

Where would arriving aircraft fly?

5.40 The installation of PBN routes to final approach would make them available for controllers to choose to use – the routes are tools to reduce the complexity of a controller's task, giving them confidence that the aircraft will follow a precise track, and descend to the correct altitudes, without constantly talking to the pilot. This reduces the controller's workload per flight, reducing the likelihood of delays and improving the resilience of the air traffic system.

5.41 For this option, controllers would use the available PBN routes as they see fit, based on the other aircraft in the airspace at the time. This might be for an individual aircraft, or for many arriving aircraft over a longer period of time. Controllers may direct aircraft off the route part way along and vector them the rest of the way, or they may choose to vector continuously, or they may send some on the PBN route and vector or shortcut others into the gaps. It is not possible to say exactly when the routes would be fully or partly used because each air traffic scenario requires judgement by the controller. We have provided estimates of how often we expect the route to be used.

5.42 In the diagrams below we have shown the areas likely to be overflown if this option is implemented, and the low-altitude PBN routes. You can see on the diagrams that the overall region overflown would be the same as Option 1, but with greater concentration along each PBN route, if that one was in use on the day (see paragraphs 5.60-5.63 on p.36 for a description on how the PBN routes could be managed).

5.43 The solid-outlined coloured polygons represent different altitudes and the broadest tolerance of the PBN route. In reality, we would expect aircraft flying the PBN route to be within the solid black lines. Aircraft being vectored or shortcut would follow similar flightpaths to those described in Option 1, represented by dashed-outlined shapes in our diagrams. Air traffic controllers would continue to use vectoring and shortcuts as they do today, for about half the arriving flights, with about half expected to use the PBN routes as per Table 6.

Why couldn't all arrivals use the PBN routes, all the time?

5.44 It is not yet possible, for safety, efficiency and available technology reasons, for all aircraft to follow PBN routes to final approach at LLA all of the time. For the most efficient arrival sequence, the spacing between a leading and following aircraft is regularly adjusted throughout the flight – the spacing between two aircraft near the start of the route, where airspeeds are higher, always needs to be larger than the required spacing at the end of the route near the runway where speeds are slower. This means that some degree of tactical control – vectoring – will be needed for the near to medium term future. The establishment of PBN routes would enable the development of future technology, where more precise arrival times and spacing could be managed effectively a long way from landing at LLA, but this technology is not yet in place.

Easterly Runway 07 – Half of the arrivals use one of the two PBN routes from the hold to final approach, some arrivals given shortcuts as per Option 1, some vectored as per Option 1

5.45 About half the arrivals would use whichever of the two PBN routes is available on the day, should this runway be in use – see paragraphs 5.60-5.63 on p.36 for a description on how the PBN routes could be managed. They would descend to the altitudes indicated by the solid-outlined coloured shapes as they progress from the start of the route near Grafham Water and St Neots, towards Gamlingay and Potton and then southwest. They would most likely stay within the solid black lines (Figure 12, p.38 for PBN Route 1 passing south of Leighton Buzzard, Figure 13 p.39 for PBN Route 2 passing north of Leighton Buzzard). This would mean about half the arrivals fly one of two consistently flown flightpaths[19].

5.46 The remaining half of the arrivals would behave similarly to Option 1's Runway 07 arrangement as in the previous paragraphs, repeated here.

5.47 Controllers would take the remaining LLA arrivals at 8,000ft and direct them south of Grafham Water past St Neots, to the east of the A1 main road and roughly parallel with it.

5.48 To the east of Sandy, aircraft would be descended to 5,000ft and turned right (in the vicinity of Biggleswade or Henlow), mostly north of the A1-A505 junction near Letchworth similar to today. The LLA arrival flow continues west, level at 5,000ft for about 40km, over the northern part of the Chilterns AONB, with the controller vectoring most aircraft south of Leighton Buzzard (but some may be vectored to the north).

5.49 As the traffic reaches an area northeast of Aylesbury the aircraft will be turned left, roughly perpendicular to the extended runway centreline, and descended to 4,000ft, then turned left and descended once more to establish on final approach, typically somewhere between the east of Stoke Mandeville area around 4,000ft and Pitstone Hill around 3,000ft. The swathe within which controllers vector aircraft narrows until it aligns with the runway on final approach. The final approach path to Runway 07 always overflies part of the Chilterns AONB, from Pitstone Hill to Kensworth Common, in a very narrow path.

5.50 Vectoring naturally causes some dispersion of the remaining arrivals, and controllers expect the areas described here to be the most commonly overflown below 7,000ft. Some flights could be vectored on shortcuts from the east similar to today, or to the north of Leighton Buzzard like today.

5.51 In Figure 12 and Figure 13 we show the areas likely to be overflown by aircraft arriving to Runway 07. The dashed-outlined coloured shapes represent the area in which aircraft would be vectored to the runway at different altitudes and the solid-outlined shapes represent those using the available PBN route, where the greatest concentration of overflight is likely. Areas outside the coloured polygons

[19] There is a technical restriction making PBN Route 1 more likely to be used than PBN Route 2 should the runway in use change from westerly Runway 25 to easterly Runway 07 under certain circumstances, see paragraphs 5.60-5.63 on p.36.

would typically experience the same level of overflight as today, represented by the blue dashed arrows (shortcuts or alternate flightpaths).

5.52 The two PBN routes to Runway 07 are shown separately on these two diagrams, but only one would be in use at a time – either Figure 12 *or* Figure 13 would be in operation if Runway 07 was in use. This enables you to compare them, and understand overflight concentrations depending on which PBN route is in use.

Westerly Runway 25– Half of the arrivals use one of the two PBN routes from the hold to final approach, some arrivals given shortcuts as per Option 1, some vectored as per Option 1

5.53 About half the arrivals would use whichever of the two PBN routes is available on the day, should this runway be in use – see paragraphs 5.60-5.63 on p.36 for a description on how the PBN routes could be managed. They would descend to the altitudes indicated by the solid-outlined coloured shapes as they progress from the start of the route near Grafham Water and St Neots, towards Gamlingay and Potton and then south. They would most likely stay within the solid black lines (Figure 14, p.40 for PBN Route 3 making an S-shape, Figure 15 p.41 for PBN Route 4 heading directly south). This would mean about half the arrivals fly one of two consistently flown flightpaths.

5.54 The remaining half of the arrivals would behave similarly to Option 1's Runway 25 arrangement as in the previous paragraphs, repeated here.

5.55 Controllers would take the remaining LLA arrivals at 8,000ft and direct them south of Grafham Water past St Neots, to the east of the A1 main road and roughly parallel with it, some traffic heading further east, so the 8,000ft arrivals may be spread between the east of Sandy and the west of Bourn. The controllers would then descend the traffic to 5,000ft in this same spread, between Biggleswade and Royston, where it would likely stay level at 5,000ft for about 10-15km. The controllers would turn the traffic to the south, either in an S-shape, or it may be straight. As the traffic reaches the Letchworth-Baldock-Wallington area the controller turns the aircraft roughly perpendicular to the extended runway centreline, and descends it to 4,000ft, then turns right and descends once more to establish on final approach typically around Buntingford from 4,000ft to 3,000ft and Stevenage 3,000ft and below. The swathe will narrow until it aligns with the runway on final approach. The final approach path to Runway 25 always overflies Ardeley, Walkern, Stevenage and St Paul's Walden in a very narrow path. Vectoring naturally causes some dispersion of the remaining arrivals, and our controllers expect the areas described here to be the most commonly overflown below 7,000ft. Some could be vectored from the east to shortcut aircraft to the runway if the opportunity exists, similar to today.

5.56 In Figure 14 and Figure 15 we show the areas likely to be overflown by aircraft arriving to Runway 25. The dashed-outlined coloured shapes represent the area in which aircraft would be vectored to the runway at different altitudes and the solid-outlined shapes represent those using the available PBN route, where the greatest concentration of overflight is likely. Areas outside the coloured polygons would typically experience the same level of overflight as today, represented by the blue dashed arrows (shortcuts or alternate flightpaths).

5.57 The two PBN routes to Runway 25 are shown separately on these two diagrams, but only one would be in use at a time – either Figure 14 *or* Figure 15 would be in operation if Runway 25 was in use. This enables you to compare them, and understand overflight concentrations depending on which PBN route is in use.

5.58 As part of your feedback, you may wish to consider the noise analysis data provided in Annexes D, E, and F of this document, such as noise contours, population counts, and the numbers of sensitive buildings (hospitals, schools, and places of worship) overflown now and any differences due to the design options presented in this proposal.

5.59 See Section 6 on p.43 for full details on how to understand the maps and data tables.

How would the PBN routes be managed?

5.60 It is important to understand that we cannot predetermine which runway would be in use, so we cannot consult on this. The runway in use is predominantly determined by the wind direction – departing and arriving aircraft usually face into the wind. This enables aircraft to reduce speed over the ground just before landing and to maximise efficiency during take-off. Prevailing winds in the UK suggest that the westerly runway would be in use for approximately 70% of the time.

5.61 This option proposes introducing two PBN routes to each runway, with their availability managed to offer equitable noise distribution for local communities. These routes have been designed to minimise overflight of population centres wherever possible, whilst being as far apart as technically possible to maximise the opportunity for equitable traffic distribution. Where possible we have avoided a design which results in the same communities being overflown by multiple routes, and we have taken into account other airports' routes below 7,000ft. It is also important to note that there are international technical design requirements with which we must comply. These restrict the distances between turns, which can limit the choice of exactly where routes from the hold to the runways could be positioned. These restrictions ensure that aircraft are able to safely follow the turns. It is also important to note that, if the controller decides to vector or shortcut any particular flight or flights, those flights would behave in a similar way to Option 1.

5.62 We have set out questions (see Annex A) to gain your feedback on the scheduling of alternation between the two PBN routes from the hold to Runway 25, for instance at what time of the day the switch from one route to the other should be made. There are some operational factors that must be considered before a final decision, if this option is progressed; for example, how busy the airspace is at specific times as it becomes more complicated to make a change to the arrival process during busy periods. Table 6 p.33 shows the expected number of aircraft arriving at LLA each hour, so from this information we have concluded that the most appropriate time to change between PBN routes would be around midnight, in the early morning or mid-morning.

5.63 It is also important to note that, due to the way we propose to manage the additional controlled airspace needed for the PBN route north of Leighton Buzzard, there is an additional restriction. Whenever the runway direction changes from Runway 25 to Runway 07, safety dictates that the rotation pattern must always start on PBN Route 1 which goes south of Leighton Buzzard. This allows us to work with other airspace users to ensure that the newly proposed volume of CAS in the vicinity is made available to protect LLA arrivals. This means it would not be feasible to produce a schedule for Runway 07, but for periods of sustained use it would be possible to switch between the route passing south of Leighton Buzzard and the route passing north. More details are provided in Section 7.

Intentionally blank for pagination purposes.

Maps and diagrams illustrating Option 2 follow:

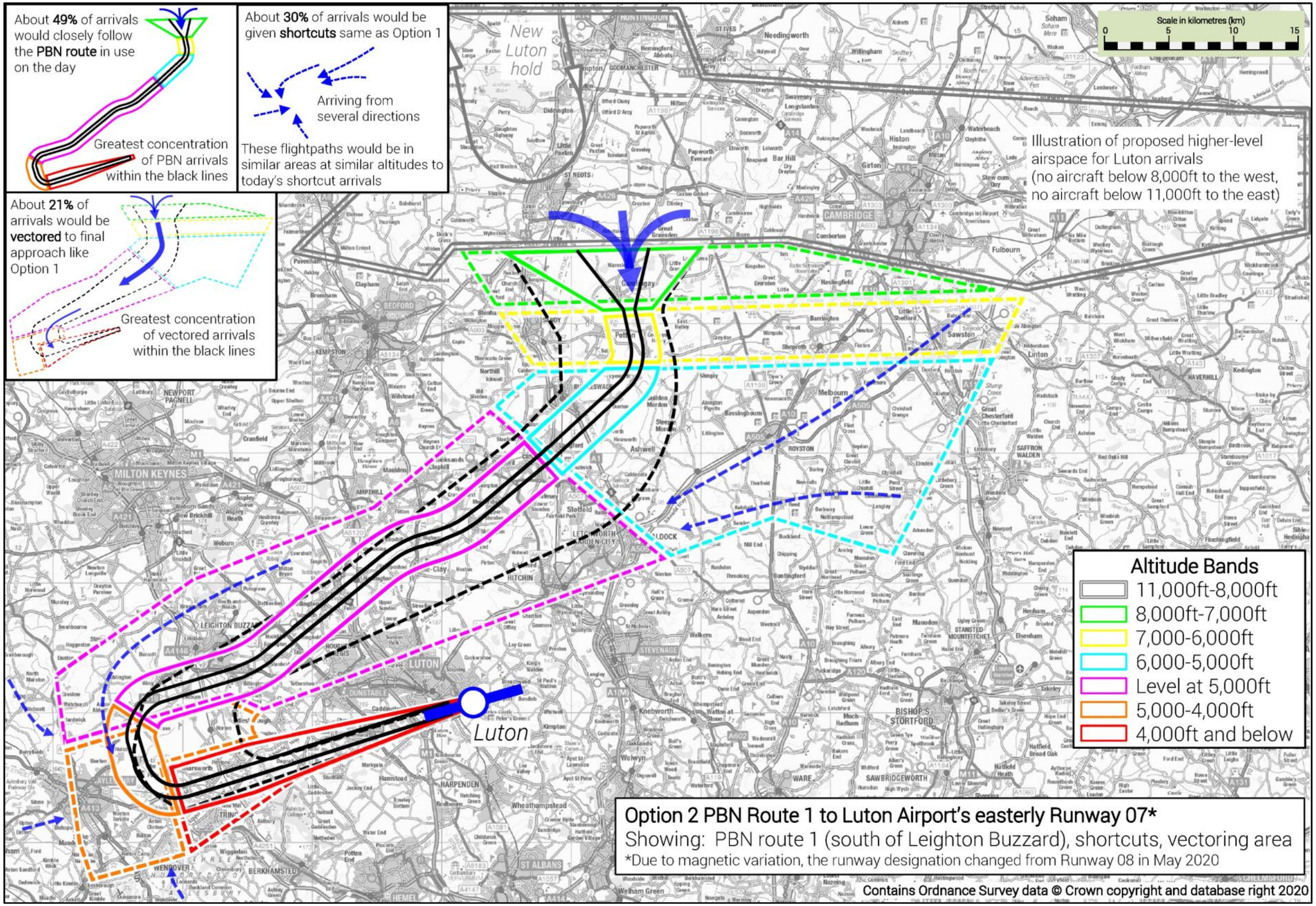


Figure 12 Option 2, PBN Route 1 (south of Leighton Buzzard) for Easterly Runway 07 – Proportions using PBN route, shortcuts, and vectoring

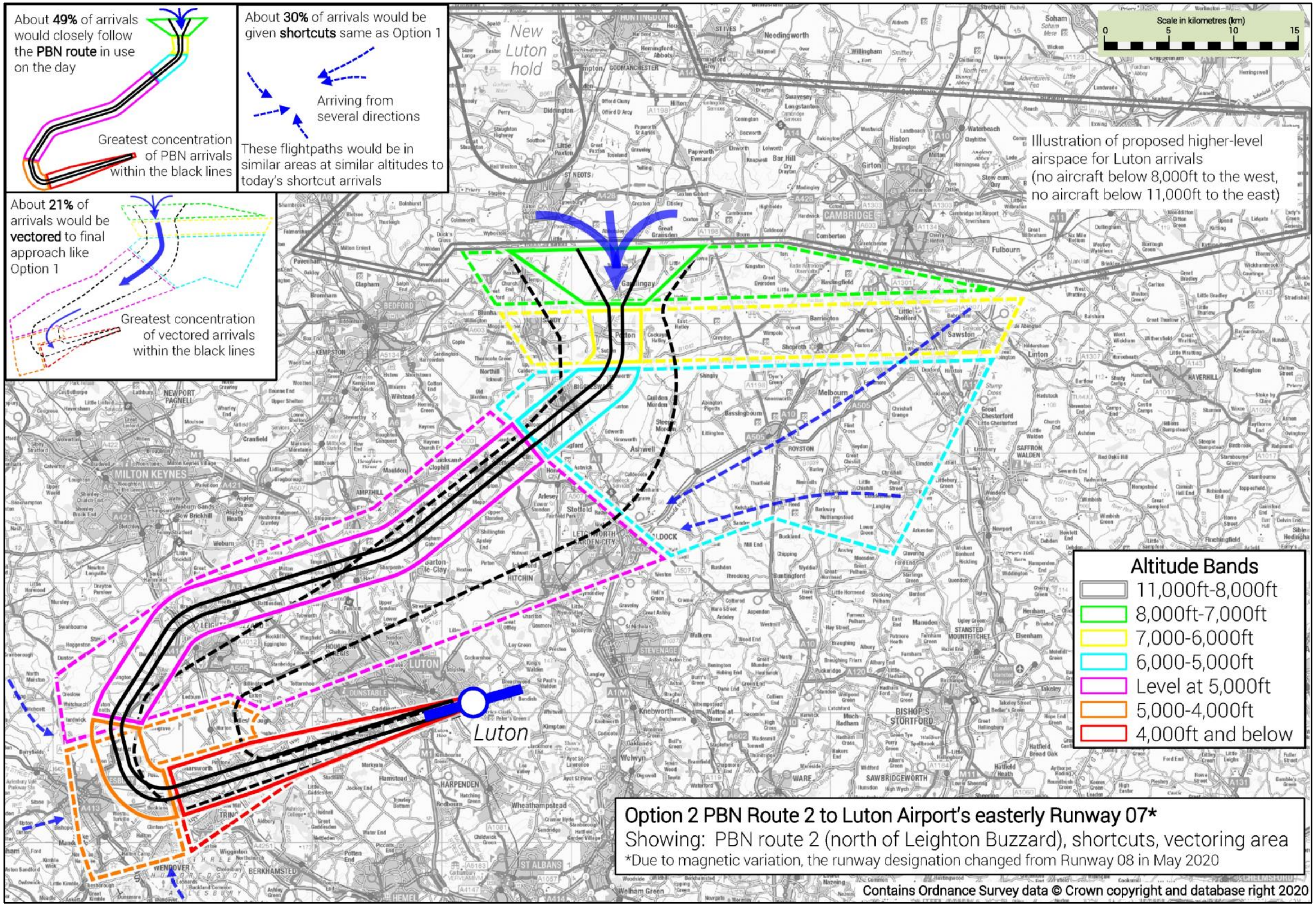


Figure 13 Option 2, PBN Route 2 (north of Leighton Buzzard) for Easterly Runway 07 – Proportions using PBN route, shortcuts, and vectoring

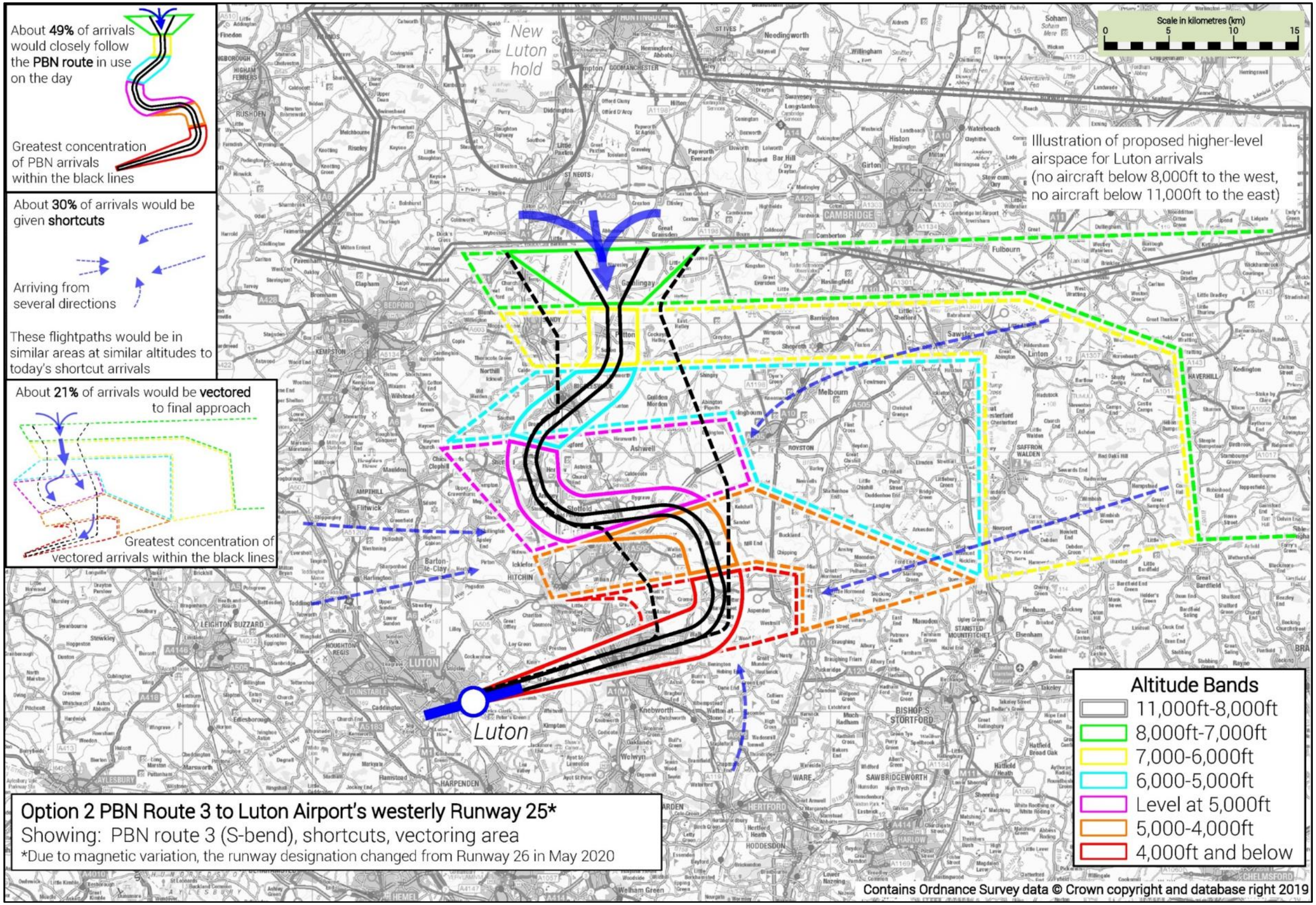


Figure 14 Option 2, PBN Route 3 (S-bend) for Westerly Runway 25 – Proportions using PBN route, shortcuts, and vectoring

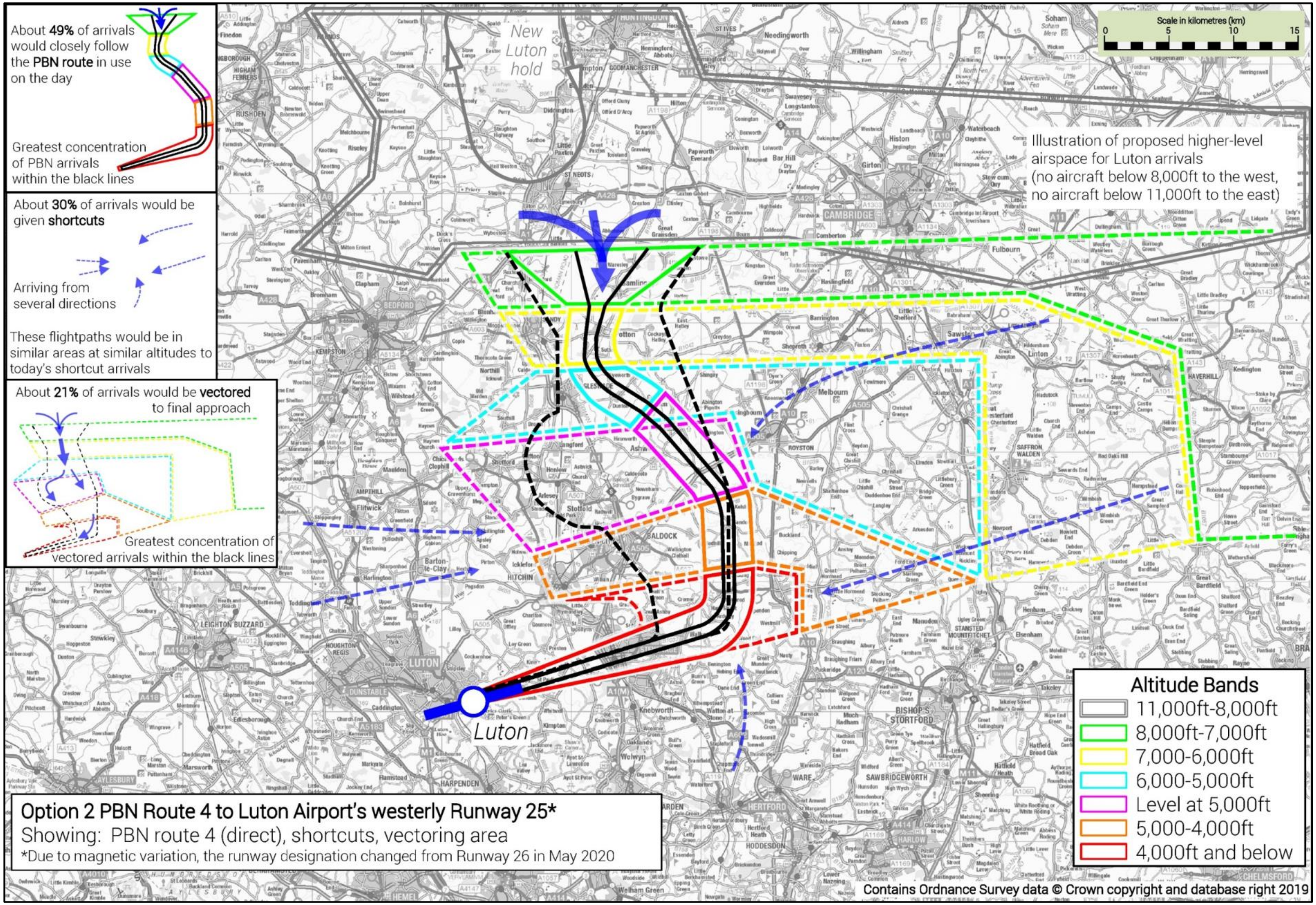


Figure 15 Option 2, PBN Route 4 (direct) for Westerly Runway 25 – Proportions using PBN route, shortcuts, and vectoring

Aviation fuel and CO_2 greenhouse gas emissions comparison

5.64 At Stage 2 Initial Options Appraisal (ref 8) we stated that most arrivals to LLA would need to travel further, and provided simplified estimated averages on the differences in fuel cost per flight based on those additional distances. These simplified estimates did not account for aircraft staying higher longer, the lower likelihood of holding (including less holding for Stansted arrivals), and the provision of shortcuts similar to today.

5.65 An updated analysis accounting for those items has been undertaken using a combination of the NATS fuel analysis simulator and appropriate scaling of traffic levels. From a fuel analysis point of view, vectoring (Option 1) and PBN routes with vectoring (Option 2) has no impact because the aircraft are still flying the equivalent distances; the type of route they follow is immaterial. Also, the DCO is outside the scope of this consultation, however for consistency we present data for scenarios with and without.

5.66 Like all fossil fuels, aviation fuel burns to emit mainly CO_2, and other greenhouse gases. A change in fuel burn can be converted to CO_2 equivalent (CO_2e – see paragraph 3.35 on p 17).

5.67 The average LLA arrival in 2022 is expected to increase fuel use by c.89kg, emitting c.285kg more CO_2e.

5.68 The average LLA arrival in 2032 without the DCO is expected to increase fuel use by c.89kg, emitting c.285kg more CO_2e, because there would be no predicted increase in flights without the DCO.

5.69 The average LLA arrival in 2032 with the DCO is expected to increase fuel use by c.80kg, emitting c.254kg more CO_2e. There would be more flights with the DCO, but relatively, there would be a smaller increase in holding due to the arrival flow separation from Stansted at upper altitudes, compared with the baseline where the flows are not separated.

5.70 The average Stansted arrival in 2022 is expected to decrease fuel use by c.5kg, i.e. c.15kg less CO_2e.

5.71 The average Stansted arrival in 2032 is expected to decrease fuel use by c.11kg, emitting c.35kg less CO_2e. Stansted arrivals are forecast to grow slightly, and this would not be affected by LLAL's DCO because the arrival flows would be pre-separated and far less dependent on each other.

	Fuel per year, tonnes, negative is disbenefit		
Scenario	2022	2032 No DCO	2032 With DCO
Do Nothing	Baseline	Baseline	Baseline
Option 1	-5,841	-5,219	-6,191
Option 2	-5,841	-5,219	-6,191
	CO_2 equivalent (3.18 conversion)		
Do Nothing	Baseline	Baseline	Baseline
Option 1	-18,574	-16,596	-19,687
Option 2	-18,574	-16,596	-19,687
Scenario	Overall Fuel cost (at £356.76/tonne) IATA jet fuel cost USD457.38, USD to GBP 0.78 Rates dated 28 Feb 2020		
Do Nothing	Baseline	Baseline	Baseline
Option 1	-£2,084,000	-£1,862,000	-£2,209,000
Option 2	-£2,084,000	-£1,862,000	-£2,209,000

	Average change in fuel cost per flight (LLA Arrivals)		
Scenario	2022	2032 No DCO	2032 With DCO
Num flights	70,740	70,740	91,500
t fuel total	-6,330	-6,330	-7,302
t fuel per flight	-0.089	-0.089	-0.080
t CO2e per flight	-0.285	-0.285	-0.254
£/flt Opt 1	-£31.92	-£31.92	-£28.47
£/flt Opt 2	-£31.92	-£31.92	-£28.47
	Average change in fuel cost per flight (Stansted Arrivals)		
Num flights	101,719	102,410	102,410
t fuel total	489	1,111	1,111
t fuel per flight	0.005	0.011	0.011
t CO2e per flight	0.015	0.034	0.034
£/flt Opt 1	**£1.72**	**£3.87**	**£3.87**
£/flt Opt 2	**£1.72**	**£3.87**	**£3.87**

Table 7 Fuel and CO_2e greenhouse gas summary

Option Preference Statement

5.72 Both options have the same fuel and greenhouse gas disbenefit, there is no preference via that metric.

5.73 Option 2, a new hold to the north of LLA with a mix of PBN routes, shortcuts and vectoring to the runway, is the preferred option.

5.74 Option 2 gives air traffic controllers additional tools to manage and reduce the complexity of their workload. It is likely to lead to periods of flightpath concentration, split equitably where possible, for about half the arrivals to LLA (see Table 6 on p.33). About half of the arrivals would have some natural dispersion as described in Option 1. This option also aligns more closely with the Government's Airspace Modernisation Strategy (ref 15, see also paragraph 2.35 onwards, p.10).

6. How to understand changing noise impacts below 7,000ft

6.1 To fully understand the potential noise impacts of this proposal, we ask you to invest time in understanding the data and maps presented here. This section explains how you can use the information to compare your current experience of overflight with that of the proposed design options so that you can provide feedback on those proposed designs.

Things to remember when considering noise impacts:

6.2 This airspace change is designed only to change LLA arrivals – there are no proposed changes to LLA departures, nor to routes to or from other airports.

6.3 The current airspace and flightpath arrangements are not suitable for a return to traffic levels exceeding 2019's summer period, even though there has been a temporary decline due to the coronavirus pandemic. Doing nothing is not an option, and it would be preferable that the change happens as soon as possible.

6.4 The forecast numbers of aircraft provided here are based on recovery from the decline due to the pandemic. This means that 'worst case' data is presented, illustrating the greatest potential noise impacts this proposal could have. If traffic numbers are less, the cumulative noise impact will be proportionately less, and the noise contours/swathes/data would be smaller.

6.5 Over the long term (averaged over months and years), westerly runway 25 is used c.70% of the time, easterly runway 07 c.30% of the time in line with prevailing wind conditions. But in the shorter term, (usually days, sometimes hours, occasionally weeks) 100% of arrivals will land on whichever runway is defined by the wind direction until the wind changes. This cannot be defined in advance, and there may be extended periods where either runway is used consistently.

6.6 Applications to grow the airport's passenger numbers are separate projects outside this proposal – this proposal is driven by the underlying safety need to reduce the airspace complexity.

6.7 Option 2 is the preferred option, but the results of this consultation – the feedback you give – will influence the final design put forward for consideration by the regulator, the CAA.

6.8 The results of technical analyses including noise contours, population counts, hospitals, places of worship, schools and more are provided in Annexes D, E, and F at the end of this document.

6.9 You may be interested in the potential impact on tranquillity – under Government guidance, this applies to the Chilterns Area of Outstanding Natural Beauty. Illustrations are provided in Annex G.

6.10 You may be interested on the potential impact on our historic environment, defined here by registered historic parks and gardens. Illustrations are provided in Annex H.

6.11 You may wish to consider any or all of the data provided, to help you understand the differences and similarities between these airspace design options, and to inform your feedback to this consultation.

6.12 Regretfully, requests for analysis of specific locations cannot be answered. Only you can understand your own arrival noise experience under the current airspace arrangement vs. the proposed arrangements. The method below will help you interpret the maps and tables.

Current airspace – Consider the most recent busy period of air traffic arrivals at LLA (summer 2019)

Method:

6.13 Find the place you want to study, such as your home, place of work or where you spend leisure time, using the maps in Section 4. Remember there is one set of maps for each runway – check if your location gets overflown by arrivals to just one runway, or to both.

6.14 Use the Density Maps (easterly runway Figure 5 p.22, westerly runway Figure 7 p.24) to understand typical arrival traffic patterns. These are illustrative - there would be daily or weekly variations due to wind direction, weather, traffic levels, operational need and vectoring practice, but the general flows and densities would be similar.

6.15 Use Table 1 (p.14) and associated text to understand how many arrivals LLA had per average summer day, and which hours were typically the busiest, in 2019.

6.16 Use the operational diagrams, showing altitude-band flightpath maps (easterly runway Figure 6 p.23, westerly runway Figure 8 p.25) to understand how high those flights were, where they were most likely to be concentrated, and where some aircraft got 'shortcuts' or alternate flightpaths (see Figure 2 p.13 to understand shortcuts).

- You now understand the general arrival flow patterns including shortcuts and alternate flightpaths, how many arriving flights there were per hour, the typical spread of overflights in the most recent busy summer period, and how high you were overflown.

6.17 Use Table 2 (p.15) to find out the typical noise levels produced by different categories of aircraft at different altitudes.

6.18 Use Table 3 (p.15) to understand the proportions of each aircraft category that arrived at LLA in 2019. The vast majority (79%) were 125 -180 seat single aisle twin-jet aircraft such as versions of the Airbus A320 and Boeing 737.

6.19 Use Table 4 (p.16) to compare the typical noise levels of arriving aircraft with other sounds and noises

- You are now familiar with the maps and tables, and how they combine to illustrate the current noise impacts of arriving aircraft at your location.
- You can now think about your actual experience of aircraft noise in relation to these illustrations, interpreting the data in this section to compare with what you hear in real life.
- You will be able to interpret how your current experience might change, given an explanation of the proposed airspace design options.

Now consider the proposals for changing the arrival flows.

6.20 As described in Section 5 on p.26, during the previous Stage 2 of the airspace change process (November 2019) a comprehensive list of upper-level options (8,000ft and above) to separate LLA and Stansted arrival flows was considered.

6.21 When these upper options were assessed against the design principles, all were ruled out except the single upper option presented within this document. Full details of the assessment of these options is available on the CAA Airspace Change Portal under Stage 2 (ref 7).

6.22 This single upper option determines the location of the 'funnel' where the upper arrival flow prepares to leave c.8,000ft and descend to lower altitudes. That upper design is common to both Options, and the diagram illustrating how the upper arrivals work is shown in Figure 9 (p. 27). The funnel shape is visible in the upper design diagram, and also visible to the north of the lower-altitude design diagrams.

Things to remember when considering noise impacts:

6.23 There are two design options, both with maps for each runway – check if your location is overflown by arrivals to just one runway, or to both.

6.24 The overall areas covered by Option 1 and Option 2 are the same, but with different predicted concentrations of overflight. Your location may be affected similarly by both options, or differently depending on the concentrations.

6.25 Areas outside the coloured polygons would experience similar levels of overflight as today, at similar altitudes and directions, therefore there would be no change in impact.

Option 1, where all arrivals are vectored (manually directed by air traffic controllers), with some given shortcuts similar to today

Method:

6.26 Find the place you want to study, such as your home, place of work or where you spend leisure time, using the maps in Section 5 which show the arrivals' predicted location, altitude, concentration, shortcuts and alternate flightpaths.
For vectored/shortcut arrivals to easterly runway 07, see Figure 10 (p.30)
For vectored/shortcut arrivals to westerly runway 25, see Figure 11 (p.31)

6.27 Use Table 5 (p.28) to understand the estimated frequency of flights during summer busy periods. This table provides an average of how many flights are estimated per day and per hour, the peak number of arrivals per hour, which hours are likely to be busiest, and the proportion being given shortcuts. Information is given for the planned year of implementation 2022, for ten years after implementation without the airport's DCO planning application, and ten years after implementation assuming the DCO planning application does progress.

- You now understand the proposed arrival flow patterns including shortcuts and alternate flightpaths, how many arriving flights there could be per hour on the busiest summer days (with and without the future planning application), the typical spread of overflights, and how high you could be overflown.

6.28 Use Table 2 (p.15) to find out the typical noise levels produced by different categories of aircraft at different altitudes.

6.29 Use Table 3 (p.15) to understand the proportions of each category of aircraft expected to arrive at LLA. The vast majority (79%) are expected to continue to be 125 -180 seat single aisle twin-jet aircraft such as versions of the Airbus A320 and Boeing 737. This proposal is not predicted to cause a change in the proportions of aircraft types using LLA and versions of these two aircraft types are expected to continue to be the most common, as accounted for in the noise analysis.

6.30 Use Table 4 (p.16) to compare the typical noise levels of arriving aircraft with other sounds and noises

- You are now familiar with the maps and tables, and how they combine to illustrate the proposed noise impacts of arriving aircraft at your location.
- You can now compare this proposed design option with your recent (pre-pandemic), actual experience of aircraft noise from the previous exercise.
- You can draw conclusions on whether there would be a change, and how significant those changes may be for your location.

Option 2, where about half of the arrivals use predetermined automatically-flown PBN routes and the rest are given shortcuts and vectored as per Option 1

6.31 This option **requires** an understanding of Option 1.

6.32 Option 2 is the preferred option. It would further reduce overall complexity and workload for the controller compared with Option 1, reducing the likelihood of delay and increasing resilience, while paving the way for the future.

Things to remember when considering noise impacts, for Option 2 only:

6.33 There are two routes available for each runway, which would be alternated to offer more equitable noise distribution for local communities where possible – although there are restrictions on how this can work in practice (see paragraphs 5.60-5.63 on p.36 for a description on how the PBN routes could be managed).

6.34 There would be a published schedule defining which of the two PBN routes to westerly Runway 25 would be allocated on any given day. This runway is generally in use c.70% of the time, but either runway could be used constantly for extended periods according to the wind direction.

6.35 See paragraphs 5.60-5.63 on p.36, which explains the possibilities and limitations of route availability, including restrictions on how easterly Runway 07's PBN routes could be operated. As part of your feedback to this consultation, provide your thoughts on how often, and when, this scheduled alternation should occur, bearing in mind the possibilities and limitations.

6.36 If this option is progressed, there would tend to be a concentration of flights following the route in use on the day (or close to that route), and there would still be some distribution of flights over the rest of the region (via shortcuts and vectoring) as per the maps.

Method:

6.37 Find the place you want to study, such as your home, place of work or where you spend leisure time, using the maps in Section 5 which show the arrivals' predicted location, altitude, concentration, shortcuts and alternate flightpaths.
For arrivals to easterly Runway 07 with PBN Route 1 available, see Figure 12 (p.38)
For arrivals to easterly Runway 07 with PBN Route 2 available, see Figure 13 (p.39)
For arrivals to westerly Runway 25 with PBN Route 3 available, see Figure 14 (p.40)
For arrivals to westerly Runway 25 with PBN Route 4 available, see Figure 15 (p.41)
(Erratum – Issue 1.1: Minor typographical errors corrected here in cyan)

6.38 Use Table 6 (p.33) to understand the estimated frequency of flights during summer busy periods. This table provides an average of how many flights estimated per day and per hour, the peak number of arrivals per hour, which hours are likely to be busiest, and also the proportion being given shortcuts. Information is given for the planned year of implementation 2022, for ten years after implementation without the airport's DCO planning application, and ten years after implementation with the DCO.

- You now understand the proposed arrival flow patterns including shortcuts and alternate flightpaths, how many arriving flights there could be per hour on the busiest summer days, the typical spread of overflights, and how high you could be overflown.

6.39 Use Table 2 (p.15) to find out the typical noise levels produced by different categories of aircraft at different altitudes.

6.40 Use Table 3 (p.15) to understand the proportions of each category of aircraft expected to arrive at LLA. The vast majority (79%) are expected to continue to be 125 -180 seat single aisle twin-jet aircraft such as versions of the Airbus A320 and Boeing 737. This proposal is not predicted to cause a change in the proportions of aircraft types using LLA.

6.41 Use Table 4 (p.16) to compare the typical noise levels of arriving aircraft with other sounds and noises

- You are now familiar with the maps and tables, and how they combine to illustrate the proposed noise impacts of arriving aircraft at your location.
- You can now compare this proposed design option with your recent (pre-pandemic), actual experience of aircraft noise from the first exercise, and with your understanding of the other design option in the second exercise.
- You can draw conclusions on whether there would be a change, and how significant those changes may be for your location.

When you have completed the three exercises (current flightpaths, Option 1 and Option 2)

6.42 Consider your thoughts and conclusions in relation to the questions asked in Annex A on p.A-1 and prepare your feedback. These are the same questions asked in the online survey. When you have prepared your feedback please complete the online survey.

Noise impacts above 7,000ft

6.43 As stated previously in paragraph 3.22 on p.15, aircraft noise can be less distinguishable at altitudes higher than 7,000ft, depending on local circumstances.

6.44 This section targets those stakeholders potentially affected by flightpath changes below 7,000ft; which is where noise impacts are considered a priority. Government guidance (Ref 16) is prioritised in accordance with the altitude of the change, and its impacts on key noise metrics.

6.45 This Government guidance for airspace changes can be generally summarised as:

- The minimising of noise impacts up to 7,000ft is the greatest priority; and
- In the airspace above 7,000ft the minimising of noise is no longer a priority, and airspace efficiency is promoted.

6.46 Nevertheless, feedback is welcomed from everyone potentially affected by these proposed flightpath changes, whether they occur below, at, or above 7,000ft over their location of interest.

7. Aviation Technical Information

7.1 This section provides additional information in technical language to enable aviation experts to interpret the proposed options for technical purposes. Feedback is welcomed from everyone – aviation experts and non-experts.

What has changed since Stage 2?

7.2 Some technical changes were made to refine the Upper design (c.8,000ft and above). When the options were finalised for the Stage 2 gateway, there was an expectation that the specific dimensions and locations of controlled airspace (CAS) volumes for the only Upper option (8,000ft and above) to progress, would be determined later in the development process (following further engagement both internally with NATS controllers and externally).

7.3 It was clear in the text of the stage 2 material that the CAS concepts were illustrative – see Stage 2A(i) Design Options document (v1.1 pages 16 and 17), Ref 6.

7.4 Subsequent to Stage 2, air traffic control simulations gathered more evidence from a wider pool of air traffic control experts. This led to the revision of the dimensions and locations of some volumes of controlled airspace (CAS) compared with that originally presented in Stage 2.

7.5 These opportunities could not have been identified until those simulations were completed, and the additional expert evidence gathered.

7.6 The Civil Aviation Authority and the stakeholders who would be impacted by these changes were engaged, to ensure transparency and understanding. Further stakeholder engagement took place; with representatives of the Ministry of Defence (MoD) and of the General Aviation (GA) community.

7.7 Both these representatives of the MoD and the GA community understood the rationale for these refinements and were content for the consultation to include the updated design.

7.8 Note that the technical changes between stages would have passed the design principle evaluation, and in doing so, would have progressed to this stage.

7.9 This was all based on development work identifying potentially different impacts, identifying the appropriate representative stakeholder groups, engaging them directly, openly and transparently, describing the differences to them in detail, and acquiring confirmation that they are both content that the developed design will be in the consultation material.

7.10 A summary of the differences between the original upper airspace design option and the design presented in this Consultation Document is detailed on the next page.

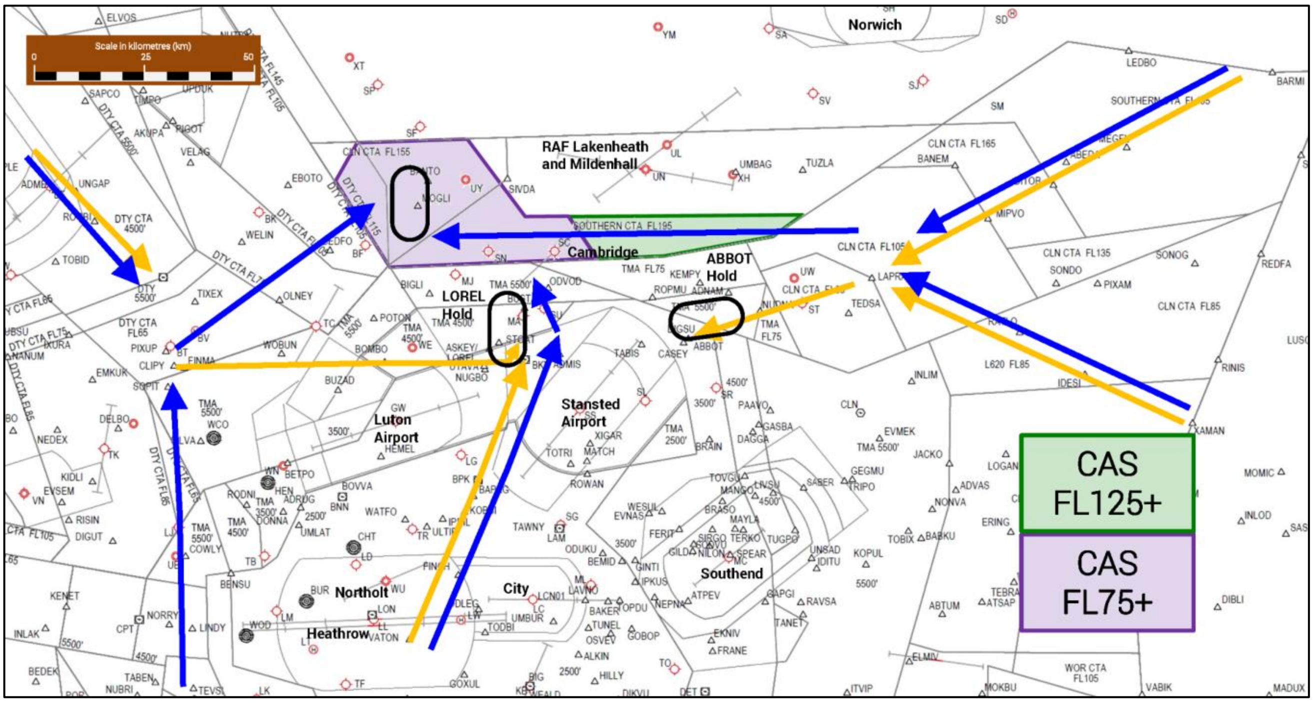


Figure 16 Original upper airspace option (as per Stage 2)

7.11 The developed upper option would introduce an additional volume of CAS to the south west of the new LLA hold to fully contain the STAR from the west.

7.12 This volume of CAS would require a base of FL85.

7.13 The descent profile of aircraft on the STAR from the east to the new LLA hold requires an additional step in the base of CAS to the north of the existing LTMA as shown in Figure 17.

7.14 Full technical details of the airspace volumes are provided later in this section.

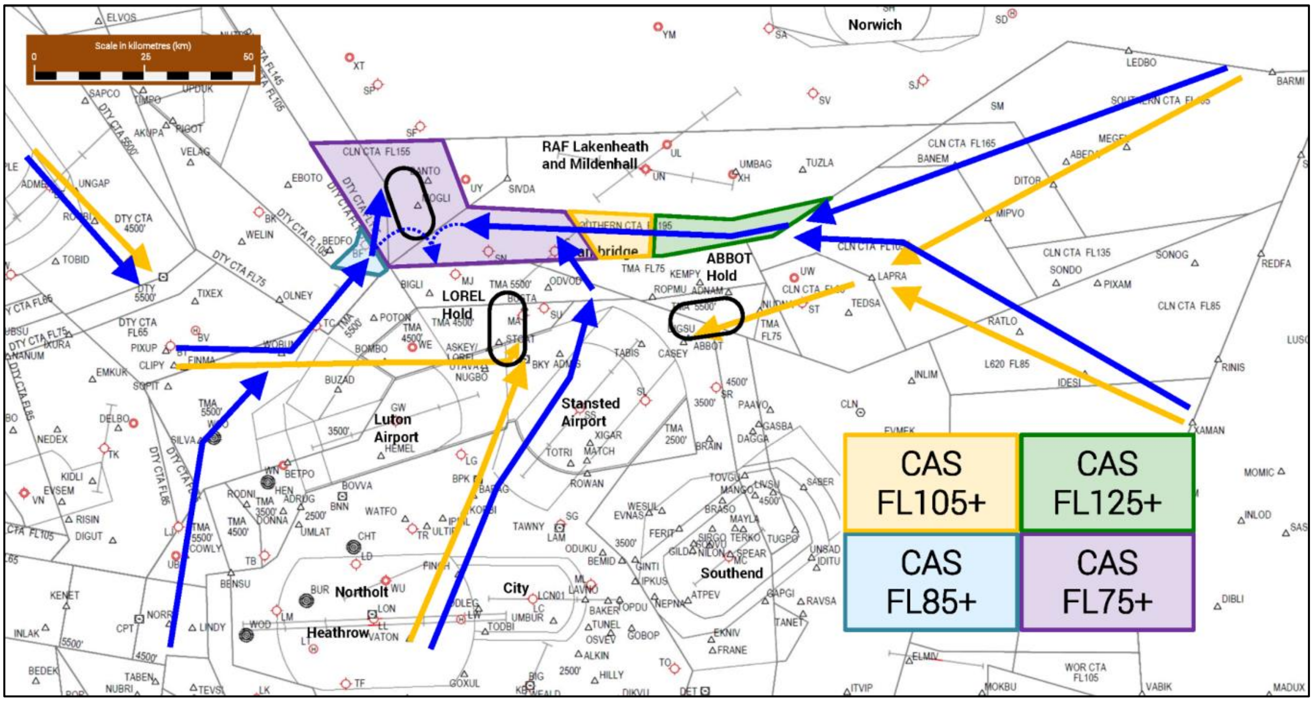


Figure 17 Developed upper airspace option (for consultation)

7.15 This table summarises the engagement on the differences of the post-Stage 2 design:

Stakeholder	Date of Engagement	Method of Engagement	Outcome of Engagement
MoD/USAFE	10/12/2019	Face to face meeting	Briefing on the developed design
MoD/USAFE	25/2/2020	Email and Telephone call	Confirmation and acknowledgment that they have been engaged and understand the change to the upper option. Confirmation that they are content (verbally) to see the developed design described in the consultation material.
GA Alliance	4/2/2020	Email and Telephone call	Confirmation and acknowledgment that they have been engaged and understand the change to the upper option. Confirmation that they are content (verbally) to see the developed design described in the consultation material.

Table 8 Engagement summary (developed upper design)

Commercial aircraft operators – Delay Avoidance, Capacity Improvements and Resilience

7.16 Separating the LLA arrival flow from the Stansted arrival flow at an earlier, higher part of the flight provides a significant reduction in airspace complexity and an improvement to controller workload. This leads to a capacity benefit as illustrated by the diagrams in Annex I, and is independent of the lower Options and the DCO.

7.17 The extra capacity created by separating the LLA flow from the Stansted upstream flow removes the probability of upstream delay and enables changes to the Monitoring Values (MV[20]) as a result.

- In 2022 the forecast shows an estimated net delay avoidance (reduction) of c.10,200 minutes given either Option 1 or Option 2.
- In 2032 this forecast rises to an estimated saving of c.11,200 minutes (with or without LLAL's DCO).

7.18 Airspace resilience is related to capacity and delay. The concept is summarised in Annex B and explained diagrammatically in Annex I, where we provide a metric indicating the relationship between resilience and the typical number of radio exchanges between pilot and controller.

7.19 Under this metric against the baseline Option 0, Option 1 would improve resilience by up to c.30%, while Option 2 would improve it by up to c.50% (which is up to c.20% improved over Option 1).

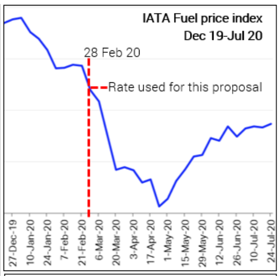
Commercial aircraft operators – Fuel costs

7.20 This proposal is expected to cause an average fuel-cost disbenefit of c.£32 per LLA arrival flight, given a fuel cost per tonne of £356.76 (correct as of 28 Feb 2020). The routes are slightly longer.

7.21 Stansted arrivals are expected to make a slight fuel saving due to the separation of flows.

	Fuel per year, tonnes, negative is disbenefit		
Scenario	2022	2032 No DCO	2032 With DCO
Do Nothing	Baseline	Baseline	Baseline
Option 1	-5,841	-5,219	-6,191
Option 2	-5,841	-5,219	-6,191
	CO_2 equivalent (3.18 conversion)		
Do Nothing	Baseline	Baseline	Baseline
Option 1	-18,574	-16,596	-19,687
Option 2	-18,574	-16,596	-19,687
Scenario	Overall Fuel cost (at £356.76/tonne) IATA jet fuel cost USD457.38, USD to GBP 0.78 Rates dated 28 Feb 2020		
Do Nothing	Baseline	Baseline	Baseline
Option 1	-£2,084,000	-£1,862,000	-£2,209,000
Option 2	-£2,084,000	-£1,862,000	-£2,209,000

	Average change in fuel cost per flight (LLA Arrivals)		
Scenario	2022	2032 No DCO	2032 With DCO
Num flights	70,740	70,740	91,500
t fuel total	-6,330	-6,330	-7,302
t fuel per flight	-0.089	-0.089	-0.080
t CO2e per flight	-0.285	-0.285	-0.254
£/flt Opt 1	-£31.92	-£31.92	-£28.47
£/flt Opt 2	-£31.92	-£31.92	-£28.47
	Average change in fuel cost per flight (Stansted Arrivals)		
Num flights	101,719	102,410	102,410
t fuel total	489	1,111	1,111
t fuel per flight	0.005	0.011	0.011
t CO2e per flight	0.015	0.034	0.034
£/flt Opt 1	£1.72	£3.87	£3.87
£/flt Opt 2	£1.72	£3.87	£3.87



The blue graph above illustrates the IATA aviation fuel price index and its fluctuations caused by the coronavirus pandemic.
The IATA index is proportional to the specific fuel cost per tonne used in the calculation assumptions for this document.
The rate was taken on 28 Feb 20 as per the red dashed line.

Table 9 Forecast average fuel costs for this proposal

[20] Broadly, MV indicates the number of movements per hour which can be safely handled by the controllers operating the flows in each associated airspace sector.

7.22 Overview diagrams for the proposed STARs are provided below, illustrating current and draft proposed arrival routes.

Current and Proposed STARs

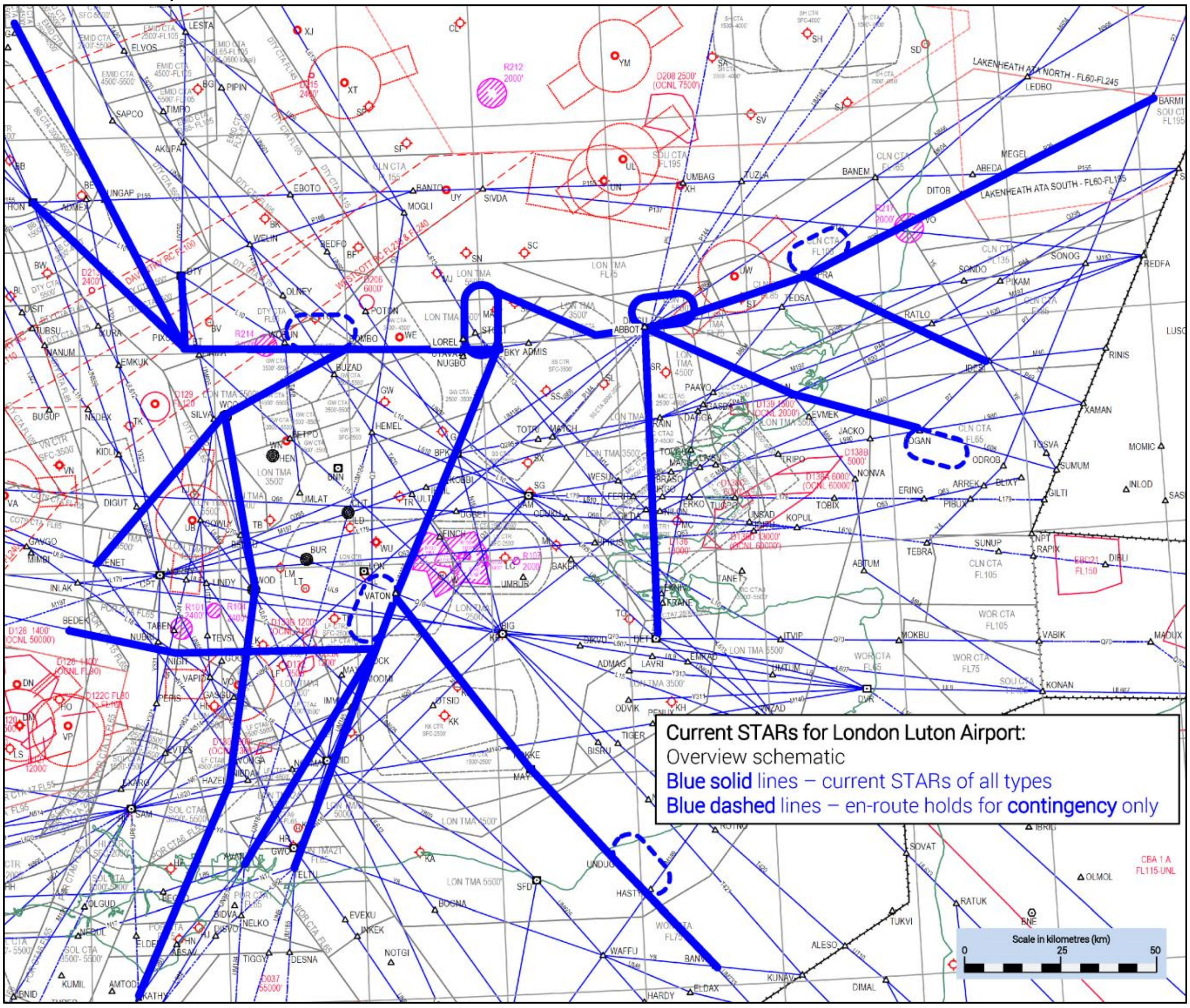


Figure 18 Overview of current STARs for LLA arrivals

Current STARS – Note on DVOR Rationalisation

7.23 NATS (NERL) is currently undergoing a separate project, which would result in ABBOT and LOREL shared STARs being replicated to RNAV5 standards, their ASKEY/CASEY contingency versions removed, with some STARs partially truncated or with minor adaptations. This work is expected to slightly change arrangements for the current STARs to both LLA and Stansted after this consultation, but before this proposal is complete. At the time of writing this document, the overview in Figure 18 is correct, however the baseline STAR arrangements are expected to complete in February 2021.

New LLA Hold

7.24 As stated in the main text of this document, both Option 1 and Option 2 would use the same proposed changes above FL75. Therefore, the hold and STARs are only presented once and should be considered with each of the lower options to transition from the hold to final approach.

7.25 Aircraft inbound to LLA would flight plan to the new separate dedicated holding fix. The proposed STARs would start at the same or similar primary directions as the current LLA STARs, providing the same connectivity from the main air route network.

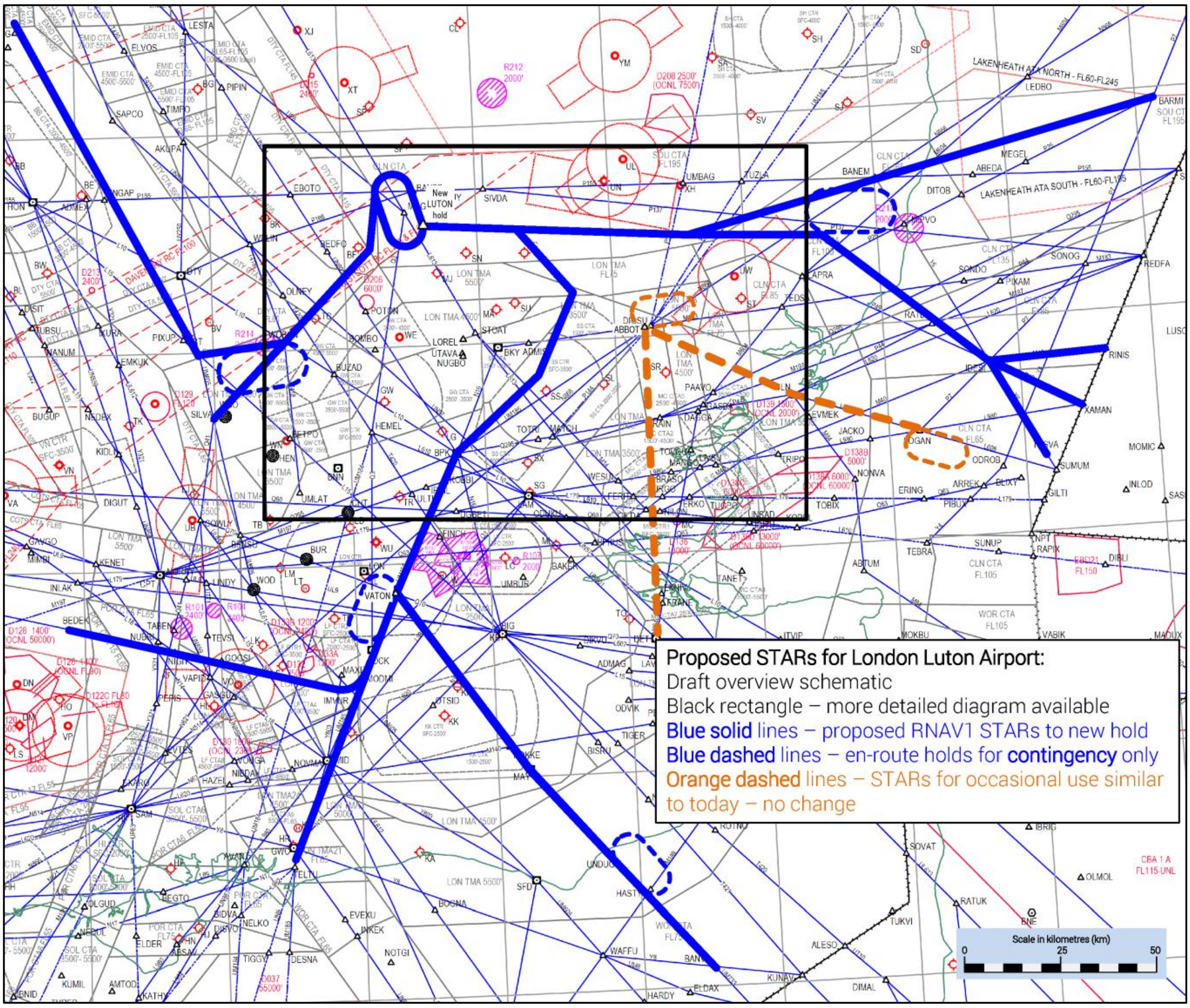


Figure 19 Overview schematic of proposed new, and retained, STARs for LLA arrivals

Proposed RNAV1 STARs

7.26 All LLA arrivals would plan via the new LLA holding fix. There would be ten new RNAV1 STARs from three primary directions with dedicated routes to the new holding fix – each proposed STAR currently has placeholder name codes, subject to change. There would be no changes to the present flight-level requirements at the start of each STAR. As is the case today, radar vectors may be used to assist with separation from other TMA traffic and direct routeings to give shortcuts when available. The STARs are designed to allow for better use of continuous descent profiles where possible.

7.27 When routeing along the STAR, aircraft would be controlled by London Control and transferred to TC Luton on approaching the hold area for onward clearance when appropriate as they do today.

7.28 Non-RNAV1 flights, some low flight level (FL120 or below) and some inter-TMA positioning LLA arrivals from the east and south east must continue to arrive via existing STARs to ABBOT.

7.29 The LOGAN (RFL100 and below) and DET (RFL170 and below) STARs would be retained as shown in Figure 19, as per the orange dashed lines. These are expected to be rarely used, similar to today.

7.30 For a more detailed overview with VFR chart background, including draft RNAV1 transitions, please see Figure 20 on the next page. Figure 20 is a closer view of the inner black rectangle from Figure 19 above.

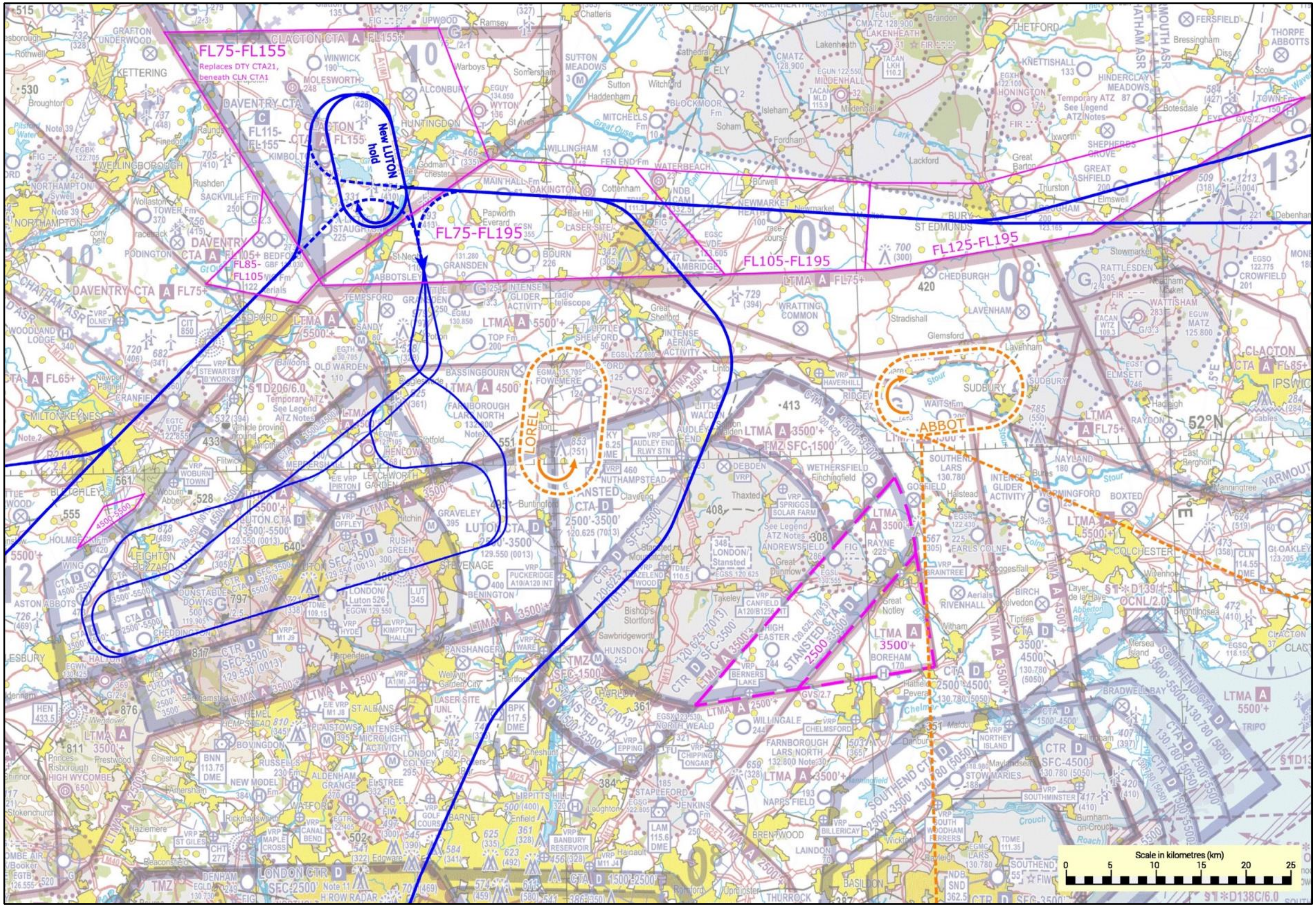


Figure 20 Draft overview: Proposed CAS changes (magenta), STARs and LLA hold (blue), PBN transitions to final approach (Option 2 only, also blue)

Options 1 and 2, proposed new controlled airspace north of LLA, FL75 and above, and current volumes to be reclassified as Class G

7.31 To contain the proposed new LLA hold and associated STARs, new volumes of CAS are proposed. The preferred airspace classification would be Class C. We would like your views on this classification and have asked a specific technical question within this consultation. The coordinates of the proposed new CAS are detailed in Table 10 and illustrated in Figure 22 overleaf.

7.32 During the assessment to determine the requirement for CAS, two volumes of existing CAS were identified that would no longer be required east of Stansted – our thanks to London Stansted Airport for their agreement. This proposal would allow for easier GA access to airspace east of the Stansted CTR and would include the following changes to the AIP – see Figure 21 below:

- Stansted CTA -3 Class D raise base from 2,000ft to 2,500ft.
- London LTMA-2 Class A raise base from 2,500ft to 3,500ft. This would have the same effect as deleting the volume and expanding LTMA-3 (Class A base 3,500ft) to 'fill' the triangular gap.

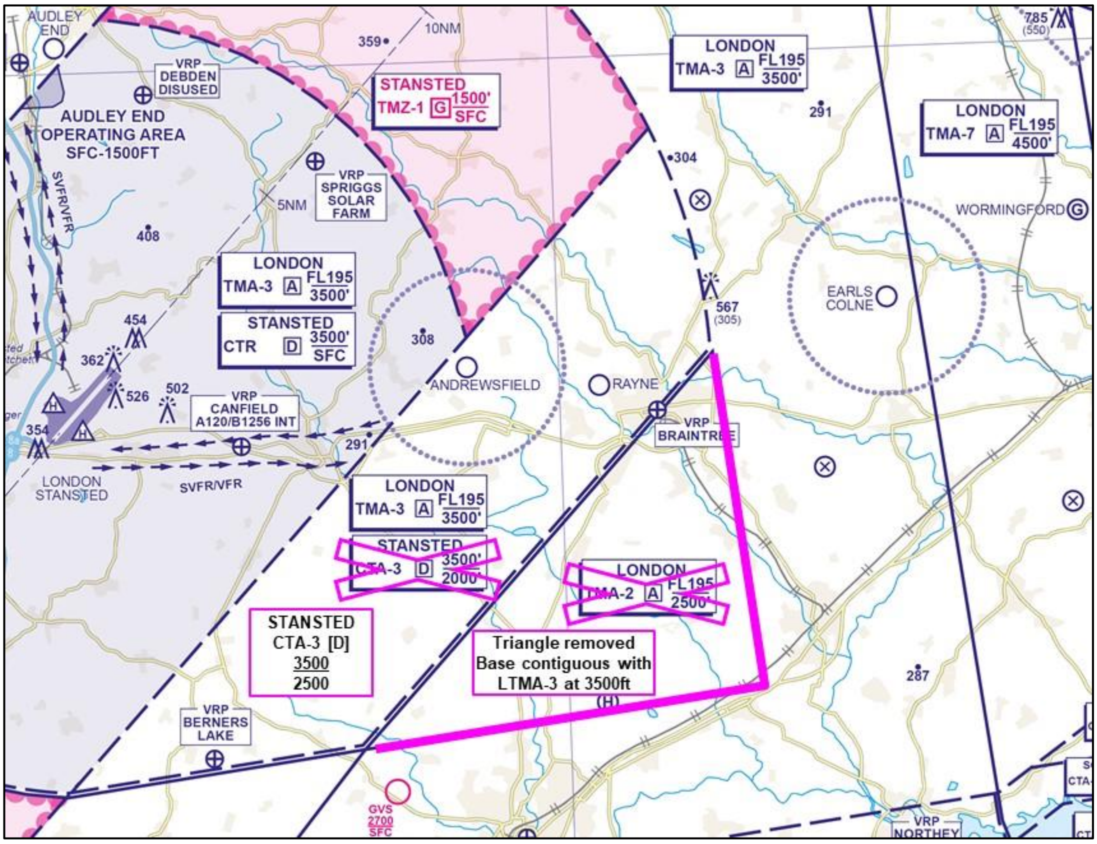


Figure 21 Proposed declassification of Class D and Class A volumes east of Stansted Airport

7.33 An additional volume of CAS is required for Option 2 only, see later in this section.

Military Traffic - Daventry Corridor

7.34 The position of the new LLA hold and associated CAS sits adjacent to the existing military Daventry radar corridor. We are proposing to extend the Daventry radar corridor to coincide with the boundary of the new CAS to minimise the impact to military air traffic as illustrated in Figure 22. Although military radar corridors are not defined in the AIP, we have included approximate coordinates in Table 10 of the proposed extension to enable military stakeholders to assess how we intend to mitigate this impact.

7.35 We have engaged extensively with the MoD and specifically the USAFE, based at RAF Lakenheath and RAF Mildenhall. We have worked with them to consider the impact of this proposal on existing and future military procedures and airspace use requirements, and will continue to do so during this consultation. We also concluded that it would not be appropriate to publish details of military procedures in this document.

CAS requirements common to Option 1 and Option 2

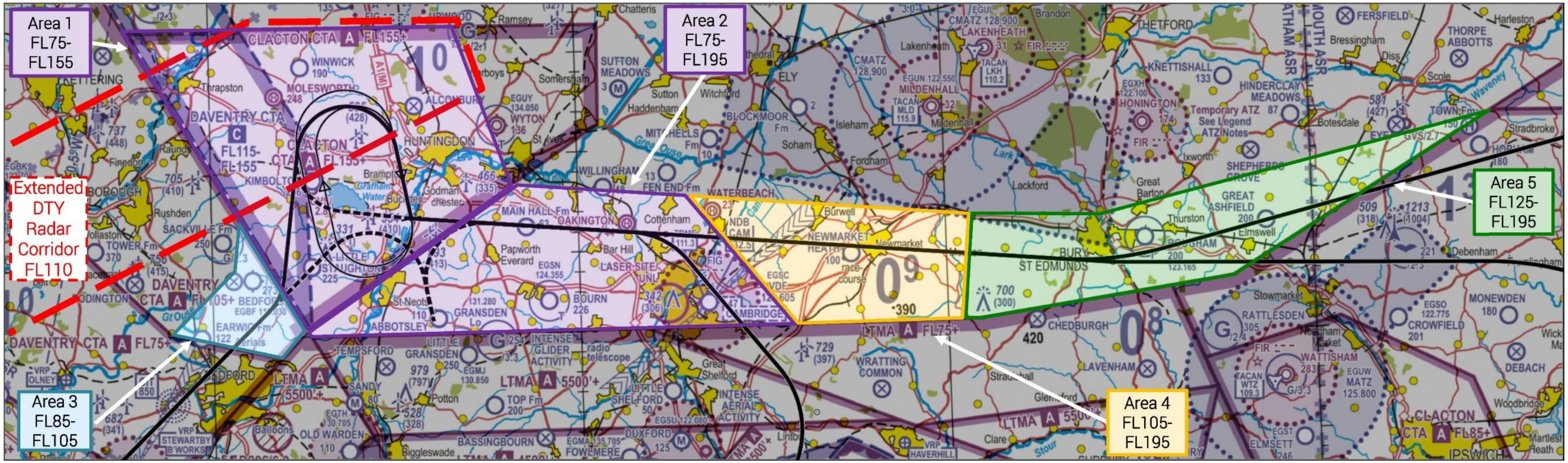


Figure 22 Proposed CAS illustration, with DTY Radar Corridor extension, STARs and new LLA hold (both Options)

New lat	New long	Details
52°26'32.45'N	0°37'01.57'W	Area 1 FL75–155
52°26'25.93'N	0°10'00.78'W	
52°18'25.05'N	0°05'23.92'W	
52°11'26.00'N	0°22'20.00'W	

New lat	New long	Details
52°18'25.05'N	0°05'23.92'W	Area 2 FL75–195
52°17'38.07'N	0°08'48.82'E	
52°11'4.77'N	0°17'20.99'E	
52°11'04.00'N	0°21'59.00'W	
52°11'26.00'N	0°22'20.00'W	

New lat	New long	Details
52°11'26.00' N	0°22'20.00'W	Area 3 FL85-105
52°10'02.00'N	0°24'27.00'W	
52°11'18.00'N	0°33'23.00'W	
52°14'26.53'N	0°28'08.20'W	
52°16'54.47'N	0°27'38.26'W	

New lat	New long	Details
52°17'38.07'N	0°08'48.82'E	Area 4 FL105–195
52°11'04.77'N	0°17'20.99'E	
52°16'18.06'N	0°31'53.55'E	
52°11'04.18'N	0°31'04.09'E	

New lat	New long	Details
52°16'18.06'N	0°31'53.55'E	Area 5 FL125-195
52°11'4.18'N	0°31'04.09'E	
52°16'1.58'N	0°42'38.69'E	
52°20'25.24'N	1°14'50.23'E	
52°12'45.44'N	0°53'21.97'E	
52°12'21.00'N	0°48'19.00'E	
52°11'04.00'N	0°32'42.00'E	

New lat	New long	Details
52°25'13.00'N	0°37'44.00'W	Extension to DTY Radar Corridor FL110
52°26'31.51'N	0°30'54.81'W	
52°26'25.93'N	0°10'00.78'W	
52°23'53.00'N	0°08'31.25'W	
52°18'21.00'N	0°29'02.00'W	

Table 10 Draft coordinates (both Options) - proposed CAS to the north of LLA FL75+, DTY Radar Corridor DRAFT NOT FOR NAVIGATION

Option 1 – RNAV Hold North of LLA with Vectoring

7.36 Aircraft would be radar vectored from the holding area to the final approach by TC Luton. If there is no delay, instructions would be given to bypass the holding fix, to reduce flying time and distance.

Runway 07 vectoring

7.37 Aircraft would be vectored in a southerly direction from the holding area and, when controlled airspace allows, (approximately 6nm south of the new LLA hold), given an instruction to descend to 6,000ft on the QNH, after approximately 5nm, further descent instructions would be given to 5,000ft where the TC Luton controller would instruct aircraft to turn in a westerly direction downwind. The aircraft would then follow a similar route as used today being vectored around the town of Leighton Buzzard before turning base and given descent to 4,000ft and 3,000ft before being instructed to establish on the ILS or extended runway centreline. As the speed constraint at the new LLA hold is 220kt, this would be the default speed on leaving the hold for Runway 07 which is a change from the present 250kt from LOREL and ABBOT holding areas. However, the controller/pilot may request other speeds as appropriate. Speeds in the base leg/final approach area would remain the same, 180kt to 160kt.

Runway 25 vectoring

7.38 Aircraft would be vectored in a southerly direction from the holding area and, when controlled airspace allows, (approximately 6nm south of the new LLA hold), given an instruction to descend to 6,000ft on the QNH, after approximately 5nm, further descent instructions would be given to 5,000ft where the TC Luton controller would either allow the aircraft to continue on the southerly heading for base leg or, vector the aircraft on a south westerly track to create a small downwind/base leg circuit pattern for Runway 25. For both these methods the aircraft would then follow a similar pattern as they do today. Aircraft would be given further descent from 5,000ft as controlled airspace allows to 4,000ft and 3,000ft when on base leg before being instructed to establish on the ILS or extended runway centreline. Speed control would be similar today from leaving the present LOREL and ABBOT holds (typically 220kt for Runway 25 arrivals due to the shorter distance and tighter vectoring requirement). However, the controller/pilot may request other speeds as appropriate. Speeds in the base leg/final approach area would remain the same, 180kt to 160kt.

Option 2 – RNAV Hold North of LLA with PBN routes and vectoring to the runway

7.39 In addition to the new hold, four Performance Based Navigation (PBN) routes to transition from the new hold to the runways would be introduced; two from the hold to Runway 07 and two from the hold to Runway 25. The RNAV1 transitions would be coded with level and speed constraints to reduce R/T loading and give predictability to flight planning. However, the need to appropriately space and sequence arriving traffic means that the PBN routes cannot be used all of the time. For example, during peak arrival periods when several inbound aircraft arrive at the same time on the STARs, the controller may need to vector one or more aircraft to manage this scenario to ensure that the space between arriving aircraft is appropriate and to minimise any undue delays. There would be occasions when the LLA tower controller would ask for a change in the final spacing to assist with departure planning that affects the short-term use of the runway. Other factors, such as weather, emergencies, special flights and shortcut routeings may require vectoring off the transitions to final approach. When an aircraft is vectored off the transition, it would continue to be vectored until established on final approach. Although we are consulting on the alternation between the PBN transitions, the pilot would be informed of the transition in use by the controller before reaching the new LLA holding fix.

PBN Route 2 to Runway 07 – Additional CAS requirement

7.40 To ensure minimum but effective CAS containment for PBN Route 2, the northerly transition to Runway 07, an additional volume of CAS would be required from 4,500ft – 5,500ft as shown in Figure 23. Our pre-consultation engagement highlighted that this additional CAS would primarily impact GA gliders operating from London Gliding Club near Dunstable, Bedfordshire. We are proposing that this volume of CAS be introduced as Class D airspace, the lowest possible to afford appropriate containment. It would need to exist 24 hours a day because we cannot predict in advance which runway would be in use, and if that is Runway 07 then we cannot predict which of the two proposed PBN routes would be in use. We understand that this would have an impact on some GA operating in this area – through our GA Alliance and BGA engagement with London Gliding Club we are aware they regularly fly in this area at these altitudes. We propose mitigating these impacts by managing this airspace volume via Letter of Agreement (LoA). Airspace users operating from specific local airfields, under the terms of the LoA, would be free to use this proposed volume as if it was Class G whenever it was not needed to provide containment for the Runway 07 northern PBN route. Runway 07 is used approximately 30% of the time, so alternating between the two transitions would mean that access to this airspace would only be restricted for approximately 15% of the time, minimising the impacts on GA. The specifics of how the airspace would be managed would be negotiated by Letter of Agreement.

7.41 In the event of a runway change to Runway 07, the default initial transition to be used would always be PBN Route 1, the route south of Leighton Buzzard, allowing time to inform impacted GA communities of the runway in use and the times when the proposed Area 6 airspace would not be available for their use.

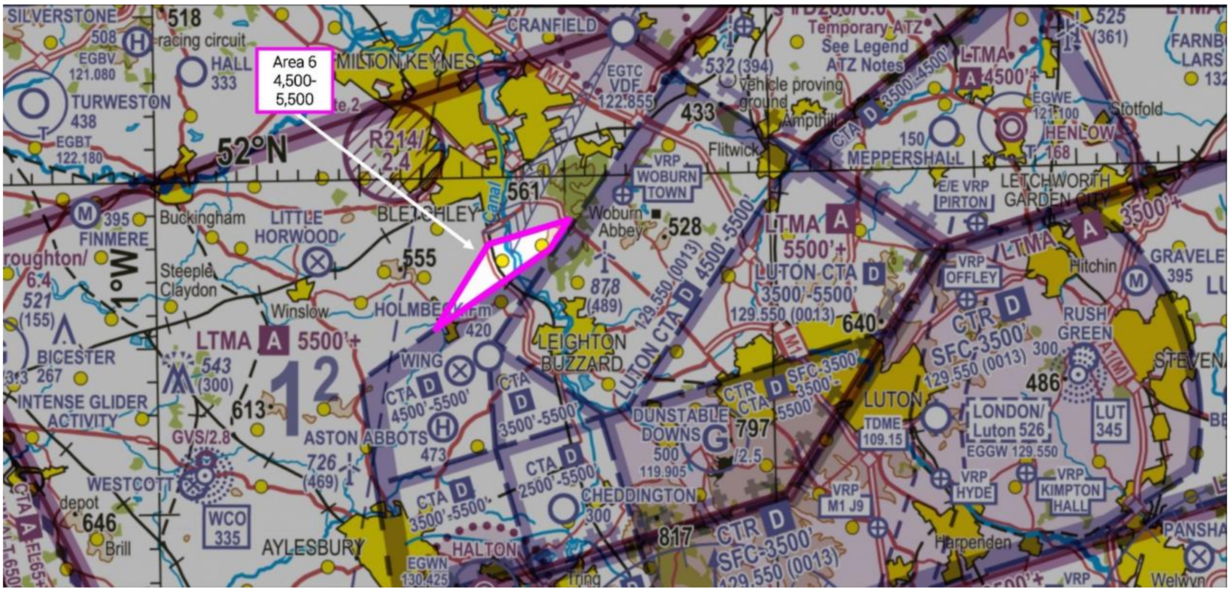


Figure 23 Option 2 only, proposed new controlled airspace west of LLA, 4,500ft-5,500ft

New lat	New long	Details
51°55'27.84' N	0°46'26.45' W	
51°57'59.27' N	0°43'44.58' W	Area 6 4,500-5,500ft
51°58'41.47' N	0°39'49.09' W	
51°57'49.00' N	0°40'48.00' W	

Table 11 Option 2 only, draft coordinates of proposed CAS volume providing containment assurance for PBN Route 2 (to Runway 07 north of Leighton Buzzard) DRAFT NOT FOR NAVIGATION

Contingency Procedures

7.42 These procedures enable aircraft to safely reposition to the final approach under certain circumstances if they are unable to land from their initial approach. A missed approach is what happens when a pilot cannot complete the final part of the landing, increases engine power, and climbs away from the runway. Once the aircraft is established in a stable climb away from the runway, the controller issues heading and altitude instructions in order to fit the aircraft back into the approach sequence, or to put the aircraft into a safe area to resolve any potential issues. This is a safe and routine part of operations for all pilots and controllers. There are many reasons for a pilot, or a controller, to initiate a missed approach (such as wind shear causing an unstable approach, blocked runway, or preceding aircraft not vacating the runway etc). These can be split broadly into two categories; one where the reason for the missed approach does not preclude the pilot from immediately making another approach, and one where the cause needs to be addressed before making another approach. There were c.370 missed approaches at LLA recorded in 2019, the vast majority of which resulted in the aircraft being immediately positioned for another approach.

7.43 If radar and/or radio has failed, the pilot must be able to navigate from the missed approach itself to a position where it is safe to hold and then to make another approach, all without the guidance of a controller. Flight procedures are published for these possibilities, at all airports. LLA is no exception – there is a suite of instrument flight procedures to accommodate such situations, though they are very rare events because the radio and radar technology is extremely reliable with redundant backups (no failures causing the use of these contingency procedures were recorded in the past ten years).

7.44 Given the need to change the way arrivals work at LLA, we would also need to update the contingency procedures to match, and also the procedures to be used should the radar or radio fail so a pilot can find the runway and land safely. These procedures would detail how a pilot could fly, without assistance from a controller, from the upper section via the lower section to making an approach at the runway if radar is not available, and also from any missed approach to a safe contingency holding pattern.

Arrival procedures: From the new LLA hold to c.10nm on the extended runway centreline

7.45 Under normal operations (defined here as radar control, radio communications and ILS-DME all functioning nominally), for Option 1 all arrivals would be vectored to c.10nm on the extended runway centreline, and the same would happen for c.51% of Option 2's arrivals. The remaining c.49% of Option 2's arrivals would follow the PBN transition to its end, which would also be on the extended runway centreline at c.10nm.

7.46 Should radar and/or radio communications failure (RCF) occur, two defined contingency routes would be needed; one from the proposed LLA hold to a position c.10nm on runway 07's extended centreline, and an equivalent from the proposed hold to runway 25.

7.47 These routes would need to be consistent with the proposed arrival patterns described in Section 5 (from p.26) and would need to be compatible with the following:

From c.10nm final to the runway

7.48 The proposed procedures would be similar to the current procedures, minimising the change from today.

7.49 Under normal operations, for all arrivals via either Option, the aircraft would already be in position to intercept the ILS-DME and descend on the glideslope from 3,000ft to land.

7.50 Under RCF or radar-fail contingency operations, the aircraft would complete the RNAV1 transition, intercept the ILS-DME at c.10nm and descend on the glideslope from 3,000ft to land.

In the event of a missed approach

7.51 The proposed procedures would be similar to the current procedures, minimising the change from today.

7.52 Under normal operations, for all arrivals via either Option, the aircraft would climb to 3,000ft and proceed as vectored by the controller to rejoin the arrival sequence.

7.53 Under RCF or radar-fail contingency operations, assuming the ILS-DME remains serviceable, aircraft would follow a defined runway-dependent missed approach procedure towards an Initial Approach Fix IAF c.4.5nm east of LLA, in a similar location and similar way to the current equivalent procedure. At the IAF, aircraft would enter a contingency hold at 3,000ft. From this IAF, arrivals to runway 07 would complete a procedure similar to the current procedure – fly outbound on a reciprocal heading to final approach at 3,000ft, overhead and past the airport, at a defined DME distance descend to 2,000ft, make a 45° left turn and then a right turn to intercept the ILS-DME to land. Arrivals to runway 25 would also complete a procedure similar to the current procedure – from the IAF make a right turn following the outbound leg of the hold on a reciprocal heading to final approach at 3,000ft, on reaching a specified DME distance make a 180° right turn onto runway heading to intercept the ILS-DME to land.

Other unusual operational circumstances

7.54 Should the glideslope become unserviceable, a PBN approach procedure would be provided for aircraft so equipped, and a localiser-DME procedure would be available for others. The LOC-DME procedure would be similar to the proposed ILS-DME procedure discussed above, which in turn would be similar to the current equivalent procedure published in the UK AIP.

7.55 In the event of significant navaid unserviceability, surveillance radar approaches to each runway would remain available assuming radar and radio communications was unaffected. Those SRA procedures would be similar to the current equivalent procedures published in the UK AIP.

Stansted Airport

7.56 There are no material changes proposed for any Stansted Airport procedure. However, administratively there would be changes required to several Stansted AIP entries to account for the change from shared STARs and holds to Stansted-only STARs and holds, and the reclassified CAS volumes to the southeast.

Section Summary

7.57 This section illustrated the current LLA STARs, describes planned near-future changes to some STARs under a separate project, and provides a draft overview of the proposed STARs to a new LLA hold. It illustrates how arrivals would be vectored from the proposed LLA hold to final approach (Option 1, and c.51% of Option 2 arrivals). It illustrates how controllers would employ Option 2's proposed PBN routes from the proposed LLA hold to final approach, should that option progress.

7.58 This section described the potential changes to CAS . It demonstrates an understanding that those CAS changes would have impacts on military and GA airspace users, and a commitment to continue the working engagement with those stakeholders.

7.59 Finally, this section described how approach and contingency procedures would be kept as similar as possible to currently published equivalent procedures, minimising the change from today.

Option Preference Statement (Aviation Section)

7.60 Both options have the same fuel and greenhouse gas disbenefit, there is no preference via that metric.

7.61 Option 2, a new hold to the north of LLA with a mix of PBN routes, shortcuts and vectoring to the runway, is the preferred option.

7.62 Both options would have an impact on other airspace users, with Option 2 slightly more impact than Option 1 due to the additional CAS requirement of Area 6.

7.63 Option 2 gives controllers additional tools to manage and reduce the complexity of their workload over Option 1 and increases resilience by up to c.50% compared with the baseline, and up to c.20% compared with Option 1.

8. The Consultation Process and Next Steps

8.1 Consultation is a formal process seeking input into a proposal, undertaken in line with the Gunning Principles[21] and Government guidance. Consultation is an essential part of the airspace change process. It allows us to explain our proposal in a fair, transparent and effective way, and gather information to understand views about the impact of the options presented. It allows stakeholders to provide relevant and timely feedback to us, which we can then use to inform our final proposal.

How are we consulting on this Airspace Change?

8.2 The requirements of the Airspace Change Process mean that the formal consultation must be undertaken through the CAA Airspace Change Portal, where you will be able to find all the information on this proposal. We recognise that this may not suit all stakeholders, so we have produced a comprehensive consultation strategy that will enable us to capture views from the broadest possible audience.

8.3 There is a wide audience for this consultation, including local authorities, airlines, private pilots, businesses, environmental and community organisations, and the general public. The Consultation Strategy (ref 10) explains how we analysed our audience and identified categories which will help us seek feedback from stakeholders who may be both positively and negatively affected by this proposal.

8.4 This consultation commences at 0001 on the morning of Monday 19th October 2020 and closes at 2359 on the evening of Friday 5th February 2021, a period of 15 weeks and 5 days

How to respond

8.5 Part of the CAP1616 process requires all responses to Airspace Change consultations to be uploaded to the CAA Airspace Change Portal. All of the information regarding this airspace change, including this consultation document, Full Options Appraisal, and consultation strategy will be published on the CAA's Airspace Change Portal.

8.6 We invite all stakeholders to respond to the consultation on the portal here: https://consultations.airspacechange.co.uk/london-luton-airport/ad6_luton_arrivals

8.7 We recognise that not all stakeholders may have access to the internet.

8.8 Responses can be sent by post using the feedback form in Annex A of this document to:

Airspace Change

Flight Operations

London Luton Airport

Percival House, Percival Way

Luton

LU2 9NU

8.9 For transparency, all responses will be collated and published on the CAA's Airspace Change Portal. We will upload postal responses to the portal on behalf of respondents. All stakeholders have the option to redact personal information, such as name, address, and position from publication; please select your preference when submitting your feedback[22]. The CAA will moderate consultation responses to remove material not appropriate for publication.

---

[21] The Gunning Principles are a set of rules for public consultation that were proposed in 1985 by Stephen Sedley QC, and accepted by the Judge in the Gunning v LB of Brent case. They consist of four rules, which if followed, are designed to make consultation fair and a worthwhile exercise:

- that consultation must be at a time when proposals are still at a formative stage;
- that the proposer must give sufficient reasons for any proposal to permit of intelligent consideration and response;
- that adequate time is given for consideration and response; and
- that the product of consultation is conscientiously taken into account when finalising the decision.

[22] NATS-LLA, our subcontractors and the CAA will see your personal information if you select this option, however it will not be visible on the CAA portal when your response gets published after moderation by the CAA.

Can I speak to you about the proposal?

8.10 Due to the ongoing impact of COVID-19 it is clear that the primary method for providing information, engaging with stakeholders, and gathering feedback during this consultation will be online. We do not plan to hold face-to-face events given the current social distancing requirements relating to public gatherings which are likely to remain in place for the foreseeable future.

8.11 This has changed our approach to consultation. We will provide a variety of methods and materials to engage stakeholders. The Consultation Strategy document (ref 10) details those methods and materials, summarised as:

- The consultation website, including downloadable documents and the online survey where feedback can be submitted;
- A virtual exhibition hall, a more interactive way to access the material;
- Video conferencing, a series of online video meetings to give stakeholders the opportunity to engage as directly as possible;
- Social media platforms, to promote awareness of the consultation in a targeted way; and
- Traditional media to raise awareness using local newspapers and broadcast interviews.

8.12 There are several groups which should be considered as 'digitally excluded' or 'seldom heard' audiences, where the internet is less widely used. We will take extra steps to communicate with these groups, see the Consultation Strategy document (Ref 10).

How we will use your feedback from this consultation

8.13 All feedback from this consultation will be collated and published on the CAA's Airspace Change Portal. The portal will maintain a transparent and complete record of online consultation responses, and of any paper responses which we will upload on behalf of the respondent. Within the portal we will monitor all feedback and produce frequently asked questions.

8.14 Alongside this review of responses, we will collate and categorise all responses as shown below; following the process outlined in CAP1616:

Category	Responses which may impact the final proposal		Responses which do not impact the final proposal
Subcategory	Responses which have impacted the final proposal	Responses which have not impacted the final proposal	

Table 12 Response categorisation method as per airspace change process

What happens next?

8.15 During Stage 4 of the airspace change process, Update and Submit, we will produce a report showing the consultation responses and how these have shaped the final airspace change proposal. This report will be produced alongside a final options appraisal, and the final design. In the event that the final options appraisal shows that impacts have changed substantially, we will undertake a second consultation before progressing to Stage 4b submission of the airspace change proposal. As is the case with all stages of the airspace change process, all reports and outcomes from each stage will be published on the CAA Airspace Change portal.

8.16 We expect the formal airspace change submission to be completed in June 2021, the Stage 5 Decide gateway is expected to be completed in October 2021 and implementation is targeted for 24th February 2022 (in aviation terms this is AIRAC 02/2022).

9. Reversion Statement

9.1 We consider the designs presented in this consultation to be the 'do minimum' option. The 'do nothing' option has been discounted at the previous Stage of the process, however doing nothing is used for comparison with the baseline.

9.2 We have identified that the intensity of workload complexity may become unsustainable for air traffic controllers. While the amount of air traffic has been impacted by the 2020 coronavirus pandemic, the need to change the design of this airspace remains. We must ensure it is fit for purpose when traffic recovers to pre-pandemic levels, and we must ensure it is safe for potential future growth.

9.3 In order to maintain safety, which is our highest priority, temporary limits are placed on the number of flights entering the sector when the workload is predicted to exceed safe limits. This causes delay and is a short-term solution to the underlying problem. The longer the temporary limits are applied, the later flights are pushed back in the day, causing different complexity issues for controllers, airports and airlines, and can cause flights to be delayed into the night-time noise period.

9.4 Should the proposal be approved and implemented, it would be extremely difficult to revert to the pre-implementation state. This is due to the reduction in complexity and controller workload this proposal is designed to bring to the region, increasing its capacity. Reintroducing a high-complexity, high-workload environment at the same time as traffic is predicted to increase to a level unsustainable by that environment is not a desirable situation.

9.5 In the unlikely event of unexpected issues caused by this proposal, short notice changes could be made via flight planning restrictions or other temporary notices to the aviation community. Direct reversion to the pre-existing arrangements could not occur. Any long-term issues identified would need to be resolved either at the post-implementation review (PIR) stage or by another airspace change.

End of main document.

Annexes follow.

Annex A. Consultation Response Proforma

NATS London Luton Airport

London Luton Airport Arrival Flightpaths Consultation Feedback Form

The feedback we receive from this consultation is very important to us. It is a key factor in shaping the final airspace change proposal and it provides us with assurance that we have considered the needs of those who would be impacted by this change. We are therefore asking a series of questions about our proposed options that will help us to understand your views.

These questions do not ask your opinion on the do-nothing option - Option 0. We have concluded that it is not sustainable for air traffic controllers, and we ask you to understand that we seek your opinions on Option 1 and Option 2.

Some of the questions we are asking are necessarily technical in nature. These are annotated as technical questions which you may choose not to answer.

Please respond to this consultation using the feedback form published on the CAA Website. However, if you would rather respond by post, please print these pages, answer the questions, and return this form to:

Airspace Change
Flight Operations
London Luton Airport
Percival House, Percival Way
Luton
LU2 9NU

All responses are moderated by the CAA and then published online.
If you wish your response to be published anonymously, your personal details (name, postcode, email) will be redacted and only be seen by LLA, NATS and the CAA[23].

☐ YES, I want my response to be published with my details
☐ NO, I want my response to be published anonymously

Name: ____

Representing (Self or an Organisation): ____________________________

Postcode: ____

Email: ____

Question 1

To what extent do you agree that Option 1 is an acceptable solution for Runway 07 (easterly)?
☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly Disagree
Tick **one** box above, and add your reason for your answer below if you wish:

____

____

____

____

[23] This may include 3rd party contractors.

Question 2

To what extent do you agree that Option 1 is an acceptable solution for Runway 25 (westerly)?

☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly Disagree
Tick **one** box above, and add your reason for your answer below if you wish:

____

____

____

____

Question 3

To what extent do you agree that Option 2 is an acceptable solution for Runway 07 (easterly)?

☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly Disagree
Tick **one** box above, and add your reason for your answer below if you wish:

____

____

____

____

Question 4

To what extent do you agree that Option 2 is an acceptable solution for Runway 25 (westerly)?

☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly Disagree
Tick **one** box above, and add your reason for your answer below if you wish:

____

____

____

____

Question 5

Do you prefer Option 1 or Option 2?

☐ Option 1 Vectoring ☐ Option 2 PBN Routes and Vectoring ☐ No preference ☐ Don't know
Tick **one** box above, and add your reason for your answer below if you wish:

____

____

____

____

Question 6

If Option 2 is progressed, how frequently would you like to alternate between the routes, from the hold to the runway in use, to provide a degree of respite?

☐ Daily ☐ Every two days ☐ Weekly ☐ No preference ☐ Other (specify below) ☐ Don't know
Tick **one** box above, and add your reason for your answer below if you wish:

____

____

____

____

Question 7

If Option 2 is progressed, at what time of day would you like to change between the two routes from the hold to the runway in use?

☐ Around midnight ☐ Early morning ☐ Mid-morning ☐ No preference ☐ Don't know

Tick **one** box above, and add your reason for your answer below if you wish:

____

____

____

____

Question 8 Technical Question (no requirement to respond)

What classification of airspace would you like the high level additional controlled airspace to the north of Luton to be?

☐ Class A ☐ Class C ☐ Class E ☐ No preference

Tick **one** box above, and add your reason for your answer below if you wish:

____

____

____

____

Question 9 Technical Question (no requirement to respond)

How much would the proposed Class D airspace required to contain the RNAV1 Transition to runway 07 north of Leighton Buzzard (PBN Route 2) impact your operation?

☐ No impact ☐ Some impact ☐ Moderate impact ☐ Significant impact ☐ Major impact

Tick **one** box above, and add your reason for your answer below if you wish:

____

____

____

____

Question 10

If you have any other comments you would like to make, please provide them here:

____

____

____

____

____

____

____

____

____

____

____

Question 10 Additional Comments (continued…)

You may include more pages, a separate letter, picture or diagram if you wish.
Thank you for your time.

Annex B. Full Options Appraisal Summary

Criteria against which the options have been assessed

During the earlier stages of the airspace change process a number of options were developed to address the identified issue. These were narrowed down following an assessment against the design principles. Full details of this process and the full range of options explored are available on the CAA airspace change portal.

The options taken forward to Full Options Appraisal have been assessed, as per the guidance provided in CAP1616a (ref 13). A summary of the full technical assessment of each option can be found below. See ref 11 for the complete Full Options Appraisal document.

The same criteria have been used to assess the current day 'baseline' operation outlined in Section 5 of the Full Options Appraisal. This helps to compare the proposed options against what happens today. Below is a summary of the criteria against which each option has been assessed.

Monetising

Where possible and in accordance with government guidance, these impacts have been monetised. Monetising is a way of converting an impact into a value to enable comparison between different options.

London Luton Airport's application for a Development Consent Order (DCO)

Not within scope of this consultation are future growth plans at London Luton Airport, including the Development Consent Order (DCO) application for 32 million passengers per year. That is a separate project being conducted by London Luton Airport Limited (LLAL), the owners of the airport. This Airspace Change Proposal is co-sponsored by London Luton Airport Operations Limited (LLAOL) who are the current operators of the airport.

Over the past 12 months, LLAOL have submitted a scoping document and Environmental Screening request to the local planning authority (Luton Borough Council) for consideration to grow to 19 million passengers per annum. That is also not within the scope of this consultation or proposal.

The analysis for this FOA has considered the influence of increased passengers on increased air traffic movements in the forecasts. See Annex C for details on how the forecasts and associated analyses were conducted.

Noise

The impact of aviation noise is an important consideration to many communities, individuals and organisations, particularly at lower altitudes. These noise differences are explained as simply as possible.

How noise is perceived is highly subjective, and what may not be acceptable to one individual would be acceptable to another. In this document you will find a written summary and diagrams describing each option we have taken to Consultation, and summary tables of the noise assessments undertaken. This will help you to gauge the impacts each option might have on where you live, work or spend time.

The key impact measures used to assess the noise impacts of each option are:

- Number of households overflown
- Number of households newly overflown
- Households experiencing increased day time noise
- Households experiencing decreased day time noise
- Households experiencing increased night-time noise
- Households experiencing decreased night-time noise

The impacts are described on how each option would change flightpaths, and you can interpret the maps to understand where aircraft could fly, how often, how high, and how much noise you may experience.

It should also be noted that the contours in this submission have all been created using the Federal Aviation Administration's (FAA) Aviation Environmental Design Tool (AEDT) version 3.0b. This software is different to the normal reporting undertaken by LLAOL, which uses the FAA's Integrated Noise Model (INM) version 7.0d and therefore should not be directly compared. Instead, a baseline for 2019 using the AEDT software has been used for comparison.

The Government has produced guidance (ANG2017, ref 16) also see Table 2 on p15 on the relative priorities for the minimising of aviation noise, based on the altitude of the aircraft which is summarised as:

- Below 4,000ft the impact of aviation noise should be prioritised, with preference given to options which are most consistent with existing arrangements.
- Between 4,000ft-7,000ft minimising the impact of aviation noise should be prioritised unless this disproportionately increases CO_2 emissions; and
- From 7,000ft upwards the minimising of CO_2 emission is of greater priority than minimising noise.

Air Quality

Government guidance (ANG2017, ref 16) says that aircraft flying higher than 1,000ft are unlikely to have a significant impact on local air quality. For all options proposed, arriving aircraft would still descend through 1,000ft between 2 and 4 nautical miles (about 7-4km) from touchdown at either end of the runway as they do today. None of the options presented in this consultation will make any changes to aviation emissions (volume or location) below 1,000ft and therefore there will be no change to the impact on local air quality. It would be disproportionate to analyse this phase of flight where no change is proposed.

Greenhouse Gas and Fuel Burn

Key impact measures:

- Change in CO_2e compared to baseline
- Change in fuel burnt compared to baseline

A change in track distance flown would change the amount of fuel needed to fly that new distance – a longer route may mean more fuel burnt. A change in fuel burnt can be converted to CO_2 equivalent (CO_2e, using a standard multiplier of 3.18), which represents the estimated change in greenhouse gas impacts.

Often an increase in track mileage can be partially offset by keeping aircraft higher (where fuel efficiency is significantly better), and a longer route can result in fewer delays due to less holding. Using the analogy of driving a car, it can be more efficient to take a longer route to travel around a city by motorway, than to take a shorter route straight through the city centre. This is because a car operates more efficiently at a constant speed on a motorway than stop/start or crawling in traffic jams on the shorter route thereby burning less fuel.

Each option was reviewed in terms of total annual fuel burn/mass of CO_2 in metric tonnes emitted and this is detailed based on the current traffic levels and the traffic levels predicted for ten years after implementation.

Capacity and Delay

Delay was analysed to see how much can be avoided for each of the proposed options, measured in minutes. This is presented as a measure of the impact on capacity. Delay has been expressed by quantifying the impact to airlines, however, it is recognised that delay has a much broader impact to the travelling public, businesses and local communities, so this has been considered qualitatively during the assessment.

Resilience

Resilience in this context is the ability to react to unforeseen events that affect the air traffic network, such as a runway closure or bad weather. It is how quickly the air traffic controllers and the airspace they control can recover from disruption. There are many elements to resilience, including capacity, delay, staffing, the nature of the disruption, and airspace complexity.

These factors are so interlinked that a metric for the concept of resilience cannot be provided – it is not proportional to perform a quantitative assessment, nor to monetise it, and there are no market prices for air traffic control resilience. However, the ability of a controller to react to, and manage the impacts of, a disruptive event is an indicator of resilience. This is proportional to the balance of a controller's 'thinking time' vs. 'doing time', with that balance proportional to the number of radio transmissions the controller makes, per flight.

The expertise of senior air traffic control staff (a Group Supervisor of more than ten years' experience canvassed other experienced controllers qualified to work on the relevant sectors) was used to determine the typical number of radio exchanges an air traffic controller would make, for each option. This indicates the workload balance which is proportional to resilience. As a general rule the fewer radio exchanges per flight, the less complex the air traffic situation, the greater the ability of a controller to manage disruptive events, the greater the resilience.

Airspace Access

Controlled Airspace (CAS) is the name given to a specific volume of airspace which normally requires the pilot of an aircraft to obtain the permission from an air traffic controller prior to entry. The primary purpose of CAS is to provide an additional layer of protection for aircraft flying along air traffic routes. CAS boundaries and classifications have been qualitatively outlined, including any additional CAS that may be required in order to implement each option. This includes details on any CAS that would no longer be required and can be changed to uncontrolled airspace for each option.

Commercial Airlines / General Aviation

The number of minutes of delay that the options reduce, or increase compared to the baseline to assess the economic impact from increased effective capacity, has been analysed.

NATS has a standard cost-per-minute for delay of £3.68[24], from which the monetised annual cost or benefit of the delay avoided has been calculated.

Costs

Any airspace change will result in additional costs. The following key impact measures for each option have been qualitatively assessed:

- Training costs for airline crew
- Infrastructure costs for airports or ANSPs
- Operational costs
- Deployment costs

Tranquillity

Tranquillity as a concept is generally considered by the CAP1616 process, and government guidance, with reference to impacts on Areas of Outstanding Natural Beauty (AONB) and National Parks.

There are no National Parks in the vicinity, but the Chilterns AONB is nearby. The impacts today's flightpaths currently have, and potential future flightpaths might have, on the Chilterns AONB, have been considered as part of the full options appraisal.

The Government's altitude-based guidance states 'Where practicable, it is desirable that airspace routes below 7,000ft should seek to avoid flying over Areas of Outstanding Natural Beauty (AONB) and National Parks'. However, where an AONB or National Park is close to an airport, (such as the Chilterns Conservation AONB to the west of LLA) it may not be practicable to avoid the AONB. As such, the overflight of the AONB is taken into consideration alongside other impacts such as overflight of populated areas.

Biodiversity

From a biodiversity point of view and CAP1616, airspace changes at the altitudes proposed here would not have an impact on biodiversity because they do not involve ground infrastructure changes. Therefore, consideration of the biodiversity legislation or guidance is not required. Changes in greenhouse gas emissions, which may have a potential *indirect* impact on biodiversity, are described separately in this document.

Historic Environment

Historic environments, in this context, mean formally registered historic parks and gardens. We identified the relevant places overflown below 4,000ft and assess the impact to these areas in the full options appraisal.

---

[24] This is a standard cost to airlines, provided that delay is up to 15 minutes. For this proposal, delay avoided was assumed to be less than 15 minutes and the figure of £3.68 was used.

Full Options Appraisal: Summary of conclusion

Under FOA paragraph 5.1, the geographical and numerical analyses tend to favour Option 2 except where the WebTAG monetising of noise impacts heavily favours Option 1. As noted, this metric essentially quantifies the difference between keeping the low-altitude arrivals similar to today's arrangements and making a change which would tend to systemise and concentrate flights and noise impacts.

However, under FOA paragraph 5.2, Government policy direction via the AMS is to use precise and flexible satellite navigation. Airports in the South (including LLA) are already working on their FASI-S airspace changes to align their arrival and departure routes with the AMS by using satellite-based navigation standards. These changes are coming in the medium to longer term. The more this shorter-term proposal is aligned with the FASI-S proposal, the lesser the likelihood or scope of a significant change to low altitude arrival flightpaths in the medium to longer term.

Under FOA paragraph 5.3 it was explained that, when comparing the Net Present Value (NPV, see glossary) of both options, the difference in disbenefit is relatively small.

Under FOA paragraph 5.4, the resilience of Option 2 is greater than that of Option 1

Taking all these into account, including the safety assessments in Section 4 on p.33, the outcome of the full options appraisal is that the preferred option is Option 2, a new RNAV hold north of LLA with PBN routes, shortcuts and vectoring all available for controllers to use.

For complete details of the data, analysis and how the conclusions were drawn, please see the Full Options Appraisal document (ref 11) in the CAA's airspace change portal.

Annex C. Analysis Forecasts and Methodology Summaries

The analysis for the Full Options Appraisal (FOA) has considered the influence of increased passengers on increased air traffic movements within our forecasts. At the time analysis was started, 2018 was the most complete and appropriate base year from which to derive the forecasts. Annual movements at LLA in 2018 were 136,270 (68,135 arrivals).

The number of arrivals at LLA for 2022 is assumed to be 70,740 for the purpose of these analyses.

Should the application for LLAL's DCO not succeed, the same number of arrivals is assumed for 2032 (ten years from implementation) because the 18 million passengers per annum limit is already reached and the number of arrivals could not increase.

Should LLAL's application for the DCO succeed, the number of LLA arrivals is forecast to be 91,500 aircraft in 2032. This proposal is not directly related to LLAL's DCO; however the traffic forecasts and analyses used here must be consistent with the forecasts publicly available as part of the separate DCO process – see below for further details.

The noise and fuel/CO_2e analyses were performed pre-pandemic, assuming this proposal's originally-planned implementation year of 2021, with a ten-year forecast up to 2031 as required by the airspace change process CAP1616 (ref 12). Those forecasts were consistent with the forecast non-DCO traffic levels and with LLAL's published DCO traffic forecasts, for 2021-2031. The purpose of fuel/CO_2e and noise modelling analyses is to illustrate the differences between the potential impacts of different airspace design options, and their respective methodology assumptions are summarised later in this Annex.

The coronavirus pandemic has caused impacts on the aviation industry which has meant that the original timescale to implement this proposal in May 2021, subject to CAA approval, has moved to February 2022, nine months later. We have assumed the remainder of 2020 and 2021 will now be stabilisation and recovery years, where traffic levels return to pre-pandemic levels.

The forecast period for this airspace change must therefore now run from 2022-2032 and must still be consistent with LLAL's DCO forecast. There is a small difference in LLAL's DCO forecast arrivals between 2031 and 2032,
rising from 90,500 in 2031 to 91,500 in 2032, an increase of 1,000 arrivals per year, c.2.8 per day, or a 1.1% increase.

The analyses must be realigned with LLAL's DCO 2022-2032 forecast; however this presents significant challenges of proportionality, given that small difference. The with-DCO analyses must also be consistent with the non-DCO forecast years.

- From a fuel/CO_2e analysis point of view, the original 2021-2031 results can be adapted to account for this small difference, to directly illustrate the 2032 with-DCO scenario. It would not be proportionate to re-run the analysis in full using a slightly-revised traffic forecast, this would require several weeks of expensive work, and result in a minimal difference which would not affect stakeholders' understanding of the likely impacts.
- From a noise analysis point of view (contours, overflight swathes, population and sensitive-building data) the 2021-2031 modelled results cannot be adapted to account for this small difference and cannot directly illustrate the 2032 with-DCO scenario. It would not be proportionate to re-run the analysis in full using a slightly-revised traffic forecast for the reasons stated in the paragraph above.
    - The 2031 noise analyses represent the most up-to-date, credible, clearly referenced source of data with modelling carried out in line with best practice described in CAP1616 (ref 12) and CAP1616a (ref 13).
    - The noise modelling methodology acknowledges that its output is a representation of what may occur given the potential influences, and should not be taken as definitive (see summary of noise modelling later in this Annex).
    - We contend that a qualitative assessment of the difference between the 2031 and 2032 noise scenarios is proportionate.

- We contend that the small differences between 2031 and 2032 noise scenarios would be outweighed by the uncertainties inherent in the non-definitive nature of the modelling, discussed above.
- We contend that the 2031 noise scenarios are sufficiently representative of the 2032 noise scenarios for stakeholders to understand and make informed decisions about the differences between Option 1 and Option 2, in line with Gunning's second principle of consultation.
- Population counts were embedded in the noise analysis methodology, and conducted using data supplied by CACI for 2021-2031. We must assume this to be representative of likely 2022-2032 populations.
- There have been unprecedented impacts on NATS, LLA, and the entire aviation industry due to the coronavirus pandemic. We contend these statements on proportionality are reasonable and do not reduce the effectiveness of the data to illustrate its intended purpose.

From a fuel/CO_2e point of view for Stansted, annualised figures are based on a linear growth from the NATS traffic forecast from 2021 to 2031 to calculate the 2022 and 2032 traffic figures. From this, in 2022 Stansted is forecast to have 101,719 arrivals and, in 2032, 102,410 arrivals. There would be no noise impacts for Stansted aircraft, and Stansted's traffic is assumed not to be impacted by LLAL's DCO.

Therefore, each analysis considers 2021 as a recovery year, the implementation year of 2022, 2032 non-DCO and 2032 with-DCO, using the above arrival numbers for LLA, and Stansted arrival numbers where needed to form part of the analysis. The exception is for LLA arrival noise 2022-2032, which we assume to be the same as 2021-2031 as explained above.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
LLA Arrivals No DCO	Recovery period	70,470	70,470	70,470	70,470	70,470	70,470	70,470	70,470	70,470	70,470	70,470
LLA Arrivals With DCO		70,470	70,470	70,470	79,000	79,000	80,500	83,500	86,500	89,500	90,500	91,500
Stansted Arrivals NERL Base Case		101,650	101,719	101,788	101,857	101,926	101,996	102,065	102,134	102,203	102,272	102,341

Table C13 Forecast arrivals 2021-2032 including recovery period and intermediate years

LLA's arrival forecast with-DCO expects no change for the first three years due to the timetable of the DCO submission and expected planning decisions. For full details see the separate DCO process.
This table has used linear interpolation for Stansted arrivals from 2022-2032.

Fuel/CO_2e Analysis Methodology Summary

The airspace change has been modelled using the fast-time simulation software AirTOp.

The following dates were used as a traffic sample; 14th June, 27th June, 25th July, 30th July, 27th September and the 28th September 2021 and 2031(flight plans were grown from 2018 data using LLAL's DCO growth forecast for Luton traffic and NATS Stansted's forecast for Stansted traffic). Annualised traffic figures for LLA are based on their 2022 and 2032 DCO forecast. Annualised figures for Stansted are based on a linear growth from the NATS Stansted traffic forecast from 2021 to 2031 to calculate the 2022 and 2032 traffic figures.

The traffic sample contained all aircraft which arrived and departed at either LLA (EGGW) or Stansted (EGSS). The fuel burn was modelled for both easterly and westerly runway directions. The results are weighted 70/30% in favour of westerly operations.

The fuel burn for the baseline and options was calculated using Base of Aircraft Data (BADA) v4.2.

Fuel uplift is included in the assessment.

The Baseline traffic data was based on flight plan data and not actual flown data. This ensured that network constraints associated with excessive demand did not mask underlying demand requirements on the airspace.

When undertaking comparative analysis between the options, the traffic samples remained the same as that in the baseline. This was to ensure any observed differences were due to the airspace design, not due to changes in the traffic sample.

A 'blue sky' weather picture with no wind was assumed.

Unconstrained demand was modelled thereby excluding the naturally occurring influence of flow restrictions, minimum departure intervals or departure slot compliance.

Controller tasks were completed instantaneously with each controller able to control multiple aircraft simultaneously (no workload constraints or response limitations applied).

AirTOp version 2.3.28B159 was used.

The average fuel burn benefit per aircraft was calculated using only the traffic and aircraft types observed on the particular traffic flows relevant to the scenario.

The airline fuel burn results were calculated by taking their procedural benefit/disbenefit. The average path-stretching for each arrival airport was calculated and it was assumed that this would take place at FL80 for all aircraft as this was the average holding level pulled from NATS data. This was added to the procedural fuel burn to give a fuel figure for each airline that assumes the holding is the same per aircraft.

Fuel burn modelling has been undertaken using the KERMIT emissions model which uses BADA data made available by the European Organisation for the Safety of Air Navigation (EUROCONTROL). All rights reserved. The AirTOp simulation model also uses BADA aircraft performance data.

Noise Modelling Methodology Summary

All noise modelling undertaken for this airspace change has had regard for CAA guidance as provided in CAP1616a (ref 13). The modelling has also taken into account the categories of noise modelling described in the CAA's 2020 consultation on the minimum requirements.

All noise modelling has been carried out using the Federal Aviation Administration's (FAA) Aviation Environmental Design Tool (AEDT) version 3.0b.A1.4. The construction and validation aspects of the noise modelling have been carried out with the support of Noise Consultants Ltd (NCL)'s OnTrack software suite.

It is stressed that modelling of these forecasts has been carried out to provide an indication of the impact of the airspace change in combination with other forecast changes at LLA over the next ten years. The consideration of the forecasts provides some insight into the potential influence that other infrastructure projects currently being planned for LLA could also have on aircraft noise. It should also be noted that the forecasts provided present a representation of what may occur and should therefore not be taken as a definitive impact from infrastructure change or changes to LLA's existing consents.

To determine the proportions of flights used in the tables below, the average proportion of typical flights that arrive into LLA during the day and night was assessed. Annual average runway-use data was used to understand the percentage of the time that each runway is used, based primarily on the wind direction.

The proportion of aircraft that are vectored and those which use shortcuts (Option 1) and those which would also use the PBN routes (Option 2) was estimated, using senior air traffic control experts (minimum ten years' experience as a Group Supervisor). These proportions have been factored into the noise analysis in the FOA to represent typical behaviour but are not a guarantee of the proportions for any particular period.

	Day				Night			
	90% of flights				10% of flights			
	RWY 25 Day		RWY 07 Day		RWY 25 Night		RWY 07 Night	
	70% of flights		30% of flights		70% of flights		30% of flights	
	Shortcut	Vectoring	Shortcut	Vectoring	Shortcut	Vectoring	Shortcut	Vectoring
Proportion %	30.0	70.0	30.0	70.0	30.0	70.0	30.0	70.0
Multiplied by RWY %	21.0	49.0	9.0	21.0	21.0	49.0	9.0	21.0
Overall time %	18.9	44.1	8.1	18.9	2.1	4.9	0.9	2.1

Table C14 Indicative air traffic proportions for Option 1

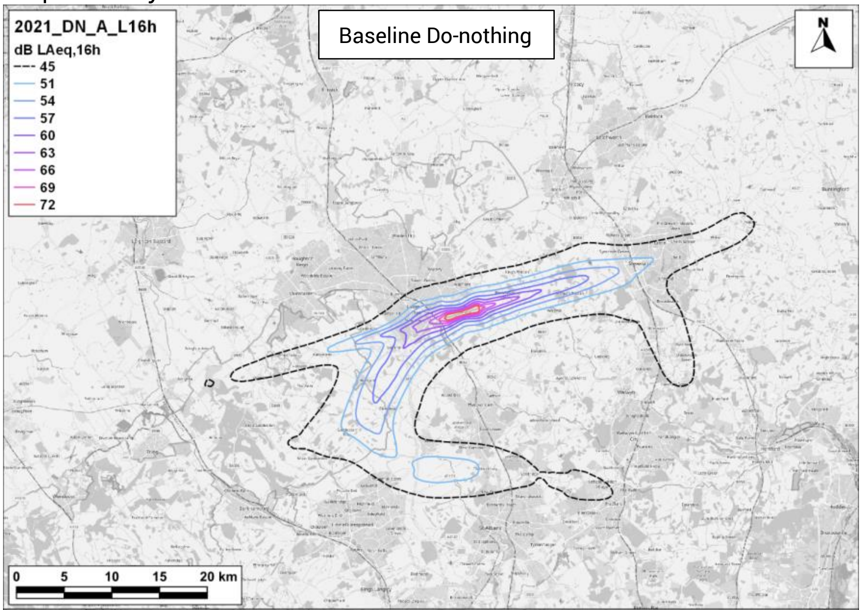
	Day						Night					
	90% of flights						10% of flights					
	RWY 25 Day			RWY 07 Day			RWY 25 Night			RWY 07 Night		
	70% of flights			30% of flights			70% of flights			30% of flights		
	Shortcut	PBN	Vectoring	Shortcut	PBN	Vectoring	Shortcut	PBN	Vectoring	Shortcut	PBN	Vectoring
Proportion %	30.0	49.0	21.0	30.0	49.0	21.0	30.0	49.0	21.0	30.0	49.0	21.0
Multiplied by RWY %	21.0	34.3	14.7	9.0	14.7	6.3	21.0	34.3	14.7	9.0	14.7	6.3
Overall time %	18.9	30.87	13.23	8.10	13.23	5.67	2.10	3.43	1.47	0.90	1.47	0.63

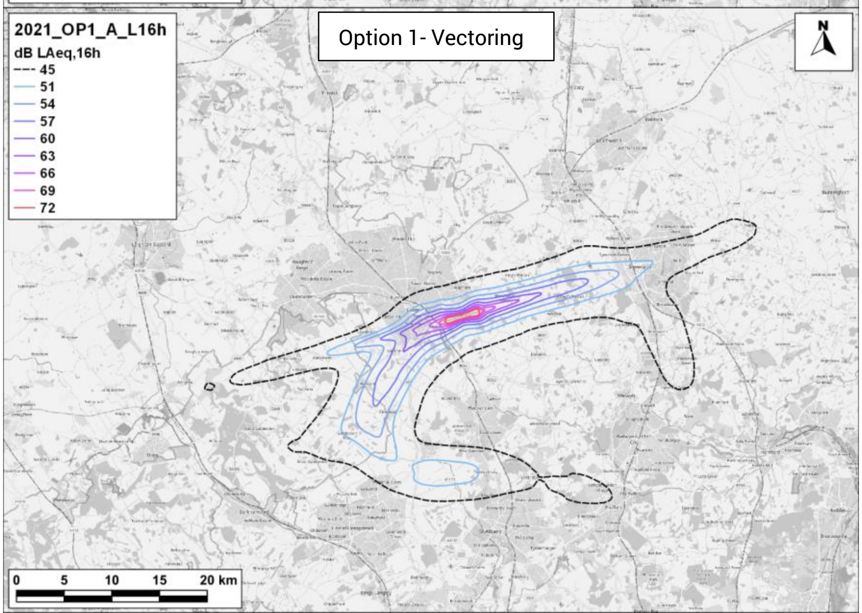
Table C15 Indicative air traffic proportions for Option 2

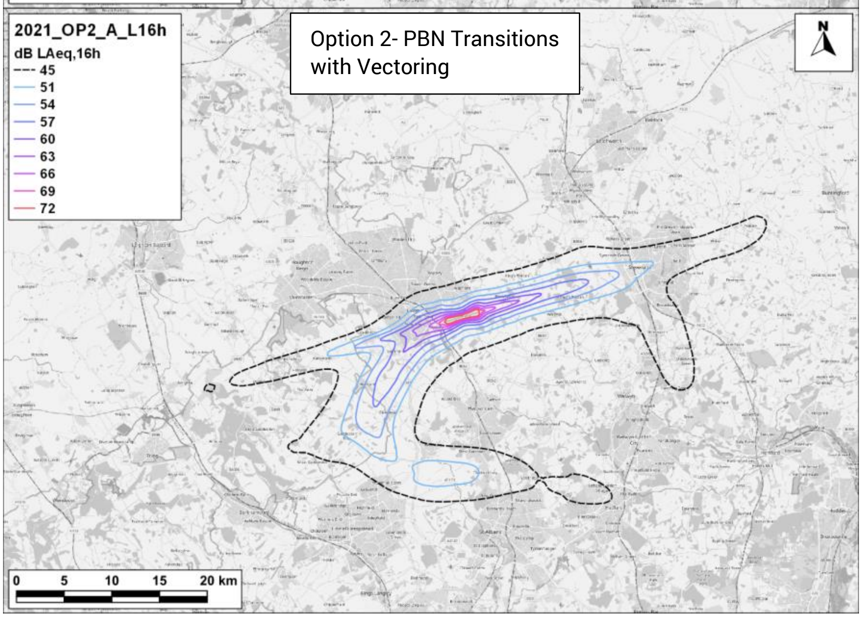
Intentionally blank

Annex D. 2021 Implementation Year Noise Metric Images, Data

LAeq16hr- Day Time







Areas of Contours (km²)

Scenario	2021, dB Laeq,16h									
	45	48	51	54	57	60	63	66	69	>=72
Do-nothing (km^2)	202.5	121.6	72.4	39.6	20.2	8.52	4.35	2.08	1.17	0.73
Option 1 (km^2)	201.9	121.5	72.3	39.5	20.2	8.53	4.34	2.08	1.17	0.73
Option 2 (km^2)	203.0	121.5	72.3	39.6	20.2	8.52	4.34	2.08	1.17	0.73

Population and Household counts

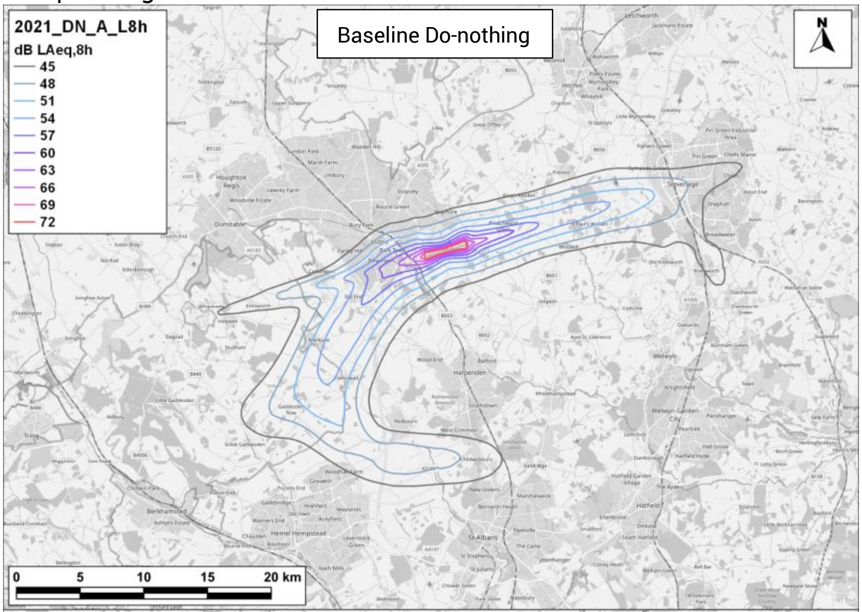
Scenario	2021, dB Laeq,16h Population Counts									
	45	48	51	54	57	60	63	66	69	>=72
Do-nothing	165119	82329	35222	17603	8558	2602	517	0	0	0
Option 1	164812	82677	35201	17497	8528	2602	432	0	0	0
Option 2	164452	82333	35118	17412	8558	2505	432	0	0	0
	Household Counts									
Do-nothing	67758	34068	14715	7233	3547	935	179	0	0	0
Option 1	67677	34208	14673	7199	3535	935	147	0	0	0
Option 2	67508	34070	14666	7164	3547	906	147	0	0	0

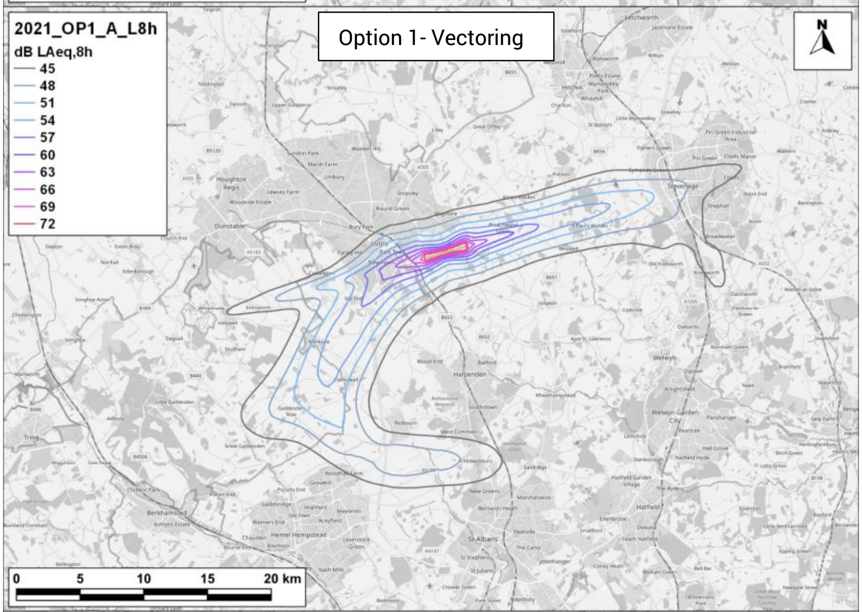
Hospitals, Places of Worship and Schools counts

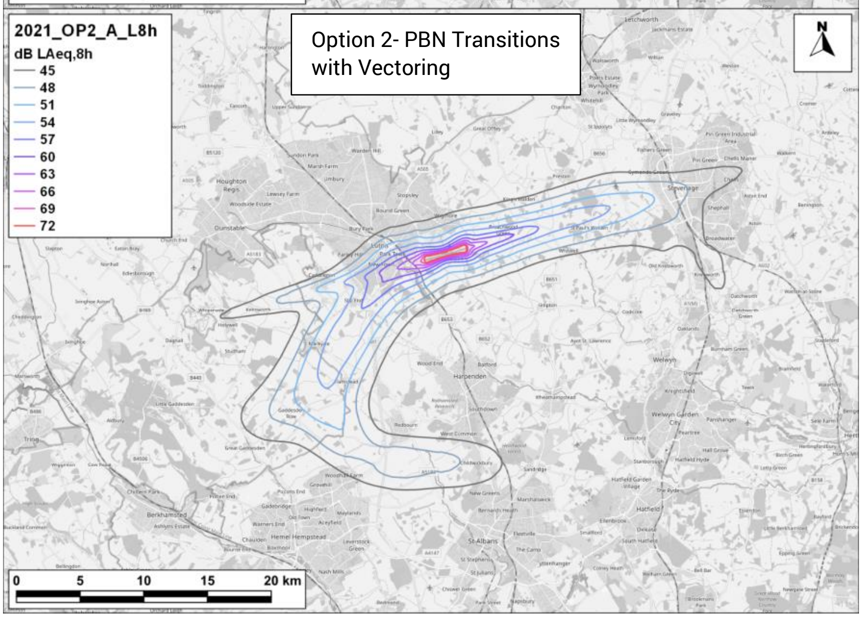
Scenario	2021, dB Laeq,16h Hospitals									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	1	0	0	0	0	0	0	0	0	0
Option 1	1	0	0	0	0	0	0	0	0	0
Option 2	1	0	0	0	0	0	0	0	0	0
	Places of Worship									
Do Nothing	101	57	33	16	5	3	0	0	0	0
Option 1	101	57	33	16	5	3	0	0	0	0
Option 2	101	57	33	17	5	3	0	0	0	0
	Schools									
Do Nothing	179	102	51	25	14	7	2	0	0	0
Option 1	178	101	51	25	14	7	2	0	0	0
Option 2	178	102	51	26	14	6	2	0	0	0

Images and data were produced for 2021. They also represent the impacts for 2022, see Annex C for full details

LAeq8hr- Night-time







Areas of Contours (km²)

Scenario	2021, dB Laeq,8h									
	45	48	51	54	57	60	63	66	69	>=72
Do-nothing (km^2)	129.0	78.5	44.1	22.7	9.15	4.58	2.22	1.24	0.77	0.52
Option 1 (km^2)	128.8	78.5	44.0	22.7	9.15	4.58	2.25	1.25	0.77	0.52
Option 2 (km^2)	128.9	78.5	44.0	22.7	9.15	4.57	2.23	1.24	0.77	0.52

Population and Household counts

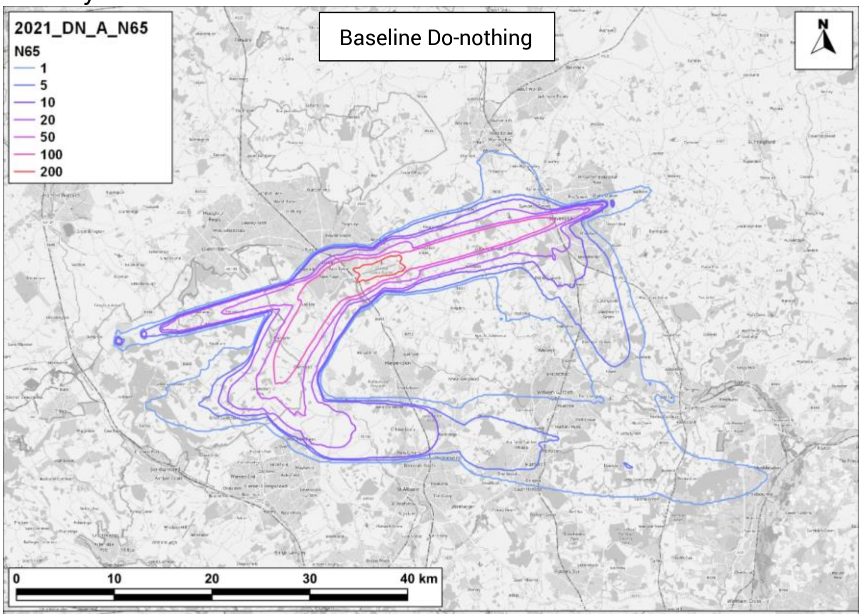
Scenario	2021, dB Laeq,8h Population Counts									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	86055	36834	19102	10160	3613	854	7	0	0	0
Option 1	86294	36762	19064	10160	3613	854	7	0	0	0
Option 2	86040	36677	19072	10160	3613	854	7	0	0	0
	Household Counts									
Do Nothing	35810	15236	7916	4277	1321	315	2	0	0	0
Option 1	35916	15166	7899	4277	1321	315	2	0	0	0
Option 2	35807	15159	7903	4277	1321	315	2	0	0	0

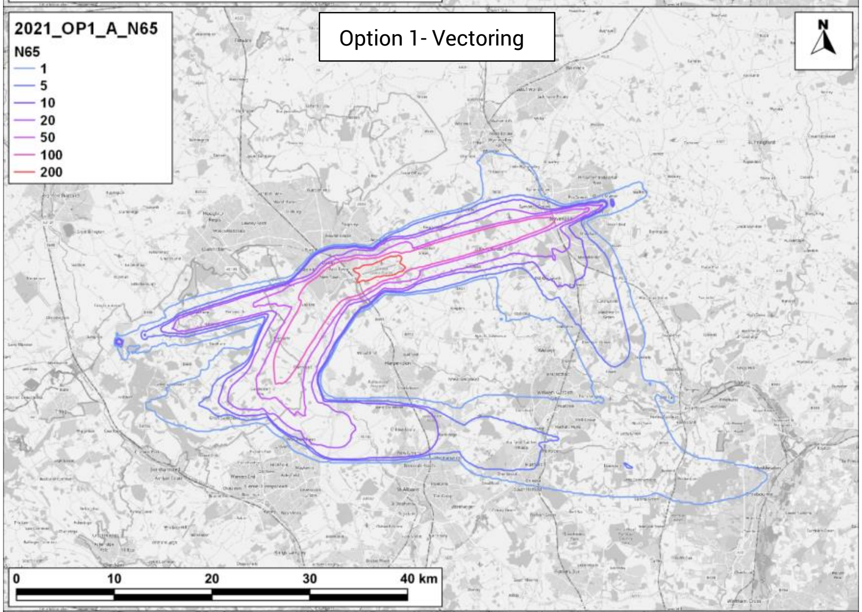
Hospitals, Places of Worship and Schools counts

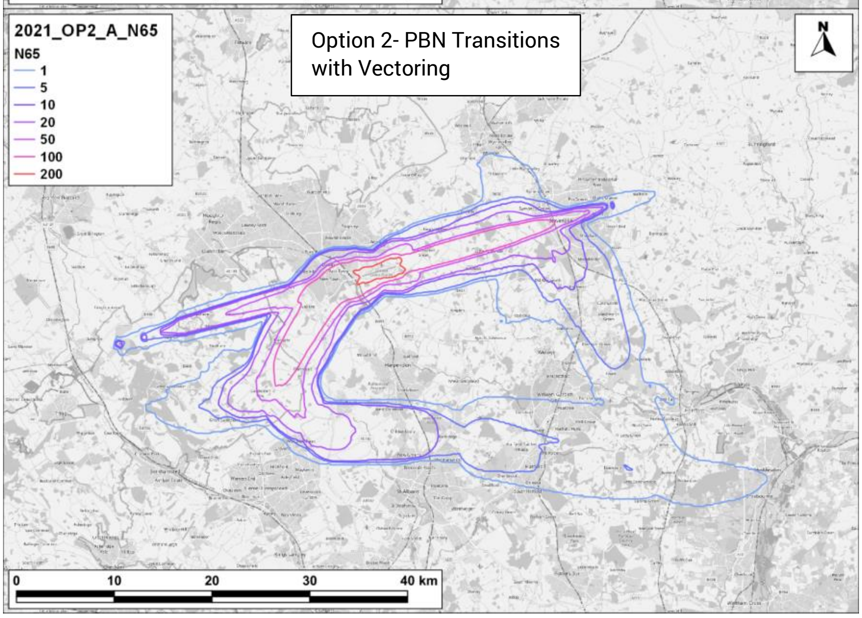
Scenario	2021, dB Laeq,8h Hospitals									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	None									
Option 1										
Option 2										
	Places of Worship									
Do Nothing	65	34	19	5	3	0	0	0	0	0
Option 1	65	33	19	5	3	0	0	0	0	0
Option 2	65	34	19	5	3	0	0	0	0	0
	Schools									
Do Nothing	115	54	28	14	7	2	0	0	0	0
Option 1	115	53	28	14	7	2	0	0	0	0
Option 2	115	54	28	14	7	2	0	0	0	0

Images and data were produced for 2021. They also represent the impacts for 2022, see Annex C for full details

N65- Day Time


2021_DN_A_N65
N65
1
5
10
20
50
100
200
Baseline Do-nothing
N
0
10
20
30
40 km


2021_OP1_A_N65
N65
1
5
10
20
50
100
200
Option 1- Vectoring
N
0
10
20
30
40 km


2021_OP2_A_N65
N65
1
5
10
20
50
100
200
Option 2- PBN Transitions with Vectoring
N
0
10
20
30
40 km

Areas of Contours (km^2)

Scenario	2021, N65						
	1	5	10	20	50	100	200
Do-nothing (km^2)	540.0	202.1	144.5	97.9	53.8	32.5	2.91
Option 1 (km^2)	548.9	204.8	145.4	97.9	52.4	32.4	2.91
Option 2 (km^2)	543.2	202.4	144.6	97.9	53.4	32.5	2.91

Population and Household counts

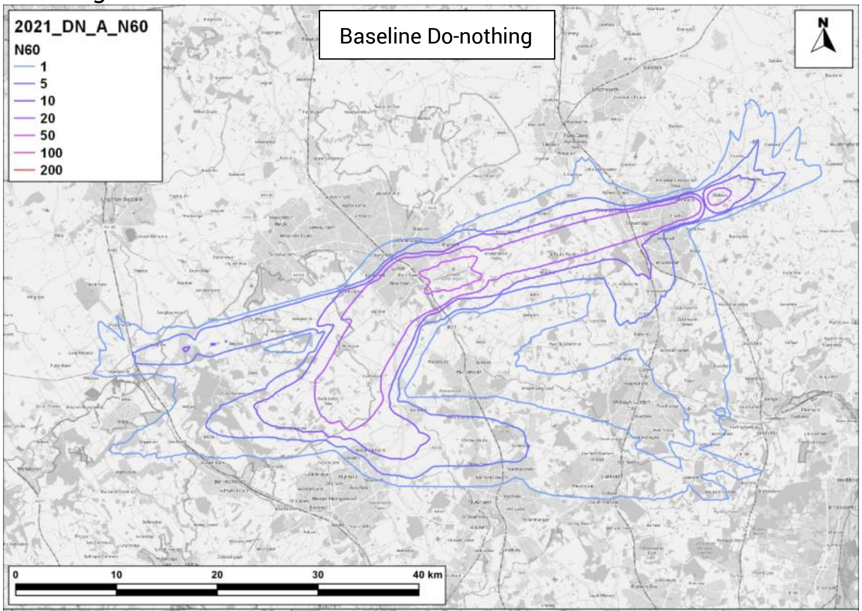
Scenario	2021, N65 Population Counts						
	1	5	10	20	50	100	>200
Do Nothing	256921	153072	95643	52897	32010	15654	35
Option 1	258602	154339	96418	52755	30586	15795	35
Option 2	257302	153412	95684	52683	31334	15697	35
	Household Counts						
Do Nothing	103687	62034	39349	22209	13495	6437	15
Option 1	104444	62608	39721	22160	12829	6495	15
Option 2	103827	62194	39367	22130	13169	6453	15

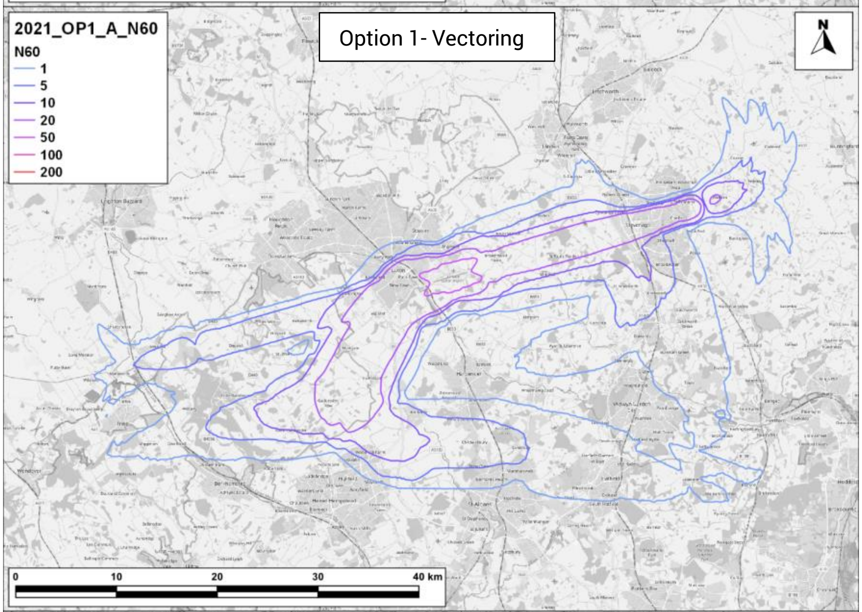
Hospitals, Places of Worship and Schools counts

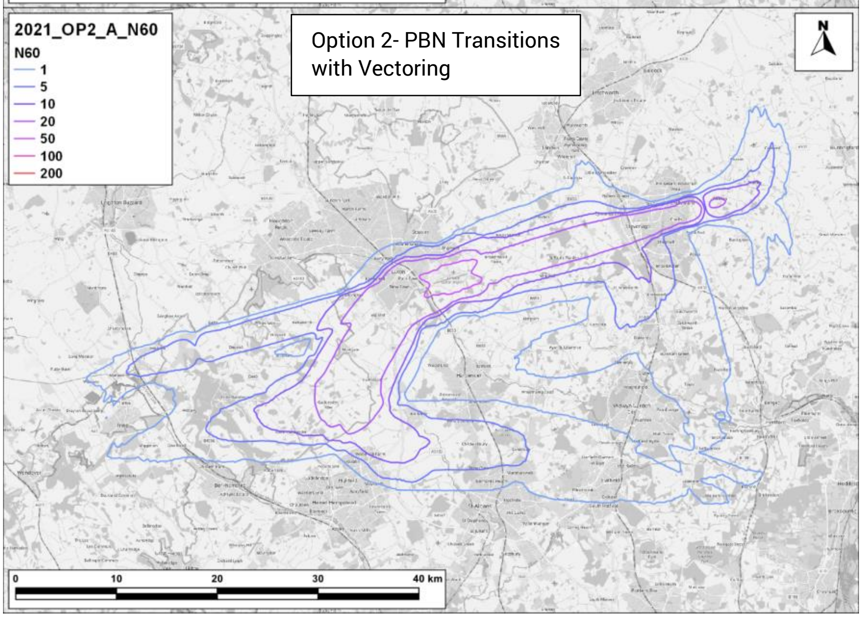
Scenario	2021, N65 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	3	1	0	0	0	0	0	0
Option 1	3	1	0	0	0	0	0	0
Option 2	3	1	0	0	0	0	0	0
	Places of Worship							
Do Nothing	142	97	74	46	30	14	0	0
Option 1	144	99	75	45	29	14	0	0
Option 2	144	97	74	45	30	14	0	0
	Schools							
Do Nothing	266	170	120	77	45	23	0	0
Option 1	269	172	122	75	43	23	0	0
Option 2	268	170	120	75	45	23	0	0

Images and data were produced for 2021. They also represent the impacts for 2022, see Annex C for full details

N60- Night-time







Areas of Contours (km²)

Scenario	2021, N60						
	1	5	10	20	50	100	200
Do-nothing (km²)	606.9	221.5	126.2	72.9	5.27	0.00	0.00
Option 1 (km²)	619.2	220.8	125.4	72.0	5.27	0.00	0.00
Option 2 (km²)	610.3	221.8	126.4	72.2	5.28	0.00	0.00

Population and Household counts

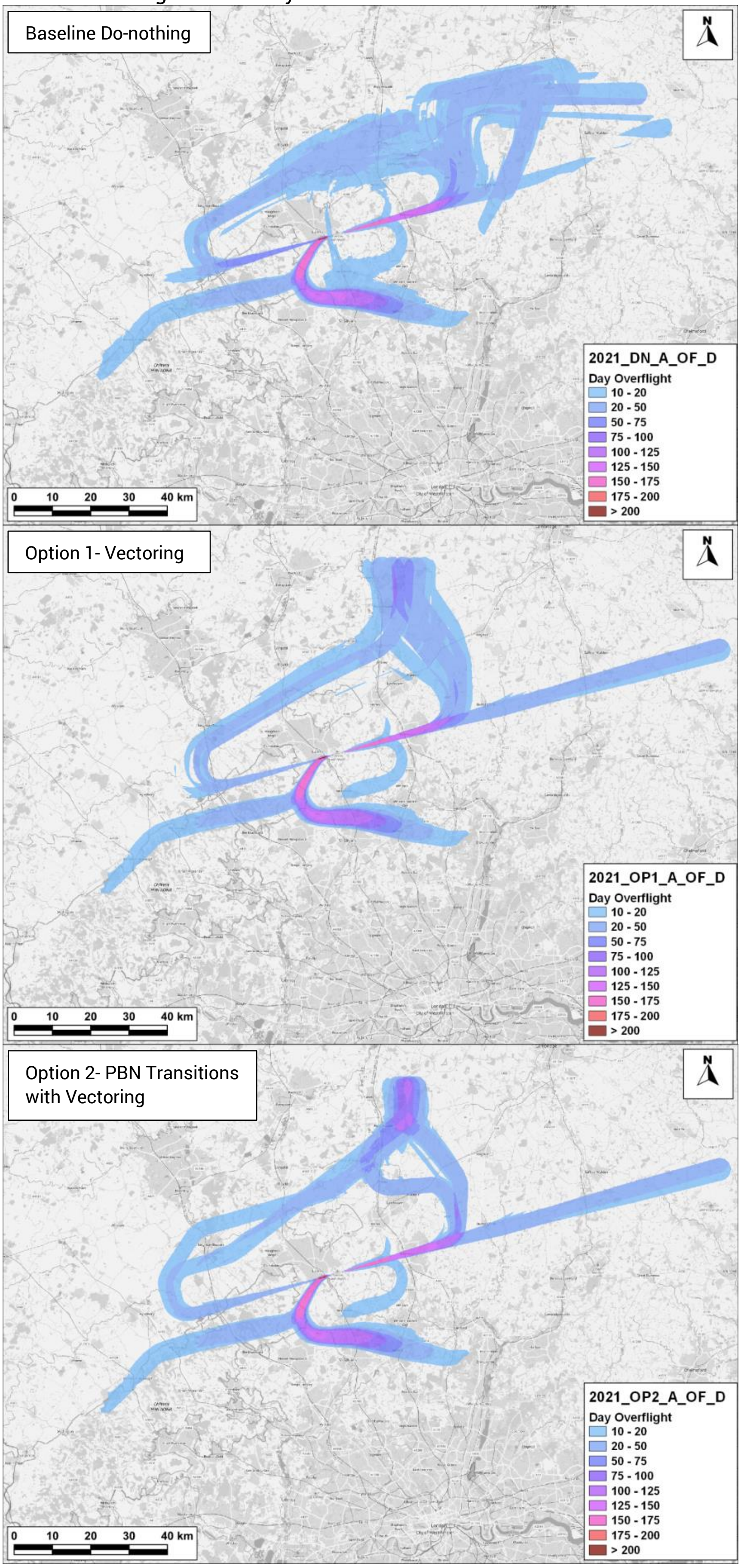
Scenario	2021, N60 Population Counts						
	1	5	10	20	50	100	>200
Do Nothing	308894	153198	94331	65857	68	0	0
Option 1	309277	153914	94584	64542	68	0	0
Option 2	308839	152924	94420	64812	68	0	0
	Household Counts						
Do Nothing	121795	62881	39347	27418	26	0	0
Option 1	121959	63263	39442	26911	26	0	0
Option 2	121769	62788	39383	27001	26	0	0

Hospitals, Places of Worship and Schools counts

Scenario	2021, N60 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	3	0	0	0	0	0	0	0
Option 1	3	0	0	0	0	0	0	0
Option 2	3	0	0	0	0	0	0	0
	Places of Worship							
Do Nothing	181	101	64	43	0	0	0	0
Option 1	181	100	64	42	0	0	0	0
Option 2	180	99	64	42	0	0	0	0
	Schools							
Do Nothing	328	176	111	81	0	0	0	0
Option 1	327	174	110	79	0	0	0	0
Option 2	326	173	111	80	0	0	0	0

Images and data were produced for 2021. They also represent the impacts for 2022, see Annex C for full details

CAP1498 Overflight 48.5°- Day



CAP1498 48.5° Overflights, Population and Household Counts, Day Time, N65 Metric

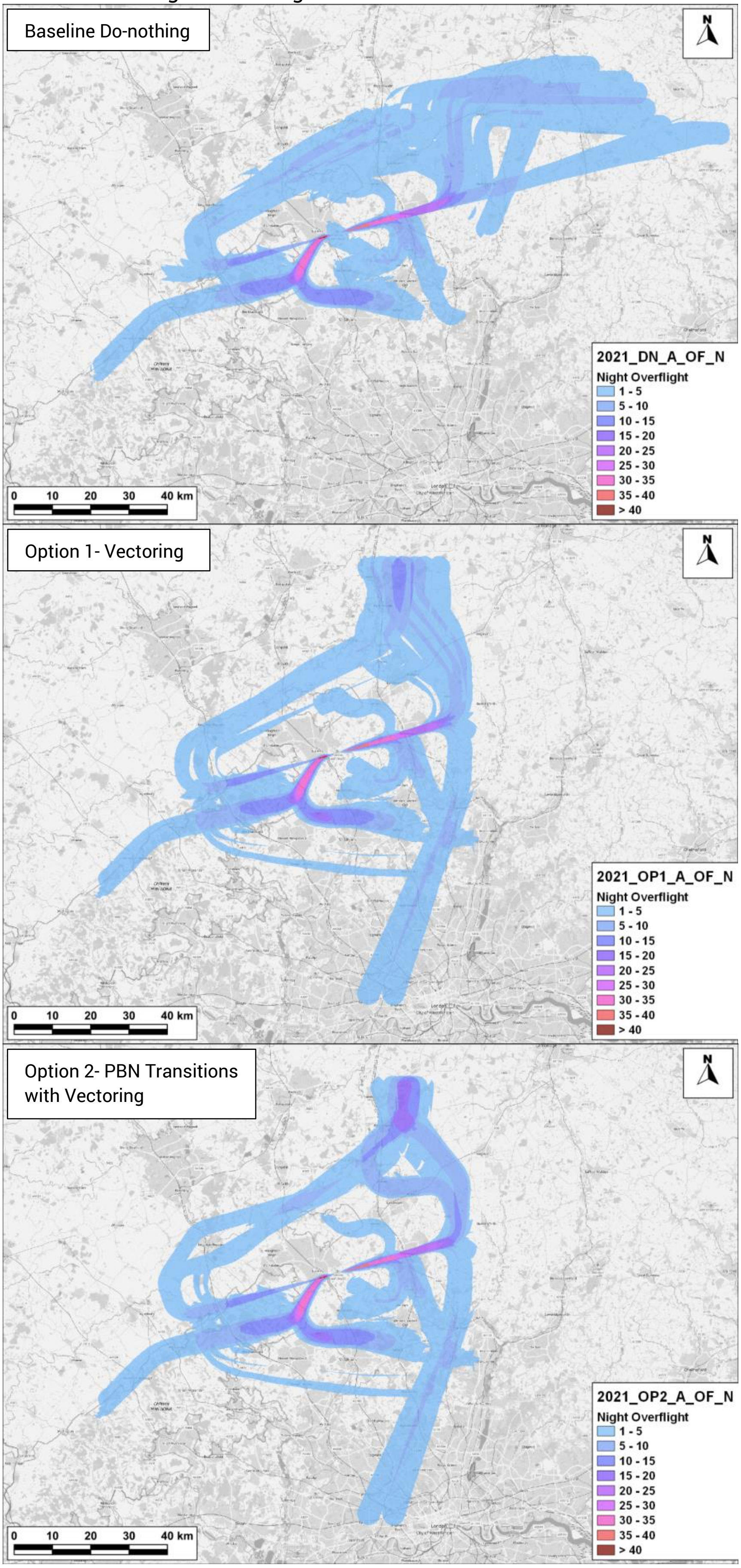
Scenario	2021, CAP1498 48.5° Overflights Population Counts Day Time							
	>=1	>=5	>=10	>=20	>=50	>=100	>=200	>500
Do Nothing	1268391	708283	438954	198471	67851	28719	7	0
Option 1	900363	477354	295395	167230	62171	26798	0	0
Option 2	872684	424117	285471	175087	79706	26902	0	0
	Household Counts							
Do Nothing	507467	284103	178200	79838	27011	12172	2	0
Option 1	367350	194800	119048	66891	24986	11397	0	0
Option 2	356077	172213	115313	70663	32044	11449	0	0

CAP1498 48.5° Overflights, Hospitals, Places of Worship and School Counts, Day time, N65 Metric

Scenario	2021 CAP1498 48.5° Overflight Day Time N65 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	30	12	10	3	1	0	0	0
Option 1	18	10	6	1	1	0	0	0
Option 2	18	10	5	1	1	0	0	0
	Places of Worship							
Do Nothing	851	497	345	153	25	13	0	0
Option 1	594	355	239	119	24	13	0	0
Option 2	586	318	236	122	35	13	0	0
	Schools							
Do Nothing	1507	876	588	252	58	30	2	0
Option 1	1065	621	404	206	57	30	2	0
Option 2	1046	549	396	217	76	31	2	0

Images and data were produced for 2021. They also represent the impacts for 2022, see Annex C for full details

CAP1498 Overflight 48.5°- Night



CAP1498 48.5° Overflights, Population and Household Counts, Night-time, N60 Metric

Scenario	2021, CAP1498 48.5° Overflights Population Counts Night Time							
	>=1	>=5	>=10	>=20	>=50	>=100	>=200	>500
Do Nothing	497854	111501	35407	25467	0	0	0	0
Option 1	540013	107284	37415	23300	0	0	0	0
Option 2	486582	139590	41982	23302	0	0	0	0
	Household Counts							
Do Nothing	202324	45536	14824	10870	0	0	0	0
Option 1	221276	43997	15774	9953	0	0	0	0
Option 2	198544	57794	17661	9953	0	0	0	0

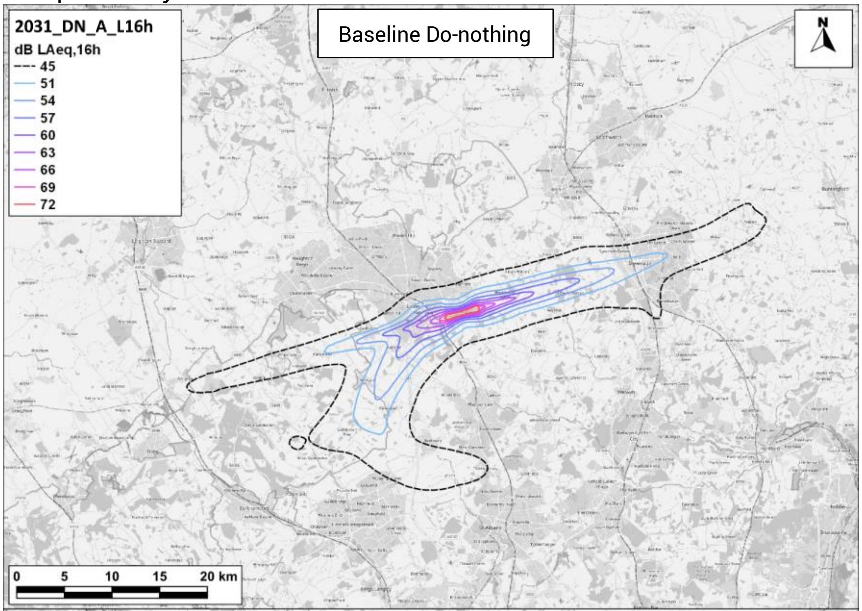
CAP1498 48.5° Overflights, Hospitals, Places of Worship and Schools, Night-time, N60 Metric

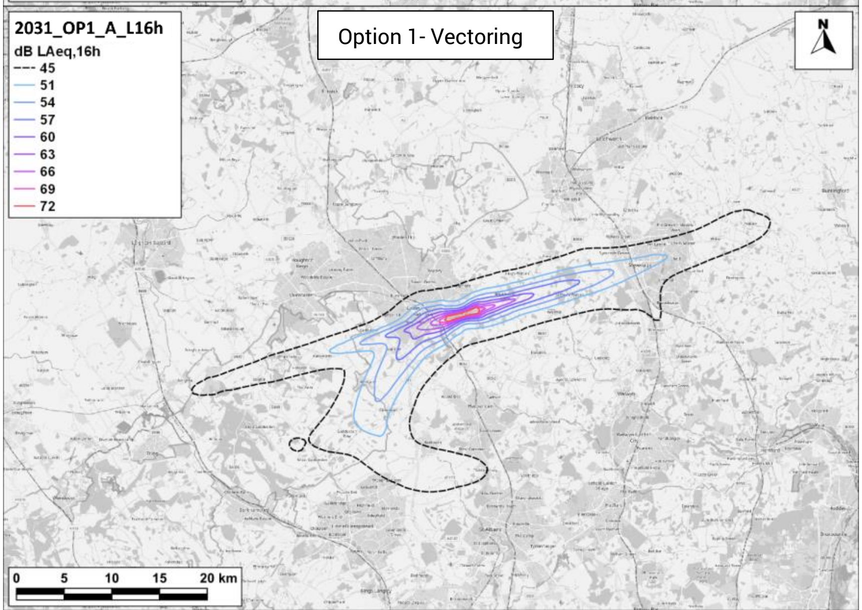
Scenario	2021 CAP1498 48.5° Overflight Night Time N60 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	11	1	0	0	0	0	0	0
Option 1	12	1	0	0	0	0	0	0
Option 2	12	1	0	0	0	0	0	0
	Places of Worship							
Do Nothing	394	88	21	9	0	0	0	0
Option 1	393	77	27	7	0	0	0	0
Option 2	357	100	31	7	0	0	0	0
	Schools							
Do Nothing	670	149	45	24	0	0	0	0
Option 1	695	148	53	22	0	0	0	0
Option 2	627	185	60	22	0	0	0	0

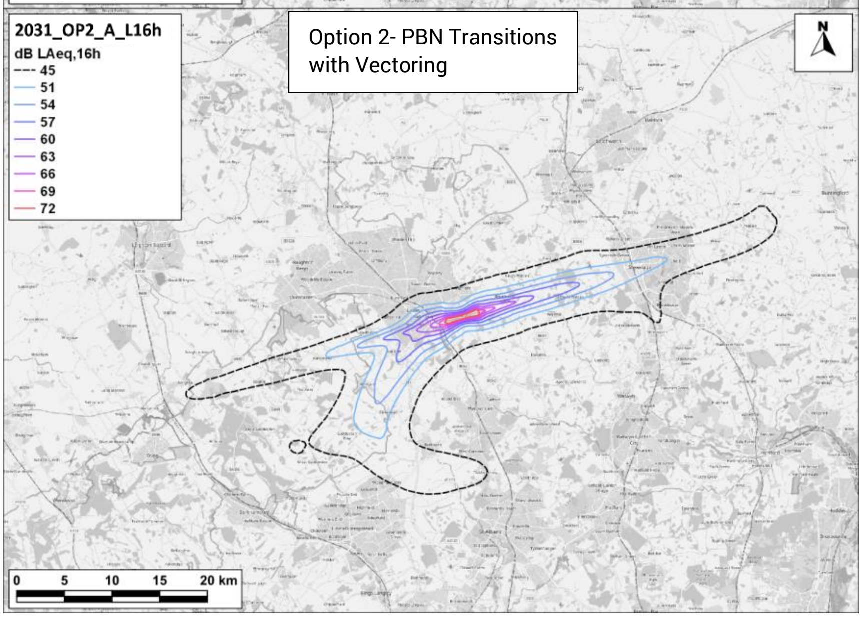
Images and data were produced for 2021. They also represent the impacts for 2022, see Annex C for full details

Annex E. 2031 Noise Metric Images and Data - Without DCO

LAeq16hr- Day Time







Areas of Contours (km²)

Scenario	2031 No DCO, dB Laeq,16h									
	45	48	51	54	57	60	63	66	69	>=72
Do-nothing (km^2)	164.3	97.0	54.9	29.2	14.3	6.84	3.64	1.83	1.02	0.62
Option 1 (km^2)	164.9	96.9	54.8	29.1	14.3	6.81	3.63	1.83	1.03	0.62
Option 2 (km^2)	165.6	97.3	54.8	29.1	14.3	6.83	3.64	1.83	1.03	0.62

Population and Household counts

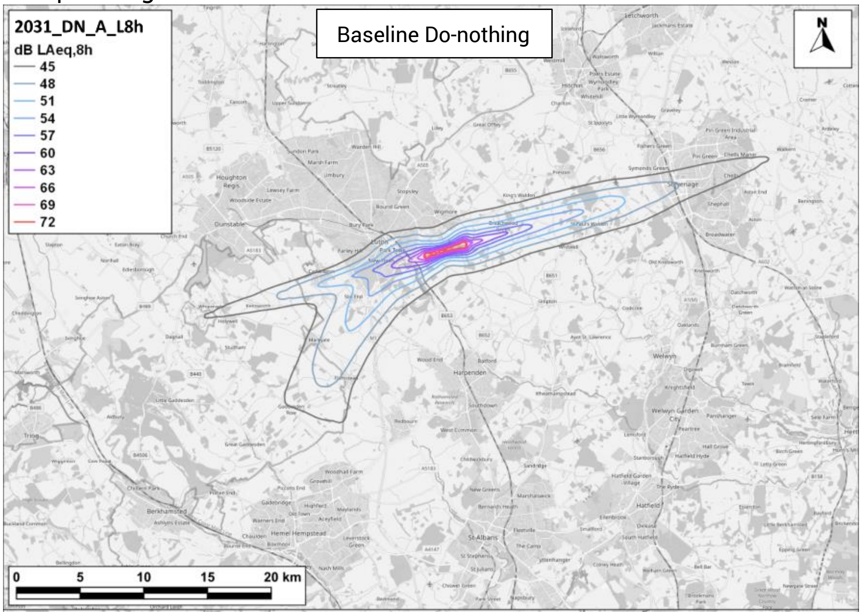
Scenario	2031 No DCO, dB Laeq,16h Population Counts									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	134971	81363	36678	14559	6345	2088	71	0	0	0
Option 1	135355	81355	36351	14275	6399	2085	71	0	0	0
Option 2	134452	81141	36333	14287	6345	2088	71	0	0	0
	Household Counts									
Do Nothing	56539	34248	15680	6092	2510	747	26	0	0	0
Option 1	56704	34330	15500	5993	2534	746	26	0	0	0
Option 2	56349	34208	15508	5992	2510	747	26	0	0	0

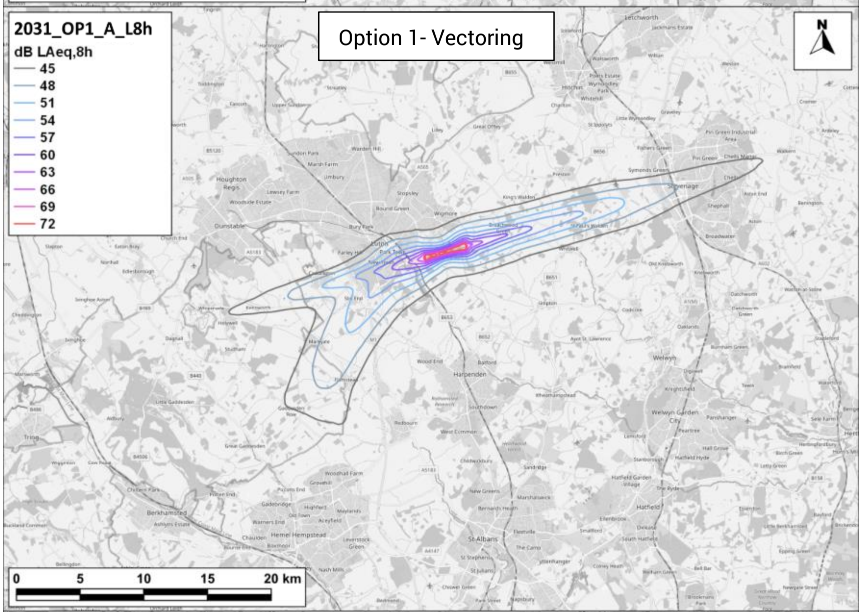
Hospitals, Places of Worship and Schools counts

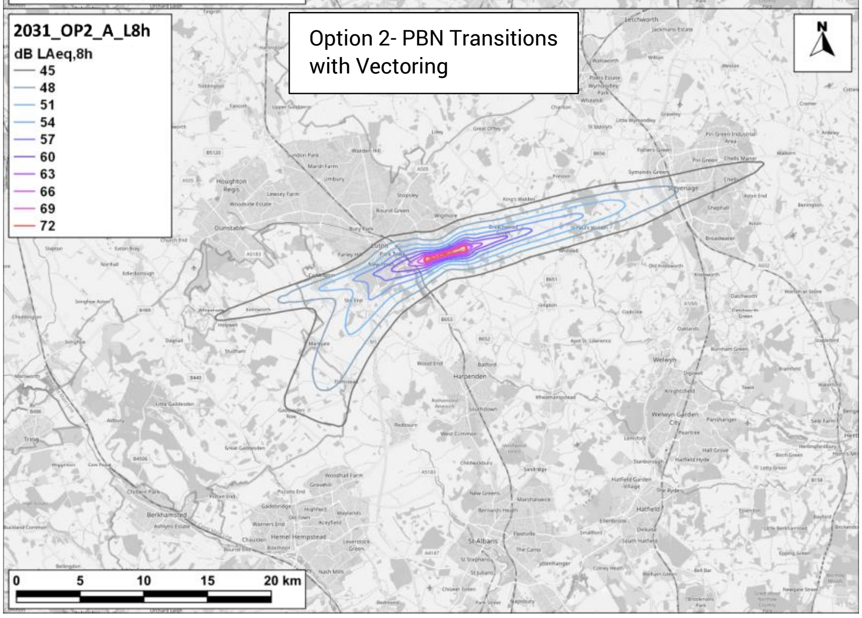
Scenario	2031, No DCO, dB Laeq,16h Hospitals									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	None									
Option 1										
Option 2										
	Places of Worship									
Do Nothing	87	49	30	9	4	1	0	0	0	0
Option 1	87	49	30	9	4	1	0	0	0	0
Option 2	87	49	30	10	4	1	0	0	0	0
	Schools									
Do Nothing	142	91	49	18	10	4	2	0	0	0
Option 1	143	92	46	18	10	4	2	0	0	0
Option 2	143	91	48	19	10	4	2	0	0	0

Images and data were produced for 2031 without LLAL's DCO. They also represent the impacts for 2032 without LLAL's DCO, see Annex C for full details

LAeq8hr- Night-time







Areas of Contours (km²)

Scenario	2031 No DCO, dB Laeq,8h									
	45	48	51	54	57	60	63	66	69	>=72
Do-nothing (km^2)	73.8	41.1	21.0	10.4	5.28	2.77	1.41	0.83	0.52	0.29
Option 1 (km^2)	73.2	40.9	21.0	10.4	5.27	2.76	1.41	0.83	0.52	0.29
Option 2 (km^2)	73.4	41.0	21.0	10.4	5.28	2.76	1.41	0.83	0.52	0.29

Population and Household counts

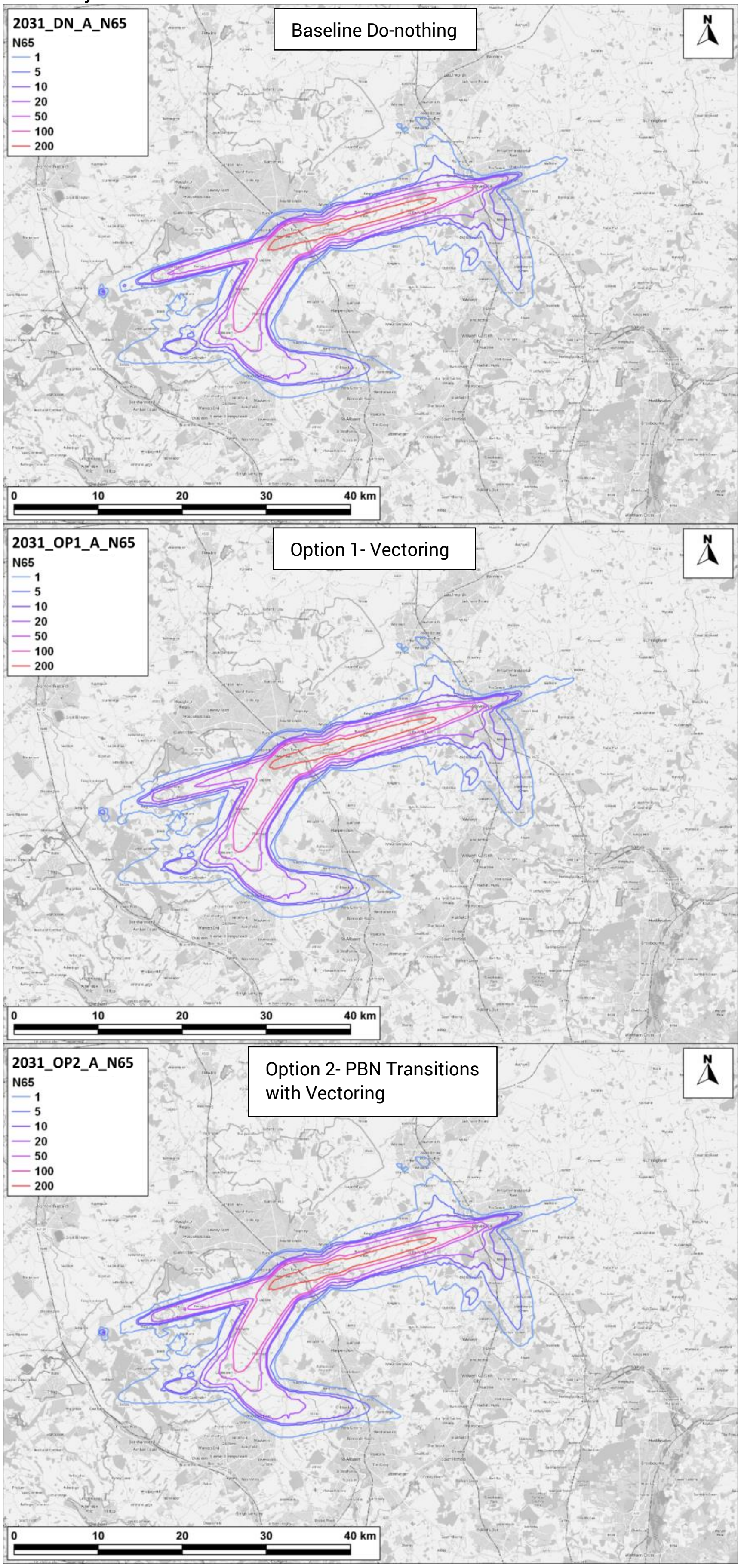
Scenario	2031 No DCO, dB Laeq, 8h Population Counts									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	62026	20926	10549	3769	1030	17	0	0	0	0
Option 1	62394	21179	10600	4030	1038	17	0	0	0	0
Option 2	61800	20720	10561	3758	1030	17	0	0	0	0
	Household Counts									
Do Nothing	26352	8760	4562	1385	395	6	0	0	0	0
Option 1	26505	8837	4574	1492	398	6	0	0	0	0
Option 2	26248	8632	4570	1382	395	6	0	0	0	0

Hospitals, Places of Worship and Schools counts

Scenario	2031, No DCO, dB Laeq,8h Hospitals									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	None									
Option 1										
Option 2										
	Places of Worship									
Do Nothing	41	18	6	3	1	0	0	0	0	0
Option 1	41	18	6	3	1	0	0	0	0	0
Option 2	41	18	6	3	1	0	0	0	0	0
	Schools									
Do Nothing	75	28	15	8	3	0	0	0	0	0
Option 1	75	28	15	9	3	0	0	0	0	0
Option 2	75	28	15	8	3	0	0	0	0	0

Images and data were produced for 2031 without LLAL's DCO. They also represent the impacts for 2032 without LLAL's DCO, see Annex C for full details

N65- Day Time


2031_DN_A_N65
N65
1
5
10
20
50
100
200
Baseline Do-nothing
0 10 20 30 40 km
2031_OP1_A_N65
N65
1
5
10
20
50
100
200
Option 1- Vectoring
0 10 20 30 40 km
2031_OP2_A_N65
N65
1
5
10
20
50
100
200
Option 2- PBN Transitions with Vectoring
0 10 20 30 40 km

Areas of Contours (km²)

Scenario	2031 No DCO, N65						
	1	5	10	20	50	100	200
Do-nothing (km²)	216.4	143.6	108.7	82.7	53.7	33.1	9.37
Option 1 (km²)	225.3	146.4	110.1	83.0	52.1	33.1	9.24
Option 2 (km²)	220.6	143.9	108.9	82.7	52.9	33.1	9.35

Population and Household counts

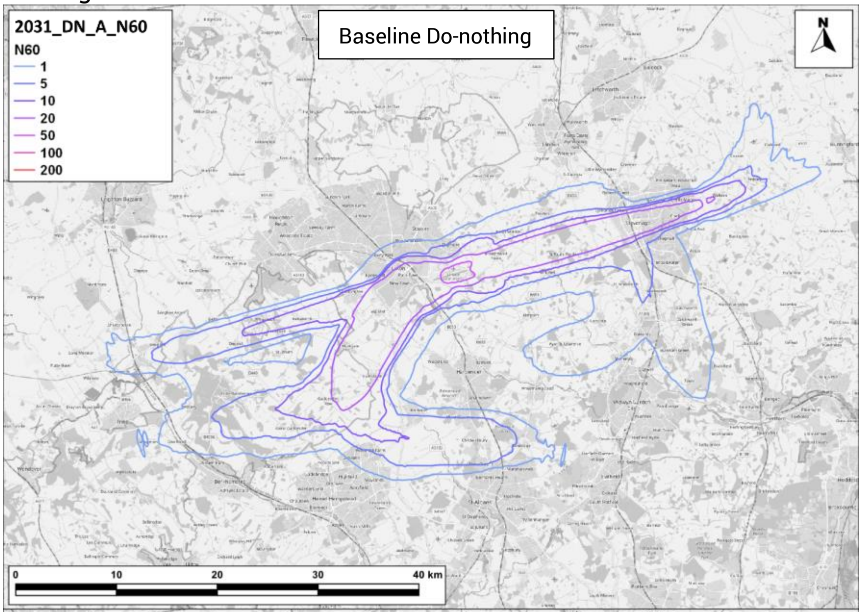
Scenario	2031, No DCO, N65 Population Counts						
	1	5	10	20	50	100	>200
Do Nothing	157323	107124	64441	43729	26961	17374	3757
Option 1	158810	108360	64652	44258	26037	17381	3635
Option 2	157737	107170	64407	43827	26646	17246	3750
	Household Counts						
Do Nothing	65641	44890	27352	18806	11497	7249	1366
Option 1	66372	45440	27412	18971	11075	7253	1323
Option 2	65822	44908	27350	18860	11363	7204	1366

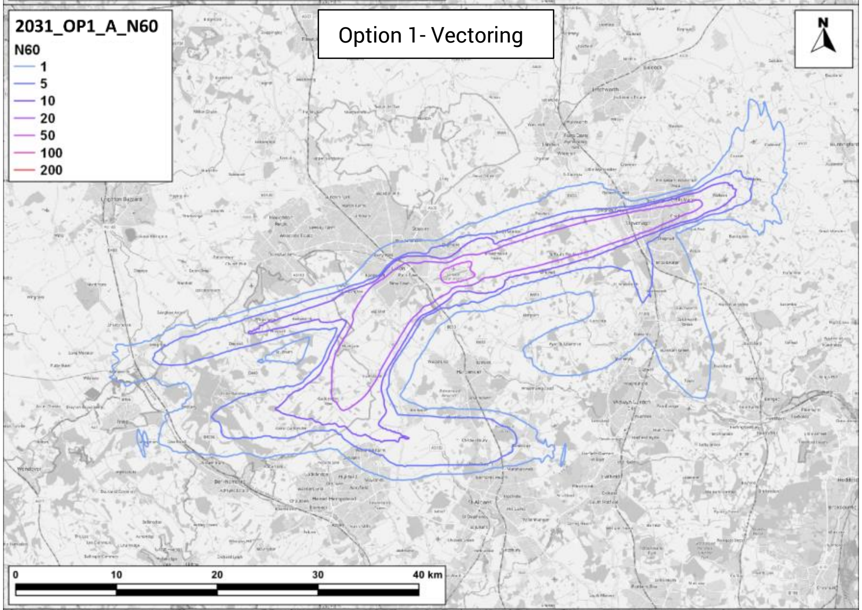
Hospitals, Places of Worship and Schools counts

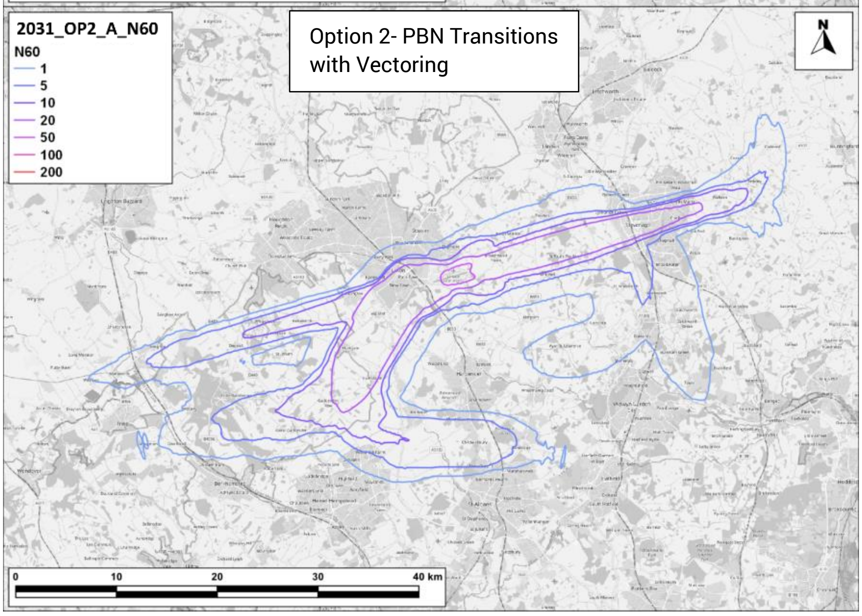
Scenario	2031, No DCO, N65 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	None							
Option 1								
Option 2								
	Places of Worship							
Do Nothing	101	80	49	36	25	15	3	0
Option 1	102	82	49	36	24	15	3	0
Option 2	102	79	49	36	24	15	3	0
	Schools							
Do Nothing	180	136	81	55	38	24	9	0
Option 1	182	138	82	54	37	24	9	0
Option 2	181	135	80	55	37	24	9	0

Images and data were produced for 2031 without LLAL's DCO. They also represent the impacts for 2032 without LLAL's DCO, see Annex C for full details

N60- Night-time







Areas of Contours (km^2)

Scenario	2031 No DCO, N60						
	1	5	10	20	50	100	200
Do-nothing (km^2)	362.9	175.6	97.6	54.4	1.88	0.00	0.00
Option 1 (km^2)	365.7	175.1	95.5	54.2	1.88	0.00	0.00
Option 2 (km^2)	361.3	175.7	97.5	54.3	1.88	0.00	0.00

Population and Household counts

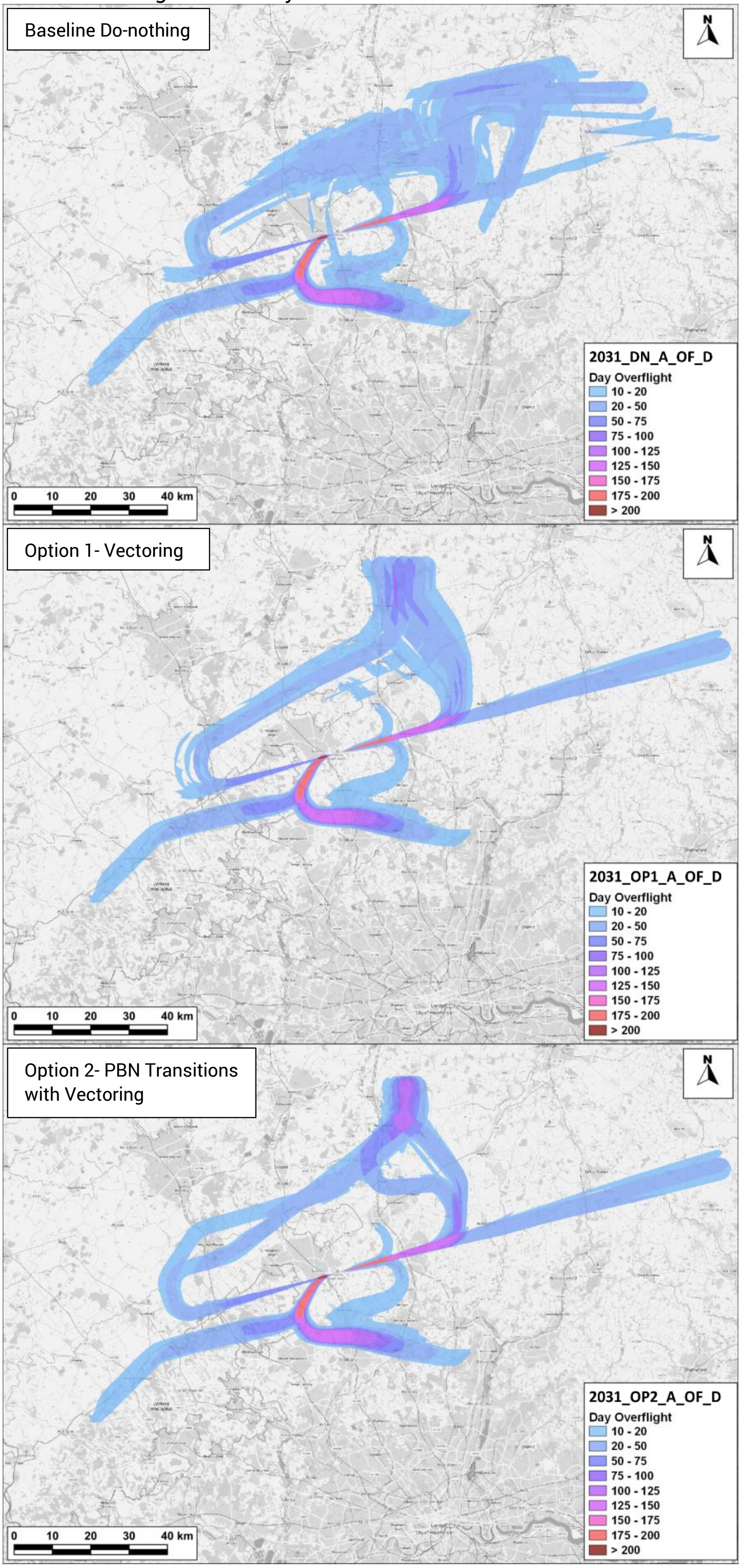
Scenario	2031, No DCO, N60 Population Counts						
	1	5	10	20	50	100	>200
Do Nothing	240366	111913	79820	50687	11	0	0
Option 1	242148	112599	80319	50084	11	0	0
Option 2	241289	112349	79100	49672	11	0	0
	Household Counts						
Do Nothing	98150	47054	33732	21650	5	0	0
Option 1	98855	47356	33930	21440	5	0	0
Option 2	98494	47215	33367	21239	5	0	0

Hospitals, Places of Worship and School counts

Scenario	2031, No DCO, N60 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	1	0	0	0	0	0	0	0
Option 1	1	0	0	0	0	0	0	0
Option 2	1	0	0	0	0	0	0	0
	Places of Worship							
Do Nothing	150	75	52	35	0	0	0	0
Option 1	152	75	51	35	0	0	0	0
Option 2	150	76	50	35	0	0	0	0
	Schools							
Do Nothing	261	128	94	62	0	0	0	0
Option 1	263	127	94	62	0	0	0	0
Option 2	261	129	93	62	0	0	0	0

Images and data were produced for 2031 without LLAL's DCO. They also represent the impacts for 2032 without LLAL's DCO, see Annex C for full details

CAP1498 Overflight 48.5°- Day Time



CAP1498 48.5° Overflights, Population and Household Counts, Day Time, N65 Metric

Scenario	2031 No DCO, CAP1498 48.5° Overflights Population Counts Day Time							
	>=1	>=5	>=10	>=20	>=50	>=100	>=200	>500
Do Nothing	1464930	886614	530029	302520	85226	32770	423	0
Option 1	1116408	564788	390157	210568	80748	30944	183	0
Option 2	1112788	494259	356435	216555	103699	33103	305	0
	Household Counts							
Do Nothing	594077	361611	215335	123473	34204	14066	142	0
Option 1	459844	233340	159381	85714	32643	13279	64	0
Option 2	458253	203465	145559	88463	42259	14276	106	0

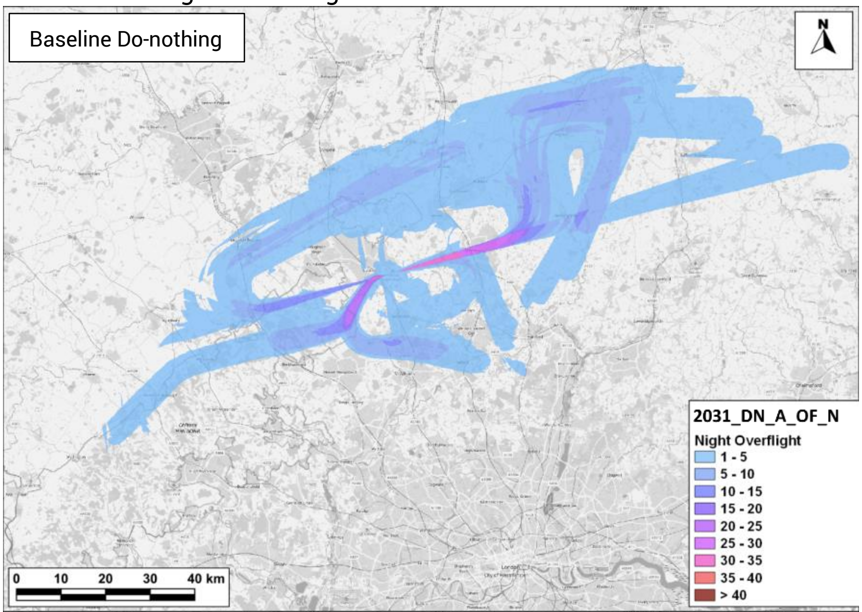
Erratum – Issue 1.1: A duplicate of the N60 Night Time table from page E-12 was originally published incorrectly in this location. This has been corrected by the table highlighted cyan above, which replaces the incorrect table. No other data or contour maps are affected.

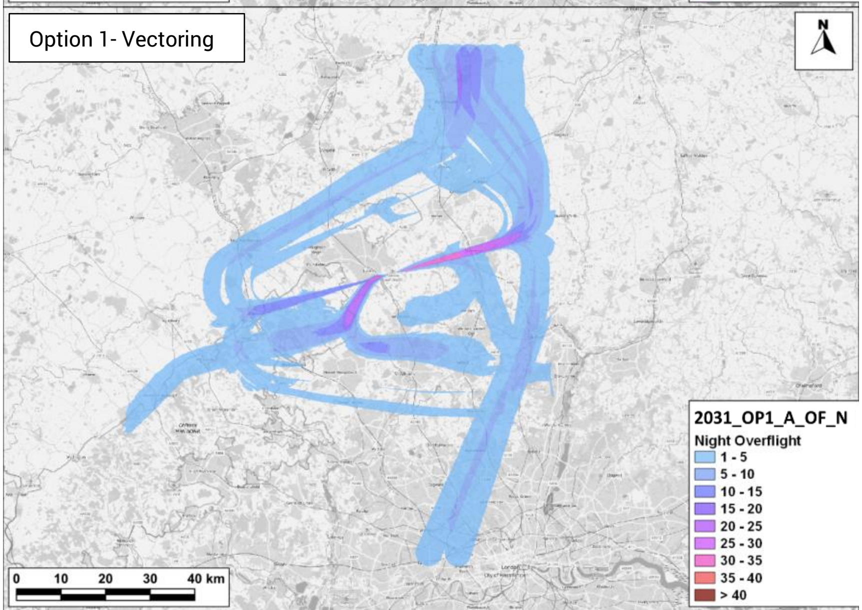
CAP1498 48.5° Overflights, Hospitals, Places of Worship and Schools, Day time, N65 Metric

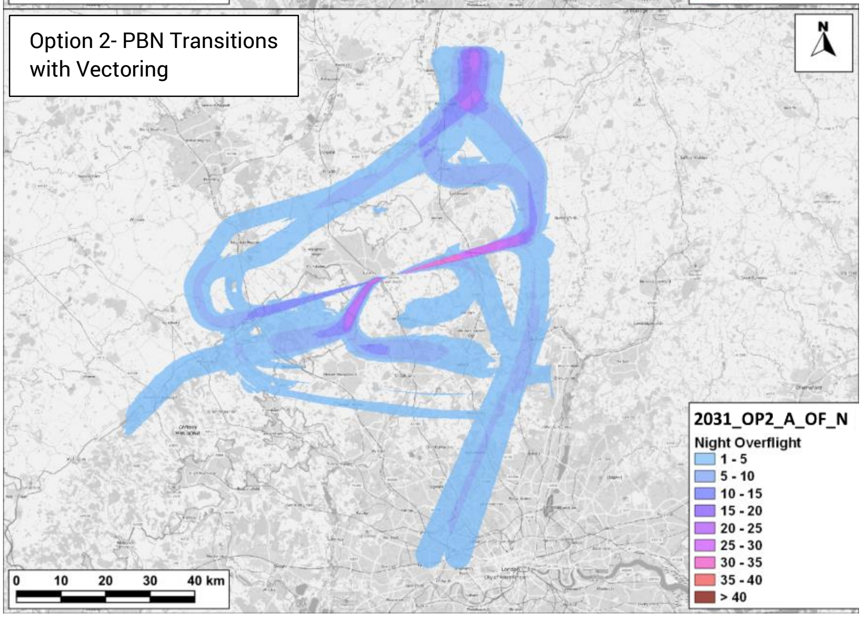
Scenario	2031 No DCO CAP1498 48.5° Overflight Day Time N65 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	36	20	10	6	1	0	0	0
Option 1	23	10	7	2	1	0	0	0
Option 2	23	10	6	1	1	0	0	0
	Places of Worship							
Do Nothing	927	577	369	227	32	14	0	0
Option 1	696	387	273	156	31	14	0	0
Option 2	694	341	257	151	49	16	0	0
	Schools							
Do Nothing	1624	1005	633	382	74	35	2	0
Option 1	1226	670	474	257	72	33	2	0
Option 2	1220	580	437	259	99	37	2	0

Images and data were produced for 2031 without LLAL's DCO. They also represent the impacts for 2032 without LLAL's DCO, see Annex C for full details

CAP1498 Overflight 48.5°- Night-time







CAP1498 48.5° Overflights, Population and Household Counts, Night-time, N60 Metric

Scenario	2031 No DCO, CAP1498 48.5° Overflights Population Counts Night Time							
	>=1	>=5	>=10	>=20	>=50	>=100	>=200	>500
Do Nothing	998924	132823	40940	26489	0	0	0	0
Option 1	1045351	137945	40469	24831	0	0	0	0
Option 2	951855	149082	60517	24765	0	0	0	0
	Household Counts							
Do Nothing	400697	55294	17315	11470	0	0	0	0
Option 1	430507	58129	17254	10791	0	0	0	0
Option 2	391822	63152	25381	10770	0	0	0	0

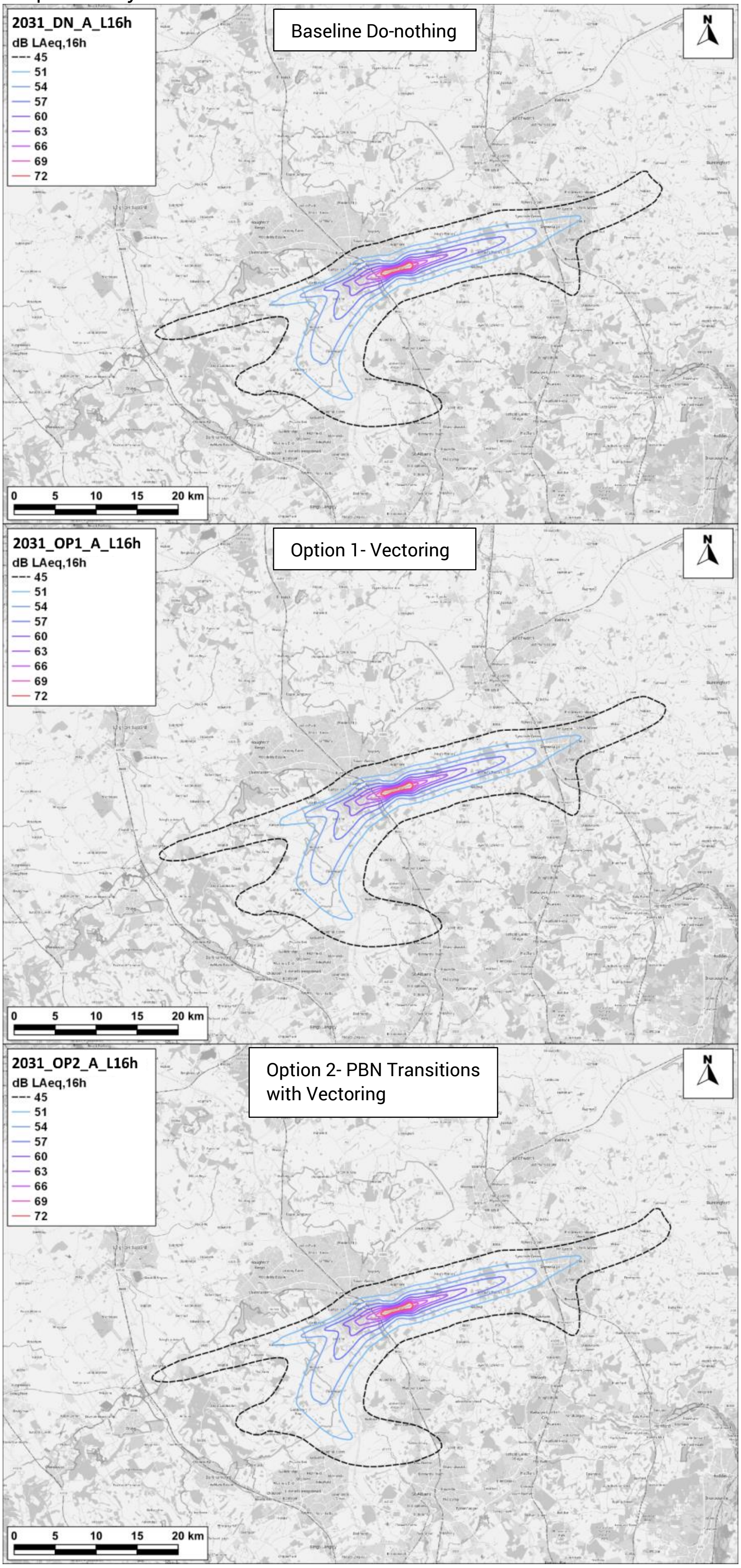
CAP1498 48.5° Overflights, Hospitals, Places of Worship and Schools, Night-time, N60 Metric

Scenario	2031 No DCO CAP1498 48.5° Overflight Night Time N60 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	21	2	0	0	0	0	0	0
Option 1	16	0	0	0	0	0	0	0
Option 2	16	0	0	0	0	0	0	0
	Places of Worship							
Do Nothing	619	109	25	11	0	0	0	0
Option 1	621	88	25	8	0	0	0	0
Option 2	570	98	37	8	0	0	0	0
	Schools							
Do Nothing	1101	176	48	27	0	0	0	0
Option 1	1149	164	49	22	0	0	0	0
Option 2	1058	179	69	22	0	0	0	0

Images and data were produced for 2031 without LLAL's DCO. They also represent the impacts for 2032 without LLAL's DCO, see Annex C for full details

Annex F. 2031 Noise Metric Images and Data– With DCO

LAeq16hr- Day Time



Areas of Contours (km²)

Scenario	2031 With DCO, dB Laeq,16h									
	45	48	51	54	57	60	63	66	69	>=72
Do-nothing (km^2)	207.4	124.2	71.8	39.6	18.5	8.34	4.38	2.20	1.21	0.73
Option 1 (km^2)	208.2	124.2	71.7	39.4	18.5	8.34	4.38	2.20	1.21	0.73
Option 2 (km^2)	209.1	124.6	71.8	39.5	18.5	8.34	4.38	2.21	1.21	0.73

Population and Household counts

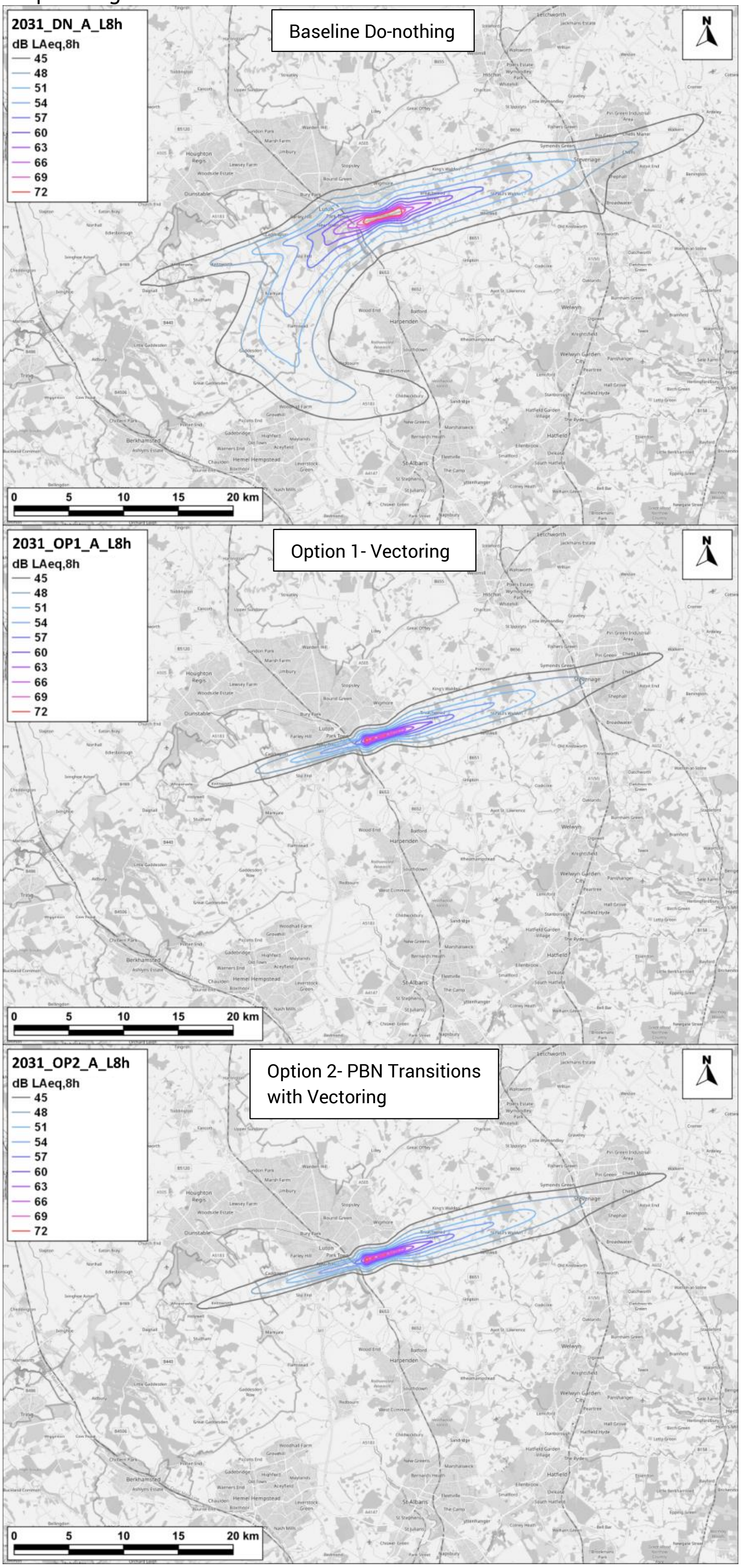
Scenario	2031, With DCO, dB Laeq,16h Population Counts									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	173115	98708	48030	19649	9022	2371	698	8	0	0
Option 1	172911	99036	47724	19910	9137	2555	698	8	0	0
Option 2	172865	98204	47972	19612	9022	2371	698	8	0	0
	Household Counts									
Do Nothing	71788	41736	20431	8146	3823	860	265	2	0	0
Option 1	71780	41843	20339	8270	3885	936	265	2	0	0
Option 2	71697	41521	20420	8134	3823	860	265	2	0	0

Hospitals, Places of Worship and Schools counts

Scenario	2031, With DCO, dB Laeq,16h Hospitals									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	None									
Option 1										
Option 2										
	Places of Worship									
Do Nothing	104	68	39	17	5	3	0	0	0	0
Option 1	104	68	38	17	5	3	0	0	0	0
Option 2	103	67	39	17	5	3	0	0	0	0
	Schools									
Do Nothing	186	116	64	27	14	6	2	0	0	0
Option 1	186	116	63	27	14	6	2	0	0	0
Option 2	185	115	64	27	14	6	2	0	0	0

Images and data were produced for 2031 with LLAL's DCO. They also represent the impacts for 2032 with LLAL's DCO, see Annex C for full details

LAeq8hr- Night-time



Areas of Contours (km^2)

Scenario	2031 With DCO, dB Laeq,8h									
	45	48	51	54	57	60	63	66	69	>=72
Do-nothing (km^2)	82.1	44.9	21.4	9.80	4.93	2.54	1.33	0.79	0.48	0.25
Option 1 (km^2)	82.1	44.9	21.4	9.80	4.93	2.54	1.33	0.79	0.48	0.25
Option 2 (km^2)	81.8	44.8	21.4	9.79	4.93	2.54	1.33	0.79	0.48	0.25

Population and Household counts

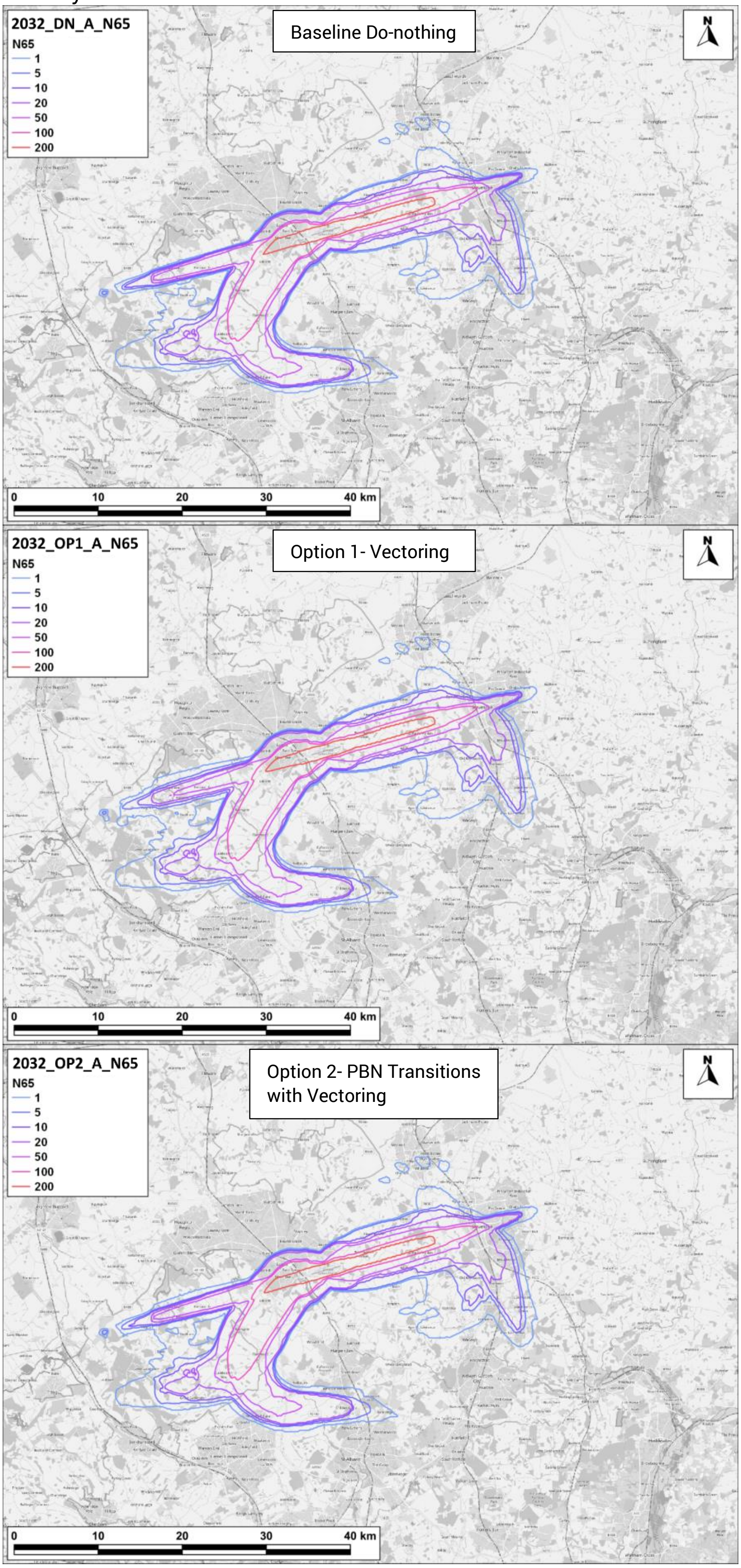
Scenario	2031, With DCO, dB Laeq,8h Population Counts									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	63406	22402	10403	3454	1018	12	0	0	0	0
Option 1	63841	22441	10665	3485	906	12	0	0	0	0
Option 2	63510	22232	10397	3454	1005	12	0	0	0	0
	Household Counts									
Do Nothing	26915	9387	4505	1258	391	3	0	0	0	0
Option 1	27138	9394	4590	1271	338	3	0	0	0	0
Option 2	26943	9303	4502	1258	386	3	0	0	0	0

Hospitals, Places of Worship and Schools counts

Scenario	2031, With DCO, dB Laeq,8h Hospitals									
	45	48	51	54	57	60	63	66	69	>=72
Do Nothing	None									
Option 1										
Option 2										
	Places of Worship									
Do Nothing	43	19	5	3	0	0	0	0	0	0
Option 1	43	19	5	3	0	0	0	0	0	0
Option 2	44	19	5	3	0	0	0	0	0	0
	Schools									
Do Nothing	80	29	14	8	2	0	0	0	0	0
Option 1	80	29	14	8	2	0	0	0	0	0
Option 2	80	29	14	8	2	0	0	0	0	0

Images and data were produced for 2031 with LLAL's DCO. They also represent the impacts for 2032 with LLAL's DCO, see Annex C for full details

N65- Day Time



2032_DN_A_N65
N65
1
5
10
20
50
100
200
Baseline Do-nothing
N
0
10
20
30
40 km
2032_OP1_A_N65
N65
1
5
10
20
50
100
200
Option 1- Vectoring
N
0
10
20
30
40 km
2032_OP2_A_N65
N65
1
5
10
20
50
100
200
Option 2- PBN Transitions with Vectoring
N
0
10
20
30
40 km

Areas of Contours (km²)

Scenario	2032 With DCO, N65						
	1	5	10	20	50	100	200
Do-nothing (km^2)	233.9	172.9	147.4	118.0	68.6	37.8	10.62
Option 1 (km^2)	248.1	175.8	148.2	118.4	66.7	37.8	10.40
Option 2 (km^2)	245.1	173.3	147.4	118.0	68.4	37.8	10.60

Population and Household counts

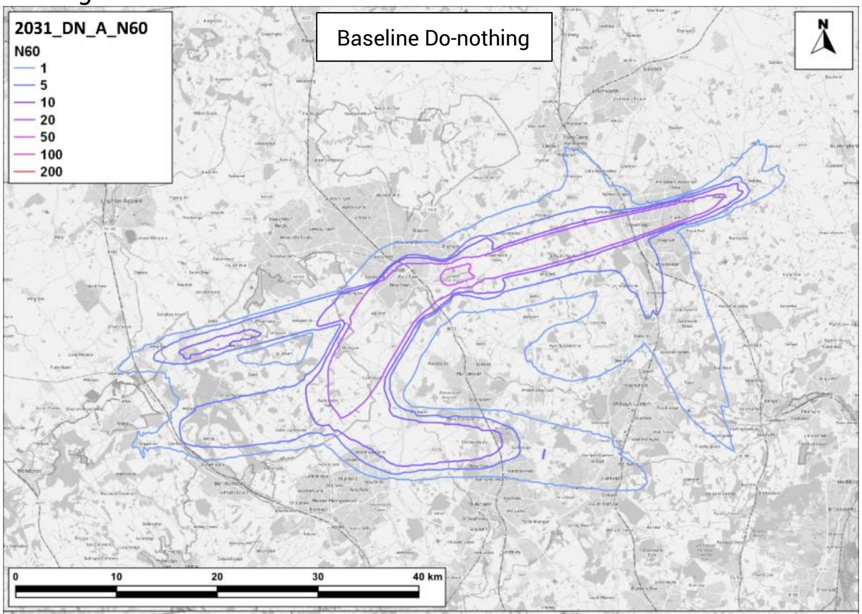
Scenario	2031, With DCO, N65 Population Counts						
	1	5	10	20	50	100	>200
Do Nothing	164064	125841	109378	85186	32618	19901	4816
Option 1	165732	127500	109989	85317	31953	19972	4484
Option 2	165259	126213	109552	85071	32390	19931	4736
	Household Counts						
Do Nothing	68223	52597	45754	35666	13872	8347	1780
Option 1	69009	53304	46050	35701	13580	8371	1662
Option 2	68774	52751	45835	35608	13775	8358	1747

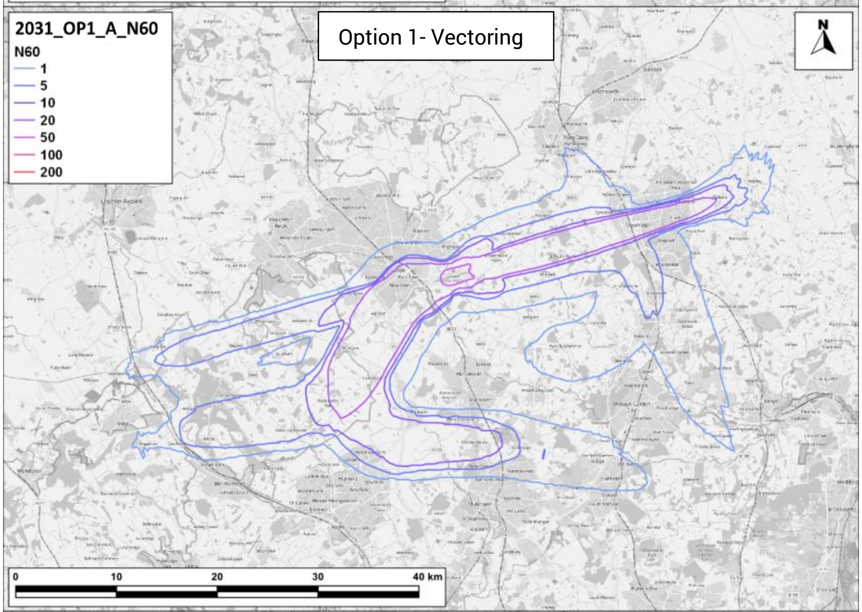
Hospitals, Places of Worship and Schools counts

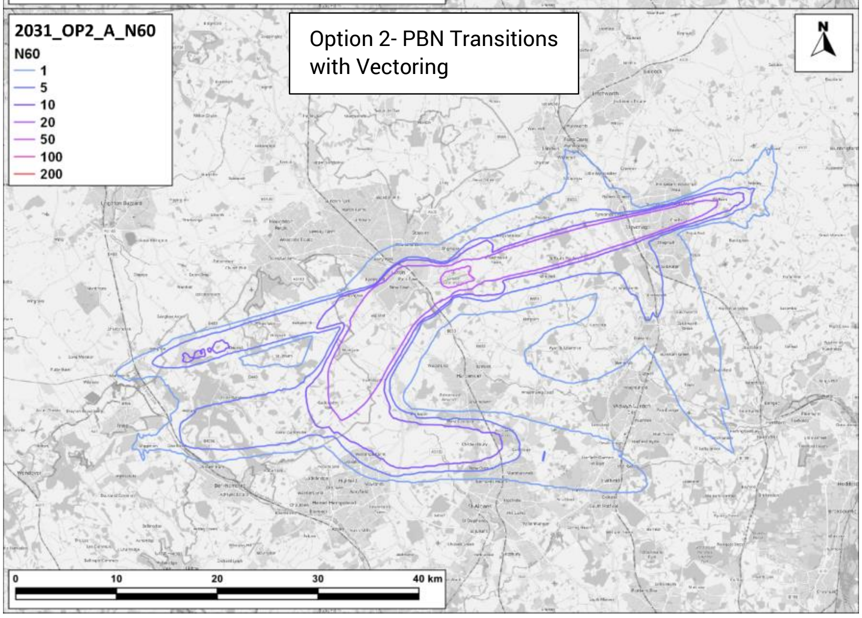
Scenario	2031, With DCO, N65 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	None							
Option 1								
Option 2								
	Places of Worship							
Do Nothing	107	91	82	64	32	19	4	0
Option 1	110	93	83	64	32	19	4	0
Option 2	110	91	82	64	31	19	4	0
	Schools							
Do Nothing	183	154	138	103	46	28	10	0
Option 1	188	157	139	102	46	28	10	0
Option 2	186	155	138	103	45	28	10	0

Images and data were produced for 2031 with LLAL's DCO. They also represent the impacts for 2032 with LLAL's DCO, see Annex C for full details

N60- Night-time







Areas of Contours (km^2)

Scenario	2031 With DCO, N60						
	1	5	10	20	50	100	200
Do-nothing (km^2)	389.8	187.5	108.3	58.9	1.75	0.00	0.00
Option 1 (km^2)	391.4	188.2	105.2	58.3	1.75	0.00	0.00
Option 2 (km^2)	389.8	187.7	106.6	58.4	1.75	0.00	0.00

Population and Household counts

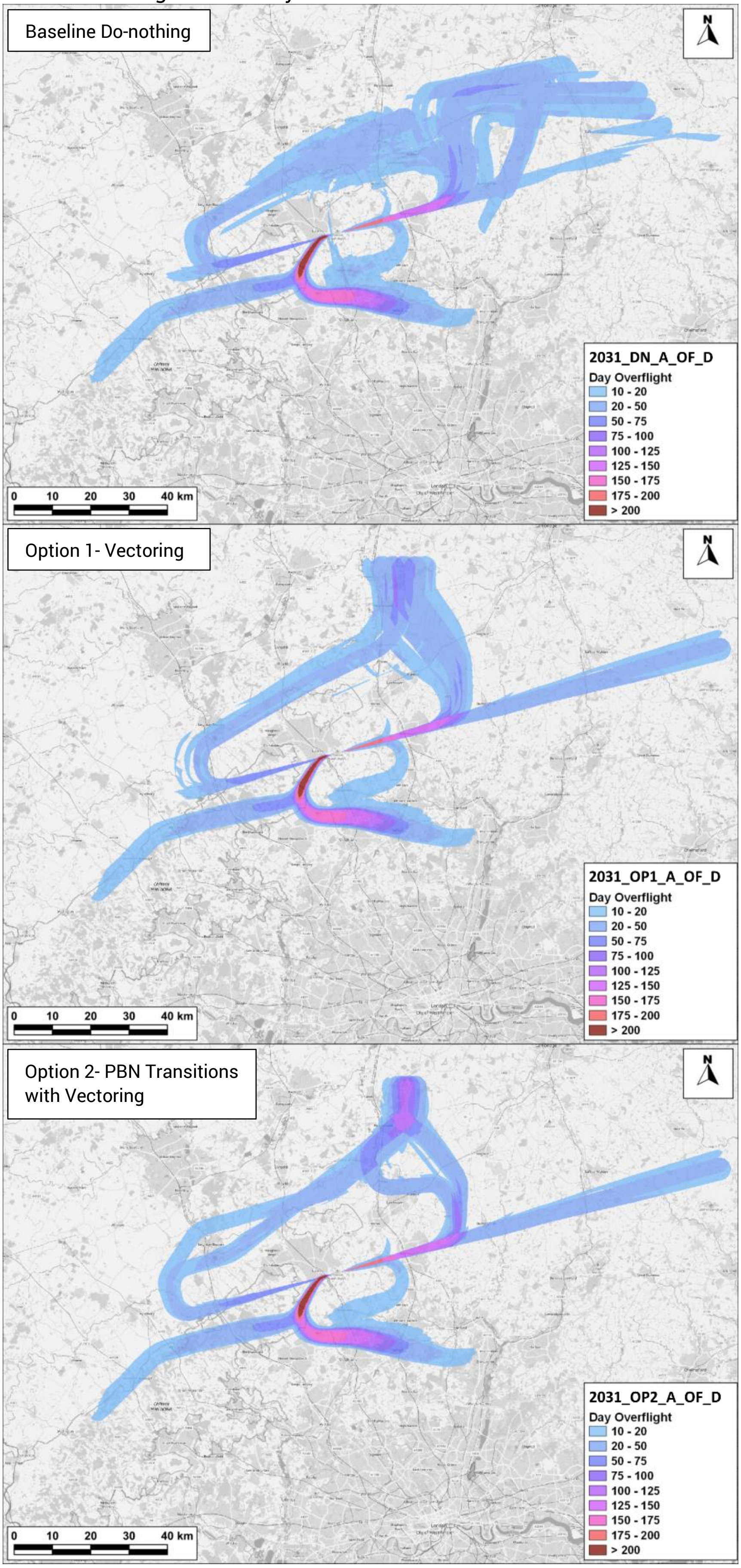
Scenario	2031, With DCO, N60 Population Counts						
	1	5	10	20	50	100	>200
Do Nothing	291638	115624	78585	56907	11	0	0
Option 1	291521	115805	78670	55636	11	0	0
Option 2	290404	115799	78453	55446	11	0	0
	Household Counts						
Do Nothing	117668	48708	33226	24290	5	0	0
Option 1	117596	48782	33278	23737	5	0	0
Option 2	117147	48765	33171	23663	5	0	0

Hospitals, Places of Worship and School counts

Scenario	2031, With DCO, N60 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	2	0	0	0	0	0	0	0
Option 1	2	0	0	0	0	0	0	0
Option 2	2	0	0	0	0	0	0	0
	Places of Worship							
Do Nothing	162	82	50	36	0	0	0	0
Option 1	161	82	48	36	0	0	0	0
Option 2	160	82	47	36	0	0	0	0
	Schools							
Do Nothing	297	141	90	66	0	0	0	0
Option 1	296	142	88	66	0	0	0	0
Option 2	294	142	86	66	0	0	0	0

Images and data were produced for 2031 with LLAL's DCO. They also represent the impacts for 2032 with LLAL's DCO, see Annex C for full details

CAP1498 Overflight 48.5°- Day Time



CAP1498 48.5° Overflights, Population and Household Counts, Day Time, N65 Metric

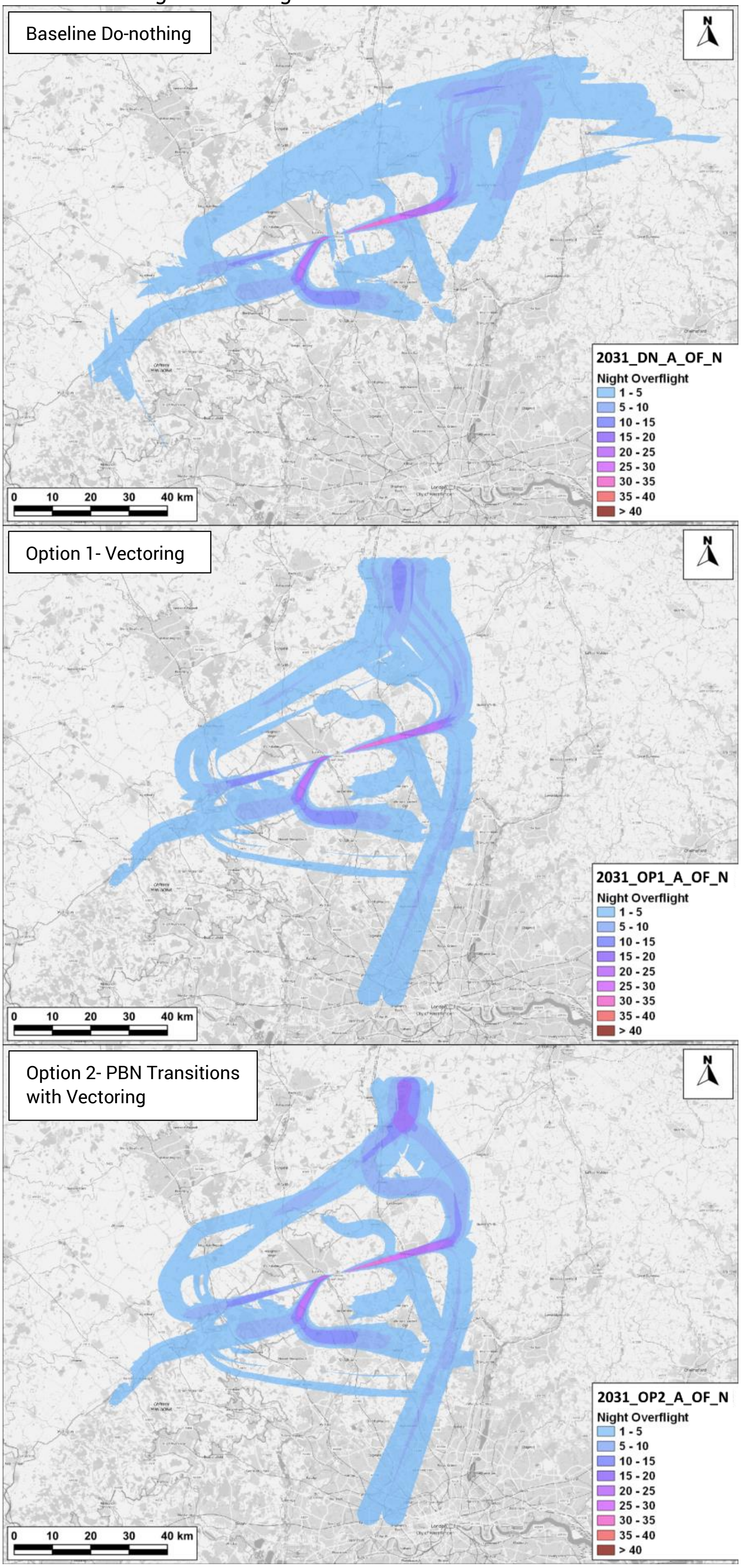
Scenario	2031 With DCO, CAP1498 48.5° Overflights Population Counts Day Time							
	>=1	>=5	>=10	>=20	>=50	>=100	>=200	>500
Do Nothing	1464359	806478	498135	258835	88527	34997	1389	0
Option 1	1116628	562037	377526	202844	85183	33024	1289	0
Option 2	1112771	495235	352271	214216	107572	35126	1374	0
	Household Counts							
Do Nothing	593830	328279	204653	105413	35571	14971	579	0
Option 1	459877	232207	153680	82428	34395	14186	544	0
Option 2	458194	203791	143457	87419	43798	15149	572	0

CAP1498 48.5° Overflights, Hospitals, Places of Worship and Schools, Day time, N65 Metric

Scenario	2031 With DCO CAP1498 48.5° Overflight Day Time N65 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	36	13	10	5	1	0	0	0
Option 1	21	10	7	1	1	0	0	0
Option 2	21	10	6	1	1	0	0	0
	Places of Worship							
Do Nothing	925	527	358	200	34	14	0	0
Option 1	692	384	265	152	33	14	0	0
Option 2	689	340	252	150	50	16	0	0
	Schools							
Do Nothing	1622	926	606	326	82	35	2	0
Option 1	1225	667	453	251	82	35	2	0
Option 2	1218	581	426	259	108	37	2	0

Images and data were produced for 2031 with LLAL's DCO. They also represent the impacts for 2032 with LLAL's DCO, see Annex C for full details

CAP1498 Overflight 48.5°- Night-time



CAP1498 48.5° Overflights, Population and Household Counts, Night-time, N60 Metric

Scenario	2031 With DCO, CAP1498 48.5° Overflights Population Counts Night Time							
	>=1	>=5	>=10	>=20	>=50	>=100	>=200	>500
Do Nothing	882907	89397	35653	25969	0	0	0	0
Option 1	922361	121593	36458	23969	0	0	0	0
Option 2	861214	132309	47481	23964	0	0	0	0
	Household Counts							
Do Nothing	360094	37311	15242	11272	0	0	0	0
Option 1	379957	51052	15680	10412	0	0	0	0
Option 2	354047	55956	20117	10432	0	0	0	0

CAP1498 48.5° Overflights, Hospitals, Places of Worship and Schools, Night-time, N60 Metric

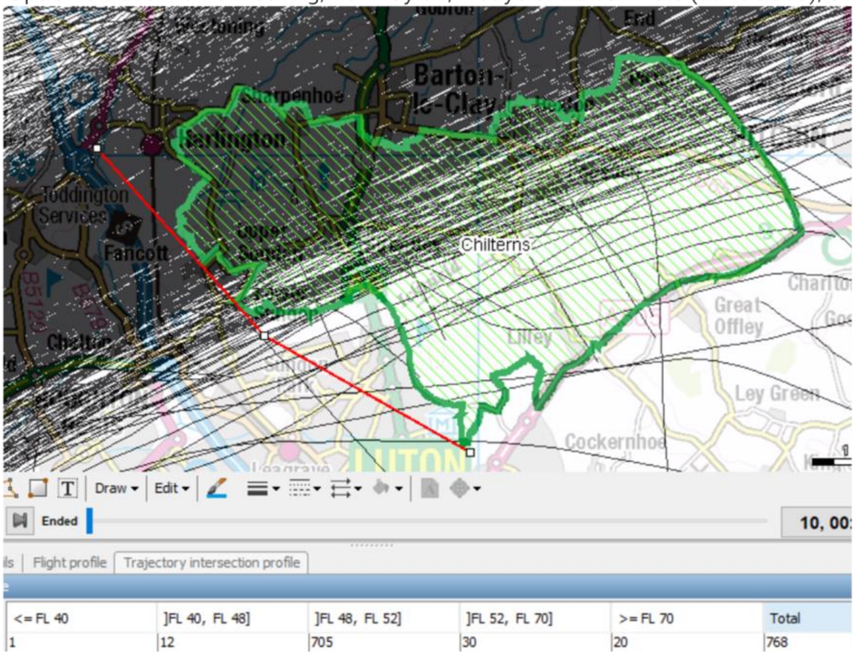
Scenario	2031 With DCO CAP1498 48.5° Overflight Night Time N60 Hospitals							
	1	5	10	20	50	100	200	500
Do Nothing	18	1	0	0	0	0	0	0
Option 1	15	0	0	0	0	0	0	0
Option 2	15	0	0	0	0	0	0	0
	Places of Worship							
Do Nothing	574	78	17	8	0	0	0	0
Option 1	563	69	24	6	0	0	0	0
Option 2	519	80	31	6	0	0	0	0
	Schools							
Do Nothing	1013	130	38	22	0	0	0	0
Option 1	1032	135	46	20	0	0	0	0
Option 2	959	152	58	20	0	0	0	0

Images and data were produced for 2031 with LLAL's DCO. They also represent the impacts for 2032 with LLAL's DCO, see Annex C for full details

Annex G. Tranquillity Illustrations

Tranquillity – Chilterns Conservation AONB (northern)

Option 0 Baseline Do-Nothing, Runway 07, 7 days of LLA arrivals (June 2019), below 7,000ft



The northern part of the Chilterns AONB is overflown by some Runway 07 arrivals below 7,000ft, mostly level at 5,000ft.

No. overflights <5,000ft: 1+12=13

No. overflights level 5,000ft: 705

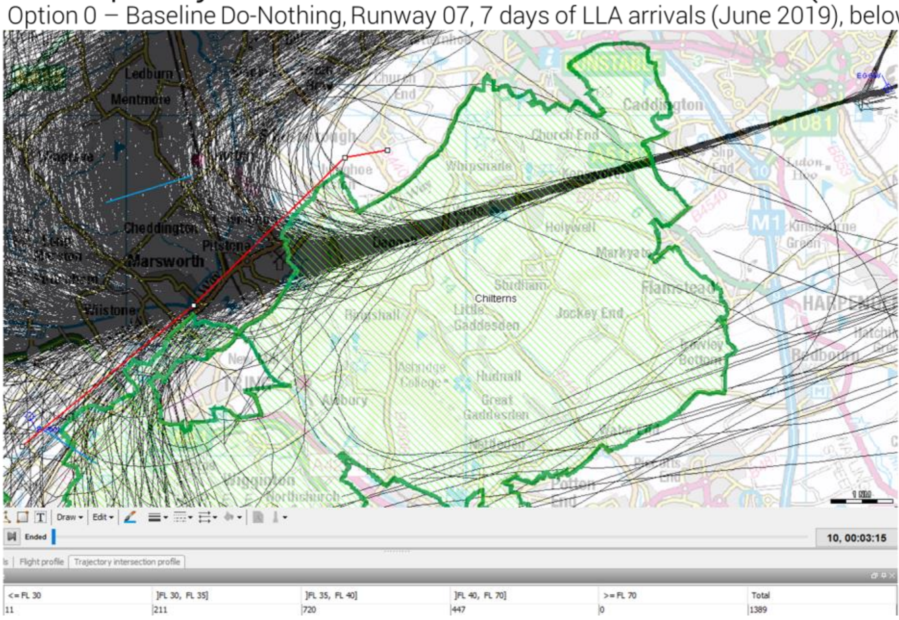
No. overflights 5,000ft-7,000ft 30

Total overflights <7,000ft: 13+705+30=748

This would be broadly similar under Option 1

Tranquillity–Chilterns Conservation AONB (southern)

Option 0 – Baseline Do-Nothing, Runway 07, 7 days of LLA arrivals (June 2019), below 7,000ft



The southern part of the Chilterns AONB is overflown by all Runway 07 arrivals below 7,000ft and cannot be avoided by the final approach track.

No. overflights <4,000ft: 11+211+720=942

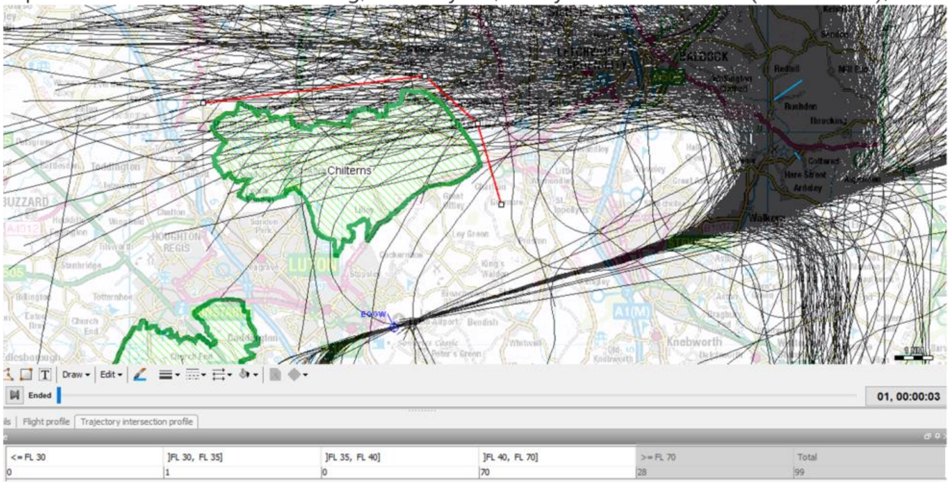
No. overflights 4,000ft-7,000ft: 447

Total overflights <7,000ft: 942+447=1389

This would be broadly similar under Option 1

Tranquillity – Chilterns Conservation AONB

Option 0 – Baseline Do-Nothing, Runway 25, 7 days of LLA arrivals (June 2019), below 7,000ft



Chilterns AONB is overflown by some Runway 25 arrivals below 7,000ft, generally those shortcutting from the west direct to downwind right hand.

No. overflights <4,000ft: 1

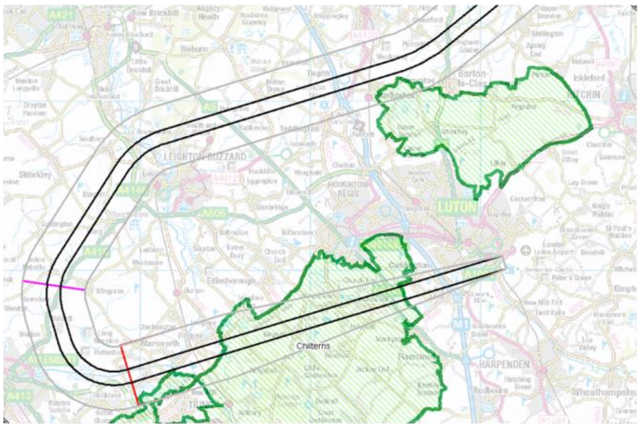
No. overflights 4,000ft-7,000ft: 70

Total overflights <7,000ft: 1+70=71

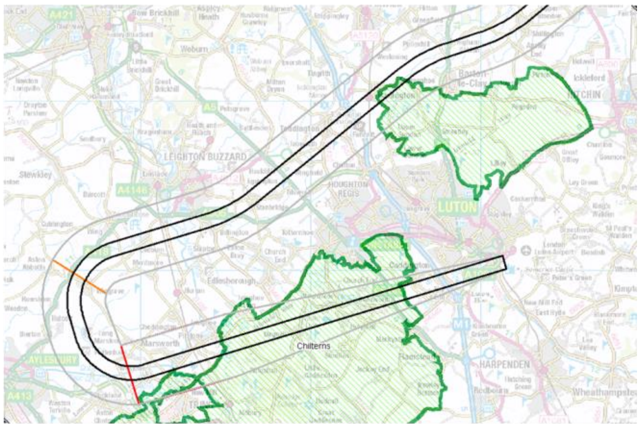
This would be broadly similar under Option 1

Tranquillity – Chilterns Conservation AONB (northern)

Option 2 PBN Routes, Runway 07



PBN route to final approach, northern
Aircraft using this route are likely to narrowly avoid overflying the northern section of the Chilterns Conservation AONB at 5,000ft, but will continue to overfly the southern section on final approach below 4,000ft.

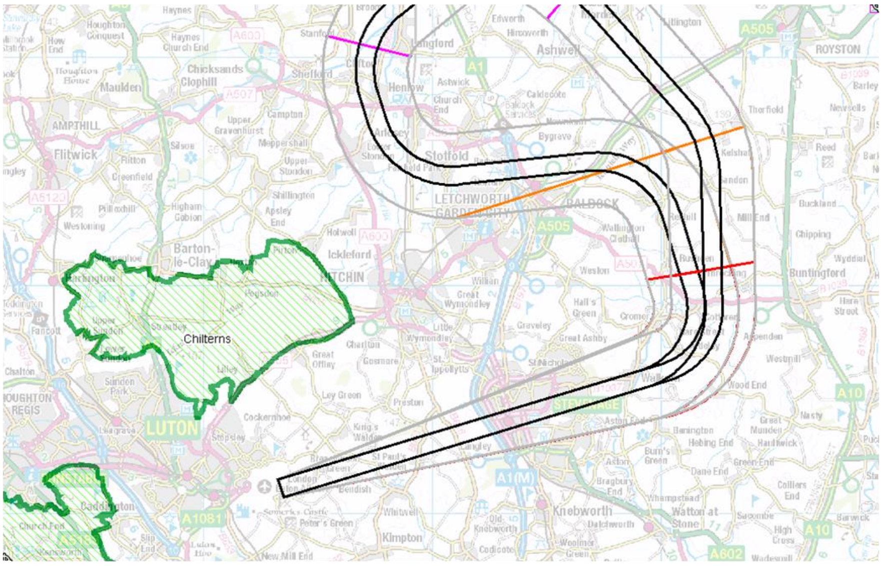


PBN route to final approach, southern
Aircraft using this route are likely to overfly the northwestern tip of the northern section of the Chilterns Conservation AONB at 5,000ft, and will continue to overfly the southern section on final approach below 4,000ft.

Controller intervention - shortcut and vectored arrivals
These manually-controlled aircraft are likely to behave in the same way they do under Option 0 (similar locations and altitudes), however they would be a smaller proportion of flights because c.49% of arrivals would follow the active PBN route for the runway in use.

Tranquillity – Chilterns Conservation AONB (northern)

Option 2 PBN Routes, Runway 25



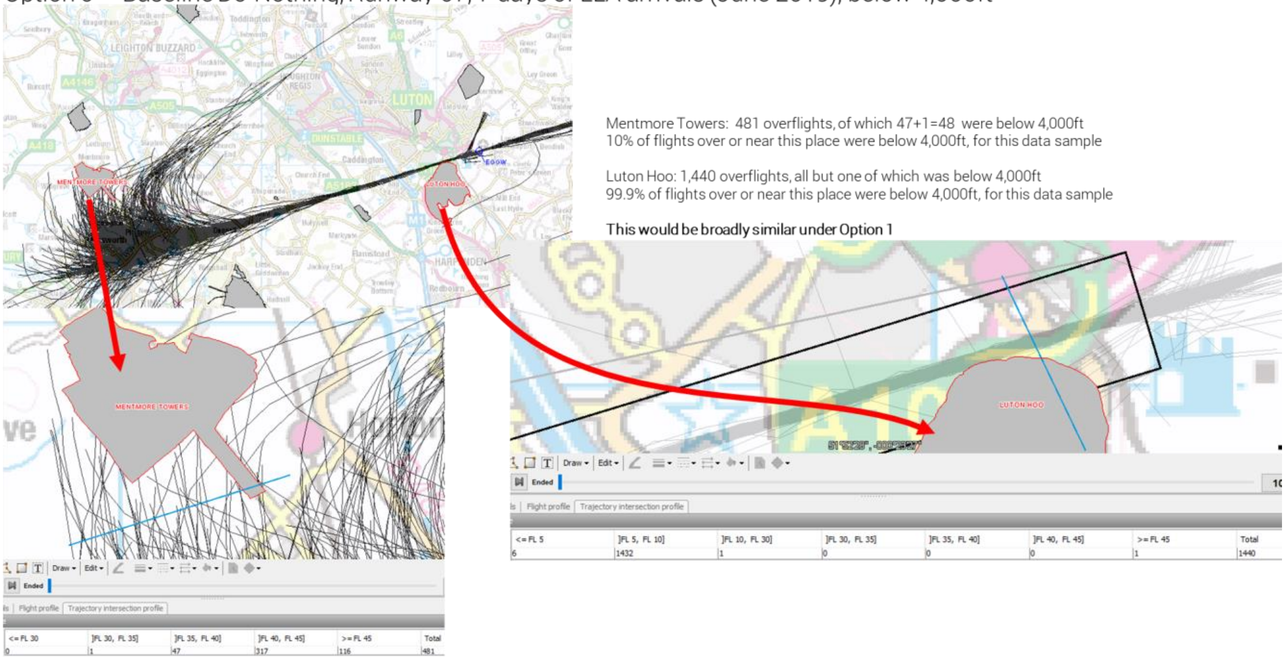
Both PBN routes to final approach
Aircraft using this route are likely to avoid overflying the Chilterns Conservation AONB.

Controller intervention - shortcut and vectored arrivals
These manually-controlled aircraft are likely to behave in the same way they do under Option 0 (similar locations and altitudes), however they would be a smaller proportion of flights because c.49% of arrivals would follow the active PBN route for the runway in use.

Annex H. Registered Historic Parks and Gardens

Registered Historic Parks and Gardens

Option 0 – Baseline Do-Nothing, Runway 07, 7 days of LLA arrivals (June 2019), below 4,000ft



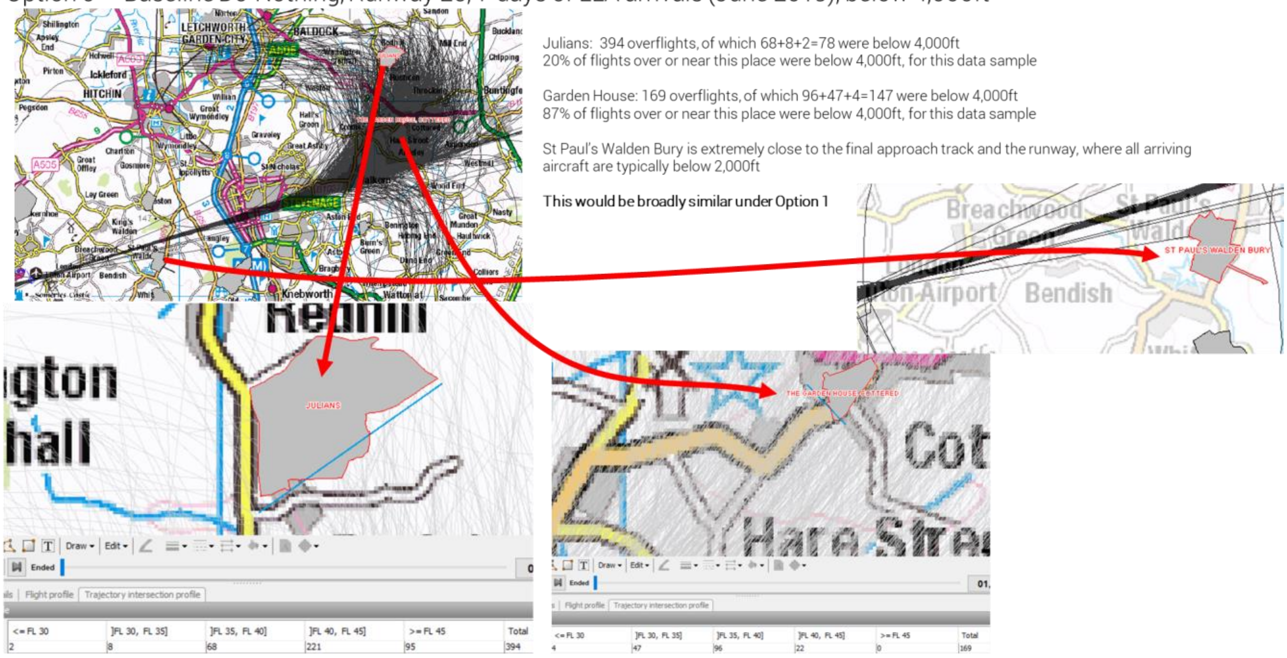
Mentmore Towers: 481 overflights, of which 47+1=48 were below 4,000ft
10% of flights over or near this place were below 4,000ft, for this data sample

Luton Hoo: 1,440 overflights, all but one of which was below 4,000ft
99.9% of flights over or near this place were below 4,000ft, for this data sample

This would be broadly similar under Option 1

Registered Historic Parks and Gardens

Option 0 – Baseline Do-Nothing, Runway 25, 7 days of LLA arrivals (June 2019), below 4,000ft



Julians: 394 overflights, of which 68+8+2=78 were below 4,000ft
20% of flights over or near this place were below 4,000ft, for this data sample

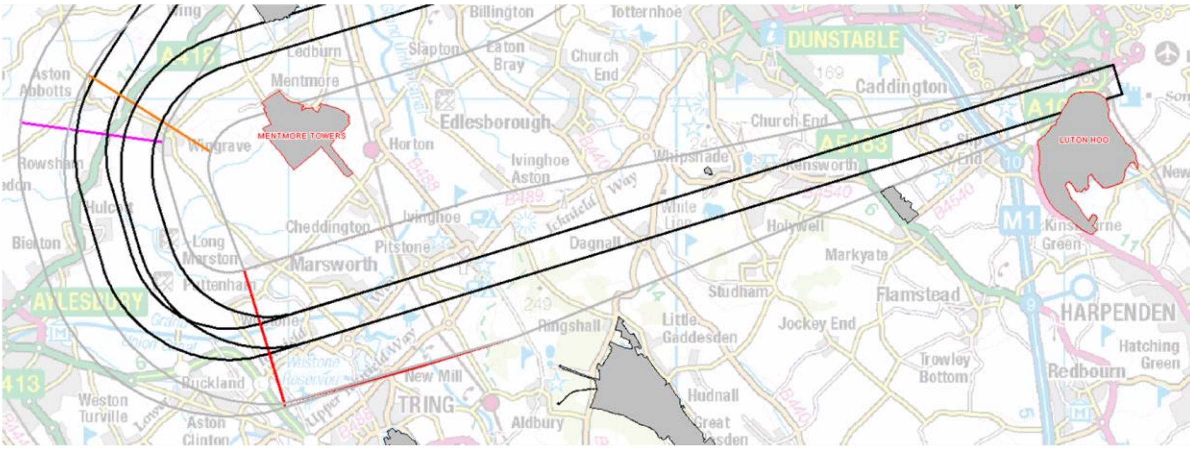
Garden House: 169 overflights, of which 96+47+4=147 were below 4,000ft
87% of flights over or near this place were below 4,000ft, for this data sample

St Paul's Walden Bury is extremely close to the final approach track and the runway, where all arriving aircraft are typically below 2,000ft

This would be broadly similar under Option 1

Registered Historic Parks and Gardens

Option 2 PBN routes, Runway 07



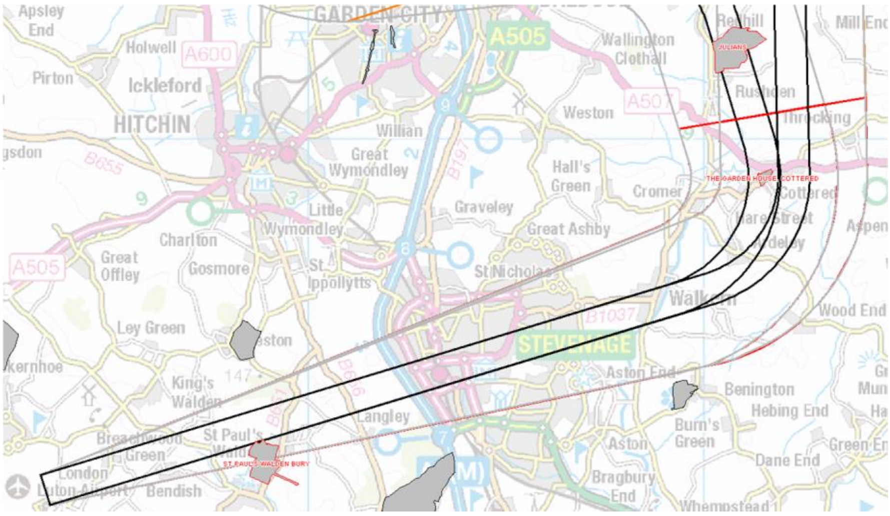
Mentmore Towers would not be overflown by either PBN route below 4,000ft (the orange line indicates where aircraft would descend below 5,000ft)

Luton Hoo's northern tip lies under the final approach path close to the runway, and will continue to be overflown below 1,000ft.

Controller intervention - shortcut and vectored arrivals
These manually-controlled aircraft are likely to behave in the same way they do under Option 0 (similar locations and altitudes), however they would be a smaller proportion of flights because c.49% of arrivals would follow the active PBN route for the runway in use.

Registered Historic Parks and Gardens

Option 2 PBN routes, Runway 25



Julians would be overflown by both PBN routes but not below 4,000ft. The red line indicates where aircraft would descend below 4,000ft.

Garden House would be overflown by the S-bend PBN route, and narrowly avoided by the Direct PBN route, between 4,000ft and 3,000ft.

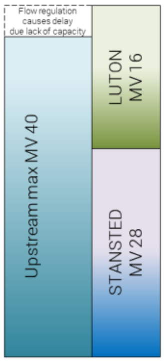
St Paul's Walden Bury would continue to be overflown by all LLA arrivals below 2,000ft.

Controller intervention - shortcut and vectored arrivals
These manually-controlled aircraft are likely to behave in the same way they do under Option 0 (similar locations and altitudes), however they would be a smaller proportion of flights because c.49% of arrivals would follow the active PBN route for the runway in use.

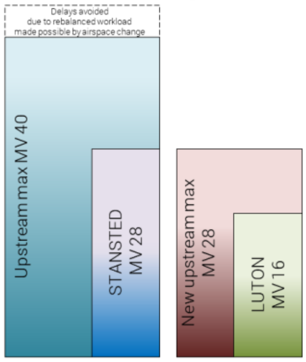
Annex I. Capacity and Resilience Illustrations

Capacity

Simplified diagram of how different flow groups are, and would be, managed



Option 0 Baseline do-nothing when LLA and Stansted arrivals are at maximum

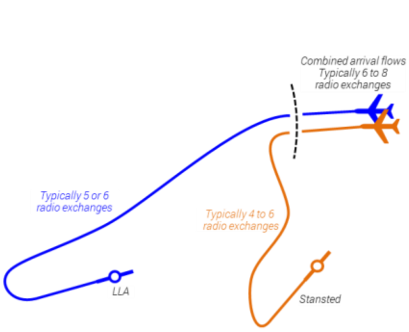


Option 1 and Option 2 when LLA and Stansted arrivals are at maximum

Broadly, MV indicates the number of movements per hour which can be safely handled by the controllers operating the flows in each associated airspace sector.
These are not necessarily geographical "boxes", but they describe how certain arrival flows are measured and managed.
The current upstream (the flow of arriving traffic before reaching LUTON or STANSTED) flow group has a Monitoring Value (MV) of 40.
When the actual number of upstream movements per hour approaches the MV (known as over-demand), safety is highest priority so the air traffic control supervisor considers applying flow regulations.
This stabilises the number of movements until the expected peak subsides. That action causes delay to the air traffic yet to arrive at the airports, which in turn generates more delay for both arriving and departing traffic.
The LUTON arrival flow has an MV of 16, STANSTED an MV of 28, totalling 44, which is greater than the upstream MV. This means flow regulation is more likely to be applied when both LUTON and STANSTED are busy.
The LUTON and STANSTED arrival flows cannot be separated without changing the airspace design.
Under Option 1 and Option 2 of this proposal, the LUTON flow is separated from the STANSTED flow and it would be moved into a new upstream flow, thus separating the flow dependency.

Resilience

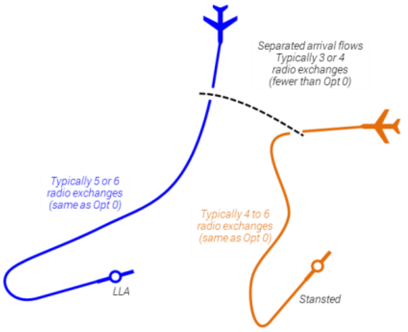
Simplified illustration of current and predicted relationship between Options and radio exchanges per flight



The upstream controller works both upper LLA and Stansted arrivals in a combined complex flow, and separates them into one flow per airport, then passes each flight on to the next controller.

The LLA or Stansted controller vectors their respective flight to the runway in a similar way to today.

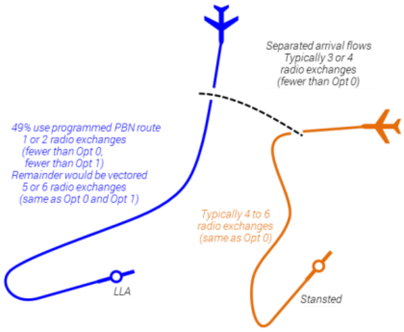
Option 0 Baseline do-nothing
(LLA and Stansted flows are combined)
Easterly runway illustration (westerly is similar)



The new upstream controller works both upper LLA and Stansted arrivals, which are already in two separate flows.
They then pass each flight on to the next controller.

The LLA or Stansted controller vectors their respective flight to the runway in a similar way to today.

Option 1 Vectoring
(LLA and Stansted flows are pre-separated)
Easterly runway illustration (westerly is similar)



The new upstream controller works both upper LLA and Stansted arrivals, which are already in two separate flows.
They then pass each flight on to the next controller.

The LLA controller would use the programmed PBN route 49% of the time and shortcutting or vectoring for the remainder, depending on the specific traffic arrangement at the time.
The Stansted controller would vector their arrivals to the runway in a similar way.

Option 2 PBN routes and Vectoring
(LLA and Stansted flows are pre-separated)
Easterly runway illustration (westerly is similar)

Annex J. Glossary of Terms

Airspace Modernisation Strategy AMS	(See also ref 15). UK Government has tasked the aviation industry to modernise airspace in the whole of the UK. The long-term strategy of the CAA and the UK Government is called the Airspace Modernisation Strategy (AMS). The AMS identifies fifteen initiatives to modernise airspace. Its CAA document reference number is CAP1711.
Altitude	The distance measured in feet, above mean sea level. Due to variations in terrain, air traffic control measures altitude as above mean sea level rather than above the ground. If you are interested in the height of aircraft above a particular location to assess potential noise impact, then local elevation should be taken into account when considering aircraft heights; for example an aircraft at 6,000ft above mean sea level would be 5,500ft above ground level if the ground elevation is 500ft.
AMSL	Above Mean Sea Level, see Altitude.
AONB	Area of Outstanding Natural Beauty
ATC	Air traffic control
ATC intervention	This is when ATC instruct aircraft off their planned route, for example, in order to provide a shortcut, they may be instructed to fly directly to a point rather than following the path of the published route
CAA	Civil Aviation Authority, the UK Regulator for aviation matters
CAP1616	Civil Aviation Publication 1616, the airspace change process regulated by the CAA (ref 12)
Capacity	A term used to describe how many aircraft can be accommodated within an airspace area without compromising safety or generating excessive delay
CAS	See Controlled Airspace
Centreline	The nominal track for a published route (see Route)
CO_2, CO_2e	Carbon dioxide, and carbon dioxide equivalent – the latter is a representative of all greenhouse gas emissions.
Concentration	Refers to a density of aircraft flight paths over a given location; generally refers to high density where tracks are not spread out; this is the opposite of Dispersal
Continuous descent	A climb or descent that is constant, without long periods of level flight
Controlled airspace (CAS)	Generic term for the airspace in which an air traffic control service is provided as standard; note that there are different sub classifications of airspace that define the particular air traffic services available in defined classes of controlled airspace. Abbreviated to CAS.
Conventional navigation	The historic navigation standard where aircraft fly with reference to ground based radio navigation aids
Conventional routes	Routes defined to the conventional navigation standard, i.e. using ground based radio navigation beacons to determine their position.
Dispersal	Refers to the density of aircraft flight paths over a given location; generally refers to lower density – tracks that are spread out; this is the opposite of Concentration

Easterly operation	When a runway is operating such that aircraft are taking off and landing in an easterly direction
Final approach path	The final part of a flight path that is directly lined up with the runway;
Flexible Use Airspace FUA	Airspace which is not solely designated for a single purpose, but can be allocated flexibly according to need, or switched entirely on/off according to a schedule or agreed process.
Flight-path	The track flown by aircraft when following a route, or when being directed by air traffic control (see also Vector)
ft, feet	The standard measure for vertical distances used in air traffic control
Future Airspace Implementation Strategy South (FASI-S)	Under the Government's Airspace Modernisation Strategy (AMS, ref 15) airports in the southern UK are required to update their airspace and routes in a coordinated way. LLA is a part of FASI-S and accordingly has a separate longer term airspace change proposal. See also paras 2.35-2.46.
General Aviation (GA)	All civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire. The most common type of GA activity is recreational flying by private light aircraft and gliders, but it can range from paragliders and parachutists to microlights, balloons and private corporate jet flights.
Holds/Holding Stacks	An airspace structure where aircraft circle in a racetrack-shaped pattern above one another at 1,000ft intervals when queuing to land. A way of absorbing delays and smoothing out the arrival flow.
Independent Commission on Civil Aviation Noise ICCAN	A non-statutory, advisory body created to provide independent, impartial advice to government, regulators and the UK aviation industry on aviation noise and consultation
LLA	London Luton Airport, a general reference to the airport itself
LLAL	London Luton Airport Ltd, the owners of the airport, a separate company from LLAOL.
LLAOL	London Luton Airport Operations Ltd, the operators who run the airport, a separate company from LLAL.
Lower airspace	Airspace in the general vicinity of the airport containing arrival and departure routes below 7-8,000ft. Airports have the primary accountability for the design of this airspace, as its design and operation is largely dictated by local noise requirements, airport capacity and efficiency
Monitoring Value (MV)	MV indicates the number of movements per hour which can be safely handled by the controllers operating the flows in each associated airspace sector. It is an indication of airspace capacity.
NATS: NATS NERL and NATS NSL	NATS NERL - The UK's licenced air traffic service provider for the en route airspace that connects our airports with each other, and with the airspace of neighbouring states. NATS NSL - the air navigation service provider at LLA, under commercial contract for the aerodrome control provision and via the London Licence for the approach control function.
Nautical Mile	Aviation measures distances in nautical miles. One nautical mile (nm) is 1,852 metres. One road mile ('statute mile') is 1,609 metres, making a nautical mile about 15% longer than a statute mile.

Net Present Value NPV	Applies to a series of cash flows occurring at different times. The present value of a cash flow depends on the interval of time between now and the cash flow. It also depends on the discount rate. NPV accounts for the time value of money. It provides a method for evaluating and comparing projects such as an airspace change. The Net Present Value of each option is calculated as the difference in total impacts between the option and the baseline scenario.
Network airspace	En route airspace above 7,000ft in which NATS has accountability for safe and efficient air traffic services for aircraft travelling between the UK airports and the airspace of neighbouring states
nm	See Nautical Mile
PBN	See Performance Based Navigation
Performance Based Navigation (PBN)	Referred to as PBN; a generic term for modern standards for aircraft navigation capabilities including satellite navigation (as opposed to 'conventional' navigation standards).
Post-implementation review PIR	The final stage of the airspace change process (see CAP1616 ref 12). The CAA reviews how the airspace change has performed, including whether anticipated impacts and benefits in the original proposal and decision have been delivered, typically started after a full year of operation of the new airspace.
Radar, radar blip, radar target, radar return	Generic terms covering how ATC 'sees' the air traffic in the vicinity. One type of radar (Primary) sends out radio pulses that are reflected back to the receiver (the 'return'), defining the target's position accurately and displaying a marker on the controller's screen ('blip' or 'target'). The other type of radar (Secondary, often attached to the Primary and rotating at the same speed) sends out a request for information and receives coded numbers by return (see Transponder). These numbers are decoded and displayed on top of the Primary return, showing an accurate target with callsign identity and altitude.
RFL	Requested Flight Level. This is the term used for the flight level that the aircraft is formally requesting, when it files a flightplan.
RNAV	Short for aRea NAVigation. This is a generic term for a particular specification of Performance Based Navigation
RNAV1	See RNAV. The suffix '1' denotes a requirement that aircraft can navigate to with 1nm of the centreline of the route 95% or more of the time. In practice the accuracy is much greater than this.
RNP1+RF	Required Navigation Performance 1. An advanced navigation specification under the PBN umbrella. The suffix '1' denotes a requirement that aircraft can navigate to with 1nm of the centreline 95% or more of the time, with additional self-monitoring criteria. In practice the accuracy is much greater than this. The RF means Radius to Fix, where airspace designers can set extremely specific curved paths to a greater accuracy than RNAV1.

Route	Published routes that aircraft plan to follow. These have a nominal centreline that give an indication of where aircraft on the route would be expected to fly; however, aircraft will fly routes and route segments with varying degrees of accuracy based on a range of operational factors such as the weather, ATC intervention, and technical factors such as the PBN specification. RNAV1 routes and RNP1 routes are flown accurately.
Route system or route structure	The network of routes linking airports to one another and to the airspace of neighbouring states.
Separation	Aircraft under Air Traffic Control are kept apart by standard separation distances, as agreed by international safety standards. Participating aircraft are kept apart by at least 3nm or 5nm lateral separation (depending on the air traffic control operation), or 1,000ft vertical separation.
Sequence	The order of arrivals in a queue of airborne aircraft waiting to land
SID	See Standard Instrument Departure
Standard Arrival Route (STAR)	The published routes for arriving traffic. In today's system these bring aircraft from the route network to the holds (some distance from the airport at high levels), from where they follow ATC instructions (see Vector) rather than a published route. Under PBN it is possible to connect the STAR to the runway via a Transition.
Standard Instrument Departure SID	Usually abbreviated to SID; this is a route for departures to follow straight after take-off
STAR	See Standard Arrival Route
Statute mile	A standard mile as used in normal day to day situations (e.g. road signs) but not for air traffic where nautical miles are used
Stepped descent	A descent that is interrupted by periods of level flight required to keep the aircraft separated from another route in the airspace below
Systemisation	The process of reducing the need for human intervention in the air traffic control system, primarily by utilising improved navigation capabilities to develop a network of routes that are safely separated from one another so that aircraft are guaranteed to be kept apart without the need for air traffic control to intervene so often
Tactical methods	Air traffic control methods that involve controllers directing aircraft for specific reasons at that particular moment (see Vector)
Terminal airspace, including Terminal Manoeuvring Area (TMA)	An aviation term to describe a designated area of controlled airspace surrounding a major airport or cluster of airports where there is a high volume of traffic; a large part of the airspace above London and the South East is defined as terminal airspace (or Terminal Manoeuvring Area – TMA). This is the airspace that contains all the arrival and departure routes for London Heathrow, London Gatwick, London Stansted, LLA and London City from around 2,000ft-3,000ft up to approximately 20,000ft.
Tonne, t	Metric Tonne (1,000kg), coincidentally almost identical to a British Imperial ton (2,240lbs, 1,016kg)
Top of Descent (TOD)	The aircraft ends its cruise phase and starts its descent from the en-route environment towards the runway

Transition	The part of a PBN arrival route, defined to either RNAV1 or RNP1 standard, between the last part of the hold and the final approach path to the runway. Typically followed accurately in three dimensions by an aircraft's flight management system (autopilot).
Transponder	An electronic device on board aircraft which sends out coded information which is picked up by radar and other systems. Most importantly the aircraft altitude, and identity code, by which the aircraft can be identified on the radar screen.
Uncontrolled Airspace	Generic term for the airspace in which no air traffic control service is provided as standard, also known as Class G
Unknown traffic	Aircraft not participating in ATC services. They may show on radar with altitude information (if they are operating with a Transponder) or in the worst case they will only show as a blip on the radar screen (a radar primary return) with no other information.
Vector, Vectoring, Vectored	An air traffic control method that involves directing aircraft off the established route structure or off their own navigation – ATC instruct the pilot to fly on a compass heading and at a specific altitude. In a busy tactical environment, these can change quickly. This is done for safety and for efficiency.
Westerly operation	When a runway is operating such that aircraft are taking off and landing in a westerly direction

End of document